Department of Water and Power the City of Los Angeles

ANTONIO R. VILLARAIGOSA
Mayor

Commission
LEE KANON ALPERT, *President*
EDITH RAMIREZ, *Vice President*
FORESCEE HOGAN-ROWLES
JONATHAN PARFREY
THOMAS S. SAYLES
BARBARA E. MOSCHOS, *Secretary*

S. DAVID FREEMAN
Interim General Manager
RAMAN RAJ
Chief Operating Officer

April 19, 2010

The Honorable City Council
City of Los Angeles
Room 395, City Hall
Los Angeles, California 90012

Honorable Members:

Subject: Agreement No. 47941 with Systems Integrated, LP

Pursuant to Charter Section 245, enclosed for approval by your Honorable Body is Resolution No. 010-275, adopted by the Board of Water and Power Commissioners (Board) on April 6, 2010, approved as to form and legality by the City Attorney, which authorizes execution of Agreement No. 47941 with Systems Integrated, LP, to provide design, fabrication, procurement, commissioning, and field technical representatives for a new control system at the Castaic Power Plant. As directed by the Board, transmitted to you are supporting documents.

If there are any questions regarding this item, please contact Ms. Winifred Yancy, Manager – Government and Neighborhood Relations, at (213) 367-0025, or Mr. Aram Benyamin, at (213) 367-4435.

Sincerely,

Barbara E. Moschos
Board Secretary

BEM: oja
Enclosures: LADWP Resolution
Board Letter
Agreement No. 47941

71351

10-0611-S4

c/enc: Mayor Antonio Villaraigosa
Ms. Jan C. Perry, Chair, Energy and the Environment Committee
Mr. Gerry F. Miller, Chief Legislative Analyst
Mr. Miguel A. Santana, City Administrative Officer
Mr. Rafael Prieto, Legislative Analyst, CLA
Mr. William R. Koenig, Chief Administrative Analyst
Ms. Winifred Yancy
Mr. Aram Benyamin

Resolution No. 010 275

WHEREAS, the Los Angeles Department of Water and Power (LADWP) seeks materials and technical services in the implementation of the Castaic Power Plant Control System Upgrade project; and

WHEREAS, Castaic Power Plant Control System Upgrade will assure accurate control and monitoring of Castaic Power Plant Units 1 through 6 systems, and Balance of Plant equipment; and

WHEREAS, on July 6, 2009, LADWP released a Request for Proposal (RFP273-10) seeking proposals from qualified firms/organizations to advise and assist in the implementation of the Castaic Power Plant Control System Upgrade and six firms responded; and

WHEREAS, LADWP evaluated the proposals submitted in response to the RFP, interviewed firms/organizations, and contacted references, and selected Systems Integrated LP (Contractor) as being the most qualified firm to provide professional advice and assistance to the Power System in the implementation of the Castaic Power Plant Control System Upgrade; and

WHEREAS, the Contractor has reviewed the services to be provided by the Contractor incorporated in the Agreement, and represents that it has the qualities, expertise, skills, and abilities to perform such work; and

WHEREAS, LADWP proposes to enter into Agreement No. 47941 with the Contractor for implementation of the Castaic Power Plant Control System Upgrade for three years in an amount not to exceed $12,641,008, which includes a 15% contingency: and

NOW, THEREFORE, BE IT RESOLVED that Agreement No. 47941 approved as to form and legality by the City Attorney, and filed with the Secretary of the Board, between LADWP and the Contractor be and the same is hereby approved.

BE IT FURTHER RESOLVED that pursuant to Charter Section 1022, such services covered by this Agreement are for expert services to implement the Castaic Power Plant Control System Upgrade, which requires knowledge and skills that are not available within LADWP and the work can be performed more economically and feasibly by an independent contractor than by City employees.

BE IT FURTHER RESOLVED that the President or Vice President of the Board, or the General Manager or such person as the General Manager shall designate in writing, and the Secretary, Assistant Secretary or the Acting Secretary of the Board be and they are hereby authorized and directed to execute said Agreement No. 47941 for and on behalf of LADWP.

BE IT FURTHER RESOLVED that the Chief Accounting Employee, upon proper certification, is authorized and directed to draw demands on both the Water Revenue Fund and the Power Revenue Fund in payment of the obligations arising under this Agreement.

I HEREBY CERTIFY that the foregoing is a full, true, and correct copy of a resolution adopted by the Board of Water and Power Commissioners of the City of Los Angeles at its meeting held APR 0 6 2010

Barbara E. Moschos
Secretary

CARMEN A. TRUTANICH, CITY ATTORNEY

MAR 11 2010

BY _____
DIRK R. BROERSMA
DEPUTY CITY ATTORNEY

LADWP BOARD APPROVAL LETTER

TO: BOARD OF WATER AND POWER COMMISSIONERS

DATE: March 11, 2010

SUBJECT:

**Agreement No. 47941
Castaic Power Plant
Control System Upgrade
Between Systems Integrated, LP
and the Los Angeles Department of
Water and Power**

RAMAN RAJ
Chief Operating Officer

S. DAVID FREEMAN
Interim General Manager

ARAM BENYAMIN
Senior Assistant
General Manager
Power System

RECEIVED
MAR 2 6 2010
Board of Water & Power Com'rs.
CITY OF LOS ANGELES

FOR COMMISSION OFFICE USE:

RES. NO. 010 275
APR 0 6 2010

CITY COUNCIL APPROVAL REQUIRED: Yes ☐ No ☒

IF YES, BY WHICH CITY CHARTER SECTION:

The Contracts Committee reviewed Request for Proposal (RFP) 237-09 on March 3, 2009.

PURPOSE

Transmitted for approval by your Honorable Board is a resolution, approved to form and legality by the City Attorney, that authorizes the Los Angeles Department of Water and Power (LADWP) to execute Agreement No. 47941 (Agreement) with Systems Integrated, LP (Contractor) to provide a new control system for the Castaic Power Plant Control System Upgrade Project.

The purpose of this Agreement is for the Contractor to provide design, fabrication, procurement, commissioning, and field technical representatives during the installation of the new control system, which will be installed by LADWP personnel.

The Agreement is for a duration of three years, and is for a total of $12,641,008, which includes a 15 percent contingency.

BACKGROUND

LADWP developed and approved an Integrated Resource Plan which calls for multiple major power projects, including the modernization of hydroelectric power plants such as Castaic Pumped Storage Power Plant (CPP) which includes the Castaic Power Plant Control System Upgrade.

The program was started in 2001, and consisted of the refurbishment of Units 1 through 6. The mechanical refurbishments of Units 2 through 6 were completed in June 2009. Automation equipment was installed on Units 2 and 6 only. This Agreement will upgrade the existing control system for Units 1 through 6 and Balance of Plant.

RFP 237-09 was initiated in March 2009. Two bidders responded, and both bids were found to be non-responsive. As a result, RFP 237-09 was cancelled, and a new RFP was issued. RFP 273-10 was publicly released on July 6, 2009. Six proposals were received on October 30, 2009.

COST AND DURATION

The cost of this Agreement is $10,992,181 and is for a duration of three years. Additionally, due to the complex nature of the control system and the condition of the existing 40-year-old control system, a contingency of 15 percent is recommended. This contingency shall not exceed $1,648,827, with the overall amount not to exceed $12,641,008.

FUNDING SOURCE

The cost of this contract is included in the Multi-Year Expenditure Plan of LADWP's, Power System Capital Budget.

Fiscal Years: 2010-11, 2011-12, and 2012-13
Functional Item No.: 21169

The Financial Services Organization reviewed and validated funds on March 2, 2010.

FISCAL IMPACT STATEMENT

The Agreement costs, including contingency, have been incorporated in LADWP's 2007-2013 multiple-year expenditure plan capital budget. There is no fiscal impact.

TYPE OF INSURANCE COVERAGE(S)

☒	Workers' Compensation	$1,000,000	☐	Property Damage	
☒	Automobile Liability	$1,000,000	☐	Water Craft	
☒	General Liability	$5,000,000	☐	Pollution	
☐	Professional Liability		☐	Crime	
☐	Aircraft Liability		☐	Asbestos	

PRE-AWARD CHECKLIST

Yes ☒	No ☐	N/A ☐	Contract Compliance
Yes ☒	No ☐	N/A ☐	Subcontracting Opportunities
Yes ☒	No ☐	N/A ☐	Service Contractor Worker Retention Ordinance
Yes ☒	No ☐	N/A ☐	Child Support Policy
Yes ☒	No ☐	N/A ☐	Living Wage Ordinance
Yes ☒	No ☐	N/A ☐	Labor Relations Notification
Yes ☒	No ☐	N/A ☐	Charter Section 1022 Findings

CONTRACT ADMINISTRATION

The Agreement will be administered by an LADWP Electrical Engineer, who will be the Project Manager for the Castaic Power Plant Control System Upgrade Project and will be supported by experienced LADWP staff.

The Project Manager will submit monthly written reports on the progress of design, construction, shop inspection, shipping, and delivery of all equipment included in the Agreement.

The Contractor will set up weekly meetings with the LADWP Project Manager and staff to monitor the progress of work, schedule, review document submittals, and schedule LADWP personnel for shop inspections during fabrication of replacement materials.

The Project Manager will ensure that all quality control procedures required by the Agreement are met and LADWP personnel will witness the critical inspections of materials supplied under this Agreement.

The Project Manager will verify and approve all invoices against the Contractor's actual progress of work utilizing information from the weekly and monthly written reports.

No change orders are anticipated on this Agreement, however, in the event of a Change Order or Amendment, payments are subject to the change order provisions of the agreement and will be subject to cost analysis by the Project Manager.

Time and Material ☐Yes ☒No

Markup: None

JOB OPPORTUNITIES AND TRAINING POLICY ☒Applicable ☐Not Applicable

INTERNAL AUDIT ☐Yes ☒No

EXTERNAL AUDIT ☐Yes ☒No

METHOD OF SELECTION

☒ Competitive ☐ Cooperative Purchase ☐ Sole Source

This Agreement is the result of RFP 273-10. The selection panel was comprised of five LADWP engineers – three from Power Engineering Division, one from Integrated Support Services Division, and one from Generation Division. Six proposals were subsequently received on October 30, 2009. One proposal was deemed non-responsive.

The evaluation of written proposals were based on the criteria defined in the RFP and includes the following:

- Cost competitiveness
- Firm's experience with hydroelectric pumped storage controls
- Personnel's experience with hydroelectric pumped storage controls
- Compliance with technical requirements
- Compliance with LADWP's Job Opportunities and Training Program (JOTP)
- Financial stability of the firm
- Compliance with proposed project schedule

The Contractor was determined to be the most responsive, qualified, and experienced contactor that will provide the ultimate least cost of the upgraded control system.

OUTREACH EFFORTS TAKEN

Notices Issued			Responses Received		
Total	*MBE	**WBE	Total	MBE	WBE
27	N/A	N/A	6	N/A	N/A

RFP 273-10 was issued and posted on July 6, 2009, on the LADWP and Los Angeles Business Assistance Virtual Network websites and an advertisement was placed with the Metropolitan News Enterprises. The City of Los Angeles Mayor's Office and the Minority Business Opportunity Center was provided a notice of the RFP.

A pre-bid conference scheduled on July 21, 2009, was attended by 33 bidders to discuss the RFP, scope of work, and doing business with LADWP.

MBE SUBCONTRACTING PARTICIPATION

Name	Description of Subcontracting Work	Dollar Amount	Percentage
One Source Distributors LLC	Supply material, consulting services, documentation services, and PLC programming services.	$1,200,000	10.9%

WBE SUBCONTRACTING PARTICIPATION

Name	Description of Subcontracting Work	Dollar Amount	Percentage
Systems Analysis & Integration, Inc.	Hydroelectric HMI programming, communications and services, and integrations services.	$1,500,000	13.6%

Other Business Enterprise (OBE) SUBCONTRACTING PARTICIPATION

Name	Description of Subcontracting Work	Dollar Amount	Percentage
Piglar Automation	Support PCS7 programming	$ 50,000	0.5%
Siemens	Protection relays, synchronizers, and integration services.	$1,300,000	11.8%
American Governor	Supply governors and integration services.	$1,200,000	10.9%
Basler Electric	Supply exciters and integration services.	$1,800,000	16.4%

VENDOR HISTORY

Contract No.	Contract Description	Term of Contract	Original Contract Amount	Change Order No. (CO)/Amendment No. (A)				
				CO/A No.	Increase/ Decrease	Term of Extension	Other	Ending Date
P.O. 14905-05	Provide Remote Terminal Unit	9 months	$25,000	N/A	N/A	N/A	N/A	12/2/05

VENDOR PERFORMANCE

Remote Terminal Unit provided under P.O. No. 14905-05 was a pilot project for a pole top switch automation. Systems Integrated, LP successfully provided equipment to LADWP, and this equipment was used for evaluation purposes only.

CHARTER SECTION 1022 FINDINGS AND BASIS THEREOF

This Agreement is a service contract with a material component.

It has been determined that services provided by the Contractor will require experience and expertise in the design, installation, and acceptance testing of these replacement materials and no LADWP staff is available to meet these needs. Therefore, the services covered by this Agreement can be performed more economically and feasibly by an independent contractor than by City employees.

MEMORANDUM OF UNDERSTANDING PROPOSED CONTRACT REVIEW PROCESS

The services in this Agreement require special expertise to perform the work, and therefore, are exempt from Appendix B processing procedures.

CONFLICT OF INTEREST STATEMENT

All conflict of interest procedures were followed. No conflict of interest issues were identified.

RECOMMENDATION

It is recommended that your Honorable Board adopt the accompanying Resolution and that the Agreement be approved as authorized in the Resolution.

RMF:gg
Attachments
e-c/att: S. David Freeman
Raman Raj
Richard M. Brown
Aram Benyamin
James B. McDaniel
Cecilia K.T. Weldon
Jeffery L. Peltola
Lorraine A. Paskett
Maria Sison-Roces
Marvin D. Moon
Robert M. Fick
Mokhtar Moulay

PROFESSIONAL SERVICES AGREEMENT

Contractor: *Systems Integrated, LP*

Subject: *Castaic Power Plant Control System Upgrade*

Agreement Number: 47941

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AGREEMENT NUMBER 47941
BETWEEN
THE CITY OF LOS ANGELES LADWP OF WATER AND POWER
AND
SYSTEMS INTEGRATED, LP.

THIS AGREEMENT is made and entered into by and between the City of Los Angeles acting by and through its Department of Water and Power, a municipal corporation, (hereinafter the "LADWP" or "DWP") and Systems Integrated, LP 2200 N. Glassell Street, Orange, CA 92865, a limited partnership (hereinafter the "Contractor"). Individually, LADWP and Contractor are referred to under this Agreement as a "Party" and collectively as the "Parties."

RECITALS

WHEREAS, the Los Angeles LADWP of Water and Power (LADWP) seeks materials and technical services in the implementation of the Castaic Power Plant Control System Upgrade project; and

WHEREAS, Castaic Power Plant Control System Upgrade will assure accurate control and monitoring of Castaic Power Plant Units 1 – 6 systems, and Balance of Plant equipment; and

WHEREAS, on July 6, 2009, LADWP released a Request for Proposal (RFP273-10) seeking proposals from qualified firms/organizations to advise and assist in the implementation of the Castaic Power Plant Control System Upgrade; and

WHEREAS, LADWP evaluated the proposals submitted in response to the RFP, interviewed firms/organizations, and contacted references, and selected Systems Integrated LP (Contractor) as being the most qualified firm to provide professional advice and assistance to the Power System in the implementation of the Castaic Power Plant Control System Upgrade; and

WHEREAS, the Contractor has reviewed the services to be provided by the Contractor incorporated in the Agreement, and represents that it has the qualities, expertise, skills, and abilities to perform such work; and

WHEREAS, the services to be performed require special expertise and can be performed more economically and feasibly by an independent contractor than by City employees.

NOW THEREFORE, in consideration of the premises and of the covenants, representations and agreements set forth herein, the Parties hereby covenant, represent and agree as follows:

ARTICLE I.
INTRODUCTION

101. Parties to the Agreement

The Parties to this Agreement are:

A. The LADWP having its principal office at 111 North Hope Street, Los Angeles, California 90012.

B. The Contractor, Systems Integrated, LP, having its corporate headquarters located at 2200 N. Glassell Street, Orange, CA 92865.

102. Representatives of the Parties and Service of Notices

102.1 Authorized Representatives

The representatives of the respective Parties authorized to administer this Agreement, including, but not limited to, Tasks and Change Orders, and to whom formal notices, demands and communications shall be given are as follows:

A. The authorized representatives of the LADWP shall be, unless otherwise stated in the Agreement:

Mr. Nazih Batarseh
Electrical Service Manager
Engineering Services Division
111 N. Hope Street, Room 1255
Los Angeles, California 90012
Telephone: (213)367-5059
Facsimile: (213)367-5003
Nazih.Batarseh@ladwp.com

With copies to:

Mokhtar Moulay
Project Manager
Castaic Power Plant Control System Upgrade
Castaic Power Plant
37700 Templin Highway
Castaic, CA 91384
Telephone: (661)294-3327
Facsimile: (661)294-3282
Mokhtar.Moulay@ladwp.com

B. The authorized representatives of the Contractor shall be:

Susan Corrales-Diaz
President
Systems Integrated, LP
2200 N. Glassell Street
Orange, CA 92865
Telephone: (714)998-0900
Facsimile: (714)998-6059
scorrales-diaz@systemsintegrated.com

And

John Holbrook
General Manager
Systems Integrated, LP
8080 Dagget Street
San Diego, CA 92111
Telephone: (858)277-0700
Facsimile: (858)277-1490
jholbrook@systemsintegrated.com

With Copies to:

Larry Pomatto
Director of Engineering
Systems Integrated, LP
2200 N. Glassell Street
Orange, CA 92865
Telephone: (714)998-0900
Facsimile: (858)277-1490
lpomatto@systemsintegrated.com

102.2 Authority of the Project Manager

A. The Project Manager or their designated representative will give the orders and directions as provided in the Contract Documents and will determine, within the limitations of these Contract Documents, the amount, quality, acceptability, and fitness of the various kinds of work and materials to be paid for.

B. Should any discrepancy appear or any misunderstanding arise regarding anything contained in these Contract Documents, the matter shall be immediately referred to the Project Manager or their designated representative, who will decide the matter in accordance with the true intent and meaning.

C. If the Contractor at any time fails to maintain adequate progress, or to schedule or employ sufficient and adequate work forces, plant, materials, tools, and methods, the Project Manager or their designated representative may notify the Contractor of the deficiency, and the Contractor shall increase the progress of the work and modify procedures and activities to meet the approval of the Project Manager or their designated representative. Such approval shall not relieve the Contractor of the obligation to comply with these Contract Documents and to complete the work within the time specified and at the Agreement cost.

D. If the Contractor at any time fails to comply with these Contract Documents in any way, the Project Manager or their designated representative shall have the right to order all work or a portion of the work stopped at a time specified by the order. Such Stop Work Order shall be in writing and shall allow the Contractor 3 working days in which to comply with the demands of the order. The work to which a Stop Work Order is directed shall be corrected to the entire satisfaction of the Project Manager or their designated representative. Any such order shall not relieve the Contractor of the obligation to complete the entire work within the time specified and at the Agreement cost.

102.3 Service of Notices

Unless otherwise stated herein, formal notices, demands and communications required hereunder by either Party shall be made in writing and may be effected by personal delivery or by certified mail, overnight carrier, or confirmed facsimile and shall be deemed communicated as of the date of delivery or the date of mailing, whichever is applicable, or in the case of a facsimile, upon receipt if transmitted during the receiving Party's normal business hours, otherwise on the first business days following receipt.

If the name or address of the person designated to receive notices, demands or communications, is changed, or additional persons are added to receive notices, demands or communications, written notice shall be given, in accord with this section, within five (5) business days of said change.

103. Purpose of the Agreement

The purpose of this Agreement is for the Contractor to provide planning, design, fabrication, procurement, and commissioning of modernized unit and plant controls and protection for the Castaic Power Plant. Services, Equipment, and Work by the Contractor shall be performed in conjunction with Work by the LADWP and others on the Castaic Power Plant Control System Upgrade, described in this document, Exhibits F, Technical Specifications, and Exhibit G, Systems Integrated Technical Approach. The Contractor represents that they are well qualified and experienced to provide such Work. Contractor's Work shall be closely coordinated with Work by the LADWP and others.

104. Definitions

Key terms used in this Agreement are defined as below:

A. Board
The Board of Water and Power Commissioners of the City of Los Angeles

B. Contract Documents
The Agreement including Appendices, Amendments, Reference Drawings, and Reference Documents and Material.

C. LADWP
The Los Angeles Department of Water and Power of the City of Los Angeles.

D. Project Manager
The LADWP's designated Project Manager, or their designated representative.

~~E.~~ Director of Supply Chain Services
The Director of Supply Chain Services, or the Assistant Directors of Supply Chain Services, of the LADWP.

F. Owner's Engineer
Organization of individual(s) designated by the LADWP as Owner's Engineer.

G. Contractor

The person, firm, or corporation to whom the Agreement is awarded.

H. Subcontractor

A person, firm, or corporation, other than the Contractor and employees thereof, who is under contract to the Contractor and supplies labor or materials on a portion of the work and who performs all or a portion of its work on the property of the LADWP.

I. Supplier

A person, firm, or corporation, other than the Contractor and employees thereof, who is under contract to the Contractor and supplies materials on a portion of the work and who does not perform any of its work on the property of the LADWP.

J. Reference Specifications

Those bulletins, standards, rules, methods of analysis or test, codes, and specifications of other agencies, engineering societies, or industrial associations referred to in these Contract Documents. These refer to the latest edition, including amendments, published and in effect at the date of advertising these Contract Documents, unless specifically referred to by edition, volume, or date.

K. Directed, Required, Approved, Etc.

The words "directed", "required", "approved", "permitted", "ordered", "designated", "prescribed", "instructed", "acceptable", "accepted", "satisfactory", or similar words shall refer to actions, expressions, and prerogatives of the Project Manager or their designated representative, unless otherwise expressly stated.

L. Project

Castaic Power Plant Control System Upgrade.

M. Work

Work consists of Statement of Work as stated in Exhibit F, Technical Specifications, Exhibit G, Systems Integrated Technical Approach, and all its subsections.

ARTICLE II.
TERM OF THE AGREEMENT

201. Term of the Agreement

The term of this Agreement shall commence, provided the events identified in Exhibit E, PSC-4 have occurred, upon execution of this Agreement by all Parties hereto and shall terminate three (3) years thereafter, subject to the termination provisions herein. Performance shall not begin until the Contractor has obtained LADWP approval of insurance required herein.

202. Time is of the Essence

A. Time is of the essence of the Agreement. All work shall be completed within the times and by the dates specified. Time shall not be extended except as provided in this Article.

B. If the Contractor makes a timely written request in accordance with this Article, the time for performance will be extended by the Project Manager or their designated representative for a period of time equivalent to any delay of the whole work which is (1) authorized in writing by the Board or the Director of Supply Chain Services acting through the Project Manager or their designated representative, or (2) caused solely by the LADWP, or (3) due to unforeseeable causes (such as war, strikes, natural disasters, or abnormal amounts of adverse weather), and which delay is beyond the control and without the fault or negligence of the Contractor and Subcontractors. The Contractor shall promptly notify the Project Manager or their designated representative in writing at both the beginning and ending of any delay, of its cause, its effect on the whole work, and the extension of time claimed. Failure of the Contractor to provide such written notices and to show such facts shall constitute conclusive evidence that no excusable delay has occurred and that no extension of time is required.

C. The Project Manager or their designated representative will ascertain the facts and the extent of the delay and will extend the time for performance when the Project Manager or their designated representative's findings of fact justify such extension. The Project Manager or their designated representative's determination shall be final and conclusive.

D. If, as a result of delay caused solely by the LADWP, and except as indicated elsewhere herein the Contractor sustains a loss which could not have been reasonably avoided, the Contractor will be paid such amount as the Project Manager or their designated representative finds to be fair and reasonable compensation for such part of the Contractor's actual loss as

the Project Manager or their designated representative finds to have been unavoidable and caused solely by the LADWP. Claims for any such loss shall be made and determined in accordance with the applicable Articles of this Agreement. The Contractor shall provide the Project Manager or their designated representative with all records regarding the handling of forces, equipment, and plant and regarding the costs incurred. The findings of the Project Manager or their designated representative shall be final and conclusive.

E. The requirements of this Article shall be in addition to, and shall not be construed as waiving, claims provisions of the Los Angeles City Charter and of the Government Code of the State of California. The LADWP will be responsible for extensions of time as herein provided, but will not otherwise be responsible in any manner or to any extent for compensation in addition to the Agreement price or for damages directly or indirectly suffered by the Contractor because of delay.

ARTICLE III.
COMPENSATION AND METHOD OF PAYMENT

301. Compensation

301.1 Not-to-Exceed Amount

The total compensation that may be paid to the Contractor by the LADWP for complete and satisfactory performance of services under this Agreement shall not exceed Ten Million Nine Hundred Ninety Two Thousand One Hundred Eighty One Dollars ($10,992,181).

301.2 Authorized Expenditures

Of the total amount of compensation included in Section 301.1 above, the LADWP shall pay the Contractor for services to be performed, tasks to be implemented, and deliverables in accordance Section 302, Allowable Fees and Costs, of this Agreement. The LADWP shall not be liable for payment of monies unless there is a written Task Order approved by the LADWP's authorized representative(s) identified in Section 102.1 of this Agreement. Therefore, there is no guarantee that the Contractor shall receive any amount of work during the term of this Agreement.

301.3 Maximum Contract Compensation

The Statement of Work of this Agreement has authorized expenditures in the amount of Ten Million Nine Hundred Ninety Two Thousand One Hundred Eighty One Dollars ($10,992,181).

Due to the complex nature of the control system, and the condition of the existing 40 year old control system, a 15% contingency is designated in the amount One Million Six Hundred Forty Eight Thousand Eight Hundred Twenty Seven Dollars ($1,648,827). The contingency fund will be available for purchases authorized solely by the LADWP in accordance with Article IX, Amendments and Change Orders to the Agreement. LADWP will not be liable for payment of contingency monies unless there is a written Change Order issued by LADWP.

In no event shall the total amount of all expenditures for Statement of Work under this Agreement exceed the maximum of Twelve Million Six Hundred Forty One Thousand Eight Dollars ($12,641,008) without an amendment to this Agreement properly approved by both the Contractor and LADWP Board of Commissioners.

302. Allowable Fees and Costs

In consideration of the scope and pricing sheets detailed in Exhibit F, Technical Specifications, Exhibit G, Systems Integrated Technical Approach, and Exhibit H, Pricing, and upon satisfactory performance of the Services, Equipment, or Work required herein, the LADWP agrees to pay and the Contractor agrees to accept in full satisfaction thereof the cost of Services Equipment or Work rendered payable in accordance with the pricing sheets and the payment schedule as shown in Exhibit H, Pricing and Exhibit I, Payment Schedule, as actually performed or provided by Contractor, appropriately documented by Contractor, and verified by the LADWP.

Payment will generally be made based on a payment schedule shown in Exhibit I, Payment Schedule, of the Agreement, provided the Services, Equipment, and Work described for the payment has actually been performed and/or provided by the Contractor. Payments will be requested by Contractor based on specific work progress and completions defined for each payment that are delineated in the payment schedule and actually provided and/or performed. Invoices provided by Contractor requesting payments must include documentation and certification (acceptable to the LADWP in form and content) that the specific work progress and completions defined for that payment have been completed by Contractor.

The LADWP will retain 10% of each progress payment and pay it into an escrow account pursuant to Public Contract Code §22300. The retention in that escrow account shall be released 60 days after completion by Contractor and acceptance by LADWP of all of the specific Services, Equipment, and Work that relates to that unit outage, and the unit has successfully been Returned to Service.

302.1 Reimbursement of Subcontractor Costs

Exhibit H, Pricing, shall be all inclusive of Subcontractor Costs.

302.2 Reimbursement of Travel Expenses

Exhibit H, Pricing, shall be all inclusive of Travel Expenses.

302.3 Other Reimbursable Expenses

Exhibit H, Pricing, shall be all inclusive of Other Reimbursable Expenses.

302.4 Conditions for Payment for Overtime

The LADWP shall not be liable for any overtime expenses incurred by the Contractor, or any Subcontractors.

302.5 Taxes

All costs contained herein are inclusive of any applicable State of California Sales Tax, California Use Taxes or Federal Excise Tax. Such taxes are the only taxes for which the LADWP shall be liable for payment and any such taxes paid by the Contractor for tangible property to be delivered to the LADWP pursuant to Section 302.3 of this Agreement shall be separately identified on the Contractor's invoices. The Contractor agrees to abide by the Board of Equalization's determination for all sales or use taxes and payment thereof, and shall adjust for any overpayment or underpayment of such taxes to date on the next regularly scheduled invoice following receipt of the determination. The Contractor agrees to assist the LADWP in preparing and filing any application for a refund of any overpayment of such taxes. In the event that pursuant to state or federal law, the LADWP is required to pay taxes for tangible property delivered to the LADWP by the Contractor pursuant to Section 302.3 of this Agreement directly to the state, the amount of said taxes shall be deducted from the costs contained herein.

303. Method of Payment

The Contractor shall submit, at the conclusion of each monthly or other payment period listed in Exhibit I, Payment Schedule, and prior to the 10th day of the following month, submit to Mr. Robert M. Fick, Project Manager, 37700 Templin Highway, Castaic, CA 91384, in triplicate, verified and itemized invoices stating and certifying that such Services or Work were performed and/or such Goods and Equipment were provided to LADWP, and such expenses were necessarily incurred. Such invoices shall conform to the line-item costs and any rate(s) established in this Agreement. Support of payment for such invoices shall consist of detailed invoices from the Contractor and a copy of any invoice submitted to the Contractor from each of the Subcontractors. All invoices related to SCWRO and LWO Contracts shall contain the following statement: "The Contractor fully complies with Section 10.36 et. seq. And Section 10.37 et. seq., SCWRO and LWO, respectively, of the Los Angeles Administrative Code." The detailed invoice shall include the following information:

303.1 Required Invoice Information

Invoices shall be submitted by the Contractor to the LADWP in triplicate. The following information shall be included in each invoice submitted by the Contractor to the LADWP:

1. Contractor name, address, and vendor code number as registered on the LADWP vendor database.
2. City of Los Angeles Business Tax Registration Number
3. Date of invoice
4. Invoice number
5. Contract number
6. Summary of individual Task Items, including amount of current invoice, total invoiced to date, total authorized Task Order amount, Task Item percent complete, and percent of authorized Task Item cost invoiced to date, and the end date of the Task Item.
7. Taxes
8. Total amount of invoice
9. Description of services and deliverables provided related to each individual Task Order and associated costs
10. Supporting documentation for all costs and expenses, in a format acceptable to the LADWP.
11. Following certification statement signed by the Contractor:

"I hereby certify, under penalty of perjury, that the services rendered and billings reflected in this invoice are true, accurate and in conformance with the terms of this Agreement, including but not limited to the Living Wage Ordinance, Los Angeles Administrative Code Section 10.37 et. Seq.

12. Approval signature blocks for LADWP project manager and LADWP authorized representative(s) identified in Section 102.1, Representative(s) of the Parties and Service of Notices, of this Agreement .
13. An accompanying LADWP Subcontractor Tracking Form, or its successor reporting format, identifying the amounts paid to each authorized Subcontractor for both the current invoice and total invoiced to date. The Contractor shall explain any deviations from the anticipated Subcontractor percentages identified in Exhibit C, List of Subcontractors, attached hereto and made a part hereof, and recommendations for recovering any shortfalls in Subcontractor utilization.
14. An accompanying document identifying the Contractor labor amounts paid for both the current invoice and total invoiced to date. The Contractor shall explain the amounts expended on implementation of the job opportunities and training program developed pursuant to Section 401.7of this Agreement, the actual programs implemented, and the location and date the activities occurred.
15. Contractor agrees to submit a statement along with any invoices or billing associated with this Agreement which certifies all work performed under this Agreement at critical facilities as designated by LADWP to Contractor was conducted by persons for whom background checks have been conducted and who do not have disqualifying background information in their histories pursuant to this section.

Invoices shall be submitted to:

Mokhtar Moulay
Project Manager
Castaic Power Plant Control System Upgrade
Castaic Power Plant
37700 Templin Highway
Castaic, CA 91384
Telephone: (661)294-3307
Facsimile: (661)294-3282

Contractor's failure to submit accurate and all required information shall result in LADWP's rejection of the invoice and non-payment.

Such invoices, if correct, will be certified, and paid within 45 days after receipt of invoice. Invoice payments will not be made if the invoice is received more than six months after the billing period. Contractor's failure to submit accurate and all required information shall result in LADWP's rejection of the invoice and non-payment.

303.2 Time and Material Task Order Invoices

Not applicable.

303.3 Fixed Price Task Order Invoices

For Task Orders specifying a lump sum method of payment, payment shall be made within forty-five (45) calendar days after review and approval of the deliverable by the LADWP or receipt of the Contractor's invoice prepared in accordance with the requirements of Section 303.1, whichever is later.

303.4 Notice of Items Not Approved for Payment

The LADWP project manager will review the Contractor invoice within fifteen (15) working days and notify the Contractor of any missing or required additional documents, questioned costs, inaccuracies, or concerns.

In the event that any deliverables, labor, or reimbursable expenses invoiced by the Contractor are not approved for payment, the LADWP shall provide the Contractor with detailed comments addressing the shortfalls or costs of concern and shall meet with the Contractor to discuss such issues. Any disputes between the LADWP and the Contractor regarding invoices costs and expenses shall be resolved in accordance with Article X, Disputes, of this Agreement. The LADWP shall pay undisputed invoice amounts.

303.5 Notification of Status of Task Order Expenditures

Not applicable.

303.6 Timely Invoicing

All charges related to the performance of the Contractor's work or services shall be invoiced by the Contractor to the LADWP within six (6) months of the cost or expenses being incurred by the Contractor or Subcontractor. The LADWP shall not reimburse the Contractor for any costs, expenses, work, or services invoiced to the LADWP six (6) months after the date the costs were incurred by the Contractor.

303.7 Maximum Authorized Amount

Notwithstanding any other provision of this Agreement, any changes or additions hereto that shall increase the LADWP's total obligation above the maximum authorized amount set forth in Section 301.3 of this Agreement shall be subject to prior approval by the Board of Water and Power Commissioners. The LADWP shall not be obligated to pay for work performed by the Contractor for any such changes made in violation of this Agreement.

ARTICLE IV.
SERVICES TO BE PROVIDED

401. Services to be Provided by the Contractor

See Exhibit F, Technical Specifications, and Exhibit G, Systems Integrated Technical Approach, for a general description and requirements of Work to be performed. Details and sequencing of the Work are provided in the technical specifications, reference drawings and other reference materials provided by Contractor.

401.1 Description of Contractor Services

The Contractor shall perform all work necessary to complete the Agreement in a satisfactory manner. The Contractor shall at all times schedule and employ sufficient forces, plant, materials, equipment, tools, labor, and incidentals to assure compliance with these Contract Documents and shall progress and properly inspect the work to assure completion within the time specified. The obligation to deliver finished work in accordance with the Agreement shall be absolute and shall not be affected by the Project Manager or their designated representative's approval of, or failure to prohibit, actions, means, or methods of the Contractor prior to final acceptance of the complete work.

401.2 LADWP Approval of Work

All services, work, tasks, and deliverables are subject to LADWP approval, which approval shall not be unreasonably withheld. Failure to receive approval may result in withholding compensation for such services, work, tasks, and deliverable pursuant to Article III, Compensation and Method of Payment, of this Agreement.

401.3 Errors and Omissions

Notwithstanding any other provisions of this Agreement, approval by the LADWP of any task or deliverable, or any part thereof, shall not relieve the Contractor of the responsibility to meet all of the requirements as set forth in this Agreement. The Contractor shall have no claim for additional costs due to correction of its errors or omissions in said previously approved Deliverables or any other action that may be necessary to comply with this Agreement, including all Exhibits, and authorized Task Orders.

Revising Contractor-prepared designs at the request of the LADWP to incorporate comments or recommendations by LADWP engineers or LADWP value engineering Contractors is not considered to be a remedy of errors or omissions, but is considered an integral part of engineering which may be called for by a task assignment.

401.4 Industry Standard of Care

The Contractor shall perform the work described herein in accordance with industry standards of care and shall reflect competent professional knowledge and judgment.

401.5 Additional Services

In the event that the LADWP requires services in addition to those specified in this Agreement, the Contractor agrees to provide such services in accordance with Article IX, Amendments and Change Orders to this Agreement, of this Agreement. Prior to performance of additional work, this Agreement shall be amended to include the additional work and payment thereof.

401.6 Safety and Non-Interference

The Contractor shall comply and require that all Subcontractors comply with the safety requirements, including, but not limited to, the following:

a. The Contractor's representatives and the Subcontractor's representatives shall follow the Plant's safety policies and shall stay

within their assigned areas at all times while within the plant's premises. The Plant's safety policies will be available at the Pre-construction Meeting. All representatives shall attend one Plant-Contractor safety policy meeting.

b. The Contractor shall possess and shall have available at the jobsite, at all times, for inspection by the Project Manager or their designated representative, an Injury and Illness Prevention Program (IIPP) complying with OSHA and Cal/OSHA regulations and LADWP requirements.
c. The Contractor shall furnish and require all Subcontractors to furnish all necessary safety equipment, including, but not limited to, personal protective equipment, safety devices, and safeguards.
d. The LADWP reserves the right to review safety programs and practices and to make recommendations to the Contractor. Any such review or recommendation by the LADWP shall not increase the LADWP's liability or responsibility and shall not relieve the Contractor from providing a safe work environment and complying with legal requirements.
e. If the LADWP determines that there is a material deviation from any regulatory agency's requirements or the IIPP that could result in serious injury, the Contractor may be ordered to stop work. Failure by the Contractor to comply with any regulatory agency's requirements or the Contractor's IIPP may result in termination of this Agreement.

401.7 Job Opportunities and Training Program

The Contractor shall devote three percent (3%) of the total direct Contractor labor costs to job development and training activities, with approximately half of that outlay funding job opportunities for unemployed and at-risk workers. The Contractor shall develop a job opportunities and training program plan that includes organized and formal activities designed to facilitate and aid in the training and hiring of job seekers, laid-off workers, youth, incumbent workers, new entrants to the workforce, veterans, and persons with disabilities in professional/engineering, skilled craft, para-professional, clerical, and administrative functions. The Contractor shall report on the job opportunities and training program plan implementation and expenditures with submittal of all invoices for payment. More frequent reports may be required at the request of the LADWP.

401.8 Contractor's Quality Assurance Program

The Contractor shall perform the work in accordance with the Contractor's Quality Assurance Program, which shall be subject to review, approval, and audit by the LADWP. The Contractor's work shall reflect competent

professional knowledge, judgment, and accepted industry practice. The Contractor shall promptly correct, or remedy any work, errors, or omissions, at its sole expense, which do not conform to the provisions of this Agreement. See Section 01400 in Exhibit F, Technical Specifications, for additional details.

401.9 Contractor's Illness and Injury Prevention Program

The Contractor shall do everything reasonable to protect the life, safety, and health of persons at the construction site. The Contractor shall furnish and use safety devices and safeguards and shall adopt and use practices, means, methods, operations, and processes which are reasonably adequate to render safe and healthful employment, in accordance with requirements and standards of OSHA, Cal-OSHA, the LADWP, and Contractor's best policies and procedures; in case of conflict the most stringent shall govern. The Contractor shall be responsible for ensuring that each of the Contractor's employees, and its Subcontractors' employees, meet the standards of this Article.

401.10 Security

Facility visits shall be arranged through the Project Manager who will advise the Contractor of appropriate safety and security rules. The Contractor shall adhere to the restrictions and instructions of LADWP personnel when visiting any facility. Contractor's access to the Facility shall be in accordance with Exhibit J, Site Access Security.

An up-to-date list of employees' names and addresses shall be kept by the Contractor and shall be furnished to the Project Manager or their designated representative upon request.

The Contractor shall be responsible for providing the Contractor's own security for the Contractor's facilities, equipment, tools, and materials at the jobsite.

The Contractor shall provide identification for the Contractor and Subcontractors, employees, and representatives who will be required to enter upon the LADWP's construction site.

The identification shall be readily visible on each person, and shall be worn at all times while on the site and shall be provided for examination whenever requested. The identification shall consist of the Contractor's name or logo and the employee's name and identification number or designation prominently displayed.

401.11 Express Warranty Provision

Contractor warrants that the software Deliverables furnished hereunder shall be free from programming errors and form defects in workmanship and materials and shall operate in conformity with the performance capabilities, specifications, functions, and other descriptions and standards applicable thereto as set forth in the Exhibits; and that the software shall conform to the standards generally observed in the industry for similar software (including source code) so long as the Contractor can discharge any warranty obligations notwithstanding such modifications or following their removal by the LADWP.

401.12 Rights of Way

The site or right of way for structures, if any, to be constructed will be provided by the LADWP. The Contractor shall make arrangements, pay for, and assume all responsibility for acquiring, using, and disposing of additional work areas and facilities required. The Contractor shall indemnify and hold the LADWP harmless from all claims for damages caused by such actions.

401.13 Language

Everything submitted by the Contractor shall be written in the English language. All key personnel and all site personnel provided by Contractor and any Subcontractors shall be fluent in written and spoken English.

401.14 Drawing Requirements

Drawings produced by the Contractor shall conform to the best standards of the profession. Information shall be organized in a logical, systematic manner with as much information on a single drawing as can be done without impairing clarity and quality.

To facilitate revision on the LADWP's automated drafting system, all drawings shall be composed using Microstation or a compatible CAD system. Final submission of all digital files shall be in or converted to Microstation (*.dgn) Version 8.5 format or greater.

Files submitted shall reflect all as-built conditions. This includes layering of information and the attachment of data files to the drawing. Each file shall include only one drawing per file.

A PDF file of each drawing shall be submitted for the purpose of record management. The file shall include the date, revision number, and have all signatures.

All drawings submitted shall be indexed in a text file with the following information, and in the format as listed below.

DWP Drawing Number (include format .dgn), Revision, Contract Number, Facility Code, Title 1, Title 2, Catalog, Contractor Drawing Number

Each drawing shall include a unique LADWP number that identifies the Castaic Power Plant as follows:

PA – Castaic Power Plant Common

PA1 – Castaic Power Plant Unit 1

PA2 – Castaic Power Plant Unit 2

PA3 – Castaic Power Plant Unit 3

PA4 – Castaic Power Plant Unit 4

PA5 – Castaic Power Plant Unit 5

PA6 – Castaic Power Plant Unit 6

PA7 – Castaic Power Plant Unit 7

Each drawing shall identify the engineering discipline with the following letter designations:

–E Electrical

– M Mechanical

– S Structural

Example: PA3-E – Unit 3 Electrical Drawing

Each drawing shall be assigned a letter designation identifying the size of the drawing.

R – 24" x 36"

U – 8 ½" x 11"

T – 11" x 17", 12" x 18", 16" x 22", 17" x 22", 18" x 22", or 18" x 24"

Example: PA7-ER – Unit 7 Electrical, 24" x 36"

All drawings shall have a LADWP number assigned from a block of numbers to be issued by the LADWP once the Contractor provides the number and type of drawings that will be prepared.

Once a block of numbers has been provided, the Contractor shall include the numbers on all drawings and documents.

A drawing index shall be included to cross reference the contract number, Contractor drawing number, and the LADWP drawing number.

401.15 Instruction Books

Not less than 30 calendar days prior to the start of site construction, the Contractor shall furnish 3 complete, identical sets of detailed instruction books for all new, repaired, modified, and refurbished equipment furnished under these Contract Documents. These books shall be accompanied by a letter of transmittal and shall contain all catalog data, illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall not include instructions not applicable. Photographs, ozalids, xerox, and similar types of reproductions shall not be attached to pages. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book. The books shall be the three-hole punched, clamp bar system type.

The LADWP will inform the Contractor by letter within 30 calendar days after receipt of the instruction books, either that there are no exceptions noted or that there are corrections needed. If there are no exceptions noted, the Contractor shall promptly furnish 10 additional sets, identical to the submitted copy. If there are corrections needed, one set will be returned to the Contractor for corrections needed. The corrections needed shall be promptly incorporated in the instruction books, and a total of 12 complete, identical sets of such revised instruction books shall be furnished to the Project Manager or their designated representative.

401.16 Shipment

All shipments shall be properly crated, boxed, packed, or otherwise protected to prevent damage in transit and in storage. Shipments involving sea transportation shall be crated with dry materials, shall be packed with a desiccant, shall be sprayed or treated with a fungicide or given equivalent treatment, and shall be otherwise protected to insure delivery with no fungus growth, rust, or other damage due to such transportation.

All parts shall be prepared for shipment so that slings for handling can be readily attached while the parts are on the car or on the truck. Where it is unsafe to attach

slings to the box, the boxed parts shall be packaged with slings attached to the parts so that attachments can readily be made. Before shipment, all finished iron and steel external parts shall be covered with a readily removable rust-preventing compound, and all finished bright work shall be suitably wrapped or otherwise protected from damage. All pipe flanges shall be protected by flange protectors bolted on, metal plugs shall be screwed into all tapped holes, and other openings shall be adequately protected to prevent entrance of dirt and moisture during shipment. All electrical equipment, cabinets, and cubicles, shall be provided with appropriate means to protect against damage or deterioration due to lifting, handling, storage, temperature, humidity, and all other environmental conditions.

Each package shall be plainly marked with the following:

An identifying number which also shall appear on the bill of lading and other documents relating to shipment.

LADWP's Agreement number and Item number.

Consignee's name and address.

Sufficient information to identify the contents, and when possible, the name of the machine or equipment of which the contents form a part.

Shipping weight.

402. LADWP Responsibilities

Refer to Exhibit F, Technical Specifications,for a Summary of Responsibilities. The new control system and associated equipment will be installed by LADWP personnel, under the technical advice of the Contractor.

If LADWP, as a result of its own operations, delays, disrupts, or otherwise interferes with and materially affects the Contractor's performance hereunder or if the LADWP is unable to approve the services, work, task, or deliverables, or perform its other responsibilities, in accordance with the agreed upon time schedule, the schedule may be adjusted in accordance with the provisions of Article IX, Amendments and Changes to this Agreement, of this Agreement. The Contractor agrees to cooperate with LADWP to minimize, and if possible, to eliminate the impact of any delays on completion of the services, work, tasks, or deliverables. The Contractor shall promptly notify the LADWP if delays, regardless of the cause, begin to put the schedule or authorized budget in jeopardy.

403. Contractor Personnel

403.1. Key Contractor Personnel

Key Contractor personnel to be assigned to this Agreement are identified in the List of Key Contractor Personnel set forth in Exhibit D, which is attached hereto and made a part hereof. Exhibit D, List of Key Contractor Personnel, also contains a description of the Contractor's business location the person is assigned to, the position within the Contractor's organizational hierarchy, special expertise of the person, the number of years employed by the Contractor, and the number of years of experience for each person identified in Exhibit D. Key Contractor personnel shall be available to perform under the terms and conditions of this Agreement immediately upon commencement of the term of this Agreement.

The LADWP considers the services of the Contractor's key personnel listed in Exhibit D, List of Key Contractor Personnel, essential to the Contractor's performance under this Agreement. The Contractor shall not reassign any key personnel without the LADWP's prior written consent. The LADWP shall have the right to approve or disapprove the reassignment of Contractor key personnel listed in Exhibit D for any reason at its sole discretion.

403.1.1 Unavailability of Key Personnel

In the event individual key personnel listed in Exhibit D, List of Key Contractor Personnel, are terminated either by the Contractor or the individual, with or without cause, or if individual key personnel are otherwise unavailable to perform services for the Contractor, the Contractor shall provide to the LADWP written notification detailing the circumstances of the unavailability of the individual key personnel and designating replacement personnel prior to the effective date of individual key personnel termination or unavailability date, to the maximum extent feasible, but no later than five (5) business days after the effective date of the individual key personnel termination or unavailability. The Contractor shall propose replacement personnel that have a level of experience and expertise equivalent to the unavailable individual key personnel for LADWP review and approval.

The LADWP shall review and approve or disapprove any personnel who are designated as key personnel. The LADWP shall act reasonably in exercising its discretion to approve or disapprove any key personnel.

The Contractor recognizes and agrees that early notification of the unavailability of key Contractor personnel and proposed

replacement personnel is essential to avoiding delays in completing the services, work, tasks, and deliverables established in this Agreement or authorized Task Orders because the award of which was predicated upon the competency of the personal services provided.

403.2 Removal of Contractor Personnel

The Contractor agrees to remove personnel from performing work under this Agreement if reasonably requested to do so by the LADWP within 24 hours or as soon thereafter as is practicable

404. Contractor Use of Subcontractors

Subcontractors, including but not limited to individuals, contract employees, sole proprietors, firms, and corporations, designated to perform work under this Agreement are identified in Exhibit C, List of Subcontractors. Exhibit C, List of Subcontractors, also contains a description of the service, task responsibilities, and anticipated participation (percentage of overall cost of services) of each Subcontractor identified in Exhibit C.

Notwithstanding the fact that the Contractor is utilizing Subcontractors, the Contractor shall remain responsible for performing all aspects of this Agreement and for ensuring that all services, work, and tasks are performed in accordance with the terms and conditions of this Agreement and authorized Task Orders.

The LADWP has no obligation to any Subcontractor and nothing herein is intended to create any privity between the LADWP and the Contractor's Subcontractors.

404.1 LADWP Pre-Approval of Subcontractors

The LADWP shall pre-approve, in writing, the Contractor's utilization of Subcontractors in the event that additional Subcontractors or substitutions for Subcontractors listed in Exhibit C, List of Subcontractors, are proposed by the Contractor. This applies to individuals, contract employees, sole proprietors, firms, and corporations.

404.2 Subcontractor Subcontracting

Subcontractor's subcontracting or delegation of services is expressly prohibited unless approved in writing by the LADWP.

404.3 Agreement Provisions Applicable to Subcontractors

Contractor shall require any subcontract entered into pursuant to this Agreement to be subject to Sections 404.2 and 1103, the provisions of Article VI, Ownership, and Article VII, Confidentiality, Restrictions on Disclosure, and, PSC-13, PSC-19, PSC-21, PSC-22, and PSC-24 of this Agreement.

404.4 Copies of Contractor/Subcontractor Contracts

The Contractor shall provide the LADWP with copies of Contractor Subcontractor contracts associated with the performance of this Agreement within fifteen (15) working days of execution of such contracts by the Contractor.

The Contractor is solely responsible for ensuring that all subcontracts comply with the provisions and the terms of this Agreement, as applicable.

405. Special Conditions

405.1 Holidays

Recognized holidays shall be New Year's Day, Martin Luther King's Birthday, Presidents' Day, Memorial Day, Independence Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day, the day after Thanksgiving Day, and Christmas Day. If any of said holidays should fall on a Sunday, the following Monday shall also be considered a holiday; and if a holiday should fall on a Saturday, the previous Friday shall also be considered a holiday.

405.2 Time of Completion and Delivery:

The LADWP requires that any Unit outage be completed and the unit Returned to Service no later than June 30 of that year; specific contractual milestone dates, including the Final Completion Date, shall be shown in Exhibit I. Unit outages shall be scheduled to commence in October of a given year and conclude by June 30th of the subsequent year. The Contractor may work 24 hours per day using two or three shifts if desired, subject to local regulations, law and ordinances, and the approval of the LADWP Project Manager and the Castaic Power Plant Manager.

405.3 Right to Operate Unsatisfactory Equipment

If the operation of the equipment after installation proves to be unsatisfactory to the Project Manager or their designated representative, the LADWP shall have the right to operate such equipment until it can be taken out of service without injury to the LADWP for the correction of defects,

errors, or omissions, provided the period of such operation pending the correction of defects, errors, or omissions shall not exceed one year without written consent of the LADWP and the Contractor.

405.4 Printed Documents

All printed documents, including drawings and instruction books, if applicable, shall be in the English language. All units of measurement shall be in the English foot-pound-second system.

405.5 Identification of Contractor's Employees

The Contractor shall provide identification for the Contractor and Subcontractors, employees, and representatives who will be required to enter upon the LADWP's construction site. The Contractor shall meet the Site Access Security requirements listed in Exhibit J.

The identification shall be readily visible on each person, and shall be worn at all times while on the site and shall be provided for examination whenever requested. The identification shall consist of the Contractor's name or logo and the employee's name and identification number or designation prominently displayed.

406. Monitoring of Work

406.1 Records and Audits

See Exhibit E, Section PSC-22, "Standard Provisions for LADWP of Water and Power Professional Services Contracts – Retention of Records, Audit, and Reports (revised October 16, 2007)."

406.2 Progress Reports

The Contractor shall, as required by the Project Manager or their designated representative, submit monthly reports summarizing all the tasks under this Agreement, the work accomplished, work left to be done, work to be done in the coming months, and the estimated completion dates. Each report shall be organized by work item and shall include the task item number, item coordinator, item title, the authorized expenditure, the start date and completion date, and the total of dollars received to date by the Contractor. Each report shall show the projected and actual progress for the reporting period and to date, by work item and any subtask(s). The Contractor's scheduling information shall show precedence and duration of each activity. The schedule shall be organized to correspond with the performance of the Services, design and fabrication of Equipment, and Work, and shall be subdivided into component parts in sufficient

detail to allow control of Contractor's scheduled performance. Each report shall also show the total dollars invoiced by Contractor and received by the Contractor under this Agreement.

On a weekly basis, Contractor shall report in detail their progress on each specific Work item, in form and content acceptable to the LADWP, for incorporation into weekly updates to the LADWP's master unit outage schedule. If and to the extent the overall unit outage schedule is adversely affected by Contractor's actual progress, Contractor shall immediately take all actions necessary to correct and eliminate the adverse impacts to the overall unit outage schedule.

If the Contractor intends to change the method or operations, or if the schedule fails to reflect the actual progress, the Contractor shall promptly submit a proposed revised schedule of their Work before beginning revised operations, and no later than the next weekly update. This proposed revised scheduling information shall be in a form that will permit the Project Manager or their designated representative to enter the data into a computerized Critical Path Method CPM) schedule. Contractor shall implement any such revisions only after review and approval by the LADWP's Project Manager or their designated representative.

406.3 Right to Review Services, Facilities, and Records

The LADWP reserves the right to review any portion of the services, equipment, and work performed by the Contractor under this Agreement (including any subcontractor(s)), and the Contractor agrees to cooperate to the fullest extent possible. Contractor shall furnish to the LADWP such reports, statistical data, documentation, records, and other information pertaining to the Contractor's services, equipment, and work as shall be reasonably required by the LADWP to carry out its rights and responsibilities under its agreements with its bondholders or noteholders and any other agreement relating to the development of the project(s) and in connection with the issuance of its official statements and other prospectuses with respect to the offering, sale, and issuance of its bond and other obligations.

The right of the LADWP to review or approve drawings, Contract Documents, procedures, instructions, reports, test results, calculations, schedules, or other data that are developed by the Contractor shall not relieve the Contractor of any obligation set forth herein.

406.4 Factory Inspection and Tests

Inspection will be made, and tests shall be performed in the Contractor's mill, factory, yard, or warehouse in accordance with the following:

406.4.1 Access

The Project Manager or their designated representative shall have the right to inspect the Contractor's and the subcontractor's work in the course of manufacture, fabrication, or installation, and shall make such inspections or tests from time to time as may be deemed advisable, provided that such inspections or tests will cause no delay in the production of acceptable materials or equipment. The Contractor shall furnish, at the Contractor's own expense, reasonable facilities, including tools and instruments for so doing and for obtaining such information as the Project Manager or their designated representative desires, respecting the progress and manner of the work and the character of the materials used.

406.4.2 Notification

The Contractor shall notify the Project manager or their designated representative not less than 14 calendar days in advance of key hold or witness points. Should the Project Manager or their designated representative elect to waive the right of witnessing tests, and accept certified test reports instead, the Project Manager or their designated representative will promptly inform the Contractor.

406.4.3 Witness Tests

Mill or factory witness tests shall be made in the presence of the Project Manager or their designated representative. The test procedures shall be submitted and shall be subject to review and acceptance by the Project Manager or their designated representative. The Contractor shall bear all costs of such tests, except for compensation and expenses of the Project Manager or their designated representative.

406.4.4 Certified Reports

Five copies of certified reports of all tests shall be furnished to the LADWP for review.

The LADWP will notify the Contractor within 10 calendar days after receipt of the certified reports either that there are no exceptions noted or that the reports show noncompliance with the Contract Documents. If the LADWP does not notify the Contractor within 10 calendar days, the Contractor may consider the reports as "no exception noted".

If any certified report shows noncompliance, the Contractor shall not ship the equipment covered by such report until the noncompliance is corrected or until otherwise instructed by the Project Manager or their designated representative.

406.4.5 Release

Materials or equipment to be inspected by the Project Manager or their designated representative at the Contractor's mill, factory, yard, or warehouse shall not be released for shipment until they have satisfactorily passed the Project Manager or their designated representative's inspection and test. Applicable materials or equipment shipped without the Project Manager or their designated representative's shipment release may be rejected.

406.4.6 Contractor's Inspectors

The Contractor shall furnish a sufficient number of qualified inspectors to perform inspections and assure compliance with the requirements of the American Welding Society (AWS), American Society of Mechanical Engineers (ASME), National Electric Code (NEC), or other applicable Code(s), the Contractor's overall quality assurance and/or quality control (QA/QC) requirements and practices, any project-specific QA/QC documents, and these Contract Documents. If welding is performed, the Contractor shall furnish a certified welding inspector, approved under the American Welding Society (AWS) Code, ASME Boiler and Pressure Vessel Code, or other applicable Code(s) who shall make all inspections, tests, and stampings required under such code.

406.4.7 Documentation:

The Contractor shall submit a detailed Inspection and Test Plan (ITP) for review and acceptance by the Project Manager or their designated representative, not less than 30 calendar days prior to starting of any fabrication, installation, or commissioning and testing.

The ITP shall list the major components of the work, subassemblies, final assemblies, and each inspection and testing point for each of the items identified. The ITP shall include the Contractor's plan for inspecting Subcontractors' work, including inspection by the Contractor at each subcontractor's facilities. The Contractor shall inspect the work of the Subcontractors to the extent necessary to assure that proper materials and equipment are furnished and that fabrication and erection are accomplished in accordance with these Contract Documents. The tests to be performed shall be listed but need not be described.

The ITP shall have attached to it, all documents referred to in its text, including the Test Program, which has been previously reviewed and accepted by the Project Manager or their designated representative as being in compliance with these Contract Documents. The testing shall be performed in accordance with said Test Program. The Test Program shall not be changed without the review and acceptance of the Project Manager or their designated representative as to compliance with these Contract Documents.

406.5 Quality Assurance (Q/A)

The Contractor shall thoroughly test and inspect (in accordance with the requirements specified herein, the Contractors established Quality System, and industry standards and practices), materials, equipment, and work in order to assure that the requirements of the Contract Documents and/or best industry practices have been met. The Contractor shall eliminate all materials, equipment, and work which are defective or which do not meet the requirements of the Contract Documents or best industry practices before inspection, testing, or acceptance by the Project Manager or their designated representative. Materials and equipment not so inspected and tested by the Contractor shall not be incorporated in the work. The Contractor shall submit materials, equipment, or work for the Project Manager or their designated representative's approval, acceptance, or inspection only after such testing and inspection by the Contractor.

The Contractor shall keep the Project Manager or their designated representative informed of the progress of the work and of the times and places of manufacture of materials and equipment. The Contractor shall give ample advance notice of inspections and tests. The Contractor shall furnish the Project Manager or their designated representative with reasonable facilities and samples, with such information as the Project Manager or their designated representative may desire, and with proper authority for access to observe inspections and tests. If these Contract Documents or best industry practices require specific inspections or tests to be made or observed by the Project Manager or their designated representative or designated agent of the LADWP, the Contractor shall not proceed beyond the point of any such inspection or test until the same has been made and so observed or until this requirement is waived by the Project Manager or their designated representative in writing with respect to such inspection or test.

All test procedures shall be subject to review and acceptance by the Project Manager or their designated representative. All materials, equipment, and work shall be subject to rigorous inspection by the Project Manager or their designated representative. Inspection, testing, approval, or acceptance by the Project Manager or their designated representative shall not relieve the Contractor of the responsibility of furnishing the best labor, materials, and equipment in accordance with these Contract Documents or best industry practices, or of the responsibility for later discovered flaws or defects. If any material, equipment, or portion of work does not meet the requirements of the Contractor's Quality System, the Contract Documents, or best industry practices, the material, the equipment, or the portion of work, or any faulty portion, may be rejected.

The provisions of this Article shall take precedence over any conflicting inspection, testing, and quality assurance provisions, but shall not waive any such inspection, testing, and quality assurance activities.

406.5.1 Q/A Program

As a means of assuring that the performance of the work fulfills the requirements of these Contract Documents, the Contractor shall implement a Quality Control and Quality Assurance program for all work. This program shall be in accordance with the Contractor's established Quality System, and industry Codes, Standards, and Procedures. The program shall provide assurance that design, purchasing, manufacturing, shipping, storage, construction, testing, and examination of all equipment, materials, and services will comply with the requirement of these Contract Documents and with best industry practices

406.5.2 Q/A Manual

The Q/A program shall be documented by the Contractor in a Q/A manual. The form and the format of the Q/A manual shall be developed by the Contractor. The content of the Q/A manual shall be in the form of written description of Q/A assurance policies, procedures, methods, instructions, exhibits, or other Q/A method descriptions. Copies of the Q/A manual can be made available to the Project Manager. The project Quality Plan developed from this manual and other resources shall conform to the requirements of this Agreement and be submitted to the LADWP for review and approval.

The Q/A manual shall describe the authority and the responsibility of the persons in charge of the Q/A program and inspection activities. The manual shall also include, as a minimum, control procedures or methods to assure the following:

The design documents, drawings, specifications, Q/A procedures, records, inspection procedures, and purchase documents are maintained current, accurate, and under control.

The purchased materials, equipment, and services comply with the requirements of these Contract Documents.

Receiving inspection, in-process inspection, examination, testing, and checkout.

Adequate inspection of subcontracted work.

The quality of work, including machining, welding, heat treating, hot forming, nondestructive testing, wiring, programming, and other such special processes.

The proper methods are employed for the qualification of personnel who are performing work, including machining, welding, nondestructive testing, wiring, and programming.

The proper documentation, control, and disposition of nonconforming equipment and materials.

The Quality Verification Plans (QVP) designed for activities related to construction, installation, and performance testing on the site.

406.5.3 Records, Inspections, and Audits

The Contractor's and the Contractor's subcontractor's work, shop, and related records shall be subject to inspection and audit by the Project Manager or their designated representative to assure compliance with applicable requirements. Upon detection of a noncompliance with the requirements of these Contract Documents or the accepted Q/A manual, corrective action may be requested by the Project Manager or their designated representative. The Contractor shall correct in a timely manner all such deficiencies so identified. All noncompliant items shall be recorded on a punchlist. The Contractor shall be responsible for correcting all noncompliant items discovered during testing and the warranty period.

406.5.4 Failure Review Program

Failure shall be taken to refer to uncorrected deviations from manufacturing specifications and tolerances, inability of a piece of equipment to meet specified test performance or operating performance due to any cause not immediately identifiable as being unrelated to that piece of equipment, damage to a piece of equipment at any time between the date of start of manufacture and the date of expiration of the warranty, or any combination of the above. As a guideline, all failures except for the first type listed above shall be designated "major failures" with any other types constituting "minor failures". The Project Manager or their designated representative, however, shall have the final decision as to failure classification, and to this end, all records of nonconforming items shall be made available to the Project Manager or their designated representative upon request, within the Contractor's facilities.

1. Requirements

   a. The Contractor shall develop a formal failure review method for documentation and analysis of all failures occurring in equipment within the Contractor's scope of supply from start of manufacturing until date of completion of all commissioning and testing. This failure review method shall be transmitted to the Project Manager or their designated representative before the Contractor commences any manufacturing or procurement work required under these Contract Documents. No manufacturing may take

place until the Project Manager or their designated representative has reviewed this failure review method.

b. Failure review method shall consist of both failure identification and failure diagnosis. The Contractor's failure review method shall include, but not be limited to, the following features:

1) Reporting of each failure on a standard form which describes the deficiency, date of failure, time of failure, item, part number, serial number, failure location in the item, designation as a major or minor failure, and technical specification reference.

2) Investigation and determination of the nature, extent, validity, and cause of each failure, and the reporting of this on the standard report form. Post-mortem examination of the discrepant item shall be carried out to establish the mechanism of failure, if appropriate.

3) Establishment of corrective action to prevent recurrence, and monitoring of the results of the corrective action to ensure that the problem has been fixed.

The Contractor shall establish a Failure Review Board to review each report of a major failure. The Failure Review Board shall coordinate and provide timely disposition of each problem. The Failure Review Board shall provide a Failure Analysis Status Summary. The Failure Analysis Status Summary shall be capable of indicating trends or recurrences of failures. The Project Manager or their designated representative will be a member of the Failure Review Board. The Project Manager or their designated representative's attendance will be mandatory for all Failure Review Board reviews of major failures, unless permission to proceed in the Project Manager or their designated representative's absence is received in writing.

Failure Review Board actions shall require the Project Manager or their designated representative's review to be valid. The Contractor may elect to continue a test pending a review. However, continuing the test shall be at the Contractor's risk, as the Project Manager or their designated representative's action may invalidate the test and require it to be reconducted.

ARTICLE V.
TASK ORDER DEVELOPMENT AND APPROVAL

501. Task Order Development

Not applicable.

501.1 Task Order Proposal

Not applicable.

501.2 Task Order Development

Not applicable.

501.3 Task Order Approval and Authorization

Not applicable.

501.4 Task Order Modifications

Not applicable.

ARTICLE VI.
OWNERSHIP

601. Ownership Rights

It is understood and agreed that the deliverables, including software, that are being developed by the Contractor for the sole and exclusive use of the LADWP. The LADWP shall be deemed the sole and exclusive owner of all right, title, and interest therein, including all copyright and proprietary rights relating thereto ("Deliverables"). All work performed by the Contractor on Deliverables and any supporting documentation therefore shall be considered as "Works-Made-for-Hire" (as such are defined under the U.S. Copyright Laws and international treaties) and, as such, shall be owned by and for the benefit of the LADWP. The LADWP owns any and all trademarks, patents, copyrights, and any other intellectual property rights for any and all Deliverables generated as a result of this Agreement, regardless of the state of completion of said deliverables.

In the event it should be determined that any of such Deliverables or supporting documentation, or parts thereof, do not qualify as a "Works-Made-for-Hire" the Contractor shall and hereby does transfer and assign to the LADWP for no additional consideration, all right, title, and interest that it may possess in such deliverables and documentation including, but not limited to, all copyrights to the

work and all rights comprised therein, and all proprietary rights relating thereto. Upon request, the Contractor shall take such steps as are reasonably necessary to enable the LADWP to record such assignment. Further, the Contractor shall contractually require all persons performing under this Agreement, including all Subcontractors, to assign to the LADWP all rights, , title, and interest, including copyrights to all such "Works-Made-for-Hire."

601.1 Use of Deliverables

The LADWP has the right to use or not use the Deliverables and to use, reproduce, re-use, alter, modify, edit, or change the deliverables as it sees fit and for any purpose. If the LADWP determines that a deliverable, or any part thereof, requires correction prior to LADWP approval, the LADWP has the absolute right to use the deliverable until such time as the Contractor can remedy the identified deficiency.

601.2 Execution of Ownership Documents

The Contractor shall sign, upon request, any documents needed to confirm that the Deliverables or any portions thereof are "Works-Made-for-Hire" and to effectuate the assignment of its rights to the LADWP.

602. Warrant Against Infringement

The Contractor warrants that the performance of the services by the Contractor or its Subcontractor of any tier, pursuant to this Agreement, shall not in any manner constitute an infringement or other violation of any trademark, copyright, patent and/or trade secret of any third party.

603. Subcontractors Subject to This Article VI

Any Subcontract entered into pursuant to the terms of this Agreement shall be subject to, and shall incorporate, the provisions of this Article VI, Ownership. The Contractor shall contractually require all persons performing under this Agreement, including all Subcontractors, to assign to the LADWP all rights, title, and interest, including copyrights to all Deliverables and other "Works-Made-for-Hire."

604. Survival of Provisions

The provisions of this Article VI, Ownership, shall survive termination and expiration of this Agreement.

604.1 As part of the Contractor's provision of the services hereunder, the Contractor may utilize pre-existing proprietary works of authorship that

have not been created specifically for the LADWP, including without limitation methodologies, templates, and research, as well as, ideas, concepts, know-how, analytical approaches, and analytical processes which have been originated, developed or purchased by the Contractor or by third parties under contract to the Contractor that have not been created specifically for the LADWP (all of the foregoing, collectively, "Contractor's Information"). For the purposes of this Agreement, Contractor's Information shall remain the sole and exclusive property of the Contractor. The Contractor and the LADWP, including LADWP Contractors, shall have the right to use for themselves and other clients the ideas, concepts, and know-how developed during the performance of work and tasks under this Agreement and retained in the unaided memory, provided they do not infringe upon the LADWP's copyright or patent rights as set forth in this Article VI, Ownership. The LADWP acknowledges that the Contractor provides consulting and services to other clients, and agrees that nothing hereunder shall be deemed to prevent the Contractor from carrying on such business.

ARTICLE VII.
CONFIDENTIALITY AND RESTRICTIONS ON DISCLOSURE

701. Confidentiality

All documents, records, and information provided by the LADWP to the Contractor, or accessed or reviewed by the Contractor, during performance of this Agreement shall remain the property of the LADWP. All documents, records and information provided by the LADWP to the Contractor, or accessed or reviewed by the Contractor during performance of this Agreement, are deemed confidential. The Contractor agrees not to provide these documents and records, nor disclose their content or any information contained in them, either orally or in writing, to any other person or entity. The Contractor agrees that all documents, records, or other information used or reviewed in connection with the Contractor's work for the LADWP shall be used only for the purpose of carrying out LADWP business and cannot be used for any other purpose. The Contractor shall be responsible for protecting the confidentiality and maintaining the security of LADWP documents, records, and information in its possession.

701.1 Document Access/Control

A. The Contractor shall make the confidential information provided by the LADWP to the Contractor, or accessed or reviewed by the Contractor during performance of this Agreement, available to its employees, agents and /or Subcontractors, only on a need-to-know basis. Further, the Contractor shall provide written instructions to all of its employees, agents and Subcontractors, with access to the

confidential information about the penalties for its unauthorized use or disclosure.

B. The Contractor shall store and process confidential information in an electronic format in such a way that unauthorized persons cannot retrieve the information by computer, remote terminal or other means.

C. The Contractor shall not remove documents, records, or information used or reviewed in connection with the Contractor's work for the LADWP from LADWP facilities without prior approval from the LADWP. The Contractor shall not use, other than in direct performance of work required pursuant to the Agreement, or make notes of any home address or home telephone numbers contained in personnel or customer files, confidential information, documents, or records provided by the LADWP that are reviewed during work on this Agreement.

D. The Contractor shall not make or retain copies of any such documents, written and electronic materials, notes, documents, confidential information, records, or other information. Provided however, with prior written approval from the LADWP, the Contractor may make copies of such documents, written materials, notes, documents, confidential information, or other information, as necessary to perform its duties under this Agreement.

E. The Contractor shall document and immediately report to the LADWP any unauthorized use or disclosure of confidential information of which the Contractor becomes aware.

F. The Contractor shall require that all its employees, agents, and Subcontractors who shall, or may, review, be provided, or have access to LADWP data, information, personnel or customer files, confidential information, documents, or records during the performance of this Agreement, execute a confidentiality agreement that incorporates the provisions of this Article VII, Confidentiality and Restrictions on Disclosure, prior to performing work under this Agreement.

701.2 Return of All Documents to the LADWP

The Contractor shall, at the conclusion of this Agreement or at the request of the LADWP, promptly return any and all written materials, notes, documents, records, confidential information, or other information obtained by the Contractor during the course of work under this

Agreement to the LADWP, and all paper and electronic copies thereof. Provided however, the Contractor may retain duplicates and originals, as appropriate, of Contractor's administrative communications, records, files, and working papers relating to the services provided by the Contractor pursuant to this Agreement. Contractor shall under no circumstances retain any copies of LADWP financial of LADWP employee or customer confidential data or information.

701.3 Work Product and Deliverable Confidentiality

Any reports, findings, deliverables, analyses, studies, notes, information or data generated as a result of this Agreement are to be considered confidential. The Contractor shall not make such information available to any individual, agency, or organization except as provided for in this Agreement or as required by law. Notwithstanding the foregoing, the Contractor may reference its work under this Agreement in general terms in presentations and proposals, provided that in doing so, the Contractor does not disclose any non-public information. The Contractor may not release any information, whether or not such information is public information, to the media without prior written approval from the LADWP.

701.4 Subcontractors Subject to This Article VII

Any subcontract entered into pursuant to the terms of this Agreement shall be subject to, and shall incorporate, the provisions of this Article VII, Confidentiality and Restrictions on Disclosure.

702. Survival of Provisions

The provisions of this Article VII, Confidentiality and Restrictions on Disclosure shall survive termination and expiration of this Agreement.

703. Reference Checks

To the extent permitted by applicable law, the LADWP may conduct reference checks on the Contractor, its employees, agents, and Subcontractors who shall have, or may have, access to LADWP customer, employee, power system, or water system information and data during performance of this Agreement. The Contractor recognizes the highly sensitive nature of such information and data and agrees to cooperate with the LADWP and provide, to the extent permitted by applicable law, whatever information the LADWP requires in order to conduct reference checks. The LADWP may request changes to Contractor personnel pursuant to Section 403.2 of this Agreement in response to reference check

information, and the Contractor shall accommodate such request for personnel changes.

ARTICLE VIII.
TERMINATION AND SUSPENSION

801. Termination for Convenience

A. The LADWP may terminate this Agreement, or any part hereof, for its convenience upon giving at least thirty (30) calendar days written notice to the Contractor prior to the effective date of such termination, which date shall be specified in such notice.

B. After receipt of a notice of termination and except as otherwise directed by the LADWP, the Contractor shall:

1. Stop work under the Agreement on the termination effective date and to the extent specified in the notice of termination.

2. Deliver to the LADWP, within ten (10) calendar days after termination, any and all data, reports, other documents, and deliverables, or portions thereof, if any, prepared pursuant to this Agreement, but not already delivered.

3. Transfer title to the LADWP (to the extent that title has not already been transferred) in the manner and at the times and to the extent directed by the LADWP, the work in process, completed work, and other material produced as part of or required in respect to performance of this Agreement.

C. The amount due Contractor by reason of termination for the LADWP's convenience shall be determined as follows:

1. The Contractor shall be paid on the basis of work completed as set forth in authorized Task Orders after LADWP review and approval of the work.

2. The Contractor shall also be compensated by the LADWP on a percentage completed basis of the applicable Deliverables for work in process, when appropriate, in compliance with authorized Task Orders after LADWP review and approval of the work.

802. Termination for Cause

A. The LADWP may terminate this Agreement for cause by giving the Contractor a written notice of breach. The Contractor shall have ten (10) calendar days from the date of the LADWP's notice of breach to cure, or diligently commence to cure such breach. The LADWP's notice of breach shall include a time and location for the individuals identified in Section 102.1 of this Agreement to meet and discuss the notice of the breach. Such meeting shall be scheduled within ten (10) calendar days of the date of the notice of breach. If the Contractor is unable or unwilling to cure, or diligently commence to cure, such breach, or meet within the ten (10) day timeframe, the LADWP may terminate this Agreement anytime thereafter upon providing the Contractor written notice..

B. If this Agreement is terminated for cause, the Contractor shall comply with Section 801B, above. The LADWP shall pay for the LADWP accepted deliverables, less the amount of any damages incurred as a result of the Contractor's failure to perform its responsibilities under this Agreement.

803. Suspension of Work

The LADWP may orally direct the Contractor to suspend, and to subsequently resume performance of all or any of the work. Such LADWP direction shall be confirmed in writing. In the event that the LADWP suspends work, the authorized Task Order scheduled and budget shall be adjusted as appropriate in accordance with the provisions of Section 501.4 of this Agreement.

ARTICLE IX.
AMENDMENTS AND CHANGE ORDERS TO THE AGREEMENT

901. Amendments

Any change in the terms of this Agreement, including changes in the services to be performed by the Contractor, extension of the term, and any increase or decrease in the amount of compensation authorized in Section 301.1 of this Agreement, agreed to by the Parties, shall be incorporated into this Agreement by a written amendment properly executed and signed by the Board of Water and Power Commissioners and the person(s) authorized to bind the Contractor thereto.

Agreement extensions that result in an Agreement term of greater than three (3) years in the aggregate may require City Council approval pursuant to Section 373 of the Charter of the City of Los Angeles (hereinafter "City Charter").

902. Change Requests

902.1 LADWP Change Requests

During the term of this Agreement the LADWP shall have the right to request changes to the work within the general scope of work contemplated by this Agreement and consistent with the work described in Section 401, Services to be Provided by the Contractor, of this Agreement. A "change," as that term is used in this Section means adjustments made within the scope of the services to be provided by the Contractor established in Section 401 of this Agreement, including adjustments to schedule, which do not extend the term of the Agreement or increase the authorized amount set forth in Section 301.1 of this Agreement. The LADWP shall make a formal written request with respect to each change it desires to make.

902.2 Change Order Development

Within ten (10) calendar days following the Contractor's receipt of the LADWP's written change request, the Contractor, at its own expense, shall prepare and deliver to the LADWP written statement that includes the following:

1. Impact that the change would have on existing Contractor service requirements and characteristics;

2. Impact of the change on authorized Task Orders and any other part of this Agreement.

The Contractor may suggest to the LADWP that changes be made to the work within the general scope of the work contemplated in this Agreement. All such suggested changes shall be made in accordance with the provisions of this Section.

Upon the LADWP's review of the Contractor's written response to the change request proposal, the LADWP and Contractor shall cooperatively work to develop a change order. To that end, informal exchanges between the Contractor and LADWP are encouraged to aid in the development of a change order.

902.3 Change Order Approval and Authorization

Upon approval of the Contractor's written statement prepared pursuant to Section 902.2, the LADWP's authorized representatives as identified in Section 102.1, of this Agreement, or their designee established in writing, the LADWP shall deliver to the Contractor a change order (hereinafter ("Change Order Notice") for execution, consistent with Section 102.1 of this Agreement. The Change Order Notice shall contain the full and

complete agreement among the Parties regarding the modifications to the scope of services to be provided.

903. Order of Precedence

In the event of any conflict between the terms of this Agreement and the terms of any exhibit, the terms of the exhibit shall control. In the event of any conflict between the following documents, all of which are hereby incorporated by reference into this Agreement, the order of precedence shall be as follows:

(a) Latest Amendment

(b) Agreement

(c) Latest Change Order

(d) Other reference documents

904 Requests for Substitution of Equivalent Materials or Equipment

A. Unless otherwise specifically approved, where these Contract Documents identify a specific material, manufacturer, type, and/or model, Contractor shall include that exact item in their Appendix D Pricing and the Total Agreement Cost. If any material or equipment is offered as the equivalent to that specified, the Contractor shall submit to the Project Manager or their designated representative for approval or acceptance a written request for substitution not more than 35 calendar days after date of award of Agreement. The request shall contain name of the manufacturer, brand, catalog number, catalog or relevant portions thereof, and other information sufficient to show that such material or equipment is equivalent to that specified. If requested by the Project Manager or their designated representative, the Contractor shall, at no cost to the LADWP, provide test reports of such equivalent material or equipment as to its quality, strength, durability, design, efficiency, finish, service, or chemical and physical characteristics. Only equivalent materials or equipment, approved in writing by the Project Manager or their designated representative, may be substituted for specified materials or equipment.

B. Substitutions for material or equipment having a Los Angeles Research Report will require that the substitute material or equipment have an active Los Angeles Research Report and that the Contractor shall obtain approval from the Los Angeles City LADWP of Building and Safety. Evidence of the City's approval shall be furnished to the Project Manager or their

designated representative prior to the LADWP's approval or acceptance of the substituted material or equipment.

C. All costs incurred by the LADWP arising from the Contractor's requests for substituted or equivalent materials or equipment, including, but not limited to, those arising from additional engineering or adaptation of other parts of the design, shall be borne by the Contractor.

ARTICLE X.
DISPUTES

1001. Disputes

1001.1 Dispute Resolution

Both Parties shall agree to reach an amicable settlement in cases of dispute. If an amicable settlement cannot be reached, or in the event of default that could result in termination of this Agreement, the LADWP and the Contractor shall schedule a meeting of the individuals identified in Section 102.1 in a good faith attempt to resolve the issues in dispute. Such Dispute Resolution meeting shall be scheduled and held within 10 days of written request by either party. The meeting shall allow for a detailed presentation of each Party's views on the issues and potential solutions to the dispute or default. If possible, the meeting should result in an agreed upon course of action to resolve the dispute or default.

This Agreement together with the Exhibits hereto completely and exclusively states the agreement of the Parties regarding its subject matter. No verbal or written agreement or conversation with any officer or employee of either Party, including, but not limited to, proposals, e-mails, and other communications, shall affect or modify any of the terms and conditions of this Agreement. This Agreement shall not be modified except as provided for in Article IX, Amendments and Changes to the Agreement.

1001.2 Continued Work

The Contractor and the LADWP shall continue to perform work under the Agreement during any dispute.

1001.3 Claim Procedures

The provisions of Sections 5.169 and 5.170 (Div. 5, Ch. 10, Art. 1) of the Los Angeles Administrative Code and Section 350 of the City Charter shall govern the procedure and rights of the Parties with regard to claims

arising from this Agreement. Nothing herein shall be construed as a waiver of the claim requirements set forth in Government Code 900 *et. seq.*

1001.5 Venue

Venue for any dispute or litigation shall be in Los Angeles, California.

ARTICLE XI.
STANDARD PROVISIONS

1101. Standard Provisions for LADWP Contract

The Contractor shall comply with the *Standard Provisions for LADWP of Water and Power Professional Service Contracts (Revised June, 2007)*, which are attached hereto as Exhibit E, and made a part hereof.

1102. Audit Cost Recovery

If an examination or audit undertaken pursuant to the Retention of Records, Audit, and Reports provision of the Standard Provisions PSC-22 for LADWP of Water and Power Professional Service Contracts reveals that the LADWP overpayment to the Contractor is more than 5% of the billings reviewed, the Contractor shall pay all expenses and costs incurred by the Authorized Auditors arising out of or related to the examination or audit. Such examination or audit expenses and costs shall be paid by the Contractor to the LADWP within fifteen (15) calendar days of notice to the Contractor of the costs and expenses.

1103. Infringement of Intellectual Property Rights

A. Contractor will defend at its expense and hold harmless in any infringement claim, demand, proceeding, suit or action ("Action" hereinafter) against the LADWP, its officers, directors, agents, employees, or affiliates for any infringement or violation, actual or alleged, direct or contributory, intentional or otherwise, of any intellectual property rights, including patents, copyrights, trade secrets, trade marks, service marks, and other proprietary information or rights (collectively "Intellectual Property Rights" hereinafter), (1) on or in any design, medium, matter, plant, article, process, method, application, equipment, device, instrumentation, software, hardware, or firmware used by the Contractor in the construction of the work under this Agreement; or (2) as a result of the LADWP's actual or intended use under the specifications contained herein by the LADWP of any product furnished by Contractor (herein after "Contractor Product". Contractor Product herein includes, without limitation, any hardware, software, firmware, equipment, device,

instrumentation, design, medium, matter, plant, article, process, method, and application. Contractor also shall indemnify the LADWP against any loss, cost, expense, liability, and damages finally awarded against the LADWP for settlement as a consequence of such Action.

B. Contractor, however, shall have no liability to the LADWP herein under with respect to any claim of infringement which is based upon the combination or utilization of the Contractor Product with machines or devices not reasonably anticipated hereunder; or based upon an unintended modification by the LADWP of the Contractor Product furnished hereunder.

C. In Contractor's defense of the LADWP, negotiation, compromise, and settlement of any such infringement action, the LADWP shall retain discretion in and control of the litigation, negotiation, compromise, settlement, and appeals thereof, as required by the City Charter, particularly Article II, Sections 271, 272 and 273 thereof.

D. In addition, if any part of the Contractor Product (a) becomes the subject of an action, (b) is adjudicated as infringing any Intellectual Property right, or (c) has its use enjoined or license terminated, Contractor shall, with the LADWP's consent, do one of the following immediately. Contractor shall at its expense either: i) procure for the LADWP the right to continue using said part of the product; ii) replace the product with a functionally equivalent, non-infringing product; or iii) modify the Product so it becomes non-infringing.

Exercise of any of the above-mentioned options shall not cause undue business interruption to the LADWP or diminish the intended benefits and use of the Contractor Product by the LADWP under the specifications herein. If Contractor proves to the LADWP's satisfaction that none of option (i), (ii), or (iii) is commercially feasible, Contractor shall instead refund the full purchase price of the product.

E. Rights and remedies available to the LADWP hereinabove shall survive the expiration or other termination of this Agreement. Further, the rights and remedies are cumulative of those provided for elsewhere in this Agreement and those allowed under the laws of the United States, the State of California, and the City of Los Angeles.

F. This Section 1103 shall survive the expiration or other termination of this Agreement.

1104. Performance Bond

Within thirty (30) calendar days of execution this Agreement, the Contractor will post a performance bond in the sum of the not-to-exceed amount established in Section 301.1 of this Agreement for the work detailed in this Agreement, including all Exhibits, from a corporate surety which is acceptable to the LADWP, conditioned for the faithful performance by the Contractor of all terms, covenants and conditions of this Agreement. The performance bond must remain effective for thirty (30) days after the termination or expiration of all Task Orders authorized pursuant to this Agreement.

Duplicate copies of all performance bonds required hereunder must conform to the requirements established by the City Charter, ordinance or LADWP policy and must be filed with the Office of the City Attorney for its review in accordance with the Los Angeles Administrative Code Sections 11.47 through 11.56.

1105. Labor and Material Payment Bond

The successful bidder shall furnish and maintain a satisfactory labor and material payment bond. The bond shall be executed by a responsible corporate surety, authorized to issue such bonds in the State of California and in other states where work is to be performed, and shall be secured through an authorized agent with an office in California. The bond shall be in an amount of not less than the Total Contract Price of the Work Authorized and released by the LADWP, including and Amendments that modify the Agreement amount, and shall be accompanied by a current copy of the surety company's license issued by the LADWP of Insurance of the State of California. In general, a separate satisfactory labor and material payment bond shall be furnished and maintained for all Contractor Work associated with each unit outage, if and when Contractor is given Notice to Proceed for Contract Work on each unit outage.

The labor and material payment bond shall be maintained in accordance with the Civil Code of the State of California and the laws of other states where work is performed. Such bonds shall extend to work performed pursuant to Amendments and to Extensions of Time, although such changes or extensions be ordered without notice to the surety. The labor and material payment bond shall be furnished by the successful bidder within 30 calendar days after the date of award/Notice to Proceed for each unit outage, and prior to start of any Agreement work on a unit outage.

1106 Liquidated Damages

The LADWP and Contractor recognize that time of the essence of this Agreement and that LADWP will suffer financial loss if the Services, Equipment, or Work are not completed and delivered to the Castaic Power Plant on the dates specified in Appendix F, plus any extensions or changes thereof allowed by executed amendment(s) to this Agreement. They also recognize that delays, expense, and difficulties involved in proving the actual loss suffered by the LADWP if the Services, Equipment or Work are

not completed on time. Accordingly, instead of requiring such proof, LADWP and Contractor agree that as liquidated damages for delay caused by the Contractor (but not as a penalty) the Total Contract Cost shall be reduced by $5,000 Dollars for each calendar day that expires after the dates for equipment delivery specified in Appendix F. Total liquidated damages shall not exceed 10% of the Contractor's portion of the project cost.

ARTICLE XII.
ENTIRE AGREEMENT

1201. Complete Agreement

This Agreement together with the Exhibits hereto completely and exclusively states the agreement of the parties regarding its subject matter and its terms govern, all prior proposals, agreements, or other communications between the parties, oral or written, regarding such subject matter. No verbal, or written agreement nor conversation with any officer or employee of either Party nor any or all prior proposals shall affect or modify any of the terms and conditions of this Agreement. This Agreement shall not be modified except provided by Article IX, Section 902.1, LADWP Change Request, signed on behalf of the LADWP and Contractor and by their duly authorized representatives. Any purported oral amendment to this Agreement shall have no effect.

1202. Number of Pages and Attachments

This Agreement is executed in two (2) duplicate originals, each of which is deemed to be an original. This Agreement includes *[fifty-four (54)]* pages and *[twelve (12) Exhibits]*, which constitute the complete understanding among the Parties.

1203. Represented by Counsel

Each Party acknowledges that it was represented by counsel in the negotiation and execution of this Agreement.

IN WITNESS WHEREOF, the Parties have caused this Agreement to be executed by their duly authorized representatives.

For: DEPARTMENT OF WATER AND POWER OF THE CITY OF LOS ANGELES BY BOARD OF WATER AND POWER COMMISSIONERS OF THE CITY OF LOS ANGELES

By:_____
S. DAVID FREEMAN
Interim General Manager

Date:_____

For: SYSTEMS INTEGRATED, LP

By: Susan Corrales-Diaz
SUSAN CORRALES-DIAZ
President

Date: March 15, 2010

And:_____
Secretary

By: _____
Vice-President

Date:_____

APPROVED AS TO FORM AND LEGALITY
CARMEN A. TRUTANICH, CITY ATTORNEY

MAR 11 2010

BY _____
DEPUTY CITY ATTORNEY

City Business Tax Registration Certificate Number: 002467438-0001-9
Internal Revenue Service ID Number: 20-1033290
Agreement Number 47941

EXHIBIT A

Contractor Labor Rates and Fees

Labor Category	Hourly Rate
Systems Integrated, LP	
Project Management	$185.00
Contract Administration	$175.00
Sr. Software Engineering	$155.00
Software Engineering	$135.00
Electrical Engineering	$125.00
CAD	$95.00
Shop Technician	$75.00
Field Technician	$105.00
Documentation	$105.00
Reimbursable Expenses	
None	

Labor Category	Hourly Rate
SUBCONTRACTOR	
Basler Electric – Engineering	$225.00
Basler Electric – Field Services	$280.00
American Governor – Engineering	$120.00
American Governor – Field Services	$250.00
Siemens Energy – Engineering	$195.00
Siemens Energy – Field Services	$235.00
Reimbursable Expenses	
None	

EXHIBIT A

Contractor Labor Rates and Fees

LADWP will pay for services based on the fixed cost established in Exhibit H. The rates and fees herein are for use in the event of a change order or Amendment, approved according to the terms of the Agreement. LADWP will reimburse reasonable and necessary Subcontractor costs at the actual amount paid by the Contractor to the Subcontractor, consistent with the Subcontractor rates established in this Exhibit. LADWP will not pay mark-up on Subcontractor services, costs, or expenses.

EXHIBIT B

Allowable Travel Expenses

Exhibit H, Pricing, is all inclusive of all Allowable Travel Expenses.

EXHIBIT C

List of Subcontractor

The following Subcontractors are authorized to work on the Project:

Name	Special Expertise of Firm	Anticipated Task/Service Responsibilities	Location	Firm Type (MBE/WBE/OBE)	Anticipated Compensation*
OneSourceDistributors	*Distributor of electrical materials used for automation*	*Supply materials used for automation; consulting services; documentation services and PLC programming services*	*Southern California*	MBE	*$1, 200,000*
Pigler Automation, LLC	*Siemen's Programming*	*Support PCS7 programming*	*Colorado*	*OBE*	*$50,000*
Systems Analysis & Integration, Inc.	*Systems Integration of hardware and software*	*Hydroelectric HMI programming experience; communication and integration services*	*Southern California*	*WBE*	*$1,500,000*
Siemen's	*Equipment Manufacturer*	*Protection relays, synchronizers and integration services*	*North Carolina*	*OBE*	*$1,300,000*
American Governor	*Equipment Manufacturer*	*Supply governors and integration services*	*Pittsburg*	*OBE*	*$1,200,000*
Basler Electric	*Equipment Manufacturer*	*Supply exciters and integration services*	*Illinois*	*OBE*	*$1,800,000*

* Subcontractor participation is estimated and may be modified to reflect actual services requested.

EXHIBIT D

List of Key Contractor Personnel

The following people are designated as Contractor's Key Personnel:

Name	Project Position	Labor Category	Location	Special Expertise	No. of Years Employed by Contractor/ Experience
Larry Pomatto	Project Manager	Project Management	Orange, CA	Experience designing and managing process control systems.	35/40
John Holbrook	Contract Administrator	Contract Administration	San Diego, CA	Experience in engineering design, control systems, project management and operations management.	20/31
Tom Waldowski	Sr. Software Engineer	Sr. Software Engineering	San Diego, CA	System design and planning, developing and implementing software solutions for the automation of control systems in the utility industry.	22/27
Greg Conley	Sr. Software Engineer	Sr. Software Engineering	San Diego, CA	Principal member of the *ONSITE*® SCADA software design group, and continues to participate in directing the software development effort. Network	22/25
Arde Kirka	Sr. System Engineer	Sr. Software Engineering	San Diego, CA	Responsible for the development of Siemens/Allen-Bradley PLC and HMI/GUI software applications for our customers.	2/18
Frank Zhang	Sr. System Engineer	Sr. Software Engineering	San Diego, CA	Developer of control system software for Remote Terminal Units and Siemens/Allen-Bradley Programmable Logic Controllers used in SCADA system projects.	10/15

[Note: all Labor categories listed should also appear on Exhibit A Contractor Labor Rates and Fees. Any Subcontractor personnel that are key to the Project should also be included in this Exhibit]

STANDARD PROVISION FOR LADWP OF WATER AND POWER PROFESSIONAL SERVICE CONTRACTS

PSC-1 Construction of Provisions and Titles Herein

All titles or subtitles appearing herein have been inserted for convenience and shall not be deemed to affect the meaning or construction of any of the terms or provisions hereof. The language of this Agreement shall be construed according to its fair meaning and not strictly against the LADWP or the Contractor. The word "Contractor" herein and in any amendment hereto includes the Party or Parties identified in this Agreement wherein this Appendix is incorporated by reference; the singular shall include the plural; if there shall be more than one Contractor herein, unless expressly stated otherwise, their obligations and liabilities hereunder shall be joint and several; use of feminine, masculine, or neuter gender shall be deemed to include the genders not used.

PSC-2 Number of Originals

The number of original texts of this Agreement shall be equal to the number of the Parties hereto, one text being retained by each Party.

PSC-3 Applicable Law, Interpretation, Enforcement and Severability

Each Party's performance hereunder shall comply with all applicable laws of the United States of America, the State of California, and the City of Los Angeles, including but not limited to laws regarding health and safety, labor employment, wage and hours, workers compensation, and licensing laws which affect employees. Contractor shall comply with new, amended, or revised laws, regulations, and/or procedures that apply to the performance of this Agreement.

This Agreement was made and entered into in the City of Los Angeles and shall be governed by, interpreted and enforced in accordance with the laws of the State of California and the City of Los Angeles, without regard to conflicts of laws principles. All litigation arising out of, or relating to, this Agreement shall be brought in a State or Federal court in the County of Los Angeles in the State of California. The Parties irrevocably agree to submit to the exclusive jurisdiction of such courts in the State of California and waive any defense of *forum non conveniens*.

If any part, term or provision of this Agreement shall be held invalid, void, illegal, unenforceable, or in conflict with any law of a federal, state or local government having jurisdiction over this Agreement, the validity of the remaining parts, terms or provisions shall not be affected or impaired thereby.

The provisions of this section shall survive the expiration or termination of this Agreement.

PSC- 4 Time of Effectiveness

Unless otherwise provided, this Agreement shall take effect when all of the following events have occurred:

(a) This Agreement has been signed on behalf of the Contractor by the person(s) authorized to bind the Contractor hereto.

(b) This Agreement has been approved by the City Council or by the Board, inclusive of City Council review period, officer, or employee authorized to give such approval.

(c) The Office of the City Attorney has indicated in writing its approval of this Agreement as to form and legality.

(d) This Agreement has been signed on behalf of the LADWP by the person designated by the Board, officer or employee authorized to enter into this Agreement.

PSC-5 Integrated Agreement

This Agreement sets forth all of the rights and duties of the Parties with respect to the subject matter hereof, and replaces any and all previous agreements and understandings, whether written or oral, relating hereto. This Agreement may be amended only as provided for in paragraph SP-6.

PSC-6 Amendment

All amendments hereto shall be in writing and signed on behalf of both Parties by the persons authorized to bind the Parties hereto.

PSC-7 Excusable Delays

In the event that performance on the part of any Party hereto shall be delayed or suspended as a result of circumstances beyond the reasonable control and without the fault or negligence of said Party, none of the Parties shall incur any liability to the other Parties as a result of such delay or suspension. Circumstances deemed to be beyond the control of the Parties hereunder shall include, but are not limited to, acts of God or of the public enemy; insurrection; fires; floods; epidemics; quarantine restrictions; strikes; freight embargoes; to the extent that they are not caused by the Party's willful or negligent acts or omissions, and to the extent that they are beyond the Party's reasonable control.

PSC-8 Breach

Except for excusable delays as defined in PSC-7, if any Party fails to perform, in whole or in part, any promise, covenant, or agreement set forth herein, or should any representation, warranty, certification or other statement made by it be untrue, any aggrieved Party may avail itself of all rights and remedies, at law or equity, in the courts of law.

PSC-9 Waiver

A waiver of a default of any part, term, or provision of this Agreement shall not be construed as a waiver of any succeeding default or as a waiver of the part, term or provision itself. A Party's performance after the other Party's default shall not be construed as a waiver of that default.

PSC-10 Independent Contractor

The Contractor is acting hereunder as an independent contractor and not as an agent or employee of the LADWP or the City of Los Angeles, and all of the terms and conditions of this Agreement shall be interpreted in light of that relationship. The Contractor, including Contractor's Subcontractors, suppliers, employees, and agents, shall not represent or otherwise hold out itself or any of its directors, officers, partners, employees, or agents to be an agent or employee of the LADWP for any purpose whatsoever. The Contractor shall not be entitled to any LADWP or City of Los Angeles benefits, including but not limited to, vacation, sick leave, Workers' Compensation, or pension.

PSC-11 Prohibition Against Assignment or Delegation

The Contractor may not, unless it has first obtained the written permission of the LADWP, such permission may be withheld at the LADWP's sole discretion for any reason or no reason at all since the award of this Agreement was based upon the personal services to be provided by the Contractor

(a) Assign or otherwise alienate any of its rights hereunder, including the right to payment; or

(b) Delegate, subcontract, or otherwise transfer any of its duties hereunder.

PSC-12 Licenses and Certifications

The Contractor and its officers, agents, and employees shall obtain and maintain all licenses, permits, certifications and other documents necessary for the Contractor's performance hereunder and shall pay any fees required therefor. Such licenses, permits, certifications shall be specific to the State of California or regional regulatory agencies,

as applicable to Contractor's services, work, task, and deliverables pursuant to this Agreement. Contractor agrees to immediately notify the LADWP of any suspension, termination, lapse, non-renewal, or restriction of such licenses, permits, certifications, or other documents.

Drawings (designs, specifications, and reports) shall be signed and sealed by professional engineers and architects with appropriate legal registration in the State of California.

PSC- 13 Non Discrimination/Equal Employment Practices/Affirmative Action

The Contractor shall comply with the applicable non-discrimination and affirmative action provisions of the laws of the United States, the State of California, and the City of Los Angeles. In performing this Agreement, the Contractor shall not discriminate in its employment practices against any employee or applicant for employment because of such person's race, religion, national origin, ancestry, sex, sexual orientation, age, disability, domestic partner status, marital status or medical condition. The Contractor shall also comply with all rules, regulations, and policies of the LADWP relating to nondiscrimination and affirmative action, including the filing of applicable forms or affirmative action plan.

Any subcontract entered into by the Contractor relating to this Agreement, to the extent allowed hereunder, shall be subject to the provisions of this paragraph. Failure of the Contractor to comply with this requirement or to obtain the compliance of its Subcontractors with such obligations shall subject the Contractor to the imposition of any and all sanctions allowed by law, including but not limited to termination of this Agreement.

PSC-14 Claims for Labor and Materials

The Contractor shall promptly pay, when due, all amounts payable for labor and materials furnished in the performance of this Agreement so as to prevent any lien or other claim under any provision of law from arising against the LADWP or City of Los Angeles or any of their respective property (including reports, documents, and other tangible matter produced by the Contractor hereunder), against the Contractor's rights to payments hereunder, and shall pay all amounts due under the Unemployment Insurance Act with respect to such labor.

PSC- 15 Los Angeles City Business Tax Registration Certificate Required

The Contractor represents that it has obtained and presently holds a Business Tax Registration Certificate(s) required by the City of Los Angeles Business Tax Ordinance (Article 1, Chapter II, Section 21.00 and following, of the Los Angeles Municipal Code). For the term covered by this Agreement, the Contractor shall maintain, or obtain as necessary, all such Certificates required under said ordinance and shall not allow any such Certificate to be revoked or suspended.

PSC -16 Bonds

Duplicate copies of all bonds which may be required hereunder shall conform to the LADWP requirements established by Los Angeles City Charter, ordinance or policy and shall be filed with the Office of the City Attorney for its review in accordance with Los Angeles Administrative Code Sections 11.47 through 11.56.

PSC-17 Indemnification

Except for the gross negligence or willful misconduct of the LADWP, the Contractor undertakes and agrees to defend, indemnify and hold harmless the LADWP, the City of Los Angeles, including but not limited to any of its boards, commissioners, officers, agents, employees, assigns and successors in interest (hereinafter, collectively, "Indemnitees") from and against any and all suits and causes of action, claims, losses, demands, penalties, judgments, costs, expenses and disbursements of any kind or nature whatsoever, including but not limited to attorney's fees (including allocated costs of internal counsel) and costs of litigation, damage, obligation or liability of any kind or nature whatsoever, in any manner arising by reason of, incident to, or connected in any manner to performance, non-performance or breach of this Agreement or any other act or omission by or of the Contractor or Contractor's officers, employees, agents or Subcontractors of any tier, including but not limited to any such act or omission that results in death or injury to any person, including but not limited to Contractor, Contractor's officers, employees, agents, and Subcontractors of any tier, or damage or destruction to property of any kind, of either Party hereto, or of third Parties, or loss of use(hereinafter, collectively, "Indemnified Liabilities"). The provisions of this paragraph shall survive expiration or termination of this Agreement, and shall be in addition to, and not exclusive of, any other rights or remedies which Indemnitees have at law, in equity, under this Agreement or otherwise. To the extent that the undertakings to defend, indemnify, pay and hold harmless set forth in this subsection may be unenforceable in whole or in part because they are violative of any law or public policy, Contractor shall contribute the maximum portion that it is permitted to pay and satisfy under applicable law to the payment and satisfaction of all Indemnified Liabilities incurred by Indemnitees or any of them. The provisions of this paragraph shall survive the expiration or termination of this Agreement.

PSC-18 Insurance

A. General Statement

Acceptable evidence of required insurance, from insurers acceptable to the LADWP, is required to be submitted by the Contractor and must be maintained current by the Contractor throughout the term of this

Agreement. Said evidence of insurance must be on file with the Risk Management Section in order to receive payment under any agreement for services rendered, and in order to commence work under this Agreement.

B. Applicable Terms and Conditions

1. Additional Insured Status Required

Contractor shall procure at its own expense, and keep in effect at all times during the term of this Agreement, the types and amounts of insurance specified on the attached Contract Insurance Requirements page. The specified insurance shall also, either by provisions in the policies, by City's own endorsement form or by other endorsement attached to such policies, include and insure City, the LADWP, the Board, and all of their respective officers, employees and agents, their successors and assigns, as additional insureds (except for Professional Liability and Workers' Compensation), against the area of risk described herein as respects Contractor's acts or omissions in its performance of this Agreement, hereunder or other related functions performed by or on behalf of Contractor. Such insurance shall not limit or qualify the liabilities and obligations of the Contractor assumed under this Agreement.

2. Severability of Interests and Cross Liability Required

Each specified insurance policy (other than Workers' Compensation and Employers' Liability and Property coverage) shall contain a Severability of Interest and Cross Liability clause which states, "It is agreed that the insurance afforded by this policy shall apply separately to each insured against whom claim is made or suit is brought except with respect to the limits of the company's liability," and a Contractual Liability Endorsement which shall state, "Such insurance as is afforded by this policy shall also apply to liability assumed by the insured under this Agreement with the City of Los Angeles."

3. Primary and Non-Contributory Insurance Required

All such insurance shall be Primary and Noncontributing with any other insurance held by the LADWP where liability arises out of or results from the acts or omissions of Contractor, its agents, employees, officers, assigns, or any person or entity acting for or on behalf of Contractor. Any insurance carried by the LADWP which may be applicable shall be deemed to be excess insurance

and the Contractor's insurance is primary for all purposes despite any conflicting provision in the Contractor's policies to the contrary.

4. Deductibles Subject to LADWP's Discretion

Deductibles and/or self-insured retentions shall be at the sole discretion of the Risk Manager of the LADWP (hereinafter referred to as "Risk Manager"). The LADWP shall have no liability for any premiums charged for such coverage(s). The inclusion of the LADWP, its board, and all of its officers, employees and agents, and their agents and assigns, as additional insureds, is not intended to, and shall not, make them, or any of them a partner or joint venturer with Contractor in its operations.

5. Proof of Insurance for Renewal or Extension Required

At least ten (10) days prior to the expiration date of any of the policies required on the attached Contract Requirement page, documentation showing that the insurance coverage has been renewed or extended shall be filed with the LADWP. If such coverage is canceled or reduced in coverage, Contractor shall, within fifteen (15) days of such cancellation or reduction of coverage, file with the LADWP evidence that the required insurance has been reinstated or provided through another insurance company or companies.

6. Submission of Acceptable Proof of Insurance and Notice of Cancellation

Contractor shall provide proof to the Risk Manager of all specified insurance and related requirements either by production of the actual insurance policy(ies), by use of LADWP's own endorsement form(s), by other written evidence of insurance acceptable to the Risk Manager, but always in a form acceptable to the Risk Manager and the Office of the City Attorney. The documents evidencing all specified coverage shall be filed with the LADWP prior to Contractor beginning operations hereunder. Said proof shall contain at a minimum, the applicable policy number, the inclusive dates of policy coverage, the date the protection begins for the LADWP, and the insurance carrier's name. It shall bear an original signature of an authorized representative of said carrier, and shall provide that such insurance shall not be subject to

cancellation, material reduction in coverage or non-renewal except after written notice by certified mail, return receipt requested, to the City Attorney of the City of Los Angeles at least thirty (30) calendar days prior to the effective date thereof. The notification shall be sent by registered mail to: The Office of the City Attorney, Water and Power Division, Post Office Box 51111, JFB Room 340, Los Angeles, California 90051-0100.

7. Claims-Made Insurance Conditions

Should any portion of the required insurance be on a "Claims Made" policy, the Contractor shall, at the policy expiration date following completion of work, provide evidence that the "Claims Made" policy has been renewed or replaced with the same limits, terms and conditions of the expiring policy, or that an extended three (3) years discovery period has been purchased on the expiring policy at least for the agreement under which the work was performed.

8. Failure to Maintain and Provide as Cause for Termination

Failure to maintain and provide acceptable evidence of the required insurance for the required period of coverage shall constitute a breach of contract, upon which the LADWP may immediately terminate or suspend this Agreement.

9. Periodic Right to Review/Update Insurance Requirements

The LADWP and Contractor agree that the insurance policy limits specified on the attached Contract Insurance Requirements page may be reviewed for adequacy annually throughout the term of this Agreement by the Risk Manager/City Attorney, who may thereafter require Contractor to adjust the amounts and types of insurance coverage however the Risk Manager/City Attorney deems to be adequate and necessary. The LADWP reserves the right to have submitted to it, upon request, all pertinent information about the agent and carrier providing such insurance, including applicable license and ratings.

10. Specific Insurance Requirements

See Exhibit E-1, "Contract Insurance Amount Requirements."

C. Worker's Compensation

By signing this Agreement, Contractor hereby certifies that it is aware of the provisions of Section 3700 et. seq., of the Labor Code which requires every employer to be insured against liability for Worker's Compensation or to undertake self-insurance in accordance with the provisions of that Code, and that it will comply with such provisions at all such times as they may apply during performance of the work pursuant to this Agreement.

PSC -19 Child Support Policy

The Contractor and any Subcontractor(s) must fully comply with all applicable State and Federal employment reporting requirements for the Contractor's and any Subcontractor(s)' employees. The Contractor and any Subcontractor(s) must fully comply with all lawfully served Wage and Earnings Assignment Orders and Notices of Assignment in accordance with the California Family Code. The Contractor and any Subcontractor(s) must certify that the principal owner(s) thereof (any person who owns an interest of 10 percent or more) are in compliance with any Wage and Earnings Assignment Orders or Notices of Assignment applicable to them personally. The Contractor and any Subcontractor(s) must certify that such compliance will be maintained throughout the term of this Agreement.

Failure of the Contractor and/or any Subcontractor(s) to fully comply with all applicable reporting requirements or to implement lawfully served Wage and Earnings Assignments or Notices of Assignment or failure of the principal owner(s) to comply with any Wage and Earnings Assignments or Notices of Assignment applicable to them personally shall constitute a default under this Agreement. Failure of the Contractor and/or any Subcontractor(s) or principal owner(s) thereof to cure the default within ninety (90) calendar days of notice of such default by the LADWP shall subject this Agreement to termination.

The Contractor will contractually require all Subcontractors performing services under this Agreement to comply with the provisions of this section.

PSC- 20 Service Contract Worker Retention Ordinance and Living Wage Policy

A. General Provisions

This Agreement is subject to the Service Contractor Worker Retention Ordinance (SCWRO), Section 10.36 et. seq., and the Living Wage Ordinance (LWO), Section 10.37 et. seq., of the Los Angeles Administrative Code. The Ordinances require that, unless specific exemptions apply, employers who are awarded service contracts that involve expenditures in excess of $25,000, and have a duration of at least

three months; and any persons who receive City financial assistance of one million dollars or more in any 12-month period, shall comply with the following provisions of the ordinances:

(a) Retention for a ninety (90) calendar day transition period, the employees who were employed for the preceding twelve (12) months or more by the terminated Contractor or Subcontractor, if any, as provided for in the SCWRO;

(b) Payment of a minimum initial wage rate to employees as defined in the current LWO, Employee Information Form OCC/LW-6 and /or Subcontractor's Declaration of Compliance Form OCC/LW-5..

B. Termination Provisions

Under the provisions of Section 10.36.3(c) and Section 10.37.5 of the Los Angeles Administrative Code, the LADWP shall have the authority, under appropriate circumstances, to terminate this Agreement and otherwise pursue legal remedies that may be available, if the LADWP determines that the subject Contractor or financial assistance recipient violated the provisions of the referenced Code Section.

C. Invoice Provisions

All invoices related to SCWRO and LWO Contracts shall contain the following statement:

"The Contractor fully complies with Section 10.36 et. seq. and Section 10.37 et. seq., of SCWRO and LWO, respectively, of the Los Angeles Administrative Code."

PSC-21 American with Disabilities Act

The Contractor hereby certifies that it will comply with the Americans with Disabilities Act 42, U.S.C. Section 12101 et seq., and its implementing regulations. The Contractor will provide reasonable accommodations to allow qualified individuals with disabilities to have access to and to participate in its programs, services and activities in accordance with the provisions of the Americans with Disabilities Act. The Contractor will not discriminate against persons with disabilities nor against persons due to their relationship or association with a person with a disability. Any subcontract entered into by the Contractor, relating to this Agreement, to the extent allowed hereunder, shall be subject to the provisions of this paragraph.

PSC -22 Standard Provisions for LADWP of Water and Power Professional Service Contracts – Retention of Records, Audit, and Reports (revised October 16, 2007

Contractor shall maintain, and shall cause Contractor's Subcontractors and suppliers as applicable to maintain all records pertaining to the management of this Agreement and, related subcontracts, and performance of services pursuant to this Agreement, in their original form, including but not limited to, reports, documents, deliverables, employee time sheets, accounting procedures and practices, records of financial transactions, and other evidence, regardless of form (e.g., machine readable media such as disk, tape, etc.) or type (e.g., databases, applications software, database management software, utilities, etc.), sufficient to properly reflect all costs claimed to have been incurred and services performed pursuant to this Agreement. If the Contractor, the Contractor's Subcontractors and/or suppliers are required to submit cost or pricing data in connection with this Agreement, the Contractor must maintain all records and documents necessary to permit adequate evaluation of the cost or pricing data submitted, along with the computations and projections used. All records shall be retained, and shall be subject to examination and audit by LADWP personnel or by the LADWP's agents (herein after "Authorized Auditors"), for a period of not less than four (4) years following final payment made by the LADWP hereunder or the expiration date of this Agreement, whichever is later.

The Contractor shall make said records or to the extent accepted by the Authorized Auditors, photographs, micro-photographs, etc. or other authentic reproductions thereof, available to the Authorized Auditors at the Contractor's offices at all reasonable times and without charge. The Authorized Auditors will have the right to reproduce, photocopy, download, transcribe, and the like any such records. Any information provided by the Contractor on machine-readable media shall be provided in a format accessible and readable by the Authorized Auditors. The Contractor shall not, however, be required to furnish the Authorized Auditors with commonly available software.

Contractor, and the Contractor's Subcontractors and suppliers, as applicable to the services provided under this Agreement, shall be subject at any time with fourteen (14) calendar day's prior written notice to audits or examinations by Authorized Auditors, relating to all billings and to verify compliance with all Agreement requirements relative to practices, methods, procedures, performance, compensation, and documentation.

Examinations and audits will be performed using generally accepted auditing practices and principles and applicable City, State and Federal government audit standards. For Contractors that utilize or are subject to FAR, Part 30 and 31, et seq. accounting procedures, or a portion thereof, examinations and audits will utilize such information.

To the extent that the Authorized Auditor's examination or audit reveals inaccurate, incomplete or non-current records, or records are unavailable, the records shall be considered defective.

Consistent with standard auditing procedures, the Contractor will be provided fifteen (15) calendar days to review the Authorized Auditor's examination results or audit and respond to the LADWP prior to the examination's or audit's finalization and public release.

If the Authorized Auditor's examination or audit indicates the Contractor has been overpaid under a previous payment application, the identified overpayment amount shall be paid by the Contractor to the LADWP within fifteen (15) calendar days of notice to the Contractor of the identified overpayment.

The Contractor shall contractually require all Subcontractors performing services under this Agreement to comply with the provisions of this section by inserting this provision PSC- 22 in each Subcontractor contract and by contractually requiring each Subcontractor to insert this provision PSC-22 in any of its Subcontractor contracts related to services under this Agreement. In addition, Contractor and Subcontractors shall also include the following language in each Subcontractor contract:

> "The LADWP of Water and Power is a third party beneficiary of the foregoing audit provision. The benefits of the audit provision shall inure solely for the benefit of the LADWP of Water and Power. The designation of the LADWP of Water and Power as a third party beneficiary of the audit provision shall not confer any rights or privileges on the Contractor, Subcontractor or any other person/entity."

The provisions of this section shall survive expiration or termination of this Agreement.

PSC- 23 Discount Terms

Contractor agrees to offer the LADWP any discount terms that are offered to its best customers for the goods and services at the same level and volume to be provided hereunder and apply such discount to payments made under this Agreement which meet the discount terms.

PSC-24 Contractor Responsibility

By signing this Agreement the Contractor pledges, under penalty of perjury, to comply with all applicable federal, state, and local laws in the performance of this Agreement, including but not limited to, laws regarding health and safety, labor and employment, wages and hours, and licensing laws which effect employees. The Contractor further agrees to provide written notice to the LADWP within thirty (30) calendar days after being notified or acquiring knowledge of the following: 1) that any government agency has initiated an investigation which may result in a finding that the Contractor, or any of its Subcontractors of any tier, is not in compliance with any applicable federal, state, and local laws in the performance of this Agreement; 2) all findings by a government agency

or court of competent jurisdiction that the Contractor, or any of its Subcontractors of any tier, has violated any applicable federal, state, and local laws.

Further, by signing this Agreement the Contractor pledges, under penalty of perjury, that the Contractor has not been found by a court of competent jurisdiction to have violated the California or Federal False Claims Act with an act of moral turpitude or committed a crime involving moral turpitude. The Contractor further agrees to notify the LADWP within thirty (30) calendar days of any adverse finding by a court of competent jurisdiction related to the Contractor's violation of the California or Federal False Claims Act with an act of moral turpitude or committed a crime involving moral turpitude.

The Contractor shall contractually obligate all Contractor Subcontractors to comply with all applicable federal, state, and local laws in the performance of this Agreement and report any governmental agency investigations or violations of such applicable federal, state, and local laws or violations of the California or Federal False Claims Act to the LADWP, consistent with the provisions of this Section.

PSC-25 Warranty and Responsibility of Contractor

The Contractor shall warranty, for a period of 24 months after completion of an Outage for which Contractor provided Work (completion for purposes of initiating the warranty is defined as "Returned to Service" after the Availability Demonstration in accordance with Appendix C, Section 16300 and LADWP standards) that all Equipment, Services, and Work furnished for such generating unit or system, and other Work by Contractor associated with the Project, shall be free from defects in design, fabrication, installation,. Any claims for breach of any express or implied warranty, including the implied warranties of merchantability and/or fitness of use or for a particular purpose, must be brought in writing within the Warranty Period. The Contractor shall repair or replace, installed, all such defective Equipment, Services, or Work at no cost to the LADWP. The same obligations and conditions and 24 month warranty period shall extend to replacement parts and services furnished by Contractor hereunder. If the Contractor has performed three separate corrections or replacements on any equipment or work item(s) without correcting the equipment or work to the LADWP's satisfaction, the Contractor shall replace the subject item(s) or reperform the work with items and/or work that shall meet or exceed the specifications as directed by the LADWP, at no additional cost to the LADWP.

PSC-26 Minority, Women, and Other Business Enterprise Outreach

Contractor agrees and obligates itself to utilize the services of Minority, Women and Other Business Enterprise firms on a level so designated in this Agreement, if any. Contractor shall not change any of these designated Subcontractors, nor shall Contractor reduce their level of effort, without prior written approval of the LADWP, provided such approval shall not be unreasonably withheld.

PSC-27 Ownership

Unless otherwise provided for herein, all documents, material, data, and reports originated and prepared by Contractor or Contractor's subcontracts under this Agreement shall be and remain the property of the LADWP for its use in any manner it deems appropriate. The provisions of this paragraph shall survive expiration or termination of this Agreement.

PSC -28 LADWP of Water and Power's Recycling Policy

The Contractor shall submit all written documents on paper with a minimum of thirty (30) percent post-consumer recycled content. Existing company/corporate letterhead/stationery that accompanies these documents is exempt from this requirement. Documents of two or more pages in length shall be duplex-copied (double-sided pages). Neon or fluorescent paper shall not be used in any written documents submitted to the LADWP.

PSC 29 Taxpayer Identification Number (TIN)

The Contractor represents that it has obtained and presently has a Tax Identification Number (TIN). For the term covered by this Agreement, the Contractor shall maintain, or obtain as necessary, a TIN. No payment will be made under this Agreement without a valid TIN number.

PSC 30 Beneficiaries

This Agreement is intended only for the benefit of the Parties hereto and does not, nor shall be interpreted to, create any rights in any nonsignatory to this Agreement.

PSC 31 Contractor's Successors and Assigns

All indemnifications and warranties provided by the Contractor pursuant to this Agreement will be assumed by and binding upon the Contractor's successors and assigns. The provisions of this paragraph shall survive expiration or termination of this Agreement.

PSC- 32 Attorney's Fees and Costs

Both Parties hereto agree that in any action to enforce the terms of this Agreement, each Party shall be responsible for its own attorneys' fees and costs. The provisions of this paragraph shall survive expiration or termination of this Agreement.

EXHIBIT E-1
CONTRACT INSURANCE REQUIREMENTS

CONTRACT INSURAN REQUIRMENTS – DEPARTMENT OF W. .R AND POWER
For Contractors, Service Providers, Vendors, and Tenants

Agreement/Activity/Operation: Agreement No. 47941
Reference/Agreement: Castaic Power Plant Control System Upgrade
Term of Agreement: 3 years
Contract Administrator and Phone: Mokhtar Moulay - 43327
Buyer and Phone Number: Jackie Antonio - 71545

Contract-required types and amounts of insurance as indicated below by checkmark are the minimum which must be maintained. All limits are Combined Single Limit (Bodily Injury/Property Damage) unless otherwise indicated. Firm 30 day Notice of Cancellation required by Receipted Delivery.

PER OCCURRENCE LIMITS

(✓) WORKERS' COMPENSATION(Stat. Limits)/Employer's Liability: ($1,000,000.00)
- (✓) Broad Form All States Endorsement
- ( ) Jones Act (Maritime Employment)
- (✓) Waiver of Subrogation
- ( ) Other: _____
- ( ) US L&H (Longshore and Harbor Workers)
- ( ) Outer Continental Shelf
- ( ) Black Lung (Coal Mine Health and Safety)
- ( ) Other: _____

(✓) AUTOMOBILE LIABLITY: ($1,000,000.00)
- (✓) Owned Autos
- (✓) Hired Autos
- (✓) Contractual Liability
- ( ) MCS-90 (US DOT)
- ( ) Waiver of Subrogation
- ( ) Any Auto
- (✓) Non-Owned Auto
- (✓) Additional Insured
- ( ) Trucker's Form
- ( ) Other: _____

(✓) GENERAL LIABILITY: ( ) Limit Specific to Project ( ) Per Project Aggregate ($5,000,000.00)
- (✓) Broad Form Property Damage
- (✓) Premises and Operations
- (✓) Fire Legal Liability
- ( ) Corporal Punishment
- ( ) Watercraft Liability
- ( ) Waiver of Subrogation
- ( ) Marine Contractors Liability
- (✓) Contractual Liability
- (✓) Products/Completed Ops.
- ( ) Garagekeepers Legal Liab.
- ( ) Collapse/Underground
- ( ) Pollution
- ( ) Airport Premises
- ( ) Other: _____
- (✓) Personal Injury
- (✓) Independent Contractors
- ( ) Child Abuse/Molestation
- ( ) Explosion Hazard
- (✓) Addition Insured Status
- ( ) Hangarkeepers Legal Liab.
- ( ) Other: _____

( ) PROFESSIONAL LIABILITY: ( )
- ( ) Contractual Liability
- ( ) Additional Insured
- ( ) Waiver of Subrogation
- ( ) Vicarious Liability Endt.
- ( ) 3 Year Discovery Tail
- ( ) Other: _____

( ) AIRCRAFT LIABILITY: ( )
- ( ) Passenger Per Seat Liability
- ( ) Pollution
- ( ) Contractual Liability
- ( ) Additional Insured
- ( ) Hull Waiver of Subrogation
- ( ) Other: _____

( ) PROPERTY DAMAGE: ( ) Loss Payable Status (AOIMA) ( )
- ( ) Replacement Value
- ( ) All Risk Form
- ( ) Builder's Risk:$_____
- ( ) Transportation Floater:$_____
- ( ) Scheduled Locations/Propt.
- ( ) Actual Cash Value
- ( ) Named Perils Form
- ( ) Boiler and Machinery
- ( ) Contractors Equipment$_____
- ( ) Other: _____
- ( ) Agreed Amount
- ( ) Earthquake: _____
- ( ) Flood: _____
- ( ) Loss of Rental Income: _____
- ( ) Other: _____

( ) WATERCRAFT: ( )
- ( ) Protection and Indemnity
- ( ) Waiver of Subrogation
- ( ) Pollution
- ( ) Other: _____
- ( ) Additional Insured
- ( ) Other: _____

( ) POLLUTION: ( )
- ( ) Incipient/Long Term
- ( ) Waiver of Subrogation
- ( ) Sudden and Accidental
- ( ) Contractor's Pollution
- ( ) Additional Insured
- ( ) Other: _____

( ) CRIME: ( ) Joint Loss Payable Status ( ) Additional Insured ( )
- ( ) Fidelity Bond
- ( ) Employee Dishonesty
- ( ) Computer Fraud
- ( ) Other: _____
- ( ) Financial Institution Bond
- ( ) In Transit Coverage
- ( ) Commercial Crime
- ( ) Other: _____
- ( ) Loss of Monies/Securities
- ( ) Wire Transfer Fraud
- ( ) Forgery/Alteration of Docs.

( ) ASBESTOS LIABLITY: ( ) Additional Insured ( )

EXHIBIT F
TECHNICAL SPECIFICATIONS

EXHIBIT F CASTAIC POWER PLANT CONTROL SYSTEM UPGRADE TECHNICAL SPECIFICATIONS	
01010	Summary of Work
01011	Existing Control System
01012	Enhancement/Modifications to Existing Automated Systems for Units 2 and 6
01019	Mobilization
01060	Codes, Standards and Specifications
01200	Project Meetings
01300	Project Submittals
01310	Project Schedule and Coordination of Contract
01320	Progress Reports
01400	Quality Control
01500	Construction Facilities
01600	Materials and Equipment
01640	Owner Furnished Equipment
01720	Project Record Documents
01730	Software Support
01740	Training
01750	Warranties and Guaranties
16075	Electrical Identification
16300	Plant Control System Requirements
16310	Distributed Control Panels
16315	Bay Controller Panels
16320	Data Acquisition And Control System
16325	PLC/HMI/I-O HARDWARE AND SOFTWARE SIMULATOR
16330	Human Machine Interface System
16340	Interface With Energy Control Center
16350	Historian System
16360	Process Networks
16365	230 kV Baycontrollers
16370	Excitation System
16380	Digital Governing System
16390	Turbine Shut Off Valve
16611	Uninterruptible Power Systems

SECTION 01010

SUMMARY OF WORK

PART 1 – GENERAL

1.1 SECTION INCLUDES

1.2 Summary of Work.

1.3 Access to the Site.

1.4 Project Site Conditions.

1.5 Intent.

1.6 Work by the Department.

1.7 Work by Contractor.

1.8 Existing Cranes.

1.9 Project Site Coordination.

1.10 Contract Coordination.

1.11 Project Meetings.

1.12 Copyrights and Software Licenses

1.13 Acceptance

1.2 SUMMARY OF WORK

A. These Specifications cover the general requirements for the Castaic Pumped Storage Plant Control System.

B. The overall goal is to upgrade and enhance the existing automated Units 2 and 6 and complete the modernization of the Castaic hardwired controls for Units 1, 3, 4, and 5, turbine governing system, turbine shut off valves, Balance of Plant controllers and to standardize the hardware and software for all units and system throughout the plant and remote facilities to match what was installed on Units 2 and 6. This project will be executed concurrently and in coordination with the ongoing turbine, generator and TSOV upgrade for Units 1 and 7. Currently all controls are executed from the Plant Control Room via a hardwired system for units 1, 3, 4, 5, and 7 and from the new computer control system for units 2 and 6. Remote monitoring of the Castaic powerplant is performed via the Energy Control System (ECC) RTU installed at Castaic and currently integrated with the

Unit 2 and 6 controls. The upgrade of the Unit 7 controls will be performed under a separate RFP to be issued at a later date that will include the mechanical upgrade of the unit.

C. The Contractor shall design, manufacture, program, factory test, deliver to site, provide support during installation and commissioning of the Plant Control System as requested by LADWP, including all appurtenances, maintenance equipment, and spare parts. The Contractor shall maintain the functional operation and sequence of all unit and plant controls.

D. The Department under the supervision of the Contractor shall install, commission and field test all the equipment and components associated with this Contract. The Contractor shall interface and integrate the future Unit 7 control system with the control system developed under this RFP.

E. The work under this contract performed on a particular unit or a plant system shall not affect the operation of other units or other balance of plant systems, except shared systems and pump start controls. The units are paired in sharing mechanical systems for the turbine shut off valve and wicket gate controls. A joint pump control panel performs the pump starting function.

F. The contractor shall design the cabinets, terminals and connection arrangements as shown on the drawings, where possible to simplify installation and maintenance.

G. The Contractor shall provide training for the Department's project, operations, maintenance and engineering personnel as specified in the Technical Specifications.

H. The Contractor shall provide detailed installation instructions for removal, upgrade or replacement, adjustment, testing and starting up, commissioning, initial operation and testing of all the equipment and systems under this Contract.

I. The Contractor shall provide complete Operating and Maintenance Manuals and Instructions in both interactive electronic and paper forms.

J. Penstock Shut Off Valves (PSOV)

Existing Equipment and Systems.

The existing penstock shut off valve on each Unit penstock is equipped with provisions for automatic closure in the event the penstock mounted pressure taps and the hydraulic power unit mounted transducer detect and trip the valve actuator on high penstock flow. This automatic closure of the valve would be the result of a penstock rupture. This feature is currently disabled. The operators may initiate a valve closure from the control room or locally via operator station at the penstock shutoff valve. Opening of a PSOV can only be initiated locally at the valve. The existing Supervisory System consists of two independent master and remote stations that control and monitor the seven PSOV's. Each PSOV has a control station which houses local control equipment for the valve. The controls are hardwired to the primary and backup Supervisory System. The

primary master station is located in the CPP main powerhouse relay room with the remote station located in the South Portal Control House nearby to the PSOVs. Communication between the master/remote stations is over a single telephone pair. The backup master station is also located in the relay room with the remote station located in the South Portal Auxiliary Control House, also nearby to the PSOVs. The Backup master station communicates with the remote station via a microwave link with the capability of manually switching to telephone lines in case the microwave fails. Accusonic flow monitoring system sensors located downstream of each of the seven PSOV's monitors unit flows. The flow signals for each penstock are transmitted to the plant. The existing control system includes a select – check feature employing unit PSOV selection with feedback to indicate the PSOV selected before a trip signal is issued. Voith-Siemens installed a PLC based system to monitor all PSOV valves that includes a radio based remote I/O and is integrated with the Plant Computer Control System.

Work Scope.

The scope of PSOV work under this Contract includes all the hardware and software necessary to interface the new Unit Control system for Units 1, 3, 4, and 5, as well as Units 2 and 6, to the contractor supplied PSOV remote I/O. The remote I/O shall communicate with the existing Plant Computer Control System Process Control Network via the existing fiber optics cables. Existing functionality will remain and physical wiring kept in place to enable all manual control functions currently present. The existing back-up system using a radio link shall be integrated for emergency closure of all or selected PSOV's in the event of fiber optic cable failure. The new remote I/O shall continue to monitor unit flow, PSOV position, PSOV hydraulic power units sensors, instruments and devices, and shall provide remote control (close only) from the Plant Control Room. The estimated I/O requirements for the Controllers are shown in Attachment A – Point Database. All necessary shop and installation drawings shall be provided.

K. Elderberry Lake Outlet Controller

Existing Equipment and Systems.

The existing controls at the Elderberry Lake Outlet works consist of reversing motor controllers for ten motor operated slide gates. A GPE Controls Digital Electric Level Transmitter with an RS 232 interface is used for telemetry of lake level. The gates are equipped with local control stations and not equipped for remote control. The water level signals are transmitted via local microwave to the receiver at the plant.

Work Scope.

The scope of this Contract includes the supply of the PLC's and the necessary I/O for the remote control and monitoring of the slide gates and water level. The PLC controllers shall monitor and control the operation of the gates, monitor gate position limit switches and shall monitor miscellaneous points that currently exist at the Elderberry Lake Control Building. The estimated I/O requirements for the

Controllers are show in Attachment A - I/O Count, and Attachment B – I/O List . All necessary shop and installation drawings shall be provided.

The communication to the Elderberry Lake shall be via a new radio system that includes a solar powered repeater provided by the Contractor. The antennas at Elderberry Lake will be mounted on existing poles. The antennas at the repeater station will be mounted on Contractor furnished poles.

Work by the Department.

The Department will install the new cabinets in the Elderberry Lake Building.

The Department will be responsible for all field modifications based on the Contractors installation drawings. The control inputs and outputs from and to field devices and systems will be wired by the Department to Contractor furnished remote I/O cabinets as shown on the drawings. The Department will be responsible for all wiring drawings external to contractor supplied equipment.

L. Unit Controllers (Units 1, 3, 4 and 5)

Existing Equipment and Systems.

The existing hardwired relay sequence controls system was furnished by ASEA and consists of relay panels located in the cable room directly below the main control room. Operator interface with the control is via hardwired control equipment (switches, lamps and indicators) located in the main control room and consists of multi section benchboards dedicated to each unit and auxiliary system. All control, whether manual, or semi-automatic or full automatic with electrical interlocking is by way of the control relays in the cable room. Unit auxiliary and common plant equipment is controlled from benchboards located in the main control room.

Work Scope.

The scope of this Contract includes replacing the hardwired relay sequence control logic with PLC based control logic and software in order to provide fully automatic operation. The Contractor shall provide fully redundant Allen-Bradley ControlLogix (latest hardware and software version) PLC's for each of the unit controllers. The Contractor shall provide all the necessary equipment for interfaces, including but not limited to cabling and hardware interfaces. The Unit Controllers shall be provided in cabinets to be installed by the Department in the terminal room at El. 1562. The Contractor shall provide all required shop and installation drawings. All communications shall be designed using fiber optic interfaces. Each unit shall be provided with redundant standalone PLC's, local and remote I/O's and redundant power supplies. The HMI shall be implemented using a Windows based PC system as specified in Section 16330 and shown on the control system block diagrams. All critical faults that require immediate separation of a unit Generator/Motor from the electrical grid shall be implemented using hardwired trips initiated by the protection relays. Each Unit Controller shall include a digital (processor to processor) interface with the

Department's furnished digital excitation controller, Switchyard Controller and Unit Protection panels, Contractor's furnished Governor and Turbine Shut-Off Valve control systems, Pump Start Controller, and Balance of Plant Controllers. Monitoring for the step-up transformer (main bank) shall also be provided.

The unit control cabinet will interface with the generator I/O cabinet, RTD I/O cabinet, turbine pit I/O cabinet and 4.16kV unit bay controllers.

Work by the Department.

The Department will install and wire the new cabinets as shown on the drawings.

The Department will be responsible for all field modifications based on the Contractors installation drawings. The control inputs and outputs from and to field devices and systems will be wired by the Department to Contractor furnished remote I/O cabinets as shown on the drawings. The Department will be responsible for all wiring drawings external to contractor supplied equipment.

M. Unit Controller Unit 7

Existing Equipment and Systems.

The existing hardwired relay sequence controls system consists of a protective relay panel located in the control room of the Unit 7 Powerhouse. The operator interface with the control relays is via hardwired control equipment (switches, lamps and indicators) located in the Unit 7 control room and in multiple sections. All controls are manual, semi-automatic or full automatic with hardwired electrical interlocking. Unit auxiliary and common plant equipment is controlled from the switchboard. Remote control is from the Main Plant Powerhouse main control room. This unit control differs from the Main Generating unit as all control are located in the Unit 7 Control room. The protection for unit 7 resides in the Unit 7 powerhouse.

Work Scope.

The scope of this Contract includes only the interface between Unit 7 and the new Plant Control System including 230kV and 11kV breaker/sync control. This will be done in two phases: the first phase is the interim hardwired interface of the existing benchboard into the HMI system. The second phase is the integration of the future Unit 7 automated control system (to be installed under a separate, future contact) and the new Plant Control System. The Contractor shall cooperate with others to exchange information and develop the Unit 7 interface.

Work by the Department.

The Department will install and wire the new cabinets as shown on the drawings.

The Department will be responsible for all electrical field modifications based on the Contractors installation drawings. The control inputs and outputs from and to field devices and systems will be wired by the Department to Contractor furnished remote I/O cabinets as shown on the drawings. The Department will be responsible for all wiring drawings external to contractor supplied equipment.

N. Unit Controllers (Units 2 and 6)

Existing Equipment and Systems.

The existing Plant Control system is Siemens PCS based system and includes a fully redundant Simatic S7-400 PLC for each of the Unit Controllers. The Unit Controllers are installed in a cabinet in the cable room at El. 1562. The inputs and outputs from and to field devices and systems are wired to remote Profibus I/O cabinets as shown on the drawings. All communications outside cabinets are designed using OLM fiber optic modules. The existing HMI is WinCC. The control system interfaces Siemens protective relays and breaker (bay) controllers via Profibus. All electrical trips are hardwired, while the majority of the process trips are generated by the unit PLCs. Each Unit Controller includes a digital (processor to processor) interface with the digital excitation controller. The "digital" governor system is embedded in the unit controller. Monitoring for the step-up transformer (main bank) is also provided.

Work Scope.

The scope of this Contract includes the replacement of the existing PLC based control system. The Contractor shall provide fully redundant Allen-Bradley ControlLogix (latest hardware and software version) PLC's for each of the unit controllers. Enhancements identified in Section 01012 shall be incorporated into the new Allen-Bradley based unit controllers. These enhancements shall also be incorporated in Units 1, 3, 4 and 5. The Contractor shall be fully responsible for the design including Department identified enhancements, and hardware and software installation. The Unit Controllers shall be provided in cabinet to be installed by the Department in the terminal room at El. 1562. The field wiring will be done by the Department. The Contractor shall provide all necessary communication equipment, including, but not limited to, cabling and hardware interfaces. However, the design shall be done as a retrofit in order to minimize field-wiring modifications. The Contractor shall provide all required shop and installation drawings. All communications to outside cabinets shall be designed using fiber optic interfaces. Each unit shall be provided with redundant standalone PLC's, I/O's and a local HMI. The HMI shall be implemented using a Windows based PC system as specified in Section 16330. Similarly, each TSOV shall be provided with new redundant standalone PLC's, I/O's and a local OIT. Governor control logic currently located in the Unit 2 and 6 Unit Controller shall be relocated to a new redundant Governor controller. All critical faults that require immediate separation of a unit Generator/Motor from the electrical grid shall be implemented using hardwired trips initiated by the protection relays. Each Unit Controller shall include a digital (processor to processor) interface with the existing digital excitation controller, unit control protection panels, Switchyard Controller and Contractor's furnished Governor Control system, TSOV

Controller, Generation Protection Equipment, and Balance of Plant Controllers. Monitoring for the step-up transformer (main bank) shall also be provided.

The Contractor shall be responsible for integrating all new controllers and demonstrating that the new control system is fully functional as required including the following modes: generate, condense, pump, pump start, speed no load, and cold start.

Work by the Department.

The Department will install the new cabinets provided by the contractor with contractor supplied drawings.

The Department will be responsible for all electrical field modifications based on the Contractors installation drawings. The control inputs and outputs from and to field devices and systems will be wired by the Department to Contractor furnished remote I/O cabinets. The Department will be responsible for all wiring drawings external to contractor supplied equipment.

O. Hydraulic Governor and Digital Governor Controllers

Existing Equipment and Systems.

Units 1, 3, 4, 5 and 7 are currently equipped with a Woodward 517 microprocessor based governor controller. The digital governors for Units 2 and 6 are embedded in the Siemens PLC based unit controller PLC's.

Work Scope.

The scope of this Contract includes replacing the existing Woodward 517 Governor controllers installed on Units 1, 3, 4, and 5, and the existing Siemens Units 2 and 6 remote governor I/O cabinet with new redundant standalone Governor controllers, each with an integrated local OIT. The governor control logic shall be relocated from the existing Unit Controllers for Units 2 and 6 into the new redundant standalone Governor controllers. Allen-Bradley ControlLogix (latest hardware and software version) PLC shall be used. Each controller shall be connected to its unit process control network. The OIT shall be also connected to the HMI network for maintenance purposes. The Contractor shall provide all necessary communication equipment, including, but not limited to, cabling and hardware interfaces. The Contractor shall provide all required shop and installation drawings. The Contractor shall propose as an option, upgrades as specified in section 16380.

Work by the Department.

The Department will be responsible for all electrical, mechanical and hydraulic field modifications and installation based on the Contractors installation and demolition drawings.

P. Turbine Shut Off Valves (TSOV)

Existing Equipment and Systems.

Units 1, 3, 4 and 5 TSOV's have the original mechanical/hydraulic control systems still in place. The Units 2 and 6 TSOVs are currently equipped with Siemens PLC controllers and have undergone hydraulic and instrument upgrades.

Work Scope.

The scope of this Contract includes redundant PLC controllers for each TSOV. Allen-Bradley ControlLogix (latest hardware and software version) PLCs shall be used. The Contractor shall provide all necessary communication equipment, including, but not limited to, cabling and hardware interfaces. Each controller shall be connected to its unit process control network. The controllers shall be located adjacent to the unit governor cabinets and shall include one local OIT display. The OIT shall be also connected to the HMI network for maintenance purposes. The Contractor shall provide all required shop, demolition and installation drawings. The Contractor shall also perform instrument upgrades for Units 1, 3, 4, and 5 as specified herein and shall upgrade instruments for Units 2 and 6 as required to make them identical with the rest of the units. The TSOV systems shall be upgraded as specified in section 16390.

Work by the Department.

The Department will be responsible for all electrical field modifications based on the Contractors installation drawings. The control inputs and outputs from and to field devices and systems will be wired by the Department to Contractor furnished remote I/O cabinets as shown on the drawings. Units 1, 3, 4, and 5 shall have instrumentation upgrade only. A mechanical upgrade is not required.

Q. Units 1-6 Exciters

Existing Equipment and Systems.

Units 2 and 6 are already equipped with One Siemens Type THYRIPOL Excitation System. Units 1, 3, 4, 5 are still using the original excitation system.

Work Scope.

The Contractor shall provide all required shop, demolition and installation drawings. The Contractor shall provide Supervision Services during the installation and commission of the excitation system for Units 1 through 6 utilizing experts from the manufacturer as requested by the Department.

The Contractor shall replace the existing exciters with Basler ECS-2100 exciters to meet the Departments, per Section 16370, PSS2B requirements, as well as full functionality in all modes (generator, pump, pump start, condense, cold start), provide a two year warranty after final acceptance of each system and provide a minimum 10 years spare part inventory. The exciters shall communicate to the new control system via native Industrial Ethernet ports. The Contractor shall be responsible for integrating upgraded or new exciters in the new Plant Control

System using Industrial Ethernet. The Contractor shall provide all necessary communication equipment, including, but not limited to, cabling and hardware interfaces. The Contractor shall provide specialized services during the installation, commissioning and testing of the excitation system for all units, including experts from the manufacturer and communication and integration experts on the Plant Control System from the Contractor or as requested by LADWP.

Work by the Department.

The Department will be responsible for installing the new Excitation Systems for all units and shall be responsible for all electrical field modifications.

R. Balance of Plant Controllers

Existing Equipment and Systems.

The existing plant controls system was furnished by ASEA and consists of relay panels located in the cable room directly below the main control room. Operator interface with the control is via hardwired control equipment (switches, lamps and indicators) located in the main control room and consists of multi section benchboards dedicated to common systems and plant auxiliary systems. All control is manual, semi-automatic, or full automatic with electrical interlocking by way of the control relays in the cable room. Unit auxiliary and common plant equipment is controlled from benchboards located in the main control room. Currently, some balance of plant signals are temporarily wired to the Unit 2 Siemens unit controller. These signals are required for the operation of Units 2 and 6 and will eventually be relocated to the new BOP Controllers.

Work Scope.

The scope of this Contract includes providing new PLC-based controllers and remote I/O to replace the existing hardwired relay control logic, interfacing the new controllers with the new contractor provided 230kV and 4.16kV station service Bay Controllers, new Penstock Shutoff Valve (PSOV) redundant remote I/O, the new Elderberry Lake controllers, Air Compressor Building Remote I/O, and 480 Volt Station Service Remote I/O. Redundant Allen-Bradley ControlLogix (latest hardware and software version) PLC's shall be used. Each controller shall be connected to the plant process control network as shown on contractor provided drawings. The Contractor shall include all necessary communication equipment, including, but not limited to, cabling and hardware interfaces. The Contractor shall provide all required shop and installation drawings. The Balance of Plant Controller(s) shall monitor and control miscellaneous plant common systems. The new controllers shall include a fully integrated Industrial Ethernet interface. The Balance of Plant Controller shall be installed and made operational before all Unit Controllers are installed, at the beginning of the project.

Work by the Department.

The Department will be responsible for all electrical field modifications and installation based on the Contractors installation drawings. The control inputs and outputs from and to field devices and systems will be wired by the Department to Contractor furnished remote I/O cabinets as shown on the drawings. The Department will be responsible for all wiring drawings external to contractor supplied equipment.

S. Pump Start Controller

Existing Equipment and Systems.

Hardwired "pump panel" for operator interface is located on the control room benchboard to perform the selection of the pump starter unit and pump unit. The pump start control logic is in the hardwired relay and I/O panel located in the cable room directly below the main control room. The existing pump start controls for Units 2 and 6 are embedded in the Siemens PCS unit controllers and the I/O is hardwired to the existing pump start relay cabinet.

Work Scope

During the installation of the Unit Control systems for Units 1, 3, 4, 5, and 7, the new Unit Controllers shall interface with the existing pump panel. Full flexibility of pump and pump start functions shall be maintained.

The scope of this Contract includes replacing the existing hardwired pump panel by splitting the functionality between the Contractor supplied unit synchronizer relays, modifications to the existing 230kV bay controller relays (to be installed on a new contractor supplied set of panels describe in section 16365) and with the new balance of plant controllers. The cutover from the hardwired relay pump panel to the new Controllers and relays via "soft" connection shall be done after Units 1, 3, 4, and 5 Unit Controllers are installed, at the end of the project. The "soft" connection shall be via the Plant Communication Network and shall include Units 1, 2, 3, 4, 5, and 6. Provisions shall be made for all necessary hardwired connections to integrate Unit 7 into the Pump Start Controller. When Unit 7 is automated, in the future under a separate contract, provisions shall be made to convert the Unit 7 I/O into "soft" points. The Contractor shall provide all necessary communication equipment, including, but not limited to, cabling and hardware interfaces. The controller shall be connected to the plant process control network except as required to interface Unit 7 via hardwired connections. The Contractor shall provide all required shop and installation drawings. All communications outside of the cabinets shall be designed using fiber optic interfaces. The Contractor shall be responsible for the integration of the Industrial Ethernet link and database with the existing bay controllers. Control shall be accomplished via the Control Room HMI system.

Work by the Department.

During the initial phase, the Department will install the hard wired connection between the new Unit Controllers and the existing pump panel. When the new pump panel is installed, the Department will be responsible for all electrical field modifications based on the Contractors installation drawings. The new pump panel shall be connected to the new Plant Control System by the plant communication network. The control inputs and outputs from and to field devices and systems will be wired by the Department to Contractor furnished remote I/O cabinets as shown on the drawings.

T. Plant Control Room

Existing Equipment and Systems.

The existing Plant Control room is the central location from where the entire plant is controlled. The main control room consists of benchboards, a mimic board for the project's overall water conveyance system, revenue meters for MWH, temperature recorders for unit and plant equipment and AGC control equipment. The main control benchboards are arranged in a semi horseshoe configuration with unit control on one side and auxiliary control on the opposite side. The control room is arranged for unit control by the operators at dedicated benchboards which are utilized for unit sequence control, interface to AGC signals once the units are partially loaded, electrical monitoring, synchronization, auxiliary system control, annunciation, equipment status, and SOE recording. The benchboards are equipped with control switches, indication lamps, meters for display of electrical parameters, synchroscopes, annunciation panels, breaker controls switches for generator breaker control, governor speed adjust and limits, exciter voltage control, and other unit and plant auxiliary equipment control. All operator controls are located on the surface of the benchboards. The large mimic board of the water conveyance system shows the conveyance and the status of inlet and outlet water control valves as well as water levels. The mimic board is only partially automated and animated. In addition to the existing hardwired controls, the control room includes two operator's consoles provided by Voith-Siemens and used to monitor and control units 2 and 6 and limited signals from BOP equipment. One engineering console was also provided in the relay room for units 2 and 6.

Work Scope.

The scope of this Contract includes replacing all hardwired and PC based control equipment located in the control room with a new PC / Workstation / PLC based control system. The new control system shall consist of both hardware and software required for plant and unit control, auxiliary equipment control, plant and switchyard monitoring, alarm and fault indication, GPS time synchronization, status indication, event recording, historian, trending and report generation as required per Section 16300, Plant Control System Requirements. The Contractor shall provide all required shop and installation drawings.

The system architecture shall be as shown on the Bid drawings. The Unit Controllers, including Unit Protection panels, Switchyard Controllers, Balance of

Plant Controllers, PSOV Controllers, shall be configured for connection to the plant process control network as shown on the drawings. All other remote I/O and controllers shall be connected to the associated unit process control network.

Provisions shall be made for the control of Unit 7 via the new HMI system prior to its automation.

The new control system shall have full trending capabilities including real time and historical trending. Trending shall be in the form of selectable and expandable graphs and curves displaying plant variables from available data stored in servers or historians.

The new control system shall have a comprehensive alarm system with alarm processing, management, prioritization and archiving.

The Contractor shall design and provide new furniture for the non-panel mounted HMI equipment located in the control and relay rooms which will be reviewed and approved by the Department.

Work by the Department.

The Department will decommission the existing bench board, deactivating the bench board unit-by-unit and removing each unit and other section in a step-by-step process according to a demolition plan and process developed jointly by the Contractor and the Department to facilitate transferring the units to the new Plant Computer Control System.

The Department will install all equipment in accordance with the Contractor's drawings.

U. Network and Communication Systems

Work Scope.

Each unit shall be provided with an Industrial Ethernet based network as specified herein and as shown on Contract drawings. The contractor shall provide all necessary communication equipment, including, but not limited to, cabling and hardware interfaces. The Contractor shall provide all required block diagram, shop and installation drawings.

The unit process control network shall be interconnected via the Unit Controllers into the plant process control Ethernet based network as specified herein and as shown on Contract drawings.

The two HMI servers shall bridge the plant network and a separate Ethernet based HMI network.

All networks shall be redundant and the network architecture shall be designed to optimize network traffic.

Network connections to intelligent devices and systems shall be provided to integrate these devices and systems including but not limited to protective relays, breaker bay controllers, Excitation System, Energy Control Center, etc. The protocols will include but may not be limited to Profibus, Modbus and DNP 3.0.

Work by the Department.

The Department will be responsible for all electrical field modifications based on the Contractors installation drawings. The Department will wire the networks to Contractor furnished cabinets as shown on the drawings.

V. Uninterruptible Power Supply

Work Scope.

The Contractor shall furnish one redundant Uninterruptible Power Supply ("UPS") for conditioning power to the Control Room and Relay Room equipment as specified in section 16611. The Contractor shall provide all required shop and installation drawings.

Work by the Department.

The Department will be responsible for the installation and all electrical field modifications and wiring based on the Contractors installation drawings.

W. Connection to Energy Control Center (ECC)

Work Scope.

Three PLC's shall be provided to communicate with the primary and backup Energy Control Center systems. The Contractor shall provide all required shop and installation drawings.

The primary link with ECC's Energy Management System (EMS) shall be through a serial 4-wire copper independent line utilizing DNP 3.0 protocol. This link will connect to the first communication PLC. The communication link will be provided by the Department. The secondary link with ECC's Energy Management System (EMS) shall be through a serial 4-wire copper independent line utilizing DNP 3.0 protocol. The link will connect to the second communication PLC.

The connection to the ECC's Backup Automatic Generation Control (BAGC) shall be through a serial 4-wire copper independent line utilizing DNP 3.0 protocol. This link shall be connected to the third communication PLC. The communication link will be provided by the Department.

Work by the Department.

The Department will be responsible for all electrical field modifications and wiring based on the Contractors installation drawings.

X. Relay Protection

Work Scope:

Plant 4.16 kV Station Service

The 4.16 kV circuit breakers will be interfaced to new bay controllers with protective functionality, and separate protective equipment, if needed. These devices will communicate via Industrial Ethernet IEC 61850.

Unit Auxilary 4.16 kV Unit Service

The four 4.16 kV circuit breakers used for each unit auxiliaries will interface to new bay controllers with protective functionality for units 1, 3, 4 and 5 and to upgrade the existing controllers bay controllers with protective functionality for units 2 and 6. All the devices will communicate via Industrial Ethernet IEC 61850.

230 kV Bus and Line Protection

The Department will provide a redundant system consisting of primary and back-up relays. Both systems will run in parallel. The connection of status alarms from these relays will be hardwired to the new contractor provided 230 kV bay controller equipment and panel.

1. 230 kV Bay controllers

    a. (2) 7SJ64 Bay Controllers will be used to:

        1) Control the breaker

        2) Collect metering data

        3) Support control of synchronization

        4) Collect alarm data from external LADWP supplied protection relays

2. Support manual synchronization of the generators. Unit and Line Metering

    Provide equipment to collect metering data indentified. This to replace the data previously provided by Siemens relays being removed.

Work by the Department

1. Design, procure, assemble, and install the protection equipment listed in this section.

2. Describe the relay logic and provide settings, studies, and other data necessary for relay configuration and programming.

3. Verify the operability and performance of the existing field devices, i.e. PT's, CT's, etc.

4. Provide engineering drawings and locations of hard I/O interface from the relays to the control system.

5. Install all cables for the above I/O points.

6. Install all cables (including network cable) between the Relay Protection equipment and the unit controller or plant controller.

7. Provide personnel to perform pre-commissioning and commissioning functional checks of all protective equipment.

8. Install contractor provided 230 kV bay controller and synchronization panels.

Work by the Contractor

1. Provide new replacement doors for unit 4160V switchgear positions complete with bay controllers, terminals, and accessories per Technical Specs 16315, which will be integrated into the Unit Controls, 16 total. Doors shall be pre-wired and tested at the Contractor's facility.

2. Provide new 230 kV bay controllers and panels.

3. Upgrade unit 4160V bay controllers on units 2 and 6 to match what will be installed in 1 above, 8 total.

4. Provide new replacement doors for station service 4160V switchgear positions complete with bay controllers, terminals, and accessories per Technical Specs 16315, which will be integrated into the Unit Controls, 22 total. Doors shall be pre-wired and tested at the Contractor's facility.

5. Provide all unit controller 4160 breakers with support for Make-before-Break functionality.

6. Replicate Unit 2 & 6 protective settings on remaining units 1, 3, 4 and 5.

7. Replicate protection functionality and schemes for 4160 station service breakers.

Y. Field Devices and Instrumentation

Work Scope.

The Contractor shall provide all required shop and installation drawings for the field devices and instrumentation for systems furnished under this Contract.

Work by the Department.

The Department will be responsible for the purchase and installation of all field devices and instrumentation required for a fully functional control system as shown on Contractor's installation drawings. The Department reserves the right to change the type of instrumentation currently used on Units 2 and 6. The Department shall provide the Contractor ample notification of any change.

Z. The work under this contract shall be performed based on a transition plan prepared by the Contractor and approved by the Department. The transition plan shall describe and detail the decommissioning and replacement of the existing control systems, including both hardwired and PLC based systems.

AA. Hazardous Materials. The Department shall be responsible for disposing of any hazardous materials associated directly or indirectly with items demolished by the Contractor. The Contractor shall be responsible for the removal of any hazardous materials he brings to site.

1.3 ACCESS TO THE SITE

A. Access to Site shall be coordinated with the Department.

1.4 PROJECT SITE CONDITIONS

A. The Contractor shall go through plant operations and safety orientation and follow the Department's operations, security and safety procedures.

B. Contractor shall thoroughly familiarize itself with details of the WORK and working conditions before starting the Work.

C. Before performing Work, Contractor shall verify in the field any and all information that might be necessary or beneficial to Contractor's Work, and submit a letter to Department describing any conflicts or conditions that may affect Contractor's Work. No request or claim for additional costs and/or time based on changed or unforeseen conditions that are not documented in this letter provided before performing Work shall be considered or accepted.

1.5 INTENT

A. These Specifications utilize the Construction Specifications Institute (CSI) 16 division format. Sections of Division 1, General Requirements, govern the execution of all Sections of the Specifications.

B. All Services, Equipment, and Work specified herein shall be provided under a single Contractor. The Contractor may, with the review and approval of the Department, subcontract specific Services, Equipment, and/or Work as required. Any such subcontracted Services, Equipment, and Work must fully conform to and comply with the terms and conditions, responsibilities and obligations, and requirements of the Technical Specifications. Contractor shall be responsible for

all Services, Equipment, and Work, whether self-performed or performed by Subcontractors.

C. Furnish and provide.

1. Furnish means to design including Contractor equipment interconnection wiring and installation detail drawings, detail, fabricate, procure, assemble, test, supply and deliver to project sites.

2. Provide means to furnish, checkout, commission, verify equipment ready for installation, verify equipment ready for energization and verify equipment ready for testing, verify that equipment is ready for commercial and the intended use.

1.6 WORK BY THE DEPARTMENT

A. Prepare all field wiring drawings to connect the field devices to the equipment supplied under this Contract.

B. Verify all external wiring up to Contractor's interconnection terminal blocks.

C. Perform all physical installation and wiring of all electrical equipment, including wiring between equipment supplied under this Contract.

D. Provide existing power supplies, lighting, heating, service water, and service air.

E. Operating the generating units and auxiliary equipment.

F. Provide limited storage area as available within immediate Project boundaries for Contractor's materials and equipment.

G. Provide existing drawings of electrical interfaces. Contractor shall independently field verify and markup to document actual as-found conditions, which are assumed to accurately reflect current conditions.

H. Replace plant instruments, which may be obsolete and/or unusable for the new control system as determined by mutual agreement of Contractor and Department.

I. Provide auxiliary relays or interfaces to temporarily provide signals to the new Balance of Plant or Switchyard controllers and the existing systems during the transition period.

J. Provide one T1 and one microwave communication links to the Energy Control Center

1.7 WORK BY CONTRACTOR

A. The listing of Work by the Contractor contained in this paragraph is not intended to be an all-inclusive listing of Work to be performed by the Contractor that is contained in the Specifications, but is only a summary of principle items of Work. All material, equipment, services, and work necessary or beneficial for the turbine, generator, TSOV, PSOV, unit auxiliary systems, Elderberry Lake, Balance of Plant, Switchyard and ECC interfaces to fulfill the requirements of these Specifications, to provide safe working conditions, and to ensure safe, reliable, long-term operation shall be furnished by Contractor, whether or not such items are specifically listed in these Specifications.

B. Work includes, but is not limited to, all labor, materials, goods, equipment, and services for inspection; shipping and handling of items off-site; design, detailing, fabricating, procuring, assembling, shop testing, and delivery of new components, equipment, and systems; delivery, installation supervision, field inspection, checkout, startup, commissioning, and field testing, necessary or beneficial to meet the scope and requirements of these Contract Documents and best hydroelectric industry practices.

C. Contractor shall plan, schedule, and implement all Work on site in coordination with the Department so as to preclude disruptions to other generating units and plant operations, unless such disruptions are specifically approved by the Department in writing prior to each disruption.

D. General Work.

1. Verify existing plant layouts, dimensions, equipment and access.

2. Develop and maintain overall schedule for planning, design, testing, disassembly, demolition, evaluation, fabrication/procurement, repair / refurbishment, delivery, installation, testing and required by the contract meetings. The schedule shall be coordinated with the ongoing site work by others under this and other Department projects.

3. Develop and maintain detailed sequence of site work, coordinated with the ongoing site work by others under this and other Department projects.

4. Prepare and submit Shop Drawings, Manuals and Instructions, Calculations and Analysis, Progress Schedules, and other submittals. The shop drawings shall include detailed internal panel wiring diagrams for the panels supplied by the Contractor.

5. Design, detail, manufacture, and shop test new equipment and systems.

6. Design and manufacture retrofits or modifications to existing equipment and systems.

7. Provide Method Statements, being detailed installation instructions for upgrades, removal, overhaul or replacement, adjustment, testing and

starting up, commissioning, initial operation and testing of all the equipment included in this Contract.

8. Protect materials and equipment from damage during packing, shipping, and handling.

9. Ship, and supervise unloading, storage, inventory, handling, and protection of materials and equipment.

10. Comply with Plant safety procedures.

11. Modify, and/or upgrade parts, equipment, and systems.

12. Supervise installation of new, modified, and/or upgraded equipment and systems.

13. Perform or supervise checks and tests of electrical routings and connections.

14. Provide qualified field representatives.

15. Provide Assistance during checkout, startup, initial operation, field-testing, and commissioning of equipment and systems.

16. Prepare Record Documents.

17. Protect existing equipment from damage.

18. Perform surveys, make measurements, and keep records.

19. Maintain the project site in a clean, orderly condition. Keep areas free of waste materials, debris, and rubbish.

E. Automation Work.

1. The Contractor shall guarantee and meet the performance requirements of these Specifications for the entire system, including new or upgraded automation for Units 1, 2, 3, 4, 5, 6 and 7 and new automation for non-unit-specific equipment and systems.

2. The controllers shall be redundant PLC based, unless noted otherwise, as required in the Technical Specifications.

3. The control, status visualization and other Operator interface functions shall be via a personal computer (PC) based Human Machine Interface (HMI) system with OIT devices located in local panels or in the Plant Control Room as specified in the Technical Specifications, Section 16300.

4. The automation drops shall be networked and integrated as specified in the Technical Specifications.

5. The Plant Control System shall communicate with the Department's Energy Control Center (ECC) as specified in the Technical Specifications.

6. The new controllers, remote I/O, local control stations, governor, UPS, etc. shall be located in new control cabinets provided by the Contractor and located as shown on the drawings. The Contractor shall provide furniture for the office-based workstations as specified in the Technical Specifications.

F. SEQUENCE OF SITE WORK

1. Develop detailed sequence of site work that minimizes the total duration of the site work.

2. The sequence of work shall avoid disruption of the operation of the plant and other units.

3. The sequence of work shall maximize electrical energy production during the Contractor's site work.

4. The detailed sequence of work will be defined during planning meetings after award of contract and presented by the Contractor to LADWP for approval. The preferred sequence of work shall be as follows:

   a. Upgrade and enhance Units 2 and 6 hardware and software (one unit at a time).

   b. Partial delivery of control room HMI and workstations.

   c. Automate Units 3 and 4 (one unit at a time).

   d. Automate Units 1 and 5 (one unit at a time).

   e. Integrate existing Unit 7 controls into new HMI system.

   f. Install remaining required Balance of Plant and associated controllers.

   g. Control Room Equipment (final delivery) including the large scale video screens and permanent furniture.

   The sequence of site work shall be approved by the Department. Refer to Section F, "Project Schedule" for details.

1.8 PROJECT SITE COORDINATION

A. The Department and other contractors will need access to and through the powerhouse, both for normal plant operations and maintenance, and during other outage work by others concurrent with Contractor's work. Contractor shall plan for and accommodate such activities as a normal part of Contractor's WORK. Contractor shall fully coordinate its activities with the Department and other contractors. This includes promptly bringing any conflict or coordination problem to Owner's Engineer's and the Department's attention.

B. Contractor shall be responsible for coordinating the design, manufacturing, testing, inspection, offsite storage, and delivery of all materials and equipment furnished under this Contract.

C. The Department will be responsible for on-site storage and handling of all material and equipment at the Project site.

D. The Department shall be responsible for security, storage, and handling of controlled or hazardous materials furnished or used by the Contractor in accordance with OSHA, Cal-OSHA, and Department regulations, standards, and guidelines.

1.9 CONTRACT COORDINATION

A. The Contractor shall inform the Department of the address for sending official correspondence and the address, telephone number, e-mail address, and fax number of Contractor's representative who will be Project Manager for the Contract.

B. The Contractor shall submit formal requests for information and other project related letters using the Contractor's official letterhead and unique letter reference number. All letters shall be signed by the Project Manager or his/hers designee. The letters shall be submitted in PDF format.

C. During periods of installation and testing keep the Department and Owner's Engineer informed in writing with names, addresses, telephone numbers, e-mail addresses, and fax numbers of Contractor's field representatives who will be responsible for work activities in the field.

D. The Contractor shall coordinate scheduling, submittals, manufacture, equipment delivery, testing, and other work in an orderly sequence.

E. The Contractor shall coordinate installation sequence and interdependent responsibilities for installing, connecting to, and placing the automation equipment and systems into service.

1.10 PROJECT MEETINGS

A. The Contractor shall schedule project meetings and technical workshops as required in section 01200 of the Technical Specifications.

1.11 COPYRIGHTS AND SOFTWARE LICENSES

A. Copyrights, licensing and software ownership shall be as described in section 16300.

1.12 ACCEPTANCE

A. The work performed for each unit and common systems will not be accepted unless all operations and maintenance instructions and other applicable documentation are received, and all training is completed to the satisfaction of the Department.

B. The system will not be accepted unless it meets the performance requirements required in the Technical Specifications.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01011

EXISTING CONTROL SYSTEMS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Existing Systems

1.2 EXISTING SYSTEMS

A. General

1. The Castaic Pumped Storage Plant has six 240MW reversing units and 1 conventional 55MW unit. The pump/generating units 1 through 6 are located in the main powerhouse and the generating unit 7 is located in a separate powerhouse. In pumping mode each pumping unit has a power input of 320,000 horsepower and a pump rate of 230 cfs (1,030,000 GPM). The pumps are started back to back by any of the other units including Unit 7 running in Pump Starter mode.

2. Pyramid Lake with a storage capacity of 170,000 acre-ft is used as the upper reservoir for the Castaic power plant. The water from Pyramid Lake is run through the 7.2 mile Angeles tunnel including the individual 2,400 ft unit penstocks for a total of 1060 ft water drop.

3. Elderberry Lake is used as the lower reservoir for the power plant. The water from Elderberry Lake is released to the Castaic Lake through the control gates located at the Elderberry Lake outlet structure. The capacity of the Elderberry Lake is 33,000 acre-ft.

B. Hardwired Control System Units 1, 3, 4 and 5

1. The original hardwired control system is still in use for units 1, 3, 4 and 5 and they consist of field devices, relay cabinets located in the relay room and control bench boards located in the control room.

2. For additional information on the existing hardwired systems refer to Section 01010 of these specifications.

C. Hardwired Control System Unit 7

1. The original hardwired control system is still in use for unit 7 and consists of field devices, relay cabinets located on the generator floor at the Unit 7

powerhouse and control bench board located in the main powerhouse control room.

D. Siemens Based Control System

1. Background

Voith Siemens Hydro Power Generation, Inc. (VSH) was selected to perform a modernization of the pump-turbines, turbine shutoff valves, generator-motors, automation and controls, and other Castaic project features under a lump-sum, design-build contract that began in October 2001. After the assessment and optimization phases of VSH's contract, the VSH contract was amended in January 2003 to include a more comprehensive modernization of the unit and plant controls and replacement of the unit and substation protective relaying, using Siemens hardware and software. In September 2005, the Department and VSH, through a contract amendment, mutually agreed to terminate their contract. At that point the overall controls and automation modernization was completed only on Units 2 and 6, PSOV's and Plant Control Room and Relay Room equipment.

The termination amendment included provisions that would allow a new third party to come in carry over the unit controls modernization to date on the four remaining main reversible units. The modernization of the balance of plant controls and Unit 7 controls was not started by VSH.

2. Overview of Existing Status and Condition

a. General

The control system hardware is based on Simatic S7 PLC's. One unit controller for Unit 2 and one for Unit 6 are implemented in a redundant configuration and are used to run all Unit 2 and Unit 6 control algorithms, programmed in Siemens environment utilizing sequential function charts and functional blocks. Remote I/O racks connected via Profibus are used at the governor and several other locations. The governor function is a software module embedded in the unit controller software. An independent PLC connected to the unit controller via Profibus is used for Turbine Shut Off Valve control.

The Human Machine Interface (HMI)/SCADA software is based on Siemens' process control system package Win CC. The following systems are integrated into the HMI:

- Unit protective relays via Profibus
- THYRIPOL Excitation system via Profibus

- Energy Control Center (ECC) interface via Modbus over Ethernet

Mechanical tripping functions are executed at the PLC level with no external hardwired backup. The protective relay panels utilize Siemens and Schweitzer protective relays in a redundant configuration. Only the Siemens relays are connected to the HMI.

b. Current Hardware Situation

The existing system was designed to eventually provide for control of all seven units, plant auxiliaries, PSOVs, and remote facilities. At the Control Room level, Voith-Siemens supplied and installed the SCADA Servers, Engineering Workstation, SCADA Clients and the Communications and Server Cabinet (CCS2). The Fiber Optic Local Area Network for the ultimate number of PLC's is installed and in operation. At the Unit Control level, Voith-Siemens supplied and installed all the control system equipment for Units 2, 4 and 6. The RTD cabinet, Governor Remote I/O modules and protective relaying for Unit 4 was supplied but not installed. The exciter systems for Units 2 and 6 are installed. The exciters for Units 1, 3, 4 and 5 were supplied but not installed by VSH.

c. Current Software Situation

The current unit controller software design includes embedded functions such as the governor. Maintaining the reliability of the overall existing software requires the support of the original software designer. Current system performance is considered slow for some functions such as feedback indication of field devices on the HMI after executing controls.

d. Current Control Room Situation

All HMI functions are currently implemented and available through the workstations located in the plant control room for Units 2 and 6. Other units are controlled using the original hardwired system.

e. Current Warranty Situation for Unit 2 and Unit 6

Maintenance and warranty support on the VSH software and hardware is for a period of two years after the unit system is accepted. As of June 2006 the Department has not issued the acceptance of the current system for either Unit 2 or Unit 6.

E. Excitation Systems

1. THYRIPOL Excitation systems were purchased installed and commissioned for Units 2 and 6. The excitation systems were integrated with the Siemens based control system via Profibus interface. The Contractor will be responsible for integrating the existing exciter of Units 2 and 6 after replacing the Siemens based control system with the new Plant Control System.

2. THYRIPOL Excitation systems were purchased for Units 1, 3, 4 and 5 and will be installed by the Department. The Contractor shall integrate the excitation systems into the new Plant Control System.

3. Unit 7 still utilizes the original exciter. A new exciter for Unit 7 will be installed under a new contract , and will be installed at a later date.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01012

ENHANCEMENTS TO EXISTING AUTOMATED CONTROL SYSTEMS

PART 1 – GENERAL

SECTION INCLUDES:

Enhancements to existing Automated Control Systems Units 2 and 6, that will also be incorporated into the Control Systems of Units 1, 3, 4, and 5.

1. **System Response**
   A. Improve system response for Units 2 and 6, and incorporate in controls for Units 1, 3, 4, and 5. See Section 16300, "Controller and Remote I/O Requirements", for System Response requirements.

2. **Sequence Flexibility and Organization**
   A. SFC 1
      1. Open the TSOV first. Don't wait until later in the sequence.
      2. If the HPLO pressure is OK, then don't set the brakes.
      3. TGB oil cooling water pressure not needed for this SFC. Use TGB flow instead.
      4. Eliminate checking AC HPLO pressure to enable starting unit with DC HPLO's in an emergency. Monitor thrust bearing temperatures instead.
      5. Furnish narratives on all SFC's to be reviewed, and approved by LADWP personnel.
   B. SFC 2
      1. Remove TGB oil cooling water pressure check from SFC. Use TGB flow instead.
      2. After commissioning remove commissioning bypasses from all SFC's.
   C. SFC 3
      1. Remove check for TGB oil cooling water pressure.
      2. Create a "Help" button for bypass info or for manual modes.
   D. SFC 4
      1. Eliminate checking AC HPLO pressure to enable use of DC HPLO's to start the unit. Monitor thrust bearing temperatures instead.
   E. SFC 7
      1. The controls should zero out the reactive power on unit shutdown similar to non-modernized units.
   F. SFC 9
      1. Continue to allow transition back to generate from anywhere in the SFC.
      2. Remove "Reactive Power Control On" requirement.
      3. If transition to condense is selected, and air header pressure is too low (<100 psi), leave on in generate mode. Do not start transition to condense mode.

4. Draft Tube Depression logic runs in the TSOV controller.
   Add better visibility/status of this sequence in the control room.
   a. View TSOV PLC sequences directly.
   b. Improve existing DTD screens.

G. SFC 11
   1. When shutting down from condense, AW1 and AW2 close after 3 minutes or if Level 1 is reached, even intermittently.
      a. Leave AW1 and AW2 open for 2 minutes minimum, or delay in DTD level.

H. SFC 12
   1. Want phase reversal operation to occur first, then the mode change.
   2. Delay closing exciter breaker until SFC 14.
   3. Don't require the unit to be tied up on the pump panel until SFC 14.

I. SFC 13
   1. Do not close exciter CB in SFC 12.

J. SFC 14
   1. Add exciter breaker operation here.
   2. Make pump panel active here.
   3. Wear ring flow trips must be active until 150 psi is reached on priming pressure, then disabled.
   4. Open 20WP.
   5. Keep exciter on current control (both starter and pump) until 95% speed (Currently set for 90%).
   6. Remove Turbine Cooling Water Pressure as a requirement to complete the sequence.
   7. Check dead bus.
   8. Verify no trips.
   9. Add TSOV oil pressure check before opening the TSOV.
      a. In TSOV sequence.
   10. Verify wicket gates closed.
   11. Check TSOV closed.

K. SFC 15
   1. Allow to return to "Pump Ready" in addition to "Available/Stop."
      a. If back to "Pump Ready" keep air bubble.
      b. If back to "Available/Stop" vent air bubble.

L. SFC 16
   1. As soon as "Start" is initiated, 230 kV and field breakers should close simultaneously.
      a. With VSH logic, field breakers close sequentially, and is slower.
   2. AVR transitions at 80% speed under current logic. Change to 95%.
   3. Eliminate "Creep" alarm during a pump start.
   4. In TSOV PLC, DTD state 21 to 22 should be 65° (which is 72% TSOV open) not 65%.
   5. At DTD sequence 22, keep AW1, AW2, and 20 WP open until priming pressure is reached. Current logic closes 20 WP at TSOV 65% open.

M. SFC 17
   1. Unload reactive power first.
   2. Close wicket gates.

3. Separate from system when the gates reach 20%.
4. At TSOV step, add differential pressure check; don't release brakes until pressure differential across valve is reached. Verify differential pressure across the TSOV is greater than 450 psi.

N. SFC 18
1. Open TSOV first.
2. Add check of TSOV Oil Pressure before opening TSOV.
3. VSH logic has AVR set to 18 kV. Controls should be in current control at this point.
4. Remove check of Turbine Oil Cooling Water pressure. Monitor TGB flow instead.
5. Verify "Creep" before hitting the start button. Also, as unit is starting up, set gate limit to 10% until 75 rpm is reached. Then set gate limit to 22%. Minimum time for gate opening from 10% to 22% is 30 seconds.

O. SFC 20
1. Pump starter currently ties through the even bus; Bus 1 and Bus 3 selection makes no sense. Remove.
2. Remove check of Turbine Oil Cooling Water pressure. Monitor TGB flow instead.
3. Verify pump 230 kV CB is closed before spinning the pump starter.
4. Remove "Pump Unit to Synchronize Across Bus 1 or Bus 3?"

P. SFC 21
1. With the "Hold" unit, have the option to match pump load during pump start – between 25 – 40 MW. Also, optional load matching after synchronization.
2. Remove Bus 1 and Bus 3 selection.

Q. SFC 22
1. Remove "Rotor Up" check.
2. Add ability to defeat interlock to close 4.16 kV circuit breaker to a dead source.
    a. Interlocks in 4.16 kV Baycontrollers.
3. Move TSOV opening to start of sequence.

R. Miscellaneous
1. Exciter Alarm/Trip
    a. If in, do not allow unit to roll. Currently, unit goes to full speed, but has to be stopped to reset the exciter.
2. Generate/Pump/Pump Start Select
    a. Currently, can select more than one simultaneously. When this occurs, selection control is locked out and must be reset in software. Prohibit multiple selection of modes.
3. Booster Pump
    a. Allow operators the option to have booster pump come on automatically during pump or condense starts. Booster pump "Auto-Manual" selection.

3. Alarm and Archiving Management

A. Improve alarm and archiving management for Units 2 and 6, and incorporate in controls for Units 1, 3, 4, and 5. See Section 16320, "Data Acquisition and

Control System", Section 16330, "Human Machine (HMI) System" and Section 16350, "Historian" for Alarm and Archiving Management requirements.

4. HMI Configuration and Implementation

A. Equipment Tag Out Screen
   1. Use plant specific description of equipment, i.e. 4.16 kV switchgear instead of "Protective Relay 7SJ64-21."

B. One Line Diagram
   1. Widen synchronization band to full range of voltage – 17.1 – 18.9 kV. Currently around 17.7 – 18.3 kV.
   2. Use plant specific description of equipment, i.e. Synchronizer instead of 7SA6, 7VE512.

C. Penstock Overview
   1. Eliminate pressure transducer to measure level, replace with different, more accurate instrumentation.
   2. Tail Water Pressure shown incorrectly. Change to Draft Tube Pressure.

D. Unit Control Screen
   1. Eliminate Bus Selection – Pump Starter section. Makes no sense if only one bus is active to the SFC all ready. Should indicate even bus. Confusing to the operators.

E. Network Topology Screen
   1. Better description of equipment needed.

F. Generator Capability Curve
   1. Gen/Pump current – Change from kAmps to Amps.

G. Unit Runtime Screen
   1. Don't reset runtime after a software download.
   2. Add gross and net MWh's, per unit, hourly, over a 24 hour period.
   3. Import ION meter data – MW, runtime, generate.
   4. Ability to automatically generate reports - daily, monthly, yearly reports automatically.

H. ECC Interface
   1. Increase communication speed between Castaic and ECC.
   2. Add the following data to be transmitted to the ECC:
      a. Unit head
      b. Generator capability curves.
      c. Hill charts.
      d. Headloss
      e. Head calculation
      f. Calculated plant limit.

I. TSOV
   1. Add spiral case drain control.
   2. Cannot manually operate TSOV from control room until the TSOV controller is placed in manual. Add the ability to take into manual control from the control room without intervention at the TSOV control cabinet.
   3. Add ASCDV to screen.

J. TSOV Pressure System
   1. Screen should mimic P&ID drawing.
   2. Label all pipes, valves, etc.
   3. Include all piping.

K. Cooling Water System – Pump/Strainer
    1. Link Generator Air Coolers to GAC screen.
L. Cooling Water System – Turbine Bay
    1. Need to lock out Tyton Seal Cooling Water Flow Set Points
M. Draft Tube Depression – Water
    1. Add cavity temperature.
N. DTD Mode SFC
    1. Need better description of steps - show what is needed to move from one step to the next, show current status.
O. Draft Tube Depression – Air
    1. On face plate, unclear operation of auto/manual.
    2. Cannot manually operate from control room until the TSOV controller is placed in manual. Should have the ability to take into manual control from the control room without intervention at the TSOV control cabinet.
P. Generator Brakes
    1. Watchdog timeout on brake solenoid should not block operation.
Q. HPLO System
    1. Screen should mimic P&ID drawing.
    2. Label Arlon filter.
    3. Add labels to all valves, pipes, etc.
    4. Show destination for Tygon tube.
    5. Allow for easy calibration checks and range changes – from faceplate, not in software logic.
R. Upper Guide Lube System
    1. Add complete diagram for Oil Transfer System.
    2. Add better valve ID, labels for all components.
    3. Include all cooling water valves.
S. Thrust Bearing Temperatures
    1. Add oil temperature.
T. Upper Guide Bearing Temperatures.
    1. Add oil temperature.
U. Lower Guide Bearing Temp.
    1. Add oil temperature
V. Turbine Guide Bearing Temperatures.
    1. Better description of oil temperature.
W. Vibrations
    1. Relocate Pressure Cavity Above and Below Runner from this screen.
X. Governor
    1. On left side, under Generator Modes, create a help for each setting that gives an explanation for each selection. Better definition.
    2. Change Speed Droop from 4 to 5%.
    3. Change "Frequency Influence" to "Speed Droop." Default to On, OK to turn off.
    4. Improve governor response. Limit over/undershoot to 3 MW and one oscillation.
    5. Governor Setpoint Control – Move scale description outside of value box; provide label for unit speed.
    6. Allow full manual operation of governor to drain penstock, instead of sequence procedure.

Y. Governor Hydraulic System
    1. Label rate limiters.
    2. Duplicate P&ID drawing. Better labeling on oil and air systems.
    3. Add feeds to WW, WR, WP valves.
Z. General Screen Comments
    1. Add unit speed to top of all screens.
    2. Provide some type of means to indicate when portable grounds have been applied to the unit.
    3. During unit shutdown, when the SFC is running, unable to operate the TSOV or phase reversal switches. Allow for this operation.
    4. If additional pumps are needed and the pump panel is tied up with a modernized unit, not additional modernized units can be made pump ready. Allow for pumps to be made pump ready as another pump is starting.
    5. If exciter is in manual, start up sequence stalls. If this occurs, and exciter is placed back into auto mode, allow SFC to continue.
    6. Change "High High" and "Low Low" to High Trip or Low Trip.
    7. Allow for operation of the TSOV and phase reversal during shut down.
    8. In pump starter, make the TSOV the first steps in the SFC.
    9. No need for AW-1 and AW-2 to operate when transitioning from condense to generate. This action causes the DW pumps to operate more frequently.

5. Field Device Interface

A. The Control System shall have the capability to interface with intelligent field devices, i.e. typical instrumentation such as transducers that interface directly via the communication network to the controller, including data monitoring and device configuration.
B. It is the Department's intent to eliminate the use of pressure transducers for level measurement. The Contractor and Control System shall be able to deal with this change.

6. Software Configuration Control and Update

A. See Section 01730, "Software Support" and Section 01740, "Training" for the Software Configuration Control and Update requirements.

7. 230 kV and 4.16 kV Baycontroller Implementation

A. Unit Stop
    1. During a normal shutdown (Unit Stop Command) provide for a close transition of transferring the aux power back to station service.
        a. Currently open shutdown, the transition back to Station Service occurs with a Break-Before-Make transition. This drops all the mag-starters for auxiliaries, and brings in nuisance alarms. It also creates wear and tear on the transformers from inrushes, and torque on fan motors, cooling water pumps, lube oil pumps. They also can create a pressure drop on the thrust bearing lube oil pressures. Enable make-before-break with paralleled alarm.

    2. Suggested sequence upon Stop command:

a. Close command to CB 62 – Transfer back to Station Service.
b. Open command to CB 61 – Upon successful closing of CB 62 (Make-Before-Break).
c. Close command to CB 63 – Transfer back to Station Service.
d. Open command to CB 64 – Upon successful closing of CB 63 (Make-Before-Break).
e. This sequence needs to occur before opening any 230 kV CB's in the shutdown sequence.
f. Do not perform a transfer if a shutdown is initiated by any relay protection, mechanical shutdown, or 86P, 86S, or 86M operation.

B. 4.16 kV switchgear operations
1. Unit start (GEN, COND, PUMP, and PUMP START modes)
a. During the opening SFC, the following sequence occurs
1. Open command to CB 61 – This breaker should already be open from the previous shutdown.
2. Close command to CB 62 – Occurs on verification that CB 61 is open.
3. Open command to CB 64 – This breaker should already be open from the previous shutdown.
4. Close command to CB 64 – Should already be closed. Supports PC from station service.
b. After Unit synchronization:
1. Close command to CB 61 – Transfer to Unit Aux bank.
2. Open command to CB 62 – Upon successful closing of CB 61 (Make Before Break).
3. Close command to CB 64 – Transfer to Unit Aux bank.
4. Open command to CB 63 – Upon successful closing of CB 64 (Make Before Break).
2. If during the starting SFC, the above transfers do not occur due to some sort of breaker problem, then allow the following to occur:
a. Provide a dropdown screen or a bypass which will allow the Unit to remain on the station service source and complete the SFC.
b. Generate an alarm that will indicate the abnormal condition of the unit auxiliary supply is on station service and not on the Unit supply.
c. Also create, on the Unit Control screen, status points that indicates the connected source as a reminder of the abnormal supply. This is necessary to prevent tripping the unit if it is on station service and if operations transfers from station service source 1 to 2, or vice versa.

C. Changes to Bay Controllers for Local Operations
1. Currently, operation from the local push buttons on the Bay Controllers can occur when the key is turned to Local Mode. The interlocks are active all the time.
2. Problem: The breaker cannot be tested at the cabinet without adding jumpers and/or Potential inputs to simulate bus pots required for sync check operations. Maintenance needs to vary operation of these breakers locally with the breaker in the cubicle.
3. The switchgear should operate as follows:

a. LOCAL Test Position – without interlocks. Allows operation of the CB at any time without being connected. Permits testing of breaker control wiring.
    1. Breaker installed in test position.
    2. Bay Controller top key to Local.
    3. Bay Controller bottom key to interlock Off.
b. LOCAL Test Position – with interlocks. Allows operation of the CB using interlocks and not connected. Permits testing of interlocks and synchronizer.
    1. Breaker installed in test position.
    2. Bay Controller top key to Local.
    3. Bay Controller bottom key to interlock On.
c. LOCAL Racked In Position – With Interlocks. Allows operation of the CB using interlocks and connected. Permits operation in case of remote WINCC failure.
    1. Breaker installed in racked in position
    2. Bay Controller top key to Local
    3. Bay Controller bottom key to interlock On.
d. LOCAL Racked in Position – Without Interlocks – PREVENT OPERATION IN THIS MODE. UNSAFE – NO SYNC CHECK.
    1. Breaker installed in racked in position.
    2. Bay Controller top key to Local
    3. Bay Controller bottom key to interlock Off.
e. REMOTE Racked in position – With interlocks – Normal mode of operation with WINCC.
    1. Breaker installed in racked in position.
    2. Bay controller top key to Remote
    3. Bay controller bottom key to interlock ON.
f. REMOTE Racked in position – Without interlocks – PREVENT OPERATION IN THIS MODE. UNSAFE – NO SYNC CHECK.
    1. Breaker installed in racked in position.
    2. Bay controller top key to Remote
    3. Bay controller bottom key to interlock Off.
g. One additional requirement is that LOCAL tripping always be active in case of an emergency.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01019

MOBILIZATION

PART 1 - GENERAL

1.1 MOBILIZATION

A. This Section covers the mobilization of personnel, equipment, materials and supplies, and their transport to the job site. Also included is setting up the Contractor's complete field office and other construction facilities, as required for the Contractor's operation, all in adequate time for satisfactory performance of all Work under the Contract.

1.2 CONTRACTOR'S TEMPORARY FACILITIES

A. The Contractor shall furnish, install, and maintain temporary offices, tooling/equipment containers, equipment and material storage facilities, and parking facilities at the project site and convenient to the project site as necessary or desirable for Contractor's Work. Contractor shall provide potable water and sanitary facilities for Contractor's and their subcontractor's personnel to the extent the total number of Contractor's and their subcontractor's personnel exceed three personnel total on-site. The Department shall provide up to 50 kVA of three-phase 480V power and small volumes of nonpotable water for Contractor's use. The size, number, and location of Contractor's temporary facilities shall be subject to the approval of the Department.

1.3 DEMOBILIZATION

A. Demobilization by Contractor shall include the removal of all field offices, containers, equipment and accessories, materials, supplies, appurtenances, construction debris and the like from the job site upon completion of the Work. Contractor shall restore the site to its as-found condition prior to Contractor's mobilization.

1.4 PERMITS

A. The Contractor shall obtain, and pay for, all required permits, and comply with applicable laws and regulations and restrictions and limitations regarding mobilization, transport of equipment, personnel and supplies, and the construction and maintenance of temporary facilities including but not limited to structures, storage sites, laydown areas, and construction utilities.

B. Permits for any necessary temporary or permanent facilities including, but not limited to, permits for Building, Plumbing, Electrical, Sanitary, or other permits required by Los Angeles County and the State of California, shall be applied for, administered, and, when completed and signed off, shall be furnished to the Department.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

SECTION 01060

CODES, STANDARDS AND SPECIFICATIONS

PART 1 - GENERAL

1.1 GENERAL

A. The standards under which the Work is to be performed or tested are specified throughout the Contract Documents. Where such standards are specified, it shall be understood that the latest revision or edition at time of submission of bids shall apply. Other standards may be substituted for those specified, provided prior approval is obtained from the Department. If the Contractor desires to deviate from the specified or approved standards, a statement of the exact nature of the proposed deviation shall be submitted for approval.

B. In referring to standards the following abbreviations have been used:

1.	American Association of State Highway & Transportation Officials 444 North Capitol Washington, DC 20001	AASHTO
2.	American Concrete Institute Box 19150, Redford Station Detroit, MI 48219	ACI
3.	American Institute of Steel Construction 1221 Avenue of the Americas New York, NY 10020	AISC
4.	American Institute of Timber Construction 333 W Hampden Avenue Englewood, CO 80110	AITC
5.	American Iron and Steel Institute 1000 - 16th Street NW Washington, D.C. 20036	AISI
6.	American National Standards Institute 1430 Broadway New York, NY 10018	ANSI
7.	American Petroleum Institute 2100 "L" Street NW Washington, D.C. 20037	API
8.	American Plywood Association P.O. Box 11700 Tacoma, WA 98411	APA
9.	American Public Works Association	APWA
10.	American Society for Testing and Materials 1916 Race Street Philadelphia, PA 19103	ASTM

11.	American Society of Civil Engineers 345 East 47th Street New York, NY 10017	ASCE
12.	American Society of Heating, Refrigerating, and Air Conditioning Engineers	ASHRAE
13.	American Society of Mechanical Engineers 345 East 47th Street New York, NY 10017	ASME
14.	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235	AWWA
15.	Architectural Woodwork Institute	AWI
16.	American Welding Society 2501 NW 7th Street Miami, FL 33125	AWS
17.	American Wood Preservers Bureau	AWPB
18.	Associated General Contractors of America 1957 East Street NW Washington, D.C. 20006	AGC
19.	California Department of Industrial RelationsCal- Division of Occupational Safety and Health 320 West 4th Street, Suite 850 Los Angeles, CA 90013	OSHA
20.	Concrete Plant Manufacturers Bureau 900 Spring Street Silver Springs, MD	CPMB
21.	Concrete Reinforcing Steel Institute 933 Plum Grove Road Schaumburg, IL 60195	CRSI
22.	Federal Specification Board c/o Superintendent of Documents U.S. Government Printing Office Washington, D.C. 20402	U.S. Fed. Spec. Mil. Spec.
23.	Institute of Electrical and Electronics Engineers, Inc. 445 Hoes Lane, P.O. Box 1331 Piscataway, NJ 08855-1331	IEEE
24.	Insulated Power Cable Engineers' Association 192 Washington Street Bellmount, MA 02178	ICEA
25.	International Electro Technical Commission 1, Rue De Varemb, Geneve, Switzerland	IEC
26.	Joint Industrial Council	JIC
27.	Manufacturer's Standards Society	MSS

28.	National Bureau of Standards c/o Superintendent of Documents U.S. Government Printing Office Washington, D.C. 20402	NBS
29.	National Association of Corrosion Engineers P.O. Box 1499 Houston, TX 77001	NACE
30.	National Electrical Manufacturers Association 2101 L Street NW Washington, D.C. 20037	NEMA
31.	National Fire Code	NFC
32.	National Fire Protection Association Batterymarch Park Quincy, MA 02269	NFPA
33.	National Forest Products Association 1619 Massachusetts Avenue NW Washington, D.C. 20036	NFPA
34.	Occupational Safety and Health Administration US Department of Labor Governmental Printing Office Washington, D.C. 20402	OSHA
35.	Society of Automotive Engineers 485 Lexington Avenue New York, NY 10017	SAE
36.	Steel Structures Painting Council 4400 Fifth Avenue Pittsburgh, PA 15213	SSPC
37.	Underwriters Laboratories 333 Pfingsten Road Northbrook, IL 60062	UL
38.	Uniform Building Code	UBC
39.	Uniform Mechanical Code	UMC
40.	Uniform Plumbing Code	UPC
41.	Western Wood Products Association 1500 Yeon Bldg. Portland, OR 97204	WWPA

C. Additional abbreviations will be defined as they appear in the specifications.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

SECTION 01200

PROJECT MEETINGS

PART 1 – GENERAL

A. Post Award Meeting.

1. A post-award meeting will be held at the Department's office in Los Angeles, California, no later than ten days after Notice of Award of this Contract.

2. The purpose of the post award meeting is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The meeting agenda will be prepared by the Department in advance of the meeting. Agenda will include, but not limited to, a review of the following:

   a. Specification requirements.

   b. Major design issues.

   c. Contractor's proposed schedule.

   d. Transmittal, review, and distribution of Contractor's submittals.

   e. Processing applications for payment.

   f. Critical work sequencing.

   g. Constraints on site work.

   h. Coordination with Department and others.

   i. Major equipment deliveries and priorities.

   j. Submittal Transmittal Form, which Department or Department will furnish.

3. Contractor and representatives from major Subcontractors, and others as required by the Department or Department, shall participate in the post-award meeting.

4. Contractor shall bring the post award meeting submittals in accordance with Section 01300, Submittals.

B. General Project and Coordination Meetings.

1. It is anticipated that at least four general project coordination meetings will be held at various stages during Contractor Work before the first generating unit outage, and at least seven meetings during each generating unit outage. The dates and times will be determined by the Department. These general meetings are in addition to any meetings referred to in subsequent sections.

2. Review meetings shall be held at the Department's offices in Los Angeles, California, or at the Project site.

3. The meeting agenda will be prepared by the Department prior to the meeting.

4. Contractor and representatives from other major Subcontractors, and others, as required by the Department, shall participate in the meetings.

C. Coordination Teleconference Calls

1. Coordination teleconference calls shall be scheduled as required during the duration of the project.

2. During the design and application engineering phase and if no other meetings are scheduled, a design coordination teleconference call shall be scheduled at least every two weeks.

D. Pre-construction Conference.

1. Prior to the commencement of Work at the Site, a pre-construction conference will be held at the project site. The conference shall be attended by the Contractor's Project Manager, its site superintendent, and its Subcontractors, and others as the Contractor deems appropriate. Other attendees will be:

   a. Department.

   b. Representatives of the Department.

   c. Others as requested by Contractor, or the Department.

2. The Contractor shall bring the preconstruction conference submittals in accordance with Section 01300 - Submittals.

3. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the Contractor prior to the meeting date. However, the Contractor should be prepared to discuss all of the items listed below.

   a. Contractor's contact information for responsible personnel.

   b. Contractor's tentative schedules.

   c. Transmittal, review, and distribution of Contractor's submittals.

   d. Processing applications for payment.

   e. Maintaining record documents.

   f. Critical work sequencing.

   g. Site work constraints.

   h. Coordination with Department and others.

i. Field decisions and Change Orders.

j. Use of Site, office and storage areas, security, housekeeping, and the Department's needs.

k. Major equipment deliveries and priorities.

l. Contractor's assignments for safety and first aid.

m. Daily Report Form, which the Department or Department will furnish.

n. Submittal Transmittal Form, which the Department will furnish.

4. The Department will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.

5. The Contractor and its Subcontractors should plan on the conference taking no more than one full working day. The first half-day will cover the items listed in paragraphs 2 and 3, and the following half-day will be spent on reviewing the Drawings and Specifications, in extensive detail, with the Department.

E. Progress Meetings.

1. During construction, start up and commissioning, the Contractor shall schedule and hold regular on-Site progress and site coordination meetings at least weekly and at other times as requested by Department or as necessary or beneficial during the progress of the Work. The Contractor, Department, and all Subcontractors active on the Site shall attend each meeting. Contractor may at its discretion or as requested by the Department request the attendance by representatives of its Suppliers, design engineer, manufacturers, and other Subcontractors.

F. Design Workshops

1. During the design and application engineering phase of the project the Contractor shall schedule and hold Design Workshops for these and other beneficial for the project topics: software functional design (unit start and shut down sequences for all modes, etc.); TSOV modifications; governor modifications; input/output hardwired and soft point list; balance of plant systems; graphics design; short term and long term historian, trending, reports, alarm system, lock-out/tag-out from the control system; I/O and control panel design; other workshops as required.

G. Factory Meetings

1. Meetings associated with each major and final inspection or factory testing.

H. Meeting Protocols

1. The Contractor shall include tentative dates for the project meetings and workshops in the project schedule and coordinate the exact dates with the Department. The contractor shall ensure the participation of the appropriate personnel from the Contractors side for each meeting or workshop, and advise the Department on the topics and Department specialists required to attend the meetings.

2. The Department will preside at the meetings. The Contractor shall furnish draft meeting minutes within 7 calendar days after completion of each meeting. The minutes shall be subject to the Project Manager or their designated representative's review and approval. In addition to specific agenda items, each meeting shall review the progress of the Work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems, which may develop. During each meeting, the Contractor shall present any issues, which may impact its progress, with a view to resolve these issues expeditiously.

PART 2 – PRODUCTS

Not applicable.

PART 3 – EXECUTION

Not applicable.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.1 SCOPE

A. This Section covers general procedures for submittals made by the Contractor.

B. Related Work in Other Sections:

1. Appendix A, "Professional Services Agreement", Section 401.14 – Drawing Requirements

2. Section 01310 - Project Schedule and Coordination of Contract.

3. Section 01720 - Project Record Documents.

4. Divisions 2-16 Sections for specific submittal requirements in each Section.

1.2 SUBMITTAL SCHEDULE

A. The Contractor shall, within 20 working days after receiving the Notice to Proceed, submit for review a detailed list of all the submittals which he proposes to make to meet the requirements stated herein and those cited in other sections of the Specifications, together with the dates on which he proposes to make such submittals. The list shall include but not limited to:

- Shop Drawings including part list
- Equipment Layout showing overall details and cabinet internals
- Schematic Diagrams for all internal and field interface signals circuits
- Detailed cabinet internal wiring diagrams sufficient to troubleshoot or trace circuits
- Manuals
- Project Record Documents including as builts
- All other items for which a submittal is deemed required.

The list shall include identifying references for each item to relate it to the specific section of the Specifications.

B. With each revision or certification of the construction schedule, the Contractor shall either revise this schedule of submittals and resubmit it for approval or certify that the previously furnished schedule is still in effect.

C. It is imperative that the drawings be furnished within the time required herein, in order that the design of related facilities may be progressed on schedule.

D. After the submittal schedule is reviewed by the Department, it shall become the basis for the submittal of all items by the Contractor.

1.3 SUBMITTAL REQUIREMENTS

A. General: The Contractor shall furnish for review its submittals as outlined herein. The sequence of submission shall be such that information is available for review of each submittal when it is received. Drawings and schematics shall not be of typical equipment, but shall be as-built and shall accurately represent the proposed equipment. All submittals furnished formally shall bear an approval stamp or a certification. The stamp or certification shall be signed by an authorized representative of the Contractor. The Contractor's stamp or certification on any submittals shall constitute a representation to the Department and the Owner's Engineer that the Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers and similar data, or that he/she assumes full responsibility for doing so, and that he/she has reviewed or coordinated each submittal with the requirements of the Contract Documents. Before submitting any drawings for review, the Contractor shall obtain approval of the list of drawings he proposes to submit, showing sequence of submittal and submittal dates. All drawings shall be submitted in accordance with the approved schedule specified in Paragraph 1.2, Submittal Schedule.

B. The drawings shall fully demonstrate that the equipment to be furnished will comply with the provisions of these Contract Documents and shall furnish a true and complete record of the equipment as manufactured and delivered. Additional drawings, instructions, or information which may be requested by the Project Manager or their designated representative for erection, operation, and maintenance of the equipment or to determine compliance with the Agreement shall likewise be submitted for review. Review of the Contractor's drawings by the Project Manager or their designated representative shall not relieve the Contractor of the responsibility to meet all of the requirements of these Contract Documents and correct detail and fit of parts when installed, or of the responsibility for the correctness of the drawings furnished by the Contractor. The Contractor shall have no claim for additional costs or extension of time on account of delays due to revisions of the drawings and/or preparation of additional drawings, which may be found necessary to comply with the Contract Documents. In case of later discovery of errors, omissions, or inconsistencies in the Contractor's drawings, the Contractor shall promptly make any necessary

corrections and submit revised transparencies and copies to the Project Manager or their designated representative for re-review.

C. Refer to Appendix A, "Professional Services Agreement", Section 401.14 – Drawing Requirements. Four print copies on durable paper with dark lines on a white background shall be furnished. Two electronic copies shall be furnished on CD or DVD discs in native format for future modifications. The drawings shall be in Microstation format, version coordinated with the latest Department standard. AutoCAD and Intergraph drawings may be accepted if agreed with the Department. All other documents shall be in Microsoft Office formats, as appropriate. PDF documents are acceptable for equipment data and original vendor documentation. The Contractor shall verify by inspection of sample reproductions that good legible reproductions can be obtained from the reproducible before submittal.

D. All drawings shall be submitted on the LADWP border with the appropriate assigned number. The border file and drawing numbers will be furnished by the Department at the first design review meeting.

E. All submittals shall be addressed to the Department (two hard copies plus one electronic copy) and Owner's Engineer (two hard copies plus one electronic copy).

F. Each submittal shall be accompanied by a transmittal letter, which describes the items submitted. The transmittal letter shall be clearly labeled Castaic Modernization Project Controls and Automation Modernization, and shall have a serial number. The first submittal shall have serial number 001, and subsequent submittals shall be consecutively numbered. Resubmittals of previously submitted information shall bear the same serial number as the initial submittal with a sequential alpha character as a suffix. For example, the second resubmittal of the submittal 001 shall be 001-A and the second resubmittal shall be 001-B, and so on.

1.4 REVIEW OF SUBMITTALS:

A. The review prints shall be complete with title and drawing number, and shall be dated.

B. The Department's review procedures shall apply to each revision of each submittal transmitted to the Department. Within 30 calendar days after receipt of drawings or documents for review, or such time as required to complete the review, one print of each will be returned to the Contractor designated "no exception noted", "Corrections needed", "rejected", or "not required".

C. If a drawing is designated "no exceptions noted", the Contractor may proceed with the work in accordance with the drawing. If the Department does not respond within 30 calendar days, or notify the Contractor that additional review time is required, the Contractor may consider the drawings designated as "no exception noted". However, if a drawing is designated "no exceptions noted" and later revisions are needed to conform to the requirements of these Contract

Documents, and/or to suit Contractor's design, such revisions shall be made promptly and Contractor shall resubmit the revised drawing in accordance with the corrections needed and shall furnish 4 prints and two electronic copies made there from to the Project Manager or their designated representative within 14 calendar days after Contractor's receipt of that drawing. Any such revision shall be considered a normal part of the Work and shall not be subject to additional costs or extensions of time.

D. If a drawing is designated "corrections needed", the Contractor may proceed with the work covered by the drawing and the corrections needed. However, the Contractor shall resubmit the revised drawing in accordance with the corrections needed and shall furnish 4 prints and two electronic copies made therefrom to the Project Manager or their designated representative within 14 calendar days after Contractor's receipt of that drawing.

E. If a drawing is designated "rejected", the Contractor shall revise it to comply with the requirements of the Contract Documents and shall resubmit 4 revised prints and two electronic copies for review within 10 calendar days after the Contractor receives the drawings, which have been rejected from the Department. The Contractor shall not proceed with the work until a drawing is designated either "no exceptions noted" or "corrections needed."

F. Every revision shall be shown by number, date and subject in a revision block, and in addition, each revised drawing shall have its latest revision clearly indicated by clouding around the revised areas on the drawing. Drawings submitted without these indications will be considered nonconforming.

G. If a drawing or a drawing is designated "not required", it is not required under the Agreement.

H. Revised drawings shall be submitted in the same size as the original submittal.

I. If the drawings contain information, which does not pertain to the Agreement, the Contractor shall either delete the information which is not applicable or plainly identify the pertinent information.

J. No revision in any way shall be made after a drawing has been marked "no exceptions noted" without resubmitting the drawing for review.

K. The applicable parts of the requirements specified above for drawings shall apply equally to design data, calculations, analyses, catalog cuts, illustrations, printed specifications, draft reports, documents or any other submittal furnished for review.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

A. Review Drawings

1. General

B. Final Drawings

1. Signature of the Contractor

a. The Contractor shall complete and sign two transparencies, four prints, and two electronic copies of each of the drawings after the review, with no corrections needed, or after the revised drawings, with corrections made or resolved after review.

b. The final drawings shall be marked in the revision block with the words "Issued for Construction".

C. Signature of Registered Engineers

1. All original construction and installation, equipment mounting and support, and seismic drawings shall be signed and sealed by an applicable professional Civil, Electrical, Mechanical, or Structural Engineer registered in the state of California.

D. Signed Drawings

1. After drawings are signed and dated, the Contractor shall furnish the Department 4 prints, two full-size transparencies, and 4 electronic copies placed on CD *ROM.* The 4 electronic CD ROM copies shall be submitted after all the drawings are finalized, shall be AutoCAD Release 14 or MicroStation format, and shall be furnished with a suitable protective container to insure that the CD ROMS will not be damaged in transit.

E. Drawing Revisions

1. The Contractor shall make revisions needed to correct the drawings for all errors or omissions which may be found by the Project Manager or their designated representative. A brief description of all such revisions shall be made by the Contractor in the revision block area of the drawings. The review and signatures of revisions shall be handled the same as for the original drawing, except that signatures shall be by initials only. Revisions shall be raised numerically with each successive revision.

END OF SECTION

SECTION 01310

PROJECT SCHEDULE AND COORDINATION OF CONTRACT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: This section covers submittals of Project Schedule, coordination of work of others and required completion dates.

1.2 PROJECT SCHEDULE

A. Within 20 working days after issuance of the Notice to Proceed, the Contractor shall submit for review by the Department a Critical Path Method ("CPM") schedule. The CPM schedule and reports shall be generated with computer software in Primavera Project Planner (P3) or Microsoft Project 2007/2010. Every four weeks thereafter the Contractor shall revise the CPM schedule and shall resubmit it to the Department for review. The latest revised schedules shall be submitted for discussion at each meeting.

B. The project schedule shall be a time-scaled network diagram prepared using the critical path method and shall clearly show each unit of Services, Equipment, and Work to be performed under the Contract, and all items involved in the overall sequencing of the Work. All precedences, succeedences, and schedule item links shall be clearly indicated on the schedule.

C. The schedule shall be prepared and maintained on a reproducible medium preferably in 11" X 17" size to show required data clearly for the entire duration of the Contract, and to permit reproduction for required distribution.

D. The project schedule shall be arranged with notations to show how the sequence of Work is affected by site restrictions, purchase of materials, fabrication progress, shipping issues, seasonal weather variations, and any other items deemed appropriate.

1.3 COORDINATION OF CONTRACTS

A. Contractor shall cooperate with Department and other contractors and shall not hinder, delay or prevent Department or other contractors from performing work. Portions of the Contractor use areas may also be required for use by other contractors or the Department.

1.4 REQUIRED COMPLETION DATES

A. The overall outage schedule and scheduled completion date is of the essence. Contractor may propose provisional intermediate milestones to suit their Work, subject to review and approval by the Department. However, provisionally scheduled dates for individual work items will shift as part of the normal course of work, and such changes are not cause for extension of time or additional costs under this Agreement.

B. In case of failure on the part of the Contractor to perform its Work such that the scheduled completion date is not met, the Contractor shall pay to the Department fixed and agreed to liquidated damages as specified in the Agreement, Part 4.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

SECTION 01320

PROGRESS REPORTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. A monthly progress report shall be submitted to the Department in a form approved by the Department. The progress report shall be submitted by the Contractor together with his Application for Progress Payment. The monthly progress report shall include:

1. Progress of Work: Provide a brief narrative description of all management, planning, design, fabrication/procurement, factory inspection/testing, shipment, installation/construction supervision, checkout, start-up, commissioning, field testing activities and related events during the report period. Report major items of work that reflect overall progress, rather than detailed statistical information.

2. Status of design/fabrication/construction: Furnish schedules and progress charts. Describe the status of progress monthly, as related to the original schedule. Provide an appraisal as to whether work is proceeding at such a rate as to enable completion within the specified contract time. If not, include plans to regain lost time.

3. Contract Status: Identify principal subcontractors engaged on the work. Show subcontractor progress and status as described above. Describe any special expertise or equipment possessed by subcontractors. Show changes monthly.

4. Critical Events and Dates: Report important items and events such as delivery of principal equipment, start and completion of construction, and initial unit testing.

5. Sources of Major Materials/Equipment : Provide information on the sources from which major materials and equipment are being obtained.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

SECTION 01400

QUALITY CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. General: This Section covers quality control requirements supplementary to those in the other Specification sections. In general, the Contractor will perform comprehensive quality control and quality assurance of all Services, Equipment, and Work provided under this Contract, and shall provide documentation, including but not limited to, material and other records and certifications for materials and equipment furnished under this contract only.

B. Off-Site and On-Site Testing: The Contractor shall conduct tests and provide test results or reports on testing as described in the Specifications. These tests will be conducted both off-site and on-site as is applicable to the particular situation.

1.2 QUALITY ASSURANCE

A. Tests:

1. Where the Specifications require Work to be inspected, tested or approved, it shall be tested only in the presence of the Department (and the Manufacturers Representative if applicable) after timely notice of its readiness for inspection and test, and after testing, the Work shall be covered up only upon the consent thereto of the Department.

2. The results of any tests made are for the information of the Department. Regardless of any test results, the Contractor is solely and exclusively responsible for the quality of workmanship and materials and for compliance with the requirements of the Drawings and Specifications.

3. Except as specifically required under detail material specifications for shop or field testing and inspection, certain tests of materials furnished by the Contractor will be made by the Contractor in accordance with the commonly recognized standards of national or international organizations. The Contractor shall furnish such samples of all materials as required by the Department without charge. No material shall be used unless it has been approved by the Department.

4. Where such inspection and testing are to be conducted by an independent laboratory or agency, the sample or samples of materials to be tested shall be selected by such laboratory or agency or the Department and not by the Contractor.

B. Costs of Testing:

1. The Contractor shall be responsible for and shall pay for all tests of materials and equipment, except as specified otherwise. The Department shall have the right to witness all tests, and the Contractor shall furnish advance notice when tests will be made.

2. When, in the opinion of the Department, additional tests or inspections are required because of the results of any tests or inspections, and/or because of the manner in which the Contractor executes his work, such additional costs thereof shall be paid for by the Contractor. Examples of such additional tests and inspections are tests of materials or equipment substituted for previously accepted materials or equipment or substituted for specified materials or equipment or retests made necessary by failure of materials or equipment to comply with the requirements of the Specifications.

1.3 TEST AND START-UP PLANS (TSPS)

A. The Contractor shall prepare written TSPs to ensure proper testing and start-up of components, equipment, subsystems, and systems.

B. The TSPs shall provide written instructions to ensure the proper installation of components and equipment and to verify that functional, performance, and operability requirements are consistent with the specified design objectives and criteria. The TSPs shall specify safety precautions and practices for personnel in accordance with the applicable codes and regulations and shall verify operation within rated limits for all reasonably anticipated operating conditions. The TSPs shall be prepared and submitted by the Contractor not less than 45 calendar days prior to initial operation.

1. TSP Information

C. The TSP shall state, in the proper sequence of actions to be taken, the following information:

1. List of test (s) to be performed.

2. Objectives of each test.

3. Prerequisites to testing.

4. Instrumentation required.

5. Safety considerations.

6. Equipment, instrumentation, and tools required.

7. Requirements and precedent work and testing for Interfacing systems.

8. Coordination required with other organizations and other agencies.

9. Tests to be made (action) with steps noted.

10. Test procedure listing step-by-step actions to be taken or reference to a standard test procedure with explanatory remarks as required.

11. Expected results, including results of analytical studies used to predict expected results.

12. Remarks.

D. TSP Interrelationships

1. The TSPs shall identify other components/equipment and subsystems/systems that may be affected and the need for accident prevention and the required clearances.

2. The TSPs shall state the initial operating conditions required for components and equipment involved outages, safety precautions, test duration, test schedules, approvals required, and any unusual constraints or limitations.

3. The above information shall be referenced to the appropriate key drawings, engineering drawings, and other documents.

4. Instrumentation, wiring, control system arrangements and control settings, and hardware and software inputs and outputs and changes shall be described with schematics, drawings, or other documents. Locations, connections, signal conditioning, scaling, and variables being measured for each transducer, instrument, and input/output utilized during test and start-up work shall be shown.

E. TSP Safety Considerations List

1. The safety considerations for carrying out the TSP activities shall be stated on a TSP Safety Considerations List.

F. TSP Equipment and Tools List

1. The special test equipment and tools and temporarily installed equipment and components required to support or carry out the TSPs shall be stated on a TSP Equipment and Tools List.

G. TSP Data

1. The actual test and start-up results or data shall be attached to a copy of the TSP and returned to the Project Manager or their designated representative for review and acceptance.

H. Key Drawings

1. Key drawings or drawings such as schematic diagrams, flow diagrams, equipment wiring, and others, necessary for test personnel to conduct testing, shall be included with the TSPs.

1.4 SUBMITTALS

I. Where testing is done for the Contractor by an independent laboratory, each laboratory test or inspection report shall be signed and certified by the supervising engineer of the testing laboratory. Unless otherwise specified, three copies of each report shall be signed and certified by Contractor and submitted to the Department.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 CONTRACTOR-FURNISHED ACCESS

A. When requested, the Contractor shall furnish access to the facilities and labor assistance at the job site as necessary for the duties to be performed by the testing inspector, including temporary wiring, signal conditioning equipment, monitoring and recording equipment, ladders, hoists, platforms, temporary lighting, and similar equipment and services.

3.2 TESTING

A. Testing by the Contractor of materials and independent components provided on this project is not required if manufacturer's certification can be substituted in lieu of required tests, if and only if approved in writing by the Department. This waiver of testing does not preclude the Department from making tests, or requiring Contractor to make tests, on any of the materials or equipment supplied. The Contractor shall cooperate fully with the Department by providing items for testing or retesting or performing the testing. The Department will bear the cost of its own testing unless otherwise provided for in the applicable section of the Specifications or the material or equipment has to be retested due to improper or incomplete initial testing performed by the Contractor or his representative.

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Scope: This Section covers the following:

1. Construction facilities.
2. Construction aids and safety precautions.
3. Special controls.
4. Sanitary facilities and domestic water supply.
5. Traffic control at site.
6. Telephone services and communications systems.
7. Field office and parking areas.
8. Temporary buildings.
9. Temporary power supplies.
10. Use of Project site.

1.3 SUBMITTALS

A. Submit a construction staging and Site construction facility layout plan in accordance with Section 01300 – Submittals.

PART 2 – MATERIALS

N/A

PART 3 – EXECUTION

3.1 CONSTRUCTION FACILITIES

A. Temporary Facilities Supplied by Contractor: Contractor shall supply temporary services and facilities if and when required in their execution of the Work, such as electrical distribution, compressed air, fuel, telephones, temporary lighting, change house, potable water, sanitary facilities, field office, warehouses, and other facilities required by Contractor. See herein under for facilities provided by the Department.

B. Location: Contractor's field office, temporary facilities and laydown areas shall be located in the areas approved by the Department and as shown on approved Contractor's Drawings.

C. CONSTRUCTION AIDS AND SAFETY PRECAUTIONS

D. The Contractor shall comply with applicable laws, ordinances, rules, regulations and orders pertaining to personnel, construction machinery and equipment, hoists, cranes, scaffolding, staging, electrical equipment, fuel storage, materials handling facilities, tools, appliances and other construction aids.

E. The Contractor shall provide first aid facilities where required.

F. The Contractor shall provide barriers and shall post "No Trespassing" and other construction safety signs as necessary to protect the public.

3.2 SPECIAL CONTROLS

A. Project Water Control. The Contractor shall be responsible for control, management, and care of water incident to Contractor's Work.

B. Airborne Fumes, Vapors, and Particulates. Contractor's Work may include activities that will generate airborne fumes, vapors, and particulates. Such activities include, but are not limited to, soldering, welding, brazing, grinding, air-arcing, paint removal, and painting. When and where Contractor's Work has the potential to generate airborne fumes, vapors, and/or particulates, Contractor shall provide access controls, containments, screening, vacuums, blowers, ventilators, ducts, filters, etc to control and prevent personnel exposure to reportable, recordable, and/or actionable airborne materials such as fumes, vapors, or particulates. These provisions and practices shall be in accordance with federal, state, and local regulations, and Department policies and practices.

3.3 SANITARY FACILITIES AND DOMESTIC WATER SUPPLY

A. Toilet and Washing Facilities and Drinking Water: When and for the durations Contractor has more than three (3) combined Contractor and subcontractor personnel on site, Contractor shall provide sanitary and drinking water facilities to

accommodate his employees and project visitors as may be necessary to comply with the applicable requirements and state regulations. When and for the durations Contractor has more than three (3) combined Contractor and subcontractor personnel on site, the Contractor may not use rest room facilities in the power plant and project offices.

B. Non-potable water may be obtained from a location indicated by the Department and only upon approval of the Department. No use other than general Contractor's use at the construction offices and project site will be permitted.

3.4 TRAFFIC CONTROL AT SITE

A. The Contractor shall conduct operations to minimize obstruction to Project operations and public traffic. The public roads adjacent to the project site must remain operational at all times. The Contractor shall coordinate use and closure of existing roads with governing agencies.

B. Project roads must remain open to the extent possible and never be closed for an extended period of time. Project personnel must have continuous access to essential Project features including, but limited to, the powerhouse, substation, project offices, and interconnecting roads. Prior to any use or closure of Project roads, the Contractor shall coordinate at least two weeks in advance with the Department.

C. Flaggers, warning signs, barricades, standard construction signs and traffic control conforming to the standards established in the latest adopted edition of the "Manual of Uniform Traffic Control Devices" published by U.S. Department of Transportation and Caltrans standards shall be utilized as necessary to warn and protect the public from injury or property damage as a result of the construction.

D. When it is necessary to have one-way traffic control, two flaggers shall control the traffic at the ends of the public road segment affected by the construction work area and the adjacent public road shall be left in a condition that it can be traveled without danger to users.

E. State and local traffic control and safety requirements take precedence over this Specification if more stringent.

3.5 TELEPHONE SERVICES AND COMMUNICATION SYSTEMS

A. The Contractor shall make arrangements for and pay for his own phone services. Project telephone lines will not be available.

3.6 PARKING AND OFFICE AREAS

A. The Contractor shall confine parking and office facilities to areas designated on the Contractor's Drawings approved by the Department.

3.7 TEMPORARY BUILDINGS

A. The Contractor may construct or provide necessary temporary buildings or trailers at approved locations within the Project area.

B. Camp for employees at the Project will not be allowed except for those necessary for security personnel (evenings and weekends).

3.8 TEMPORARY POWER

A. Electric power (up to 50 kVA of three-phase, 480V power) will be provided to the Contractor to the extent the Department can reasonably provide energy at the Site. Contractor shall pay the Department to install metered, construction drops of the type and at the locations desired by the Contractor. The locations and design will be as agreed upon by the parties at the preconstruction conference. See Section 01200 - Meetings. Modifications to the plan subsequent to this meeting will be at the Contractor's expense. Contractor is to provide all hookup to both the Contractor's and the Department's facilities beyond the standard construction power drops. The Contractor will pay all costs of power and demand charges.

3.9 USE OF PROJECT SITE

A. The Castaic Power Plant is a functioning facility that serves a vital role in delivering electrical energy and capacity to the City of Los Angeles. The powerplant and surrounding facilities will be occupied by operations and maintenance personnel, other Department employees, and other personnel throughout the period of construction. Contractor will not have exclusive or unrestricted use of the Project site for storage and his operations. Contractor's facilities, materials, equipment, and Work cannot constrain or disrupt Plant operations and maintenance.

B. Contractor shall recognize and take into account in his planning and execution of his work that the work of other contractors, the Project operators, and the Department will require that they have reasonable access to and use of certain areas or spaces during certain periods.

END OF SECTION

SECTION 01600

MATERIALS AND EQUIPMENT

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section includes general administrative and procedural requirements governing the Contractor's selection of products for use in the Work.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300, "Contractor Submittals"

1.3 DEFINITIONS

A. Definitions used in this Section are not intended to change the meaning of other terms used in the Contract Documents, such as "materials", "equipment", "specialties", "systems", "structure", "finishes", "accessories", and similar terms. Such terms are self-explanatory and have well recognized meanings in the construction industry.

1. "Products" are items purchased for incorporation in the Work, whether purchased for the project or taken from previously purchased stock. The term "product" includes the terms "material", "equipment", "system", and terms of similar intent.

   a. "Named Products" are items identified by the manufacturer's product name, which may include make or model number of other designation, shown or listed in the manufacturer's published product literature, that is current as of the date of the Contract Documents.

   b. "Foreign Products" as distinguished from "domestic products", are items substantially manufactured (50 percent or more of value) outside the United States and its possessions. Products produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens of, nor living within, the United States and its possessions are also considered to be foreign products.

2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.

3. "Equipment" is a product with operational parts, whether automatically or manually operated, that requires service connections, such as wiring, conduit, or piping.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.

1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3. Deliver products to the site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units. All electrical equipment and cabinets shall be stored in a covered, weather tight, ventilated, temperature and humidity-controlled facility, and stored with desiccants, thermostatically controlled heaters, and other appropriate means and methods to maintain a regulated, suitable environment for storage of sensitive electronic equipment.

6. Store heavy materials away from any project structure (s) in a manner that will not endanger the supporting construction.

7. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 – PRODUCTS

2.2 PRODUCT SELECTION

A. General Product Requirements: Provide products that fully comply all applicable requirements of the Contract Documents, and best electric utility industry practices, that are undamaged and, unless otherwise indicated, new at the time of installation.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01640

OWNER FURNISHED EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section covers the care and handling of Owner-furnished equipment. Contractor shall be responsible for the inventory and handling, and, in certain cases, off-loading, inspection, and storage of certain Owner-furnished equipment.

B. The Owner-furnished material is listed in the Bill of Materials, included as a part of the Reference Material of this specification, or may by provided by Owner during the course of Contractor's Work.

1.2 MANUFACTURERS' RECOMMENDATIONS

A. Except as otherwise approved in writing by the Department, Contractor shall handle, store, provide assistance during installation and testing of all equipment in accordance with the manufacturers' recommendations and with the consent of any manufacturers' site installation/start-up engineers either provided by the Contractor or on-site. Contractor shall be responsible to determine any additional handling and storage requirements.

1.3 PACKAGING

A. Maintain packaged materials with seals unbroken and labels intact and legible.

B. Provide and maintain packing and protection suitable for the actual duration of storage.

C. Promptly notify the Department of any apparent shipping damage or damage incurred during handling.

D. In case of visible damage at the time of delivery, such condition to be noted on the delivery ticket and the delivering driver is to sign this notation.

1.4 SUBMITTALS

A. The Contractor shall submit plans for material and equipment storage. The Contractor shall determine the size, construction, and other aspects of and on-site or other storage facilities to adequately protect the equipment, both Owner and Contractor furnished.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 DELIVERY AND OFF-LOADING

A. Certain Owner-furnished equipment will be delivered either to Contractor's facilities or to the site by the Suppliers. The Contractor shall coordinate with shipper the time and place of delivery and equipment needed for off-loading.

B. Before unloading, the Contractor shall accompany the Department on the inspection of the deliveries to verify completeness and condition of parts. If the Contractor discovers any defect in material or equipment, he shall notify the Department at that time. Such material and equipment after receipt at the point of delivery shall form part of the Work for all purposes of the contract as if it had been supplied by the Contractor himself.

C. Off-load all Owner-furnished equipment with appropriate handling equipment in approved storage areas. All lifting equipment shall be operated by qualified personnel.

3.2 INVENTORY

A. Maintain a record of all Owner-furnished materials and equipment currently on-site or received by Contractor, including date received, condition on delivery, carrier who made delivery and location stored.

3.3 STORAGE

A. The Contractor shall make arrangements for the proper storage of Contractor's and Owner-furnished materials and equipment, including equipment which requires temperature and humidity-controlled space or electric supply for internal space heaters. Exposed machined surfaces shall have a suitable protective coating applied and maintained and shall be covered adequately to protect them from rust and other damage. Storage conditions shall be maintained as recommended by the manufacturer.

3.4 MOVEMENT AND INITIAL PLACEMENT OF PARTS

A. The Contractor shall obtain clearance from the Department prior to moving any part which is in site storage, either within the site storage area or to the site assembly or installation area.

END OF SECTION

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. At the beginning of the Work, the Contractor shall set aside one complete set of prints of the Reference Drawings, Contract Drawings, Contractor's design drawings, and any later supplementary drawings and other Contractor-furnished documents, upon which shall be recorded all deviations in construction and all deviations due to Change Orders. Notations and changes shall be done with a red pen in a neat and legible manner as prescribed by the Department. At any time during normal working hours, the Contractor shall make the Record Drawings available to the Department to examine and verify that they are being kept up to date.

B. Upon completion of the project, the Contractor shall electronically transfer all completed software and drawings to the Departments local servers. The contractors shall also provide reproduction services for a complete set of Contract Drawings, Contractor's design drawings, supplementary drawings, and other Contractor-furnished documents showing and annotating the as-built conditions, as a set of marked-up Reference Drawings showing as-built conditions to the Department before final payment will be made.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

SECTION 01730

SOFTWARE SUPPORT

PART 1 - GENERAL

1.1 DESCRIPTION

A. General

1. The services identified in this Contract shall be designed to provide the technical services required to maintain the control systems and products at high performance levels. The cost of these services shall be included in the RFP during installation and through the warranty period. The cost of services after the warranty period shall be continued on a separate year to year maintenance contract. Services shall be included to maximize equipment and process availability. The contractor and the Department share the responsibility to coordinate and schedule the delivery of the purchased services to ensure their timely completion before the expiration of this Contract. Rollover of unused services purchased in this Agreement to a renewal Agreement is not possible unless specifically stated otherwise.

B. Online Support

1. Department Engineering, Maintenance, and Operations personnel shall have on-line access to: product user manuals, firmware updates, software service packs, online knowledge base and FAQ's, product newsletters and technical bulletins.

C. Technical Support

1. Telephone support shall be available on demand, as needed, 24 hours a day, 365 days per year. Technical Support Technicians shall have knowledge of the hardware, software, and communications systems installed at the Castaic Power Plant.

2. During normal business hours, Monday – Friday 8:00 a.m. – 5:00 p.m. Pacific Time, qualified technical support technicians, familiar with the installation at the Castaic Power Plant, shall be available for immediate support.

3. During non-business hours, including weekends and holidays, qualified technical support technicians, familiar with the installation at the Castaic Power Plant, shall be available for phone support within two (2) hours of the initial call.

D. Field Service Support

1. On occasion, on-site support will be needed. The contractor shall provide up to five (5) on-site support visits per year during the warranty period, to troubleshoot, maintain, and/or repair the control hardware, software, or communications systems installed. This shall include all expenses that may be incurred, including, but not limited to, labor hours (including overtime), travel, lodging, tools, and other expenses. If some or all of the on-site visits are not used, the contractor shall reimburse the Department.

E. Updates

1. The contractor shall upgrade the control system with any applicable software and/or firmware upgrades as determined in item 2 below that may occur two (2) years after the final commissioning and acceptance of the control system by the Department. This shall include support with installation of the software and/or firmware, as well as any troubleshooting or repair required.

2. The contractor shall analyze any control system software and or firmware upgrade offered by manufacturer or software vendor to determine applicability to the system. If the update will provide bug fixes or functional upgrades that do not adversely affect the operation of the system, then it will be recommended to the Department for installation.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

SECTION 01740

TRAINING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Training

1) Training shall be provided in three separate phases.

a. Up to 15 engineers at contractor facilities after award of contract and prior to delivery of equipment. Cost of training will be broken down per engineer, and the Department will only be charged for the classes taken.

b. Up to 20 maintenance mechanics. Training shall be geared towards troubleshooting, diagnosis, and repair of control hardware and software. Training shall be completed prior to the completion of commissioning. All classes will be held on Department premises.

c. Up to 30 operations' personnel. Training shall be geared towards the operation of the units, as well as alarm management, report generation, etc. Training shall be completed prior to the completion of commissioning. All classes will be held at the Castaic Power Plant. Step by step training shall include, but not be limited, the following items:

1) Simulate all computer activities required to operate Units 1 through 6 and the Balance of Plant controls.

2) Create common problems or conditions that could be encountered in the operation of the units and allow the operators to respond to the problems or conditions.

3) Step by step training instructions on how to set up trends for any parameter.

B. The training curriculum shall include, but not be limited to, the following topics. The contractor shall provide his recommendation for additional training.

a. ControlLogix Systems Fundamentals

Upon completion of this course, the student shall be able to:

- Identify the components of a typical Logix5000 system including hardware and software.
- Identify industrial networks including Ethernet for use in a Logix5000 system.
- Use standard RSLogix 5000 software to create and modify a project file.

- Use RSLogix 5000 software to transfer a project file to a PLC controller.
- Configure a PLC controller with local 1756-I/O analog and discrete modules.
- Creating I/O tags and monitoring real-time data in a PLC.
- Basic Ladder Logic fundamentals.

Topics

- ControlLogix Family Overview
- PLC Hardware and Cabling
- Configuring the Hardware
- Communication to the PLC
- Using Software Tools
- Programming Languages Introduction
- Archiving and Retrieving

b. ControlLogix Maintenance and Troubleshooting

Upon completion of this course, the student shall be able to:

- Perform basic hardware assembly, cabling, wiring and testing.
- Perform troubleshooting of an operational ControlLogix based control system.
- Connect a computer to control network and establish communication with an operational PLC.
- Use standard Logix5000 tools to understand project organization and execution.
- Monitor all data types supported by the ControlLogix platform.
- Edit Ladder Logic online, search for project components and print projects.
- Troubleshoot PLC problems by applying troubleshooting strategies and use of preventive maintenance.
- Troubleshoot Digital, Analog and Remote I/O
- Troubleshoot power supply and noise related problems.
- Use of RSLogix5000 software tools such as trend charting for monitoring and troubleshooting a system.

Topics

- Troubleshooting PLC Hardware including local and remote I/O and power supplies
- Troubleshooting and debugging PLC Software
- Communication to the PLC over a network using a maintenance computer
- Ladder Logic editing
- PLC Project management, documentation and printing

c. Basic Ladder Logic Interpretation

Upon completion of this course, the student shall be able to:

- Have a basic understanding of RSLogix 5000 ladder logic instructions and terminology.
- Apply ladder logic strategies and Techniques
- Document and be able to search for elements within a ladder logic project.
- Modify program control, timer, counter, compare, compute, math and move instructions.

Topics

- Understanding of basic ladder logic concepts
- Understanding and practice of basic ladder logic editing
- Training on existing ladder logic projects to practice editing techniques
-

d. Basic Ladder Logic Programming

Upon completion of this course, the student shall be able to:

- Create and test ladder diagrams.
- Program control, timer, counter, compare, compute, math and move instructions.
- Program a procedure including the ability to separate it from equipment control.

Topics

- Development of new ladder logic programs.

e. ControlLogix Project Development

Upon completion of this course, the student shall be able to:

- Create and organize a new Logix5000 based controller project.
- Creating periodic tasks within a controller project.
- Configuring a controller to produce and consume data over the industrial Ethernet network.
- Configure a controller to share data with other controllers over an industrial Ethernet network.
- Program the controller to create event tasks, use of GSV/SSV instructions and configuring messages.
- Developing an Add-On instruction in Ladder Logic.

Topics

- Advanced RSLogix 5000 project concepts
- Integrating Logix controller features with basic ladder logic programs

- Efficient organization of Logix programs to maximize performance
- Connecting a Logix based PLC with other PLCs in a networked environment to share data

f. Function Block Programming

Upon completion of this course, the student shall be able to:

- Create a function block diagram
- Program logical function block instructions
- Program timer, counter, analog, device driver and totalize function block instructions.
- Program and tune a PID loop using function block instructions and ActiveX controls.
- Program and modify Ramp/Soak function block instruction.
- Implement program flow control using function block instructions.

Topics

- RSLogix 5000 Function Block diagrams
- Function Block instructions
- Implementing functional specification using function block program

g. Structured Text/Sequential Function Chart Programming

Upon completion of this course, the student shall be able to:

- Design a sequential function chart
- Program a sequential function chart
- Test, store, reset and pause a sequential function chart in the RSLogix 5000 programming environment.
- Program assignments, expressions and instructions in structured text.
- Program constructs and comments in structured text within the RSLogix 5000 programming environment.
-

Topics

- RSLogix 5000 Sequential Function chart programming
- RSLogix 5000 Structured Text programming

h. HMI Operator Training

Upon completion of this course, the student shall be able to:

- Understand the architecture of the HMI system including computers, redundancy, network and how they relate to the control system (PLCs).
- Describe how security and authentication is important to the use and protection of the system.

- Navigate the Windows based graphical user interface presented by the HMI system.
- Interpret, operate and configure alarms during all possible scenarios of plant operation.
- Work with real-time and historical trends
- Perform setpoint, discrete and lock-out control of plant equipment.

Topics

- Display a graphic window using the grid or navigation buttons
- Use animated graphics to observe and control a process
- Ramp a setpoint and view controller alarm parameters and tuning using the point detail
- View, silence, and acknowledge alarms
- View historical process data using historical logger and trend windows
- Identify the methods of animation
- Configure tagnames to display on the correct alarm group window
- Make graphic objects display alarm states

i. HMI Graphics Editor Training

Upon completion of this course, the student shall be able to:

- Understand the architecture of the HMI GE Dataviews based process graphic system.
- Describe the differences between the run-time and editor versions of the process graphic system.
- Efficiently navigate the process graphics editor interface to open, modify, close and distribute changes to the graphic views.
- Understand the concepts of graphic objects, subdrawings, substitution variables, data expressions, data conversions and linking a view to real-time data sources.
- Modify an existing process graphic to add new static screen elements
- Modify an existing process graphic to add new dynamic screen elements
- Save graphic screen changes and preview in run-time viewer.
- Create a process graphic view from scratch using a functional specification.
- Link tagnames to process graphic elements to enable real-time data display.
- Become proficient in the use of the many graphical object types that will model plant operations.

Topics

- Process graphic view tool usage in edit and run-time modes
- Process graphic view file management and distribution
- Standardization of drawing elements to maximize efficiency
- Creating a new process graphic
- Graphic editor palette of tools for drawing
- Creating symbols and subdrawings
- Use of different navigation styles when developing screens
- Dynamic data types and their relationship to various graphic object types
- Dynamic data sources, substitution variables, manual data and expression
- Relationship and the details of tagname point types and their attributes that can be displayed on a process graphic view

j. HMI System Administration Training

Upon completion of this course, the student shall be able to:

- Efficiently navigate the onSITE system and use the standard system tools.
- Perform a safe shutdown, restart and system backup
- Perform preventive and basic diagnostic maintenance using onSITE system tools.
- Perform basic hardware changes and system reconfiguration.
- Use the Help, Documentation and On-line support tools.
- Perform system / user administration tasks
- Configure Ethernet networks, Allen-Bradley PLCs and Siemens Relays for use on the industrial Ethernet based network using the System Configuration tool.
- Add, delete and modify users of the system, change security settings. Add user groups, modify area-of-responsibility settings.
- Add new tag names, modify alarm settings, create real-time and historical trends

Topics

- onSITE System Overview
- User Administration
- System Hardware
- System Communications
- System Redundancy
- System Software Components
- Function Block Configuration

k. Exciter Training – Course shall include the following topics:

Upon completion of this course, the student shall be able to:

- Recognize Basler Excitation system and its components
- Locate specific terminal blocks, circuit breakers, contactors etc. in the system
- Discuss the effects of the over or under excitation on the motor or generator
- Discuss the capability curve

Operating methods

- Set the control of the machine for PF or VAR controller
- Interpret and navigate through various HMI screens

Field Application

- Recognize the application of field flashing in a synchronous machine
- Understand the method of field build up in a synchronous machine
- Understand the operation of the field controls in both Manual and Automatic settings
- Understand the concept of "bumpless transfer" from Auto to Manual control
- Understand the effect of the field on synchronization of the machine to the line
- Understand the reaction of the excitation system to a loss of field current
- Understand the application of field current to control of Power Factor and the definition of the terms leading and lagging as applied to a generator or motor

Limits

- Understand the reaction of the excitation system to under or over excitation
- Understand the excitation systems ability to limit stator current
- Understand the reaction of the excitation system to reduced frequency

Troubleshooting

- Respond to failure to initiate
- Respond to a trip from a protective device or digital input
- Perform a "bumpless" switch form Automatic mode to Manual mode
- Interpret fault messages and initiate appropriate response
- Follow the logic of the control system to determine where a problem has occurred
- Read fault logs from the protective devices to determine appropriate action

Producing the Field

- Understand single phase and three phase controlled bridge rectifiers as applied in the excitation system
- Understand the use of Field Forcing to provide improved response of the field control
- Recognize the required inputs to the excitation system such as voltage setpoint, VAR/PF setpoint, current regulator setpoint
- Recognize the required outputs of the excitation system such as field current connection, field discharge resistor
- Recognize the required feedback to the excitation system such as line voltage, field current, stator current, machine speed
- Read Siemens control drawings relevant to the excitation system
- Program the excitation system controller

Power System Stabilizer

- Understand the concept of a Power System Stabilizer
- Input the parameters required for the setup of the Power System Stabilizer
- Perform self tuning of the Power System Stabilizer
- Understand the operation of the Power System Stabilizer

I. Governor Training

Operations and Maintenance

Upon completion of this course, a combination of classroom and hands-on sessions, the student shall be able to:

- Understand the theory and operation of a digital governor system
- Discuss the basic operational modes of a digital governor system including normal shutdown, speed references, pump mode, spinning reserve, manual and emergency contingency response.
- Identify the locations and function of all discrete and analog inputs/outputs.
- Operate all menus and sub-menus of the local HMI to view live data and control the governor.
- Perform all scheduled maintenance required on the governor: oil filters, maintain cleanliness, oil pressure check, pump cycling check, control relays, solenoids, fastener security and corrosion checks.
- Perform tuning and calibration of governor including wicket gate position feedback calibration, valve calibration and tuning.

- Skilled in troubleshooting of all governor alarms, turbine alarms and trips, position oscillation, dirty/foaming/moisture in oils, overheating and foreign matter sources in circuit.

Topics

- Digital Governor System Overview
- Digital Governor Operation
- Governor hardware and electrical terminations
- Maintenance Procedures
- Troubleshooting Techniques

Engineering

Upon completion of this course, the student shall be able to:

- Understand the theory and operation of a digital governor system.
- Understand the software architecture programmed into the governor.
- Proficient in the PLC program blocks that operate the digital governor.
- Operate all menus and sub-menus of the local HMI to configure governor operation, view live data, analyze historical data and events.
- Modify PLC and HMI Application code.

Topics

- Digital Governor System Overview
- Software Internals
- Governor setup and configuration
- Software programming

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

The Contractor shall develop the training program as outlined above. The Department shall approve the proposal before implementation.

END OF SECTION

SECTION 01750

WARRANTIES AND GUARANTIES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This section covers manufacturer's standard warranties and guaranties required of the Contractor. These are in addition to the warranties and guarantees specified in the Contract Agreement itself.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

Contract Agreement – Part 3

1.3 MANUFACTURERS' WARRANTIES

A. All warranties which are available in the normal course of business from manufacturers of equipment or components shall be obtained by the Contractor and furnished to the Department as follows:

1. Assemble warranties from manufacturers and subcontractors.

2. Provide two signed original copies.

3. Provide a Table of Contents, neatly typed, in orderly sequence. Provide the following information for each item:

   a. Product or work item.

   b. Manufacturer, with name of principal, address and telephone number.

   c. Scope.

   d. List and details of guaranties.

   e. Date of beginning of warranty.

   f. Duration of warranty.

   g. Proper procedure in case of failure.

   h. Instances which might affect the validity of warranty.

1.4 RIGHT TO OPERATE UNSATISFACTORY EQUIPMENT

A. The Department shall have the right to operate any and all equipment as soon as, and as long as, it is in operating condition whether or not such equipment has been accepted as complete and satisfactory, except that this shall not be construed to permit operation of any equipment which may be materially damaged by such operation before any required alterations or repairs have been made.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Specifications Electrical (GSE), apply to this Section.

1.2 SUMMARY

A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, and OSHA standards.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 – PRODUCTS

2.1 NAMEPLATES

A. Engraved Plastic Nameplates:

1. Engraving stock, melamine plastic laminate, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

2. Engraved legend with black letters on white face.

3. Punched or drilled for mechanical fasteners.

2.2 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties:

1. Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

2. Minimum Width: 3/16 inch (5 mm).

3. Tensile Strength: 50 lb (22.3 kg) minimum.

4. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

B. Control and Instrument Wire Identification Markers:

1. All instrumentation and control wiring shall be identified and permanently labeled with plastic sleeve wire markers.

2. Numbering system shall be consistent throughout, and wires shall be marked at both ends.

3. Manufacturer: Grafoplast Wiremarkers Inc., or equal.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 16300

CONTROLLER AND REMOTE I/0 REQUIREMENTS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. This section included general requirements for the Castaic Pumped Storage Plant control system upgrade.

B. Attachments:

1. Attachment A – I/O Points Count

2. Attachment B – I/O List

1.2 GENERAL REQUIREMENTS

A. The Plant Control System shall provide local and centralized control and monitoring of the power plant from local panel mounted human machine interfaces and workstations located in the control room of the powerhouse. When the units are on-line and within parameters, the units may be transferred to the Energy Control Center for set point control as specified in Section 16340.

B. The system shall be configured to provide the following control functions:

1. Local Control: In this mode of operation the equipment and systems are locally and manually operated at each device (local OITs in the case of digital governor, TSOV and south portal, and operator interface at the digital exciter). This also includes the ability to operate the unit, with full automatic sequences, from the governor HMI, as can currently be done on Units 2 and 6.

2. Central Control: This is the preferred method of operation. When in central control the start and stop of the units in the modes of generate, condense, pump, pump start, speed no load, and cold start shall be performed in the same automatic sequence that can be currently performed on Units 2 and 6, with the enhancements identified.

3. Off-Site Control: In this mode limited unit parameters can be controlled by the LADWP's Energy Control Center (ECC). This mode does not have provisions for off-site sequencing control. The on-site operator in the Central Control room shall place the unit in the desired mode and transfer the parameters control to ECC, when the unit is within the allowable for off-site control range.

4. Control of MW and MVAR or kV output of the generating units.

5. Monitor and log the status of the units during pumping and generation.

6. Monitor and control the station service, generating unit auxiliaries, penstock valves, reservoir levels including Elderberry Lake and tailrace channel, cooling water systems, 4160V station service equipment, 230kV switchyard and other powerhouse common services hereinafter specified.

C. Features of the control system shall include:

1. Data Acquisition and Control (DAC).

2. Human Machine Interface (HMI)

3. Historical Data Management (HDM).

4. Interface with Energy Control Center

D. The control system shall be PLC/PC based, completely integrated industry standard state-of-the-art system. The system shall have an "open architecture" which shall permit reconfiguration, expansion, interface with third party equipment and future upgrades.

E. The control system shall be designed to provide sufficient plant level and cyber security in compliance with the Department IT and NERC security standards.

F. The control system shall include as a minimum the following subsystems:

1. Controller Stations (CS), each including PLCs, communication controllers, and input-output modules as follows:

a. One Unit Controller (redundant PLC's) (for each unit) including remote I/O modules for generator I/O, turbine I/O and RTD I/O.

b. One TSOV Controller (redundant PLC's) (for each unit)

c. One Digital Governor Controller (redundant PLC's) (for each unit)

d. One Excitation Controller (redundant PLC's) (for each unit)

e. One South Portal Control House remote I/O interface (to operate in parallel to existing) (PSOV's plant wide)

f. One Balance of Plant Controller (redundant PLC's) (plant wide)

g. One Elderberry Lake Controller consisting of two stand-alone PLCs

h. One Compressor Controller interface

i. One Station Service control and interface

j. Three ECC Controllers.

k. New 230 kV Bay Controller panels to provide control to breakers and synchronization, sync check and monitoring of unit parameters and to replace existing 230kV Switchyard control function.

l. Unit 7 Interface

2. One Control Room/Computer Room Human Machine Interface System (plant wide) as follows:

a. Two HMI Servers (Existing) to be replaced.

b. Ten Workstations with Two Monitors each.

c. One Workstation with Two Large Scale Video Displays.

d. Two Engineering Workstations with Two Monitors each.

e. One Workstation with Two Monitors for Unit 7, to be installed at Unit 7

f. One Operations Supervisor Workstation with One Monitor.

g. One Maintenance Supervisor Workstation with One Monitor.

h. One Panel Mounted Touchscreen based HMI workstation for each unit (6 total) mounted adjacent to the Governor Cabinet.

3. Local Interface Panel Mounted Terminals (OIT) as follows:

a. One OIT at TSOV Cabinet (for each unit)

b. One OIT at Governor Cabinet (for each unit)

c. One OIT at South Portal Building

d. One complete unit HMI touchscreen unit adjacent to unit controller for all units.

4. Two Historical Data Management Servers with Raid Drives (plant wide) – To be proved by the Department and integrated into the control system by the Contractor.

5. Two portable PCs for Maintenance and Diagnostics (plant wide)

6. One Color and two black and white network laser printers

7. One GPS based Time-Frequency System to provide a time and frequency reference signal.

8. Fault-tolerant Industrial Grade Ethernet LANs.

9. All other hardware and software necessary to fulfill the requirements of the Technical Specifications and to provide for a fully functional control system.

G. Design and Performance Criteria.

1. Availability.

   a. The control system shall be designed to minimize the consequences of failures by providing sufficient failure detection, and recovery procedures, such that no single device failure shall result in the loss or degradation of any other station in the system.

   b. The control system shall be designed to minimize the duration of failures by the ability to diagnose and resolve problems quickly and to replace any failed part easily.

   c. The Average System Availability for three consecutive 500-hour periods shall be 99.98% or better.

2. Maintainability. The hardware and software elements of the Control system shall be easy to maintain using the maintenance facilities, hardware and software tools, and recommended spare parts provided by the Contractor.

3. Expandability.

   a. The Control system shall be capable of being expanded over and above the specified system by adding more stations, PLCs, functions, input-output modules, or intelligent devices such as metering modules, etc. This expansion shall not degrade the performance of the existing system.

   b. For ease and flexibility in expanding the Control system, the Contractor shall conform to the industry standard open architecture concept as described herein.

4. Product Quality and Advanced Technology.

   a. The Department requires hardware and software products of high quality in design, fabrication, and performance.

   b. The standard hardware equipment (such as printers, etc) and devices of the control system shall be brand-new and shall be as close as possible to being of the latest design technology. In order to meet this requirement equipment, the Contractor shall defer the procurement of all standard hardware as late as possible in the project schedule until just prior to system integration. The Contractor shall not use project laptops and workstation as development tools during the design and applications engineering phase of the project.

c. For the standard software, the latest versions available at time of Factory Acceptance Test (FAT) shall be delivered.

d. The Contractor shall use and provide the latest versions of all the standard software, e.g., the operating system, utilities, language compilers, graphics software, picture editor, networking software, database management system, which are available at the time of system integration, as long as there is full upward compatibility with the control system software.

e. All software shall be standard. Therefore, Contractor's code modification on standard software packages shall not be permitted.

f. At the end of the project the Contractor shall upgrade all firmware and software to latest editions. PLC flash memories shall also be updated as required.

H. Testing Requirements.

1. The Contractor shall meet the system functional and performance requirements given in these Department's Requirements. The verification of compliance with the requirements shall be done through a series of tests focused primarily on functionality, response, CPU utilization, and system availability.

2. The testing sequence of the complete system shall consist of the following:

   a. Pre-Factory Acceptance Test (PreFAT).

   b. Factory Acceptance Test (FAT).

   c. Site Acceptance Test (SAT).

   d. Availability Demonstration (AD).

3. All system testing shall be made with a representative number of control nodes and stations and the ultimate number of points simulated.

4. The Contractor shall use PLC/HMI/I-O based hardware and software to test the Controller Station functions specified in Sections 16320 and 16325 and simulate plant conditions. The inputs and outputs of the simulator shall be hardwired to the I/O modules in the controllers and I/O cabinets. The HMI in the simulator shall be used to generate particular conditions and responses required by the software simulation. All inputs and outputs required by the software shall be simulated including the serial or other interfaces with intelligent devices such as the excitation system, multifunction meters and bay controllers. All hardware and software developed for this testing shall be delivered to the Department.

5. The FAT of the ECC interface PLCs shall include an actual test of the link to ECC. If this is not possible, the Contractor shall provide all the

necessary equipment to simulate the ECC and fully test the operation of the interface.

I. Software

1. All software including operating licenses, manuals, documentation, and electronic files used for developing and implementing the automation system PLCs and HMI stations shall be furnished to and become the property of the Department.

J. Training

1. Training shall include sessions and courses in the theory, detailed operation, testing, and maintenance and troubleshooting of the automation system and as a minimum shall include the hardware and software training modules as specified in Technical Specs 01740.

2. The Contractor shall submit a training plan, instructor's background and qualifications, course outline, course material and subject matter. Training course material shall include the use of site-specific Operations and Maintenance Manuals, to the maximum extent possible.

3. The Contractor shall provide off-site and on-site training for the Department's staff as specified in Technical Specs 01740.

4. Continuous on site support shall be provided as specified in Technical Specifications 01730.

5. REFERENCES, SPECIFICATIONS, CODES AND STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

IEEE C37.2	Standard Electrical Power System Device Function Numbers

B. National Fire Protection Association (NFPA)

NFPA 97	Electrical Standard for Industrial Machinery

1.3 REFERENCE SECTIONS

A. SECTION 01010 SUMMARY OF WORK

B. SECTION 01011 EXISTING CONTROL SYSTEM

C. SECTION 01012 ENHANCEMENTS TO EXISTING AUTOMATED CONTROL SYSTEMS

D. SECTION 01740 TRAINING

E. SECTION 16075 ELECTRICAL IDENTIFICATION

F. SECTION 16310 CONTROL SYSTEM PANELS

G. SECTION 16315 BAY CONTROLLER PANELS AND DOORS

H. SECTION 16320 DATA ACQUISITION AND CONTROL SYSTEM

I. SECTION 16330 HUMAN MACHINE INTERFACE (HMI) SYSTEM

J. SECTION 16340 INTERFACE WITH ENERGY CONTROL CENTER

K. SECTION 16350 HISTORIAN SYSTEM

L. SECTION 16360 PROCESS NETWORKS

M. SECTION 16365 230 KV BAY CONTROLLER

N. SECTION 16370 EXCITATION SYSTEM

O. SECTION 16380 DIGITAL GOVERNOR CONTROLLER

P. SECTION 16390 TURBINE SHUT-OFF VALVE

Q. SECTION 16611 UNINTERRUPTIBLE POWER SUPPLY

1.4 SUBMITTALS

A. Submittals for this section shall be submitted in accordance with Section 01300.

B. Project Implementation Plan Submittal

1. The Contractor shall submit a Project Implementation Plan no later that 20 working days after the notice to proceed. The plan shall provide a description of the implementation approach and shall include:

   a. Design memorandum together with a system architecture drawing and a technical description of the proposed system;

   b. Detailed project organization chart

   c. Overview of the transition from the existing systems to the new PC/PLC based systems.

   d. Factory and Field Testing Approach.

   e. Training Approach

   f. Operations and Maintenance Instructions and Documentation Approach.

   g. Proposed project schedule as per Section 01310 including: milestones, meetings and workshops; submittals; manufacturing

and procurement; factory tests; installation; field tests; training, etc.

h. The submittal shall provide coordination details for the installation work to be performed by the Department, coordination with other ongoing projects at the Castaic power plant.

C. Project Schedule and Progress Report Monthly Submittals

1. The project schedule shall be updated and submitted monthly for the duration of the project as per Section 01310.

2. The progress report shall be submitted monthly for the duration of the project as per Section 01310.

D. Application Software Functional Design Submittal

1. The Contractor shall submit the Application Software Functional Design 60 working days after notice to proceed.

2. The Application Software Functional Design submittal shall include a functional description of the application software for the unit and plant monitoring and control. Modular approach shall be used for the software design. Each module shall be described in detail and include the functions of the module and its interface with other modules, field input/outputs and HMI. The intent of the software functional design is not to include printouts of actual programming.

3. The application software functional design submittal shall include, but not be limited to:

a. An updated system architecture that identifies all cabinets and PLC that will host the application software modules.

b. An overall diagram and subsystem diagrams including major modules, data structures and data flow. Location (PLC) for each module shall also be included.

c. A description of the functions to be performed by each module.

d. A diagram and/or description of the manner in which the module interfaces with other modules.

e. A detailed description of all interfaces between the system and the operator shall be provided. All related HMI graphics shall be shown.

f. A description of the distribution of the modules, loading of controllers and memory requirements.

g. Input, output and software points database.

h. A description of the impact of power failures, system failures redundancy switch over, normal restarts for all systems and

subsystems and application software approach for mitigating issues.

i. Description of the original vendor software and programming environment with a list of software licenses provided with the system

E. Control Panels Submittal

1. The Contractor shall submit the Control Panels Design 120 working days after notice to proceed.

2. The Control Panel submittals shall include but not be limited to:

   a. Outline Drawings of cabinets, control cubicles and control console including:

      1) Front, rear and side views of control cubicles and control console.

      2) Inside view of equipment arrangements, including terminal blocks and cable entrance details for external cables.

      3) Conduit and cable entrances.

   b. Schematic/Elementary Diagrams

   c. Wiring Diagrams and Cable Schedules

   d. Termination Drawings/Schedules

   e. Nameplate Schedules

   f. Design Calculations

   g. Bills of Material

   h. Loop diagrams

3. The Instructions Submittals shall include but not be limited to:

   1. Shop Assembly and Testing Procedures

   2. Handling and Storage Instructions

   3. Installation Instructions

   4. Installation instructions for removal, overhaul or replacement, adjustment

   5. Reports

   6. Field Commissioning Procedures of Check-Out, Start-Up, Initial Operation and Testing.

F. Test Plan, Test Procedures and Test Reports Submittals

1. The Contractor shall submit a test plan for review and approval as described in Section 3.3 of this section. The test plan shall include as a minimum:

    a. Outlines of each proposed tests describing the specific tasks to be performed and the time allotted for each task.

    b. Examples of the proposed forms and checklists.

2. The Contractor shall submit factory and site acceptance test procedures and requirements for the new control systems based on the approved test plan. The site acceptance test procedures shall be based on the factory acceptance test procedures modified for field conditions. All procedures and requirements shall be reviewed and approved by the Department.

3. After completion of the factory and site testing the Contractor shall submit test reports documenting the test procedures and test results.

G. Training Plan Submittal

1. Within 120 working days of notice to proceed the Contractor shall submit a training plan. The training plan shall include, but not limited to:

    a. An overview of the training plan with an explanation of the selection of the specific courses.

    b. Course titles, definitions and objectives

    c. Course Durations

    d. Suggested Course Locations - Training center or job-site

    e. Recommended attendees: project (management personnel); operations personnel; maintenance personnel; engineering personnel.

    f. Prerequisite training and background of attendees for each course

    g. Schedule of training courses including dates, duration, and location of each class

    h. Resumes of the instructors who will actually conduct the training

    i. On the Job Training – to include: software; hardware; PLC programming and HMI development.

H. Operations and Maintenance Instructions Submittals

1. The Contractor shall provide multiple revisions of the Instructions. The first revision of the Operations and Maintenance Instructions shall be submitted immediately after the commissioning of the first unit. Subsequent revisions shall be submitted after commissioning of each unit. One final revision shall be submitted at the end of the project. The electronic versions shall be interactive with intuitive navigation.

2. Operations and Maintenance instructions, including descriptive text detailing operation of the new system controllers. All modes of operation shall be covered including, but not limited to: generator, pump and pump starter start, condensing, cold start, stop, synchronizing, loading, unloading, gate operation, automatic and manual operation, emergency stop, graphics and alarm system utilization, short and long term history, reports, etc. A detailed narrative shall also be provided for each SFC and CFC.

3. Application Software

    a. System architecture and network diagrams, network configuration descriptions, managed Ethernet switches configuration, communication devices programming and configuration.

    b. Controller programming details. The programming shall be fully annotated with sufficient information for determining operation of the system.

    c. HMI programming details. HMI programming for the servers and workstations and all of the graphic screen configurations, alarm system configuration, short term history configuration, historian configuration, reports configuration, etc.

    d. Input, output and software points database.

4. Manufacturer's Information

    a. The Manufacturer's information shall be tabulated / located in subfolders based on the usage of the devices and equipment.

    b. Manufacturer's data sheets for all PLC components used in the system including but not limited to: CPUs, power supplies, I/O modules, communication modules, software, etc.

    c. Manufacturer's data sheets for all network and communication components used in the system including but not limited to: Ethernet switches, cables, connectors, radios, antennas, power supplies, software, etc.

    d. Manufacturer's data sheets for all of the HMI components used in the system including but not limited to: server computers, workstation computers, monitors, printers, software, etc.

e. Manufacturer's data sheets for all of the turbine-generator control switchboard components including but not limited to: control switches, pushbuttons, indicating meters, indicating lights, auxiliary control relays, power supplies, system protective relays, etc.

f. Manufacturer's data sheets for instrumentation and other field devices.

g. Manufacturer's data sheets for the uninterruptible power supply system (UPS).

l. Spares, Consumables and Special Equipment Submittal

1. The submittal shall include a complete list for all spares, consumables, and special equipment as specified in the Technical Specifications.

2. The submittal shall include a separate list of additional spares, consumables and special equipment recommended by the Contractor, together with unit and total cost.

3. The submittal shall include handling and storage instructions for all spare parts, consumables and special equipment.

4. The submittal shall include a list of any specialty software or hardware tools used during project and not listed or provided under other submittals.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COPYRIGHTS, SOFTWARE LICENSES AND APPLICATION PROGRAMMING

A. The Department shall own the copyrights for all documentation and software purchased or developed for the project.

B. All software licenses and vendor support agreements shall be on the name of Los Angeles Department of Water and Power.

C. The programming software, instruction manuals, application software and data files shall become the property of the Department at completion of the project.

D. All program documentation shall be reviewed and approved by the Department prior to implementation. Refer to submittal requirements specified herein.

E. The Contractor shall submit a full copy of the of the current application software once a month until the warranty period expires to the Department and/or its designee to be kept in case of force major events or bankruptcy of Contractor.

3.2 INSTALLATION

A. All Contractor personnel shall go through plant operations and safety orientation during their first visit to the plant.

B. The Contractor shall follow the Department's operations and safety procedures.

C. The Contractor shall follow the Department's/NERC's cyber security procedures.

D. Refer to the individual system specification sections for installation details.

3.3 TESTING

A. Factory Acceptance Test

1. The Contractors shall prepare a Field Acceptance Test (FAT) Plan and shall submit it to the Department for review and approval at least 120 calendar days before the scheduled start of system FAT.

2. The FAT Plan shall consist of the following:

   a. FAT Overview. This shall describe the test configuration, the hardware and software simulator, the measurement tools, the complete test schedule, the forms for recording test results, the classification of discrepancies, and the processing of test reports.

   b. Test Procedures. This shall describe the test preconditions and assumptions, the detailed steps to be taken for each test and the verification of results of each step.

   c. The Test Procedures shall include both hardware and software tests and verification of the Historian System. As a minimum the step-by step procedures shall include:

      1) Hardware components and assembly are in accordance with the specifications and the latest Department approved manufacturer drawings.

      2) Redundancy testing.

      3) Software protocols for all external communication ports between the relays or intelligent devices are functional.

      4) Databases are accurate and contain all of the I/O points identified by the Contractor's latest Department approved documents.

      5) Graphical displays are complete and functional.

6) All Inputs and outputs are functional and properly calibrated.

7) Software operating logic for the various systems complies with the requirements of the specifications and the latest Department approved Contractor documents.

8) Ethernet switch networks function correctly.

3. A Pre-Factory Acceptance Test (Pre-FAT) shall be performed by the Contractor to verify that the system as fully integrated complies with all of the required functional details and that the system satisfies the response and resource utilization requirements. The Pre-FAT shall follow completely the test procedures of the FAT Plan reviewed by the Department. The Contractor shall notify the Department for the start date of the Pre-FAT at least four weeks before the test. The Department personnel shall witness the pre-FAT.

4. The Contractor must correct all discrepancies found in the pre-FAT before the Factory Acceptance Test can be started.

5. Department shall witness the actual start of the FAT upon notification by the Contractor that the system is ready for the FAT.

6. The FAT shall be started with a complete system generation performed by the Contractor. After the completion of the system generation, Contractor shall carry out the FAT test procedures.

7. Contractor shall perform the test procedures.

8. The last part of the FAT shall be devoted to the system performance tests using the normal and high-activity loading scenarios.

9. All discrepancies found in the FAT shall be corrected prior to shipment of the system.

B. After the system has been installed a complete loop test shall be performed with no exceptions for the entire input/output database.

C. After the system has been checked out completely on site to the satisfaction of the Department, Contractor shall perform the Site Acceptance Test (SAT). As part of the check-out, the SAT shall be preceded by a system generation of the clean software free of any remaining errors found in the FAT.

1. Essentially the SAT procedures shall be a repeat of the FAT test procedures under actual field conditions. Some of the FAT procedures shall be modified by the Contractor to reflect the field conditions.

2. In general, The Department's personnel will operate all equipment during testing, including the SAT. Contractor will direct and supervise, and be responsible for, all actions of The Department's operating personnel during testing.

3. The Contractor shall develop a detailed SAT procedure document for review and approval by Department prior to commencing with the SAT. The test procedure shall include, but not be limited to, the following:

   a. Dimension and finish checks

   b. Assembly and installation checks against the manufacturer's instructions

   c. Equipment and software functional tests confirming proper operation of the PLC, HMI, and communication systems.

   d. Governor operational tests, including loading and load rejection testing to confirm proper operation of the system.

   e. Exciter system operational tests including load rejection testing to confirm proper operation and interfacing of the system.

   f. Calibration of all transmitters, transducers and indicators.

   g. Operation and functionality test of all control modes, software algorithms and operator inputs.

4. Unless otherwise notified, all testing shall be witnessed by Department. The Contractor shall notify Department, in writing, a minimum of 14 days before the SAT is to proceed. The SAT shall proceed based on the latest Department approved SAT procedure.

5. Appropriate sign off sheets shall be developed for each system tested. Variances shall be noted when the system fails to comply with the specification or the latest Department "approved" Contractor documents. All variances shall be corrected at the Contractor's expense, and the system retested, before the equipment is considered fully commissioned and ready for service.

6. All instruments and test equipment necessary for the complete inspection and testing shall be provided by the Contractor. Calibration certificates for instruments shall be furnished for Department approval and, if required by Department, instruments shall be recalibrated before commencement of the tests.

7. The Contractor shall furnish all special purpose tools and test apparatus essential for the test or repair.

8. Water and electric power for testing will be furnished by the Department.

9. The Contractor shall not test, energize, or pressurize any equipment connected to existing equipment, or connected to equipment furnished by others, without approval from Department. Before testing of any equipment connected to existing equipment, or connected to equipment furnished by others, or installed in areas where others may be working or assembled, the Contractor shall notify all others that such testing is about

to commence and rope off any potentially dangerous areas with yellow "Caution" flagging.

10. A SAT report shall be furnished upon successful completion of all system testing. The report shall contain as a minimum the SAT procedures and test results of all systems.

D. Availability Demonstration

1. The system availability demonstration (AD) shall be performed for a period of 1500 hours starting at the end of the SAT for each controller and for the entire system once all units are in service after all problems have been corrected. Acceptance of the system shall be contingent upon the successful outcome of the availability demonstration.

2. The software at the start of the AD shall be assumed to be 100% reliable, i.e., free of all known errors or defects in functionality and performance.

3. The objective of the AD is to verify that the Average System Availability, A, for a 500-hour period of interest is equal to or better than specified, consistently for three successive time periods.

4. The Average System Availability, A, shall be calculated as:

   A = [1- (Downtime)/(Period of Interest)] x 100

   Where "Downtime" in minutes is defined as the time during which any one or more of the following conditions prevail:

   a. One Operator station is out of service.

   b. One Process LAN out of service.

   c. One or more PLCs out of service.

   d. HMI functions inoperative at one operator console.

   e. System events logging function lost

5. The Average System Availability, A, shall be 99.9% or better. This is equivalent to a downtime not exceeding 30 minutes during a 500-hour period of interest.

6. Within the AD period of 1500 hours, all three values of A for the three 500 hour periods of interest shall satisfy the 99.9% requirement.

7. The recording and accumulation of downtime shall be subject to the following conditions:

   a. Restart and fail over times shall be counted.

   b. Downtime due to software causes and to repair of software shall not be counted. All software errors and discrepancies found during the AD and during the warranty period shall be corrected by the Contractor.

c. Downtime due to Contractor-supplied hardware causes shall be counted and shall be the total time from the occurrence of the failure until the restoration to operation of the function lost.

d. Downtime due to problems in hardware not supplied by the Contractor shall not be counted.

e. Downtime due to undetermined causes shall be counted but will be discounted if later in the demonstration period it can be established as being due to a software problem or a problem in hardware not supplied by the Contractor.

f. Repeatable or self-recurring failures may cause a suspension of the demonstration period. Only the first downtime shall be counted. The demonstration shall be resumed only after the failure has been corrected.

g. Downtime caused by personnel action, which is not related to operation functions shall not be counted.

h. Any reasonable documented travel and make-ready time incurred by the Department's maintenance personnel prior to the start of the diagnosis of the failure shall be excluded from the down time, up to a maximum of 48 hours each time.

i. For every downtime that is discounted or excluded, the same amount shall be discounted from the accumulated time of the period of interest.

8. Rules for Restarting the Availability Demonstration.

a. If at time T, before the adjusted period of interest period has reached 500 hours, the adjusted downtime already exceeds 30 minutes by an amount x, the period of interest may be extended by (x/30) * 500 hours.

b. If the calculated extension exceeds 500 hours, or equivalently if x is 30 minutes or more, the availability test for that period of interest shall be restarted.

c. If the calculated extension is equal to or greater than T, the availability demonstration for that interest period shall be restarted.

9. Repair Procedures.

a. Whenever a failure occurs in any hardware or software component, regardless of whether it causes a downtime or not, the Contractor shall analyze the problem and carry out the necessary repairs. If the Contractor is not successful in locating and/or repairing the problem, the Department shall be notified immediately. The Contractor shall then undertake the diagnosis and repair.

If the failure had caused a downtime condition, the total repair time (diagnosis time plus actual repair time plus time to place the function back in service) shall be counted as downtime. If the

Contractor had not succeeded in locating and repairing the problem, only the repair time of the Contractor shall be counted.

10. Loading Scenarios

    a. The normal loading scenario shall be simulated as follows:

        1) All analog values updated at the specified scan cycles, processed without exception, and updated on the database.

        2) Ten (10) analog alarms occurring every 5 minutes.

        3) One Intelligent Electronic Device communicating with the PLC.

        4) One (1) status change received and alarmed every 5 minutes.

        5) One (1) display call up every 10 seconds on each monitor of all stations, each monitor having four active windows.

        6) All periodic programs in execution.

        7) Online display maintenance in progress.

        8) Trending of four (4) variables in operation.

        9) Offline software maintenance in progress.

        10) Data interchange between the Plant Control System and ECC

    b. The high-activity loading scenario shall be simulated as follows:

        1) Same as normal loading.

        2) Four (4) analog alarms every five (5) per seconds.

        3) Six (6) status alarms every two (2) seconds.

        4) Fifty (50) DI or fifty (50) AI from each PLC, resulting in 600 DI or AI changing status within the first five seconds of the disturbance. Then, one-hundred (100) DI or AI per second changing status for the duration of the first minute. After which normal load shall be assumed.

    c. The performance tests for the high-activity loading scenario shall be repeated for one process LAN out of service.

11. CPU Utilization.

    a. During the performance test with the high-activity loading scenario, the average CPU loading in any of the station servers shall not exceed 30% for a 1-hour period.

12. Memory Utilization.

    a. Memory utilization for PLCs and PCs shall not exceed 30%. The final application software shall not occupy more than 30% of the Controller Station's memory.

13. Response Requirements.

a. The verification of response times for the system shall be made under the following conditions:

1) Process LAN one device out of service or not used

2) High-activity loading scenario in effect.

3) All response time requirements shall be wall-clock times.

b. The time duration from the instant of a status change at the equipment location symbol is updated on a workstation HMI screen shall not exceed 1 sec.

c. The overall call up time of any display, from the instant the mouse is clicked until the requested display is on the monitor complete with all dynamic data, shall have an average value not exceeding 2 sec.

d. The overall time for processing an alarm from the time it is generated in the field until it is updated on the alarm list and on the System Events List, the audible sounded, and the logging initiated, shall not exceed 2 sec.

e. Time-of-day displays on the HMIs shall be as specified in Section 16320 paragraph 2.3.

f. The overall time from the initiation of command at visual display on the operator console to the output terminals of the field controller shall not exceed 1 sec.

14. Periodicity Requirements and Time Synchronization.

a. The following periodicity requirements shall be met under normal loading conditions:

1)	Status-change scan	2 seconds
2)	All closed loop variables	2 seconds
3)	All other analog scan	5 seconds
4)	Serial and IEDs	All scan at 1 minute intervals
5)	Historical Data Recording	As per scan rate
6)	Data update on a window	As per scan rate < 3s
7)	Time-of-day update on a HMI	Section 16320 p 2.4

b. All digital inputs system wide shall be GPS synchronized at 10 ms or better.

15. SYSTEM OVERLOAD

a. The control system shall be designed such that it can withstand severe system overloading or any condition worse than those defined for the high-activity loading scenario. No matter what the overload situation might be, HMI screen call up response times

shall not be affected. All functions shall be operational although degradation in periodicities shall be acceptable. No alarms shall be lost during system overloads.

b. The Contractor shall describe the methods which shall be used to guarantee that during a system overload all critical functions will be operational, HMI screen call up response times shall be within the requirements specified, and no alarms shall be lost.

E. Excitation System Test

1. The Excitation System test shall be as recommended by the manufacturer and as per section 16370.

F. Digital Governing System Tests

1. The digital governing systems shall be tested according to the requirements of section 16380.

G. The Department reserves the right to participate and monitor all installation, testing, troubleshooting and repair activities.

3.4 SPARE PARTS

A. All spare parts shall be of the same material, workmanship, and manufacturer as the corresponding original parts, completely interchangeable and packaged for long-term storage.

B. See individual sections for spare parts lists.

END OF SECTION

SECTION 16310

CONTROL SYSTEM PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section covers the requirements for the Castaic Power Project Control System Panels.

1.2 REFERENCES, SPECIFICATIONS, CODES AND STANDARDS

A. American National Standards Institute (ANSI)

ANSI C39.1	Requirements For Electrical Analog Indicating Instruments

B. Institute of Electrical and Electronics Engineers (IEEE)

IEEE C37.90.1-1989	IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems

C. National Electrical Code (NEC)

NEC-2002	National Electrical Code

1.3 SUBMITTALS

A. Refer to Section 01300 and 16300, for submittal requirements.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Exercise care in transporting and handling to avoid damage to materials.

B. Store materials on the site so as to prevent damage or theft.

C. Keep materials clean, dry, and free from deleterious conditions.

D. Do not store materials directly on the ground.

E. Repair or replace damaged material or equipment to satisfaction of the Department.

F. Protect electrical equipment, controls, and insulation against moisture or water damage.

G. The Contractor shall be responsible for the equipment included in this Contract until it has been finally inspected, tested and accepted in accordance with the requirements of these Specifications.

PART 2 – PRODUCTS

2.1 CONTROL PANELS CONSTRUCTION

A. The control panels shall be of front access, switchboard type construction. The panels shall be free standing and of indoor NEMA-1 type construction.

B. The control panels shall be of the simplex metal enclosed type consisting of stationary front, top and side panels with a hinged front mounted doors to allow access to the interior. The hinges for the doors shall be of the concealed type and shall allow the door to swing through not less than 105° from the closed position. Stops shall be provided to limit the swing and prevent damage to the hinges. The doors shall be furnished with a three point latching mechanism with keys removable in both the locked and unlocked position. The doors shall be provided with gaskets.

C. A continuous copper grounding bus bar not less than 1/4 inch by 1 inch shall be furnished, drilled and tap for ¼ - #20 screws..

D. A fluorescent lighting fixture(s), with on-off switch, shall be provided inside the switchboard and shall be suitably located to provide adequate interior lighting.

E. The control switchboard shall be equipped with a thermostatically controlled strip type space heater rated 115 volt, 1-phase, 60 Hz. The heater circuit shall be provided with a fused disconnect switch or circuit breaker.

F. The finish shall consist of a coat of air-dried enamel applied to clean and phosphatized steel for internal and external parts. Prior to shipment, the completed assemblies shall be given an exterior finish coat of gray enamel ANSI No. 61. The interior surfaces shall be finished white.

G. Nameplates

1. Furnish nameplates for instruments, relays, control switches, push buttons, indicating lights, and other items where the circuit and function of the particular device cannot be otherwise readily determined.

2. Nameplates shall be made of white plastic cut through to a black background. The lettering shall be of a size and design such that it will be legible from reasonable angles of observation and from distances of at least 10 feet.

3. Nameplates shall be screw-retained type.

H. Control Wiring

1. The control panel assembly shall be completely wired, and wires for connections to remote equipment shall be brought to terminal blocks. All wiring shall be neat and workmanlike, without splices and with a uniform arrangement of circuits. Wire bundles or single wires shall run in straight lines with 90° corners, where change of direction is required.

2. Panel wiring, inside the panel, shall be #16 AWG. Wiring shall be UL type, SIS, or MTW, flexible stranded copper, control wire. If wire is exposed to oil it shall be THN. Minimum conductor sizes shall be as follows:

   a. Current transformer circuits: #12 AWG minimum for internal wiring, #8 AWG for external, field wiring.

   b. Potential transformer and control circuits: #16 AWG minimum

   c. Alarm circuits: #16 AWG minimum

   d. Instrument and communication circuits: #18 AWG minimum

   e. Analog inputs shall be shielded triad (RTDs) or twisted pairs.

3. Where possible wiring shall be run in plastic wire duct with covers. Where it is not possible to contain the wiring in the duct, the wiring shall be wrapped with plastic spiral binding. The plastic wire duct and spiral binding shall be as manufactured by the Panduit Company, Hoffman or "approved" equal.

4. Wire bundles crossing hinges shall be securely clamped to both the door and the panel, and run parallel to the hinge for at least half the door length to prevent chafing. No splicing shall be permitted in the wire duct or spiral wrapped wire bundles.

5. The wires connecting the various devices to each other and terminal blocks shall be labeled at both ends with destination codes. Wire labels shall be white heat shrink polyolefin sleeves with black lettering. Wire labels shall be Floy Tag & Manufacturing, Inc. Type FT-200S, or "approved" equal.

6. Terminal blocks for control wiring shall be molded type, with barriers, rated not less than 300 volts, 25 amperes, suitable for conductors ranging between No. 22 and No. 14. White marking strips shall be provided with function codes (abbreviations indication function of the terminal point). Each connected terminal of each block shall have a function code placed on the marking strip with permanent marking fluid. Terminal blocks shall be Entrelec Type M 6/8.STP, or "approved" equal.

7. All terminals for connection to field devices shall be "link" type and have means of disconnecting the field device without removing wiring.

8. Terminal blocks for control power terminations shall be fused type with indicator. Fused terminal blocks shall be Entrelec Type MB 10/22.SFL with 13/32"x 1-1/2" fuse, or "approved" equal.

2.2 CONTROL SWITCHES

A. All control and instrument switches shall be of the rotary switchboard type with handles on the front and the operating mechanisms on the rear of the panel. Contacts of all switches shall be self-aligning and shall operate with wiping action. A positive means of maintaining high pressure on closed contacts shall be provided. The rear switch covers or plates shall be readily removable for inspection of contacts. Switches shall be Electro Switch Type 24, or equal.

B. The switch legend plates shall be engraved as shown on the Department approved Contractor Drawings.

2.3 PUSHBUTTONS

A. All pushbuttons shall be round, oiltight, heavy-duty type units. Pushbuttons shall be Allen-Bradley Type 800T, Cutler-Hammer or "approved" equal.

B. The pushbutton legend plates shall be engraved as shown on the "approved" Contractor Drawings.

2.4 INDICATING LIGHTS

A. Indicating lamp assemblies shall be LED assemblies of the switchboard type, suitable for 125 V dc service, with appropriate color caps and integrally mounted resistors. The LED lamps shall be replaceable from the front of the panel. All color caps shall be interchangeable, and all LED lamps shall be of the same type and rating. The lamp assemblies shall be GE Type ET-16-LED or "approved" equal.

B. The lamp legend plates shall be engraved as shown on the Department "approved" Contractor Drawings.

2.5 AUXILIARY RELAYS

A. Auxiliary control relays shall be vibration and shock resistant industrial type relays, and shall be rated for operation at 120 V ac or 24 V dc or 125 V dc, as required. Auxiliary relays shall be Potter and Brumfield Series KRP-3DH or approved equal.

2.6 SIGNAL CONDITIONERS

A. All shared analog signals shall be provided with isolated signal splitters.

B. Single and Dual Channel DC Isolator

The device shall have the following features:

1. Signal Input: 0-20mA, 4-20mA, 0-10VDC, ±10 VDC, thermocouple, RTD or as required.

2. Signal Output: one (single) or two (dual) isolated 4-20mA DC.

3. Relay Outputs: two DPDT (form C) contacts with two independent set points

4. Supply Voltage: 24 VDC

5. Protected against ground loops, high voltages and current spikes.

6. The minimum isolation from input to output, and channel to channel shall be 600VDC.

7. Outputs protected from reverse polarity.

8. Zero and span potentiometers for each channel to calibrate the output to the input source.

9. Each channel shall be 24VDC output-side loop powered.

10. Standard rail mounting.

11. Manufacturer and Model: Phoenix Contact, Action Instruments, Moore Industries or approved equal.

2.7 POWER SUPPLIES AND DISTRIBUTION CIRCUIT BREAKERS

A. The power supplies for 24V dc requirements shall be switching type power supplies. The power supplies shall be rated for 105 to 145 volts dc input and 24 volts dc, output with +/-1% load regulation from 10% load to full load. The power supplies shall be Absopulse Electronics Ltd., or "approved" equal. All power supplies shall be redundant. Failure of one power supply shall not interrupt 24V dc power to the PLC and auxiliary controls.

B. All circuits shall be provided with individual DIN rail mounted mini circuit breakers.

2.8 OTHER REQUIREMENTS

A. Each Control System panel shall have one spare RJ45 Ethernet network port for laptop connection.

PART 3 - EXECUTION

3.1 GENERAL

A. The panel shall be interfaced with the powerhouse equipment per the Department "approved" Contractor installation Drawings and instructions.

3.2 TESTING

A. Refer to Section 16300 for factory and site testing requirements.

3.3 INSTALLATION (NOT USED)

3.4 SPARE PARTS

A. All spare parts shall be of the same material, workmanship, and manufacturer as the corresponding original parts, completely interchangeable and packaged for long-term storage.

END OF SECTION

SECTION 16315

BAY CONTROLLER PANELS AND DOORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section covers the requirements for the Castaic Power Project 4160 V Unit and Station Service Switchgear Doors.

B. A total of 38 doors shall be fabricated; 16 doors for the Unit Service switchgear (4 per unit) and 22 doors for Station Service switchgear.

1.2 REFERENCES, SPECIFICATIONS, CODES AND STANDARDS

A. American National Standards Institute (ANSI)

ANSI C39.1	Requirements For Electrical Analog Indicating Instruments

B. Institute of Electrical and Electronics Engineers (IEEE)

IEEE C37.90.1-1989	IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems

C. National Electrical Code (NEC)

NEC-2002	National Electrical Code

1.3 SUBMITTALS

A. Refer to Section 01300 and 16300, for submittal requirements.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Exercise care in transporting and handling to avoid damage to materials.

B. Store materials on the site so as to prevent damage or theft.

C. Keep materials clean, dry, and free from deleterious conditions.

D. Do not store materials directly on the ground.

E. Repair or replace damaged material or equipment to satisfaction of the Department.

F. Protect electrical equipment, controls, and insulation against moisture or water damage.

G. The Contractor shall be responsible for the equipment included in this Contract until it has been finally inspected, tested and accepted in accordance with the requirements of these Specifications.

PART 2 – PRODUCTS

2.1 4160 V UNIT SWITCHGEAR DOORS

A. Door Construction

The Contractor shall furnish replacement doors with bay controller relays for all 4160V Unit Switchgear Sections. The doors shall include hinges and shall fit the switchgear without modifications at the site. Contractor shall verify door dimensions and hinge locations at the site prior to fabrication. Unit 6 shall be used as a reference for the Unit 4.16 kV switchgear. All doors shall include a three point latching system with a lockable handle.

B. Bay Controller

Each door shall include a numerical multifunction bay controller with syncheck. Bay controller shall be Siemens 7SJ6415-4EC92-3FE4d/CC+LOA, no substitute. All existing control and protection schemes shall be maintained for each position.

C. Switches

1. All control and instrument switches shall be of the rotary switchboard type with handles on the front and the operating mechanisms on the rear of the panel. Contacts of all switches shall be self-aligning and shall operate with wiping action. A positive means of maintaining high pressure on closed contacts shall be provided. The rear switch covers or plates shall be readily removable for inspection of contacts. Switches shall be Electro Switch Type 24, or equal.

2. The switch legend plates shall be engraved as shown on the Department approved Contractor Drawings.

D. Indicating lights

1. Indicating lamp assemblies shall be LED assemblies of the switchboard type, suitable for 125 V dc service, with appropriate color caps and integrally mounted resistors. The LED lamps shall be replaceable from the front of the panel. All color caps shall be interchangeable, and all LED lamps shall be of the same type and rating. The lamp assemblies shall be GE Type ET-16-LED or "approved" equal.

2. The lamp legend plates shall be engraved as shown on the Department "approved" Contractor Drawings.

E. Test Switches

1. Test switches shall be Flexitest Type ABB 129A501G01A for currents and ABB 129A501G01A for potential. All test switches shall include removable cover.

F. Wiring

1. The 4160 V bay controller door assembly shall be completely wired, and wires for connections to remote equipment shall be brought to terminal blocks. All wiring shall be neat and workmanlike, without splices and with a uniform arrangement of circuits. Wire bundles or single wires shall run in straight lines with 90° corners, where change of direction is required.

2. Panel wiring, inside the panel, shall be #16 AWG. Wiring shall be UL type, SIS, or MTW, flexible stranded copper, control wire. If wire is exposed to oil it shall be THN. Minimum conductor sizes shall be as follows:

   a. Current transformer circuits: #12 AWG minimum for panel wiring, #8 AWG for external field wiring.

   b. Potential transformer and control circuits: #16 AWG minimum

   c. Alarm circuits: #16 AWG minimum

   d. Instrument and communication circuits: #18 AWG minimum

   e. Analog inputs shall be shielded triad (RTDs) or twisted pairs.

3. Wiring shall be neatly bundled and tie wrapped.

4. Wire bundles crossing hinges shall be securely clamped to both the door and the panel, and run parallel to the hinge for at least half the door length to prevent chafing. No splicing shall be permitted in the wire duct or spiral wrapped wire bundles.

5. The wires connecting the various devices to each other and terminal blocks shall be labeled at both ends with destination codes. Wire labels shall be white heat shrink polyolefin sleeves with black lettering. Wire labels shall be Floy Tag & Manufacturing, Inc. Type FT-200S, or "approved" equal.

6. Terminal blocks shall be Department standard States Type ZWM-250 sliding link terminals.

7. All terminals for connection to field devices shall be "link" type and have means of disconnecting the field device without removing wiring.

G. Finish

1. The finish shall consist of a coat of air-dried enamel applied to clean and phosphatized steel for internal and external parts. The panels shall be given an exterior finish coat of gray enamel ANSI No. 61.

2.2 DRAWINGS

A. DRAWINGS – 4160 V UNIT SWITCHGEAR DOORS

2.3 OTHER REQUIREMENTS

PART 3 - EXECUTION

3.1 GENERAL

A. The panel shall be interfaced with the powerhouse equipment per the Department "approved" Contractor installation Drawings and instructions.

3.2 TESTING

A. Refer to Section 16300 for factory and site testing requirements.

3.3 INSTALLATION (NOT USED)

3.4 SPARE PARTS

A. All spare parts shall be of the same material, workmanship, and manufacturer as the corresponding original parts, completely interchangeable and packaged for long-term storage.

END OF SECTION

SECTION 16320

DATA ACQUISITION AND CONTROL SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section covers the requirements for the Castaic Power Plant Data Acquisition system.

1.2 REFERENCES, SPECIFICATIONS, CODES AND STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

IEEE 802.3 Standard for Information technology--Local

B. National Electrical Manufacturers Association (NEMA)

C. National Electrical Code (NEC)

NEC-2005 National Electrical Code

1.3 SUBMITTALS

A. Refer to Sections 01300 and 16300 for submittal requirements.

1.4 REFERENCE SECTIONS

A. SECTION 16360 PROCESS NETWORKS

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Exercise care in transporting and handling to avoid damage to materials.

B. Store materials on the site so as to prevent damage or theft.

C. Keep materials clean, dry, and free from deleterious conditions.

D. Do not store materials directly on the ground.

E. Repair or replace damaged material or equipment to satisfaction of the Department.

F. Protect electrical equipment, controls, and insulation against moisture or water damage.

G. The Contractor shall be responsible for the equipment included in this Contract until it has been finally inspected, tested and accepted in accordance with the requirements of these Specifications.

PART 2 – PRODUCTS

2.1 CONTROLLER STATIONS HARDWARE.

A. General Requirements.

1. The Controller Stations (CS) shall be redundant, PLC based, and shall include main and auxiliary memory, local HMI or OIT as required, interfaces with intelligent devices such as Exciter and Bay Controllers, and LAN interfaces. The Controller Stations shall be as described in Section 16300.

2. The CS shall be open architecture, use standard off the shelf PLC's, operating system and hardware components.

3. Each CS shall be a standalone system, designed to operate totally independent from other drops in the Plant Control System. Therefore, all functions shall be available in the CS drop at any time whether the Plant Process Control Network is in service or not.

4. The following level of redundancy shall be provided: redundant CPU's; redundant power supplies; redundant communication processors. No redundancy is required for input-output modules.

5. The CS shall allow for easy switching between the active and the stand by CPU. The stand by CPU should allow replacement under power conditions without shutting down the station and without affecting the performance of the controller station.

6. All CPU's and other intelligent modules shall be provided with flash memory cards to hold the up-to-date application programming without a need for a module battery backup.

7. The CS shall communicate with input-output modules, multifunction meter modules, and microprocessor-based controllers using industry-standard communication protocols. All components shall be seamlessly integrated in the Plant Control system.

8. The CS shall communicate with other drops in the system over the Process Control Networks (Unit and Plants), using industry-standard communication protocol

9. All CS functions shall be programmed in IEC61131 compliant language.

10. The CS shall have on-line, self-checking diagnostic routines periodically checking each component in the architecture. Error conditions shall identify the area where the malfunction is located and the specific problem shall be reported to the operator on a dedicated screen.

11. The CS shall have digital interface using industry standard protocols as a minimum for the turbine governor and generator excitation systems.

12. Each CS shall have the capability of automatic start-up and initialization following restoration of power after an outage without manual intervention. All restarts shall be reported to the operator.

13. Software maintenance activities shall not affect any drop in the system. All compilers, utilities, management software, and storage media required for software maintenance shall be provided.

14. The CS shall have the necessary processing power, memory, and peripheral facilities to accommodate the software tools and application software as described in this section. The final application software shall not occupy more than 30% of the PLC and PC memory.

15. Time Synchronization.

    a. The CS shall periodically synchronize their clock time using the standard time signal transmitted by the existing GPS Time-Frequency System.

    b. The periodicity of the time synchronization shall be effective enough such that the CS times are within 1 millisecond of one another, plant wide.

B. Input/Output Modules.

1. General.

    a. Each CS shall be provided with a system of input-output modules (local or remote), instrumentation bus, and power supplies.

    b. All input-output modules shall be of "hot-swappable" type, to allow for replacement under power, while the CS is running. The replacement of a module shall not cause downtime for the CPU and the other modules.

    c. The input-output modules and power supplies shall meet the Surge Withstand Capability standards as defined by IEC or ANSI/IEEE.

    d. Redundant power supplies shall power input-output modules. Each power supply shall be fed from a different AC supply. The loss of a single power supply shall not cause the loss of any input-output module and shall alarm the operator.

e. The Contractor shall provide a minimum of 25% spare capacity of input-output modules for each type used, installed, and wired to be verified when the equipment is approved for shipping after the Factory Acceptance Test.

2. Digital Input Modules.

   a. Digital input modules shall accept normally open or normally closed dry contacts for status and sequence-of-events inputs. All digital inputs shall include optical isolators and filtering to eliminate contact bounce.

   b. The digital input module shall accept bi-stable and momentary-change inputs. Circuit breaker status and switch positions are bi-stable inputs. Equipment alarms and protective relay operations are momentary-change inputs.

   c. Protective relay operations, including electrical and mechanical protective devices, shall be processed as momentary-change inputs that shall be detected within the resolution window specified in Section 16300, but not to exceed 10 (±5) ms, system wide.

3. Pulse Input Modules.

   a. The pulsed input modules shall count binary impulses and increase or decrease a counter register.

   b. The pulsed input module shall maintain one 32-bit binary register for each input.

4. Analog Input Modules.

   a. The analog input modules shall accept and process transducer voltage signals in the range of ± 10-V DC or current signals in the range of ±20 mA DC.

   b. All inputs shall be optically isolated.

   c. The analog input processing shall include filtering, scaling, and A/D conversion with a 12-bit 2's complement resolution.

   d. Accuracy shall be at least ±0.05% and linearity ±2 LSB over the full input range and temperature range.

5. Resistance Temperature Detector (RTD) Input Modules.

   a. The RTD input modules shall have the capability of interfacing with Platinum or Copper RTDs.

   b. The RTD input module shall have a resolution of 16 bits.

6. Control Output Modules.

   a. The control output modules shall support both: maintained or pulse (momentary) outputs.

b. All outputs shall use heavy duty interposing relays with two Form-C contacts rated at 3-A inductive at 240-V DC.

c. The Contractors shall be responsible for the proper settings of the pulse controls (duration and/or number of pulses) to achieve the desired control objectives.

7. Instrumentation Bus.

a. The Instrumentation Bus shall be designed in accordance with industry-standard IEC61850 over Ethernet.

8. Communications Media. The communications media for external (outside CS cabinet) communication links shall be fiber optics. The communications media for internal (inside CS cabinet) communication links may be copper.

9. Physical Requirements. The CS shall be housed in a standard electronic equipment cabinet with a window door, as specified in Section 16310.

10. Power Requirements. The CS shall be suitable for operation from a 125-VDC power source.

2.2 CONTROLLER STATIONS SOFTWARE SYSTEM

A. Maintenance Facilities.

1. Each CS shall be provided with maintenance facilities to allow the users to configure the database and program any functions using a portable personal computer or the Engineering workstation connected through:

a. Network

b. Serial port

c. Remotely via modem

2. The maintenance facilities shall be password protected and shall contain the option for a dial back security when in dial-up mode. When connected by dial-up modem, the CS shall protect itself from repeated attempts to enter erroneous passwords.

B. Configuration System.

1. The CS shall be provided with a Windows-based configuration system, which shall include all the necessary software to configure and program any function in the CS.

2. The configuration system shall be installed on the portable PCs and the Engineering workstations.

3. The configuration system shall allow downloading and uploading of configuration data files.

4. The configuration system shall program, download, debug and store programmable algorithms.

C. Programming Language.

1. The programming package shall be an industry standard package IEC 61131 compliant and shall be totally integrated with the Plant Control System software. No special database shall be required for the implementation of control programs. The control programs shall use ladder diagrams; function block diagrams, sequential function charts, structured text, instruction lists, process control language, and C++ based routines. Programs shall be self-documenting. The programming package shall support on-line and off-line development, off-line simulation, documentation and reporting capabilities.

D. Naming Conventions

1. All input, output and soft points shall be named in accordance with the naming conventions shown on the bid drawings.

2.3 CONTROLLER STATIONS FUNCTIONS

A. Data Acquisition

1. The CS shall continuously scan and process the information from input-output modules, and intelligent devices. The information shall be available system-wide and shall be displayed, integrated into the control logic, logged, trended, alarmed, integrated into operator displays, and communicated to other computer systems.

2. Digital status inputs shall be processed for changes from the previous status.

3. All digital input changes shall be collected, correlated and time tagged.

4. Pulse accumulators and analog values shall be read, converted to engineering units, and stored periodically.

B. The Contractor is responsible for verifying and implementing the correct control algorithms.

C. Unit Level Applications.

1. The CS shall be capable of performing discrete, continuous, and sequential controls. The CS shall respond to control commands from Operator Stations. Control commands shall be open-close, raise-lower, setpoint control, and sequential control. The open-close control

commands shall be used for the direct opening or closing of circuit breakers, switches, valves and other two-position devices. Setpoint control shall be used as inputs for generation control. Sequential controls shall be used for the unit automatic start and automatic stop sequences.

2. The programming for the operating modes shall reside in the individual unit controller stations. The common programming and the programming to replace the hardwired pump control bench shall reside in the switchyard controller station.

3. Logic diagrams for the majority of the control modes as in the Non Modernized and Modernized Unit Drawing sections. These logic diagrams are provided as a reference only. The Contractor shall verify and update the diagrams as required for the implementation of the control functions.

4. Operating Modes Units 1 through 6

   a. Generator Mode: In this mode the unit can be connected to the network and provide energy to the system using the aqueduct water flow. The unit running in this mode could be transitioned to synchronous condense mode.

   b. Synchronous Condense Mode: In this mode the unit can be connected to the network and provide reactive control to the system. This mode is only available in the generator rotation direction. The unit running in this mode could be transitioned to generator mode.

   c. Pump Synchronous Starting Mode: In this mode the unit can be connected to another unit in pump mode for synchronous starting. The unit running in this mode could be transitioned to generator mode.

   d. Pump Mode: In this mode the unit can be started using a pump synchronous starting unit and connected to the power system. The unit running in this mode cannot be transitioned to any other mode.

   e. Cold Start Mode: In this mode the unit can be started without an external AC supply to the grid and without a station service supply.

5. Operating Modes Unit 7

   a. Generator Mode: In this mode the unit can be connected to the network and provide energy to the system using the aqueduct water flow. The unit running in this mode could be transitioned to synchronous condense mode.

   b. Synchronous Condense Mode: In this mode the unit can be connected to the network and provide reactive control to the system. This mode is only available in the generator rotation

direction. The unit running in this mode could be transitioned to generator mode.

c. Pump Synchronous Starting Mode: In this mode the unit can be connected to another unit in pump mode for synchronous starting. The unit running in this mode could be transitioned to generator mode.

d. Cold Start Mode: In this mode the unit can be started without an external AC supply to the grid and without a station service supply.

6. Unit Control Sequencing. The unit control system currently in place on Units 2 and 6 utilize Sequential Functions Charts (SFC's) and Continuous Function Charts (CFC's). Information on these are provided in the Modernized Unit Drawing sections as a reference. The Contractor shall confirm the accuracy of this documentation with the program currently installed. The Contractor shall maintain the same overall organization of the existing SFC's and CFC's, with enhancements. Information on the enhancements is provided in Section 01012.

a. Initiation of any sequence, for any unit, shall be possible from any Unit Control workstation.

b. The following is a listing of the possible operating modes for Units 2 and 6.

1) Available/Stop
2) Ready to Start
3) Speed No Load, Sync Off
4) Generation Mode
5) Condense Mode
6) Pump Ready
7) Pump Ready to Start
8) Pump Mode
9) Pump Start Ready to Start
10) Pump Start
11) Pump Start Hold
12) Cold Start Ready to Start
13) Generator Cold Start

c. The following SFC's provide transition between the above mentioned modes.

1) SFC 1
2) SFC 2

3) SFC 3
4) SFC 4
5) SFC 5
6) SFC 6
7) SFC 7
8) SFC 9
9) SFC 10
10) SFC 11
11) SFC 12
12) SFC 13
13) SFC 14
14) SFC 15
15) SFC 16
16) SFC 17
17) SFC 18
18) SFC 20
19) SFC 21
20) SFC 22
21) SFC 24

D. Individual Control of MW Generation.

1. CS shall have the software for executing MW setpoint controls entered manually by the operator at any of the operator stations or HMI's. The setpoint control software shall be a closed loop, proportional-integral controller of the generator MW output.

2. The setpoint control software shall compare the MW setpoint with the actual generation output. The control error shall be smoothed and fed into a PI controller to determine the control requirement. The control requirement shall be converted into raise or lower pulses to drive the generation to the desired setpoint by transmitting the setpoint value to the digital governor controller.

3. The setpoint control algorithm shall respect the maximum and minimum operating limits of the generating unit that shall be calculated dynamically in the CS. The operating limits shall be calculated using the turbine efficiency curves. The setpoint control algorithm shall also respect the maximum and minimum loading rate limit, and governor deadband. These limits shall be modifiable by the operator to reflect actual operating conditions and shall reside in the CS.

4. The setpoint control algorithm shall support ramp rates. Ramp rates shall be transmitted from the HMI by the Operator or from ECC.

5. The setpoint control algorithm shall be designed to be suspended or activated by the operator or control software.

6. The setpoint control algorithm shall always operate with the last setpoint value received by the CS. The setpoint value stored at the CS shall be replaced only when a new value is received.

E. Individual Control of MVAR/Voltage Generation.

1. The CS shall have the software for executing MVAR/Voltage setpoint manually entered by the operator at any of the operator stations or HMI's. The setpoint control software shall be a closed loop, proportional-integral controller of the generator MVAR/VOLTAGE output.

2. The setpoint control software shall compare the MVAR/VOLTAGE setpoint with the actual generation output. The control error shall be smoothed and fed into a PI controller to determine the control requirement. The control requirement shall be converted into raise/lower pulses to drive the generation to the desired setpoint by transmitting the setpoint value to the digital excitation controller. The algorithms shall be capable of executing ramp control.

3. The setpoint control algorithm shall respect the maximum and minimum reactive power limits of the generating unit that shall be calculated dynamically in the CS. Reactive power limits shall be calculated using the generator capability curves. These limits shall be modifiable by the Operator to reflect actual operating conditions and shall reside in the CS.

4. The setpoint control algorithm shall support ramp rates. Ramp rates shall be transmitted from the HMI by the Operator or from ECC.

5. The setpoint control algorithm shall be designed to be suspended or activated by the operator or control software.

6. The setpoint control algorithm shall always operate with the last setpoint value received by the CS. The setpoint value stored at the CS shall be replaced only when a new value is received.

F. Penstock Shutoff Valve (PSOV)

1. The penstock shutoff valves shall normally be kept open and shall be closed either by local controls, or by the new control system.

2. The new control system shall replace the existing PSOV controller with Allen-Bradley based remote I/O and allow for PSOVs closing from the operator interface panel (OIT) at the South Portal Control Building or the main control room. The remote I/O will be controlled from the new Balance of Plant Controller. The OIT will be connected to the control

system network such that it can communicate over redundant fiber/wireless communications to the new Balance of Plant Controller. Confirmation of the close command shall be implemented and the close command shall be issued after a preset delay to allow the operator to cancel the closing. The existing manual individual valve trip block and global trip block switches must remain functional in the South Portal Control building to inhibit close commands from the new control system.

3. In case of PSOV system failure each unit shall be tripped remotely from the Balance of Plant controller based on status from the new remote I/O located in the South Portal Control Building. When a PSOV loses the open limit switch and starts to close, a trip command shall be sent from the Balance of Plant controller to the respective unit controller to initiate an 86M trip. The trip signal shall be sent through the redundant fiber instrumentation bus from Balance of Plant controller to Unit Controller. Commands and status between the Balance of Plant and new remote I/O located in South Portal Control Building will continue to utilize the redundant communication channels (radio and fiber).

4. Instantaneous penstock flows shall be monitored and accumulated flows for generating and pumping shall be calculated.

5. Alarms for the PSOV system shall be displayed on unit specific penstock overview screens. The existing alarms shall remain.

6. The existing PSOV control system shall remain in operation during the installation of the new Unit Control and Balance of Plant systems.

G. Turbine Shutoff Valve (TSOV)

1. The control system shall provide all control functions for operation of the TSOV including: opening; closing; control of the seals, bypass, and wicket gate leakage makeup valves.

2. Control Modes

   a. Local – Manual Mode. This mode shall utilize the hardwired controls, when the local/remote switch is in local mode.

   b. Remote – Manual Mode. This mode shall allow an operator to open and close valves, start, stop, and control TSOV auxiliaries via the local operator interface terminal located on the TSOV control cubicle.

   c. Local – Auto Mode. This mode shall allow an operator to automatically open and close the TSOV from the local operator interface terminal utilizing the automatic sequencing logic residing in each TSOV PLC.

   d. Remote – Auto. This mode shall allow an operator to automatically open and close the TSOV from the HMI terminals utilizing the automatic sequencing logic residing in each TSOV PLC.

H. Other Unit Auxiliary Systems

1. Draft Tube Depression and Exhaust System. The draft tube depression and exhaust system provides control over water depression air valves, water exhaust air valves, and water drain valves for units 1 to 6. The system has two control locations: local control and central control. In the central control it can be controlled automatically by the sequences or by a manual (discrete) means. The unit controller interfaces this system when it is in central control. The system has the following modes:

   a. Generator to Spin - This mode is active when the unit is running as a generator and is transitioning to condenser mode. This situation occurs during the Condense Mode start and the Generator to Condense Mode transition. This logic opens the air admission valves, and the drain valves. The operation of these valves is interlocked with unit and TSOV signals, specified gate position values, pressures, and draft tube water levels.

   b. Spin to Generator Mode - This mode is active when the unit is running as a synchronous condenser and is transitioning to generator mode. This situation occurs during the Condense to Generator Mode transition. This logic opens the air exhaust valves. The operation of these valves is interlocked with unit and TSOV signals, pressures, and draft tube water levels.

   c. Spin to Stop - This mode is active when the unit is running as a synchronous condenser and is transitioning to unit stopped. This logic opens the air exhaust valves, and the runner band drain. The operation of these valves is interlocked with unit and TSOV signals, pressures, and draft tube water levels.

   d. Pump. This mode is active when the unit is running as a pump, and is divided in two parts: pump starting (before circuit breaker closes) and pump priming (after the circuit breaker closes). The first part is a dewatering process, opens the air admission valves (the draft tube air admission valve remains closed), and opens the turbine depression drain valves. The operation of these valves is interlocked with unit and TSOV signals, pressures, and draft tube water levels for pump depression. The second part is an exhaust process, closes the air admission valves and turbine drain valves, and opens the air exhaust valves until the priming pressure is reach. The operation of these valves is interlocked with unit and TSOV signals, pressures for pump priming.

   e. Partial Load Air Injection - This mode is active in generator start and condense start sequences, when the wicket gate opening is between 10% and 60% open it opens the draft tube air admission valve, injecting air into the draft tube to smooth the unit.

2. Cooling Water System - The unit cooling water system provides control over unit cooling water pump, turbine cooling water booster pumps. This system is part of the unit auxiliary services, and is active from unit start

until the unit returns to standstill state. The system has two control locations: local control and central control. In the central control it can be controlled automatically (start/stop) by the sequences or by a manual (discrete) means. The unit controller interfaces this system when it is in central control. The system monitors the pump current, the water flow and temperature. The points are described in the I/O database. An auto cleaning strainer is provided at the outlet of the unit cooling water pump. The system monitors the differential pressure between both sides of the strainer. For the shaft seal ("Tyton" seal) a domestic water supply is provided. The system monitors the flow and pressure of this cooling water line before to enter to the seal. A standby cooling water pump that can feed the unit cooling water system is available if the unit pump is not in service. The operation of this pump is local-manual.

3. Generator Lower Guide and Thrust Bearing Lubrication System. The unit generator lower guide and thrust bearing lubrication system has three high pressure lubrication pumps: one main AC pump and two backup DC pumps. The system has two control locations: local control and central control. In the central control it can be controlled automatically (start/stop) by the sequences or by a manual (discrete) means. The unit controller interfaces this system when it is in central control. This system is part of the auxiliary systems, and is active during normal operation, and during in acceleration and deceleration procedures.

4. Generator Upper Guide Bearing Lubrication System. The unit generator upper guide bearing lubrication system has two control locations: local control and central control. In the central control it can be controlled automatically (start/stop) by the sequences or by a manual (discrete) means. The unit controller interfaces this system when it is in central control. This system is part of the auxiliary systems, and is active from unit start until unit returns to standstill state.

5. Generator Brakes System. The unit generator brakes system function is decelerate the unit to standstill, and maintain the unit stopped until a start process gets initiated. The system has two control locations: local at governor cabinet and central control. In the local position the brakes can be set in manual or automatic mode. In the central control it can be controlled automatically (apply/release) by the sequences or by a manual (discrete) means. This system is active in deceleration procedures only when the unit speed is below a predetermined brakes maximum speed. When they are automatically controlled by the sequence, the brakes are applied continuously when the speed goes below a specified speed.

6. Phase Reversal Switch. The phase reversal system allows the unit generator to change the rotation direction. The system has two control locations: local control and central control. In the central control it can be controlled automatically (generator/pump/open) by the sequences or by a manual (discrete) means. The unit controller interfaces this system when it is in central control. This system is active when the unit is stopped.

7. Unit 4160 V Switchgear. The Unit 4160 V switchgear is the main supply for the unit 480 V power center and the excitation. The switchgear consists in four breakers, two of them connected to a bus feed from the 4160 V Station Service switchgear, and the other two connected to a bus feed from the unit auxiliary transformer. The breakers can be controlled automatically (open/close) by the sequences or by a manual (discrete) means.

I. Balance of Plant

1. The station service monitoring routine shall be designed to control and give alarm and operating messages to the operator for all possible fault conditions in the automatic operation of the station service equipment.

J. Switchyard Coordination Routines.

1. The switchyard monitoring and control routines shall be designed to give alarms and operating messages to the operator for all possible fault conditions in the operation of the switchyard. The routines shall include but are not limited to:

   a. Control, Status and alarms for the 230kV circuit breakers.

   b. Control, Status and alarms for the 230kV motor operated disconnect switches (MODs).

   c. Status and alarms for the 230kV manual disconnect and ground switches.

   d. Units, Lines, Bus and Station Service transformers parameters (Current, Voltages and Power).

   e. Other routines:

      1) Initial Input Conditions evaluation for Unit 7 - This logic evaluates the initial conditions for the hardwired Unit 7. This logic shall be decommissioned when the unit is modernized.

      2) Substation Configuration Evaluation -. This logic shall be able to determine based on the unit and bus selection done by the operator, if the configuration of the switchyard allows the pump starting process, and which are the position requisites for the breakers, disconnect and ground switches (manual and motor operated). This logic also shall include a status evaluation for each breaker.

      3) Substation Status and commands for Pump Starting Control.

      4) Auto-Synchronizer - The purpose of this logic is to provide the interconnection between the unit auto-synchronizer and the exciter and the governor. In normal use (no pump starting), it will connect the devices from the same unit. When the Pump Starting Control logic is running, it will

connect the pump auto-synchronizer with the starter's exciter and governor.

K. Pump Starting Control (Starter and Pump Coordination). This control function covers all necessary routines that coordinate the pump starting process: synchronize the start control sequence between a unit in pump starter mode with a unit in pump mode. This function shall replace all the functions provided by the existing Pump Starting Panel.

L. Information Interchange with Other Drops.

1. The information interchange with other drops in the Plant Control system shall be over the Plant and Unit Process Control Networks and shall use industry standard communication protocols. Access to real time and historical data shall be via standard open access formats such as NetDDE and ODBC.

M. Information Interchange with Intelligent Devices.

1. The information interchanges between the CS and intelligent devices shall be via an industry-standard protocols or instrumentation bus.

2. Excitation System. The interface with the existing Excitation systems shall be via redundant Industrial Ethernet based network. Redundant Industrial Ethernet communication modules shall be installed in each unit controller. The information interchange with the Excitation system controller shall be designed to handle the signals included in the Database as excitation associated points (signals related to Excitation Cabinet)

3. Turbine Governor. For detailed description of the turbine governor see section 16380. The digital governor shall be directly connected to the redundant Unit Process Control Network.

4. Bay Controllers: The interface with the existing Switchyard, Station Service and Unit Switchgear Bay Controllers shall be via redundant fiber optic communication using one of the standard protocols supported by the devices (IEC61850, Modbus RTU, and DNP 3.0 over Industrial Ethernet). The configuration and programming of these devices shall be done by the Contractor following the parameters provided by the Protection Department of LADWP.

N. Information Interchange with Energy Control Center

1. For detailed description of the ECC data interchange see Section 16340.

O. Software Interlocks and Trips

1. Software interlocks and trips shall be implemented as required for the safe operation of the units and the balance of plant equipment in addition to the hardwired interlocks and trips.

2.4 TIME STANDARD SYSTEM

A. The Plant Control System is provided with an existing GPS satellite synchronized clock to maintain the time reference. The time standard shall be True Time Synchronized Clock.

B. The time standard shall be provided with direct interfaces to the Plant and Unit Control Networks independently.

C. Provisions for IRIG time synchronization connections to the unit and plant protective relays shall be made.

D. NTP Client/Server hierarchical time distribution is allowed, however no SNTP clients are acceptable for time synchronization for controllers, HMI's, Workstations, Servers or any other device that provide control, protection, historian or network management functions in the system. NTP Client shall make a transaction with its server over its polling interval. The polling interval shall be dynamically adjusted between 64 to 1024 seconds.

E. Clock synchronization shall not have an error greater than 1/10 of the timestamp resolution.

F. No domain time synchronization shall be used for the Windows computers as a primary time synch method.

2.5 METER DISPLAY

A. General Requirements.

1. The new Unit Control System and HMI network shall display data provided by the existing ION meters (model 7500) located in the Relay Room on El. 1577'. The ION meter monitors unit power, aux bank power and penstock water flow. For unit power, there are direct PT and CT inputs into each ION meter. Auxiliary Transformer Power is derived in the Unit Controller, and sent to the ION meter via a 4-20 mA signal. Penstock flow is input into the PSOV cabinet, sent to the CCS-2 cabinet, and cabled from there to the ION meter via a 4-20 mA signal. All existing signal cabling shall remain intact throughout the control system integration.

2. The preferred method of acquiring ION meter data is through a soft connection. The contractor shall utilize the existing meter's RS-232 port and Modbus RTU protocol to acquire this data. Refer to section 16360 for a description of requirements for RS232 to Fiber Media converters.

3. The following measurements shall be monitored and displayed on the HMI system.

   a. Frequency.

   b. Power Factor

c. Current RMS (A)

d. Voltage RMS (kV)

e. Apparent Power RMS (MVA)

f. Active Power RMS (MW)

g. Reactive Power RMS (MVAR)

h. Apparent Energy bidirectional (MVA)

i. Active (Real) Energy bidirectional (MWh)

j. Reactive four-quadrant energy (MVARh)

4. At a minimum the following calculations shall be implemented:

   a. Current: demand, minimum and maximum.

   b. Voltage: demand, minimum and maximum

   c. Apparent Power: demand, minimum and maximum.

   d. Active Power: demand, minimum and maximum.

   e. Reactive Power: demand, minimum and maximum.

PART 3 - EXECUTION

3.1 GENERAL

A. The system programmer shall be experienced in this type programming and have a minimum of 5 years experience in programming similar type systems. The screen graphics shall match as close as possible the actual device(s) arrangement being controlled.

B. Review meetings shall be setup between the Contractor, the Department, and Engineers to coordinate the various HMI screen control, monitoring, and arrangement details. The meetings shall be held at the Department's office. As a minimum the following meetings shall take place:

   1. Pre-design meeting to define the initial scope details for the various screen content and arrangement requirements.

   2. Review meeting at 50% design.

   3. Review meeting at 75% design

   4. Review meeting at 100% design

3.2 TESTING

A. Refer to Section 16300 for shop and field-testing requirements.

3.3 INSTALLATION

A. The design shall provide for installation that conforms to the manufacturer's requirements, the requirements of the NEC-2005, and the Technical Specifications.

3.4 SPARE PARTS

A. All spare parts shall be of the same material, workmanship, and manufacturer as the corresponding original parts, completely interchangeable and packaged for long-term storage.

B. Spare parts shall include the following:

1. Two complete controller stations with all components including PLC's, I/O racks, I/O modules, interface cards, power supplies, etc.

2. Twelve I/O modules of each type used.

3. Six communication interface modules of each type used.

4. Six power supply modules of each type used.

END OF SECTION

SECTION 16325

PLC/HMI/I-O HARDWARE AND SOFTWARE SIMULATOR

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section covers the requirements for the Castaic Plant Control System PLC/HMI/I-O Hardware and Software simulator.

B. The simulator specified in this Section shall be used during the development phase, testing phase, and training, and shall be a final deliverable to the Department.

C. The Department will use the simulator for testing, diagnosis and training of the Plant Control System Components.

1.2 REFERENCES, SPECIFICATIONS, CODES AND STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

IEEE 802.3 Standard for Information technology--Local

B. National Electrical Manufacturers Association (NEMA)

C. National Electrical Code (NEC) NEC-2005 National Electrical Code

1.3 SUBMITTALS

A. Refer to Sections 01300 and 16300 for submittal requirements.

1.4 REFERENCE SECTIONS

A. SECTION 01010 SUMMARY OF WORK

B. SECTION 16320 DATA ACQUISITION AND CONTROL SYSTEM

C. SECTION 13330 HUMAN MACHINE INTERFACE (HMI) SYSTEM

D. SECTION 16340 INTERFACE WITH ENERGY CONTROL CENTER

E. SECTION 16360 PROCESS NETWORKS

F. SECTION 16370 EXCITATION SYSTEM

G. SECTION 16380 DIGITAL GOVERNOR CONTROLLER

PART 2 – PRODUCTS

2.1 PLC/HMI/I-O BASED SIMULATOR HARDWARE.

A. General Requirements.

1. The Simulator hardware shall be configured identical to the unit controllers and shall be mounted in a standard 19" rack with rollers. Therefore, it shall include redundant PLC's, main and auxiliary memory, local HMI and interfaces with intelligent devices and LAN interfaces.

2. In order to provide full field simulation for any controller provided under this Contract, the Simulator shall include as a minimum:

a. Input Test Panels: the rack mounted input test panels shall have a minimum of 128 toggle switches (wired to digital input modules) with bicolor green-red LED for visual on-off indication. The switches shall have a label holder to contain a paper label for identification purposes.

b. Output Test Panels: the rack mounted output test panels shall have a minimum of 128 bicolor green-red LED indicators (wired to digital output modules). The indicators shall have a label holder to contain a paper label for identification purposes.

c. RTD Test Panels: the rack mounted RTD test panels shall have a minimum of minimum of 16 RTD simulation devices.

d. Digital Inputs Modules as required.

e. Digital Outputs Modules as required.

f. Analog Inputs Modules as required.

g. Analog Outputs Modules as required.

h. Communication cards as required.

i. Power supplies as required.

j. Power and Grounding Cables as required.

k. Test Cables: Wires for temporary connections to the I/O modules in the different I/O cabinets being tested.

l. Signal generators as required to simulate feedback conditions from field devices.

m. Fully develop HMI with graphics to enable the Tester to simulate various plant conditions.

n. Simulation of Exciter controller.

o. Simulation of governor controller.

p. Simulation of ECC link.

q. Simulation of Multifunction meters.

r. Simulation of Bay Controllers.

3. The simulator shall be designed to simulate the conditions for the generating and pumping units; temporary pump control panel; unit control functions; TSOV functions; governor functions; balance of plant equipment functions; the 230kV switchyard functions; Energy Control Center; and others as specified in Section 16320.

4. The simulator shall be a standalone system, designed to operate totally independent from the Plant Control System.

5. The following level of redundancy shall be provided: redundant CPU's; redundant power supplies; redundant communication processors. No redundancy is required for input-output modules.

6. All simulator functions shall be programmed in IEC61131 compliant language.

7. The simulator shall have on-line, self-checking diagnostic routines periodically checking each component in the architecture. Error conditions shall identify the area where the malfunction is located and the specific problem shall be reported to the operator on a dedicated screen.

H. Input/Output Modules.

1. General.

a. All input-output modules shall be as specified in Section 16320.

2. Digital Input Modules.

a. The number and type of the digital inputs to be supplied by the Contractor shall match the maximum number of digital outputs of each type used in any controller in the Project plus the required to provide the functionality specified in the item 2.1.A.2.a (Input Test Panels).

3. Digital Output Modules

a. The number and type of the digital outputs to be supplied by the Contractor shall match the maximum number of digital inputs of

each type used in any controller in the Project plus the required to provide the functionality specified in the item 2.1.A.2.b (Output Test Panels)

4. Analog Input Modules

   a. The number and type of the analog inputs to be supplied by the Contractor shall match the maximum number of analog outputs of each type used in any controller in the Project.

5. Analog Output Modules

   a. The number and type of the analog outputs to be supplied by the Contractor shall match the maximum number of analog inputs of each type used in any controller in the Project.

6. Pulse Input Modules.

   a. Not required.

7. Resistance Temperature Detector (RTD) Input Modules.

   a. Not required.

8. Communication Cards

   a. The number and type of communication cards to be supplied by the Contractor shall match the maximum number of cards of each type (including communication cards for the instrumentation bus and intelligent devices) used in any controller in the Project.

9. Control Output Modules.

10. Physical Requirements. The Simulator shall be housed in a standard electronic equipment rack with rollers.

11. Power Requirements. The Simulator shall be suitable for operation from a 115-VAC 60-Hz, single-phase, 2-wire, and solidly grounded.

2.2 SIMULATOR SOFTWARE SYSTEM

A. Maintenance Facilities.

   1. The maintenance facilities shall be as specified in Section 16320.

B. Configuration System.

   1. The configuration system shall be as specified in Section 16320.

C. Programming Language.

1. The programming package shall be as specified in Section 16320.

2.3 SIMULATOR FUNCTIONS

A. Simulator Functions.

1. The Simulator shall be designed to emulate the field conditions and the response of the field devices to fully test the software during the development phase and testing phase.

2. The simulator shall support the following functions as specified in Section 16320:

Function	Unit Controllers	Unit TSOV Controllers	Unit Governor Controllers	230kV Switchyard Controller	BOP Controller	South Portal (PSOV) Controller	Elderberry Lake Controller	ECC Controllers
Data Acquisition	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Pump-Generator Control Functions	Yes	No	No	(Pump Starter Functions) Yes	No	No	No	No
Individual Control of MW Generation	Yes	No	No	No	No	No	No	No
Individual Control of MVAR/Voltage Generation	Yes	No	No	No	No	No	No	No
Automatic Start Sequence Control	Yes	No	No	No	No	No	No	No
Automatic Stop Sequence Control	Yes	No	No	No	No	No	No	No
Penstock Shutoff Valve (PSOV)	No	No	No	No	No	Yes	No	No
Turbine Shutoff Valve (TSOV)	No	Yes	No	No	No	No	No	No
Pump Starting Control (Starter and Pump Coordination)	No	No	No	Yes	No	No	No	No
Other Unit Auxiliary Systems:								
Draft Tube Depression and Exhaust System	Interface Yes	Yes	No	No	No	No	No	No
Cooling Water System	Yes	No	No	No	No	No	No	No
Turbine Lubrication Greaser System	No	Yes	No	No	No	No	No	No
Generator Lower Guide and Thrust Bearing Lub System	Yes	No	No	No	No	No	No	No

Function	Unit Controllers	Unit TSOV Controllers	Unit Governor Controllers	230kV Switchyard Controller	BOP Controller	South Portal (PSOV) Controller	Elderberry Lake Controller	ECC Controllers
Generator Upper Guide Bearing Lub System	Yes	No	No	No	No	No	No	No
Generator Brake System	Yes	No	No	No	No	No	No	No
Phase Reversal System	Yes	No	No	No	No	No	No	No
Unit 4160 V Switchgear	Yes	No	No	No	No	No	No	No
Balance of Plant	No	No	No	No	Yes	No	No	No
Switchyard Routines	No	No	No	Yes	No	No	No	No
Information Interchange with Other Drops	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Information Interchange with Excitation System	Yes	No	No	No	No	No	No	No
Information Interchange with Intelligent Devices	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Software Interlocks and Trips	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Information Interchange with ECC	No	No	No	No	No	No	No	Yes

B. Data Acquisition

As specified in Section 16320.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall use the Simulator during the development phase and testing phase.

B. All signals shall be hardwired to the I/O cabinets being tested or simulated.

C. The wiring shall be designed for easy removal.

3.2 TESTING

A. Refer to Section 16300 for shop and field-testing requirements.

END OF SECTION

SECTION 16330

HUMAN MACHINE INTERFACE (HMI) SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section covers the requirements for the Castaic Power Plant Human Machine Interface (HMI) system. New Computer based control and monitoring systems for interfacing with the programmable logic controller (PLC) systems shall be designed, furnished at the designated project locations as shown on drawings.

1.2 REFERENCES, SPECIFICATIONS, CODES AND STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

IEEE 802.3 Standard for Information technology--Local

B. National Electrical Manufacturers Association (NEMA)

C. National Electrical Code (NEC)

NEC-2005 National Electrical Code

1.3 SUBMITTALS

A. Refer to Sections 01300 and 16300 for submittal requirements.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Exercise care in transporting and handling to avoid damage to materials.

B. Store materials on the site so as to prevent damage or theft.

C. Keep materials clean, dry, and free from deleterious conditions.

D. Do not store materials directly on the ground.

E. Repair or replace damaged material or equipment to satisfaction of the Department.

F. Protect electrical equipment, controls, and insulation against moisture or water damage.

G. The Contractor shall be responsible for the equipment included in this Contract until it has been finally inspected, tested and accepted in accordance with the requirements of these Specifications.

PART 2 – PRODUCTS

2.1 HUMAN MACHINE INTERFACE SOFTWARE SYSTEM

A. The Human Machine Interface (HMI) shall consist of an integrated SCADA/HMI computer-based graphic display system to support an interactive dialogue between the operator and the power plant equipment.

B. The operating system for the computer-based workstations shall be Microsoft Windows XP Professional or newer. The operating system for the computer-based servers shall be Windows Server 2003 (or newer) or Solaris 10.

C. All required service packs, updates and patches for the operating system, HMI software and other applications running on the HMI workstations and servers shall be installed and kept up to date during the duration of the project and through the warranty period.

D. The HMI package shall include alarming, reporting, event logging and trending capabilities.

E. **Alarm Philosophy:** The alarm system shall provide complete alarm and event management with a user definable message structure. Alarm messages shall be time stamped at the point of origin. Events generated in the controller shall be time-stamped in the controller. The alarm system shall alarm any change of state that the system detects, including: any violation of limits; any change of state of a device connected to the system including all of its peripherals; the failure of any communications channel used by the system; the failure of system's hardware, which results in an automatic transfer of the system's functions from the active to standby device.

1. **Alarm Acknowledgement:** The alarm system shall provide capability to acknowledge an alarm message when a data point enters and/or exits alarm state. The system shall permit alarm acknowledgement including but not limited to: for an individual alarm; for a filtered grouping of alarms; from the device faceplate; from the process display (Screen Acknowledgment). Alarm acknowledgement from one operator station shall be automatically synchronized to other stations to provide global acknowledgement capability.

2. **Filtering of Alarms:** The alarm system shall provide filtering to control the behavior of the alarm display screens. The filtering attributes shall include but not be limited to: date, time, alarm class, alarm type, alarm priority, status (in alarm, out of alarm, or acknowledged), tag name, area.

3. **Alarm Status Symbols:** The alarm system shall provide the ability to condense and present system alarming status in the form of a standard alarm status symbol. The group display shall be capable of indicating the status of an individual device or of an entire process area. When used to represent the status of a process area, the group display shall form a logical OR'ing together of the alarms states from all devices in the process area. The group display shall include the following standard alarm categories at minimum, which will each be represented in the symbol with a different color and text representation: alarm, warning, system alarm, operator message, suppressed alarm state.

4. **Alarm Priorities:** To allow for segregation of alarms based on criticality, the system shall support the assignment of individual alarm conditions to one of at least 16 different alarm priorities.

5. **Categorizing Alarms and Messages:** Process and designated system alarms shall be annunciated, displayed, and stored in history files. Normal plant operator actions, events and normal system actions and events shall not be alarmed; however, they shall be stored in centralized history files. Alarms and messages shall be grouped to allow the user to readily identify and respond to alarms and conditions (e.g. in priority sequence) in his area of responsibility. For any process alarm, it shall be possible, by no more than one operator action, for an operator to access a display from which he might take corrective action. The system shall support the ability to display the highest priority, most recent, alarms at all times.

6. **Operator Actions:** The system shall automatically store all operator actins that affect process control parameters or alarm acknowledgement in central history files, including enable/disable/acknowledge/suppress/ lock/shelve alarms, change mode of controllers, change set-point of controllers, changes to alarm limits, changes to turning parameters.

7. **Engineer Actions:** The system shall provide the ability for engineering actions that change the control and monitoring of the process to be stored in a log file along with a comment. These actions shall include: download of controller configuration, online/test mode, download of batch/operator station configuration.

8. **Process Alarm Initiation:** It shall be possible to initiate process alarms by configuring alarm attributes of any process I/O point or any calculated point. For analog tags, the configurable triggers for process alarms shall include: process variable high limit exceeded, process variable high-high

limit exceeded, process variable low limit exceeded, process variable low-low limit exceeded, process variable deviation from set-point, process variable invalid value (bad quality). For digital tags, the configurable triggers for process alarms shall include: specific state (0 or 1).

9. **Alarm Suppression/Disablement**: The system shall provide the ability to disable or suppress alarms at the following levels: for each individual alarm condition; for all alarm conditions associated with a device or point; the all alarm conditions associated with an alarm group, process area, or displayed on a process graphic.

10. **System Alarm Initiation:** Failures of individual components of the system shall result in the generation of an alarm message. A system alarm shall be generated in the event of a failure for the following components at a minimum: field device, individual I/O channel, I/O module, I/O rack, communication modules (bus and network), power supplies, communication network, controller, server/clients, central archive server, time-synchronization. All devices connected to the system communication network shall be monitored for failures. A system alarm shall be generator for each failure detected.

11. **Process and System Alarms History Retention:** All alarms shall be stored in history files with the capability to archive these to removable media. Capability shall be provided to recall these alarms in visible display lists and printed lists according to selectable filtering options.

12. **Alarm Annunciation:** The system shall be capable of annunciating process and system alarms in ways including but not limited to: activation of an external audible alarm or light; activation of the internal computer sound card, updating an alarm display with the current alarm, updating an alarm overview screen to indicate the occurrence of an alarm in a specific process area/display, printing the alarm on an alarm printer, any graphic object associated with the alarm point will change color, shape, appear, disappear, etc. as configured.

13. **Audible Alarm Annunciation:** All alarms for process area may be assigned to any operator station at configuration time. All alarms shall be displayed on the operator station(s) designated. The audible alarm system shall be user configurable for different tones or patterns. A unique tone or pattern shall be capable of being generated based on alarm priority, message class or process area. The system shall use global alarm acknowledgement allowing a single acknowledgement from any workstation to acknowledge that alarm on all stations and to silence the audible alarm.

14. **Visible Alarm Annunciation:** Alarms shall cause visible display annunciation at, and only at, an operator station configured for those alarms. It shall be possible to group alarms by unit or system for display on a dedicated workstation screen which mimics the existing unit annunciator display panels in the control room. The annunciation shall occur within 3 seconds of detecting the initiating event. It shall be possible to acknowledge process alarms only from an operator station configured for those alarms. It shall be possible for an operator to acknowledge any alarm configured at his station by no more than two actions.

15. **Alarm Summary Display Lists:** The system shall provide the following alarm summary display list capability at a minimum: active process alarms, cleared process alarms, acknowledged process alarms, active system alarms, cleared system alarms, acknowledged system alarms, journal (alarm history), operator action list, suppressed (locked) alarm list, shelved (hidden) alarm list, alarm frequency display (hit) list. Accessing an alarm summary display from any other display shall required no more than one operator action. Visible display of alarm shall not clear unless the alarm is acknowledged; and the item initiating the alarm has returned to normal condition. Multi-page displays may be used. If so, it shall be possible to page forward or backward by a single operator action. The display shall list alarms in tabular format in order of occurrence with the most recent at the top. It shall be possible to assign alarms to separate areas of the plant so that arriving alarms are entered in area message lists to create an area-related view.

16. **Minimizing Nuisance Alarms:** To minimize the occurrence and effect of nuisance alarms on an operator, the system shall provide the following capabilities for identifying, managing and preventing them.

    a. HMI Displays for Identifying Nuisance Alarms: To help plant personnel identify nuisance alarms, the system shall provide standard capability to perform and display an alarm frequency analysis which identifies those alarms that have occurred most frequently over a given period of time.

    b. Alarm Dead-bands and Chatter Suppression: To minimize analog input chattering, there shall be configurable dead band parameters, on an individual tag basis. To minimize the occurrence of nuisance alarms during startup/shutdown scenarios the system shall support alarm chatter suppression at the controller level. This feature shall ensure that alarms are not re-triggered at the HMI until they have been acknowledged.

17. **State-based, "Smart" Alarming:** To minimize the alarm load on the operator and the presentation of alarms which are meaningless in context, the system shall support state-based ("smart") alarming whereby certain alarms can be automatically hidden from the operator based on the occurrence of specific processes or plant conditions.

    a. Determination of Plant State or Process Condition: The system shall provide a standard function block for determining/signaling changes in plant state or process condition from within the control strategy. This function block shall be capable of being combined with user-defined logic.

    b. Configuration of Smart Alarming: The system shall provide tools and capability for easy configuration of which alarms will be "hidden" based on plant state or process condition. The configuration interface shall be a standard part of the Engineering system. It shall provide a spreadsheet style interface where alarms can be configured to be hidden/not hidden based on a simple checkbox.

    c. Alarm Flood Suppression: The system shall support implementation of alarm flood suppression whereby pre-defined groups of alarms are hidden based on the detection of equipment state and triggering event.

    d. Recording and Display of Alarms that are hidden based on state: Hidden alarms shall not be presented to the operator on the standard alarm displays or on process graphics, but their occurrence shall be recorded in the alarm history (journal). A "hidden alarm" display will be provided which lists all of the alarms that are currently hidden from the operator based on the occurrence of specific process or plant conditions.

18. **Alarm Shelving/Manual Alarm Hiding:** To help plant personnel respond effectively to nuisance alarms or during plant upset conditions (alarm floods), the system shall provide the capability for the operator to manually hide individual alarms or groups of alarms on a temporary basis. A central configurable timer shall monitor how long the alarm has been "on the shelf" and will place it back in the operator's view when the time has elapsed. A comprehensive display listing "hidden alarms" shall be provided to show alarms that have been hidden automatically based on smart alarm hiding techniques and manually based on operator shelving.

19. **Alarm Performance Monitoring and Analysis:** To monitor and optimize the performance of the operator in conjunction with the alarm system, the following capabilities shall be provided by the system as a standard.

a. Configuration of Troubleshooting Information and Corrective Action: The system shall support the configuration of an information text message for each alarm state. This information text message can be used to display the probable cause of an alarm or the recommended corrective action. Information text messages shall be viewable from the standard alarm display list.

b. Recording of Alarm Comments: The system shall support operator entry of a comment upon acknowledgement of an alarm. The comment shall be stored in the alarm history where it shall be associated with the event. Comments shall be viewable at a later point in time from within the alarm history. To make it easy to locate alarms that have been commented, the alarm history display shall indicate which alarms have received comments and support quick identification for sorting and/or filtering.

c. Alarm Frequency Displays: To help plant personnel identify nuisance alarms, the system shall provide standard capability to perform and display an alarm frequency analysis which identifies those alarms that have occurred most frequently over a given period of time.

d. Alarm Message Duration/Time to Acknowledge Displays: To help plant personnel continuously improve operator response to alarms and to minimize the number of standing alarms, the system shall provide a display indicating the amount of time each alarm was active along with the amount of time that elapsed before it was acknowledged.

F. The software shall provide user-friendly development environment that allows for simple interactive graphics building and application software development. The software shall provide Wizards, Experts, and other productivity tools to support development without having to learn a proprietary language. Advanced development tools such as Visual Basic and scripting shall also be available.

G. Real time process monitoring and historical trending shall be included.

H. The HMI system shall be capable of seamlessly integrating third party software such as Microsoft's Office products, including Word, Excel, and Access.

I. The HMI system shall be designed to allow for future upgrades of the software package without the necessity to reprogram the existing system.

J. The database shall be designed to support the following input types:

1. Analog Inputs - Read an analog value either directly from an A/D converter or from a register within an I/O device, and automatically convert the raw count to engineering units or use PLC scaled value.

2. Analog Alarms - Alarm capabilities for alarm suspension and remote acknowledge.

3. Calculations - Perform arithmetic calculations based on other database inputs.

4. Digital Inputs - Sense logical state of a switch or relay directly from the input module or from a bit in memory of an I/O device.

5. Digital Alarm - Alarm capabilities for alarm suspension and remote acknowledge.

6. Digital Output - Set a logical on/off state in an output relay either directly in the output module or in a bit within the memory of an I/O device.

7. Each database point shall include an instrument tag name, hardware device name, address, specific parameters, signal conditioning requirements and point description.

8. The database shall be stored as a standard Windows file.

9. The database maintenance facilities shall be totally integrated with the graphic display system.

10. The database shall make use a high-level data manipulation language, Structured Query Language (SQL).

11. The database shall support import and export of individual points, groups and complete database in Comma Separated Value (CSV) file format.

K. The HMI system configuration, screen development, and database deletions, additions and changes shall be able to be done offline or online. Online modifications, deletions and additions shall not interrupt the data acquisition.

L. Security Management.

20. The HMI software shall provide a user-based security system. The security system shall allow for the creation of users with certain rights and/or privileges. These rights must include the ability to run any combination or all of the applications in the data acquisition system.

21. The ability to allow or disallow users' access to change values, such as setpoints and machine-setups, on an individual tag basis shall be supported.

2.2 HUMAN MACHINE INTERFACE APPLICATION SOFTWARE

A. All displays (formats and design) shall be subject to review and approval by the Department. The Department reserves the right to participate in the design of the screens as needed. The Contractor shall implement screens that duplicate the navigation and design of screens utilized for Units 2 and 6. The purpose of this is to minimize the retraining of operation staff on use of the new system.

B. A minimum of four HMI software workshops shall be held at the Castaic power plant to coordinate the HMI development.

C. The Contractor shall be responsible for integrating as a minimum the following common displays:

1. Plant Navigation

2. Plant Overview

3. Plant Main One Line

4. One Line Diagrams, including: status, measurements and control for breakers, transformers, etc.

5. Alarm Lists. The alarm lists shall be developed to filter out the alarms not applicable to the particular unit or systems. The entries in the alarm lists shall be arranged in chronological order. A complete alarm management system shall be developed to group alarms by criticality, systems, complete selection and filtering capability including suppression, all operator configurable.

6. System events summary (one world map). A chronological listing of all system events, i.e., alarms, status changes and operator-initiated actions.

7. Sequence of events list (one list).

8. Balance of Plant Navigation

9. Balance of Plant Individual Screens. Arrangement and sufficient information shall be displayed for each BOP system.

10. System configuration displays as required.

11. Generator and turbine capability curves with operating point shown.

12. Intelligent devices. All intelligent devices shall be provided with a template display. This display shall include all the signals and tuning parameters provided by the manufacturer. This applies to all the interfaces with intelligent devices.

13. Auxiliary Equipment Monitor. The auxiliary equipment monitor function shall monitor the running hours including the lead-lag status of the auxiliary equipment such as governor pressure oil pumps, air compressors, main water supply pumps, etc. When the total running hours exceeds the pre-set value, and alarm shall be initiated.

14. Hydraulic Conditions. One screen showing by means of a graphic color display, unit flow rates, reservoirs and forebay levels, tailwater level, trashracks differential, turbine distributor level, turbine needle position.

15. Alarm messages shall be displayed automatically for:

    a. All devices on Instrument list.

    b. Computer system with detailed alarm items.

    c. Time count exceeding preset value.

    d. Incomplete sequences.

    e. Joint control operation.

16. Water levels and flows.

17. Status report.

18. Connected fiber-optic lines for analyzing communication faults.

19. Generation and Hydraulic daily and monthly reports.

20. Help screens.

21. Operational guidance for:

    a. Switchgear changeover procedure.

    b. Fault restoring operating procedure.

22. Status and analog signals from all devices on instrumentation list.

23. Unit and Plant Network Systems

24. Additional displays shall be as required by other functions included in this Contract.

D. The Contractor shall be responsible for integrating as a minimum the following displays for each unit:

1. Unit Screen Navigation Page

2. Unit Control Status

3. Unit Sequence Overview

4. Sequence Monitors. Each sequence monitor function shall monitor the sequential operation of the unit for each mode by checking the processing time for each step of the normal start and stop sequences. All permissive, interlock and statuses shall also be displayed. In the event of trouble in any sequential step, the step and equipment/devices shall be indicated on the sequence monitor to be mounted on the operator console.

5. Equipment Lock Out/Tag Out

6. Pump Control Screen

7. High Pressure Lube Oil System

8. Upper Guide Bearing Lube Oil System

9. Governor

10. Governor Hydraulic Systems

11. Generator Brakes

12. Draft Tube Depression - Control
13. Draft Tube Depression – Water
14. Draft Tube Depression – Air
15. Cooling Water System – Turbine Bay
16. Cooling Water System – Pump / Strainer
17. Excitation
18. Phase Reversal Switch
19. Thrust Bearing Temperatures
20. Upper Guide Bearing Temperatures
21. Lower Guide Bearing Temperatures
22. Turbine Guide Bearing Temperatures
23. Generator Temperatures
24. Vibration
25. Penstock Overview
26. TSOV
27. TSOV Pressure System
28. One Line Protection and Monitoring
29. 480V Power Center

E. All unit related screens should have a clear identification of which unit the screen is related to, and this identification should be presented in the same location for all the screens.

F. Standard faceplates shall be provided at no cost for the department and should not be counted as separate screens.

G. The HMI shall be designed to permit the addition of at least 100 CRT displays.

H. A comprehensive alarm system shall be provided. The alarms shall be prioritized and grouped to provide intuitive user-friendly operator interface. The alarm system shall comprise of process; control system; network; and communication alarms. The alarm system design shall be reviewed and approved by DWP, before implementation.

I. Alarm and event log shall be provided. The log shall include: all process alarms and events; all operator action events; all control system alarms and events; all network and communication alarms and events with no exception. Each alarm or event shall be logged together with its time stamp.

J. Sequence of Events shall be included for high-resolution discrete inputs to provide troubleshooting tools for the engineering personnel.

K. Breaker Status and Alarming

1. In addition to the opened/tripped status for each breaker the following information shall also be provided: local/remote status; racked-in status; test position status; racked-out status.

2. Breaker disagreement alarm shall be provided. The disagreement alarm shall be active when the actual status differs from the last command sent to the breaker. This alarm shall also activate the alarm horn.

L. Lock-out/Tag-out

1. In addition to the Unit and Plant Lock-out/Tag-out screens each device/equipment faceplate shall have a drop down menu for selection of Lock-out/Tag-out action. The Lock-out/Tag-out status shall be shown on each screen or faceplate that the device/equipment appears on. The Contractor shall submit the standard lock-out/tag-out system for review and approval by the Department.

M. The governor and TSOV HMI workstations shall be connected to both the Unit Process Control Network and to the HMI network. In case of a failure of the HMI servers or HMI network, the governor HMI workstation shall communicate with all controllers for its unit and perform all the functions of the control room operator workstations.

N. Color Standards

1. Equipment or device status:

Valve, Gate, Damper	**Circuit Breaker, Switch**	**Motor, Pump, Generator, Fan, etc.**	**Graphic Color**
Opened	Closed	Running	Red
In Transition	N/A	In Transition (when applicable)	Flashing Red when Opening/Starting and Flashing Green when Closing/Stopping
Closed	Opened	Stopped/Off	Green
Tagged Out	Tagged Out	Tagged Out	Yellow
Fault	Fault	Fault	Magenta

Valve, Gate, Damper	Circuit Breaker, Switch	Motor, Pump, Generator, Fan, etc.	Graphic Color
In Automatic Indication	In Automatic Indication	In Automatic Indication	Amber
In Local or Manual Indication	In Local or Manual Indication	In Local or Manual Indication	Blue
In Alarm Indication	In Alarm Indication	In Alarm Indication	Unacknowledged – Cyan Acknowledged - White

2. Electrical bus colors by voltage:

Voltage	Color	Federal Standard 595a Color No.
230 kV	Safety Yellow	13655
11/18 kV	Light Green	14533
4.16 kV	Dark Blue	15102
DC and 480 VAC	White	17875

2.3 HMI SERVERS

A. The Contractor shall utilize the existing HMI servers, provided the communication and update speeds meet the requirements as specified by the performance requirements of Section 16300. If the existing servers cannot meet the specified requirements, the Contractor shall provide a quotation, as an option, based on the specifications below.

B. Two (2) servers shall be provided configured in a redundant mode. Both, the primary and the backup servers shall collect data from the field controllers at all times. The clients shall automatically switch over to the backup server in case of a failure of the primary one.

C. Each server shall be configured to support network redundancy. The clients shall automatically switch over to the backup network path in case of a failure to the primary one.

D. The HMI servers shall be a rack-mounted computer with Windows 2003™ R2 (or newer) or Solaris 10 Server operating systems and the latest Microsoft Office Basic Edition. The server shall be located in the relay room and shall be powered from the UPS system. As a minimum server features shall include:

1. 19 inch rack mount chassis

2. Two (2) Dual-core 3 GHz minimum Intel® Xeon® processor MP with minimum 2x2MB L2 cache

3. 8GB DDR-2 400MHz memory

4. Five (5) 146 GB hot-swap hard disk in Raid configuration

5. One (1) 24X Rewrite DVD drive

6. One (1) 3.5", 1.44MB floppy drive

7. Two (2) Dual port Gigabit Ethernet adapters

8. Two (2) available PCI slots

9. Four (4) USB ports

10. One (1) PS/2 mouse port

11. One (1) PS/2 keyboard port

12. One (1) parallel port

13. Video chipset and port to support 1280 x 1024 resolution.

14. Dual power supply

15. Windows Server 2003™ R2 or newer, operating system

16. 101 key rack mounted keyboard with mouse shared between the two servers

E. High-resolution color, flat panel monitor shall be furnished. The monitor shall be shared between the two servers and shall have, as a minimum the following characteristics:

1. Active matrix – TFT LCD, 19-inch screen.

2. Minimum pixel pitch of 0.264 mm, and resolution of 1280 x 1024 at 60 Hz.

3. Viewing angle of +/-80° vertical and horizontal.

4. Antiglare with hard-coating 3H faceplate coating.

5. Inside cabinet / Rack mounting accessories.

6. External KVM switch

O. The computer assembly shall be rack mounted in a freestanding NEMA 1 enclosure. The enclosure shall house the computers, monitor, keyboard, mouse, and networking equipment as required. For networking equipment refer to specification section 16360 "Process Networks".

F. Manufacturers

1. Dell;

2. Hewlett-Packard.

2.4 HMI WORKSTATIONS

A. 10 workstations shall be provided.

B. The HMI workstations shall be tower computers with Windows XP™ Professional or newer operating system and the latest Microsoft Office Basic Edition. The workstations shall be located in the existing control rooms. The workstations shall be powered from the UPS system. Computer features shall include as a minimum:

1. Rugged heavy gauge aluminum tower cabinet

2. Two (2) Dual-core or one (1) Quad-core 3 GHz minimum Intel® Xeon® processor MP with minimum 2x2MB L2 cache

3. Capable of supporting up to 18 screens

4. Eight (8) GB DDR-2 533MH or faster memory

5. Two (2) 300 GB SATA hard disks in Backup Raid Configuration

6. One (1) 16X DVD+/-RW drive

7. Gigabit Ethernet ports as required

8. Four (4) available PCI express slots

9. Eight (8) USB ports

10. One (1) PS/2 mouse port

11. One (1) PS/2 keyboard port

12. One (1) parallel port

13. 256MB Video Card with DVI port to support 1280x 1024 resolution.

14. Windows XP™ Professional workstation operating system

C. Nine of the workstations shall be equipped with two (2) High-resolution color, flat panel monitors each one. The monitors shall have, as a minimum the following characteristics:

1. Active matrix – TFT LCD, 19-inch screen.

2. Minimum pixel pitch of 0.264 mm, and resolution of 1280 x 1024 at 60 Hz.

3. Viewing angle of +/-80° vertical and horizontal.

4. Antiglare with hard-coating 3H faceplate coating.

5. DVI input.

6. The HMI monitors shall be mounted on a multi-screen configuration (two on two) assembly as manufactured by Zenview, model Quad Screen or equal.

D. One of the workstations shall be equipped with one (1) 84" High-resolution color, wall or suspended mounting monitor. The workstation and the monitor shall be capable of displaying one or four graphics at the same time.

E. A 3-button laser mouse shall be furnished with software for interfacing with the operating system. The mouse shall be ergonomically designed for either left or right hand operation. The mouse shall be Logitech, Microsoft or approved equal.

F. An ergonomically designed keyboard shall be furnished for interfacing with the operating system. The keyboard shall be split and sloped to encourage natural hand positioning. The keyboard shall be Microsoft, or approved equal

G. One color laser and two black and white printers shall be furnished in the control room. The printers shall be used for printing reports, screens, trend data, etc. The printers shall be high volume rated. The printer shall have the following features:

1.	Print Speed higher	32 ppm for B/W or 27 ppm for color or
2.	Resolution higher for color or higher	1200X1200 for B/W or 600x600 dpi or
3.	Number of Paper Trays	2
4.	Paper Tray Capacity	500 sheets
5.	Network	Ethernet ready,10/100Base-TX
6.	Memory	128 MB minimum for B/W or 512 MB color
7.	Media size	Up to 11.7" X 17.7 "

H. Manufacturers

1. Hewlett-Packard;

2. Dell;

3. Or equal.

2.5 ENGINEERING WORKSTATIONS

A. Two workstations shall be provided.

B. The HMI workstations shall be the same type and model as provided under the HMI WORKSTATION section.

C. The workstations shall be equipped with two (2) 19-inch High-resolution color, flat panel monitors each one. The monitors shall have the same characteristics mentioned in the previous paragraph (2.4.C)

2.6 MAINTENANCE WORKSTATION

D. One workstation shall be provided.

E. The HMI workstation shall be the same type and model as provided under the HMI WORKSTATION section.

F. The workstation shall be equipped with two (2) 19-inch High-resolution color, flat panel monitors. The monitors shall have the same characteristics mentioned in the previous paragraph (2.4.C)

2.7 PORTABLE WORKSTATIONS

A. Two (2) portable workstations shall be provided.

B. The portable workstations shall be professional mobile workstation class laptop computers with Windows XP™ Professional or newer operating system and the latest Microsoft Office Basic Edition. The portable workstations features shall include as a minimum:

1. Intel® Centrino® Core 2 Duo® processor T7400 4 MB L2 cache 667 MHz front side bus or better.

2. 4 GB DDR2 SDRAM 667MHz or faster memory

3. 250 GB (7200rpm or faster) SATA hard disk

4. One (1) DVD+/-RW with Double Layer optical drive

5. Gigabit Ethernet port.

6. Intel® Pro® Wireless adapter

7. 17 inches widescreen (1680 x 1050) display

8. Four (4) USB ports.

9. One (1) IEEE1394 port.

10. One (1) serial port (internal or external)

11. 512MB Video Card with DVI port to support 1680 x 1050 resolution.

C. A 3-button laser mouse shall be furnished with software for interfacing with the operating system. The mouse shall be ergonomically designed for either left or right hand operation. The mouse shall be Logitech, Microsoft or approved equal.

D. Manufacturers

1. Hewlett-Packard.

2. Dell.

3. Or equal.

2.8 PANEL MOUNTED WORKSTATIONS / OPERATOR INTERFACE TERMINALS

A. A total of six (6) panel-mounted workstations shall be provided.

B. The panel mounted HMI workstations shall have an integral monitor and touch screen with Windows XP™ Professional or newer operating system. The workstations shall be located adjacent to the governor and the TSOV cabinets (Units 1-6). The workstations shall be powered from the UPS system. Computer features shall include as a minimum:

1. Rugged industrial enclosure

2. 2 GHz Intel® Pentium® 4 or higher,

3. 4 GB memory

4. One (1) 300 GB hard disk

5. One (1) 16X DVD ROM drive

6. 10/100 Fast Ethernet port

7. Two (2) available PCI slots

8. Two (2) serial ports

9. Four (4) USB ports

10. One (1) PS/2 mouse port

11. One (1) PS/2 keyboard port

12. One (1) parallel port

13. Active matrix – TFT LCD, 19-inch screen.

14. Minimum pixel pitch of 0.264 mm, and resolution of 1280 x 1024 at 60 Hz.

15. Viewing angle of +/-80° vertical and horizontal.

16. Antiglare with hard-coating 3H faceplate coating.

2.9 HMI FURNITURE

A. The Contractor shall furnish a desk and chair for each of the HMI stations. The desk shall be sized to comfortably accommodate the HMI computer, screens, keyboard, and mouse. Space shall also be included for note taking and log book entries. Furnish storage for miscellaneous office supplies such as pencils, scissors, tape, paper clips, etc.

B. The desks shall be constructed of pressboard panels with laminate surfaces and metal frame. The desks shall be seismically qualified for the area.

C. The chairs shall be of fabric and metal construction with a roller base. The chairs shall have adjustable back rake, and adjustable height.

D. HMI furniture submittal shall be provided for review and approval by the Department.

E. Approved Manufacturers:

1. Evans Console.

2. Swanson Dataview Console.

PART 3 - EXECUTION

3.1 GENERAL

A. The HMI programmer shall be experienced in this type programming and have a minimum of 5 years experience in programming similar type systems. The screen graphics shall match as close as possible the actual device(s) arrangement being controlled.

B. Review meetings shall be setup between the Contractor, the Department, and Engineers to coordinate the various HMI screen control, monitoring, and

arrangement details. The meetings shall be held at the Department's office. As a minimum the following meetings shall take place:

1. Pre-design meeting to define the initial scope details for the various screen content and arrangement requirements.

2. Review meeting at 50% design.

3. Review meeting at 75% design

4. Review meeting at 100% design

3.2 HMI STATIONS

A. The HMI system shall be designed to provide rapid and reliable response to project events and to provide the operator with the ability to monitor and control aqueduct and powerhouse operations without objectionable delays in system processing times. Any of the HMI stations shall be able to perform all of the HMI system functions. All monitoring functions shall be available to all personnel. Control and programming functions shall be password protected.

B. The HMI station printer shall be set up for automatic alarm and operator action logging. The report printer shall be set up for periodic report printing and trending printing.

C. The HMI station operator shall be able to use either the keyboard, or mouse to implement monitoring and control commands.

3.3 TESTING

A. Refer to Section 16300 for shop and field-testing requirements.

3.4 INSTALLATION (NOT USED)

3.5 SPARE PARTS

A. All spare parts shall be of the same material, workmanship, and manufacturer as the corresponding original parts, completely interchangeable and packaged for long-term storage.

B. Spare parts shall include the following:

1. Two complete HMI workstations.

2. Two Governor HMI workstations.

3. Four 19-inch monitors.

4. One complete HMI server.

5. Three panel mounted workstations.

6. Twelve printer cartridges for each printer furnished

END OF SECTION

SECTION 16340

INTERFACE WITH ECC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section covers the requirements for the interface between the Castaic Power Plant Control System (PCS) and the Energy Control Center (ECC).

B. The data interface between the Plant Computer Control System and ECC shall permit the exchange of digital inputs and outputs, analog inputs and outputs, and accumulator inputs and outputs between the two systems.

C. The Contractor shall provide three Programmable Logic Controllers (PLCs) as the gateway to communicate with the ECC.

1.2 REFERENCES, SPECIFICATIONS, CODES AND STANDARDS

A. Refer to Section 01060 for codes and standards.

1.3 SUBMITTALS

A. Refer to Section 16300 for submittal requirements.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Exercise care in transporting and handling to avoid damage to materials.

B. Store materials on the site so as to prevent damage or theft.

C. Keep materials clean, dry, and free from deleterious conditions.

D. Do not store materials directly on the ground.

E. Repair or replace damaged material or equipment to satisfaction of the Department.

F. Protect electrical equipment, controls, and insulation against moisture or water damage.

G. The Contractor shall be responsible for the equipment included in this Contract until it has been finally inspected, tested, and accepted in accordance with the requirements of these Specifications.

PART 2 – PRODUCTS

2.1 ECC INTERFACE

A. The Department normally operates Automatic Generation Control (AGC) and Automatic Voltage Control (AVC) from its Energy Management System at its Energy Control Center (ECC). The Department may instead operate AGC/AVC from its Emergency Dispatch Center (EDC). The ECC and EDC share a common interface to the Castaic PCS, and as far as the Castaic PCS is concerned, the EDC and ECC are one and the same. The acronym "ECC" is used exclusively hereafter for both systems.

D. The Department also operates a backup AGC (BAGC) system. The BAGC system runs concurrently with the main ECC AGC/AVC system. The Castaic PCS shall be designed to allow both systems to independently and concurrently scan the Castaic PCS for input and output data. Except under coordinated test conditions, only one system at a time shall provide inputs into the Castaic PCS. The Castaic PCS shall accept inputs from either system at any time.

E. The Castaic PCS shall interface to the ECC via redundant communication paths, each of which shall be connected to three independent PLCs as shown on the drawings.

1. The Department will provide the three communication paths. The primary communication path shall be a serial connection from a 4-wire circuit. The backup communication path is also a four-wire circuit. The ECC switches between paths at its discretion. The Castaic PCS shall not require any manual intervention to handle ECC path switching. The Castaic PCS shall not impose any delay between the time that a path is switched and the time at which the selected path becomes functional. The Castaic PCS shall provide three RS-232 serial interfaces that LADWP will accept and transfer to/from the ECC.

2. The Contractor shall provide three independent PLCs as part of the Castaic PCS. One PLC shall be connected to the primary communication path to the ECC. This shall be considered the primary PLC. The other PLC shall be connected to the backup communication path to the ECC. This shall be considered the backup PLC. The two PLCs shall be identical. The two PLC's shall be designed to operate independently. The failure of any hardware component, firmware, or software component or system, whether internal or external to the PLCs, shall not disable or degrade the functionality of the two PLC's simultaneously or otherwise disable or degrade Castaic PCS functionality.

F. The Castaic PCS shall interface to the BAGC via a single non-redundant communication path that is separate from the two paths used by the ECC communications.

1. The Department will provide the communication path.

2. The Contractor shall connect this path to the backup PLC. This will be a four-wire connection. The connection shall be independent of the connection to the ECC. The Castaic PCS shall be able to simultaneously interoperate with the ECC through the primary PLC and with the BAGC through the backup PLC. The Castaic PCS shall also be able to simultaneously interoperate with the ECC through the backup PLC and with the BAGC through the backup PLC.

E. The BAGC requires only a subset of the data required by the ECC. The database shows the data required by the ECC and the BAGC. Data that is not required for the BAGC shall not be provided to the BAGC, except as agreed to by the Department. The Castaic PCS shall provide the capability for authorized Department personnel to add and remove data objects exchanged with the BAGC, and the Contractor shall train authorized Department personnel on how to implement these modifications. The functional descriptions of points provided to or from the ECC also apply to points provided to or from the BAGC.

F. The setpoint control shall work in conjunction with setpoint control specified in Section 16320.

2.2 ECC COMMUNICATION PROTOCOL

A. The Castaic PCS shall exchange data with the ECC and BAGC using the DNP 3.0 protocol. The Castaic PCS shall not require DNP 3.0 functions not supported by the ECC and BAGC systems. The Department will provide a list of supported and non-supported functions during project implementation. The ECC and BAGC support DNP 3.0 functions sufficient for the current control system interface for Castaic Units 2 and 6, which is similar to the requirements of this section.

1. Data exchange between the ECC and the Castaic PCS though the primary PLC shall be DNP 3.0 over four-wire.

2. Data exchange between the ECC and the Castaic PCS through the backup PLC shall be DNP 3.0 over four-wire.

3. Data exchange between the BAGC and the Castaic PCS through the backup PLC shall be DNP 3.0 over four-wire.

2.3 DATA EXCHANGE AND PERIODICITY REQUIREMENTS

A. The data that the Castaic PCS provides to the ECC shall be real-time data. The events and quantities that the Castaic PCS provides via its outputs shall not have occurred more than four seconds prior to the time that the Castaic PCS provides them or is able to provide them, that is, the Castaic PCS shall be providing up-to-date data that is not more than four seconds old.

B. Digital Output Signals from Castaic PCS to ECC

1. The ECC may scan the Castaic PCS for changes in digital output signals as often as every four seconds. Upon finding a digital output change indication, the ECC will scan for the indicated digital outputs. The ECC will also make a periodic scan of all Castaic PCS digital outputs as a security measure. The security scan is typically on a five minute period, but may be more or less frequent as configured at the ECC. The Castaic PCS shall support digital outputs, in conjunction with all other specified inputs and outputs, at the rates described with no adverse effect on its performance.

2. The digital outputs are shown on Attachment B of Section 16300.

C. Digital Input Signals to Castaic PCS from ECC

1. For all digital inputs to Castaic PCS from ECC, there is a corresponding digital output from Castaic PCS to ECC. Following any digital input initiated by the ECC, the ECC may monitor the corresponding Castaic PCS digital output to determine the success or failure of the input.

2. The digital inputs are shown on Attachment B of Section 16300.

D. Analog Output Signals from Castaic PCS to ECC

1. The ECC may scan the Castaic PCS for changes in analog output signals as often as every four seconds. Upon finding an analog output change indication, the ECC will scan for the indicated analog outputs. The ECC will also make a periodic scan of all Castaic PCS analog outputs as a security measure. The security scan is typically on a five minute period, but may be more or less frequent as configured at the ECC. The Castaic PCS shall support analog outputs, in conjunction with all other specified inputs and outputs, at the rates described with no adverse effect on its performance.

2. Analog values shall follow the sign conventions below except as otherwise determined by the Department. Authorized Department personnel shall have the capability of changing any sign convention, and the Contractor shall train authorized Department personnel on how to do that.

   a. Energy flow out of a generator is positive. Energy flow in is negative.

   b. Energy flow into generator auxiliary loads is positive.

   c. Water flow rate while generating is positive. Water flow rate while pumping is negative.

   d. Frequency values, AC voltages, ramp rates, water pressures, and lake elevations are positive.

e. Energy flow into the AC switchyard is negative. Energy flow out is positive.

f. All other analog values shall have signs as determined by the Department.

3. The DNP protocol transmits analog values as 16-bit integers. The Castaic PCS shall convert analog values as necessary to maximize the precision of the transmitted value without overflowing the 16-bit representation. To this end, the Castaic PCS shall have a multiplier and offset for each point to facilitate this conversion. To the greatest extent practical, the multipliers shall be integral powers of ten, such as 0.01, 0.1, 1, 10, 100, etc. The multiplier and offset shall be configurable by authorized Department personnel on a point-by-point basis, and the Contractor shall train authorized Department personnel on how to do this. The Castaic PCS shall not use this multiplier and offset as a means of implementing the sign conventions described above.

4. The analog outputs are shown on Attachment B of Section 16300.

E. Analog Input Signals into Castaic PCS from ECC

1. For all analog inputs to Castaic PCS from ECC, there is a corresponding analog output from Castaic PCS to ECC. These can be identified by the word "confirmed" in the analog output point descriptions above. Following any analog input initiated by the ECC, the ECC may monitor the corresponding Castaic PCS analog output to determine the success or failure of the input. The purpose of this monitoring is not to determine whether or how the Castaic PCS will use the analog input, but rather simply to confirm that the Castaic PCS has received and stored the analog input that the ECC provided. The Castaic PCS shall update the analog output value with the value of the analog input immediately (not more than one second after receiving the input) and unconditionally. In particular, the Castaic PCS shall provide this feedback regardless of whether the affected unit is online or offline, regardless of whether it is in Generate, Condense, Pump Start, and/or Pump mode, or in none of those modes, and regardless of whether the particular control functionality (e.g. MW control or kV control) is enabled or disabled.

2. The Castaic PCS may provide its own internal conditioning to analog inputs, such as applying high or low limits or rate-of-change limits, as it uses such analog inputs. It may substitute plant operator-entered values or other values when operating under plant control or other control. The ECC has no requirement that the Castaic PCS provide conditioned or substituted values back to the ECC. The Castaic PCS shall not provide conditioned or substituted values using the analog outputs designated for confirmed analog inputs.

3. Analog inputs into the Castaic PCS from the ECC will follow the same sign conventions as specified above for analog outputs.

4. The DNP protocol transmits analog values as 16-bit integers. The Castaic PCS shall convert the 16-bit integer to an analog representation as required for Castaic PCS correct use of the analog input. To this end, the Castaic PCS shall have a multiplier and offset for each point to facilitate this conversion. To the greatest extent practical, the multipliers shall be integral powers of ten, such as 0.01, 0.1, 1, 10, 100, etc. The multiplier and offset shall be configurable by authorized Department personnel on a point-by-point basis, and the Contractor shall train authorized Department personnel on how to do this. The Castaic PCS shall not use this multiplier and offset as a means of implementing the sign conventions described above.

5. The analog inputs are shown on Attachment B of Section 16300.

F. Accumulator Output Signals from Castaic PCS to ECC

1. Accumulator Outputs are implemented as frozen counters in DNP. The ECC will send the accumulator freeze periodically and read the counters. The periodicity is typically one hour, but may be more or less frequent as configured at the ECC.

2. All accumulator values are positive.

3. The use of multipliers and offsets for transmission over DNP shall be as specified above for analog outputs. The multipliers will generally be unity.

4. The accumulator outputs are shown on Attachment B of Section 16300.

2.4 AUTOMATIC GENERATION CONTROL (AGC) REQUIREMENTS

A. Control Operation

1. AGC controls the gross MW output of a unit by providing a setpoint target gross MW value and a setpoint ramp rate gross MW/min value as analog inputs to the Castaic PCS. The Castaic PCS shall ramp the unit gross MW output to the target MW at the provided ramp rate. For all AGC setpoints, the last value received by the Castaic PCS shall be visible to the plant operator.

2. AGC controls each unit individually and independently of the others. The Castaic PCS shall provide independent control for each unit. Any operating unit may be on MW control without requiring any other unit or units to be on or off MW control or kV control.

3. The Castaic PCS shall be capable of MW control for units generating. There shall be no MW control for units condensing. The Department does not require MW control for units pumping.

4. The plant operator shall have the capability of enabling and disabling MW control in the Castaic PCS for each unit in the plant. The Castaic PCS shall automatically disable a unit's MW control if for any reason its MW control is not possible or becomes not possible at the plant. This shall only occur under unusual and exceptional conditions. The unit's MW control status output from the Castaic PCS shall not indicate that MW control is enabled if for any reason the Castaic PCS is unable to actually do MW control. Whenever the Castaic PCS automatically disables the MW control, it shall alarm or alert the plant operator and provide sufficient information for the plant operator to identify the cause of the disablement. If the Castaic PCS presents any error or diagnostic codes to the plant operator, it shall also present the associated meanings and descriptions.

5. The Castaic PCS shall be able to do MW control for a unit regardless of whether the unit's kV control is enabled or disabled. A unit's MW control and kV control shall be enabled and disabled independently of each other.

6. The inputs to the Castaic PCS for MW control shall not be affected by the local/remote switch for control of the switchyard equipment. The Castaic PCS shall permit MW control regardless of whether or not control of the switchyard equipment is blocked.

7. The Castaic PCS shall provide a facility for the plant operator to enter high and low MW limits and maximum ramp rate MW/min limits for each unit. The Castaic PCS may also calculate these limits based on real-time operating conditions. The Castaic PCS shall provide the most restrictive of these limits to AGC using the appropriate analog outputs listed above. Limits calculated by the Castaic PCS, limits entered by the plant operator, and the effective limits output to AGC shall be visible to the plant operator. The minimum ramp rate limit shall be zero, and zero shall be a valid ramp rate.

8. The Castaic PCS shall not allow AGC to overload a unit or operate it in an unsafe or hazardous manner. The Castaic PCS shall telemeter its most restrictive of any restricted or realized limits for MW control to AGC via the appropriate analog outputs. This will enable AGC to account for the limitation and dispatch alternate units to achieve its control objectives.

9. The Castaic PCS shall not disable MW control on account of the unit MW exceeding its high MW limit or being lower than its low MW limit. The Castaic PCS shall constrain its internal conditioned effective setpoint in use to be within the limit, and it shall provide the limit to AGC as described above.

10. When a unit is online in any mode and AGC is not on control (regardless of whether MW control is enabled or not), AGC periodically updates the MW setpoint by setting it to the current gross MW value. The purpose of this is to maintain an up-to-date setpoint so that whenever MW control transitions from being disabled to enabled, the unit MW will not ramp to

some obsolete MW setpoint value. The Castaic PCS shall retain the last MW setpoint sent, and begin using it at once when MW control is enabled, unless the MW setpoint is more than two minutes old. If the last MW setpoint was received more than two minutes prior, the Castaic PCS shall not use the MW setpoint and shall keep the unit MW output constant until it receives a new MW setpoint from AGC. The Castaic PCS shall use any MW setpoint received while MW control is enabled regardless of how long ago the Castaic PCS received it, provided that MW control has not been disabled since it received it.

11. AGC will provide a new setpoint for the MW/min ramp rate whenever the ramp rate setting is altered at the ECC. The Castaic PCS shall receive and retain the ramp rate setpoint unconditionally, that is regardless of whether the affected unit is online or offline, regardless of whether it is in Generate, Condense, Pump Start, and/or Pump mode, or in none of those modes, and regardless of whether MW control is enabled or disabled. The Castaic PCS shall use the last-received ramp rate setpoint value when MW control is enabled regardless of how long ago it received it.

12. AGC can accommodate a Castaic PCS implementation that has separate up and down ramp rate setpoints. The Castaic 2 and 6 units are currently implemented that way for MW control. If the Castaic PCS has separate up and down ramp rate setpoint analog inputs, then it shall also have separate up and down confirmed setpoint analog outputs and separate up and down ramp rate limit analog outputs.

13. The Castaic PCS shall provide AGC with the same control capability as local control at the plant. In particular, AGC shall have the same high and low MW limit capabilities and the same maximum ramp rate capability, although the normal operating limits for AGC may be more restrictive as determined by the Department at its discretion.

B. Control Performance

1. The Castaic PCS shall provide AGC with the same control performance as local control at the plant. In particular, AGC shall be able to achieve the same high and low MW outputs and the same maximum ramp rate as can be achieved by local control at the plant, although the normal operating limits for AGC may be more restrictive as determined by the Department at its discretion.

2. Notwithstanding the foregoing, at a minimum the Castaic PCS shall permit normal and usual AGC control for Units 1 – 6 to be over the range of 10 MW to 250 MW each, and shall permit normal and usual AGC control for Unit 7 to be over the range of 5 MW to 55 MW, and shall permit normal and usual ramping at rates for all units to be between 0 MW/min and 100 MW/min each.

3. When the Castaic PCS receives a MW setpoint, it shall cause the MW output to start ramping at the target ramp rate within eight seconds.

4. The MW control shall not cause the unit MW to overshoot or undershoot the MW setpoint by more than a MW value equal to the greater of one MW or five percent of the ramp rate MW per minute in effect.

5. When Castaic PCS has stopped ramping at the setpoint MW/min ramp rate value because the unit MW has come into proximity of the MW setpoint value, the MW control shall cause the unit MW to settle to within one MW of the MW setpoint value no later than twenty seconds thereafter.

6. During steady-state operation, which is the time between settling as described above and the time of receipt of the next MW setpoint that requires unit MW ramping, the Castaic PCS shall cause the unit MW to not deviate by more than two MW from the MW setpoint, and the average unit MW shall not deviate by more than one half MW from the MW setpoint.

7. During steady-state operation as defined above, the Castaic PCS shall operate to prevent MW oscillation or "hunting" by the unit. The Castaic PCS shall eliminate any oscillation in the unit MW output within a time interval not to exceed the greater of ten seconds or five times the period of the oscillation.

2.5 AUTOMATIC VOLTAGE CONTROL (AVC) REQUIREMENTS

A. Control Operation

1. AVC controls the terminal kV output of a unit by providing a setpoint kV value as an analog input to the Castaic PCS. AVC will implement its own ramp rate by incrementing the setpoint kV value at its desired rate. The Castaic PCS shall cause the ramp rate to be realized by controlling the unit's terminal kV to the provided setpoint value in a timely manner. Optionally, the Castaic PCS may accept a target terminal kV setpoint and a ramp rate kV/sec setpoint in a manner similar to AGC control described above. For all AVC setpoints, the last value received by the Castaic PCS shall be visible to the plant operator.

2. AVC provides a common terminal kV setpoint for all of Units 1 – 6 because these units share a common nominal terminal voltage. The Castaic PCS shall apply the kV setpoint to each of those units that has kV control enabled. There shall be a single analog output for the confirmed value of the Units 1 – 6 kV setpoint. Other than sharing a common kV setpoint, and except as described below, each of Units 1 – 6 shall operate kV control individually and independently of the other units. Unit 7 shall have its own kV setpoint analog input and confirmed kV

setpoint analog output. Any operating unit may be on kV control without requiring any other unit or units to be on or off kV control or MW control.

3. The Castaic PCS shall be capable of kV control for units generating, condensing, and pumping.

4. The plant operator shall have the capability of enabling and disabling kV control in the Castaic PCS for each unit in the plant. The Castaic PCS shall automatically disable a unit's kV control if for any reason its kV control is not possible or becomes not possible at the plant. This shall only occur under unusual and exceptional conditions. The unit's kV control status output from the Castaic PCS shall not indicate that kV control is enabled if for any reason the Castaic PCS is unable to actually do kV control. Whenever the Castaic PCS automatically disables the kV control, it shall alarm or alert the plant operator and provide sufficient information for the plant operator to identify the cause of the disablement. If the Castaic PCS presents any error or diagnostic codes to the plant operator, it shall also present the associated meanings and descriptions.

5. The Castaic PCS shall be able to do kV control for a unit regardless of whether the unit's MW control is enabled or disabled. A unit's kV control and MW control shall be enabled and disabled independently of each other.

6. The inputs to the Castaic PCS for kV control shall not be affected by the local/remote switch for control of the switchyard equipment. The Castaic PCS shall permit kV control regardless of whether or not control of the switchyard equipment is blocked.

7. The Castaic PCS shall provide a facility for the plant operator to enter high and low kV limits and maximum ramp rate kV/sec limits for each unit. The Castaic PCS may also calculate these limits based on real-time operating conditions. The Castaic PCS shall provide the most restrictive of these limits to AVC using the appropriate analog outputs listed above. Limits calculated by the Castaic PCS, limits entered by the plant operator, and the effective limits output to AVC shall be visible to the plant operator. The minimum ramp rate limit shall be zero, and zero shall be a valid ramp rate.

8. The Castaic PCS shall not allow AVC to overload a unit or operate it in an unsafe or hazardous manner. The Castaic PCS shall telemeter its most restrictive of any restricted or realized limits for kV control to AVC via the appropriate analog outputs. This will enable AVC to account for the limitation and dispatch alternate units to achieve its control objectives.

9. The Castaic PCS shall not disable kV control on account of the unit kV exceeding its high kV limit or being lower than its low kV limit. The Castaic PCS shall constrain its internal conditioned effective setpoint in use for the unit to be within the limit, and it shall provide the limit to AVC as described above. For Units 1 – 6, which share a common kV setpoint,

a kV limit applicable to any unit on kV control shall not restrict kV control on any other unit, unless such kV setpoint would result in a violation of the real-time MW/MVAR capability for any unit online, whether enabled for kV control or not. In the process of providing a kV setpoint for the most capable units enabled for kV control, AVC may provide a setpoint outside the limits of a constrained unit enabled for kV control, or at a rate faster than the rate limit of a constrained unit on kV control. The Castaic PCS shall not permit the terminal kV of the constrained unit to go outside its set limits or to ramp more swiftly than its set limit.

10. For any and each of Units 1 – 6, when one of them becomes enabled for kV control when none were previously enabled for kV control, the Castaic PCS shall immediately use the last kV setpoint it received, unless it is more than two minutes old. If the last kV setpoint was received more than two minutes prior, the Castaic PCS shall not use the kV setpoint and shall keep the unit kV output, and the unit kV output of any other of Units 1 – 6 subsequently enabled for kV control, constant until it receives a new kV setpoint from AVC. However, once kV control is enabled, the Castaic PCS shall use any kV setpoint received while kV control is enabled regardless of how long ago the Castaic PCS received it, provided that kV control has not been in a disabled state for all of Units 1 – 6 simultaneously since it received it. The Unit 7 kV setpoint control shall operate in a similar manner, except that it shall only consider whether or not the Unit 7 kV control has been enabled or disabled. The Castaic PCS shall be capable of receiving kV setpoints from AVC when AVC is not on control, in a manner similar to the way AGC provides MW setpoints when AGC is not on control, as described above.

11. The Castaic PCS shall provide AVC with the same control capability as local control at the plant. In particular, AVC shall have the same high and low kV limit capabilities and the same maximum ramp rate capability, although the normal operating limits for AVC may be more restrictive as determined by the Department at its discretion.

B. Control Performance

1. The Castaic PCS shall provide AVC with the same control performance as local control at the plant. In particular, AVC shall be able to achieve the same high and low kV outputs and the same maximum ramp rate as can be achieved by local control at the plant, although the normal operating limits for AVC may be more restrictive as determined by the Department at its discretion.

2. Notwithstanding the foregoing, at a minimum the Castaic PCS shall permit normal and usual AVC control for Units 1 – 6 to be over the range of 17.1 kV to 18.9 kV each, and shall permit normal and usual AVC control for Unit 7 to be over the range of 10.45 kV to 11.55 kV, and shall permit normal and usual ramping at rates for all units to be between 0 kV/sec and 0.5 kV/sec each.

3. When the Castaic PCS receives a kV setpoint, it shall cause the kV output to adjust to the kV setpoint value within four seconds, unless the Castaic PCS implements the ramping functionality and the ramp rate is constrained by the maximum ramp rate limit to ramp slower than that.

4. The kV control shall not cause the unit kV to overshoot or undershoot the kV setpoint by more than 0.1 kV.

5. The Castaic PCS shall cause the unit kV to settle to within 0.05 kV of the kV setpoint value no later than six seconds after receiving the kV setpoint.

6. During steady-state operation, which is the time between settling as described above and the time of receipt of the next kV setpoint that requires unit kV ramping, the Castaic PCS shall cause the unit kV to not deviate by more than 0.1 kV from the kV setpoint, and the average unit kV shall not deviate by more than 0.05 kV from the kV setpoint.

7. During steady-state operation as defined above, the Castaic PCS shall operate to prevent kV oscillation or "hunting" by the unit. The Castaic PCS shall eliminate any oscillation in the unit kV output within a time interval not to exceed the greater of five seconds or five times the period of the oscillation.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor's interface programmer shall be experienced in this type programming and have a minimum of 5 years experience in programming similar type systems.

B. Review meetings shall be scheduled between the Contractor, the Department, and their respective Engineers to coordinate the various interface details. The meetings shall be held at the Department's office. As a minimum the following meetings shall take place:

1. Pre-design meeting to define the initial scope details for the various screen content and arrangement requirements.

2. Review meeting at 50% design.

3. Review meeting at 75% design.

4. Review meeting at 100% design.

3.2 TESTING

A. Refer to Section 16300 for shop and field-testing requirements.

3.3 INSTALLATION

A. The installation will be by the Department.

3.4 SPARE PARTS

A. All spare parts shall be of the same material, workmanship, and manufacturer as the corresponding original parts, completely interchangeable and packaged for long-term storage.

B. Spare parts shall include the following:

1. One complete controller with all components including PLC's, I/O racks, I/O modules, interface cards, power supplies, etc.

2. Two communication interface cards of each type used.

END OF SECTION

SECTION 16350

HISTORIAN

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section covers the requirements for the Castaic Power Plant Historical Data Management System.

1.2 REFERENCES, SPECIFICATIONS, CODES AND STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

B. National Electrical Manufacturers Association (NEMA)

C. NFPA National Electrical Code 2005 (NEC)

D. OPC Foundation

E. OPC Data Access Specification

F. OPC Alarms and Events Specification

G. OPC Data eXchange Specifications

H. OPC Historical Data Access Specifications

I. OPC Security Specifications

1.3 SUBMITTALS

A. Refer to Section 16300 for submittal requirements.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Not applicable.

PART 2 – PRODUCTS

2.1 HISTORICAL DATA MANAGEMENT SOFTWARE

1. Historical Data Management (HDM) software will be furnished by LADWP..

A. Manufacturers

1. OSIsoft, PI System.

2.2 HISTORICAL DATA MANAGEMENT HARDWARE

A. The Historian hardware will be furnished by LADWP.

2.3 TIME SYNCHRONIZATION

A. The historian shall be synchronized with the plant GPS time system.

PART 3 - EXECUTION

3.1 GENERAL

A. The proposer shall provide the technical resources needed to program, integrate, and interface the furnished historian with the main control system.

B. The Historian programmer shall be experienced in this type programming and configuration and have a minimum of 5 years experience in programming similar type systems.

C. Review meetings shall be setup between the Contractor, the Department, and Engineers to coordinate the database configuration, and equipment arrangement details. The meetings shall be held at the Department's office or at the site. As a minimum the following meetings shall take place:

1. Pre-design meeting to define the details for the various parameters and arrangement requirements.

2. Review meeting at 75% design

3. Review meeting at 100% design

D. Configuration and Security:

1. The system configuration shall be done via web based administration tools.

2. All configuration changes including adding new tags must be "on-line" without the need to stop and restart the data historian.

3. The system shall automatically import the data type, description, tag name, and other data characteristics from the data source, without a need to retype the tag information

4. Role based security shall be utilized to restrict user access to different administration, system and user functions.

5. All configuration changes, user connections, security violations and other system messages shall be logged and the log shall be available for monitoring by the administrators. The logs shall not be allowed to be modified or deleted by the users or the administrators.

E. Data Collection:

1. Tags shall be added from multiple data sources utilizing a graphical interface. All major brand PLC, DCS and SCADA systems shall be supported.

2. The system shall utilize Coordinated Universal Time (UTC) for time stamping with multiple time zone support. Manual time compensation for different time zones and daylight savings time shall not be required.

3. The system shall support time synchronization to a central server.

4. The system shall support polled and exception based time collection.

5. The periodicity of data collection and storage shall be different for each data type and shall be changeable for each point for a specified period at the operator's option.

6. The system shall support input scaling.

7. The system shall support user-entered comments for any data type.

8. The systems shall support OPC "Alarms & Events" and collect and store alarms and events from any OPC Alarms & Event server.

F. Calculations and Analysis:

1. The historian shall provide a calculation engine for automatic calculations and analysis with incoming and archived data and storing the result in a historian tag.

2. The calculation engine shall support installation on remote computers.

3. The calculations shall support an unlimited number of trigger tags.

4. The calculation engine shall be able to perform mathematical and statistical operations, e.g., interpolation, maximum, minimum, average over a specific time, standard deviation, time weighted total, totalizing, etc.

5. The calculation engine shall support data filtering.

6. The calculation engine shall support Visual Basic scripting.

7. The calculation engine shall support time based, tag based and manual triggers.

8. The calculations shall have execution time control and means to disable the calculation if it exceeds a configurable maximum execution time.

9. The historian shall be capable of performing downtime analysis for process areas and subsystems.

G. Multiple Server Configuration

1. The system shall support multiple server configuration and data forwarding from one historian to a remote historian.

2. Tag browse and import shall be possible from the remote historian, without a need to re-configure the tags at the remote historian.

H. Client Interfaces

1. Interface to Microsoft Excel shall be provided. The interface shall be integrated with the historian package and should utilize drop down menus and toolbars. The interface shall be capable of extracting process, calculations and system data and developing reports using MS Excel. The interface shall provide capabilities for importing and modifying tags, stored data and user comments.

2. Interface to OLE DB shall be provided. The interface shall allow process, calculations and system data to be extracted and viewed by applications such as SQL servers and crystal reports. Modification of historian data through this interface shall not be allowed.

3. Interface to Human Machine Interface/SCADA Systems shall be provided for monitoring of the historian's process and calculations data. The interface shall be able to convert UTC to standard local and daylight savings time.

4. Web based interface to the historian shall be provided to browse, display and chart data.

3.2 TESTING

A. Refer to Section 16300 for factory and site testing requirements.

3.3 INSTALLATION (NOT USED)

3.4 SPARE PARTS (NOT USED)

SECTION 16360

PROCESS NETWORKS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section covers the requirements for the Local Area Networks (LANs) for the Castaic's Plant Computer Control System.

1.2 SUMMARY OF REQUIREMENTS

A. The Local Area Networks (LANs) shall provide interconnectivity of the distributed control devices and HMI equipment and servers specified in other sections. The LANs shall be seamlessly integrated to meet the system performance requirements specified in Section 16300.

B. One redundant Process Control Network segment shall be provided for each unit. These network segments shall be provided with both redundant hardware and communication links. The Unit Process Control Network shall be Ethernet based with a minimum speed of 100 MB/s.

C. All Unit Process Control Network segments shall be interconnected to form one redundant common Plant Process Control Network. This network shall be provided with both redundant hardware and communication links. The Plant Process Control Network shall be Ethernet based with a minimum speed of 100 MB/s and shall have 1 GB/s capability.

D. One redundant Human Machine Network (HMI) shall be provided to interconnect all operator workstations. The HMI network shall be connected to the Plant Process Control Network via the HMI Database Servers.

E. The governor HMI workstation shall be connected to both the Unit Process Control Network and to the HMI network. In case of a failure of the HMI servers or HMI network, the governor HMI workstation shall communicate with all controllers for its unit and perform all the functions of the control room operator workstations.

F. All local HMI workstations shall be connected to both the Unit Process Control Network and to the HMI network. In case of a failure of the HMI servers or HMI network, the GOV HMI workstation shall communicate with all controllers for its unit and perform all the functions of the control room operator workstations.

G. Each Control System cabinet shall have one spare RJ45 Ethernet network port for laptop connection.

1.3 REFERENCES, SPECIFICATIONS, CODES AND STANDARDS

A. IEEE 802.3 Standard for Information Technology

B. National Electrical Manufacturers Association (NEMA)

C. NFPA NEC-2005 National Electrical Code

D. TIA/EIA-455 Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices and Other Fiber Optic Components

E. TIA/EIA-606 Administration Standard for the Telecommunications Infrastructure of Communications Building

F. TSB-67 Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems

1.4 SUBMITTALS

A. Refer to Section 01300 and 13300 for submittal requirements.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Exercise care in transporting and handling to avoid damage to materials.

B. Store materials on the site so as to prevent damage or theft.

C. Keep materials clean, dry, and free from deleterious conditions.

D. Do not store materials directly on the ground.

E. Repair or replace damaged material or equipment to satisfaction of the Department.

F. Protect electrical equipment, controls, and insulation against moisture or water damage.

G. The Contractor shall be responsible for the equipment included in this Contract until it has been finally inspected, tested and accepted in accordance with the requirements of these Specifications.

PART 2 – PRODUCTS

2.1 COMMUNICATION MEDIA

A. The communication media for Process LAN shall be multimode fiber optic and category 6 copper cables. The fiber optic cable will be provided and installed by the department.

B. The main link to the South Portal for communication with the PSOVs shall be multimode fiber optic cable. The fiber optic cable will be provided and installed by the Department. One backup industrial wireless Ethernet radio link shall be provided for communication with the PSOVs.

C. One industrial wireless Ethernet radio link and repeaters, if required, shall be provided for communication with the Elderberry Lake equipment.

2.2 COMPUTER REQUIREMENTS

A. Each personal computer shall be dual ported to the redundant Process LAN. The HMI servers shall be dual ported to both Plant Process Control Network and the HMI network.

2.3 MANAGED INDUSTRIAL ETHERNET SWITCHES

A. Manufacturers

1. MOXA
2. Hirschmann
3. Sixnet
4. Phoenix Contacts
5. RuggedCom
6. Etherwan
7. Or approved equal

B. The managed industrial Ethernet switches shall support store and forward switching mode, 10/100Mbit/s as a minimum and 1,000Mbit/s or 10,000Mbit/s as required.

C. The managed switches shall support Bootstrap Protocol (BootP).

D. The managed switches shall support Simple Network Management Protocol (SNMP) Versions 1 through 3 or latest and Remote Monitoring (RMON).

E. The switch shall be manageable by the use of a standard Internet browser. If other management software is required the software shall be supplied at no additional cost.

F. SNMP OPC server shall be provided and the data from the switches shall be integrated in the DCS system.

G. The managed switches shall support Internet Group Management Protocol (IGMP) snooping and multicast filtering.

H. The managed switches shall support Virtual LAN (VLAN) network topology.

I. The managed switches shall support Rapid Spanning Tree Protocol 802.1w (RSTP).

J. The managed switches shall support industrial ring topology.

K. The managed switches shall be provided with auto negotiation and auto crossing RJ45 ports and ST style fiber optic ports as required.

L. The switches shall be provided with power indicators and link and activity indicators for each port.

M. Spare ports shall be provided for each switch. The spare ports shall be 25% as a minimum, and not less than 4 ports.

N. The nominal supply voltage shall be 24VDC with a working range of 18.5 to 30.5VDC or wider.

2.4 ETHERNET COPPER TO FIBER OPTIC MEDIA CONVERTERS

A. Ethernet converters shall only be used when it is not possible or practical to use devices or switches with fiber optic ports.

B. Manufacturers

1. Moxa
2. Dymec
3. Phoenix Contacts
4. Hirschmann
5. Or approved equal

C. The function of this module is to convert twisted pair Ethernet to and from a fiber optic segment. The physical and logical interface shall be fully compatible with IEEE 802.3. No additional adapters or transceivers shall be allowed.

D. The fiber optic ports (transceivers) shall be matched with the type of the fiber optic cable.

E. The converters shall be provided with the following indicators: power; electrical link; electrical data; fiber link; fiber data.

F. The fiber optic connectors shall be MT-RJ type (or ST or SC).

G. The nominal supply voltage shall be 24VDC.

H. The converters shall be listed for Class 1 Division 2 hazardous locations where required.

2.5 RS422/RS485 TO FIBER OPTIC MEDIA CONVERTERS

A. Manufacturers

1. Dymec
2. Phoenix Contacts
3. Moxa
4. Or approved equal

B. The function of this module is to convert the RS422/RS485 communication signal over copper cables to and from a fiber optic segment. The physical and logical interface shall be fully compatible with EIA 422/485. No additional adapters or transceivers shall be allowed.

C. The fiber optic ports (transceivers) shall be matched with the type of the fiber optic cable.

D. The converters shall be provided with the following indicators: power; transmit electrical; receive electrical; transmit fiber; receive fiber.

E. The fiber optic connectors shall be MT-RJ type (or ST or SC).

F. The nominal supply voltage shall be 24VDC.

G. The converters shall be listed for Class 1 Division 2 hazardous locations where required.

2.6 RS232 TO FIBER OPTIC MEDIA CONVERTERS

A. Manufacturers

1. Dymec

2. Phoenix Contacts

3. Moxa

4. Or approved equal

B. The function of this module is to convert the RS232 communication signal over copper cables to and from a fiber optic segment. The physical and logical interface shall be fully compatible with EIA 232. No additional adapters or transceivers shall be allowed.

C. The fiber optic ports (transceivers) shall be matched with the type of the fiber optic cable.

D. The converters shall be provided with the following indicators: power; transmit electrical; receive electrical; transmit fiber; receive fiber.

E. The fiber optic connectors shall be MT-RJ type (or ST or SC).

F. The nominal supply voltage shall be 24VDC.

2.7 POWER SUPPLIES

A. Manufacturers

1. Phoenix Contacts

2. Acopian

3. IDEC

4. Power supply packaged with the original equipment.

5. Or approved equal

B. The Contractor shall provide all necessary power supplies required to achieve the system's required functionality. The selection of the power supply shall be done considering the modularity/interchangeability criteria for the entire system. The output voltage should not vary more than 5% with voltage input variation between -20% to +10%, and output current variation between 0% to 100%.

C. Type: 125V DC to 24V DC

1. Input: 125V DC, fused.

2. Output: 24VDC +/-1%.

3. Protection: input and output side protected against overload, short circuits, and reverse voltage.

4. Nominal output current: minimum 20% greater than the maximum current to be supplied.

5. Operating and status indication.

6. The residual ripple shall be lower than the maximum required by the connected equipment.

7. Primary Switched. Electrically isolated between input and output side.

8. Modular design.

9. Mounting type: standard rail mounting or as required.

D. Type: 120V AC to 24V DC

1. Input: 120VAC 60Hz, fused, with harmonic filter (power to be provided by UPS).

2. Output: 24VDC

3. Nominal output current: minimum 20% greater than the maximum current to be supplied.

4. The residual ripple shall be lower than the maximum required by the connected equipment, but never greater than 100mVpp.

5. Operating and status indication.

6. Type: Primary switched-mode power supply.

7. Electrically isolated between input and output side.

8. The power supply shall be protected against excessive current and reverse voltage.

9. Modular design.

10. Mounting type: standard rail mounting or as required.

E. Type: 24V DC to 24V DC

1. Input: 10-32V DC, fused.

2. Output: 24VDC +/-1%.

3. Protection: input and output side protected against overload, short circuits, and reverse voltage.

4. Nominal output current: minimum 20% greater than the maximum current to be supplied.

5. Operating and status indication.

6. The residual ripple shall be lower than the maximum required by the connected equipment.

7. Primary Switched. Electrically isolated between input and output side.

8. Modular design.

9. Mounting type: standard rail mounting or as required.

F. Type: 120V AC to 125V DC

1. Input: 120VAC 60Hz, fused, with harmonic filter (power to be provided by UPS).

2. Output: 125VDC +/-1%.

3. Protection: input and output side protected against overload, short circuits, and reverse voltage.

4. Nominal output current: minimum 20% greater than the maximum current to be supplied.

5. Operating and status indication.

6. The residual ripple shall be lower than the maximum required by the connected equipment.

7. Primary Switched. Electrically isolated between input and output side.

8. Modular design.

9. Mounting type: standard rail mounting or as required.

G. Type: 120V AC to 12V DC

1. Input: 120VAC 60Hz, fused, with harmonic filter (power to be provided by UPS).

2. Output: 12VDC +/-1%.

3. Protection: input and output side protected against overload, short circuits, and reverse voltage.

4. Nominal output current: minimum 20% greater than the maximum current to be supplied.

5. Operating and status indication.

6. The residual ripple shall be lower than the maximum required by the connected equipment.

7. Primary Switched. Electrically isolated between input and output side.

8. Modular design.

9. Mounting type: standard rail mounting or as required.

2.8 INDUSTRIAL WIRELESS ETHERNET RADIO

A. Manufacturer:

1. Proxim.

2. Or approved equal

B. The Contractor shall design, furnish all labor, materials, equipment, and incidentals required to engineer, fabricate, assembly, wiring, testing, and debugging of the new Industrial Ethernet Wireless Radio system that will communicate the Elderberry Lake controller with the South Portal Control House controller. The Contractor shall select the frequencies to utilize between 5.2 and 5.8 GHz Spread Spectrum (SS) Radio for the communication link.

C. The Contractor shall provide design, equipment, materials, software, calibration, training, and services required to successfully interface and interconnect the Ethernet Wireless Radio system and associated equipment for the purpose of providing a fully integrated and functional radio system as specified.

D. The Contractor shall furnish all radios, antennas, structures, conduit, cabling, cable accessories, etc., including tools necessary for connecting the Ethernet Wireless Radio System for the sites as specified in the Contract Documents.

E. Omission of a specific item including electrical or electronic devices obviously necessary for the proper function of the equipment shall not relieve the Contractor of the responsibility of furnishing the item at no additional cost to the Owner.

F. Antenna structures shall be free-standing without guy wires.

G. Structures shall be capable of withstanding winds in accordance with EIA/TIA-222.

H. The master, remote and repeater radios must be interchangeable such that all radios are identical.

I. Industrial Ethernet Radio system:
The Ethernet Wireless Radio system shall consist of the following:

1. Radio "Master" equipment. Provide radio, tower, antennas, transmission cable, connectors and mounting hardware as required based on the Contractor provided radio survey path analysis data.

2. A "Remote" radio. Provide radio, tower, antenna, transmission cable, connectors and mounting hardware as required.

3. The topography of the service area do not permit direct line of sight radio paths to the "Remote" radio. Therefore, the radio network shall provide data routing between radios. Data routing between radios may require the use of a repeater link consisting in an arrangement of two back to back Ethernet Wireless radios. The location of repeater radios shall be determined by the Contractor after a radio survey path analysis, and shall be approved by the Owner. Provide communication cabinet, power supplies, tower, antennas, transmission cable, connectors and mounting hardware as required based on the Contractor provided radio survey path analysis data.

J. The following general requirements shall be met by the Industrial Ethernet Wireless radio:

1. Frequency: =5.2-5.8GHz hopping spread spectrum FHSS radio.

2. Data Rate: 1 MB/s minimum. Minimum Throughput 400 KB/s

3. PLC Interface: 10 Base T or better.

4. Agency Approvals: FCC Part 15.247

5. Environmental: 95% at 40 degrees C (104 degrees F); non-condensing. Full performance –30 degrees to +60 degrees C (-22 to 140 degrees F)

6. Output Power: minimum 500 mW (900 MHz), 100 mW (2.4 GHz).

7. Power: 12-24 VDC

8. Indicators: Power, Ethernet link, TX, RX, Ethernet radio link status.

K. Antennas

1. Antennas shall be provided at each site configured for radio telemetry. Antennas shall be omni-directional, sector based and/or parabolic directional as required per the recommendations provided in the Contractor Radio Survey path analysis data report. A minimum 20db fade margin shall be provided for each antenna location.

2. Cable assemblies shall be provided, complete with cable connector and fastening hardware for all antennas.

3. Lightning surge protection shall be provided for all antennas installations, and shall be of the coaxial impulse suppressors combined with AC line

protectors. Lightning surge protectors shall be manufactured by Polyphaser or approved equal. At all locations surge protection devices shall be provided. The grounding of all antennas assemblies shall be checked for the antenna, mast, supports, and where applicable, towers.

4. Antenna masts (not on towers) shall be constructed of 2-inch Schedule 40 galvanized steel or 2-inch schedule 80 aluminum tubing, free-standing without guy wires. Galvanized or aluminum mounting hardware and fasteners shall be provided for each installation, appropriate for the specific location and application.

5. Antenna masts and towers shall be capable of withstanding winds in accordance with EIA/TIA-222.

6. All remote antennas are to be identical for each radio type to reduce spare parts inventory. The repeater location(s) must be configured using the same combination of radios and antennas

7. Antenna structures shall provide grounding sufficient for reasonable lightning and surge protection.

L. Antenna Tower (Fabricated Metal)

1. The tower height shall be determined by the Contractor and be in conformance with the Contractor provided Radio Survey Path analysis data report.

2. The tower shall consist of three vertical faces and be fabricated of high grade steel tubing with steel angle braces. All structural components shall be hot-dipped galvanized after fabrication. The tower shall be fabricated in twenty-foot riser sections, each section being 6-inches smaller on each face than the lower section to which it is connected. Each section shall be provided with double bolt holes at each connection joint. Each section shall be of die-cut equilateral construction and all center section shall be provided with steel angle braces between each set of braces. The tower shall be free-standing rated up to a height of 100-feet, final height to be determined by the Contractor to be in conformance with the Contractor provided Radio Survey Path analysis data report.

3. The top section of the tower shall be provided with a 2-inch pipe projection (top tube) which shall project 30-inches above the tower (total length of top tube to be 52-inches). The top section shall be fabricated of 1 ¼-inch x #14 gauge tubing minimum. The center section shall be fabricated of 1 ½-inch x #12 gauge tubing minimum. The bottom support section shall be fabricated of 2-inch x #10 gauge tubing minimum. Each leg of the bottom support section shall be provided with thick steel base plate, welded to the bottom of the section.

4. Concrete foundations design shall be submitted for review and approval. Concrete foundations and anchor bolts shall be provided.

5. The tower shall be erected such that guy wires shall not be required. The tower erection shall meet all local codes as well as EIA Codes.

6. The complete tower installation shall be capable of withstanding 150-mph winds, with ½-inch radial ice.

7. The tower shall be manufactured by American Tower Company, Shelby, OH, PiROD Inc or approved equal.

8. The antenna shall meet the following requirements:

   - Frequency Range: As required by the Radio manufacturer
   - Gain: As required by the manufacturer.
   - Bandwidth: As required by the manufacturer.
   - Maximum power input: As required by the manufacturer.
   - Lightning protection: Direct ground
   - Connector: As required by the manufacturer.
   - Mounting hardware: As required by the manufacturer.

9. Antenna shall be manufactured by Provide Decibel Products, MaxRad, or Engineer approved equal.

M. Transmission cables and accessories

1. Antenna cable assemblies shall be provided between the antennas and the radios for all sites in the Contract. The cable shall be configured so as to be compatible with the radios and antennas to be furnished under this Contract. Cable lengths will be determined by coordinating with the Owner as to the antenna, mast, and tower locations and the location of the cabinets/enclosures in which the radio is installed.

2. Each antenna cable assembly shall consist of foam-insulation coaxial cable, connectors, grounding kits, surge protector, jumper cables, and tower clamps as required for a complete operational communications link.

3. Bandpass filters: Filters shall be furnished as required to eliminate receiver desensitizing caused by off-channel interference.

4. A radio configuration and diagnostics system shall be furnished with the radio system. This system shall be manufactured by the radio manufacturer(s). The system shall provide configuration capabilities to set up and modify, if necessary, the operating parameters of each radio and provide diagnostic features to test system performance.

PART 3 - EXECUTION

3.1 GENERAL

A. The network configuration shall be done by a person experienced in this type work and have a minimum of 5 years experience in design and configuration of similar type systems. The screen graphics shall match as close as possible the actual device(s) arrangement being controlled.

B. Review meetings shall be setup between the Contractor, the Department, and Engineers to coordinate the network details. The meetings shall be held at the Department's office. As a minimum the following meetings shall take place:

1. Pre-design meeting to define the initial scope details for the various screen content and arrangement requirements.

2. Review meeting at 50% design.

3. Review meeting at 75% design

4. Review meeting at 100% design

3.2 EXAMINATION

A. Verification of existing conditions prior to beginning of work.

B. Verify that mounting holes on panel are correct size and neatly cut.

C. Verify location, routing of cables and grounding in the panel.

3.3 INSTALLATION (NOT USED)

3.4 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under the provisions of the General Specifications and as directed by the Engineer.

B. Verify that all wiring is correct and proper polarities are observed.

C. Verify that all communication functions are available and operational.

3.5 TESTING

A. Refer to Section 16300.

3.6 SPARE PARTS

A. All spare parts shall be of the same material, workmanship, and manufacturer as the corresponding original parts, completely interchangeable and packaged for long-term storage.

B. Spare parts shall include the following:

1. One spare Ethernet switch of each type
2. One media converter of each type
3. Two industrial wireless Ethernet radios
4. Two power supplies of each type

END OF SECTION

SECTION 16365

230KV BAY CONTROLLER SUBSYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section covers the requirements for the 230KV Bay Controller subsystem.

1.2 DESCRIPTION OF WORK

A. 230kV Bay Controller system consisting of

1. 230kV bay controllers and sync check (for units 1 through 7, the 14 230kV bay positions and the unit 7 11Kv bay position).

2. One synchronizer for each generator

3. 230kV/Unit protection relay monitoring

4. High and Low side unit and transformer data acquisition

5. Mounting of all equipment on multiple panels that will present a graphical one-line representation of the 230kV and unit systems.

6. Equipment necessary to allow manual control of each 230 kV line breaker

7. Equipment necessary to allow manual synchronization of each generator and control of each 230kV /11kV breaker.

1.3 REFERENCES, SPECIFICATIONS, CODES AND STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

B. National Electrical Manufacturers Association (NEMA)

C. National Electrical Code (NEC)

NEC-2005 National Electrical Code

1.4 SUBMITTALS

A. Refer to Section 16300 for submittal requirements.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Exercise care in transporting and handling to avoid damage to materials.

B. Store materials on the site so as to prevent damage or theft.

C. Keep materials clean, dry, and free from deleterious conditions.

D. Do not store materials directly on the ground.

E. Repair or replace damaged material or equipment to satisfaction of the Department.

F. Protect electrical equipment, controls, and insulation against moisture or water damage.

PART 2 – PRODUCTS

2.1 230 KV & 11 KV BAY CONTROLLER RELAY PANELS UNITS 1, 2, 3, 4, 5, 6 & 7

A. The contractor shall furnish seven relay panels, fully engineered, assembled, wired and tested for 230 kV & 11kV Bay Controllers and unit automatic synchronizers, associated with each unit (for units 1 through 6, an additional IED for acquiring unit metering data, 230 kV Bay Controllers for transmission lines shall be used), manual synchronizing equipment and various other components. Each panel will display a graphical representation of the one-line diagram of the 230 kV & 11 kV and unit electrical systems.

B. Twenty of the twenty-seven Siemens model 7SJ64 bay controllers required for these panels are devices that are currently installed at the Castaic Power Plant in the existing 230 kV relay panels. The existing devices will be upgraded to the latest firmware and IEC61850 communications modules prior to installation into the relay panels. These units will be furnished with 5 year warranties.

2.2 230 KV BAY CONTROLLER RELAY PANELS FOR UNITS 1, 2, 3, 4, 5, 6

A. Each relay panel will be configured with the following Siemens relay equipment:

Panel No. 1	**230 kV Bays 1 and 2 and Unit 6**	
Mfg. / Part No.	**Qty**	**Description**
7SJ6415-4EC92-3FE4+LOS	2	Unit 6 Bay controllers w/ ANSI #25 synch check
7VE6320-4EC92-0CA0+LOS	1	Unit 6 Automatic synchronizer
7SJ8041-5EC90-3FB0+LOS	2	Unit 6 metering data
7SJ6415-4EC92-3FE4+LOS	2	Castaic – Olive transmission line Bay controllers w/ ANSI #25 synch check

Panel No. 2	230 kV Bays 3 and 4 and Unit 5	
Mfg. / Part No.	**Qty**	**Description**
7SJ6415-4EC92-3FE4+LOS	2	Unit 5 Bay controllers w/ ANSI #25 synch check
7VE6320-4EC92-0CA0+LOS	1	Unit 5 Automatic synchronizer
7SJ8041-5EC90-3FB0+LOS	2	Unit 5 metering data
7SJ6415-4EC92-3FE4+LOS	2	Future transmission line Bay controllers w/ ANSI #25 synch check.

Panel No. 3	230 kV Bays 5 and 6 and Unit 4	
Mfg. / Part No.	**Qty**	**Description**
7SJ6415-4EC92-3FE4+LOS	2	Unit 4 Bay controllers w/ ANSI #25 synch check
7VE6320-4EC92-0CA0+LOS	1	Unit 4 Automatic synchronizer
7SJ8041-5EC90-3FB0+LOS	2	Unit 4 metering data
7SJ6415-4EC92-3FE4+LOS	2	Bus tie Bay controllers w/ ANSI #25 synch check

Panel No. 4	230 kV Bays 7 and 8 and Unit 3	
Mfg. / Part No.	**Qty**	**Description**
7SJ6415-4EC92-3FE4+LOS	2	Unit 3 Bay controllers w/ ANSI #25 synch check
7VE6320-4EC92-0CA0+LOS	1	Unit 3 Automatic synchronizer
7SJ8041-5EC90-3FB0+LOS	2	Unit 3 metering data
7SJ6415-4EC92-3FE4+LOS	2	Castaic – Sylmar transmission line Bay controllers w/ ANSI #25 synch check

Panel No. 5	230 kV Bays 9 and 10 and Unit 2	
Mfg. / Part No.	**Qty**	**Description**
7SJ6415-4EC92-3FE4+LOS	2	Unit 2 Bay controller w/ ANSI #25 synch check
7VE6320-4EC92-0CA0+LOS	1	Unit 2 Automatic synchronizer
7SJ8041-5EC90-3FB0+LOS	2	Unit 2 metering data
7SJ6415-4EC92-3FE4+LOS	2	Castaic – NR transmission line Bay controllers w/ ANSI #25 synch check

Panel No. 6	230 kV Bays 11 and 12 and Unit 1	
Mfg. / Part No.	**Qty**	**Description**
7SJ6415-4EC92-3FE4+LOS	2	Unit 1 Bay controller w/ ANSI #25 synch check
7VE6320-4EC92-0CA0+LOS	1	Unit 1 Automatic synchronizer
7SJ8041-5EC90-3FB0+LOS	2	Unit 1 metering data
7SJ6415-4EC92-3FE4+LOS	2	Future transmission line Bay controllers w/ ANSI #25 synch check.

2.3 230 KV BAY CONTROLLER RELAY PANEL UNIT 7

A. The contractor shall furnish one relay panel, fully engineered, assembled, wired and tested for 230 kV & 11kV Bay Controllers and unit automatic synchronizer, associated with this unit, an additional IED for acquiring unit metering data, manual synchronizing equipment and various other components. The unit 7 relay panel shall be installed in the Unit 7 control room by Department personnel. The bay controller panel shall include the associated relay equipment to select the synchronization source PTs (Bank 3, Bank 4 or low side unit 7 transformer). Department shall provide the source PTs with the same phase relationship to allow the syncroscope to function correctly. Each relay panel will be furnished with the following equipment:

B. The Unit 7 relay panel will be configured with the following Siemens relay equipment:

Panel No. 7	**230 kV Bays 13 and Unit 7**	
Mfg. / Part No.	**Qty**	**Description**
7SJ6415-4EC92-3FE4+LOS	2	Unit 7 Bay controller w/ ANSI #25 synch check
7VE6320-4EC92-0CA0+LOS	1	Unit 7 Automatic synchronizer
7SJ8041-5EC90-3FB0+LOS	0	Unit 7 metering data
7SJ6415-4EC92-3FE4+LOS	1	11 kV Bay controller w/ ANSI #25 synch check

2.4 PANEL CONSTRUCTION

A. SynchroScope Meter

Each panel shall be furnished with one model 2109 Yokogawa synchroscope. For units 1 through 6 the synchroscope shall interface to the two 230 kV buses using a 3 position selector switch (off, bus 1/3, bus 2/40) that shall allow the monitoring of the phase between the generator and either bus.

B. Switches

All control and instrument switches shall be of the rotary switchboard type with handles on the front and the operating mechanisms on the rear of the panel. Contacts of all switches shall be self-aligning and shall operate with wiping action. A positive means of maintaining high pressure on closed contacts shall be provided. The rear switch covers or plates shall be readily removable for inspection of contacts. Switches shall be Electro Switch Type 24, or equal.

The switch legend plates shall be engraved as shown on the Department approved Contractor Drawings.

C. Indicating lights

1. Indicating lamp assemblies shall be LED assemblies of the switchboard type, suitable for 125 V dc service, with appropriate color caps and

integrally mounted resistors. The LED lamps shall be replaceable from the front of the panel. All color caps shall be interchangeable, and all

2. LED lamps shall be of the same type and rating. The lamp assemblies shall be GE Type ET-16-LED or "approved" equal. The lamp legend plates shall be engraved as shown on the Department "approved" Contractor Drawings.

D. Test Switches

Test switches shall be Flexitest Type ABB 129A501G01A for currents and ABB 129A501G01A for potential. All test switches shall include removable cover.

E. Wiring

1. The 230kV bay controller panel assembly shall be completely wired, and wires for connections to remote equipment shall be brought to terminal blocks. All wiring shall be neat and workmanlike, without splices and with a uniform arrangement of circuits. Wire bundles or single wires shall run in straight lines with 90° corners, where change of direction is required.

2. Panel wiring, inside the panel, shall be #16 AWG. Wiring shall be UL type, SIS, or MTW, flexible stranded copper, control wire. If wire is exposed to oil it shall be THN. Minimum conductor sizes shall be as follows:

a. Current transformer circuits: #12 AWG minimum for panel wiring, #8 AWG for external field wiring.

b. Potential transformer and control circuits: #16 AWG minimum

c. Alarm circuits: #16 AWG minimum

d. Instrument and communication circuits: #18 AWG minimum

e. Analog inputs shall be shielded triad (RTDs) or twisted pairs.

3. Wiring shall be neatly bundled and tie wrapped.

4. Wire bundles crossing hinges shall be securely clamped to both the door and the panel, and run parallel to the hinge for at least half the door length to prevent chafing. No splicing shall be permitted in the wire duct or spiral wrapped wire bundles.

5. The wires connecting the various devices to each other and terminal blocks shall be labeled at both ends with destination codes. Wire labels shall be white heat shrink polyolefin sleeves with black lettering. Wire labels shall be Floy Tag & Manufacturing, Inc. Type FT-200S, or "approved" equal.

6. Terminal blocks shall be Department standard States Type ZWM-250 sliding link terminals.

7. All terminals for connection to field devices shall be "link" type and have means of disconnecting the field device without removing wiring.

F. Finish

The finish shall consist of a coat of air-dried enamel applied to clean and phosphatized steel for internal and external parts. The panels shall be given an exterior finish coat of gray enamel ANSI No. 61.

PART 3 - EXECUTION

3.1 SHOP ASSEMBLY, MEASUREMENTS AND TESTS

A. Training. The Contractor shall provide a training program for review and approval by the Department.

B. Recommended Spare Parts. The Contractor shall include the recommended spare parts in the Bid Forms for all equipment provided as part of this subsystem.

C. Installation.

The 230KV panels will be installed by the Department in accordance with the Contractor furnished drawings under the supervision of the Contractor.

The Contractor shall power up, test, commission, and integrate the 230KV panel the Unit Control System for each specific unit.

The Contractor shall provide a Manufacturer's representative as required during the commissioning of the control system.

The Contract shall provide all Operating and Maintenance Manuals in accordance with Section 01300.

END OF SECTION

SECTION 16370

EXCITATION SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section defines the functional and performance requirements for the design, delivery, installation, start-up, commissioning, and on-site support of the new Excitation Systems for Castaic Generator/Pump Units 1-6.

1.2 DESCRIPTION OF WORK

A. The six existing excitation systems for Units 1-6, each rated at 287.5 MVA, will be replaced. Exciters installed on Units 1, 3, 4, and 5 have the original exciters. Exciters installed on Units 2 and 6 are Siemens THYRIPOL exciters.

B. The Department will remove the existing excitation systems and install the new systems designed and furnished under this Contract, utilizing the existing excitation transformer. The new excitation system shall include a Power System Stabilizer (PSS).

C. The ratings of the existing excitation transformer is as follows:

1. Capacity: 1000 kVA
2. Voltage: 4160V/460V
3. Frequency: 60 Hz

D. The nominal ratings of the new exciter shall be as follows:

1. Nominal Excitation Current: 1217 A
2. Maximum Excitation Current: 1373 A
3. Nominal Excitation Voltage: 315 V
4. Maximum Excitation Voltage: 567 V

These values shall be subject to review, and shall be confirmed to produce the maximum generator output of 287.5 MVA.

1.3 REFERENCES, SPECIFICATIONS, CODES AND STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

IEEE 421.1	IEEE Standard Definitions for Excitation Systems For Synchronous Machines

B. Institute of Electrical and Electronics Engineers (IEEE)

IEEE 421.2	IEEE Guide for Identification, Testing, and Evaluation of the Dynamic Performance of Excitation Control Systems

C. Institute of Electrical and Electronics Engineers (IEEE)

IEEE 421.3	IEEE Standard for High-Potential Test Requirements for Excitation Systems for Synchronous Machines

D. Institute of Electrical and Electronics Engineers (IEEE)

IEEE 421.5	IEEE Recommended Practice for Excitation System Models for Power System Stability Studies

E. National Electrical Manufacturers Association (NEMA)

F. National Electrical Code (NEC)

NEC-2005 National Electrical Code

1.4 SUBMITTALS

A. Refer to Section 16300 for submittal requirements.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Exercise care in transporting and handling to avoid damage to materials.

B. Store materials on the site so as to prevent damage or theft.

C. Keep materials clean, dry, and free from deleterious conditions.

D. Do not store materials directly on the ground.

E. Repair or replace damaged material or equipment to satisfaction of the Department.

F. Protect electrical equipment, controls, and insulation against moisture or water damage.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS.

A. The exciter shall be a digital static system of the potential source rectifier type. It shall consist of three (3) major components: Rectifier Assembly, Regulator Assembly, and De-excitation assembly.

B. The rectifier assembly shall be a three-phase, full-wave, inverting thyristor bridge(s), which will convert the 3-phase input power from the power potential transformer into DC and will control the DC level by firing angle control.

C. The regulator assembly shall include automatic voltage regulator, manual regulator, power factor/VAR controller, and power system stabilizer control modules. The regulator assembly shall be microprocessor based and have internal diagnostics that continuously monitor the performance of the exciter and initiate alarms and corrective action as necessary. The regulator shall include software and hardware protective functions and devices.

D. The de-excitation assembly shall include de-excitation and crowbar equipment to prevent over-voltages during abnormal conditions and normal shutdown of the exciter. It shall also provide field flashing for startup and filtering for shaft voltage suppression to minimize shaft current.

E. The rectifier assembly, regulator assembly, and the de-excitation assembly shall be an integrated unit.

F. The rectifier assembly, regulator assembly, and the de-excitation assembly shall be an integrated unit.

G. Each regulator shall be interfaced via hardwired and digital signals to the new Plant Control System (PCS) for remote control and monitoring functions, and for Back-to-Back starting mode of operation.

H. The digital interface shall be Ethernet. The Contractor shall fully integrate the regulator into the Plant Control System.

I. The regulator shall have a separate communication port to facilitate a laptop-based workstation for maintenance, calibration, and testing. All adjustments in the exciter are to be software controlled through the workstation, local OIT, or both.

J. The exciter shall be equipped with a power system stabilizer (PSS). The PSS shall introduce a supplementary control signal into the automatic regulator. The

input signal shall cause the Excitation System to introduce a change in the field voltage in proportion to and approximately in phase with deviations from the normal frequency and or power, and thereby improve power system dynamic performance.

K. The exciter shall be equipped with an internal test oscillator that is capable of introducing a software controlled step function for measuring online and offline regulator and power system stabilizer responses. The test oscillator shall also be capable of introducing random noise for regulator and power system stabilizer frequency response tests. The exciter shall have the ability to store test data either internally or in the workstation.

2.2 DESIGN REQUIREMENTS.

A. Each exciter shall be capable of providing excitation to the motor-generator under its full range of operation, in all modes, (generator, pump, condense, pump starter, cold start) without exceeding the rating of any component of the Excitation System.

B. Each exciter shall have high initial response as defined in IEEE Standard 421.1.

C. Each exciter shall have an Excitation System nominal response of not less than 4 as defined in IEEE 421.2 when bus voltage is 1.0 per unit.

D. The exciter shall be capable of both positive and negative field forcing and be capable of supplying the Excitation System ceiling voltage for a minimum of 60 seconds without overheating the Excitation System components.

E. The exciter shall have voltage matching capability for synchronization.

F. The automatic voltage regulator shall have the ability to control the motor-generator terminal voltage to within a maximum variation of one-half percent (0.5%), from no-load to full rated load. The control range limits shall typically be from eighty five percent (85%) to one hundred ten percent (110%) of rated terminal voltage with upper and lower limits adjustable over a range from 40% to 110% rated terminal voltage. Variations in terminal voltage shall not exceed plus or minus one percent (±1%) for variations in frequency of plus or minus ten percent (±10%).

G. A manual voltage regulator shall be provided to operate the Excitation System, if the automatic voltage regulator is disabled. The manual regulator shall be able to adjust the excitation output from a minimum of twenty percent (20%) of the full motor-generator field voltage to one hundred twenty (120%) of the full load motor-generator field voltage.

H. The dc output shall limit harmonic distortion with not greater than one-half percent (0.5%) total harmonic distortion (THD), controlled by suitable filters, to minimize harmonic heating of the generator field, audible noise, and possible shaft voltages.

I. All electronic equipment, such as amplifiers, integrated circuits and power semiconductors, shall use industrial or military grade components bearing Joint Electron Device Engineering Council (JEDEC) registered device numbers and shall be suitable for operation at temperatures between 0°C and 70°C. Custom designed electronic components that do not have a JEDEC designation must be identified and approved by the Engineer. The value of resistors, capacitors, and other passive components shall be marked on the device

J. SCRs, and other power semiconductors shall be commercially available from a minimum of two sources. Exception to this requirement may be considered at the sole discretion of the Engineer.

K. The cubicle interior temperatures shall be properly controlled for the design ambient conditions.

L. The new Excitation System shall include black-start capability.

M. The digital control system for the new Excitation System shall be fault tolerant, i.e. redundant processors, redundant power supplies, etc. such that no single point failure would degrade the Excitation System reliability and availability.

2.3 RECTIFIER ASSEMBLY.

A. The new rectifier assembly shall be 100% redundant, full-wave, three-phase bridge with complete draw-out capability for ready servicing. The assembly shall include individual fuses for thyristors and other critical elements and indication/locaters for blown fuses and/or bad thyristor elements.

B. Each SCR shall have no more than fifty percent (50%) of its maximum average on-state current at IFFL conduction. The repetitive peak forward and reverse voltage on the SCR shall not exceed one-third (1/3) of its rated value.

C. The SCR shall be sized so that junction temperature does not exceed 125°C or maximum temperature as recommended by manufacturer whichever is less. The case temperature shall not exceed 80°C, or the maximum temperature recommended by the manufacturer whichever is lower.

D. Each SCR shall be protected by an RC snubber network and a rectifier type fuse. The fuse shall be rated so that the maximum input AC voltage to the bridge is not more than the RMS voltage of the fuse. The fuse shall also be sized to the correct symmetrical RMS short circuit current. Each fuse shall have a fuse indicator.

E. The new rectifier assembly shall be cooled by forced convection (fans). The forced convection system shall consist of two (2) sets of fans, either of which can supply sufficient cooling air to keep the assembly within the specified temperature limits. The fan control system shall be such that if one set of fans is disabled, the control system shall automatically switch over to the set of stand-by fans and alarm the condition. There also shall be replaceable filters on the intake side of the fans or vents with the forced convection system.

2.4 REGULATOR ASSEMBLY.

A. The regulator assembly shall include the automatic regulator, manual regulator, power factor/VAR controller, and power system stabilizer modules.

B. The regulator assembly shall be a fully digital, microprocessor based, redundant controller with redundant communication channels. All regulator adjustments shall be by software parameters. Digital memory for operation, program configuration, and set points shall be non-volatile without the need for changing batteries or other maintenance.

C. The regulator shall automatically perform diagnostics and self-tests on power-up of the exciter to verify that the hardware and software are fully operational and shall continuously verify, after power-up, that the digital computer is performing all of its tasks without error. In the event of a failure, the system would automatically transfer from automatic mode to manual mode and alert the operator for system or component failure with diagnostic tools to resolve and fix the problem.

D. The regulator functions shall hold the particular regulated quantity at an operator-ordered setpoint. For each function, the regulator gain, range of setpoint and ramping rates shall be individually adjustable. Setpoint followers shall be provided to ensure 'bumpless' transfers between regulator functions – automatic to manual to power factor/VAR controls. Bandwidth and time delays shall be individually adjustable for each setpoint follower.

2.5 AUTOMATIC VOLTAGE REGULATOR

E. The motor-generator terminal voltage shall normally be controlled by the automatic voltage regulator (AVR). The AVR shall be continuously acting by comparing the average three-phase voltage of the motor-generator with a reliable voltage reference. The error voltage will automatically raise or lower the Excitation System output in such a manner as to maintain the motor-generator voltage to its desired value. The AVR shall also have appropriate current sensing and provisions for reactive current compensation to limit undesirable VAR exchange between paralleled motor-generators.

F. The AVR shall have a range of voltage control of minus fifteen percent (-15%) to plus ten percent (+10%) of rated voltage, with upper and lower limits adjustable over a range from forty percent (40%) to one hundred ten percent (110%) rated voltage. The AVR voltage adjustment shall be electronic, and not involve a motor operator. It shall have an accuracy of plus or minus one-half percent (±0.5%) over the range from no load to full load excitation.

G. When operating in automatic regulator mode, slow temperature changes within the excitation equipment over a 50°C range shall not cause a change in the motor-generator voltage of more than plus or minus one-half percent (±0.5%).

2.6 MANUAL VOLTAGE REGULATOR

A manual regulator (DC regulator) shall be furnished that regulates the dc voltage applied to the motor-generator field. The DC regulator shall have a range of adjustment of excitation voltage from twenty percent (20%) to one hundred twenty percent (120%) at rated load, rated power factor, and one hundred five percent (105%) rated motor-generator voltage. Manual voltage set point adjustment shall be available from the front of the excitation cubicle enclosure.

2.7 POWER FACTOR/VAR REGULATOR

A. A power factor/VAR regulator shall be furnished that can maintain either power factor or VARs to a preset level.

B. The VAR regulator shall be adjustable to control VAR output between one hundred percent (100%) over-excited to 0 VAR output to one hundred percent (100%) under-excited. The VAR control shall include a deadband, adjustable between one-half percent (0.5%) and ten percent (10%) rated MVA output and a time delay, adjustable between 0.02 to 10 seconds.

C. The power factor regulator shall be adjustable to control motor-generator power factor between 0.9 power-factor (pf) lead and 0.9 pf lag with a deadband adjustable between 0.01 and 0.1 pf and a time delay adjustable between 0.02 and 10 seconds.

2.8 POWER SYSTEM STABILIZER

D. The power system stabilizer (PSS) shall induce a supplementary control signal into the automatic regulator to improve power system dynamic performance. The PSS shall receive input signals from variations in both power and frequency. The PSS shall condition the signals and introduce a change in the field voltage in proportion to and approximately in phase with the deviation from power and frequency.

E. The PSS shall be a dual input integral type of PSS model, IEEE Type PSS2A., Standard 421.5 "Recommended Practice for Excitation System Models for Power System Stability Studies."

F. All PSS parameters shall be software controlled.

G. The stabilizer shall be equipped with both an external switch and a software parameter either of which can enabled/disable the feature. An external alarm shall be provided that annunciates the stabilizer's condition.

2.9 AUTOMATIC/MANUAL REGULATOR TRANSFER

A. The regulator shall have provisions for automatic tracking to accomplish bumpless transfer between AVR to Manual voltage regulator control modes.

Field excitation disturbance during transfer from one mode to the other shall not exceed 1 percent (1%) of the desired excitation.

2.10 AUTOMATIC FAILOVER CONTROL

A. The voltage regulator shall have the capability to continuously monitor its own function. When AVR failure is detected, transfer to the manual voltage regulator mode shall occur automatically without causing a motor-generator shutdown.

B. In the event of sustained over excitation, transfer from automatic voltage regulation to manual voltage regulation shall be made after an adjustable delay. If the over excitation condition persists after an additional adjustable time delay in the manual regulation mode, the Excitation System shall automatically shut down and shall initiate a generator shutdown.

2.11 WORKSTATION

A. A laptop based workstation will be supplied by the Department for maintenance, calibration, and testing. All adjustments for the exciter shall be software controlled through the workstation, or an OIT. The Contractor shall supply all software necessary to perform all Excitation System maintenance, calibration and testing. The software shall be the latest version available and shall be compatible with Windows XP Professional Edition. The regulator shall have a dedicated communication port to facilitate connection to the workstation. The Contractor shall provide any cables and /or special devices necessary to connect the workstation with the regulator.

2.12 REMOTE CONTROL

A. The Plant Control System shall perform the remote control of the existing exciter via hardwired control and Ethernet signals.

2.13 LOCAL CONTROL

The regulator shall have sufficient control and indication at the exciter cabinet to allow local control and normal and abnormal condition monitoring. The following is a list of typical expected features. The actual functions may vary provided the exciter is equipped with sufficient control and indication to allow safe, efficient local control.

1. Field current amps
2. Field voltage volts
3. Transfer from remote to local control
4. Voltage for manual and automatic regulators
5. Field raise-lower control for automatic voltage regulators with indication from minimum and maximum excitation

6. Field raise-lower control from manual regulator with indication for minimum and maximum excitation
7. Regulator mode transfer (automatic, manual, VAR/pf and test)
8. Field flashing control
9. Full local annunciation

2.14 DE-EXCITATION ASSEMBLY

A. The De-Excitation assembly shall provide all necessary protection and control functions to insure the exciter and motor-generator field do not experience excessive voltages or currents during normal operation or transient conditions. The De-Excitation assembly shall also include the field flashing circuit components.

B. The field winding shall be protected against repetitive and non-repetitive transients through the use of thyrite resistors during normal shutdown of the unit. The clamping level shall be field adjustable. The response time shall be less than 100 milliseconds.

C. The field winding shall be protected against transient over-voltage conditions with a Crowbar/De-Excitation circuit consisting of a field discharge resistor and a parallel arrangement of thyrite thyristors self-triggered by a field adjustable sensing element. Sensing of current flow in the crowbar circuit shall also phase back the excitation power bridge. The crowbar/de-excitation circuit shall be designed to rapidly discharge all energy in the field under fault conditions. The response time shall be less than 100 milliseconds.

D. The Excitation System DC output shall have suitable filters to limit harmonics to not greater than one-half percent (0.5%) total harmonic distortion (THD), or to limit shaft voltage to less than 5 volts zero to peak, whichever condition results in the minimum shaft voltage.

E. The de-excitation assembly shall include a system, which will raise the motor-generator terminal voltage to a suitable level, sufficient for the static exciter to begin to control the motor-generator voltage. Field flashing shall be accomplished through the short-term connection of a dc circuit from the existing 125VDC station battery to the motor-generator field. The field flashing circuit shall have suitable features to protect the station battery, the rectifiers and DC field flashing contactors from transient voltage spikes during connection and disconnection of the field.

F. New DC buswork, if provided, within the excitation cubicles shall be non-segregated, rigid, silver-plated copper, with bolted connections.

2.15 LIMITER AND PROTECTIVE FUNCTIONS

The Regulator shall have the following limiter and protective functions:

A. Over/Under Excitation Limiters. The Over/Under Excitation Limiters shall prevent the exciter from driving field voltage outside safe, acceptable limits. The limiters shall be equipped with adjustable timers so that temporary voltage extremes do not inadvertently trip the unit. The limiters shall function to monitor and maintain steady state stability limits, motor-generator capability limits in an under-excited mode, cumulative timed and instantaneous thyristor and field winding capability limits in an over-excited mode.

B. Motor-Generator Capability Limiter. A function shall be provided to limit exciter operation to the acceptable regions of the upgraded motor-generator capability curve.

C. Volts/Hertz Limiter. The ratio of the motor-generator voltage to motor-generator frequency shall be limited in order to prevent damage to the motor-generator and main transformer. This function shall take control of the regulator at a preset value and prevent the V/Hz ratio from exceeding this preset value. This function shall provide protection when motor-generator is either on or off line.

D. Loss of Excitation Protection. The loss of excitation may cause damage to the amortisseur winding due to unit operating as an induction motor-generator. The regulator shall be equipped with a loss of excitation relay. This relay shall be an impedance type and shall be adjustable. When loss of excitation is detected, a signal shall trip the motor-generator shut down relay.

E. Field Ground Fault Protection. The field shall have a protective relay for detecting a short circuit between the field winding and ground. Should a ground fault be detected, the relay shall initiate an alarm.

F. Field Over-Voltage Protection. The field shall be protected by normal and backup protective functions to prevent the field from being exposed to over-voltage conditions during both on-line and off-line operations. This protection shall be provided by protective functions within the regulator to detect and initiate protective measures for sustained over-voltage on the field. A backup protective relay shall be provided to detect sustained field over-voltage and, in coordination with other protection, initiate generator shutdown.

G. Loss of Voltage Detection. This protective function shall detect the loss of potential transformer (PT) voltage input to the regulator. After an adjustable time delay, the protective function shall initiate an alarm, initiate a transfer to manual regulator and/or shutdown the motor-generator depending upon the protection logic.

H. Rotor Temperature Detection. A function shall be provided to determine the rotor field temperature by calculating field resistance from the field current and voltage. An adjustable high temperature alarm shall be initiated when rotor field temperature exceeds a preset value.

I. Power Converter Temperature Detection. The power converter shall be equipped with sensors to monitor temperature and initiate two adjustable temperature alarm levels. The lower temperature shall activate an alarm. The higher temperature shall initiate a unit shutdown.

J. Loss of Cooling Monitoring. The power converter shall be equipped with loss of cooling air flow and/or pressure resulting from fan failure. Detection of loss of cooling shall activate an alarm and initiate start of the redundant fan. Loss of both fans for more than a fixed time delay shall result in automatic motor-generator shutdown.

K. Watch Dog Timer. The regulator's microprocessor shall be equipped with self-diagnostic function that, on detection of a failure shall activate a watchdog timer resulting in an alarm and unit shutdown if both processors failed.

L. Electrical Lockout Relay. Contacts from exciter for tripping Department's 86E electrical lockout relay shall be provided.

PART 3 - EXECUTION

3.1 SHOP ASSEMBLY, MEASUREMENTS AND TESTS

A. The upgraded Excitation System shall be fully assembled and tested in the Manufacturer's shop. Parts needing to be dismantled for shipment shall be properly match marked to ensure correct assembly and alignment of parts in the field.

B. The Contractor shall make available for Department's inspection all assemblies and test set-ups and shall notify the Department in advance when such assemblies and test arrangements will be completed.

C. The Contractor shall furnish the Engineer with complete copies of all factory test results. Data that involves plotted curves and other tabulated information shall be furnished in electronic form suitable for reading with an EXCEL spreadsheet.

D. Rectifier Assembly. Each new rectifier assembly shall have the following production (routine) tests performed; and the first rectifier assembly shall also have the following design tests performed:

High Potential Test	Per IEEE 421.3
Rated Current Test	Per IEEE 421.4, Sec 12.5
Rated Load Test	Per IEEE 421.4, Sec 12.5
Phase Control Test	Per IEEE 421.4, Sec 12.5
Loss Measurement	Per IEEE 421.4, Sec 12.5

Temperature Rise	The case temperature of the SCR shall be accurately measured at rated load. This shall be accomplished by using temperature sensitive paints which change states above specified temperatures. Omega Engineering paints or equal shall be used for this application. The cooling media shall be accurately measured. This rise shall not exceed that specified under the case temperature section.

Routine Tests - for the All Units

Rated Voltage Test	Per IEEE 421.4, Sec 12.5
Dielectric Strength	Per IEEE 421.4, Sec 12.5

E. Regulator Assembly. Each regulator assembly shall have the following production tests performed:

1. Continuity checks
2. Verification of all parameter settings
3. Verification of all limit settings
4. Demonstration of Diagnostic Functions
5. Other Contractor recommended tests, as necessary

F. De-excitation Assembly. Each de-excitation assembly shall have the following production tests performed:

1. Continuity checks
2. Verification of all settings
3. Other Contractor recommended tests, as necessary

G. DC Field Bus. Contractor shall perform the following tests on each manufactured length of new DC field bus:

Dielectric withstand	2.2kV RMS for 1 minute
Temperature rise of bus and enclosure	Per ANSI C37.20, Section 8.2.2.2

H. Field Tests. Contractor shall assist the Department in conducting a full set of field acceptance tests and WECC PSS certification tests described in these Specifications to ensure the Excitation System is correctly configured, fully integrated with the Plant Control System and is functioning properly.

I. Submittals. Contractor shall provide submittals in accordance with Section 16300 of the Specifications.

J. Spare Parts. The Following Spare Parts shall be furnished. A set of spare parts is defined as the total number required for the equipment.

1. One complete set of control devices including regulators, limiters, control power supplies, trip and close coils, springs, gasket, contactors, instruments, and auxiliary relays.

2. One complete power thyristor removable model of each type, including thyristor fuses, indicating lamps, firing circuits, and voltage protective elements

3. Four power thyristor and diodes of each type and rating furnished.

4. Four thyristor fuses of each type and rating furnished.

5. One printed circuit board of each type furnished.

6. One complete set of control fuses.

7. Ten complete sets of indicating lamps.

8. One complete cooling fan of each type including fan motor and controls

9. One space heater and control thermostats of each type.

K. Recommended Spare Parts. The Contractor shall indicate the price for the recommended spare parts in the Bid Forms for all new components furnished with the Excitation System.

M. Installation.

The excitation system will installed by the Department in accordance with the Contractor furnished drawings.

END OF SECTION

SECTION 16380

DIGITAL GOVERNING SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section covers the requirements for the design, manufacture, shop-testing, delivery to the Site and supervision of erection, programming, configuring and adjusting, Supervising site testing, for the upgrade of the existing governing systems of generating Units # 1 through 6, with accessories and a full set of spare parts, in accordance with the Contract Documents.

1.2 DESCRIPTION OF WORK

A. Number of digital governing systems to be upgraded:

6 for Francis pump-turbines Units # 1 to 6

B. The digital governing system comprises of the following components:

- Digital governor microprocessor controller located in the governor cabinet;
- Electro-hydraulic transducer; pilot valve assembly; distributing valve assembly; other valves controlling flow, pressure, opening/closing rates; motor driven oil pumps and associated unloader valves, check valves and strainers; oil filters; all equipment located above the sump tank;
- Sump tank with various connections for filling, draining, isolating, breathing, level and temperature measurements;
- Governor electrical cabinet housing indicating and control devices, all input and output modules, and electrical control circuits arranged in removable racks with electrical connectors;
- Accumulator tanks;
- Governor air-charging system that charges the accumulator tanks with air.

C. The scope of the upgrade for the digital governing system includes:

- Disassembly of components that will be replaced, furnishing and installation of new components of the Digital Governing System, start-up, functional testing and commissioning, acceptance testing of the upgraded governing system; studies, designs and simulations required to upgrade the existing governors;

- Elaboration of the documents and manuals, and furnishing of materials and labor required to integrate the governing system with the automatic control system of the generating units;

- Training the Department's operation and maintenance staff regarding the operation and maintenance of the upgraded digital governing system;

D. The Digital Governing System Upgrade is a part of the power plant automation upgrade.

The scope of the power plant automation upgrade contract includes replacing the hardwired relay sequence control logic with PLC based control logic and software in order to provide fully automatic operation. The contractor for the upgrade of the power plant automation shall provide fully redundant Allen-Bradley ControlLogix (latest hardware and software version) PLC's for each of the unit controllers. The Unit Controllers shall be provided in cabinet to be installed by the Department in the cable room at El. 1562. The inputs and outputs from and to field devices and systems will be wired by the Department to the contractor furnished remote I/O cabinets as shown on the drawings. All communications outside cabinets shall be designed using fiber optic interfaces. Each unit shall be provided with redundant self-standing PLC's, I/O's and a local human machine interface (HMI). Similarly, each Turbine Shut-Off Valve (TSOV) shall be provided with redundant self-standing PLC's, I/O's and a local HMI. The HMI shall be implemented using a Windows based PC system as specified in Section 16330. All critical faults that require immediate separation of a unit Generator/Motor from the electrical grid shall be implemented using hardwired trips initiated by the protection relays. Each Unit Controller shall include a digital (processor to processor) interface with the Department's furnished digital excitation controller and Governing System furnished by the Contractor. Monitoring for the step-up transformer (main bank) shall also be provided.

Units 1, 3, 4, and 5 are equipped with a Woodward 517 microprocessor based governor controller. The digital governor for Units 2 and 6 is embedded in the Voith-Siemens PLC based unit controllers PLC's, and shall be relocated into new, redundant Governor controllers.

E. The objective of the digital governing system upgrade is to upgrade the governing systems of all pump-turbine units, including the recently upgraded units # 2 and 6, with uniform equipment station-wide. The Department needs to have standard operator interfaces, standard software components, consistent and acceptable system wide performance, acceptable documentation and well-documented and maintainable digital interfaces.

The upgrade equipment for the digital governing system, control and instrumentation shall be capable of communicating with one another, and other equipment through standard industry protocols such as Modbus, Profibus etc.

F. The Contractor shall submit a coordinated and adequate design that complies with the requirements and intentions of the Contract Documents and the best engineering practice. The Contractor shall include any component necessary or

desirable to complete the supply, and for satisfactory and reliable operation even when not specifically mentioned or required in the Contract Documents.

G. Prior to starting on the design of the upgrade governing system, the Contractor shall carry out signature tests of the existing governing system to determine its present characteristics. Then stability studies and simulations to determine optimum regulation while connected to the electric grid as well as isolated load operation shall be performed.

H. The cost of installation supervisors, start-up, commissioning, and test engineers and all other costs associated with the task of supervising the installation, commissioning and testing the governing system upgrade shall be included in the corresponding bid item.

I. The Department under the supervision of the Contractor shall install all new and replacement components, and refurbished components for the Digital Governing System, such as governor control cabinets, electrical control cabinets, governor distribution valve, pilot valve, etc.

J. The Department will carry out all field wiring based on the Department's installation drawings including electrical schematics and cabinet wiring diagrams.

K. New equipment or components shall, in all respects, in the opinion of the Department, be superior to, or at least equal to, the parts they replace, or are redundant to, unless otherwise specified.

L. A site visit to assess the present status of the existing governing systems, controls and generating units shall be required of all Bidders. The Department will have drawings and instruction manuals available for reference and / or copying during the site visit. Bidders shall inform themselves fully prior to preparing their Bids.

1.3 LIST OF REPLACEMENT COMPONENTS AND OTHER IMPROVEMENTS.

A. The governing system upgrade shall include, but not be limited to, replacement, improvement, or new provision for the first time, of the following components. The Bidder may propose replacement of more components, which shall be priced as optional items that the Department may purchase under this upgrade.

- For Units # 1 through 6. New redundant digital governor microprocessor controllers for pump-turbine units, mounted in a new stand-alone cabinet adjacent to the existing Governor Control Cabinet including all auxiliaries, controls and instruments;

- For Units # 1 through 6. During Signature Testing trip, disassemble and inspect existing governor distribution valve with Department assistance. Submit findings and advise whether refurbishment is required;

1.4 GENERAL

A. The Governor equipment shall be installed and field-tested in accordance with this Section and Section 16300.

B. The requirements of this Specification, even when written in the singular for one item, shall be equally applicable to all items to be supplied unless otherwise stated.

1.5 BACKGROUND AND OUTAGE SCHEDULE

A. The Castaic Pumped-Storage Project, pump-turbine Units # 1 through 6 and the Pelton Unit #7, was commissioned in the early 1970's, with analog-type, PID, electro-hydraulic governors manufactured by Woodward Governor Company. The original governor equipment was upgraded to digital-type governor equipment in the mid 1990's by Woodward Governor Company.

B. Outage Schedule

The outage schedule shall be as stated in the RFP.

1.6 REFERENCES, SPECIFICATIONS, CODES AND STANDARDS

A. Section 01010 Summary Of Work

B. Section 01011 Existing Control System

C. Section 16075 Electrical Identification

D. Section 16300, Plant Control System Requirement

E. Section 16310 Control System Panels

F. Section 16320 Data Acquisition and Control System

G. Section 16330 Human Machine Interface System

H. Section 16340 Interface With Energy Control Center

I. Section 16350 Historian System

J. Section 16360 Process Networks

K. Section 16380 Digital Governing System

L. Section 16410 Protective Relay And Synchronization System

M. American Society of Mechanical Engineers (ASME)

ASME/ANSI B31.1-2004, Power Piping

ASME Section VIII-Div 1, Boiler and Pressure Vessel

N. Institute of Electrical and Electronics Engineers (IEEE)

IEEE 472: (ANSI C37.90A), Ringing wave immunity

O. National Electrical Manufacturers Association (NEMA)

P. National Electrical Code (NEC)

NEC-2005, National Electrical Code

1.7 REFERENCE DRAWINGS

For Pump-Turbine Units # 1 through 6:

	Drawing No.	Rev.	By	Title
1	SK2-REF-SH1	A	Department	Castaic Power Plant Automation: Equipment Placement
2	-	-	Department	Governor Oil System Units 1 – 6 (GovInfo.pdf) dated September 1996
3	9980-326	C	Woodward Gov	Diagram Hydraulic Schematic Jul 71
4	9982-712	A	Woodward Gov	Diagram Hydraulic Schematic – Main Odd Units Jul 98
5	9982-711	D	Woodward Gov	Arrangement Governor Conversion- Castaic Main Odd Units Jul 98
6	9973-167 (sheets 1-11)	E	Woodward Gov	Diagram Wiring Castaic Units # 1 thru # 6 Nov 98
7	9971-233 (sheets 1-13)	E		Diagram - Elementary Castaic Units # 1 thru # 6 Nov 98
8	-	-		Open and Close Rates.doc
9	-	-		Governor Oil Pressure and Level Setting.pdf Dated August 2004
10	4299-095	D	Woodward Gov	Tank – Pressure Units 1, 3, 5 (LADWP # PA PR 189) Dated July 1971
11	4299-097	B	Woodward Gov	Tank – Pressure Units 2, 4, 6 (LADWP # PA PR 213) Dated July 1971

1.8 SUBMITTALS

A. Refer to Section 16300, "Plant Control System Requirements" for submittal requirements. The Contractor shall also submit for review drawings and documents specified in this section, including, but not limited to, the following drawings and documents. Drawings and documents covering new, refurbished and existing equipment shall differentiate between new, refurbished and existing equipment:

- Physical layout of all equipment;
- Foundation layouts, general arrangement and detail drawings for new and refurbished equipment;
- Electrical schematics;
- Electrical wiring diagrams;
- Method Statements, being detailed installation instructions for removal, overhaul or replacement, adjustment, testing and starting up, commissioning, initial operation and testing of the digital governing system.

1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Exercise care in transporting and handling to avoid damage to materials.

B. Store materials on the site so as to prevent damage or theft.

C. Keep materials clean, dry, and free from deleterious conditions.

D. Do not store materials directly on the ground.

E. Repair or replace damaged material or equipment to satisfaction of the Department.

F. Protect electrical equipment, controls, and insulation against moisture or water damage.

G. The Contractor shall be responsible for the equipment included in this Contract until it has been finally inspected, tested and accepted in accordance with the requirements of these Specifications.

PART 2 - PRODUCTS

2.1 BASIC PARAMETERS AND OTHER PERTINENT DATA

A. The pump/turbine speed governing system shall comply with the following existing basic parameters, and other pertinent data:

For pump-turbine Units # 1 through 6:

1	Type of Governor	Electro-hydraulic, digital PID
2	Gate Servomotor timing	
	Closing full stroke	Adjustable; to be determined by the governing system manufacturer within the limitations of the components not replaced.
	Opening full stroke	Adjustable; to be determined by the governing system manufacturer within the limitations of the components not replaced.
3	Operating Oil Pressure	approx. 580 psi.
4	General Arrangement	Governor Control Cabinet which contains both mechanical-hydraulic and electrical components.
5	Machine Inertia:	
	Estimated generator WR^2	103.2×10^6 lb.ft^2
	Turbine WR^2	not available.

2.2 SIGNATURE TESTING

A. General. Prior to starting on the design of the upgrade governing system, the Contractor shall carry out signature tests of the existing governing system to determine its present operational and functional characteristics. The signature tests shall be done in accordance with procedures prepared by the Contractor and approved by the Department. Using the results of the signature tests, the Contractor shall perform stability studies and simulations of the upgraded governing system to determine optimum regulation settings of the upgraded governing system for operation while connected to the electric grid as well as isolated load operation.

2.3 RATINGS OF UNITS CONTROLLED BY GOVERNING SYSTEMS

A.

For pump-turbine Units # 1 through 6:

Description		Units
Type	Francis pump-turbine	
Turbine – Rated Net Head	900	ft
Turbine – Output at rated net head	275,000	hp
Turbine – Speed	257	rpm
Pump – Total Dynamic Head	1,065	ft
Pump – Input at total dynamic head	320,000	hp
Pump - speed	257.1	rpm

2.4 TYPE AND DESCRIPTION

A. Type and General Design. The upgraded governor shall be of the digital, solid-state, PID electro-hydraulic type with speed and acceleration sensing, speed regulation, wicket gate opening limitation, unit frequency-phase follow-up control, adaptive parameters, and self-diagnostic and stabilizing functions. All control functions shall be accomplished through a digital processor providing control signals to an electro-hydraulic transducer for controlling the position of the main distributing valve of the wicket gate servomotors for Units # 1 through 6. The governor shall be designed for remote automatic and manual control of the unit at various operating conditions. The governor shall be equipped with the accessories necessary to interface with the Plant Computer Control System furnished under Section 16300, "Plant Control System Requirements."

B. General Arrangement

Unit # 1 through 6. One redundant Governor Controller shall be provided for each pump-turbine. Additionally, the Governor Controller shall consist of redundant PLC's, and shall be a separate controller, not imbedded in the Unit Controls. The existing Governor Control Cabinet, located in the upstream gallery, at El. 1445 ft, houses in one large cabinet: the governor microprocessor controller; the electro-hydraulic transducer, pilot valve and distributing valve, oil pumps, etc.; the oil sump tank; and instruments for governor local control, electrical, and indication functions. For Unit # 2 and # 6, recently modernized, there is no governor microprocessor controller; the generating unit controller performs these functions. Each governing system shall be provided with a governor microprocessor controller, including the recently modernized Unit # 2 and Unit # 6 governing systems.

The new Governor Controller will be mounted in a stand-alone cabinet adjacent to the existing Governor Control Cabinet.".

One air-oil pressure tank (accumulator) is provided for each pump-turbine, and is located on El. 1445 ft adjacent to the Governor Control Cabinet. The air-oil pressure tank will be redeployed. One governor compressed air charging system is provided for two pump-turbines, and can be used to supply other units through a tie header. The governor compressed air system comprises of the air compressor unit, air receiver, air dryer, and valves and pressure switches, and is located on El 1445 ft.

C. Adequacy of Design. A coordinated and adequate design fulfilling the requirements of these Specifications and conforming to the best engineering practice shall be provided. Any item or device not specifically called for in these Specifications but which is necessary to provide a complete and successfully working governing systems or which may be found desirable to improve or otherwise enhance the operational quality of the governing systems shall be furnished. All controls, interfaces, devices, and auxiliary relays required to satisfy these Specifications shall be furnished. The electronic system shall be provided with over voltage and transient voltage protection and shall be properly and adequately shielded from external and internal electromagnetic interference. The governing systems shall be designed and tested for surge-withstand capability in accordance with IEEE 472.

2.5 CAPACITY AND TIMING

A. Capacity – Units # 1 through 6. The governing systems will have sufficient capacity to operate the pump/turbine wicket gate servomotors through a full opening or closing stroke in the minimum time determined by the governing system manufacturer as defined under 2.1, Basic Parameters and Other Pertinent Data, with the minimum operating oil pressure in the governor pressure tank and with the maximum opposing torque acting on the pump/turbine wicket gates. A full stroke is defined as the servomotor travel between zero and 100% gate opening, without overtravel in the opening direction or gate squeeze at the closing end of the stroke.

B. Timing – Units # 1 through 6.

1. General. The gate servomotor time for both the opening and closing strokes shall be independently adjustable within the range specified under 2.1, Basic Parameters and Other Pertinent Data. It shall be possible to modify the adjustment while the governor is in operation without disassembly of any part of the governor. Secure and rigid means shall be provided for locking the adjustments, and no control or device shall cause the gate servomotors to move at a faster rate than established. The existing mechanical rate limiting devices (distributing valve stop nuts) meet the requirements above and shall be retained. The Governor Controller shall interface with the existing rate limiting devices. The contractor shall evaluate the electrical based solenoid driver performance as part of their scope and provide recommendations to the department.

2. Timing Settings. All necessary controls and devices for a multi-rate opening or closing stroke shall be furnished. Each individual rate, as well as the

changeover point between rates shall be independently adjustable. The Contractor shall determine optimum rates and settings during development of the transient studies specified under Part 3 – Execution hereof and coordinated with and agreed to by the Department.

C. Closing Rate Limiters. An arrangement of solenoid valves or other suitable devices shall be provided to limit the wicket gate closing rates to ensure safe unit operation. The arrangement of closing rate limiters shall act independently and automatically such that wicket gate closure shall fail to the slowest rate in the generating mode and fail to the fastest rate in the pumping mode.

2.6 PERFORMANCE REQUIREMENTS

A. Stability. The governing system shall be capable of controlling with stability the speed of the unit when operating at rated speed and no-load or when operated at rated speed with isolated load at all power outputs, including maximum output. The governing system shall also be capable of controlling with stability the power output between zero and maximum power output inclusive when the generator is operating in parallel with other generators in the transmission system. The governing system shall be deemed stable, if the hydraulic system of the pump/turbine and water conduits is inherently stable, when:

1. The magnitude of the sustained speed oscillation caused by the governor does not exceed -0.15% to +0.15% of rated speed with the generator operating at rated speed and no-load or when operating at rated speed and isolated sustained load with the speed droop set at 2% or above.

2. The magnitude of the sustained power output oscillation caused by the governor does not exceed -0.2% to +0.2% of the rated power output of the turbine with the speed regulation set at 2% or above and with the generator operating under sustained load demand in parallel with other generators, which are themselves capable of operating in parallel with other generators.

B. Dynamic Characteristics.

1. Performance After Full Load Rejection. After full load rejection, the following dynamic performance of the governing system shall be achieved:

a. The number of occurrences of a peak speed over 3% of the rated speed shall not exceed 2.

b. The duration time from the point at which servomotors first travel in opening direction to the point at which the speed fluctuation does not exceed -0.5% to +0.5% of the rated speed shall not be more than 40 s.

2. Dead Time. The time interval between a speed change of 0.01 to 0.02% of the rated speed of the unit to the first detectable movement of the wicket gate servomotor for a sudden load change of more than 10% of the rated power output of the turbine, shall be not more than 0.2 s.

C. Speed Dead Band. The total magnitude of the sustained speed change within which there is no measurable change in the position of the wicket gate servomotors at rated speed of the unit shall not exceed 0.02% of the rated speed at any gate opening. The minimum speed change in percent of rated speed to which the governor will respond (sensitivity) is defined as one-half the measured dead band.

D. Speed Sensing. The speed sensing output signal shall vary directly with the speed of the main shaft of the unit for all rates of acceleration and deceleration. It shall not be directly affected by variations in the voltage or current of the generator, exciter, or the power system.

E. Permanent Speed Droop. The permanent speed droop shall be capable of adjustment, while the unit is in operation, to values between 0 and 10% when the speed adjustment is set to give rated speed with full gate opening.

F. Stability Adjustment. The dynamic performance of the governing system shall be achieved with proportional, integral, and derivative function blocks, each with independent continuously adjustable gains as described below. The range of adjustment shall be selected to suit the dynamic requirements of the controlled system. The range of adjustable gains shall not be less than:

Proportional gain K_p: 0 – 20

Integral gain K_i: 0 - 10 per s

Derivative gain K_d: 0 - 5 s

The gains shall be adjustable while the governing system is in operation and shall be automatically adjusted by the governing system depending on its operating mode. Independent adjustable gains shall be provided in the proportional and integral function blocks.

G. Range of Speed Adjustment. The governor shall permit fully opening the wicket gates when the unit is operating at speeds up to 110% of normal speed with a speed regulation setting at 10% or less. With the unit operating at zero power output, it shall permit operating the unit at speeds down to 90% of normal speed, with zero speed regulation setting. It shall permit synchronizing the generator for parallel operation with other generators at operating speeds between 90% and 110% of normal speed by local or remote adjustment of the speed setting. The rate-of-change of speed settings shall be software adjustable and, as a minimum, shall include a range of variation between 20 and 40 s to reduce the set point from maximum to zero, or vice versa.

H. Artificial Frequency Dead-Band. The governor shall be equipped with a device to control the artificial frequency dead-band with software adjustable adjustment within a range of plus or minus 0.5 Hz.

I. Frequency Follower. To facilitate synchronizing the unit with the network, the governor shall be provided with a frequency follower that shall control the opening of the wicket gates until the frequency of the generator matches closely with the frequency of the network.

J. Load Follower for Manual-Automatic Changeover. Change of the governor operating modes initiated either automatically or manually shall result in a bumpless transfer by means of a load follower device. The magnitude of the power output fluctuation shall not exceed 5% of rated load when manual-automatic changeover is operated.

K. Power Controller. The governor shall be equipped with a power controller that shall develop a governor error signal based on a power set point, real power feedback, and speed. The power controller shall be initiated by operating the appropriate control switch on the electric governor or from a remote control contact. This mode of operation shall only be in effect while the machine's speed remains within an adjustable speed band. If the machine's speed falls out of the speed band, then the governor logic shall change its operating mode to speed control and remain in this mode until a change is initiated.

2.7 OPERATING REQUIREMENTS

A. General. The governing systems shall fulfill the operating requirements specified herein. All components, devices, and items required to fulfill these operating conditions shall be furnished.

B. Control Modes.

1. Local-Remote Transfer Switch. One 2-position maintained-contact transfer switch shall be mounted on the front of the Electrical Panel of the Governor Control Cabinet to transfer control from "Local" (governing systems) to "Remote" control system. With the switch in the "Local" position, the following front-of-panel control devices mounted on the Electrical Panel of the Governor Control Cabinet shall be operational; in the "Remote" position, they shall be locked-out:
    a. Adjustment of speed changer.
    b. Adjustment of gate position.
    c. Adjustment of power set point.
    d. Power controller on/off.
2. Auto-Manual-Test Transfer Switch. One 3-position maintained contact transfer switch shall be mounted on the front of the Electrical Panel of the Governor Control Cabinet to permit the selection of the following control modes:

a. Automatic control to maintain the system frequency or unit output within the specified limits

b. Manual local control of unit start and stop from Governor HMI. Normal speed control functions enabled. Manual penstock draining enabled.

c. Test mode control from Governor HMI for unit maintenance during unwatered conditions. Gate position control only. Normal speed control functions disabled.

C. Governing System Operating Modes.

The Digital Governor Controller shall be capable of pre-selection of the following generation control modes, as applicable:

- Gate control;
- Power (MW) control;
- Speed control.

The Digital Governor Controller shall be capable of selecting the following unit control modes:

- Generating mode;
- Pump mode
- Pump starter mode (that is generator powers selected unit to run as pump);
- Synchronous condenser, unit rotating in the same direction as for generating.

D. Gate Limit Optimizing Control for Pumping. Software shall be provided in the governor controller to automatically adjust the wicket gate opening as a function of the pump head when operating as a pump. The software shall not interfere with control or setting of the gate limit device when operating as a turbine. An opening rate limiter shall be provided to adjust the rate of gate movement during pumping as determined by the pump-turbine manufacturer.

E. Only under the direction of the Department shall the Contractor adjust the maximum permissible ramping rate to load and unload the units in generating and pumping for all operating conditions.

F. Shutdown. The governor shall permit the following types of unit shutdown:

1. Normal shutdown initiated by local or remote control with wicket gate closure followed by breaker tripping at zero power output.

2. Partial shutdown to speed no-load in the event of load rejection or breaker tripping.

3. Emergency shutdown with maximum wicket gate closing rate in the event of equipment failure.

G. Start-Up. Controls shall be provided to automatically start-up and accelerate the unit to rated speed for synchronizing under local or remote control. When being started automatically, the unit shall reach rated speed within 50 s. A device which will automatically compensate for the prevailing head shall be included.

H. On-Line Self-Diagnostic Functions. The governor shall have the on-line diagnostic functions given herein. Indicating lamps on the face of the Electrical Panel of the Governor Control Cabinet shall indicate faults.

1. Analog/digital converter and input channel fault.
2. Digital/analog converter and output channel fault.
3. Feedback channel fault.
4. Hydraulic control system fault.
5. Program error and clock fault.
6. Control fault
7. Fault of emergency shutdown circuits.
8. Speed sensing system fault.
9. Gate limiter fault.

I. Off-Line Diagnostic Functions. The governor shall have the following off-line diagnostic functions:

1. Review of the accuracy of the data sampling system.
2. Review and adjustment of governor parameters.
3. Review and adjustment of software program.

J. Fault Protection. In the event of a fault in the governor system, including loss of power supply, the governor shall maintain the wicket gates in their same position and shall alarm. The shutdown circuits and the gate limit control shall remain operative. For a major fault, including loss of gate position feedback, the unit shall be shutdown. A pilot light on the Electrical Panel of the Governor Control Cabinet shall indicate the fault, and a minimum of 2 electrically independent alarm contact circuits shall be wired to terminal blocks.

2.8 DIGITAL MICROPROCESSOR

A. General. The governor functions shall be controlled by solid-state, redundant, programmable microprocessors. The microprocessors shall be located in the Electrical Panel of the Governor Control Cabinet and fulfill the requirements specified herein. It shall operate within the specified range of ambient conditions without drift. A generator power transducer to provide the feedback signal for load control shall also be furnished. In addition to the requirements specified in this Section, the microprocessors shall comply with the requirements specified in Section 16320, Data Acquisition and Control System

B. Hardware.

1. The microprocessors shall be solid-state, digital type, with input/output (I/O) modules rack mounted inside the enclosure.

2. The microprocessors shall contain a non-volatile memory of at least 6 kB, or of sufficient size to accommodate the necessary software plus an additional 50% for future expansion, whichever is larger.

3. The I/O modules shall be independently removable. All modules shall be connected to the microprocessor via printed circuit cards located on the mounting chassis. I/O modules shall be provided to interface with signals of a type and quantity required for control of the governor system including the remote interface requirements specified in these Contract Documents.

4. The microprocessors and each I/O module shall have LED type indicating lights for trouble-shooting purposes. Photoelectric isolation shall be provided for all I/O signals.

5. The I/O chassis shall be securely mounted on the rear of the control cabinet. All I/O slots shall be keyed to prevent insertion of modules in the improper slot location.

6. A minimum of 25% spare I/O modules of each type and 20% fully-wired spare slots shall be provided for future expansion.

7. The microprocessors shall continuously set and reset a watchdog timer. Time out of this device shall indicate failure of the microprocessor.
8. Redundant DC-DC power supplies shall be provided for the microprocessor equipment. Any one of the power supplies shall be capable of being selected as a hot stand-by to operate automatically and without delay when the other one fails. Input shall be designed for 125 V DC from the existing station batteries.

C. Software.

Software shall be provided to implement the requirements specified. Software shall be designed to permit revisions to the program, such as changes in the operational sequences or control parameters, from the program interface equipment specified. A back-up copy of the software on a floppy disk shall be provided for downloading into the microprocessor.

2.9 OTHER IMPROVEMENTS (OPTIONAL REPLACEMENT ITEM)

A. Improvements the Bidder may find during the process of familiarization and informing himself fully shall be offered in the Bid. The Bidder shall prepare a brief status report on such items, and justify the need to replace them. Replacement of each item shall be considered as an optional item that the Department may, or may not, choose to purchase.

2.10 CONTROLS AND INSTRUMENTS

A. New Controls and Instruments. New controls and instruments in accordance with the requirements of this section shall be provided.

B. General. The governing systems shall be provided with the controls and instruments listed below, mounted on or inside the instruments sections of the Governor Control Cabinet. Controls and instruments mounted on the faces of the respective Governor Control Cabinet shall be conveniently and symmetrically arranged. All instruments and control switches shall be similar in size and appearance. All controls and instruments shall be completely wired, with the wiring terminated at terminal blocks mounted near the bottoms of the instrument sections inside the respective Governor Control Cabinet. Unless otherwise specified, the status display instruments and control devices on the front of the governor control cabinet shall be incorporated into the HMI.

C. Instruments and Trim. Analog instruments shall be of the flush-mounting type, having white dials with black figures and pointers, except that the second pointer and figures on dual dials shall be red and of an approved type. Instruments shall have non-glare cover glass. Exposed control knobs shall have a finish and trim to harmonize with the cabinet.

D. Control Devices Inside the Governor Control Cabinet. All necessary devices, instruments, accessories, and connections to satisfy these Specifications.

E. Controls and Instruments on the Front of the Governor Control Cabinet.

1. Controls and instrumentation on the front of the governor control cabinet shall be provided by a touch screen display, similar (in function only) to those installed on Units 2 and 6 by Voith-Siemens Hydro. Refer to the Modernized Unit Drawings provided.

2. Status Displays.

    a. Indicating instruments for gate position, gate limit, unit frequency (or speed), network frequency, artificial frequency deadband, permanent speed regulation, power set point, speed changer set point, and power output.

    b. Indication for creep and power supply.

    c. Indication for auto-manual-test operation.

    d. Indication for local-remote operation.

e. Indication for Pump prime.

f. Indication for oil lift pump pressure.

g. Direction of rotation indication.

3. Fault Indicating Lights. As required by these Specifications.

4. Control Devices. Adjustment of permanent speed regulation, adjustment of speed changer, adjustment of gate position, adjustment of power set point, emergency stop pushbutton, power controller "on-off" switch, gate limit optimizing control for pumping, "auto-manual-test" transfer switch, and "local-remote" transfer switch.

F. Controls and Instruments Inside the Governor Control Cabinet.

1. Furnish controls and instruments similar (in function only) to those furnished by Voith-Siemens Hydro on Units 2 and 6, as shown on the Modernized Unit Drawings provided.

G. Interface Requirements. Provisions shall be made in each new governing system to interface with its respective Unit Controller.

1. Operating Modes. All operating modes shall be coordinated with the Control Sequences specified in Section 16320, "Data Acquisition and Control System."

2. Computer Interface. The necessary interface equipment and ports for providing full digital communications between the governing system and the Unit Controller shall be provided. The interface shall, as a minimum duplicate all the discrete digital and analog I/O functions described in this section. This digital communications interface shall be in addition to the discrete I/O interface specified.

2.11 OIL PUMPS

A. Units # 1 through 6. The existing governor oil pumps shall be redeployed.

B. Units # 1 through 6. For each existing HPU serving a pair of pump-turbine units, there are two, oil pumps.

Oil Pumps for pump-turbine Units # 1 through 6:

	Description		**units**
	Type	A608-275	
	Maker	IMO	

Oil Pumps for pump-turbine Units # 1 through 6:

	Description		units
	Serial number	509012-2	
	Motor		
	Maker	General Electric	
	Model number	5K365AK222B1-F2	
	Serial number	MHO22025	
	Power	75	hp
	Full load speed	1770	rpm
	Volts, current	460 V, 89 A	

2.12 PRESSURE TANK

A. The existing pressure tanks for pump-turbine Units # 1 through 6 shall be re-deployed for this upgrade. See reference drawings.

2.13 SUMP TANK

A. For Unit # 1 through 6. The existing sump tank is shared by two adjacent units, and shall be redeployed.

2.14 GOVERNOR COMPRESSED AIR SYSTEM

A. System Description for Units # 1 through 6, there are three governor air compressor systems; each system serves two units, and the systems can be interconnected through a tie header.

B. The existing governor compressed air system used to pressurize the governor oil pressure tanks to the normal operating pressures shall be redeployed.

1. Plant Control System. The plant control system shall be provided with status indication of the compressors, and system pressure. In addition, the following status and alarm points shall be provided:

a. Cumulative motor running time, each compressor.

b. Compressor trip, each compressor.

c. Compressor not-in-auto, each compressor.

d. System pressure – High.

e. System pressure – Low.

f. System pressure – Normal.

PART 3 - EXECUTION

3.1 GENERAL

A. The PLC programmer shall be experienced in this type programming and have a minimum of 5 years experience in programming similar type systems. The screen graphics shall match as close as possible the actual device(s) arrangement being controlled.

3.2 HMI

A. A dedicated Governor OIT shall provide operations and maintenance staff with the ability to monitor and control governor operations without objectionable delays in system processing times. All monitoring functions shall be available to all personnel. Control and programming functions shall be password protected.

3.3 SHOP ASSEMBLY AND TESTS

A. General. New governor control system shall be completely assembled in the shop and tested, insofar as practicable.

B. Operational Tests. Operational tests shall be performed on all of the new equipment or devices insofar as practicable to demonstrate that they function properly. Adjustable devices shall be checked for range of adjustment and given final adjustment, insofar as possible, in the shop. The electrical devices shall be given dielectric tests in accordance with applicable provisions of NEMA, ANSI, and IEEE standards. The electrical devices shall be tested for temperature drift, voltage drift, time drift, and electro-magnetic interference.

C. Performance Tests.

1. The governor control system shall be FAT tested to demonstrate that it will meet the requirements specified under 16300, "Plant Control System Requirements", and in respect to dead time, dead band, and speed sensing. At least 60 days prior to the performance tests, a description of the procedures and equipment to be used in making these tests shall be submitted to the Department. For the dead band tests, the speed sensing

element shall be driven from either a suitable constant frequency power source which shall have provision for plus or minus step frequency changes of 0.01% of normal frequency or by the speed sensing device which shall be driven from a suitable constant and adjustable speed source. An oscillograph, high speed strip chart recorder, or other approved means shall be used which will provide a simultaneous and parallel record of speed, relay valve position, servomotor position, and a timing signal. The oscillograph or recorder and associated movement and speed conversion devices and amplifiers shall be such that the time delay is the same in all measuring channels or can be accurately calibrated. The charts shall be marked for identification of the test performed, traces labeled, and incremental values of the recorded variables marked on the charts.

2. A complete functional test of the digital microprocessor control shall be included in the shop performance test. All I/O for status signals, analog signals, and controls shall be individually verified during the shop test. The digital communication link from the microprocessor to the plant computer shall be simulated and functionally checked to ensure it duplicates all discrete I/O signals.

3. A comprehensive, witnessed Factory Acceptance Test (FAT) will be provided in the Contractor's facility for the first unit. The first unit will be shipped to Contractor's Wisconsin Training Center and will be connected to a turbine simulator. In addition basic I/O testing, all software functionality and HMI screens will be tested as if the governor is connected to the turbine/generator. Testing for follow-on units will be done in Contractor's Pennsylvania factory and will consist of wiring and I/O functionality checks only. Certified test reports will be furnished to the Department, and the Department may observe these tests also, if desired.

3.4 FIELD TESTING

A. Refer to Section 16300 for shop and field-testing requirements.

B. All instruments required for recording governor response and relevant transient parameters shall be furnished but will remain the property of the Contractor. Unless otherwise mutually agreed upon, the tests shall be conducted in accordance with IEC Publication 308, "International Code for Testing of Speed Governing Systems for Hydraulic Turbines," and IEEE 125.

C. Initial Operation Tests. After the equipment has been installed, the Contractor shall check the equipment and perform the initial operation tests. The unit shall first be subject to a water-filling test. Initial operation of the unit will be in the pumping mode to fill the upper reservoir. The trial mechanical run, check-out and run in of this unit will be made by motoring the unit in the dry, or as mutually agreed upon with the Department. The Contractor shall establish the procedure to be used in cooperation with the Department. Load-rejection, no-load, and load acceptance tests shall then be made to adjust the governor timing elements and settings of speed switches and other protective devices. All such

adjustments and related parameters shall be recorded and included in the field test report.

D. Reliability Test Run. Before a unit is considered ready for commercial operation, the Department shall perform a test run as required to assure that the equipment has been installed and adjusted properly and that it will function safely, properly, and reliably under continuous operation with the maximum mode-to-mode changes the load dispatcher can accommodate. The test run shall be performed in the automatic control mode, without any adjustments or corrections, under certain loads specified by the Department. The duration of the test run shall be for a continuous period of 30 days (720 hours) with interruptions due to equipment malfunction not to exceed 14 hours. If the unit fails the reliability test run, the test run shall be performed over again. The Contractor shall be available by telephone during the Reliability Test Run to answer operational questions and provide other assistance.

3.5 INSTALLATION

A. The electrical installation shall conform to the manufacturer's requirements, the requirements of the NEC-2005.

B. The Electronic Governor PLC and related equipment shall be located in the space near the Hydraulic Governor occupied by the existing Woodward Governor. The Department will remove existing Woodward Governor to accommodate new Electronic Governor PLC as shown on the Department approved Contractor Drawings. Unit 2 and Unit 6 Woodward equipment has been previously removed and replaced by remote I/O. The Department will remove this existing remote I/O equipment. The Digital Governor shall support dual-redundant Ethernet connections to interface with the Plant Network as specified in Section 16330, "Human Machine Interface (HMI) System."

C. The Department under the Contractor's supervision shall install all digital governing system components, both replacement and new digital governing system components, and the Contractor shall make any required adjustments to the component and/or the system in which the digital governing system component is installed.

3.6 SPARE PARTS

A. All spare parts shall be of the same material, workmanship, and manufacturer as the corresponding original parts, completely interchangeable and packaged for long-term storage.

B. Spare parts shall include, as a minimum, the following. The Contractor shall provide a recommended spare parts list.

1. One communication module

2. One circuit breaker for each size used

3. Four spare PLC batteries

4. One relay of each type used

5. Five indicating lamps for each type used

6. One switch for each type used

3.7 TRAINING, INSTRUCTIONS AND MANUALS

A. A training program shall be conducted by the Contractor.

B. Written instructions and manuals shall be provided for all equipment and systems furnished, or for systems affected by the replacement or addition of digital governing system components. Training sessions shall be organized and administered based on the training instructions, project manuals, and operations and maintenance procedures.

C. The Contractor shall provide on-site training for the Department personnel, classroom type sessions of not less than 24 hours prior to checkout of the equipment.

END OF SECTION

SECTION 16390

TURBINE SHUT OFF VALVE UPGRADE

PART 1 - GENERAL

1.1 SCOPE

A. This Section covers the requirements for the design, manufacture, shop-testing, delivery to the Site, removal of components that will not be used, installation of new equipment and components, supervision of the erection, connecting and interfacing new controls and/or other equipment, programming, configuring and adjusting, site testing, new controls for (TSOV) oil hydraulic systems of generating units # 1 through 6, with accessories and a full set of spare parts, in accordance with the Contract Documents.

B. Number of TSOV Control Systems to be Supplied:

6 for Francis pump-turbines Units # 1 to 6

C. The TSOV oil hydraulic system comprises of the following components:

- digital microprocessor controller to be located in each TSOV control cabinet;
- solenoid valve and other valves controlling flow, pressure, opening/closing rates of the TSOV servomotor; motor driven oil pumps and associated unloader valves, check valves and strainers; oil filters; all equipment located above the sump tank;
- sump tank with various connections for filling, draining, isolating, breathing, level and temperature measurements;
- TSOV control cabinet housing indicating and control devices, all input and output modules, and electrical control circuits arranged in removable racks with electrical connectors;
- accumulator tanks;
- air-charging system for charging the TSOV-accumulator tanks with air.

The scope of the power plant automation upgrade contract includes providing each Turbine Shut-Off Valve (TSOV) with a redundant PLC configuration, I/O's and a local Operator Interface Terminal (OIT) dedicated to one TSOV. The TSOV controllers and all peripherals shall be provided in cabinet to be installed by the Department between TSOVs at El. 1445. The inputs and outputs from and to field devices and systems will be wired by the Department to the contractor

furnished local I/O in the new cabinet as shown on the drawings A separate HMI shall be provided using a panel mounted Windows based workstation system as specified in Section 16330. The workstation shall be touch screen based and mounted adjacent to the TSOV and governor controllers.

D. The Department needs to have standard operator interfaces, standard software components, consistent and acceptable system wide performance, acceptable documentation and well-documented and maintainable digital interfaces.

E. The new TSOV Controller and instrumentation for the TSOV Oil Hydraulic System, control and instrumentation shall be capable of communicating with one another, and other equipment through standard industry protocols such as Modbus, Profibus etc.

F. The Contractor shall submit a coordinated and adequate design that complies with the requirements and intentions of the Contract Documents and the best engineering practice. The Contractor shall include any component necessary or desirable to complete the supply, and for satisfactory and reliable operation even when not specifically mentioned or required in the Contract Documents.

G. Prior to starting on the design of the TSOV Control System, the Contractor shall carry out signature tests of the existing oil hydraulic systems to determine its present characteristics

H. The installation supervisors, start-up, commissioning, and test engineers, acceptance tests, etc, costs and all other costs associated with the task of supervision of the installation, commissioning and testing the TSOV Control System shall be included in the corresponding bid item.

I. The Department under the supervision of the Contractor will install the new TSOV components that are provided.

J. The Department will carry out all field wiring based on the Contractor's installation drawings.

K. New equipment or components shall, in all respects, in the opinion of the Department, be superior to, or at least equal to, the parts they replace, or are redundant to, unless otherwise specified.

L. A site visit to assess the present status of the existing oil hydraulic systems, controls and generating units shall be required of all Bidders. The Department will have drawings and instruction manuals available for reference and / or copying during the site visit. Bidders shall inform themselves fully prior to preparing their Bids.

1.2 LIST OF REPLACEMENT COMPONENTS AND OTHER IMPROVEMENTS.

A. For Pump-Turbine Units # 1 through 6. The new TSOV Control System Upgrade shall include, but not be limited to, replacement of the following components. The Bidder may propose replacement of more components, which

shall be priced as optional items that the Department may purchase under this upgrade.

- Replace the existing TSOV controllers with dual, redundant, Allen Bradley ControlLogix (latest hardware and software version) PLC controllers including all auxiliaries, controls and instruments. Each controller pair shall include one OIT display, which shall be connected to its unit process network. This controller is specified in Section 16320 "Data Acquisition and Control System" of these Contract Documents;

- The new controller shall interface with the existing hydraulic hardware components. Note that units 2 and 6 are different than those of units 1, 3, 4, and 5.

- Modifications recently made by Voith Siemens to the TSOV control systems of Units # 2 and 6 shall be replicated on Units # 1, 3, 4, and 5, along with the enhancements identified.

- The Contractor shall interface the new TSOV Control System with the TSOV instrumentation similar to the controls upgrade recently carried out by Voith Siemens on units # 2 and 6.

B. For Pelton Turbine Unit # 7 Powerhouse.

- A separate contract shall be issued to upgrade Unit 7 by others.

1.3 GENERAL

A. The TSOV Control System shall be installed and field-tested in accordance with Section 16300, "Plant Control System Requirements".

B. The requirements of this Specification, even when written in the singular for one item, shall be equally applicable to all items to be supplied unless otherwise stated.

1.4 BACKGROUND, OPERATING CONDITIONS, AND OUTAGE SCHEDULE

A. The Castaic Pumped-Storage Project was commissioned in the early 1970's.

Unit # 1, 3, 4 and 5 TSOV's have the original mechanical/hydraulic control systems still in place. Units # 2 and 6 TSOV's are currently equipped with Siemens PLC controllers and have undergone hydraulic and instrument upgrades. The Contractor shall perform hydraulic/mechanical and instrument upgrades as necessary for Units # 1, 3, 4, and 5, as specified herein, and shall upgrade Units # 2 and 6 as required, to make them identical with the rest of the units.

B. Operating Conditions

The Units # 1 through 6 TSOV's are used to prevent water flow to the turbines

from their individual penstocks during an emergency shutdown, prior to draft tube water level depression, and for maintenance. They are not designed for throttling flow; the wicket gates/needle valves perform that function.

The Units # 1 through 6 TSOV can be operated by hand or sequenced automatically.

C. Outage Schedule The upgrade must be completed within the outage period mutually agreed / specified for each unit.

1.5 REFERENCES, SPECIFICATIONS, CODES AND STANDARDS

A. Section 01010 Summary Of Work

B. Section 01011 Existing Control System

C. Section 16075 Electrical Identification

D. Section 16310 Control Systems Panels

E. Section 16320 Data Acquisition And Control System

F. Section 16330 Human Machine Interface (HMI) System

G. Section 16340 Interface With Energy Control Center

H. Section 16350 Historian System

I. Section 16360 Process Networks

J. Section 16380 Digital Governing System

M. American Society of Mechanical Engineers (ASME)

ASME/ANSI B31.1-2004 Power Piping

ASME Section VIII-Div 1 Boiler and Pressure Vessel

N. Institute of Electrical and Electronics Engineers (IEEE)

IEEE 472: (ANSI C37.90A) Ringing wave immunity

O. National Electrical Manufacturers Association (NEMA)

P. National Electrical Code (NEC)

NEC-2005 National Electrical Code

1.6 TSOV REFERENCE DRAWINGS

A. General. Some of the drawings and information listed below show the development of the TSOV equipment as a result of upgrade projects over the life of the equipment, and may not accurately show the state as at present. Furthermore, the last project upgrade was not completed, only units # 2 and 6 were upgraded, while Units # 1, 3, 4, and 5 were not upgraded. In some rare instances, the date of the last revision was barely visible and may not be accurately recorded below.

B. Units # 1 through 6.

	Drawing No.	Rev.	By	Title
1	BD-001		Department	Castaic Power Plant Automation: Equipment Placement
2	10P-001-912	D	Hitachi	Assembly of Turbine Shutoff Valve Mar 1972
3	2641-000400	C	Voith Siemens	Hydraulic Schematic – Spherical Valve – TSOV – Sh 1 of 2 Aug 2005
4	2641-000400	C	Voith Siemens	Hydraulic Schematic – Spherical Valve – TSOV – Sh 2 of 2 Aug 2005
5	2651-000256	3	Voith Siemens	Spherical Valve – Control Arrangement
6	2651-000259	0	Voith Siemens	Turbine Shutoff Valve Rehabilitation Procedure 14 sheets
7	2651-000265	1	Voith Siemens	S. V. Control – Piping Arrangement
8	LB-600-100	F	Hitachi	Schematic Diagram of Turbine Shutoff Valves Sep 1976 (This revision may not be so legible.)
9	2651-000240	-	Voith Siemens	Valve Seal Assembly
10	10R-017-725	A	Hitachi	Air Compressor for Turbine Shutoff Valves (Serial no CA-27)
11	10R-005-382	C	Hitachi	Accumulator Tanks for Turbine Shutoff Valves (Serial No CA-10) Jul 1972
12	10Q-010-147	C	Hitachi	Wiring Diagram of Oil Pumping Unit for Turbine Shutoff Valves
13	10Q-002-090	E	Hitachi	Oil Pump Set for Turbine Shutoff Valves (Serial No CA-9)
14	10R-005-374	F	Hitachi	Connection Diagram of Unit No 1, 3, & 5 Turbine Shutoff Valve Control System (Sheet 1 of 2) Connection Diagram of Unit No 2, 4, & 6 Turbine Shutoff Valve Control System (Sheet 2 of 2) Dec 1972
15	10Q-010-223	C	Hitachi	Control Devices for Upstream and Downstream Seals Aug 1974

	Drawing No.	Rev.	By	Title
16	10P-001-832	D	Hitachi	Inside Arrangement of Turbine Shutoff Valve Control System Nov 1973
17	10P-001-887	B	Hitachi	Piping Arrangement of Turbine Shutoff Valve Control System Nov 1973
18	10P-001-864	C	Hitachi	Wiring Diagram for Turbine Shutoff Valves Oct 1972
19	10Q-059-430	-	Hitachi	Assembly of Regulating Valve for Seal Valve Control Aug 1974
20	LA-600-033	B	Hitachi	Piping for Turbine Shutoff Valves Oct 1971
21	LC-600-560	D	Hitachi	Piping for Turbine Shutoff Valves – View C-C & D-D Dec 1973
22	10Q-002-313	D	Hitachi	Pressure Water Operating Seals of Turbine Shutoff Valve Mar 1972
23	2695-000306		Voith Siemens	Manifold Hydraulic Schematic
24	2695-000307		Voith Siemens	Hydraulic Manifold
25	2695-000313		Voith Siemens	Aux Manifolds
26	10S-103-220		Hitachi	Setting Oil Level – for Magnet Type Oil Level Switches June 1973

1.7 SUBMITTALS

A. Refer to Section 16300, "Plant Control System Requirements" for submittal requirements. The Contractor shall also submit for review drawings and documents specified in this section, including, but not limited to, the following drawings and documents. Drawings and documents covering new, refurbished and existing equipment shall differentiate between new, refurbished and existing equipment:

- Physical layout of all equipment;
- Foundation layouts, general arrangement and detail drawings for new equipment;
- Electrical schematics;
- Electrical wiring diagrams.
- Method Statements, being detailed installation instructions for adjustment, testing and starting up, commissioning, initial operation and testing for the TSOV Control System.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Exercise care in transporting and handling to avoid damage to materials.

B. Store materials on the site so as to prevent damage or theft.

C. Keep materials clean, dry, and free from deleterious conditions.

D. Do not store materials directly on the ground.

E. Repair or replace damaged material or equipment to satisfaction of the Department.

F. Protect electrical equipment, controls, and insulation against moisture or water damage.

G. The Contractor shall be responsible for the equipment included in this Contract until it has been finally inspected, tested and accepted in accordance with the requirements of these Specifications.

PART 2 -- PRODUCTS

2.1 BASIC PARAMETERS AND OTHER PERTINENT DATA

A. The TSOV Oil Hydraulic System Upgrade shall comply with the following existing basic parameters, and other pertinent data:

TSOV'S for Units # 1 through 6

Description	Value	units
TSOV valve type	spherical	
Diameter	8.667	ft
Maximum static head	1,148	ft
Design head	1,560	ft
Bypass valve diameter	10	in
Main valve operating time	~ 60	s

2.2 SIGNATURE TESTING

A. General. Prior to starting on the design of the TSOV Control System Upgrade, the Contractor shall carry out signature tests of the existing TSOV control system to determine its present operational and functional characteristics. The signature tests shall be done in accordance with procedures prepared by the Contractor and approved by the Department.

2.3 TYPE AND DESCRIPTION

A. General Arrangement

Units # 1 through 6.

The TSOV can be operated by hand or sequenced automatically. The hydraulic power unit consists of an oil sump, serving two adjacent units, two pumps, an air-oil tank or accumulator, a control cabinet, and an air compressor with receiver.

The TSOV's are located at El. 1430 ft at each penstock, just upstream of the pump-turbine spiral case inlet. Each oil sump, capacity of 4560 gallons, is shared by two units and is located between pairs of TSOV's at El. 1417 ft.

Two oil pumps are installed in each sump; one is driven by an ac-motor, while the other is driven by a dc-motor for emergency use. The ac-motor pump is driven by a 3-phase, induction motor rated at 460 V, 60 Hz, 45 kW, 1200 rpm. It has a capacity of 66 gpm at 1000 psi and supplies the accumulators with pressurized oil. The dc-motor driven pump is rated at 125 V, 2.2 kW, 1600 rpm. It has a capacity of 3.7 gpm at 850 psi, and bypasses the accumulators to feed

the TSOV servomotor directly. Both pumps have an unloader valve with a relief valve and check valve. The oil sump has a panel with switches for manually controlling the oil pumps and air compressor, and lights to indicate their status.

The air compressors are located at El. 1417 ft near the TSOV shaft. Each air compressor serves two paired TSOV's, is belt driven by a 3-phase, 460 V, 60 Hz 10 hp motor and has a capacity of 14.1 cfm of free air at 1500 psig. The air receiver has a capacity of 10 cubic feet, and is rated at 1200 psig. The air compressor is controlled by pressure switches set at 1020 psig to start and 1070 psig to stop. The air receiver safety valve is set at 1200 psig.

The accumulator tanks are located at El 1417 ft between the TSOV's. There is one accumulator tank per TSOV, with an oil sump and ac-motor driven pump supplying two accumulator tanks. The paired accumulator tanks are joined by piping common to both and the input of oil and air to each accumulator tank is controlled by pressure and level switches at the accumulator tanks. High pressure air is fed to each accumulator tank through a solenoid valve located at the accumulator tank. The solenoid valve closes when oil pressure reaches 1010 psi on increasing pressure. The ac-motor driven pump starts at 955 psi on decreasing pressure and stops at 1000 psi on increasing pressure. Alarms indicate high and low oil levels, and an emergency low level for shutdown. An accumulator tank mounted relief valve is set at 852 psi. The accumulator tank contains sufficient oil at normal level and operating pressure to provide 3 complete cycles of opening and closing of the TSOV.

The TSOV control panels, one per TSOV, are located in pairs at El. 1445 between the TSOV's, and contain the controls for manual and automatic sequencing of TSOV operations. Lights on the control panel indicate status of the bypass valve and TSOV rotor. A position indicator on the control panel can also monitor the TSOV rotor. Additionally, the pump-turbine bench contains switches for closing the valve in an emergency and lights to indicate its status.

The 10-in diameter, hydraulically operated bypass valve located across each TSOV serves to equalize the pressures across the TSOV prior to opening. The bypass valve can be operated manually or automatically and is interlocked by limit switches and a differential pressure switch to prevent inadvertent opening of the TSOV.

A 3-inch, air-release valve located on the turbine inlet pipe is manually operated to permit escape of air while filling the spiral case, and it is closed after all air is expelled. A limit switch on the air-release valve operates indicating lights on the TSOV control panel to indicate status.

B. Adequacy of Design. A coordinated and adequate design fulfilling the requirements of these Specifications and conforming to the best engineering practice shall be provided. Any item or device not specifically called for in these Specifications but which is necessary to provide a complete and successfully working TSOV System or which may be found desirable to improve or otherwise enhance the operational quality of the TSOV Oil Hydraulic System shall be furnished. All controls, interfaces, devices, and auxiliary relays required to satisfy these Specifications shall be furnished. The mechanical-hydraulic ports shall be designed to withstand the hydraulic oil with certain pollutants. The TSOV System shall operate normally with dust particles in the oil up to 60 μm in diameter. The

electronic system shall be provided with over voltage and transient voltage protection and shall be properly and adequately shielded from external and internal electromagnetic interference. The TSOV Oil Hydraulic System shall be designed and tested for surge-withstand capability in accordance with IEEE 472.

2.4 OPERATING REQUIREMENTS

A. General. The TSOV system through the action of a servomotor opens and closes the TSOV. The TSOV air-charging system automatically charges the air-oil pressure tank. The TSOV oil hydraulic system shall fulfill the operating requirements specified herein. All components, devices, and items required to fulfill these operating conditions shall be furnished.

B. Control Modes. The control modes are detailed in the Non Modernized and Modernized Unit Drawings sections.

2.5 OTHER IMPROVEMENTS (OPTIONAL REPLACEMENT ITEM)

A. Improvements the Bidder may find during the process of familiarization and informing himself fully shall be offered in the Bid. The Bidder shall prepare a brief status report on such items, and justify the need to replace them. Replacement of each item shall be considered as an optional item that the Department may, or may not, choose to purchase.

2.6 HYDRAULIC POWER UNIT (HPU)

A. For Units # 1 through 6. The existing HPU shall be redeployed.

B. Rating of Existing AC-Motor Driven Oil Pump. The pumps are rated as follows:

Oil Pumps for Units # 1 through 6

Description	Values	units
Maker – oil pump	Uchida	
Model – oil pump	GH8 - 250	
Date of Manufacture	1983	
Delivery diameter	1.5	in
Normal working pressure	1,000	psig
Capacity	66	gpm
Maker – oil pump motor	Hitachi	
Oil pump motor – Type / Form	EFOUP / KK	
Phase / frequency	3 ϕ / 60 Hz	
Speed	1160	rpm
Number of poles	6	
Output	45	kW
Voltage / current	460 V / 68 A	
Rotor	K2	
Code	F	
Class of Insulation	B	

C. Controls shall include pressure transmitters to start and stop the oil pumps. The existing pressure switch arrangement for controlling the oil pumps shall also be replaced by pressure transmitters. Two, redundant pressure transmitters whose output signals are continuously monitored and processed within a programmable logic controller (PLC) shall be provided to perform the pump functions specified herein. The controls shall provide an indication that the pump is running with the relief valve open. The two, main oil pumps shall be provided with echelon control. When operating together, the automatic controls shall permit use of either of the two pumps for "lead-lag" operation, with the other serving as a standby unit. Automatic, pressure transmitter motor controls that will start the pumping units when pressure in the oil pressure system drops to predetermined value and stop the pumping units when pressure rises to a predetermined value shall be furnished. The standby pump shall be started when pressure drops to a predetermined amount below the loading pressure of the "lead-lag" pumps. The starting equipment shall be arranged to start the motors, under all conditions, and to unload the pumps before the motors are electrically disconnected. The oil level switches shall give an alarm and cause shutdown on high and low oil levels.

2.7 ELECTRICAL CONTROL CABINET

A. Adjacent to each existing valve control cabinet that serves a pair of TSOV's, provide a new, floor-mounted, TSOV Electrical Control Cabinet for each unit, but only for those units for which Voith Siemens have not already provided them under the recent upgrade. Each new TSOV Electrical Control Cabinet shall serve one TSOV individually. The new TSOV Electrical Control Cabinets shall be located next to the existing valve control cabinets. Overall appearance, dimensions, and color shall match and harmonize with the Voith Siemens cubicles and other cubicles located in the same area, and shall be subject to approval by the Department. The width shall be adequate for the design.

The cubicles shall be NEMA Type 1A gasketed enclosures consisting of rigid, self-supporting, steel panels with a minimum thickness of 11 gauge steel All cubicles shall be provided with full-length, hinged and gasketed access doors to facilitate adjustment and maintenance of equipment. A tamper-proof lock shall be provided on each door of the cubicle. Interior panels shall be provided inside the cubicle for mounting items of electrical equipment. Louvers necessary for adequate ventilation shall be provided where required. Louvers shall be designed or screened to prevent the entrance of vermin. Cubicles containing electrical control and switching equipment shall be equipped with electric space heaters for moisture control. Construction of the cubicle and placement of heaters shall assure effective circulation of air and prevent damage to equipment by overheating. Heaters shall be rated 120 V, AC, single-phase. They shall be provided with thermostatically operated controls with "on-off" switches mounted inside the enclosure.

Provisions shall be furnished for securely attaching the cubicles to the powerhouse floor. Where more than one enclosure is provided for a switchgear or control line-up, the housings shall be bolted together to make one uniform assembly. All buses and wiring inside enclosures shall be furnished and installed. All buses and wiring between adjacent enclosures (internal wiring) shall be furnished and installed by the Contractor. Floor-mounted cubicles shall have removable, gasketed plates in the top and bottom for entry of cables and conduits. Provisions shall be provided to fix the entering cables and conduits.

Each cubicle shall be provided with a light and receptacle inside the enclosure to facilitate operation and maintenance. The light shall be either incandescent type or fluorescent type, as selected by the Department, with wire-guard and "on-off" switch. The receptacle shall be a duplex type, rated 16 A, 2-pole, 3-wire. Power supply to the light and receptacle will be from a single-phase, 120 V, AC, circuit provided by the Department.

Each cubicle shall be provided with a continuous copper ground bus of suitable rating, but not smaller than ¼ in x 1.5 in.,. The framework and other noncurrent-carrying metallic parts of all equipment shall be securely connected to the ground bus. Provisions for connections to the main ground bus shall be provided at 2 places.

Cable and wire terminations inside the cubicles shall be identified with adhesive, self-laminating type markers. The markers shall be printed with the cable

designation or with the conductor designation shown on the Contractor's drawings. The clear laminate shall overlap the legend and shall be resistant to oils, abrasion and high temperatures.

2.8 AIR-OIL PRESSURE TANKS FOR UNITS # 1 THROUGH 6

A. The existing air-oil pressure tanks shall be re-deployed.

B. Replace existing pressure switches for controlling the oil pumps with pressure transmitter devices for controlling the oil pumps.

C. Pressure switches shall be replaced so as to be compatible with the new control system.

2.9 SUMP TANKS FOR UNITS # 1 THROUGH 6

A. General. The existing sump tanks shall be redeployed.

2.10 COMPRESSED AIR SYSTEM FOR CHARGING AIR-OIL PRESSURE TANKS

A. System Description for Units # 1 through 6, there are three air compressor systems; each system serves two units, and the systems can be interconnected through a tie header.

B. The existing compressed air system used to pressurize the oil pressure tanks to the normal operating pressures shall be redeployed. The controls shall be upgraded if necessary to satisfy the requirements of this section. The technical details of the existing air compressors are as follows:

Unit # 1 through 6 (10R-017-725 Rev A, Air Compressor for Turbine Shutoff Valves):

Description	Values	units
AIR COMPRESSOR		
Maker – air compressor	Ingersol Rand	
Model – air compressor	10 T 2	
Serial number	30T 327539	
Maximum delivery pressure	3,500	psig
Speed	860	rpm
Capacity – free air at 1,500 psig	14.1	cfm
Brake horsepower at 1,500 psig	9.7	hp
MOTOR		
Air compressor motor – maker	General Electric Co.	
Air compressor motor – model #	5K215AK214	
Frame size	F215T	psi
Capacity	10	hp
Type	SC	
Code	H	
Phase - frequency	3 ϕ – 60 Hz	
Voltage – full load current	460 V - 13.6 A	
Starting current or locked rotor current	81	A
Motor speed at full load	1750	rpm

C. Controls.

1. General. Controls shall be designed to permit both manual and automatic operation of the compressors. In the manual mode, the compressors shall be operated from a local control panel. The normal mode shall be automatic. Pressure switches or a pressure transmitter shall be provided for compressor control and remote annunciation. Each compressor shall be furnished with a high discharge air temperature switch, suitable for mounting in the discharge air piping, to shut down the compressor upon excessive air temperature.

2. Plant Control System. The plant control system shall be provided with status indication of the compressors, and system pressure. In addition, the following status and alarm points shall be provided:

   a. Cumulative motor running time, each compressor.

b. Compressor trip, each compressor.

c. Compressor not-in-auto, each compressor.

d. System pressure – High.

e. System pressure – Low.

f. System pressure – Normal.

PART 3 - EXECUTION

3.1 SHOP ASSEMBLY AND TESTS

A. General. The equipment shall be completely assembled in the shop and tested, insofar as practicable.

B. Operational Tests. Operational tests shall be performed on all of the equipment or devices insofar as practicable to demonstrate that they function properly. Adjustable devices shall be checked for range of adjustment and given final adjustment, insofar as possible, in the shop. The electrical devices shall be given dielectric tests in accordance with applicable provisions of NEMA, ANSI, and IEEE standards. The electrical devices shall be tested for temperature drift, voltage drift, time drift, and electro-magnetic interference. The systems shall be shipped with parts complete and ready for operation.

3.2 FIELD TESTING

A. Refer to Section 16300 for shop and field-testing requirements.

3.3 SPARE PARTS

A. All spare parts shall be of the same material, workmanship, and manufacturer as the corresponding original parts, completely interchangeable and packaged for long-term storage.

B. Spare parts that may be required for ten years shall be included.

3.4 INSTRUCTIONS AND MANUALS

A. Written instructions and manuals shall be provided for all equipment and systems furnished, or for systems affected by the replacement or addition of TSOV components.

END OF SECTION

SECTION 16611

UNINTERRUPTIBLE POWER SYSTEM

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall provide a redundant three-phase uninterruptible power system (UPS) and all accessories required, complete and operable, in accordance with the Contract Documents.

B. The Contractor shall provide as a minimum the KVA rating as specified in this specification.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

1.	ANSI/IEEE 241	Electric Power Systems in Commercial Buildings, Recommended Practice for
2.	ANSI/NEMA 250	Enclosures for Electrical Equipment
3.	EIA	Electronic Industries Association Standards
4.	IEEE-587	Standards for Surge Withstandability
5.	NEC	National Electrical Code; Article 700 Emergency Systems
6.	NEMA PB2	Panelboard
7.	UL 1012	Underwriter's Laboratory Listing

1.3 CONTRACTOR SUBMITTALS

A. Shop drawings and catalog data submittals shall be made in accordance with Sections 01300 and 16300. The Contractor shall submit sufficient information to indicate the scope and quality of the UPS system installation:

1. Block diagram showing system relationships of major components and quantities and interconnecting cable requirements.

2. Control console and panel arrangements, equipment outlet devices, and special mounting details.

3. Wiring diagrams showing terminal identification for field wiring.

4. Catalog literature.

1.4 QUALITY ASSURANCE

A. Uninterruptible power system components shall be manufactured by firms that are regularly engaged in the production of UPS system including auxiliary equipment similar to that required for this project and that have been in satisfactory service for at least 10 years.

B. Operation of the uninterruptible power system shall be demonstrated to the Department to prove that under normal conditions UPS will provide power to the designated load without interruptions of functions and loss of stored information.

1.5 MAINTENANCE DURING CORRECTION OF DEFECTS PERIOD

A. The Contractor shall respond to trouble calls with a competent repair person at the project site within 24 hours; Contractor shall also maintain a full inventory of replacement parts so that all routine repairs can be completed within 24 hours.

PART 2 - PRODUCTS

2.1 THE SYSTEM

A. The UPS shall be standby for four hours, on-line, solid-state uninterruptible power system operating in conjunction with the plant electrical system to provide power conditioning, back-up, and distribution for electronic equipment loads. The system shall consist of a solid-state inverter/charger, microprocessor controlled logic, a sealed maintenance-free battery, static bypass switch, switchgear, control panel, and accessories, as described herein.

2.2 SYSTEM DESCRIPTION

A. The UPS shall consist of the following major equipment:

1. Bypass switch

2. Inverter/charger.

3. Static bypass switch.

4. Enclosed, sealed, maintenance-free battery. Battery cabinets for longer protection times.

5. Input, battery, and output breakers.

6. Microprocessor controlled logic and control panel.

7. Twelve MCB output distribution panelboard.

2.3 MODES OF OPERATION

A. The UPS shall operate as an on-line fully automatic system in the following modes:

1. Normal: The critical load is continuously controlled by the inverter/charger. It derives power as needed from the commercial ac source and supplies filtered and regulated ac power to the critical load. In addition, simultaneous float-charging of the battery occurs.

2. Emergency: Upon failure of the commercial ac power, the critical load continues to be supplied by the inverter, which without any switching, obtains its power from the storage battery. There is no interruption to the critical load upon failure or restoration of the commercial ac source.

3. Recharge: Upon restoration of the commercial ac source, the inverter/charger recharges the battery. This is an automatic function and causes no interruption to the critical load.

4. Bypass Mode: If the UPS must be taken out of service for overload, load fault, or internal failures, the bypass switch automatically transfers the load to the commercial ac power. Return from bypass mode to normal mode of operation is automatic, except for overload trip which requires manual reset. Transfer to bypass mode can also be initiated manually by operating a key controlled On/Off switch on the control panel. An external independent bypass switch shall also be provided to allow service and replacement of the UPC.

2.4 PERFORMANCE CHARACTERISTICS

A. Power Ratings: 20 kVA rating for 0.8 lagging to 0.9 leading.

B. Input

1. Nominal input voltage and frequency: 480 VAC, 60 Hz

2. Operating input voltage range: +13 percent to -20 percent of nominal without battery discharge.

3. Input power factor: 0.9 minimum at full load and nominal input voltage.

4. Input current THD: 10 percent typical at full load (linear or non-linear).

5. Input surge withstandability: Per IEEE-587 Standards.

C. Output

1. Nominal output voltage: Same as input voltage.

2. Output voltage regulation: Within plus and minus 2 percent from nominal output voltage for all operating conditions.

3. Manual output voltage adjustment: Within plus and minus 5 percent from nominal.

4. Transient voltage response: Within plus and minus 8 percent from nominal peak voltage for a 100 percent load step.

5. Transient voltage recovery: 100 msec to within plus and minus 2 percent of nominal.

6. Frequency regulation: plus and minus 0.1 Hz.

7. Output voltage harmonic distortion: 3 percent THD for 100 percent linear load, 10 percent THD for 100 percent non-linear loads at nominal input voltage.

8. Output fully isolated from input and battery.

9. Common mode noise attenuation (without static switch): 55 dB up to 500 kHz.

D. Environmental

1. Efficiency at full, unity power factor load and nominal input voltage shall be 90%.

2. Elevation: max. 1000m without derating.

3. Acoustical noise: 50 dBA at one meter. (Measured at +25 degrees C.)

4. EMI suppression: Electromagnetic effects are minimized to ensure that computer systems, or other similar electronic systems are neither adversely affecting to, nor are adversely affected by, the UPS. The UPS is certified to meet the requirements of Class A, Subpart J of Part 15 of the FCC Rules and Regulations.

5. Electrostatic discharge (commonly encountered in carpeted offices) immunity: Withstands up to 25 kV with no disturbance or adverse effect to the load.

E. Battery Pack

1. The battery consists of battery tray(s) either fully enclosed within the UPS cabinet or enclosed in metal cabinet(s) which match the UPS module in appearance. Individual battery trays are modular and individually fused.

2. Battery type: Sealed, maintenance-free, high-rate, lead-acid cells.

3. Expected life: 5 years or 200 full discharge cycles at full load.

4. Minimum final discharge voltage: 1.66 volts per cell.

5. Nominal float voltage: 2.25 volts per cell.

6. Battery Circuit Breaker: A molded case breaker is provided for battery short circuit protection and as a means of manual disconnection for battery maintenance.

2.5 FUNCTIONAL DESCRIPTION

A. Inverter/Charger: The inverter/charger shall employ Pulse Width Modulation (PWM) technology utilizing transistor power blocks as switching elements. The inverter shall be capable of providing the specified quality output power while operating from the ac utility or dc source within the specified operating range. In addition, the inverter shall simultaneously float charge the battery.

B. Electrical Protection

1. Input protection shall be provided by a thermal-magnetic molded case circuit breaker and transient suppression circuitry.

2. Battery protection shall be provided by individual fusing of each battery tray and a thermal-magnetic molded case circuit breaker.

3. Output protection shall be provided by thermal-magnetic circuit breaker(s), fuses in the inverter circuit, and current limit circuitry.

C. Static Bypass

1. A static bypass switch includes transfer control logic which automatically transfers the load to bypass upon the following conditions:

2. Output overvoltage or undervoltage.

3. Overload condition of a duration longer than 10 minutes.

4. Overtemperature

5. Inverter failure

6. Return to UPS mode of operation upon restoration of normal operating conditions shall be automatic except for overload or inverter failure which require a manual restart. Electromechanical transfers are break before make.

D. Microprocessor Controlled Logic: Fully automatic operation of the UPS shall be provided through the use of microprocessor controlled logic. All operating and protection parameters shall be firmware controlled, to eliminate the need for manual adjustments to compensate for component tolerances. The logic includes system and battery test capability to facilitate maintenance and troubleshooting. Start-up, transfers, and battery recharge shall be all automatic functions.

E. Control Panel

1. The UPS shall be equipped with a control panel that provides the following metering, monitoring, and control functions. The metering display shall automatically blank after five minutes.

i.	ac input voltage	(LINE VOLT)
ii.	ac input current	(LINE AMP)
iii.	ac input frequency	(LINE HZ)
iv.	dc battery voltage	(BATT VOLT)
v.	dc battery current	(BATT AMP)
vi.	ac inverter voltage	(LOAD VOLT)
vii.	ac inverter current	(LOAD AMP)
viii.	ac inverter frequency	(LOAD HZ)

2. Alarm Monitoring: The following alarm indicators shall be provided on the control panel display:

i. SYSTEM NORMAL (Green): Line is supplying power to the UPS. The UPS is controlling the load voltage, and charging the battery.

ii. ALARM (Red): This indicator flashes whenever an alarm condition exists.

iii. LOW BATTERY (Red): The battery voltage has fallen below 128 v dc. Alarm condition ceases when the battery voltage reaches 132 v dc.

iv. BATTERY DISCHARGE (Red): The battery is supplying power to the load.

v. OUTPUT OVERLOAD (Red): The output current exceeds the maximum rating of the system. If the output current exceeds 105 percent of system rating for 10 minutes, the system will respond by transferring to bypass.

vi. SYNC LOSS (Red): The utility line frequency has exceeded safe operating tolerances (1 Hz or 3 Hz, switch selectable) and/or the UPS is not synchronized within 5 degrees phase angle of the desired operating point.

vii. AC INPUT FAILURE (Red): The line voltage is not within normal operating range for the equipment (+13 percent to -20 percent of nominal). The load is being powered by the battery, if not in bypass mode of operation.

viii. OVER TEMP (Red): The internal temperature of the UPS cabinet is above 65 degrees C. UPS will transfer to bypass.

ix. SHUTDOWN IMMINENT (Red): Inverter shutdown is imminent (triggered by the battery discharging below 110 v dc or output overload over eight minutes). The load will be dropped when the battery falls below 95 v dc or the overload exceeds 105 percent for 10 minutes unless the bypass reacts.

x. ON BYPASS (Red): The load is receiving power which is bypassing the power protection circuitry of the UPS.

xi. INVERTER NOT READY (Red): The inverter is not ready to support the critical load.

3. Controls: The following control functions shall be provided on the control panel:

i. ON/OFF: Key operated switch which activates and deactivates UPS operation.

ii. ALARM OFF: Pushbutton which silences the audible alarm. The alarm will sound again at the reoccurrence of an alarm condition.

iii. TEST: Pushbutton which initiates a system test routine by simulating a utility power outage. The critical load

will be supplied by the battery. When the pushbutton is released, the control circuitry resynchronizes the inverter to the input line and resumes battery charging.

4. Other controls located behind the front door shall include:

   i. Audible Alarm Volume Control: Loud, soft and off.

   ii. Manual Restart: Pushbutton used to restart UPS after an overload or inverter failure trip.

F. Alarm Contact: A dry type summary alarm contact shall be provided for remote indication of alarm conditions.

G. Built-in Distribution: A 12-pole distribution panelboard shall be provided on the output of the system.

2.6 ENCLOSURES

A. The UPS shall be housed in a free standing, double dead front (safety shields behind front door) enclosure equipped with casters and leveling feet. Enclosures shall be designed for office or computer room applications. If system consists of more than one cabinet, the cabinets shall be shipped with joining hardware to be bolted together at time of installation.

B. Ventilation: Electronics cabinets shall be designed for natural convection cooling aided by a thermostatically controlled fan. Air inlets shall be in the lower front and rear; air outlets shall be in the upper rear. Battery cabinets shall be convection cooled.

C. Cable Entry: Units equipped with input cord and plug and output receptacles shall not require any installation. Hard wired systems shall provide for conduit entry through knockouts located in the rear of the unit. Connection between UPS and battery cabinets shall be provided and shall consist of cables and power plugs.

D. Front Access: Major subassemblies shall be modular and shall be replaceable from the front of the unit.

PART 3 - EXECUTION

3.1 GENERAL

A. The Department will install the Uninterruptible Power System in accordance with the equipment manufacturer's installation instructions.

B. The Contractor shall receive, store, and assemble all sections of the UPS to form complete units. The Contractor shall make all internal wiring interconnections as required for complete assembly of each UPS. Where

wiring connectors are not supplied by the manufacturer, the Contractor shall furnish the connectors required to complete internal wiring terminations.

C. The Contractor shall take all necessary precautions to eliminate moisture and foreign material from the equipment at all times during. Special care shall be taken to prevent corrosion of and damage to the UPS.

D. The UPS shall be equiped with casters and leveling feet. The Contractor shall provide all shims necessary to accomplish the leveling requirements.

- END OF SECTION -

EXHIBIT G
SYSTEMS INTEGRATED TECHNICAL APPROACH

5 TECHNICAL APPROACH

5.1 INTRODUCTION

To simplify the process of evaluating SI's technical approach to implementing a successful Castaic power plant control system upgrade, each item of Appendix 'C' will be addressed here on a section by section basis. Where required, the reader will be directed to ancillary material such as drawings and manufacturer data sheets located elsewhere in the document.

5.2 01010 SUMMARY OF WORK

SI's engineering staff has thoroughly reviewed the work summary, Appendix C and all ancillary material provided by LADWP including Addendums on through six and is prepared to provide a fully compliant system meeting all requirements as set forth in RFP NO. 273-10. Our proposal will detail the following system changes, installation and component upgrades to standardize hardware and software so that all units are identical in form and function:

1. Replacing existing Siemens Unit Controller PCS7 PLCs with Allen Bradley ControlLogix PLCs for Units 1 through 6. LADWP will provide SI with the use of the existing available equipment as needed during the installation. SI will transport equipment to their offices at their cost. In reviewing the 4160 kV installation, SI will provide 4160 Bay Controller/protection devices for each device. Remote I/O for new units will be located in same locations as was wired for Units 2 and 6 to maintain wiring consistency.

2. Provide new turbine governing system for Units 1 through 6. The recommended manufacturer is American Governor. SI recommends that LADPW replace the Governor and Distributing Valve and Pilot Valves for each unit. The reason for this change is to allow LADWP to maintain spares for these units, a consistent component makeup by the new Governor manufacturer. The valves would be provide by American Governor and

installed by LADPW under the direction of the SI team. Provide remote I/O via IEC61850 interface.

3. SI will provide new redundant Allen Bradley ControlLogix PLCs for Units 1 though 6 TSOV controllers.,

4. SI recommends that new exciters be provided for Units 1 through 6. Provide remote I/O via IEC61850 interface.

5. SI will provide new redundant balance of plant controllers that will perform the following functions: Pump Control, PSOV, outlet tower, main plant compressors (provide I/O to start, stop and monitor), station service (4.16kV and 480 monitoring and control) 230kV switchyard control and monitoring, including protection.

6. SI recommends the installation of an Allen-Bradley PanelView OITat the PSOV building. The OIT will be configured to only access PSOV configuration and control screens. SI will install Allen-Bradley FlexIO to replace the existing Siemens PCS7-300 PLC. The Phoenix contacts I/O interface will stay in place to create a redundant I/O configuration.

7. SI recommends the installation of 480V critical load monitoring for discrete and analog I/O points. LADPW will provide the total count so SI engineering can supply the correct number of I/O cards.

8. SI will provide three standalone Allen-Bradley ControlLogix PLCs for DNP 3.0 slave functionalit to the ECC and BAGC controller. SI will provide three 1200 baud modems for each of the 4-wire copper interface circuites provided by LADWP.

9. SI will provide an Allen-Bradley ControlLogix PLC and peripheral equipment to provide a training simulator as required.

10. SI will provide new standalone Allen-Bradley ControlLogix PLCs, one each in the outlet tower building and electrical building for Elderberry outlet control and monitoring.

11. SI will provide a 5.8GHz based network connection to the new PLCs in the Elderberry Lake Outlet building and tower and main plant.

12. SI is proposing to install Siemens 7SJ64 Bay Controllers including protection, in lieu of PLC remote control of existing 4160 breakers located adjacent to Unit 7.

13. SI after reviewing the existing 230kV electrical panels, is providing the following:

    a. New panels laid out with a one-line mimic the 230kV switchyard.

    b. Provide six new panels, 4 relays per panel.

    c. 7 new synchronizers

    d. Add 7 new synchroscopes.

    e. Provide manual ability to sync units.

    f. Panels will be provided with current shorting blocks and voltage disconnects.

    g. Four hot-bus lights for either side of the 2 bus-tie disconnects.

    h. SI to retrofit 21 existing breakers for IEC61850 protocol and provide 5 additional Siemens 7SJ64 relays.

    i. Mount remote AB FlexIO for providing unit control discrete I/O.

    j. Utilize synchronizers to develop a soft pump start control algorithm.

14. SI will supply a single Allen-Bradley ControlLogix PLC for Unit 7 to interface with panelboard.

15. Control Room - SI will supply Evans Design for all control room furniture.

16. Network - Refer to Proposal Section 11.1

17. UPS - Refer to Proposal Section 11.3 - Liebert

18. Field Devices and Instrumentation

The HMI servers will be the latest HP model server class platform that meets the specification requirements. The workstations will be the latest HP workstation class model that meets the specification requirements, and the notebooks will be the latest HP models that meets specification requirements. All network switches supplied will be IEC61850 compliant Industrial Ethernet switches for plant communications.

5.2.1 Penstock Shut Off Valves

Refer to proposal drawing 'DRP LADWP 273-10.02' at end of this Section.

SI will install Allen-Bradley FlexIO to replace the existing Siemens PCS7-300 PLC in the PSOV South Portal Control House. The Phoenix Contacts I/O interface will stay in place to create a redundant I/O configuration. SI will install an Allen-Bradley OIT in the South Portal Control House to replace the existing OIT. The OIT will be configured to only communicate with the new balance-of-plant controller and access PSOV configuration and control screens exclusively.

SI will install an Industrial Ethernet switch to replace the Siemens switch *OSM21*. The existing fiber connection will be re-terminated at this new switch and to switches in the main control room network closet to integrate the PSOV remote I/O and OIT into the new primary Plant Control Network loop. A new 5.8GHz radio point-to-point link will be installed between the existing mast located near the south portal control house and a new radio and mast mounted on top of the main plant's roof top. This will provide the backup link to the PSOV FlexLogix I/O for provisioning of emergency closure of some or all PSOV's in the event of primary Plant Control Network failure.

The new HMI workstations in the main control room will be programmed to provide initiation of PSOVs closing commands.

5.2.2 Elderberry Lake Outlet Controller

Refer to proposal drawing 'DRP LADWP 273-10.02' at end of this Section.

SI will provide new standalone Allen-Bradley ControlLogix PLCs, one each in the outlet tower building and electrical building for Elderberry outlet control and monitoring of the slide gates and water level. The communication path between the Elderberry Lake controllers and South Portal Control House network endpoint will be a two hop 5.8GHz radio link. The first hop will be between a repeater site located on the opposite end of the dam and two radios collocated with each new PLC. The second hope will between the repeater site and a new radio mounted on the existing mast located near the south portal control house. SI will perform a radio path study to position the repeater site and all radios such that 99.999% uptime can be achieved over the network links. From the South Portal Control house, Elderberry Lake Outlet Controller communications will be routed to the main fiber connection down to the main control house. Alternatively, the same communication will be routed over a new 5.8GHz backup link being installed as part of this proposal.

SI PLC programmers will design, write and test all PLC logic required to implement the monitoring and control functions for the standalone controllers.

5.2.3 Unit 1, 3, 4 & 5 Controllers

Refer to proposal drawing 'DRP LADWP 273-10.02' at end of this Section.

SI will supply a Unit controller consisting of redundant Allen-Bradley ControlLogix PLCs, remote I/O and power supplies to replace the existing hardwired relay sequence control logic. SI will supply a TSOV controller consisting of redundant Allen-Bradley ControlLogix PLCs, remote I/O, power supplies and OIT to replace the original mechanical/hydraulic control systems still in place. SI will supply redundant Allen-Bradley ControlLogix PLCs, remote I/O, power supplies, ElectroHydraulic Interface

assembly, local OIT and all required components to replace the existing Woodward Governors.

Each set of redundant PLCs (3 total sets) will be cabled via copper or fiber Ethernet into the primary and backup control networks.

The existing Unit controller PLC code written in Sequential Function Chart and Continuous Function chart for Unit 2 and 6 will be analyzed by SI PLC programmers to determine how to most efficiently transition existing code to the new unit controllers while making enhancements for system response, sequence flexibility and organization and field device integration. Existing code documentation will be updated with changes made and re-written if necessary to provide a readable and manageable documentation package for plant technicians to use for future upgrades.

The TSOV PLC code will be designed, developed and documented by SI staff based on requirements set forth in Section 16320 Subsection 2.3.G, Section 16390 and other relevant documentation provided in the RFP.

The Governor Controller PLC code will be provided by American Governor, the vendor of the complete digital governor control package. Their PLC staff has implemented such control logic on numerous hydroelectric facilities and is well qualified to meet the requirements of the RFP273-10 specification.

The new HMI system will be installed with a port of existing screens originally developed for Units 2 and 6 while making those changes required to improve Unit sequence flexibility and organization, specific changes defined in Section 01012, Subsection 4, 'HMI Configuration and Implementation' and as a result of design workshops held between SI staff and LADWP personnel.

5.2.4 Unit 7 Controller

Refer to proposal drawing 'DRP LADWP 273-10.02' at end of this Section.

SI will supply redundant Allen-Bradley ControlLogix PLCs, remote I/O and power supplies to interface the HMI system to the existing benchboard wiring. The Primary

PLC will be cabled into the primary control network via dual Industrial Ethernet switches.

The SI PLC programming staff will develop code for the redundant controllers based on the supplied I/O interface and for those operating modes defined in section 16320, subsection 2.3.C.5: generator mode, synchronous condensing mode, pump synchronous mode and cold start mode. The SI PLC programming staff will also utilize the initial design workshops and reviews with LADWP staff to generate an external design reference. This reference will encapsulate all requirements of the RFP to drive the code development process.

The new HMI system will be installed with new screens developed for Unit 7 based on those originally developed for Units 2 and 6 while making changes required to improve Unit sequence flexibility and organization, specific changes defined in Section 01012, Subsection 4, 'HMI Configuration and Implementation' and as a result of design workshops held between SI staff and LADWP personnel.

5.2.5 Unit 2 and 6 Controllers

Refer to proposal drawing 'DRP LADWP 273-10.02' at end of this Section.

SI will supply redundant Allen-Bradley ControlLogix PLCs, remote I/O and power supplies to replace the existing Siemens S7-400 PLCs already in place. SI will supply a TSOV controller consisting of redundant Allen-Bradley ControlLogix PLCs, remote I/O, power supplies and OIT to replace the original mechanical/hydraulic control systems still in place. SI will supply redundant Allen-Bradley ControlLogix PLCs, remote I/O, power supplies, ElectroHydraulic Interface assembly, local OIT and all required components to replace the existing Woodward Governors.

Each set of redundant PLCs (3 total sets) will be cabled via copper or fiber Ethernet into the primary and backup control networks.

As was performed for Units receiving a new control system, the existing Unit controller PLC code written in Sequential Function Chart and Continuous Function chart for Unit 2 and 6 will be analyzed by SI PLC programmers to determine how to most efficiently

transition existing code to the new unit controllers while making enhancements for system response, sequence flexibility and organization and field device integration. Existing code documentation will be updated with changes made and re-written if necessary to provide a readable and manageable documentation package for plant technicians to use for future upgrades.

The TSOV PLC code will be designed, developed and documented by SI staff based on requirements set forth in Section 16320 Subsection 2.3.G, Section 16390 and other relevant documentation provided in the RFP.

The Governor Controller PLC code will be provided by American Governor, the vendor of the complete digital governor control package. Their PLC staff has implemented such control logic on numerous hydroelectric facilities and is well qualified to meet the requirements of the RFP273-10 specification.

The new HMI system will be installed with existing screens modified as required to improve Unit sequence flexibility and organization, specific changes defined in Section 01012, Subsection 4, 'HMI Configuration and Implementation' and as a result of design meetings held between SI staff and LADWP personnel.

5.2.6 Hydraulic Governor and Digital Governor Controllers

Refer to proposal drawing 'DRP LADWP 273-10.02' at end of this Section.

SI will supply redundant Allen-Bradley ControlLogix PLCs, remote I/O, power supplies, control switches, primary speed sensors, back-up speed sensors, overspeed protection feedback and local OIT on all 6 Units. Units 1through 6 will be fitted with an ElectroHydraulic Interface assembly, dual filter assembly and distributing valve position feedback. All Unit's wicket electronic gate position feedback devices will be retained and reused.

The redundant PLCs will be cabled via copper or fiber Ethernet into the primary and backup control networks.

The Governor Controller PLC code will be provided by American Governor, the vendor of the complete digital governor control package. American Governor will provide custom governor control software adapted from proven software algorithms. For this project, SI proposes the following functionality:

- Automatic Start / Stop Control
- Manual Start / Stop Control
- Local/Remote Control Selection
- Unit Speed / Frequency Control with
    - Variable Droop
    - Dual Speed/ Load Dynamics
    - On-Line / Off-Line Gains
- Feedforward Control (for Fast Ramping)
- Gate Limit Control for Pump Mode
- Automatic MW Control with Droop
- Synchronous Condense Control
- Auto/Manual/Test Control Modes
- Automatic Pre-Load (to Prevent Reverse Power Condition)
- Soft Loading & Unloading of Unit
- Speed Switches & Gate Position Switch Functions

Refer to Section 5.9 for additional details

5.2.7 Turbine Shut Off Valve (TSOV)

Refer to proposal drawing 'DRP LADWP 273-10.02' at end of this Section.

SI will supply a TSOV controller on Units 1-6 consisting of redundant Allen-Bradley ControlLogix PLCs, remote I/O, power supplies and OIT to replace the original mechanical/hydraulic control systems still in place. Additional instrument upgrades will be provided if necessary as a result of detailed design discussions with LADPW.

The redundant PLCs will be cabled via copper or fiber Ethernet into the primary and backup control networks.

The TSOV PLC code will be designed, developed and documented by SI staff based on requirements set forth in Section 16320 Subsection 2.3.G, Section 16390 and other relevant documentation provided in the RFP.

5.2.8 Unit 1 through 6 Exciters

SI understands its role for providing shop, demolition and installation drawings for replacement of Units 1 through 6 excitation systems with new Basler Excitation Systems. SI will also provide services to power up, integrated, test and commission the Excitation systems into the associated Unit control system for each generator/turbine. SI will provide a Basler representative during the commissioning of the control system to help ensure a quality startup.

5.2.9 Balance of Plant Controllers

Refer to proposal drawing 'DRP LADWP 273-10.02' at end of this Section.

SI will supply a Balance of Plant Controller consisting of redundant Allen-Bradley ControlLogix PLCs, remote I/O and power supplies to replace the existing hardwired relay control logic. The Controller will be interfaced with the controllers and I/O defined in Section 01010, subsection 1.2.R.

The redundant PLCs will be cabled via copper or fiber Ethernet into the primary and backup control networks.

The Balance of Plant Controller PLC code will be designed, developed and documented by SI staff based on requirements set forth in Section 16320 Subsection 2.3.I, 2.3.O and other relevant documentation provided in the RFP.

The new HMI system will include screens showing individual systems monitored and controlled by the Balance of Plant controllers, navigation between these screens, all other relevant documentation provided in the RFP and as a result of design workshops held between SI staff and LADWP personnel.

5.2.10 Pump Start Controllers

Refer to proposal drawing 'DRP LADWP 273-10.02'

SI will move the pump start controller function into the Unit and synchronizer being supplied as part of this contract. The Unit Controller will be interfaced with the I/O defined in Section 01010, Subsection 1.2.S.

The redundant PLCs will be cabled into the primary and backup control networks with the primary PLC cabled to Phoenix Contact switch *PCN-SW11* and the backup PLC to switch *PCN-SW12*.

The existing Pump Start Controller PLC code written for Unit 2 and 6 will be analyzed by SI PLC programmers to determine how to most efficiently transition existing code to the pump start controllers while making enhancements for system response, sequence flexibility and organization and field device integration. Existing code documentation will be updated with changes made and re-written if necessary to provide a readable and manageable documentation package for plant technicians to use for future upgrades. The Pump Start Controller PLC code will be designed, developed and documented by SI staff based on requirements set forth in Section 01010, Subsection 1.2.S and other relevant documentation provided in the RFP.

The new HMI system will include screens showing the pump start system and any navigation screens to integrate the pump start screens with Unit screens in a logical and easy to use hierarchy. The screen design will be based on relevant documentation provided in the RFP and as a result of design workshops held between SI staff and LADWP personnel.

5.2.11 Plant Control Room

Refer to proposal drawing 'DRP LADWP 273-10.01' and 'DRP LADWP 273-10.02' at end of this Section.

The new control system computer hardware is based on HP Computer platforms. Specifically, the HMI servers will be delivered as the latest model HP server class computer. The current class of HP servers do not provide clock speed greater than 2.93GHz so this will be an exception from the specification. We will, as part of this proposal, purchase the newest model available when the project schedule requires it.

Our experience with the current class of HP servers in similar control system configurations has shown that it will exceed all performance metrics established in the RFP. The servers will be configured at a minimum with 16GB of memory, Windows Server 2008, Standard x64 (to allow for memory size greater than 4GB) and five 146GB SAS 2.5 10K RPM hard drives configured in a Raid 5 configuration. The server's monitor/keyboard/mini-mouse interface will be a rack-mounted unit by Synergy and designed to fold down and slide into the rack in less than 1U height when not in use.

The HMI workstations and all support workstations will be delivered as the latest model HP workstation class computer in a mini-tower chassis configuration. The operating system is Windows 7 with a downgrade available to Windows XP. Each workstation will have at minimum, 12GB of SDRAM memory, a 256MB video card and two Intel Gigabit ET and EF Multi-Port server adapters (each with 2 ports) to provide 4 ports total for the dual redundant networks. Each workstation will be delivered with two 320GB SATA 3.0Gb/s hard drives configured in a Raid 1 (mirroring) configuration. We will, as part of this proposal, purchase the newest model available when the project schedule requires it. As specified in Section 16300, Subsection 2.4.D, two84" video wall will be supplied with one of the ten HMI workstation in lieu of two 19" widescreen LCD monitors. This video wall will be mounted on a wall of LADWP's choosing and can support up to eight separate video feeds from the controlling HMI workstation.

The portable workstations will be delivered as the latest model HP workstation class notebook with a minimum of 2.4GHz processor, 3MB of level 2 cache, 4GB of SDRAM, a 17" 1920x1200 LCD display, a 320GB 7200RPM hard drive with free fall sensor. Software included will be Microsoft Office Basic Edition and the Windows 7 operating system. We will, as part of this proposal, purchase the newest model available when the project schedule requires it.

The black and white printers are HP model LaserJet 5200dtn and the color printers will be HP model LaserJet 5550dtn. Please refer the attached specification sheets for a complete breakdown of each printer's capabilities. The printers will be fully integrated

with the HMI software to provide printing of event logs, screen shots, alarm lists and reports.

GPS Time Synchronization will be implemented through installation of the Symmetricom SyncServer S200 GPS based network time server. This unit has multiple independent network ports, supports both IPv4 and IPv6 and can provide 0.5 - 2ms of typical client synchronization accuracy on a LAN. All new computer based assets with access to the network will be configured to utilize this appliance to keep their real-time clocks in sync with the atom clocks aboard the GPS satellite system. An L1 GPS antenna will be mounted on the control room roof and a Belden 9104 coaxial cable run to the appliance to provide satellite signal connection.

5.2.12 Network and Communication Systems

Refer to proposal drawing 'DRP LADWP 273-10.01' and 'DRP LADWP 273-10.02' at end of this Section.

The bulk of the Ethernet based control and HMI networks will be based on industrial Ethernet managed switches. The switches meet all requirements of section 16360, subsection 2.3. SI proposes a modular managed switch system with the base unit capable of supporting up to 8 Ethernet ports that can expanded with two additional bases to provide 24 Ethernet ports total. Each switch module (12 total per switch) provides two Ethernet ports in 10/100 twisted-pair copper, 100BASE-FX multimode fiber, or mixed with one of each format. SI will provide sufficient modules to populate each switch documented in the attached proposal drawing plus 25% in spare ports. The multimode fiber ports will have SC style connectors to allow all existing and new fiber cabling to direct connect to each switch. SI will provide re-termination of fiber strands where existing fiber runs have incompatible connectors. In the unlikely failure of a module, a new module can hot swapped in without affecting the operations of other ports.

Network redundancy will be accomplished by creating a 'ring' architecture of connected switches. Using this methodology, four rings will be configured, two for the HMI network and two rings for the plant process control network. As shown in the

proposal network overview drawings, each switch has two fiber based Ethernet ports dedicated to connecting with the upstream or downstream switch. The HMI network rings will be interconnected between switches to provide the root bridge function though which redundant coupling occurs. The plant Process Control Network rings will be interconnected between switches to provide the root bridge function as well.

Network optimization is performed through configuration of the switches to utilize Optimized Rapid Spanning Tree Protocol. Utilizing this protocol as the method for path resolution from one network element (computer, PLC etc.) to another can provide switch over to an alternate path in as little as 100ms.

Wireless network elements will include two 5.8GHz radio point-to-point links installed between Elderberry Lake outlet tower and control building and a new solar powered repeater station located on the opposite side of Elderberry dam. A new link will be established between the repeater site and the South Portal Control House. Finally, a single point-to-point link will be installed between an existing mast located near the south portal control house and the main power plant building roof. The manufacturer shall be Proxim Model 8100. SI network engineers will perform a radio survey for all proposed paths and design the antennas and mountings to ensure 99.999% uptime. SI has installed over 2000 Ethernet radios in many different kinds of mounting scenarios. This includes prefabricated towers between 30 and 100' in height, all self supporting without the use of guy wires.

5.2.13 Uninterruptible Power Supply

SI will supply a Liebert NX single module UPS system consisting of the following components:

- 20kVA Liebert NX 3-phase UPS, model 38SB020C0CHR with a 480VAC system input voltage and 208VAC system output voltage.
- Internal and External battery system rated for 242 minutes at 20kVA load
- Liebert maintenance bypass-transformer cabinet, model 38MB0200AC6DL
- Liebert SlimLine distribution cabinet, model 38DU020C5T000.

5.2.14 Connection to Energy Control Center

Refer to proposal drawing 'DRP LADWP 273-10.01 at end of this Section.

SI will supply three Allen-Bradley ControlLogix PLCs, power supplies and DSUs to provide the source of data for the ECC and BAGC. The primary ECC PLC will be interfaced with an LADWP supplied 4-wire copper interface DSU providing serial connectivity to the ECC center. The PLC will be cabled via copper or Fiber Ethernet to the local Industrial Ethernet switch on the primary control network. This will provide the gateway function between data supplied by various controllers in the Castaic plant control system and the ECC over the 4-wire interface..

The backup ECC PLC will be interfaced with an LADWP supplied 4-wire copper interface DSU providing serial connectivity to the ECC center. The PLC will be cabled via copper or Fiber Ethernet to the local Industrial Ethernet switch on the secondary control network. This will provide the gateway function between data supplied by various controllers in the Castaic plant control system and the ECC over the 4-wire interface.

The backup BAGC interface will include a single PLC cabled via copper or Fiber Ethernet to the local Industrial Ethernet switch on the primary control network. This will provide the gateway function between data supplied by various controllers in the Castaic plant control system and the BAGC over the 4-wire interface.

The ECC and BAGC PLC code will be designed, developed and documented by SI staff based on requirements set forth in Section 16340 and other relevant documentation provided in the RFP.

5.2.15 Relay Protection

SI will provide replacement doors for the unit 4.16KV switchgear positions as specified in section 16315 of the technical specification. In addition, SI will provide qualified personnel to provide programming services for the Siemens and Schweitzer relays for meeting operational and performance requirements. Our engineer technicians will provide all functions for integrating the replay protection equipment with Unit controls for units 1-6. SI staff will also be prepared to perform pre-commissioning and

commissioning functional checks for all equipment described in this section of the specification.

SI engineers will work with LADWP engineers to develop remote access capability of relay protection equipment. This is an area we have a wide variety of experience in: creating solutions to bring the network to devices without a native network interface. By utilizing various third party protocol convertors, packet to serial dissemblers or our own in house developed conversion appliance products, we can successfully integrate 99% of manufacturer devices into a packet based network such as Ethernet.

Finally, as part of our training curriculum, we will train LADWP on the complexities of relay integration with unit and plant controls and how to perform logic programming of relay equipment.

5.2.16 HMI SOFTWARE

SI is proposing the *ONSITE*® HMI software package to meet all requirements of the specification including sections 01010, 01012, 16300, 16330, 16360, 16380 and 16390. The software is fully compatible with all computer based equipment installed as part of this proposal, as well as any existing computer based resources not replaced during the plant upgrade. Included with the proposal are new software and licenses in quantity sufficient to properly license all computers provide under this contract. The type of licenses will include:

- *ONSITE*® Runtime License
- *ONSITE*® Development License
- GE Dataviews Runtime License
- Oracle RDBMS Licenses

Integration of the latest version of *ONSITE*®, GE Dataviews and Oracle software will require SI software engineers to engage with LADWP personnel during the duration of the project to ensure a successful upgrade of Units 2 and 6 and complete integration of Units 1, 3, 4, 5 and 7, Elderberry Lake Outlet controller, the balance of plant controllers, pump start controllers, the ECC and BAGC and relay protection.

During design workshops, SI software engineers will participate in the review of changes specified for the HMI software to determine what modifications will be required. The difference in product features of the existing WinCC software versus o *ONSITE*® will be reviewed to determine how to best port the existing project up to this latest version of software. For example, the basis for graphic displays ported or created as part of the plant upgrade should be engineered around *ONSITE*® standard and advanced process libraries. These libraries are composed of function blocks, faceplates and icons that can form the basis of an object oriented approach to standardizing the look and feel of graphics in the system.

The *ONSITE*® Development system will be used during the engineering phase of project development to integrate all field devices into this configuration tool. Device descriptions will be imported into *ONSITE*® so that all intelligent devices in the plant can be configured, parameterized and commissioned during system acceptance. This tool will also be used by LADWP personnel after the plant is fully online for diagnostics and servicing of devices when failures or alarms are detected in the device themselves.

Completion of the design phase will be followed by development of screens for Units 1 through 6and all ancillary processes. The system will be architected as a multi-user system with the HP workstations configured as *ONSITE*® clients receiving project data, process values, archives, alarms and messages from the redundant HP server platforms running the *ONSITE*® server software. New I/O for plant hardware will be imported from engineering resources using the *ONSITE*® Bulk Loading tool to ensure conformity of tag naming conventions, scaling, alarm thresholds, event detection and historical storage parameters.

In preparation of system maintenance, the *ONSITE*® Development system will be configured on the maintenance workstation. SI HMI application engineers will configure electrical components of the automation system including intelligent field devices and I/O modules, field bus communication modules, controllers, network components as well as servers and clients of the operator workstations. Mechanical assets such as pumps, motors and relays will also be configured into *ONSITE*® to track

usage, runtimes and events. *ONSITE*® can process diagnostic messages and generate maintenance requests on the workstation. The workstation will also be used for preventive and predictive diagnostics, maintenance, and service of Castaic plant computer and PLC assets.

SI's HMI software engineers will work closely with the PLC code development team during the design and integration phases of system software in preparation of the factory acceptance test (FAT). Interface requirements between the HMI and PLC will be documented to ensure that monitoring and control functions initiated by the HMI will properly map to PLC I/O. SI's application engineering team will stage a complete representation of the Castaic plant upgrade in our San Diego offices in preparation of the FAT. The *ONSITE*® software will be configured as it will be deployed into the Castaic plant during system installation.

5.3 01740 TRAINING

SI has a department dedicated to customer training. This department is responsible for the development of customer training courses, preparation of the course materials and delivery of the training at both SI facilities and customer-designated facilities. SI provides factory training at our Orange, CA corporate center and in the engineering center in San Diego, CA. Both facilities are equipped with classroom space and staging facilities that are used to deliver our customer training programs. We also provide the same level of training at our customer facilities or can develop a training regimen using both customer provided and SI facilities.

SI offers customized factory training for all levels of SCADA control system users--from operators to senior management. Courses include hands-on training that is immediately applicable on the job site. Optimum class size is between 4 and 15 students, based on individual customer requirements. SI trainers are highly qualified specialists with experience that is directly applicable to your needs. In most cases the same engineers that are responsible the development of the control system deliver the training as well. This ensures the greatest transfer of knowledge to the customers.

5.3.1 Maintenance and Engineering Training for PLCs

Following is a matrix of the recommended training that is included in our proposal:

5.3.1.1 LADWP Maintenance Track

ALLEN-BRADLEY PLC TRAINING			
COURSE CODE	NAME	DESCRIPTION	LENGTH
CCP146	RSLogix 5000 Level 1: ControlLogix Systems Fundamentals	Course provides fundamental knowledge of ControlLogix® and other Logix5000™ systems. Introduction to basic Logix5000 concepts and terminology, exposure to Logix5000 system hardware, including hands-on experience with the ControlLogix platform. Use of RSLogix™ 5000 software to perform basic system configuration tasks.	2 Days
CCCL21	RSLogix 5000 Level 2: Basic Ladder Logic Interpretation	Course is a skill-building course providing basic understanding of RSLogix 5000 ladder logic instructions and terminology. Provides resources and hands-on practice required to efficiently modify basic ladder logic instructions for a Logix5000 controller. Students use RSLogix 5000 software to perform basic software tasks to meet the requirements of a given functional specification. In addition to using ladder logic instructions, students are introduced to ladder logic techniques, established standards, and common rules for modifying ladder logic.	2 Days
CCP153	RSLogix 5000 Level 3: ControlLogix Maintenance and Troubleshooting	Course provides the necessary resources and hands-on practice to efficiently troubleshoot a previously operational ControlLogix® or other Logix5000™ system. It builds upon fundamental knowledge of common controller terms and operation, the ability to identify and create fundamental RSLogix 5000 project components, and your experience interpreting basic ladder logic. This course adds to the your skill set by introducing new tasks such as connecting to a network, interpreting project execution, editing ladder logic online, and more.	4 Days
CCP299	RSLogix 5000 Level 1: ControlLogix	Course provides a solid foundation and fundamental knowledge of ControlLogix® and	4½ Days

	Fundamentals and Troubleshooting	other Logix5000™ systems. Student is introduced to basic concepts and terminology, and Logix5000 system hardware. Students will be provided the necessary resources and hands-on practice to efficiently troubleshoot a previously operational Logix5000™ system. Students are presented with a systematic strategy for diagnosing and troubleshooting a variety of system problems, such as software configuration issues, electrical noise, controller, I/O, and other possible hardware issues.	

5.3.1.2 LADWP Engineering Track

ALLEN-BRADLEY PLC TRAINING			
COURSE CODE	NAME	DESCRIPTION	LENGTH
CCP146	RSLogix 5000 Level 1: ControlLogix Systems Fundamentals	Course provides fundamental knowledge of ControlLogix® and other Logix5000™ systems. Introduction to basic Logix5000 concepts and terminology, exposure to Logix5000 system hardware, including hands-on experience with the ControlLogix platform. Use of RSLogix™ 5000 software to perform basic system configuration tasks.	2 Days
CCP151	RSLogix 5000 Level 2: Basic Ladder Logic Programming	Course provides a basic understanding of RSLogix 5000 ladder logic instructions and terminology. This course also provides the resources and hands-on practice required to program basic ladder logic instructions for any Logix5000 controller. The student will use RSLogix 5000 software to perform basic software tasks to meet the requirements of a given functional specification. In addition to using ladder logic, the student will be introduced to ladder logic techniques, established standards, and common rules for programming ladder logic.	2 Days
CCP143	RSLogix 5000 Level 3: Project Development	Course provides students with the skills to develop a project to meet requirements of a functional specification for an RSLogix 5000 application. This course covers tasks common to the ControlLogix®	4 Days

		controllers which uses the Logix5000 control engine or operating system. This course builds upon knowledge of common controller terms and operation and student's experience with basic ladder logic programming. This course presents a deeper understanding of project development tasks that are common to all Logix5000 controllers. Such tasks include organizing tasks and routines, organizing controller data, configuring modules, and sharing data. The student will use several Logix5000 communications networks including serial, ControlNet, and EtherNet/IP. Student will also use Producer and Consumer technology to multicast input and output devices, share data between controllers, and control remote I/O.	
CCP152	RSLogix 5000 Level 4: Function Block Programming	This course is provides the student with an understanding of RSLogix 5000 function block diagrams and terminology. This course also provides the resources and hands-on practice required to efficiently program a Logix5000 controller using function block diagrams. Student will have an opportunity to use RSLogix 5000 software and perform software tasks to meet the requirements of a given functional specification. Students will perform parameter modifications to individual function block instructions, as well as create and develop function block diagram programs and routines. Student will also gain experience with a variety of function block instructions, including PIDE and add-on instructions.	2 Days
CCP154	RSLogix 5000 Level 4:	This course provides the skills and	2 Days

	Structured Text/Sequential Function Chart Programming	knowledge to program using the structured text and sequential function chart programming languages. The student will learn how to select instructions, expressions and constructs and then enter these elements and more into a routine. Student will have an opportunity to translate a functional specification in to a sequential function chart. They will learn how to test sequential function chart logic using forces and step throughs. The instructor will demonstrate the relevant procedures required to program with structured text and sequential function charts. The student will be provided ample opportunities to create and test their own projects.	
CCP153	RSLogix 5000 Level 3: ControlLogix Maintenance and Troubleshooting	Course provides the necessary resources and hands-on practice to efficiently troubleshoot a previously operational ControlLogix® or other Logix5000™ system. It builds upon fundamental knowledge of common controller terms and operation, the ability to identify and create fundamental RSLogix 5000 project components, and your experience interpreting basic ladder logic. This course adds to the your skill set by introducing new tasks such as connecting to a network, interpreting project execution, editing ladder logic online, and more.	4 Days
CCCL21	RSLogix 5000 Level 2: Basic Ladder Logic Interpretation	Course is a skill-building course providing basic understanding of RSLogix 5000 ladder logic instructions and terminology. Provides resources	2 Days

		and hands-on practice required to efficiently modify basic ladder logic instructions for a Logix5000 controller. Students use RSLogix 5000 software to perform basic software tasks to meet the requirements of a given functional specification. In addition to using ladder logic instructions, students are introduced to ladder logic techniques, established standards, and common rules for modifying ladder logic.	
CCP299	RSLogix 5000 Level 1: ControlLogix Fundamentals and Troubleshooting	Course provides a solid foundation and fundamental knowledge of ControlLogix® and other Logix5000™ systems. Student is introduced to basic concepts and terminology, and Logix5000 system hardware. Students will be provided the necessary resources and hands-on practice to efficiently troubleshoot a previously operational Logix5000™ system. Students are presented with a systematic strategy for diagnosing and troubleshooting a variety of system problems, such as software configuration issues, electrical noise, controller, I/O, and other possible hardware issues.	4½ Days

5.3.1.3 Detailed Course Descriptions

Please refer to Appendix III for a list of detailed Course Descriptions

5.3.2 Operations HMI Training

Following is a matrix of the recommended training for all operations staff that is included in our proposal:

onSITE HMI TRAINING			
COURSE CODE	NAME	DESCRIPTION	LENGTH
OPR101	*ONSITE*® Operator Training	This is a detailed course on of the *ONSITE*® Client Suite of applications for Windows. The *ONSITE*® Client is the main user interface to the *ONSITE*® SCADA system. The applications covered are the ones most commonly used by SCADA operators. The course will give a brief overview of system architecture followed by detailed discussions of each *ONSITE*® Client application. This includes Alarm viewing and modification, process control graphics, real-time and historical trends and event logging. Applications not covered in this course are Control Groups, System Configuration and the Graphics Editor.	4 Days
GRPH101	*ONSITE*® /GE Dataviews Graphics Training	This course is designed to provide the student with skills necessary to modify, add or delete new process graphic views using the GE Dataviews based editor. The four day class will introduce the student to an overview of the both the editor and runtime versions, the concept of graphic objects, subdrawings, substitution variables, data expressions, data conversions and linking a view to real-time data sources.	4 Days
CFG101	*ONSITE*® /Oracle System Configuration	This course will instruct students on how to modify common elements of the SCADA HMI that will change over the course of a system lifetime. This includes how to add, modify or delete users, change security levels or modify their area-of-responsibility. The student will learn how to add new tag names, connect tags to PLC I/O locations, add, modify and delete alarm definitions. The student will be taught how to configure new real-time and historical trends and connect them to	2 Days

		screens for access by operators.	

5.3.3 Governor Training

SI recommends a three day training course for LADWP operations and maintenance staff to become proficient in the operation of the American Governor system. The class will be presented by qualified American Governor training personnel and includes all classroom material and manuals.

GOVERNOR TRAINING			
COURSE CODE	NAME	DESCRIPTION	LENGTH
GOV101	Governor Operations and Maintenance	Students will receive in-depth training on the theory and operation of the American Governor product being installed as part of the plant upgrade. The agenda during the course includes the following subjects: 1. System Overview 2. Basic Control Theory, including Droop 3. System Components and Theory of Operation 4. Site-Specific Operational Training 5. Site-Specific Maintenance Training 6. Hands-On Sessions: Tuning, Adjustments and Calibrations 7. Question & Answer Sessions	3 Days

5.3.4 Excitation Training

SI recommends a two section training course for LADWP operations and maintenance staff to become proficient in the operation of the Basler Electric exciter systems. The class will be presented by qualified Basler Electric training personnel.

EXCITATION SYSTEM TRAINING			
COURSE CODE	NAME	DESCRIPTION	LENGTH
ECS2100-OP	ECS2100 Operation Training	Students will participate in an interactive environment with Basler trainers o learn operation techniques for the ECS2100 exciter. The ECS21000 system will be reviewed for functionality including a walkthrough of all hardware components. Basic operations including training on the PanelMate screens, local/remote control operations, startup and shutdown procedures. The student will learn how to interpret alarm conditions on the PanelMate and learn the different levels for alarms and what will constitute a trip condition.	1 Days
ECS2100-O&M	ECS2100 Maintenance Training	Students will learn the basics of generator-excitation systems including generator output, system interaction, power system oscillations, generator rotor thermal capability underexcitation, and SCR power amp bridges. The ECS2100 hardware will be studied for each functional block and one-line drawings reviewed. The individual ECS2100 electronic boards covered and their general functions introduced. Students will learn out to use the	2 Days

		ccTool software and how to use event recording and logger data as a troubleshooting aids. Training on signal path tracing is includes as well as troubleshooting techniques for isolating problems in power supplies, relays, breakers, fans and fuses. PanelMate functions will be also presented as a troubleshooting tool and for advanced configuration capabilities.	

5.4 CONTROL PANEL HARDWARE

The control panels will be manufactured at SI's UL 501 panel manufacturing facility in San Diego. The units will be completely wired and tested prior to shipping to LADWP facilities. The control panels will be manufactured in accordance with specification section 16310. Each control panel will be equipped as following:

- Allen-Bradley PLC equipment
- Redundant 24 VDC power supplies
- NEMA 1 Enclosure

The primary PLC components of each panel will include the following. Quantity will vary from panel to panel as well as the size of chassis(s).:

TYPICAL CONTROL PANEL EQUIPMENT SECTION 16310			
ITEM	DESCRIPTION	MANUFACTURER	PART NUMBER
1	7 slot ControlLogix chassis	Allen-Bradley	1756-A7
2	10 slot ControlLogix chassis	Allen-Bradley	1756-A10
3	13 slot ControlLogix chassis	Allen-Bradley	1756-A13
4	17 slot ControlLogix chassis	Allen-Bradley	1756-A17
5	Logix5563 Processor With 8mbyte Memory	Allen-Bradley	1756-L63
6	85-265 Vac Power Supply (5v @ 10 Amp)	Allen-Bradley	1756-PA72

TYPICAL CONTROL PANEL EQUIPMENT SECTION 16310			
ITEM	DESCRIPTION	MANUFACTURER	PART NUMBER
7	85-265 Vac Power Supply (5v @ 13 Amp)	Allen-Bradley	1756-PA75
8	Isolated Rtd Input 6 Pts (20 Pin)	Allen-Bradley	1756-IR6I
9	N.O. Isolated Relay Output 16 Pts (36 Pin)	Allen-Bradley	1756-OW16I
10	Analog Input - Current/Voltage 16 Pts (36 Pin)	Allen-Bradley	1756-IF16
11	10-31 Vdc Input 32 Pts (36 Pin)	Allen-Bradley	1756-IB32
12	Redundancy Module	Allen-Bradley	1756-RM
13	Empty Slot Filler Card (One Filler Per Package)	Allen-Bradley	1756-N2
14	36 Pin Screw Clamp Block With Standard Housing	Allen-Bradley	1756-TBCH
15	Redundancy Module Cable, 1M	Allen-Bradley	1756-RMC1

5.4.1 Unit Controllers

SI will provide new control panels for Units 1 through 6 configured as follows:

- Unit Control Cabinet (1 per unit)
- Generator IO Cabinet (1 per unit)
- RTD IO Cabinet (1 per unit)
- Turbine Pit IO Cabinet (1 per unit)
- Panel Mounted Operator stations and enclosures (2 per unit)

The new unit control panels will include redundant controller bundles for the unit controllers, IO modules and Industrial Ethernet network switches. All enclosures are to be manufactured in accordance with LADWP specifications and approved submittals SI will provide new Allen-Bradley PLC equipment to upgrade the control panels for Units 2 & 6 follows:

- New redundant Controller Bundle for the Unit controllers
- New Panel Mounted Operator stations and enclosures for the TSOV and the Gov IO

5.4.2 TSOV Controllers

SI will provide new TSOV control panels for Units 1, 3, 4, and 5 configured as follows:

- TSOV Control Cabinet (1 per unit)
- TSOV Shared IO Cabinet (1 per 2 units)
- Panel Mounted Operator stations and enclosures

The new unit control panels will include redundant controller bundles for the unit controllers, IO modules and Industrial Ethernet network switches. All panels are to be manufactured in accordance with LADWP specifications and approved submittals.

SI will provide new Allen-Bradley PLC equipment to upgrade the TSOV control panels for Units 2 & 6 follows:

- New redundant Controller Bundle for the Unit controllers
- New Panel Mounted Operator stations and enclosures for the TSOV

5.4.3 Balance of Plant Controllers

SI will provide new Balance of Plant control panels configured as follows:

- BOP controller cabinet, (1 each)
- Remote IO cabinets (3 each)

The new unit control panels will include redundant controller bundles for the unit controllers, IO modules and Industrial Ethernet network switches. All panels are to be manufactured in accordance with LADWP specifications and approved submittals.

5.4.4 Unit 7 Controller

SI will provide new Unit 7 control panels configured as follows:

- Unit 7 controller cabinet (1 each)
- Remote IO cabinet (1 each)

The new unit control panels will include redundant controller bundles for the unit controllers, IO modules and Industrial Ethernet network switches. All panels are to be manufactured in accordance with LADWP specifications and approved submittals.

5.4.5 Elderberry Lake Outlet Controller

SI will provide two new Elderberry Lake Outlet control panels configured as follows:

- One installed in the Elderberry Lake Outlet Tower building controller cabinet
- One installed in the Elderberry Lake main building IO cabinet

The new unit control panels will include standalone Allen-Bradley ControlLogix controllers , IO modules and Industrial Ethernt network switches. All panels are to be manufactured in accordance with LADWP specifications and approved submittals.

5.4.6 Unit 1 through 6 Exciters

SI will provide new exciters from Basler to replace the existing on units 1 through 6.

The new excitation control system will include redundant controllers and Industrial Ethernet network switches for integration on the primary and secondary control networks. All excitation control systems are to be manufactured in accordance with LADWP specifications and approved submittals.

5.4.7 ECC Interface

SI will provide new PLC equipment to interface with the three LADWP furnished 4-wire copper serial connections to the ECC and BAGC as follows:

- 3 Standalone Allen-Bradley ControlLogix PLC Controllers

The new ECC/BAGC control panels will include the PLC controllers for the serial communication interfaces and Industrial Ethernet network switches. All panels are to be manufactured in accordance with LADWP specifications and approved submittals.

5.5 PROCESS NETWORK HARDWARE

SI will provide all hardware required to meet the requirements of specification section 16360. The final layout of fiber, switches and routing of same will be finalized after design meetings required as part of the specification. The list below is a representation of the current hardware components proposed. SI will provide this or an equivalent manufacturer product line based on the result of detailed design workshops with LADWP as required by the specification.

PROCESS NETWORK EQUIPMENT SECTION 16360				
ITEM	QTY	DESCRIPTION	MANUFACTURER	PART NUMBER
1	22	Phoenix Contact Managed Ethernet FL Switch MM HS	Phoenix Contact	2832328
2	23	Phoenix Contact QUINT-PS/1AC/24DC/3.5	Phoenix Contact	2866747
3	13	Phoenix Contact FL MXT	Phoenix Contact	2832331
4	96	Phoenix Contact FL IF 2TX VS-RJ-F	Phoenix Contact	2832357
5	42	Phoenix Contact FL IF 2FX SC-F	Phoenix Contact	2866747
6	A.R.	Ethernet Copper to Fiber Optic Media Converters	TBD	
7	A.R.	RS422/RS485 To Fiber Optic Media Converters	TBD	
8	A.R.	RS232 To Fiber Optic Media Converters	TBD	
9	A.R.	Power Supplies	TBD	
10	4	Industrial Wireless Ethernet Radio 2.4 GHz Radio	Synetcom	WISE-BF
11	A.R.	Antennas & cabling	TBD	

PROCESS NETWORK EQUIPMENT SECTION 16360				
ITEM	QTY	DESCRIPTION	MANUFACTURER	PART NUMBER
12	A.R.	Antenna Tower (<=100')	TBD	

5.6 Control Room HMI System Hardware

As was stated earlier in the proposal, SI will provide the latest version of computer hardware meeting required specifications defined in 16330. The long duration of the project guarantees that computer manufacturers will not be delivering models that exist today when the time comes for purchase. SI would like to protect LADWP's investment in this technology and thus proposes that products at the beginning of their lifecycle be purchased when the accepted project schedule requires delivery to the Castaic plant. SI will provide those products as listed below or the latest model:

CONTROL ROOM HMI SYSTEMS SECTION 16330				
ITEM	QTY	DESCRIPTION	MANUFACTURER	PART NUMBER
1	3	HP Redundant 64-bit HMI Servers	HP	
2	1	Rack-mounted 19" LCD/Keyboard/mini-mouse	Synergy	
3	12	HP 64-bit HMI Workstation	HP	
4	17	HP 19in Wide Aspect Monitor	HP	
6	2	84" High-resolution color monitor	Barco	
7	1	HP Color LaserJet 5550dtn Printer	HP	Q3716A
8	2	HP LaserJet 5200dtn Printer	HP	Q7546A
9	2	HP 64-bit Engineering Workstation	HP	

CONTROL ROOM HMI SYSTEMS SECTION 16330				
ITEM	QTY	DESCRIPTION	MANUFACTURER	PART NUMBER
10	1	HP 64-bit Maintenance Workstation	HP	
11	3	HP 64-bit Governor Workstation	HP	
12	2	HP Notebook Workstation	HP	

5.7 230 kV 4.16 kV Bay Controllers

5.7.1 Introduction

SI, LP or their subcontractors will be providing material and engineering for the Automatic Synchronizing system, Bay Controllers for the 230 kV circuit breakers and MOD's, Bay Controllers for the 4.16 kV circuit breakers for both the Units and Station Service power and other miscellaneous equipment. Detailed information pertaining to each item listed below will follow in the Technical Description portion of this proposal.

This proposal includes the following items:

- Six Relay Panels, fully engineered, assembled, wired and tested for Unit Automatic Synchronizers, 230 kV Bay Controllers associated with each unit. Includes in addition to the autosync relays and bay controllers, an additional IED for acquiring Unit metering data, manual synchronizing equipment and various other components. Complete Bill of Material, Layout Drawing and additional technical information will be included in the Technical Description section of this proposal.

- One Relay Panel, fully engineered, assembled, wired and tested for Unit 7 Automatic Synchronizer, 230 kV Bay Controllers associated with Unit 7, including the GSU low-side breaker. Includes in addition to the autosync relays and bay controllers, an additional IED for acquiring Unit 7 metering data, manual synchronizing equipment and various other components. Complete Bill of Material, Layout Drawing and additional technical information will be included in the Technical Description section of this proposal.

- Upgrades to twenty-one existing 7SJ64 Bay Controllers to IEC61850 communications protocol for the 230 kV breakers for Units 2 and 6.

- Engineering Services for Automatic Synchronizing System, 230kV Bay Controllers.
  - Developing functional logic diagrams for plant operations including Automatic Synchronizing systems and 230 kV control logic
  - New Relay Configuration Files for SIPROTEC relays
  - Programming of GOOSE Messages for communication between IED's
  - Functional Testing of System
  - Commissioning Support
  - Creating new relay panel electrical schematics
  - Relay Panel Documentation
    - Panel Layout and BOM
    - Panel Wiring Diagrams
    - Panel Test Procedures and Reports / QA Report

- Sixteen new Breaker Panels with 7SJ64 Bay Controllers for the 4.16 kV breakers for Units 1,3,4,5. Complete Bill of Material, Layout Drawing and additional technical information will be included in the Technical Description section of this proposal.

- Site Upgrades to eight existing 7SJ64 Bay Controllers to IEC61850 communications protocol for the 4.16 kV breakers for Units 2 and 6.

- Twenty new Breaker Panels with 7SJ64 Bay Controllers for the 4.16 kV breakers for the Station Service Switchgear. Complete Bill of Material, Layout Drawing and additional technical information will be included in the Technical Description section of this proposal.

- Engineering Services for 4.16 kV Bay Controllers for Unit breakers and Station Service breakers.
  - Developing functional logic diagrams for protection and control logic
  - New Relay Configuration Files for SIPROTEC relays
  - Programming of GOOSE Messages for communication between IED's
  - Functional Testing of Breaker Doors
  - Commissioning Support

- Creating new breaker panel electrical schematics
- Relay Panel Documentation
  - Panel Layout and BOM
  - Panel Wiring Diagrams
  - Panel Test Procedures and Reports / QA Report

- Configured RuggedCom Ethernet switches and all fiber optic cabling between SIPROTEC relays and switches. This does NOT included external network cable connections to these switches.

- Project Management and Lead Engineer - Assigned to this project will be a project manager and lead engineer to oversee project.
- Site Commissioning Engineering Support - Included in this proposal is pricing for one three-week trip as well as the daily rate for on-site engineering services.

- Training - One four-day, fully customized training for LADWP personnel on the hardware, software and operations associated with the scope of this proposal.

  Scope of Training
  - Automatic Synchronizing System
  - Bay Controllers
  - Relay Hardware
  - Relay Software
  - System Training
- DIGSI Professional version with IEC61850

More information on the items above is included in Technical Description

This proposal excludes the following items:

- Installation of equipment found in this proposal
- External cabling,
- Relay Coordination Study
-

5.7.2 Technical Description

This section contains the technical details for the material and engineering services outlined in the introduction. Included in this section are Panel Layouts and BOM's for the various panels being offered in this proposal. Relay descriptions are also included for all of the SIPROTEC devices being offered. Product and software catalogs are included at the end of the proposal.

230 kV Relay Panel (Units 1,2,3,4,5,6)

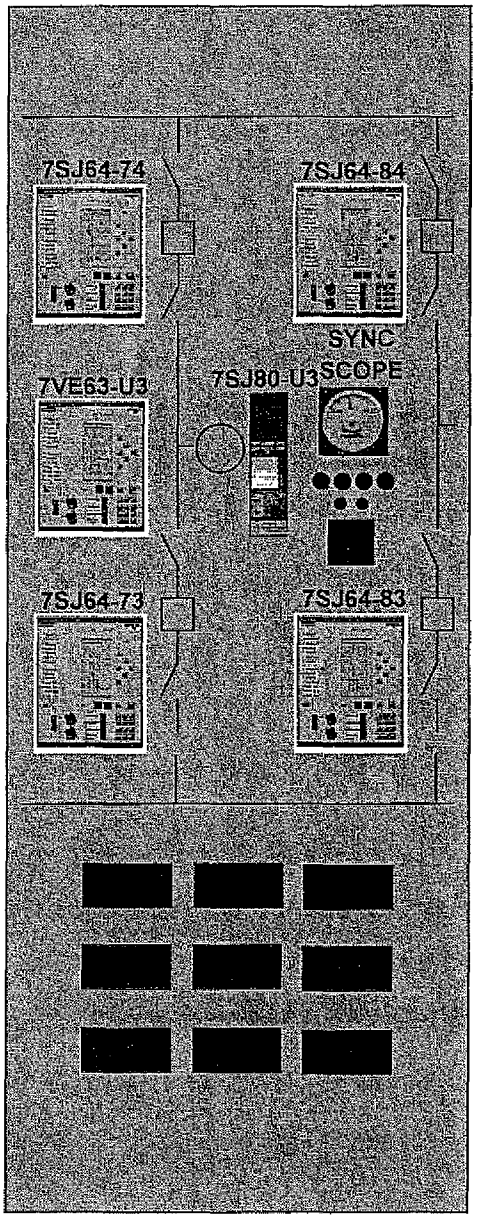
Six of these fully engineered, assembled, wired and tested panels are being offered to house the automatic synchronizers, bay controller, manual synchronizing equipment and other various items. All but five of the twenty-four bay controllers will be devices that are currently installed at the Castaic Power Plant in the existing 230 kV relay panels. The devices will be upgraded to IEC61850 communications protocol with new modules prior to installation into the relay panels at the factory. The synchronizers will be new SIPROTEC 7VE63 Automatic Paralleling devices. These devices use a patented 2-out-of-2 decision algorithm to command the closing of the circuit breaker taking into account breakers operating time. Each algorithm is assigned to its own processor and A/D converter. When both measuring functions release their respective close commands, two supervised output contacts, cross fired by the algorithms close in series with the breaker close coil as well as the sync permissive (ANSI #25) contact from the bay controller.

In addition to directing the closing of the circuit breakers through which the units can be connected, the 7VE63 relay will also send balancing commands to the voltage and speed controllers once the auto sync operation is initiated. The balancing commands issued by the 7VE63 relays will be sent via IEC61850 protocol to 7SJ802 relays residing near the voltage and speed controllers. The 7SJ802 relays will receive the balancing commands through the protocol and close output contacts that are hard-wired to the excitation and governor controls. The settings for the balancing commands can be

adapted to the actual machine characteristics using "learned data" from commissioning preliminary tests. Likewise, the actual breaker operating time can be ascertained through preliminary testing as well. Using waveform and binary data captures for both breaker operating time and voltage and speed balancing commands, the 7VE63 can be adapted to the true machine and breaker characteristics and enable fast and reliable auto sync operations.

Manual synchronizing capabilities will be made available at the 230 kV Relay Panels as well. This includes a synchroscope, which can be fed the proper voltages through a switch, a breaker control switch, and four push-buttons to manually raise and lower voltage and speed. The close contact from the breaker control switch will be in series with the sync permissive (ANSI #25) contact from the bay controller to ensure minimum sync criteria are met during closing. Finally, an additional IED will be included on each panel to gather machine data. The panel layout and BOM for these six relay panels are shown below.

230 kV Relay Panel Layout (Units 1,2,3,4,5,6)


7SJ64-74
7SJ64-84
SYNC
7VE63-U3
7SJ80-U3
SCOPE
7SJ64-73
7SJ64-83

230 kV Relay Panel Bill of Material (Units 1,2,3,4,5,6)

Part Description	Part Number	Total Quantity
7VE6320-4EC92-0CA0 +L0S	Relays	1
7SJ6415-4EC92-3FE4 +L0S	Relays	4
7SJ8041-5EC90-3FB0 +L0S	Relays	1
3RH1140-0BA10	AR	4
800T-A2A (Allen Bradley)	PB	4
FMS-10E1(States)	TSW	5
FMS-10A1(States)	TSW	4
74203 ZP (10B-2B23)Electroswitch	CSW	1
Sync Scope Switch (Electroswitch 2-pos Series 24)	SSW	1
H25030-2S (Bussmann 2-pole fuse block)	Fuses	6
LP-CC-20 (Bussmann 20A Fuse)	Fuses	24
4 Pole Slide Link (AVO)	TB	6
24 Pole Slide Link (AVO)	TB	6
90"h x 30"w Panel	Panels	1
Ground Bar	Panel misc	1
Panduit per 6' Length	Panel misc	1 Lot
Misc Materials (crimps, markers, labels) per set	Panel misc	1 Lot
Wire (per unit)	Panel misc	1 Lot
Factory Assembly	MFG Labor	1 Lot
Factory Wiring	MFG Labor	1 Lot
Factory Testing	MFG Test	1 Lot
Mfg Eng Services	Services	1 Lot
Spec Design (Production Documentation)	Services	1 Lot
Engineering Schematics	Services	1 Lot
Design Engineering (Panel Test Procedure)	Services	1 Lot

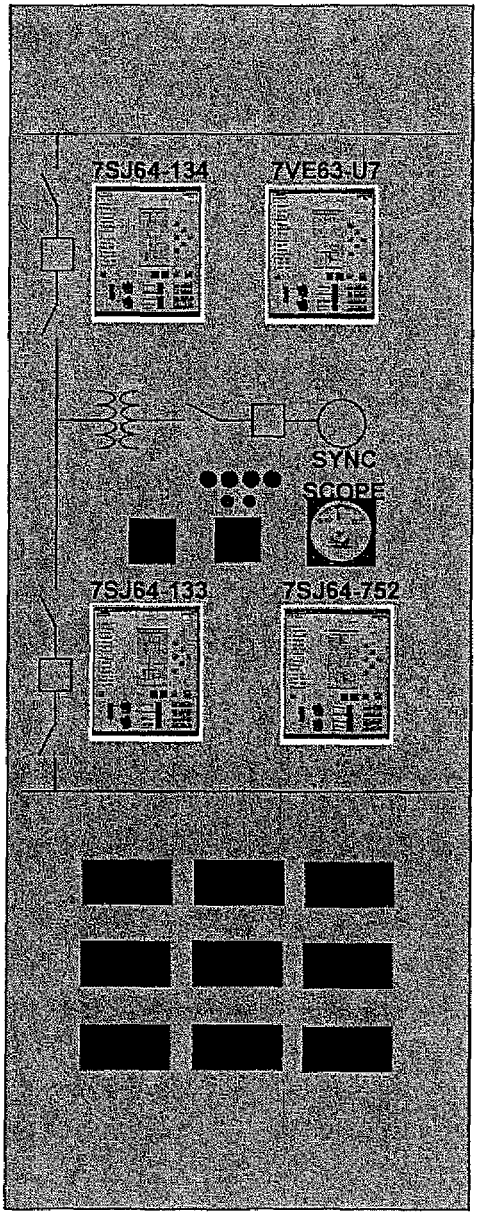
Note: Nineteen of the 7SJ64 relays for these six panels are existing relays at the power plant and will be upgraded to new firmware versions and have new IEC61850 fiber optic modules installed. Five 7SJ64 relays will be new units. The other relays and equipment will all be brand new.

230 kV Relay Panel (Unit 7)

One additional panel, fully engineered, assembled, wired and tested is being offered to house the automatic synchronizers, bay controller, manual synchronizing equipment and other various items for Unit 7. The panel configuration is slightly different to the other six relay panels in that it will have one less bay controller and will not require the additional IED for unit metering data as the low-side breaker Bay Controller will acquire that data from Unit 7. The two 230 kV bay controllers on this panel will be existing relays currently installed at the power plant and will be upgraded similar to

the nineteen bay controllers for the six other 230 kV relay panels. The panel layout and BOM for these six relay panels are shown below.

230 kV Relay Panel Layout (Unit 7)

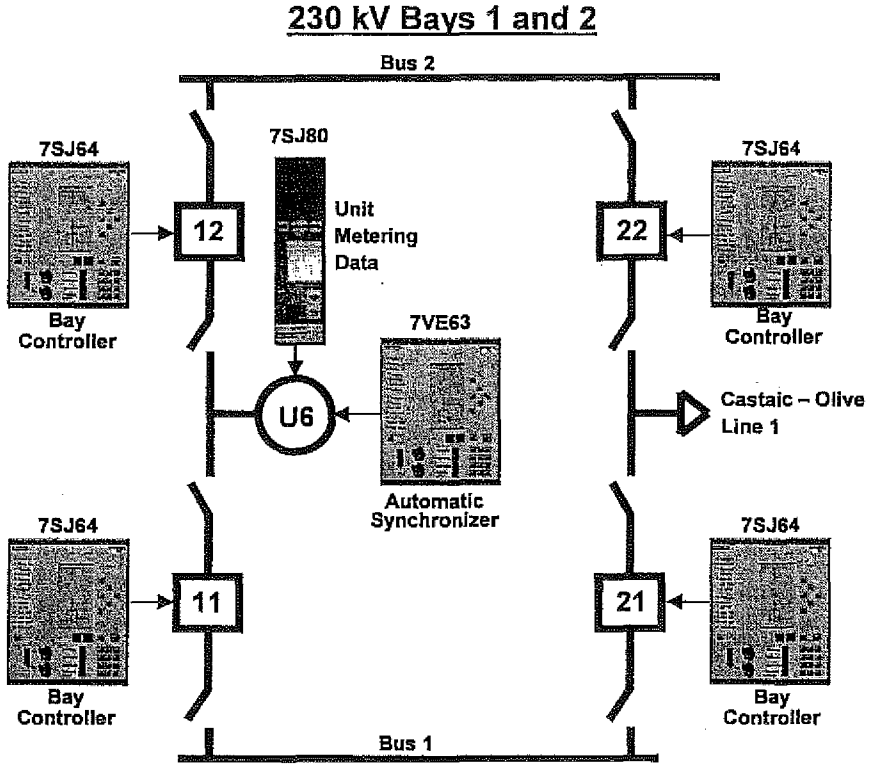


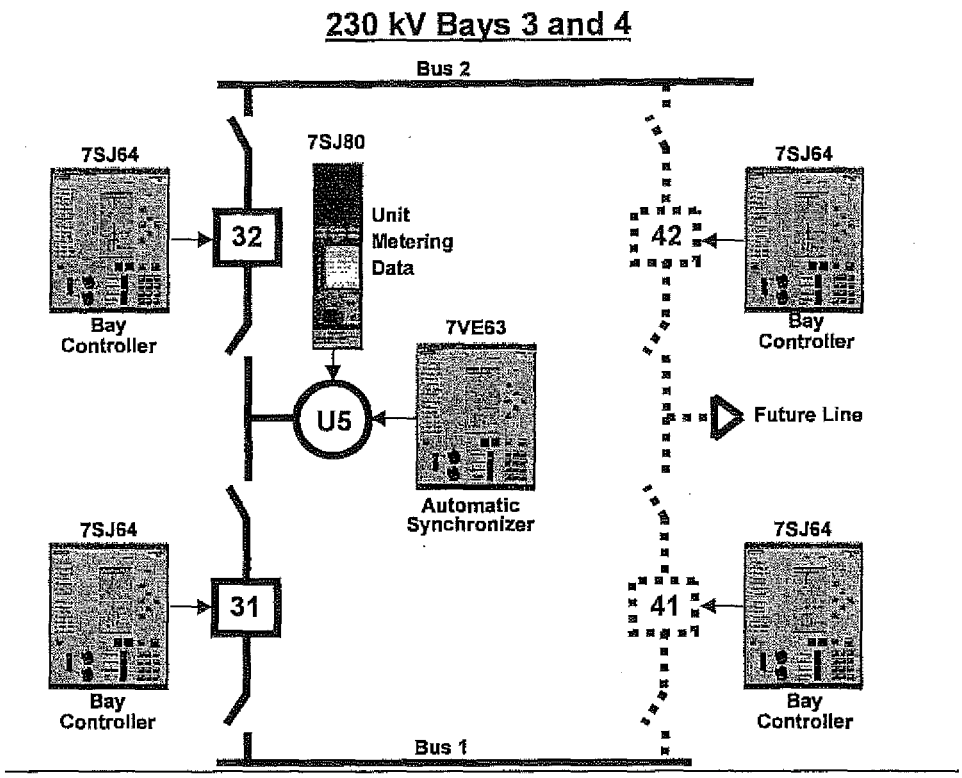
230 kV Relay Panel Bill of Material (Unit 7)

Part Description	Part Number	Total Quantity
7VE6320-4EC92-0CA0 +L0S	Relays	1
7SJ6415-4EC92-3FE4 +L0S	Relays	3
3RH1140-0BA10	AR	8
800T-A2A (Allen Bradley)	PB	4
FMS-10E1(States)	TSW	5
FMS-10A1(States)	TSW	4
74203 ZP (10B-2B23)Electroswitch	CSW	1
Sync Scope Switch (Electroswitch 2-pos Series 24)	SSW	1
Sync Scope Switch (Electroswitch 3-pos Series 24)	SSW	1
H25030-2S (Bussmann 2-pole fuse block)	Fuses	6
LP-CC-20 (Bussmann 20A Fuse)	Fuses	24
4 Pole Slide Link (AVO)	TB	6
24 Pole Slide Link (AVO)	TB	6
90"h x 30"w Panel	Panels	1
Ground Bar	Panel misc	1
Panduit per 6' Length	Panel misc	1 Lot
Misc Materials (crimps, markers, labels) per set	Panel misc	1 Lot
Wire (per unit)	Panel misc	1 Lot
Factory Assembly	MFG Labor	1 Lot
Factory Wiring	MFG Labor	1 Lot
Factory Testing	MFG Test	1 Lot
Mfg Eng Services	Services	1 Lot
Spec Design (Production Documentation)	Services	1 Lot
Engineering Schematics	Services	1 Lot
Design Engineering (Panel Test Procedure)	Services	1 Lot

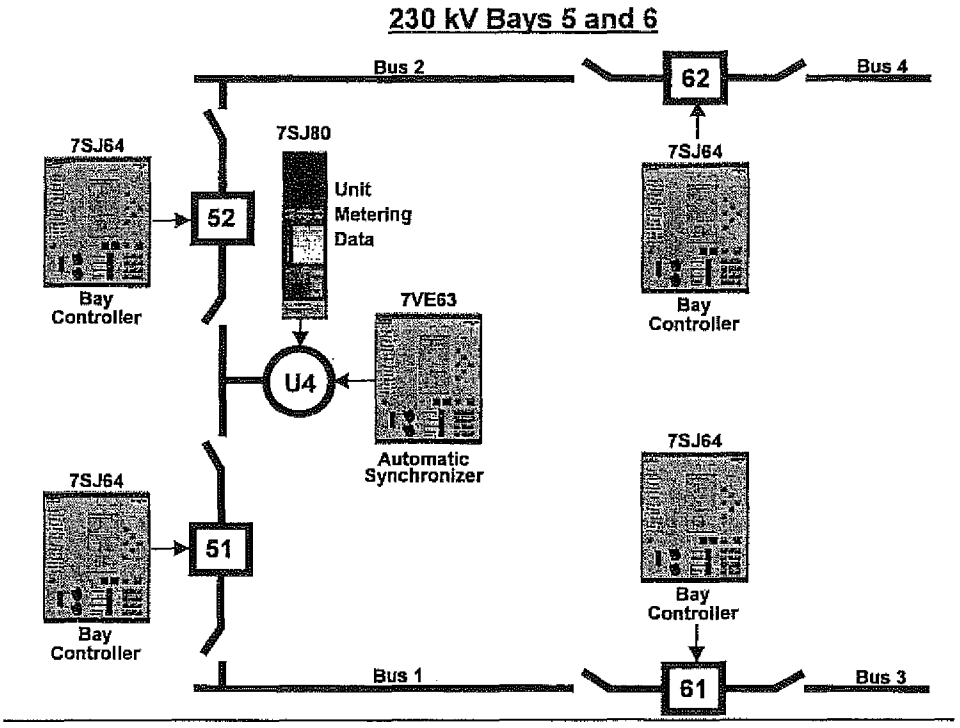
Note: Two of the 7SJ64 relays for this panel are existing relays at the power plant and will be upgraded to new firmware versions and have new IEC61850 fiber optic modules installed. The other 7SJ64 relay will be a new unit. The other relays and equipment will all be brand new.

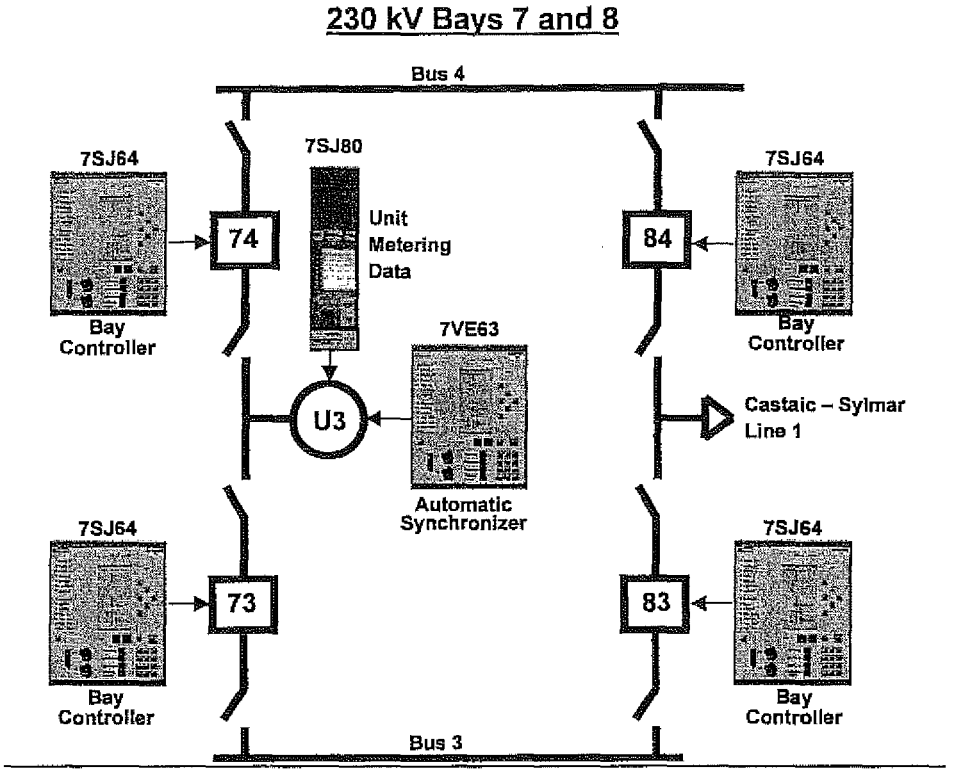
The following diagrams show typical one-line connections of the IED's included in the 230 kV panel BOM's:





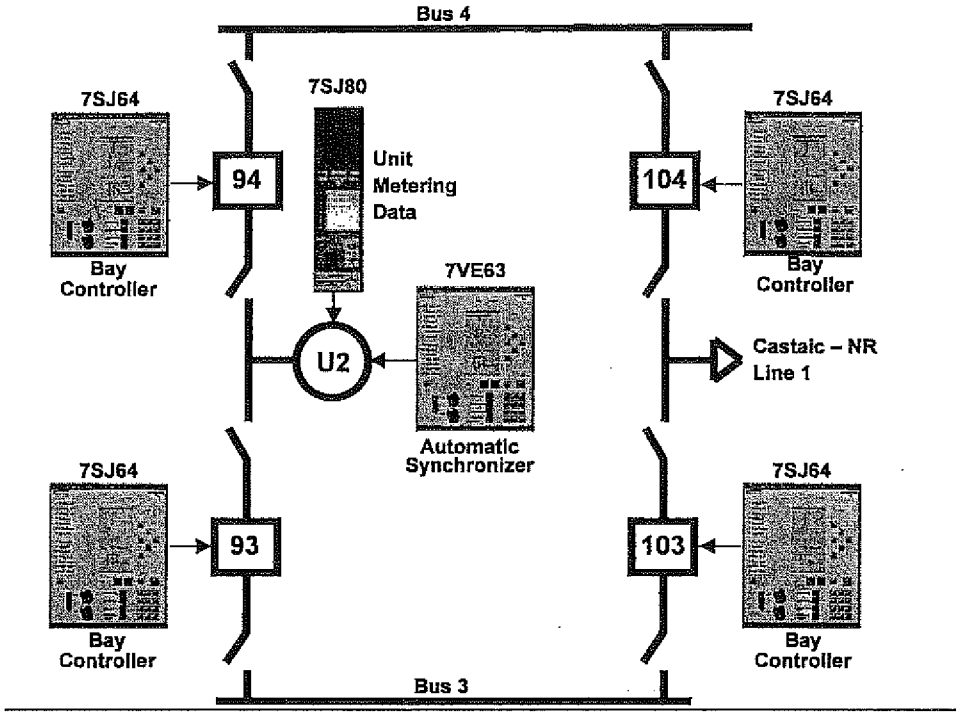
The following diagrams show typical one-line connections of the IED's included in the 230 kV panel BOM's:


230 kV Bays 5 and 6
Bus 2
62
Bus 4
7SJ64
7SJ80
Unit
Metering
Data
7SJ64
52
Bay
Controller
7VE63
Bay
Controller
U4
Automatic
Synchronizer
7SJ64
7SJ64
51
Bay
Controller
Bay
Controller
Bus 1
61
Bus 3

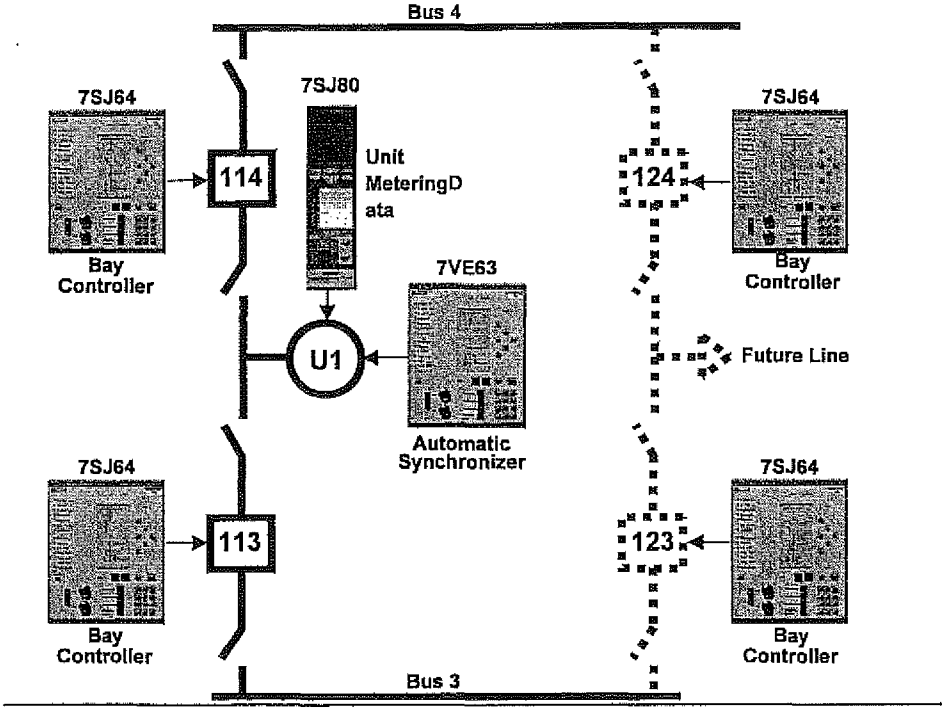


The following diagrams show typical one-line connections of the IED's included in the 230 kV panel BOM's:

230 kV Bays 9 and 10

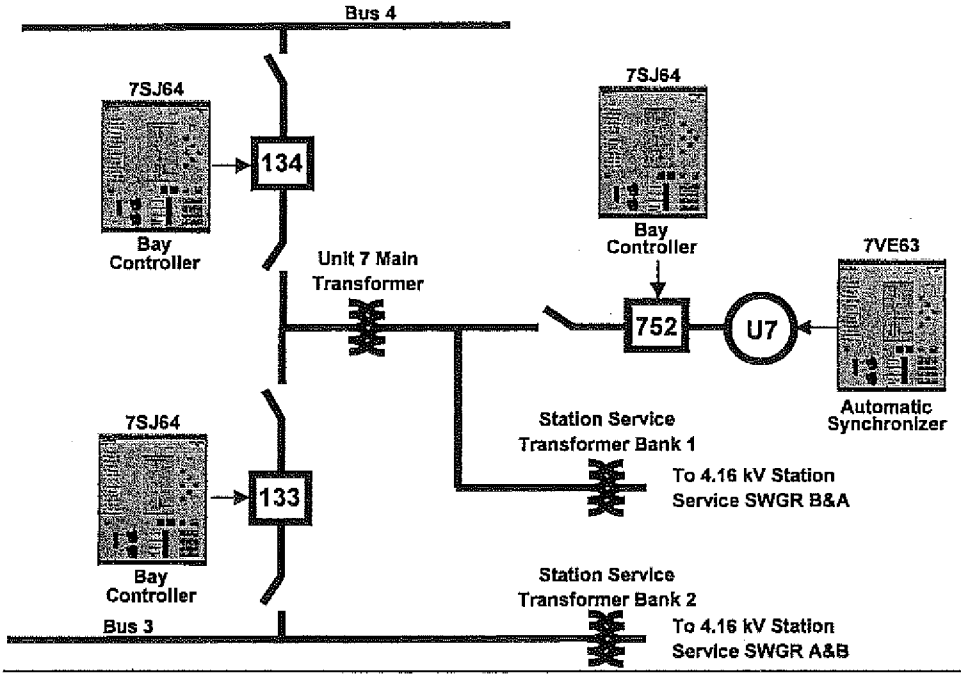


230 kV Bays 11 and 12



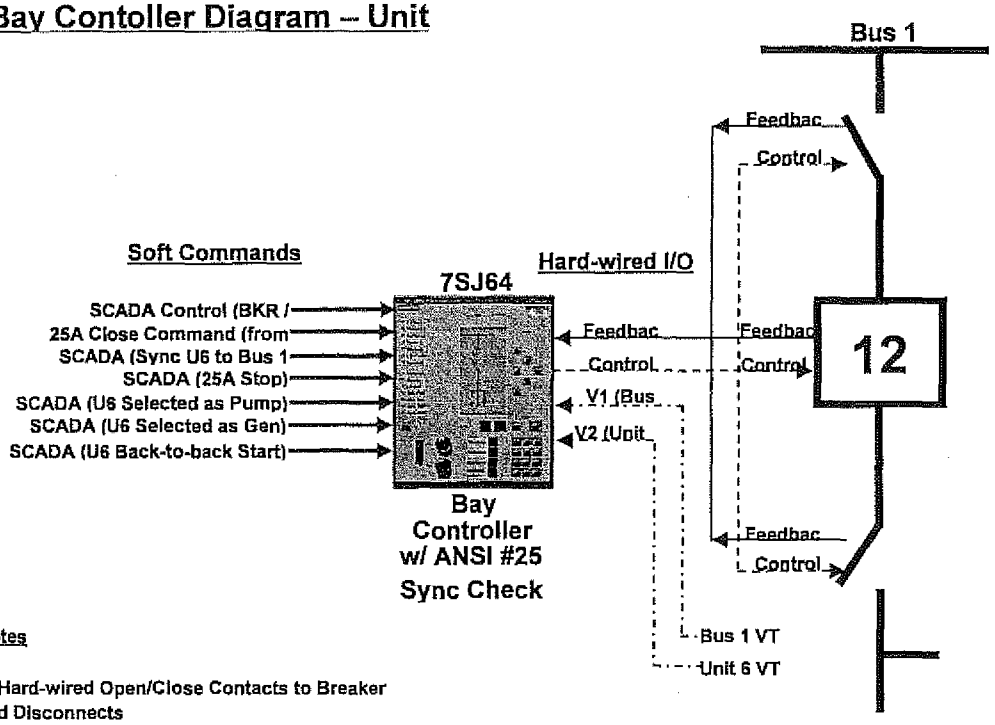
The following diagrams show typical one-line connections of the IED's included in the 230 kV panel BOM's:

230 kV Bay 13 and Unit 7



The following diagrams show conceptual designs of the 230 kV automatic synchronizing system and bay controllers.

Bay Contoller Diagram – Unit



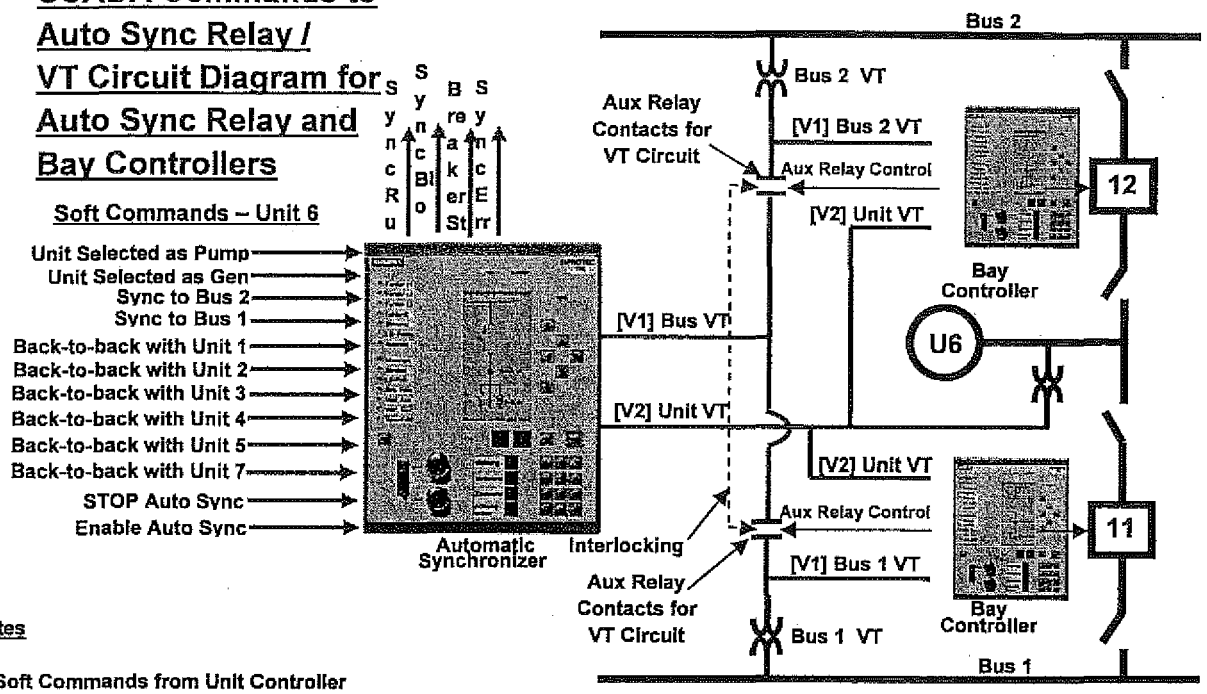
Notes

1) Hard-wired Open/Close Contacts to Breaker and Disconnects

2) Hard-wired feedback contacts from Breaker and Disconnects for status indication

3) Soft Commands over IEC61850 Network

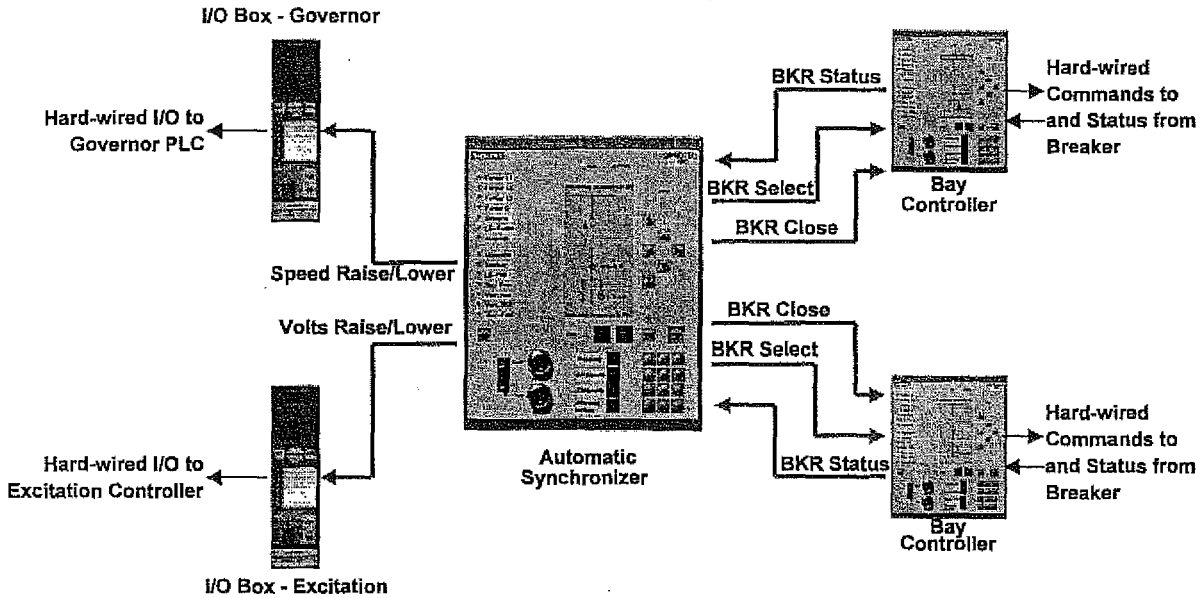
SCADA Commands to Auto Sync Relay / VT Circuit Diagram for Auto Sync Relay and Bay Controllers



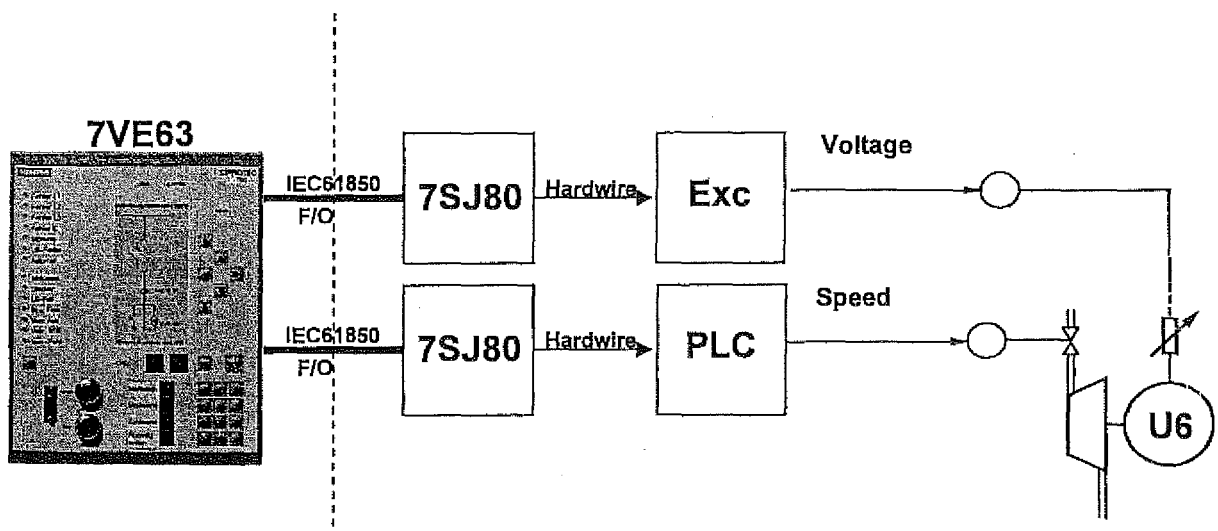
Notes

1) Soft Commands from Unit Controller
2) Bus Voltages connected to Automatic Synchronizer through aux relays controlled by Bay Controllers
3) Interlocking between aux relays to ensure only one set of Bus VT's will be connected to Automatic Synchronizer

IEC61850 GOOSE Messages – Balancing Commands and Breaker Selecting / Breaker Close Commands

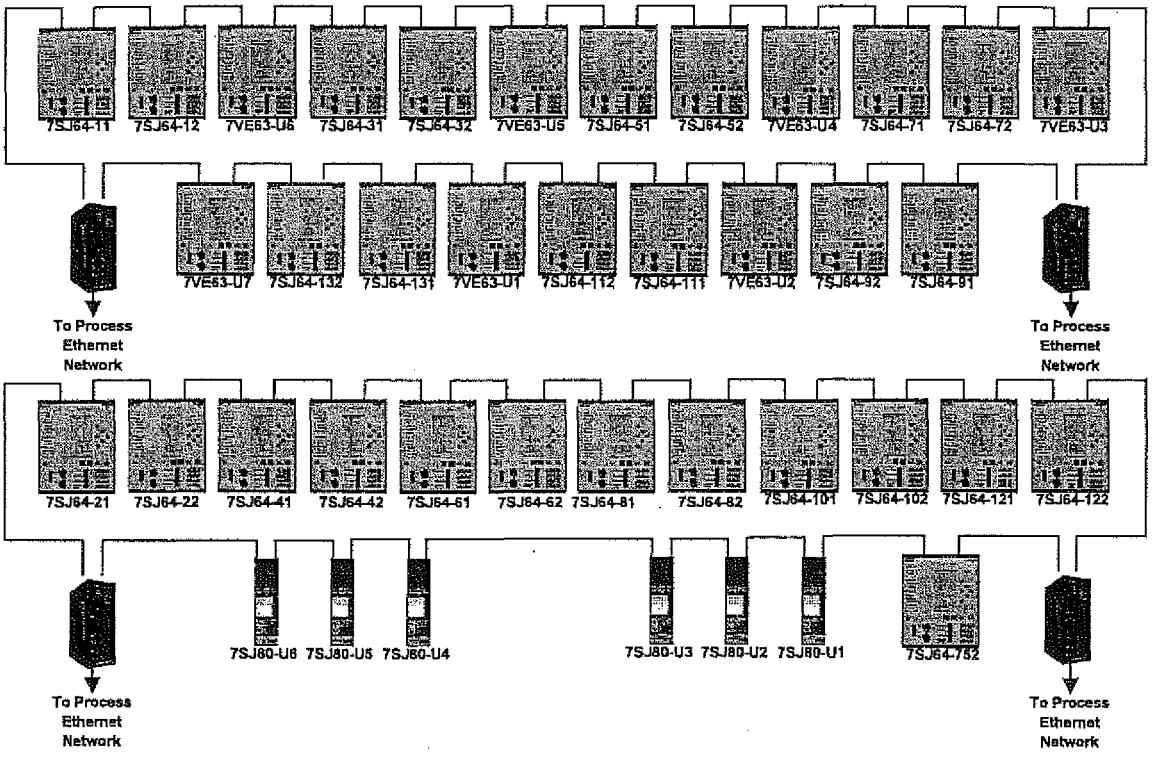


Balancing commands for Voltage and Speed Control - Automatic



The diagram below shows the 230 KV IEC61850 network architecture.

230 kV IEC61850 Communications Architecture for Relays



Engineering Services for Automatic Synchronizing System, 230kV Bay Controllers

Develop functional logic diagrams for plant operations including automatic synchronizing systems and 230 kV control logic. Engineering drawings showing logic and functional diagrams will be included in the scope of this proposal. These diagrams will be based on plant operations supplied to SI, LP as either written descriptions or flow diagrams.

New relay configuration files for SIPROTEC relays will be created for each and every Siemens relays listed in this proposal. The relays will be configured to operate based on the logic and functional diagrams, plant power system data, customer-supplied

protection settings (if applicable) and I/O requirements according to panel electrical schematics.

Programming of GOOSE Messages for communication between IED's is also included as an engineering service. GOOSE (General Object-Oriented System Event) Messages are a feature of IEC61850 and allow for fast transfer of metering and binary data between relays using a Peer-to-Peer methodology. Once added to the relay files of each relay to exchange data, the information is allocated in the IEC61850 Configurator feature of DISGI Professional with IEC61850.

Functional testing of the panels/system will be conducted in the factory prior to shipment to site. This will be done during pre-FAT testing and as well in front of the customer at the Siemens Energy facility in Wendell, NC. Breaker simulators as well as test sets to inject secondary VT and CT signals will enable system testing of the synchronizing system and breaker control logic.

Commissioning support will be provided by a qualified field service engineer. Included in the base-price of this proposal is a three weeks onsite engineering package that includes 6 ten-hour days per week with travel expenses included. Additional time on site will be billed at the standard daily rate listed in the pricing section of this proposal with travel expenses added.

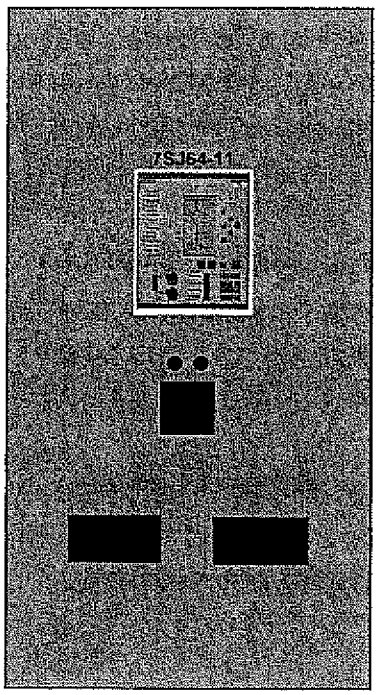
Create new relay panel electrical schematics. New panel electrical schematics will be created for the seven 230 kV relay panels. These drawings will be based on system requirements, existing plant drawings including single-line diagrams, and connections required by the components included in the BOM.

Relay panel documentation to be provided includes Panel Layout and BOM Panel Wiring Diagrams and Panel Test Procedures and Reports / QA Report. The engineering drawings will be created and will be included in the drawing package for approval.

4.16 kV Unit Bay Controllers

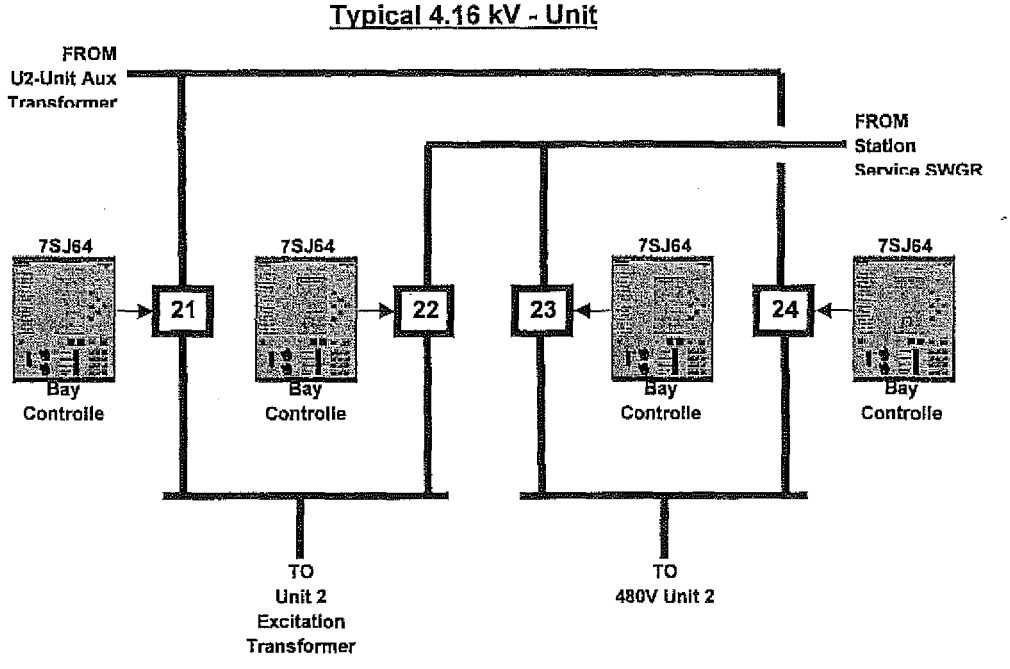
Sixteen new refurbished breaker doors will be provided for the four unit 4.16kV breakers associated with Units 1.3.4.5. These new breaker doors will house one 7SJ64 relay and other various components as found in the panel BOM below. The 7SJ64 relays will be equipped with IEC61850 and will be configured using plant and system information. In addition to the sixteen new doors, relay upgrades will be provided for eight existing bay controllers currently installed at the plant. The upgrades for these devices will be done during the unit 2 and unit 6 outages and will include programming changes to enable make before break operations.

New Unit 41.6 kV Breaker Panel Layout and Bill of Material



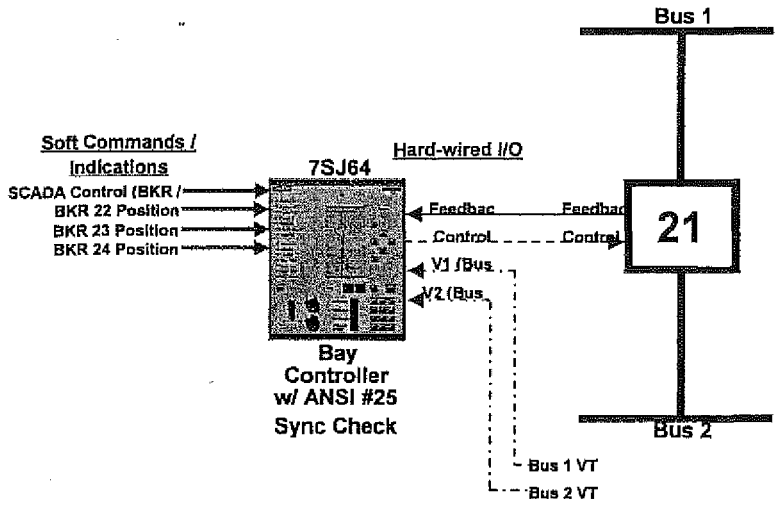
Part Description	Part Number	Total Quantity
7SJ6415-4EC92-3FE4 +L0S	Relays	1
FMS-10E1(States)	TSW	1
FMS-10A1(States)	TSW	1
74203 ZP (10B-2B23)Electroswitch	CSW	1
H25030-2S (Bussmann 2-pole fuse	Fuses	1
LP-CC-20 (Bussmann 20A Fuse)	Fuses	4
4 Pole Slide Link (AVO)	TB	2
24 Pole Slide Link (AVO)	TB	1
New Breaker Door	Panels	1
Panduit per 6' Length	Panel misc	1 Lot
Misc Materials (crimps, markers, labels)	Panel misc	1 Lot
Wire (per unit)	Panel misc	1 Lot
Factory Assembly	MFG Labor	1 Lot
Factory Wiring	MFG Labor	1 Lot
Factory Testing	MFG Test	1 Lot
Mfg Eng Services	Services	1 Lot
Spec Design (Production	Services	1 Lot
Engineering Schematics	Services	1 Lot
Design Engineering (Panel Test	Services	1 Lot

The following diagram shows typical one-line connections of the IED's included in the Unit 4.16 kV Breakers:



The following diagrams show conceptual designs of the 4.16 kV Unit bay controllers.

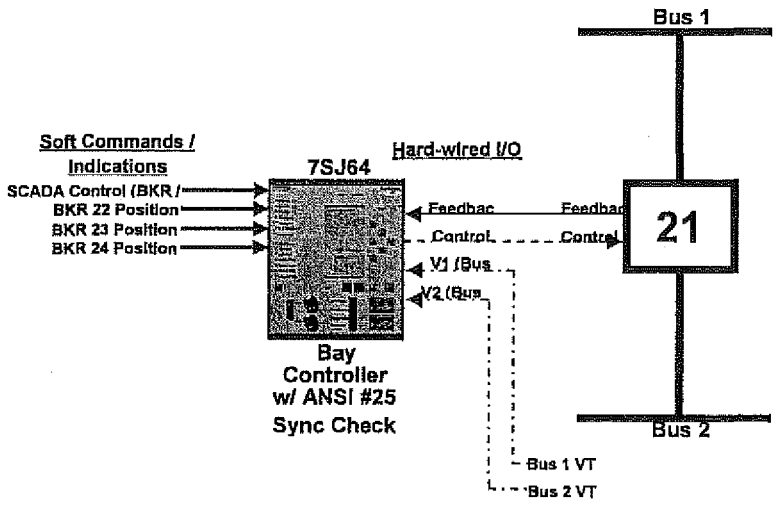
Bay Contoller Diagram – 4.16 kV



Notes

- Hard-wired Open/Close Contacts to Breaker
- Hard-wired feedback contacts from Breaker
- Soft Commands over IEC61850 Network

Bay Contoller Diagram – 4.16 kV

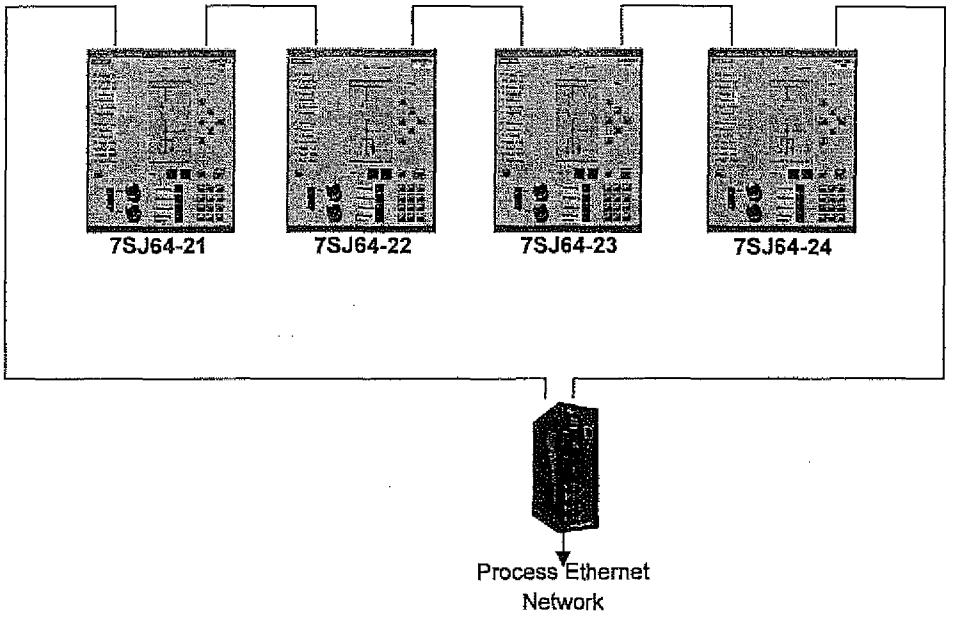


Notes

- Hard-wired Open/Close Contacts to Breaker
- Hard-wired feedback contacts from Breaker
- Soft Commands over IEC61850 Network

The diagram below shows the Unit 4.16 kV IEC61850 network architecture.

Typical 4.16 kV IEC61850
Communications Architecture for Relays



Engineering Services for Unit 4.16 kV Bay Controllers

Develop functional logic diagrams for plant operations including 4.16 kV control logic. Engineering drawings showing logic and functional diagrams will be included in the scope of this proposal. These diagrams will be based on plant operations supplied to SI, LP as either written descriptions or flow diagrams.

New relay configuration files for SIPROTEC relays will be created for each and every Siemens relays listed in this proposal. The relays will be configured to operate based on the logic and functional diagrams, plant power system data, customer-supplied protection settings (if applicable) and I/O requirements according to panel electrical schematics.

Programming of GOOSE Messages for communication between IED's is also included as an engineering service. GOOSE (General Object-Oriented System Event) Messages are a feature of IEC61850 and allow for fast transfer of metering and binary data between relays using a Peer-to-Peer methodology. Once added to the relay files of each relay

to exchange data, the information is allocated in the IEC61850 Configurator feature of DISGI Professional with IEC61850.

Functional testing of the panels/system will be conducted in the factory prior to shipment to site. This will be done during pre-FAT testing and as well in front of the customer at the Siemens Energy facility in Wendell, NC. Breaker simulators as well as test sets to inject secondary VT and CT signals will enable system testing of the synchronizing system and breaker control logic.

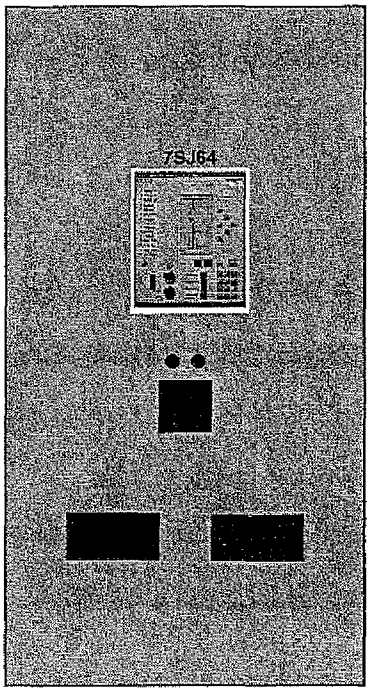
Commissioning support will be provided by a qualified field service engineer. Included in the base-price of this proposal is a three weeks onsite engineering package that includes 6 ten-hour days per week with travel expenses included. Additional time on site will be billed at the standard daily rate listed in the pricing section of this proposal with travel expenses added.

Create new relay panel electrical schematics. New panel electrical schematics will be created for the 4.16 kV breaker panels. These drawings will be based on system requirements, existing plant drawings including single-line diagrams, and connections required by the components included in the BOM.
Relay panel documentation to be provided includes Panel Layout and BOM Panel Wiring Diagrams and Panel Test Procedures and Reports / QA Report. The engineering drawings will be created and will be included in the drawing package for approval.

4.16 kV Station Service Switchgear Bay Controllers

Twenty new refurbished breaker doors will be provided for the Station Service Switchgear 4.16kV breakers. These new breaker doors will house one 7SJ64 relay and other various components as found in the panel BOM below. The 7SJ64 relays will be equipped with IEC61850 and will be configured using plant and system information.

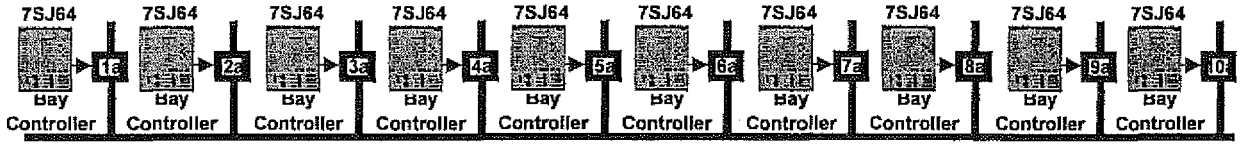
New Station Service Switchgear 4.16 kV Breaker Panel Layout and Bill of Material



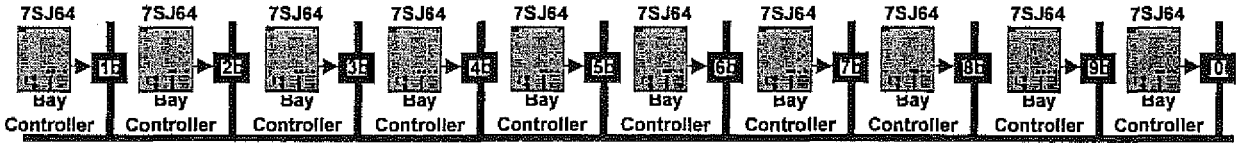
Part Description	Part Number	Total Quantity
7SJ6415-4EC92-3FE4 +L0S	Relays	1
FMS-10E1(States)	TSW	1
FMS-10A1(States)	TSW	1
74203 ZP (10B-2B23)Electroswitch	CSW	1
H25030-2S (Bussmann 2-pole fuse	Fuses	1
LP-CC-20 (Bussmann 20A Fuse)	Fuses	4
4 Pole Slide Link (AVO)	TB	2
24 Pole Slide Link (AVO)	TB	1
New Breaker Door	Panels	1
Panduit per 6' Length	Panel misc	1 Lot
Misc Materials (crimps, markers, labels)	Panel misc	1 Lot
Wire (per unit)	Panel misc	1 Lot
Factory Assembly	MFG Labor	1 Lot
Factory Wiring	MFG Labor	1 Lot
Factory Testing	MFG Test	1 Lot
Mfg Eng Services	Services	1 Lot
Spec Design (Production	Services	1 Lot
Engineering Schematics	Services	1 Lot
Design Engineering (Panel Test	Services	1 Lot

The following diagram shows typical one-line connections of the IED's included in the Unit 4.16 kV Breakers:

Station Service Switchgear Line-up "A"

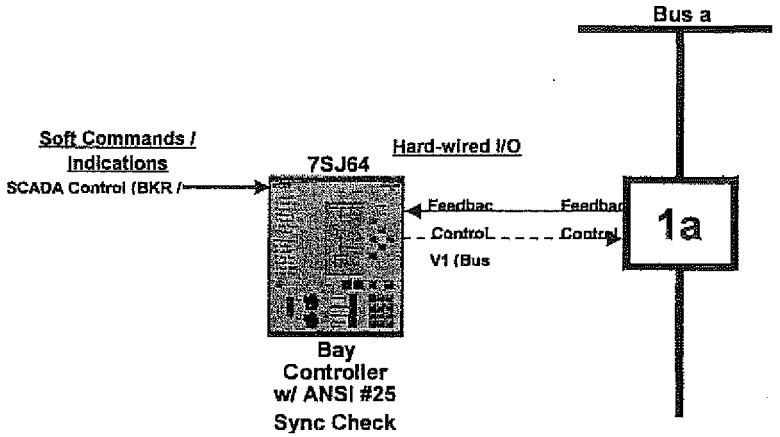


Station Service Switchgear Line-up "B"



The following diagrams show conceptual designs of the 4.16 kV Unit bay controllers.

Bay Contoller Diagram – 4.16 kV Breaker

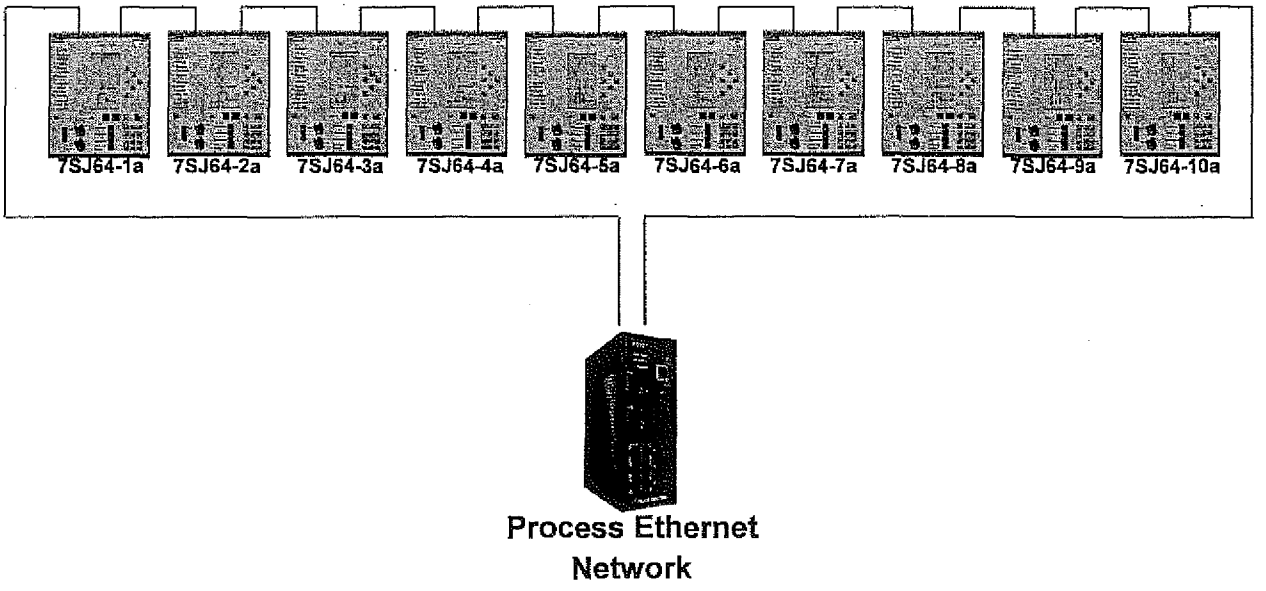


Notes

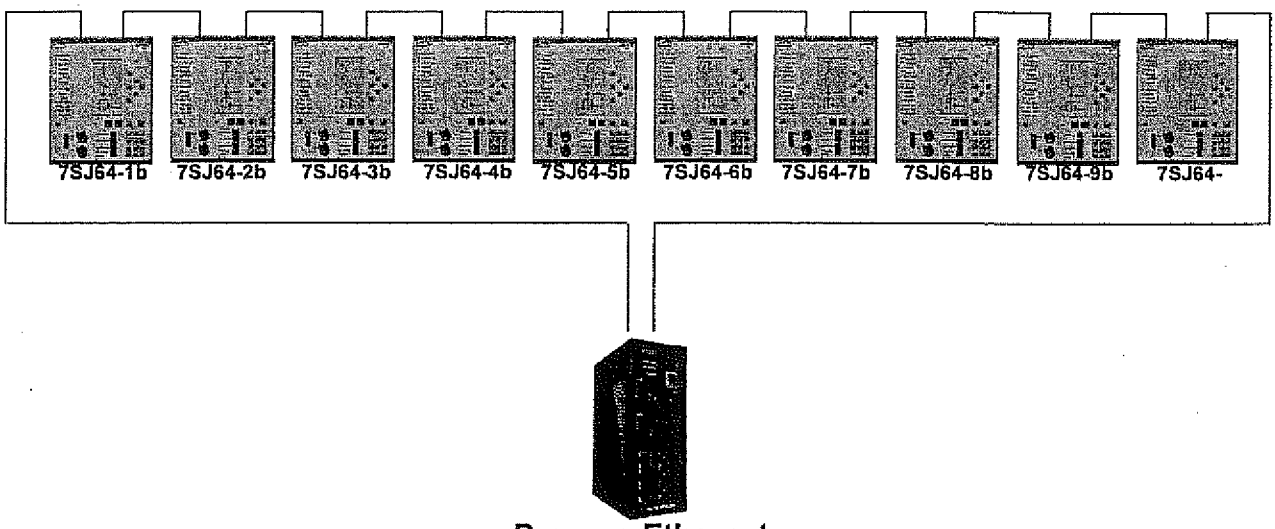
- Hard-wired Open/Close Contacts to Breaker
- Hard-wired feedback contacts from Breaker
- Soft Commands over IEC61850 Network

The diagram below shows the Station Service Switchgear 4.16 kV IEC61850 network architecture.

Station Service Switchgear "A"



Station Service Switchgear "B"



Engineering Services for Station Service Switchgear 4.16 kV Bay Controllers

Develop functional logic diagrams for plant operations including 4.16 kV control logic. Engineering drawings showing logic and functional diagrams will be included in the scope of this proposal. These diagrams will be based on plant operations supplied to SI, LP as either written descriptions or flow diagrams.

New relay configuration files for SIPROTEC relays will be created for each and every Siemens relays listed in this proposal. The relays will be configured to operate based on the logic and functional diagrams, plant power system data, customer-supplied protection settings (if applicable) and I/O requirements according to panel electrical schematics.

Programming of GOOSE Messages for communication between IED's is also included as an engineering service. GOOSE (General Object-Oriented System Event) Messages are a feature of IEC61850 and allow for fast transfer of metering and binary data between relays using a Peer-to-Peer methodology. Once added to the relay files of each relay to exchange data, the information is allocated in the IEC61850 Configurator feature of DISGI Professional with IEC61850.

Functional testing of the panels/system will be conducted in the factory prior to shipment to site. This will be done during pre-FAT testing and as well in front of the customer at the Siemens Energy facility in Wendell, NC. Breaker simulators as well as test sets to inject secondary VT and CT signals will enable system testing of the synchronizing system and breaker control logic.

Commissioning support will be provided by a qualified field service engineer. Included in the base-price of this proposal is a three weeks onsite engineering package that includes 6 ten-hour days per week with travel expenses included. Additional time on site will be billed at the standard daily rate listed in the pricing section of this proposal with travel expenses added.

Create new relay panel electrical schematics. New panel electrical schematics will be created for the 4.16 kV breaker panels. These drawings will be based on system requirements, existing plant drawings including single-line diagrams, and connections required by the components included in the BOM.
Relay panel documentation to be provided includes Panel Layout and BOM Panel Wiring Diagrams and Panel Test Procedures and Reports / QA Report. The engineering drawings will be created and will be included in the drawing package for approval.

5.8 Excitation System - Section 16370

5.8.1 Introduction

SI, LP is proposing the Basler Type ECS 2100 digital excitation system for use on LADWP's brush type synchronous generator. The digital excitation system will be designed to work directly into the main field complete with controls, limiters, and protection to safeguard the generator. The digital excitation system also will incorporate a Power System Stabilizer function, PSS 2B operating in conjunction with the AVR/Exciter function to dampen local mode, inter-area and inter-unit power system oscillations.

The Basler ECS2100 Digital Excitation System is designed to provide digital voltage regulation, control, protection, and monitoring functions for a synchronous generator. The ECS2100 Digital Excitation System is a multiple microprocessor-based control

system. The ECS2100 uses a digital signal processor for required computational speed of advanced control functions and algorithms and an integrated 32-bit communications controller for implementation of event recording, data logging, and communications to external control systems and to a user-friendly PC interface for maintenance and analysis functions. The ECS2100 can be scaled to generation units of all sizes with minimal changes except to the power electronics and the excitation power potential transformer. The included software based Controller Configuration Tool (ccTool) is used to change settings for the various limiting and protection functions, download new system firmware, and retrieve diagnostics information.

The Basler system consists of multiple thyristor power converters, each with its own digital firing control. Multiple converters operate with multi-channel control logic for increased reliability. Operator control can be provided through a single-cable interconnection to a local and/or remote IDP 1200 operator panel, interface to PLC, SCADA, or plant DCS (Distributed Control System), or traditional discrete switches and meters. Power to the ECS2100 will be supplied via the existing a power potential transformer (PPT).

5.8.2 Functional Description

5.8.2.1 General

The design of the ECS2100 Digital Excitation System permits flexibility in the system architecture. Proposed configuration includes a dual channel with an option for a supervisory control that votes best 2 out 3 with redundant power converters. The control channel will consists of microprocessor-based modules for digital sensing, regulation, SCR firing control and sequence control algorithms. The cabinet lineup includes a logic cabinet and the required number of cabinets for the power converters and auxiliary devices.

5.8.2.2 Control Channel

The dual-channel capability of the ECS2100 Digital Excitation System is configured with two identical sets of printed circuit modules. Each of the two sets has the capability of performing the voltage regulation, limiter, protection, sequence control,

and firing functions. Both sets are connected to control the firing time of a Bridge Control Module (BCM) associated with its own power converter bridge. Signals from both control channels are sent to each BCM.

Each BCM has a state select contact that determines which channel controls the BCM. The system initially is set up such that the main channel controls the BCM. Should the internal diagnostics in the main channel detect a failure, an external relay will be energized, which in turn will direct the BCM to ignore the control signal from the other channel. A remote switch may be used to transfer control from the main to redundant channel for maintenance.

5.8.2.3 Power Converter Assembly

The power converters use thyristors in a three-phase full converter bridge configuration. This configuration applies positive and negative forcing voltage to the main field for dual-directional forcing of field voltage. The field current, however, cannot be reversed. The thyristors conduct current once each cycle at a variable angle in the cycle as determined by the amplified error signal from the regulator. The earlier in the cycle that the thyristors conduct, the greater the amount of energy delivered to the field. Thus, the regulator controls excitation by varying the output of the power amplifiers by controlling the time of the firing pulses.

Each power converter is equipped with conduction monitoring and RTDs for thyristor overtemperature protection. The power converter features a compact design with drawout power converters. The converters may be isolated under full load. The power section features a forced air-cooling system with a main fan and a backup spare fan. The fan control circuits including automatic transfer to the backup fan are grouped together in one convenient location in the power cubicle section.

5.8.2.3.1 Active Temperature Balance

The patented active temperature balancing algorithms (known as "Skip Firing") is provided in multi-bridge schemes. By monitoring the temperature of each SCR in the Power Converter, this special algorithm facilitates an electronic method for rectifier

bridge current sharing. This unique approach allows excitation currents to reach up to 10,000 Adc continuously.

5.8.3 System Operation

The ECS2100 Digital Excitation System for a static exciter includes the ECS2100 Digital Voltage Regulator for automatic and manual control. In the automatic mode, the digital regulator controls generator terminal voltage by supplying a digital control signal to the firing circuits. The bridge control module (BCM) generates firing pulses for the power amplifiers in response to the ac regulator signal so as to control the power amplifier output current. In the manual mode, the dc field current regulator controls the system by sending a signal through the firing circuits to control the output current of the power amplifiers.

5.8.3.1 Regulation Modes

A variety of feedback control functions can be implemented. The purpose of these functions is to hold the particular regulated quantity at a set point. The set point is adjustable by operator action. The regulator gain, range of the set point, and the slew rate of the set point are adjustable for all regulators. Transient gain reduction is included with each regulator channel for the static exciter application. Each regulator has its own adjuster to provide a reference signal for that regulator. The slew rate, which can be set by the operator, is adjustable between 1 to over 200 seconds. The set point adjusters have position indication capability. There are 5 regulation modes of operation that can utilize the various feedback control functions.

5.8.3.2 Automatic Voltage Regulation Mode

In Automatic Voltage Regulation mode, the ECS2100 maintains the generator's voltage to <0.2% of the set point from no load to full load of the generator. The generator voltage adjustment range is 40 to 110% of nominal.

5.8.3.2.1 Reactive Compensation

Reactive compensation, either droop or rise (Line Drop Compensation), is included with the ECS2100 system. These functions modify generator voltage by regulator action to compensate for the impedance drop from the machine terminals to a fixed point in the system. Action is accomplished by inserting into the regulator a reference voltage equivalent to the settable impedance drop time's reactive current. Three types of reactive compensation are available with the ECS2100.

Generator Reactive Current Compensation - Using One Set of CTs

Line Drop Compensation Using a Line CT - Responds to both Resistive and Reactive currents (Optional)

Generator Cross-Current Compensation- Using Two Sets of CTs (Optional)

5.8.3.3 Power System Stabilizer Type PSS 2B

The Power System Stabilizer (PSS) provides a supplementary control signal input to a synchronous machine voltage regulator that improves system dynamic performance. The stabilizing signal provides positive damping of the electromechanical oscillations that occur as a result of system disturbances. Without supplementary control, a continuously acting voltage regulator can contribute negative damping to system swings, and these oscillations may be sustained or may even increase in amplitude.

The ECS2100 has a predefined PSS algorithm. Implementation of the IEEE Type 2 "Integral of Accelerating Power" Dual Input PSS (power and frequency) power system stabilizer model PSS is standard. The function produces stabilizing signal derived from two inputs: the deviation in synchronous machine speed and electrical power. The polarity of the signal is in the direction to increase excitation for terminal frequency deviations above normal frequency. This dual input PSS includes a ramp-tracking filter: one or two stages of high pass (washout) filters, and two or three lead-lag stages. Ramping output limiters are included to minimize the adverse effects of the PSS on system voltage. The Type 2 PSS requires inputs from three line CTs to achieve the best

accuracy. The PSS also incorporates a low power threshold and will automatically disable the PSS function when the generators power drop below a predetermined level.

For pumping operation, the PSS output will automatically reverse to accommodate proper control of the synchronous machine in pump mode.

5.8.3.4 Manual Regulation Mode - Generator Field Current

When the system is in the Manual Regulation-Generator Field Current mode, generator field current is regulated by the ECS2100 to within ±0.5% of the generator no load field current. The adjustment range is 20% to 125% of the generator full load rated field current. Excitation minimum and maximum excitation limiter mode is active in manual and AVR mode.

5.8.3.4.1 Manual Regulation Mode - Generator Field Voltage

When the system is in the Manual Regulation-Generator Field Voltage mode, generator field voltage is held to within ±0.5% of the generator no load field voltage. The adjustment range is from 20% to 125% of the generator full load field voltage. Excitation minimum and maximum excitation limiter mode is active in manual and AVR mode.

5.8.3.5 VAR Control Mode

In VAR Control mode, the system maintains the average VAR output of the generators output to an adjustable dead band setting (0.5%-10% or rated generator MVA). The time delay is adjustable from 0.02 to 10 seconds. The adjustment range of the VAR's set point is between 100% Overexcited to 100% underexcited.

5.8.3.5.1 Power Factor Control Mode

In Power Factor (PF) Control mode, the system holds the average power factor within an adjustable deadband of 0.01-0.1 PF with a delay of 0.02-10 seconds as the generator load changes. Below an adjustable set point or when the voltage is outside a settable

range, the power factor controller is automatically turned off and the system functions as an automatic or manual regulator. The range of adjustment is from 10 percent to 100 percent load. The range over which the power factor can be controlled is adjustable between 0.1 PF lead and 0.1 PF lag.

5.8.3.6 Operating Mode Set Point Followers

The Set point Followers function provides a virtually bumpless change in the newly regulated quantity when a transfer is made from automatic voltage regulation to manual regulation and from manual regulation to automatic regulation and or to the redundant channel under steady conditions. The bandwidth between the controlling regulator-firing command and the following regulator firing command is adjustable from 0.1 percent to more than 10 percent. The time delay during which that bandwidth can be exceeded is adjustable from .02 to more than 10 seconds.

During transients, the transfer may be made from one regulator to a second one even if that transfer will result in a bump. The var/power factor controller takes raise or lower signals and generates the referenced set point for the automatic var/ power factor regulator. The adjuster followers (when enabled) operate to raise or lower this reference set point until the difference between the automatic voltage regulator and automatic var/power factor regulator error signals is within a desired deadband. If that signal is outside the deadband for longer than an adjustable deadband delay in seconds, a raise or lower output is activated. The output remains activated until the balance signal returns to within the deadband value.

5.8.3.7 Programmable Sequence Control (PSC)

Programmable Sequence Control is the function that performs startup, running, and shutdown control of the ECS2100 Digital Excitation System. The function is implemented in the software of the ECM. All control is provided in PSC. When the power requirements of the devices being operated, such as the 41A device, require them or when a customer interface requires dry contacts, discrete relays are added. Programmable Sequence Control is made up of a series of logic blocks or gates that

can be constructed using ccTool. Sequence control is displayed in ladder logic or ladder diagram fashion using ccTool.

5.8.4 Limiters

The purpose of limiters is to take away control from any of the regulators, either manual or auto, then regulate the particular quantity at the pickup point of the limiter. The limiters provide an alternate feedback control loop to the regulators, and each limiter is provided with its own adjustable gain, adjustable transient gain reduction, or damping algorithm as needed to provide stable loop operation when the limiter is in control. Limiters operate whether the unit is in automatic or manual regulation modes. All limiters have alarms associated with them. The first alarm is generated when the pickup has been exceeded. A second alarm, for limiters with time delays, is generated after the limiter has timed out. A third alarm is generated when the limiter has taken control from the regulator.

5.8.4.1 Minimum Excitation Limiter- Steady State Stability Limit (MEL)

The Minimum Excitation Limiter (MEL) is based on generator stability. The limiter keeps the operating point of the generator within adjustable MW and Mvar curves. The operating curve, in terms of MW and Mvar will vary proportionally to the square of the generator terminal voltage. The shape of the MW and Mvar operating curves is constructed in a piecewise linear fashion made up of five straight-line segments. The inputs to the limiter are taken from machine potential and current transformers. The limiter output auctioneers against the voltage sensing signal output in an auctioneering function for control of the power amplifiers. The control of the power amplifiers by the limiter prevents the auto or manual regulator elements from decreasing machine excitation to levels below the desired set characteristic value. Both Summing Point and Takeover style limiter is available with the MEL. In all modes of the synchronous machine operation: generate, pump and condensing mode, the MEL will be sensitive to the direction of the power going either into or out of the machine and adjust its output signal accordingly to provide correct control.

5.8.4.1.1 Under Excitation Limiter- Generator Capability Curve (UEL)

The Under Excitation Limiter (UEL) prevents excitation reduction in the ac generator to levels that would result in damage to the generator while it is operating in an underexcited mode. The UEL is based on the generator capability curve. The limiter keeps the operating point of the generator within adjustable MW and Mvar curves. The shapes of the MW and MVar operating curves are constructed in a piecewise-linear fashion made up of five straight-line segments. The inputs to the limiter are taken from machine potential and current transformers. The limiter output auctioneers against the voltage sensing signal output in an auctioneering function for control of the power amplifiers. The control of the power amplifiers by the limiter prevents the auto or manual regulator elements from decreasing machine excitation to levels below the desired set characteristic value. Both Summing Point and Takeover style limiter is available with the UEL. In all modes of the synchronous machine operation: generate, pump and condensing mode, the MEL will be sensitive to the direction of the power going either into or out of the machine and adjust its output signal accordingly to provide correct control.

5.8.4.2 Over Excitation Limiter (OEL)

The Over Excitation Limiter (OEL) acts through the regulator to return the value of excitation to a preset value after an adjustable time delay during which overexcitation is permitted for field forcing. The limiter operates on an inverse time characteristic that permits lower values of overexcitation for longer time intervals and limits higher values of over-excitation for shorter time intervals. This limiter's output auctioneers with the output of the auctioneering function in a signal mixer such that reduced excitation is sent to the firing circuit. The Over Excitation Limiter keeps the generator field current or voltage below a desired value of field voltage or field current that is adjustable. This limiter functions with the Instantaneous Limiter to provide a two step operation. The first operation is the instantaneous limiter. The second operation is the time-delayed limiter.

The OEL provides a "memory" of the time-dependent nature of the residual and cumulative effects of rotor heating. If the field quantity drops below the inverse limiter

pickup, the inverse timer immediately begins to reduce the accumulated time over pickup to zero with a cool-down characteristic curve. An alarm is indicated when the limiter picks up.

5.8.4.2.1 Instantaneous Field Current Limiter

The Instantaneous Field Current Limiter keeps the generator field current or voltage below a desired level. That level may correspond to a ceiling limit for the generator field voltage in a brushless excitation system, to the instantaneous current limit of a thyristor bridge, or to a low level of current required during startup operation. The instantaneous limiter setting is automatically changed based on the status of the generator 52 breaker. When the 52 breaker is open and the unit is off line, the instantaneous limiter has an adjustable setting. When the 52 breaker is closed and the unit is on line, the instantaneous limiter has a second adjustable setting and a short adjustable delay.

5.8.4.3 Volts/Hertz Limiter (HXL)

The Volts/Hertz Limiter keeps the ratio of generator terminal voltage to line frequency below a desired value. The limiter is applied to the excitation system when the station must operate under adverse circumstances with the system frequency below normal operating range. In such cases, the reason for operating at reduced voltage during under-frequency conditions is to avoid the heating effects of excessive magnetic flux in the generator, transformers, or other magnetic devices. The limiter uses an inverse curve that coordinates with the sample volts/Hertz curves shown in ANSI C37.102. The input to the volts/Hertz limiter is machine terminal voltage, and its output is a signal that auctioneers with the positive auctioneering output signal in the signal mixer in such a manner that whichever signal that reduces excitation is sent to the firing circuit.

5.8.4.4 Generator Overvoltage Limiter (OVL)

When the Generator Overvoltage Limiter is in control, the generator voltage is regulated to a pickup point below a desired line voltage. The limiter uses a selectable fixed time delay.

5.8.4.5 Generator Line Current Limiter

The Generator Line Current Limiter keeps the generator line current below a desired level. The limiter is disabled when the power factor is near unity between 0.99 PF lag and 0.99 PF lead. The limiter is bidirectional. When the generator is operating overexcited, this limiter reduces the field current. When the generator is operating underexcited, the limiter raises the field current. The operation of the limiter occurs following a fixed time delay after the current has exceeded the pickup point. When the limiter is operating, it regulates the generator line current to within ±1.0% provided that the power factor is either less than 0.99 pf lead or less than 0.99 PF lag.

5.8.5 Excitation Control Module (ECM)

The Excitation Control Module (ECM) is the central control card in a control channel for the excitation control system. The ECM contains the intelligence to implement all of the regulators, limiters, protection, communication, and system control functions.

Each system utilizes one ECM module per channel. The function of a module as a main controller or a redundant controller is selectable in the software in its microprocessors.

Each module contains the hardware needed to implement the software functions/settings and is stored in nonvolatile flash memory.

The ECM board has the capability to synchronize the system clock with an Arbiter Systems 1084B GPS satellite clock. Currently, the software is capable of synchronizing the controller clock to within 1ms of the satellite clock. The system has been designed to allow the GPS satellite clock signal to be brought in to the ECM board through the serial port (RS-232 DB-9 pin connection or RS-485 port).

5.8.5.1 Firing Control Interface Module (FCIM)

The Firing Control Interface Module (FCIM) is the interface between each Bridge Control Module (BCM) and the Exciter Control Module (ECM). The FCIM receives a firing command signal from the ECM and signals from Field Isolation Transducers (FIT) for field voltage and the excitation transformer (PPT) secondary voltage. Based on this

information, the FCIM supervises the firing control for multiple thyristor-controlled bridges. The module receives information regarding bridge status from each BCM. The FCIM indicates loss of any one thyristor, a bridge low temperature alarm, and a bridge high temperature alarm. The FCIM also responds to phase-up, phaseback, and turn-off-pulse commands.

5.8.5.2 Sensor Input Module (SIM)

The Sensor Input Module (SIM) has high-speed analog inputs that collect data from regulation and metering potential transformers and current transformers connected to the generator's output, as well as other analog signals. The SIM receives signals from transformers that isolate it from analog inputs. The PT signals can be in the range of 20 to 160 Vrms. The CT signals are converted to a voltage through a 0.3 ohm resistor yielding voltages in the range of 0 to 1.8 Vrms. The input frequency can vary in the range of 20 to 70 Hz. The continuous line current can be in the range of 0.1 to 6 A in the CT secondary. During faults, transit signals as high as 25 A can be sensed without clipping. The SIM contains 12 analog-to-digital converters for making measurements from these transformers and other inputs. Each analog-to-digital converter has a 12-bit resolution. The high-speed analog inputs sample the incoming signals simultaneously and are updated every millisecond.

The SIM is also the controller for serial input/output links to the ECM. Fiber optic connections are made from the SIM to expansion low-speed analog (AIOM) and digital (DIOM) input/output modules.

5.8.6 Digital I/O Module (DIOM)

The purpose of the Digital Input / Output Module (DIOM) is to provide a means to interface the ECS2100 excitation control system with external devices. Each DIOM has the capability to sense twelve digital inputs (±24 - 125Vdc or 120Vdc) which are sampled every 8 ms. These inputs are commonly used to provide an interface to the excitation control system from pushbuttons, control switches, and relay auxiliary contacts.

Eight digital form C relay outputs are also provided on each module. The digital outputs are each connected to form C relays with ratings of 10A, 120Vac or 10A, 30Vdc. The ECM updates the outputs at an 8 ms rate. These outputs are commonly used to drive external relays and indicator lights, or to interface with DCSs and PLCs. Each ECS2100 control channel may be equipped with a maximum of four DIOMs that are connected in daisy chain fashion using an isolated bi-directional fiber optic communication link. Utilizing the ccTool software, the digital input and output data can be connected to any control software block input or output in the ECM.

These may be included in the original system or may be added by the customer in the field as the need for additional I/O arises. Because the fiber optic link is immune to electrical noise, the boards may be mounted in close proximity or up to 22 meters from the cubicle. This results in reduced wiring to the excitation cubicle.

5.8.6.1 Analog I/O Module (AIOM)

The purpose of the Analog Input / Output Module (AIOM) is to provide a means to interface the ECS2100 excitation control system with external devices such as meters, resistance thermal devices (RTD), transducers, chart recorders, distributed control systems (DCS), and programmable logic controllers (PLC). Each AIOM has the capability to sense two analog inputs (±10 Vdc) that could be used to interface the ECS2100 to PLCs or DCS systems. The AIOM also has one 100 ohm Platinum RTD input that is commonly used to provide temperature and hydrogen gas pressure feedback to the system for use in the generator optimization functions associated with compensated excitation limiting. The AIOM provides four individually configurable (±10 Vdc /4-20 mAdc) analog outputs on each module with 16 bit resolution.

Each ECS2100 control channel may be equipped with a maximum of three AIOMs that are connected in daisy chain fashion using an isolated bi-directional fiber optic communication link. These outputs are commonly used to drive existing panel meters

or to interface with DCS systems or chart recorders. Utilizing the ccTool software, the analog input and output data can be connected to any control software block input or output in the ECM. Because the fiber optic link is immune to electrical noise, the boards may be mounted in close proximity or up to 22 meters from the cubicle. This results in reduced wiring to the excitation cubicle.

5.8.7 Dual Source Power Supplies

The ECS2100 system can operate under extreme ranges of supply voltage. The Digital Excitation System contains dual source power supplies that provide reliable control power from both the 120 Vac excitation source and the 125 V battery. Thus, control power is available regardless of machine speed or terminal voltage.

A dc-dc converter will be supplied for applications where a 250 Vdc supply voltage is used. Dc control power is taken from either the customer's 125 V or 250 Vdc source and auctioneered with rectified 125 Vdc from 120 V, three phase ac taken from the secondary of the excitation transformer.

5.8.8 Rapid De-Excitation

An ac field breaker is provided with the ECS2100. The exciter power amplifier is a full converter (with thyristors in all legs of the three-phase bridge) with the ability to force down excitation quickly. The field is de-excited by phasing back the firing pulses to the static exciter amplifier. This action causes stored energy in the field to be inverted back to the source, which quickly reduces the field excitation to zero. Upon opening the dc field breaker, the remaining field energy will be dissipated via the de-excitation module (DX). Under emergencies when the ac field breaker is opened without de-exciting the field, the field current is discharged through the last two conducting thyristors or the DX module.

In larger static excitation systems, rapid de-excitation is accomplished by a combination of electronically inverting the field voltage and triggering the DX module that shorts the field through a discharge resistor. The energy stored in the field is

dissipated quickly in the discharge resistor that reduces the field excitation to zero. The ac field breaker is then opened to complete the shutdown.

5.8.8.1 De-excitation Module (DX)

The DX module is a thyristor-controlled circuit that provides an alternate path for the generator field current when the normal path is not available. The normal path is through the PPT, 41A-supply breaker, and the generator field. Should this path be interrupted, the DX circuit provides the safe alternate path to dissipate the field energy. To provide the alternate path, the DX thyristor is triggered by a control signal and/or excessive negative field voltage. Control firing of the thyristor is implemented when the excitation system provides a de-excitation signal, typically when device 41A, the dc output breaker, is opened. Voltage firing triggers the thyristor when the field voltage exceeds a preset negative voltage value. Feedback to the excitation system is provided when current is present in the DX module. A current sensing circuit in the module provides a logic signal to the excitation system whenever the current in the DX exceeds a minimum preset level.

5.8.8.2 Crowbar Module (CB)

The Crowbar module (CB) protects the generator field and exciter power converter from excessive high positive field voltages. Generator pole slip is a source of positive high voltage. The Crowbar self-triggers any time a high voltage occurs. The system automatically recovers once the voltage starts to go negative.

Since the power converter thyristors are likely to be phased on when the Crowbar operates, a resistor is placed in series with the module to limit the bridge current and provide a pole-slip current path. Feedback to the excitation system is provided when current is present in the Crowbar.

5.8.9 Field Flashing

Field flashing will be provided for the static exciter. It will provide the necessary voltage with a current limiting resistor to the machine field to raise the machine

terminal voltage to a suitable level that is sufficient for the static exciter to begin to build up the machine voltage.

In order to ensure positive buildup of the ac generator voltage on startup, a reliable dc source of power is required for momentary field flashing. This source of power is applied momentarily to the generator field during startup by means of contacts on the field flash contactor. Field flashing after the a-c contactor closes by automatic or manual implementation, which may be supplied as an option. The field flash contactor has a momentary action and is supplied as standard equipment. In manual if the operator releases the switch, the momentary action permits the field to be disconnected from the dc source. The field flashing circuit includes a timer to prevent overflashing the field and a phase-up circuit that minimizes the load on the station battery source. The field flash is turned off when either the terminal voltage builds up or the field current exceeds a settable minimum value. The range of settings is from 1 percent to 100 percent of no-load field current.

5.8.10 Protection

Protection functions operate whether in manual or auto. These functions provide alarm indications or trip commands when they operate. Protection functions do not tend to regulate or limit the signal, although some of them may phase back the power bridges. For every Limiting Function, there is an associated Protection Function. The protection elements are intended to back up the Limiting Functions in an effort to take control and attempt to avoid a system trip.

5.8.11 Monitoring Functions Via Color Touch Screen

The monitoring functions include a variety of items that are determined by the inputs to the control modules. Values will be displayed on the IDP1200 color touch screen locally. An alarm is generated whenever one of the monitored quantities exceeds an adjustable value. The following are the different display modes available:

- Field Values – Displays field current, field voltage, and balance signal associated with the operating modes/ channels.
- Generator Field Temperature Monitor – Monitors and displays the rotor temperature. There are two levels of alarm, low and high. An alarm is generated when either temperature exceeds a time delay.
- Generator Megawatts and Megavars – Displays Generator Megawatts and Megavars function determines the real and reactive power output of the generator for display. These values are available whether one, two, or three CT signal(s) are utilized once programmed.
- Generator Field Ground Detection – A ground in the field of a synchronous machine should be detected since the occurrence of a second ground might short circuit part of the field winding, and the resultant unbalance and vibration may damage the machine. The function of the exciter ground detector panel is to detect a ground current flowing from the machine dc field winding to the grounded machine shaft. The ground detector continuously monitors the machine field and detects ground currents ranging from 0.1 mA to 15 mA. Minimum and maximum alarms levels can be set. A remote alarm is available for annunciation whenever a ground is detected. Provision is also made for checking the operation of the ground current sensing circuitry by applying a "simulated ground" to the PC card. The ground detector panel may be applied to brush excitation systems at rated generator field voltages up to 1,250 Vdc.

5.8.12 Analog Signal Outputs Using AIO Module (Meter Drivers)

The Analog Signal Outputs function sends an equivalent analog signal to a meter or chart recorder. As a minimum, the following signals are selectable to send to the analog outputs termination point: generator or exciter field current, generator or exciter field voltage, terminal voltage, terminal voltage deviation, line frequency, line frequency deviation, line current, generator real power, generator reactive power, accelerating power, PPT voltage on static systems, any error detector output, any set point adjuster signal, any limiter output, a firing command, any field temperature, the power system stabilizer output, or the balance meter output. The user can select the analog output channel for any of the quantities. The output range is ±10 V or 4 to 20 mA.

5.8.12.1 Alarm Outputs Using DIO Module

A variety of alarm indications is available. The individual alarms can be indicated on the ccTool screen at the remote or local personal computer. An alarm (exciter trouble) relay is available to indicate that an alarm has occurred. Up to three additional individual relay contacts are available for annunciation.

5.8.12.2 Alarms Displayed on CCTool

These alarms are documented functions viewed through Level 1 of the ccTool program. The purpose of this is to detect an internal problem or fault in the ECS2100 system. If the problem is non-critical, an alarm is generated and a short description of the fault is displayed. If the problem is critical, the main controller either automatically transfers control to another ECM, if present and prior to tripping the unit, or it trips the unit if no backup controller is available. A critical problem is one that may result in tripping the turbinegenerator off line or, if left uncorrected, could result in damage to the turbine-generator unit. All other problems will be defined as non-critical.

5.8.13 Power Section Description

5.8.13.1 Digital Firing Logic

Digital firing control of the thyristor bridges in the ECS2100 utilizes field programmable gate arrays that are supervised by a microprocessor located on each Bridge Control Module (BCM). A separate microprocessor on the Firing Control Interface Module (FCIM) controls all of the Bridge Control Modules (BCM). The use of a microprocessor at each bridge provides bridge intelligence and diagnostics at each individual bridge. The use of an FCIM permits simultaneous firing of multiple bridges.

The ac error signal feeds a PID controller in the ECM and is then sent to the microprocessors in the FCIM of the digital firing circuits, and the resultant timing command, then, is sent to the field programmable gate arrays in the BCM. Then, the BCIM initiates the pulses being sent to the thyristors of the power converters. Each power converter is a three-phase, six-pulse, thyristor-controlled full converter whose

ac input line frequency can be in the range of 20 to 480 Hz. The firing circuits are synchronized with the ac supply voltage and the associated thyristors or Silicon-Controlled Rectifiers (SCR). A linear relationship is established in a firing circuit between the regulator output signal voltage and the dc output voltage of the associated power converter.

5.8.13.2 Thyristor Bridge Control

The bridge control function supports the power converters in the ECS2100 Digital Excitation System. In multiple-bridge systems any one of the power converters can be turned off and repaired without affecting the operation of the other bridges. In systems utilizing pullout drawers when a redundant drawer is present, any drawer can be removed under full load by cranking out the drawer.

5.8.13.3 Bridge Control Module (BCM)

The ECS2100 systems are configured with one or more Bridge Control Modules (BCM). A BCM is located in each converter bridge assembly. The BCM generates the firing pulses needed to fire the SCRs in the full converter. A state select port on the BCM is used to select which channel is to be in control. Monitoring functions of each BCM include the conduction of thyristors, the temperature of the bridge, and an optional magnitude of bridge current feature.

5.8.14 Power Converter Cabinet Assembly

Each power converter for this application is packaged in a three-phase, six-thyristor, full-wave bridge configuration that includes a BCM module. The power converter applies positive and negative forcing voltage to the exciter field for dual directional forcing of field voltage. The field current, however, is not reversed. The thyristors conduct current once each cycle at a variable angle in the cycle as determined by the amplified error signal from the regulator. The earlier in the cycle that the thyristors conduct, the greater the amount of energy delivered to the field. Thus, the regulator controls excitation by varying the output of the power amplifiers by controlling the associated firing circuits.

Some of the power converter bridges are constructed of drawout, compact module subassemblies that can be electrically isolated to facilitate maintenance under load or fixed bridge assemblies. Drawout power converters permit easy removal of a complete power converter for bench testing. These modular bridges can be stacked to limit the cubicle floor space required for the ECS2100 Digital Excitation System.

5.8.14.1 Power Redundancy

The ECS2100 will be configured for a spare operating power converter and associated BCM, N+1 redundancy. With redundancy, maintenance can be performed under full load. This redundancy is important to assure that the failure of one of these modules or components does not cause a unit trip.

5.8.14.2 Thyristor Protection

RC snubber networks protect the thyristors against excessive rate of change of current and voltage. Nonlinear resistor assemblies protect against excessive transient reverse voltage. For large static exciter systems, ac line filters are typically used. Protection against loss of pulse in a firing circuit and loss of conduction in any converter bridge assembly is provided. Volt-Traps or MOVs (Metal Oxide Varistors), used as line surge protection devices, are included across the input lines to the converter input. Thyristor overtemperature is monitored by thermal sensors (RTDs) embedded in the heatsinks. The thermal sensors provide heatsink temperature indication. Typically, only the hottest heatsink is displayed.

5.8.14.3 Cooling System

For the drawout converters, a main fan with a backup fan supplies forced-air cooling. The fan is designed to provide adequate cooling for the entire power cubicle. An automatic fan transfer circuit is included should the main fan fail. The fans are located in the top front and top back of the power cubicle. The fan assembly is designed to allow removal under load. A motor protection circuit is included, as well as a loss of airflow alarm. A fan selector switch is provided which allows the main fans to be alternated between the two fans.

5.8.15 Control and Maintenance Features

5.8.15.1 Operator Interface- IPD 1200

Flexibility in the ECS2100 control room interface capability permits the operator to monitor status, perform control operations, and make routine adjustments in the voltage regulator. For replacement installations, the customer may choose to use an existing control room panel. In that case, the system is operated with traditional switches, lights, and meters connected to programmable I/O terminals. For new installations or for sites where the customer chooses to replace existing controls, the ECS2100 can be connected to the control room by a single cable. Control then may be done through the Color Touch Screen Operator Control Module. This module can be mounted locally on the excitation cubicle or remotely in the control room, or it can be mounted at both locations. Critical switches such as the ac supply breaker can be direct connected to a relay via a terminal block.

Alternately, control may be done through the plant digital control system via a communication processor in that system.

The excitation control system can also be interfaced to a SCADA remote terminal unit, a process controller, or a backup set of control room switches, lights, and meters.

5.8.15.2 Controller Configuration Tool (ccTool)

The ccTool is an easy-to-use software tool for configuring, monitoring, and maintaining the ECS2100 Digital Excitation Control System purchased. It provides operators and maintenance personnel with password access to the operational parameters and optional configuration management of the ECS2100 Digital Excitation System through a laptop or desktop PC.

- Level 1: View – the basic access capability, includes the ability to monitor generator system values, digital regulator operating parameters such as gains, time constants, and limiting and protective set points, and view job-specific drawings, instruction books, help menus and help screens.

- Level 2 (includes Level 1): Settings – allows a user to modify selectable and adjustable parameter settings.
- Level 3 (includes Levels 1 and 2): Configuration Management – includes capabilities for the reconfiguration of software regulator function blocks and sequence control connections.

The ccTool can be accessed locally or from a remote location through the RS232 port on the ECM module. The access capability also includes the ability to view the data collected by the ECS2100 Transient Event Recorder. The Transient Event Recorder is a software package that includes the standard Event and Alarm recorder that is accessed through Level 1: View of ccTool. Special features include the optional Single Event Recorder and Analyzer, and the optional Data Logger applications programs, both of which are accessed through optional Level 3: Configuration Management of ccTool. All events are time and date-tagged. CCTool is compatible with industry standard software such as Embedded Windows NT and Windows XP.

5.8.15.3 Transient Event Recorder

The Transient Event Recorder is a software package that consists of three applications programs for recording and processing transient events.

5.8.15.4 Event and Alarm Recorder

The Event and Alarm Recorder generates a time and date stamped list of events. The events and alarms included in the list are pre-selected. The following items are included:

- Pickup of limiters
- Operation of limiter
- Pickup of protection functions
- Operation of protection functions
- Internal failure in the controllers

Up to 2000 events may be recorded, then uploaded to a personal computer file using CCTool. An ACCESS spreadsheet may be used for viewing or printout.

5.8.15.5 Single Event Recorder and Analyzer

The Single Event Recorder records up to eight simultaneous signals. These signals can be selected from any input or output signals and selected internal signals. The record shows both pre-trigger and post-trigger information. The system provides a time that the event trigger occurred. A selectable remote trigger or an internal one can initiate the event recording. The Single Event Recorder can accept a time synchronization command from an external source such as a personal computer or plant digital control system.

Each record contains up to 9600 points per channel. The resolution is sufficient to allow a cycle-by-cycle analysis for an event. Up to 4 records are stored. The time between recorded points, as well as the number of recorded points, is adjustable. The minimum time between recorded points is one millisecond.

These data points can be viewed using a personal computer that can be directly connected to the ECM or connected via a modem to the ECS2100 Digital Voltage Regulator. Using CCTool, data for the event can be uploaded to a text file and viewed directly. The output file from the transient event is compatible with commercially available software such as Microsoft EXCELTM. Using such commercially available software, one can also view and plot the recorded information without being connected to the excitation system.

5.8.15.6 Data Logger

The Data Logger is a log of the value of selected inputs. The items to be logged are selectable from 1 to 12 items. The last 1000 samples of an item that is contained in a circular buffer are logged. The following is a list of items that, as a minimum, may be logged:

Generator output such as watts, vars, power factor

Excitation cubicle output, amps, and volts

Field temperature

The time between value readings is selectable in one second increments starting at one second. When requested, the last 1000 values logged may be uploaded using CCTool.

The log can be stored on disk or printed.

5.8.15.7 Communications

The ECS2100 will be provided with the following communication ports:

- RS-232 Configuration Port (local),
- RS-485 Communication Port 1: Modbus
- RS-485 Communication Port 2: Modbus.
- Telephone Modem
- Ethernet Port (Modbus)

5.8.16 Excitation Cubicle

All components of the excitation system will be mounted in a formed 13-gauge sheet steel NEMA 1 enclosure built in accordance with ICS6-110.10.02 for ventilated enclosures. The cubicle will be rigid and self-supporting with enclosed panels on rear, all mounted on a steel channels.

A full-length door equipped with a 2 handles will be provided for access to inside mounted equipment. Openings will be provided as necessary for adequate ventilation.

5.8.16.1 Standard Cubicle Accessories

Incandescent Light Fixture Assembly, with door-activated switch and convenience outlet.

Space heater with thermostat

5.8.16.2 CT Shorting Terminal Block

A safety shorting block will be provided for the connection of the remote parallel current transformer.

5.8.16.3 Shaft Voltage Suppression

Shaft voltage suppression will be supplied across the exciter field to prevent bearing deterioration caused by the high frequency voltages generated by the power rectifiers.

5.8.16.4 Control Power

The system will be designed to accept redundant 125 Vdc and 120 Vac sources of control power for all electronic circuits. Unless otherwise specified, the system will be designed to derive AC control power from the Power Potential Transformer secondary. In the event of loss of one of the control power sources, the other source will be used to keep the excitation system operating.

5.8.16.5 Protective Finishes

All fabricated metal parts will have a protective finish. Finish process will include metal cleaning and preparation followed by one coat ANSI Z55.1 color number 61 gray for the cabinet enclosure. All subpanels will have a color white finish process. Paints will be in compliance with the 1990 U.S. Clean Air Act.

5.8.17 Operating Environment

5.8.17.1 Temperature

The cabinet and the installed components will be designed to function without degradation in performance for an outside cabinet ambient temperature of 50°C

5.8.17.2 Humidity

The cabinet will be designed for a 95% humidity non-condensing.

5.8.17.3 Altitude

The system will be designed for operation at rated conditions at altitudes to 1000 meters.

5.8.18 Equipment Testing

5.8.18.1 Device Testing

Prior to mounting, all devices of Basler manufacture will be individually tested in accordance with the acceptance test procedure for that device.

5.8.18.2 System Testing

The excitation system will be thoroughly factory tested to determine compliance with the specification and the functional design of the system.

5.8.18.3 Dielectric Cabinet Test

Electrical dielectric tests will be performed on the excitation cabinet in accordance with IEEE 421.3.

5.8.19 Documentation

The final system will be supplied with the following information:

a. Excitation Enclosure Outline Drawing including:

   (1) Lifting angles with dimensions
   (2) Maximum Weight and Dimensions
   (3) Cabinet Mounting Hole Sizes and Location
   (4) Size and Location of Ventilation Openings

b. Schematic/Interconnect Diagram with Wiring Number Identification

c. Instruction Manual

d. Internal Layout Drawing

e. Wiring Diagram

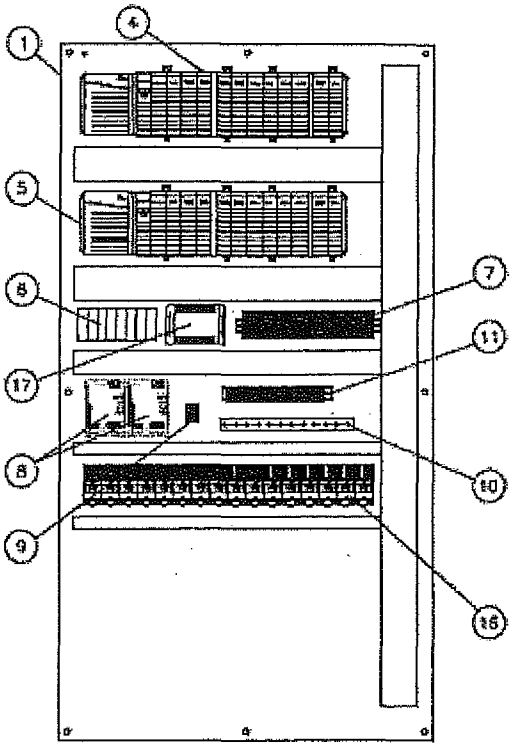
f. Drawings in digital format

5.9 Digital Governing System – Section 16380

5.9.1 Governor Equipment

The following is a detailed description of the major elements in American Governor's scope of supply:

Governor PLC System



The heart of each new governor system will be a redundant Programmable Logic Controller (PLC). Our approach is based on full platform redundancy: a Primary and Back-up PLC. Two controller racks will be provided, each with their own CPU, memory and I/O modules, and the feedback signals are shared between the controllers to further enhance reliability of the system. Each PLC rack has its own power supply, and redundant cabinet power supplies are provided with diode switching to power the proportional valve, interposing relays and field devices.

The Governor PLC and accessories will be mounted in a stand-alone control cabinet located adjacent to the existing actuator cabinet. The sample arrangement shown at right is excerpted from the enclosed proposal drawings. Field terminal blocks will be mounted on side panels (not shown).

The Primary and Backup communicate in two ways. An Ethernet link connects the two systems together and data is exchanged at 10ms intervals. The shared data is monitored to verify such things as operational mode, faults, alarms, setpoints, I/O values, and heartbeats.

Each controller also has a relay output that drives a discrete input to the other controller. When the relay is energized it tells the other controller that it is functioning and ready to assume control of the wicket gates if required. This hardware link has been made available to reduce the absolute reliance on the Ethernet link.
Status and alarms are communicated to the local operator interface touch screen as well as the Unit Control system.

PLC Equipment

Allen-Bradley Control Logix	Model	Qty
CPU - Logix 5561, 2Mb CompactFlash Memory	1756-L61	2
Power supply (125VDC)	1756-PH75	2
13 Slot Chassis	1756-A13	2
Analog Input - 8 Channel	1756-IF8	2
Analog Output - 8 Channel	1756-OF8	2
Contact Input - 16 Channel (125VDC)	1756-IH16I	4
Contact Output - 16 Channel (24VDC)	1756-OW16I	2
HS Counter Module - 2 Channel	1756-HSC	2
Configurable Flow Meter (Speed Measurement)	1756-CFM	2
Ethernet Module	1756-ENBT	2

Each governor cabinet will also include the following devices:

- Redundant Cabinet Power Supplies
- Signal Conditioning Devices
- Terminal Blocks
- Interposing Relays
- Color touchscreen HMI mounted on front door
- Control switches mounted on front door

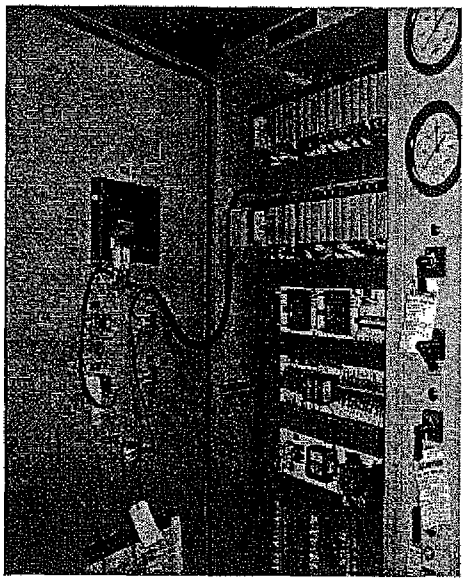
These devices will be described in more detail in the following pages.

Cabinet Power Supplies

Redundant 125VDC/24VDC cabinet power supplies with automatic diode switching will be provided to power the proportional valve, interposing relays, accessory equipment and field devices.

Control Switches

An Emergency Shutdown pushbutton, Local/Remote control switch and Auto/Manual/Test control switch (keyed) will be provided on the front door of the control cabinet. When depressed, the red mushroom ESD pushbutton causes an immediate shutdown external to the PLC controls, directly to the emergency shutdown valve.



Helms Governor Cabinet
Color touchscreen and control switches mounted on front door

When in Local mode, the operator has exclusive control of the unit from the governor control cabinet. When in Remote mode, the Unit and Plant Controllers are in control of the unit.

In Automatic mode, all normal automatic control functions are enabled. In Manual mode, the operator can start, synchronize, load/unload and stop the unit manually. When in Test mode, the governor is switched to a Maintenance Manual control mode. Through a password-protected access screen, the operator can set and observe gate position manually, or run other unit tests, using the touchscreen. This mode is specifically designed and recommended for unit maintenance, since normal unit speed control and overspeed trip functionality are disabled.

Primary Speed Sensing

Primary speed sensing will be done via connection to a generator Potential Transformer (PT). The PT signal will be sampled, amplified, filtered, and converted to a 24VDC pulse train using a commercially available interface card. With the Allen-Bradley platform, the signal is then routed into the 1756-CFM Configurable Flow Meter module, which generates a high-resolution speed signal with a module accuracy of 0.00045HZ. This arrangement has been tested and is compliant with IEEE 125 "IEEE Recommended Practice for Preparation of Equipment Specifications for Speed-Governing of Hydraulic Turbines Intended to

Drive Electric Generators." For the Allen-Bradley platform, the primary signal will be routed to the High-Speed Counter module.

Algorithms in the Governor will detect failure of this speed signal, trigger an alarm - and a specific alarm indication on the HMI - and automatically switch to the back-up speed signal.

Back-up Speed Sensing

Back-up speed sensing will be provided by connecting the existing proximity probes (also called Zero Velocity Pickups or ZVPUs) directly to the High Speed Counter module. The ZVPUs are located in the Speed Signal Generator. As the teeth pass the probes two speed signals are generated by the HSC module. While the speed signals generated by the proximity probes are not as stable as the PT method, the ZVPUs can reliably detect rotational speed down to 0.0 rpm and are thus ideally suited for brake actuation and creep detection. The ZVPU speed signal is also preferred during starting and stopping sequences. Algorithms in the Governor PLC will detect failure of either of the two ZVPU speed signals, trigger an alarm - and a specific alarm indication on the HMI.

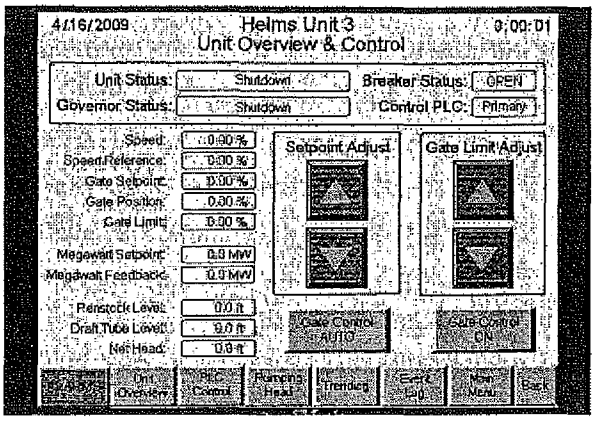
Loss of both Primary and Back-up speed signals will result in Emergency Shutdown of the unit.

Overspeed Protection

Three forms of turbine-generator overspeed protection will be provided. The primary and back-up speed signals are continuously monitored by the PLC for an overspeed condition. The overspeed trip logic has an operator configurable trip level. As a final overspeed defense, the mechanical main overspeed switch on the SSG will be retained. This switch will be integrated directly into the governor trip string and initiate an Emergency Shutdown.

Local Operator Interface

A 15" color touchscreen is proposed to serve as the Local Operator Interface for the governor. The touchscreen will be mounted on the control cabinet door and will communicate with the PLC governor system. The touchscreen computer operates independently and automatically establishes communication with the PLC upon boot-up; no operator intervention is required. System screens are stored in non-volatile memory. The basic screens described below will be provided by AGC. Touchscreen software will also be provided to allow site staff to modify or add new screens, as desired.



Helms Touchscreen Display

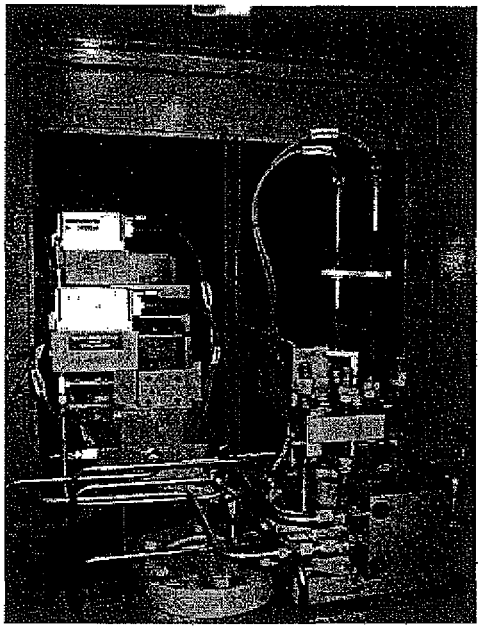
Provides local control and monitoring of all governor functions. Gains and other tunable parameters are password protected

The system will have the following capabilities:

- Local control and monitoring of the unit
- System alarm display and event log
- Input / Output (I/O) Status display
- Trending of unit data
- Governor diagnostic and test functions
- Access to tunable parameters for the unit
- On-board data archiving

ElectroHydraulic Interface (EHI) – Units 1, 2, 3, 4, 5, 6

An ElectroHydraulic Interface (EHI) assembly will be provided to interface the digital governor to the existing distributing valve, hydraulic system and servomotors. During normal operation, the EHI ports oil via a proportional valve to move an existing pilot servomotor, which hydraulically positions the distributing valve plunger, which in turn ports large volumes of oil to the servomotors to move them to the desired position at the desired rate (subject to mechanical rate limits). During emergency conditions, the EHI ports oil via a solenoid valve to move the existing pilot servomotor, the distributing valve plunger and the servomotor at the maximum allowable rate (subject to mechanical rate limits). Emergency shutdown, whether from the external pushbutton or hard-wired 86, does not require any intervention by the Governor PLC.



Helms Electrohydraulic Interface

Redundant proportional valves and LVDT feedback shown mounted on distributing valve

The Gate Control EHI will include the following devices:

- Proportional Control Valve (provides primary control during normal operation)
- Solenoid Shutdown Valve and Manifold (emergency shutdown independent of PLC)
- Mounting hardware, fittings, brackets and mounting hardware

Redundant EHI systems are available, but were not specified and are not included. As part of the standard Electro-hydraulic interface (EHI) kit, AGC supplies a shutdown shuttle block manifold. The manifold combines the forced shutdown function and normal control function into a single compact assembly. The shutdown valve (2-position directional valve) and the control valve (proportional valve) are both mounted on the manifold. The shutdown valve controls an internal piston that moves between two positions.

When the shutdown valve is energized, the internal piston moves to the Run position which allows oil to flow to the proportional valve. The proportional valve responds to the governor control signals to control the pilot stage of wicket gate positioning. The shutdown valve remains energized during normal operation and the proportional valve is free to position the wicket gates as directed by the Governor PLC.

When the shutdown solenoid is de-energized, the piston moves to the shutdown state and oil is ported in a manner that causes the gates to close. At this point the proportional valve cannot open the gates even if directed by the Governor PLC; it has been isolated from the control ports. The manifold acts as the ultimate fail-safe device for gate positioning because a minimum of two failures (one being an internal piston failure) are required to stop the gates from closing. In addition, the proportional control valve also fails to a safe position.

Dual Filter Assembly - Units 1, 2, 3, 4, 5, 6

A dual filter assembly with on-line changeover valve will be provided and is required to meet the recommended oil cleanliness specifications for the new EHI control valves. The assembly will include a 10-micron filter elements, high differential pressure (ΔP) indicators and mounting stand.

Distributing Valve Position Feedback - Units 1,3,4,5

A Linear Variable Differential Transformer (LVDT) will be provided for distributing valve position feedback. This non-contacting device is highly accurate, and as with mechanical governor relay restoring, the electronic relay restoring ratio is fully adjustable for proper hydraulic system step response. Mounting hardware, connector and junction box will be included.

Redundant feedback arrangements are available for use with redundant EHI systems.

Wicket Gate Position Feedback - All Units

The existing electronic position feedback devices for all units will be retained and reused.

Governor PLC Control Software

American Governor will provide custom governor control software adapted from proven software algorithms. For this project, we propose the following functionality:

- Automatic Start / Stop Control
- Manual Start / Stop Control
- Local/Remote Control Selection
- Unit Speed / Frequency Control with
  - Variable Droop
  - Dual Speed/ Load Dynamics
  - On-Line / Off-Line Gains
- Feedforward Control (for Fast Ramping)
- Gate Limit Control for Pump Mode
- Automatic MW Control with Droop
- Synchronous Condense Control
- Auto/Manual/Test Control Modes
- Automatic Pre-Load (to Prevent Reverse Power Condition)
- Soft Loading & Unloading of Unit
- Speed Switches & Gate Position Switch Functions
- System Alarm Indications
- I/O and CPU Diagnostics
- Ethernet Communication Port

The following descriptions are provided to illustrate some of the advanced control modes and algorithms we incorporate into our governor systems.

On-Line Operation - Megawatt Control (Speed Regulation Mode)

Megawatt Control Mode is a droop-based control scheme that is sensitive to grid frequency changes. Once the unit is on-line, the wicket gates will be used to regulate load.

The controller will use a Speed Regulation methodology to control the power output. The megawatt setpoint ramp will be maintained in the governor. The actual megawatt signal will be compared and the error evaluated. The error is then scaled and converted

to a normalized error signal. This is then converted to a Speed Reference value and fed to the PID algorithm. The response formula is as follows:

MW Speed Reference = 100 + [(MW Set-MW Actual)/Max MW] x Droop

Actual Unit Speed = MW Speed Reference - (Droop x Actuator Position)

As the MW Setpoint or MW Actual changes, the Speed Reference is adjusted accordingly. The control setpoint (Actuator Position) will be changed via the PID to restore balance to the equation. As the grid speed varies (Actual Unit Speed), the control setpoint (Actuator Position) will be changed via the PID to restore balance to the equation.

By using this methodology, MW output can be controlled while taking unit speed into consideration. A typical droop value is 5%. This helps stabilize the local grid and meets IEEE 125 and NERC standards.

Islanded Operation

In some instances the Unit Controller will signal islanded condition, however; we will provide algorithms in the Governor PLC that automatically detect this condition.

If a large, maintained frequency excursion is detected (tunable, typically 1%), the governor will enter Small System mode. In this mode, the unit will operate in frequency control with speed droop set to a low value (typically 2.5%) to allow the islanded units to work together to maintain 60Hz while loads are added and the grid is being put back together. The governors will continuously monitor system frequency and make periodic small corrections to their internal Speed Adjustment setting to keep islanded system frequency dialed in to 60Hz. No intervention by the operator, Unit Controller or Plant Controller is needed.

Once the grid has stabilized for a period of time, the Governor can return to the mode it was in prior to the excursion, or wait for the operator or other controller to signal the transition. This decision can be made during detailed design phase of the project.

Null Point Automatic Calibration

Even with meticulous field calibration and the best operating environments, gate driver circuits can fall out of calibration over time. AGC has developed time-tested driver logic that incorporates a self calibration routine. Because of mechanical differences and changes over time, the wicket gate driver system null current may change. This induces an offset in the wicket gate position. The governor driver logic monitors the wicket gate setpoint, compares it to the actual position value, and determines if a null correction is necessary. The wicket gate positioning bias error is automatically removed from the system.

Wicket Gate Position Monitoring

The wicket gate positioning error is continually monitored and evaluated. If the wicket gates are not responding properly, the governor will initiate an immediate shutdown. For example, if the wicket gates are off their setpoint by 5% (according to both position feedback transducers) and not moving in the correct direction, there could be a problem in the proportional control valve. The governor will initiate a shutdown after 10 seconds (tunable). The wicket gates will be forced closed by the shutdown solenoid and the breaker opened when the unit is unloaded.

Creep Detection

After a stop signal has been issued and the governor has secured the wicket gates, a creep enable timer starts incrementing. The delay allows the unit to come to a full stop before the governor starts monitoring for creep. After the timer expires, the creep detection circuit is armed.

The ZVPU proximity probes are mounted such that both probes cannot land on the edges of gear teeth at the same time. This helps to prevent false alarms. If both probes are observed to change state, a creep alarm is triggered. The governor will respond in a manner dictated by the customer. Typical responses are to start the high lift pump and apply the unit brakes for a period of time. If the unit continues to creep, a second alarm is sounded and the brakes are released with the high lift pump running

to protect the thrust bearing. The customer has complete control over the governor's response to a creep situation.

If the unit does stop creeping, the high lift pump is stopped, and a few moments later the brakes are released. The system then resumes monitoring. Creep detection is disabled when a turbine start command is received.

Site Coordination Meetings

Two site engineering meetings will be provided. The first will be for the Signature Testing. A subsequent design review kick-off meeting will occur after preliminary design is complete. This meeting provides an opportunity for your staff to review the proposed design and offer valuable input and guidance that will insure a smooth project and a successful start-up. It also gives our Project Manager the opportunity to perform a thorough plant inspection, confirm dimensions, and take any other measurements needed to complete the detailed system design.

Assemble, Wire & Test

American Governor will assemble and wire the complete governor system. The control system will be tested on our Turbine Simulator Test Stand, which will be programmed to closely match existing site conditions. All hardware and software will be tested completely before leaving our factory.

Witness Test

Duplicating the factory testing American Governor already performs, a witness test will be provided to enable the customer to participate in the testing and evaluation of the first system.

Typical Documentation

A list of drawings and documents typically included in our Operation and Maintenance manual is provided below:
Description of System Operation

1. Governor Elementary Diagram
2. Cabinet Wiring Diagrams
3. Elementary Diagram
4. Hydraulic Schematic Diagram
5. Hydraulic Arrangement Drawing
6. Bill of Material and Cut Sheets

Application Software

American Governor will provide the application code so that you have the ability make changes to the system in the future.

Spare Parts

The minimum spare parts specified will be provided. AGC recommends the following spare parts to minimize the potential for future downtime:

Description	Note	Qty
Circuit Breaker for 125VDC		1
Interposing Relay	P & B KUEP	1
E-Stop Push Button		1
Auto/Manual/Test Transfer Switch	3-way, held	1
Local/Remote Control Switch	2-way, held	1
Speed Sensor Module (Square Wave)	5439-213	1
LVDT Signal Conditioner	E030819	1
Cabinet Power Supply	Vicor	1
Filter Elements (Case of 12)	Schroeder	1
LVDT	Schaevitz	1
CPU - Logix 5561, 2Mb CompactFlash Memory	1756-L61	1
PLC Battery	A-B	4
Flash Memory	A-B	1
Ethernet Module	A-B 1756-ENBT	1
Power Supply (125VDC)	A-B 1756-PH75	1
Analog Input - 8 Channel	A-B 1756-IF8	1

Analog Output - 8 Channel	A-B 1756-OF8	1
Contact Input - 16 Channel (125VDC)	A-B 1756-IH16I	1
Contact Output - 16 Channel (24VDC)	A-B 1756-OW16I	1
HS Counter Module - 2 Channel	A-B 1756-HSC	1
Configurable Flow Meter (Speed Measurement)	A-B 1756-CFM	1
Complete EHI and Filter Assy.	See BOM	1

Field Testing and Commissioning Services

American Governor will perform system check-out, start-up, testing and commissioning services for the equipment proposed. We will provide an experienced, qualified Field Service Engineer for this work. We estimate the work can be completed in three weeks for the first unit and two weeks for each additional unit, presuming the equipment has been mounted and wired prior to our arrival. This is an estimate only, based on our experience with similar conversions.

CASTAIC POWER PLANT
CONTROL ROOM COMPUTER & NETWORK OVERVIEW

PLANT CONTROL / COMPUTER ROOM

Barco Video Wall
84"
84"
HMI Workstation 5
Black & White Printer #1
Color Printer
Black & White Printer #2
Unit 7 Workstation
Engineering Workstation #1
Engineering Workstation #2
Operations Supervisor Workstation
Maintenance Supervisor Workstation
Network Time Server/ GPS
Maintenance & Diagnostics Portable PC #1
Maintenance & Diagnostics Portable PC #2
HMIN-SW1
From HMIN-SW7 Drawing # LADPW 273-20-02
HMIN-SW3
To HMIN-SW5 Drawing # LADPW 273-10.02
Terminal Bus
*1
HMIN-SW2
*1
HMIN-SW4
(Servers share a common keyboard & monitor)
HMI Workstation 1
HMI Workstation 4
*2
HMI Server #1
Historical Data Server #1
From PCN-SW13 Drawing # LADPW 273-20-02
HMI Server #2
Historical Data Server #2
Governor HMI Workstation
HMI Workstation 6
HMI Workstation 10
*2
PCN-SW1
PCN-SW3
To PCN-SW5 Drawing # LADPW 273-10.02
System Bus
*1
PCN-SW2
*1
PCN-SW4
To PCN-SW6 Drawing # LADPW 273-10.02
From PCN-SW16 Drawing # LADPW 273-20-02
Basestation 5.8 GHz Radio (to South Portal)
Subscriber 5.8 GHz Radio (to Elderberry)
*3
See Plant Control Network Drwg# 273-10.03

EQUIPMENT LEGEND

- Phoenix Contact FL Switch MM HS
- 64-bit Server
- 64-bit Workstation
- Workstation Class Notebook
- 4Wire line
- T1 line
- Fiber Optic Cable
- Serial RS232 Cable
- Ethernet CAT6 Cable
- Wireless Link

* Note

*1 Ethernet bus shown for simplicity. Each network element connected to Ethernet switches via dedicated Cat-6 Cable.
*2 Not all HMI workstations show for clarity of drawing. Port count calculated in configuration of Ethernet switches.
*3 See Plant Control Network Drwg# 273-10.03 for wireless network detail

		LADWP RFP273-10 CASTAIC POWER PLANT CONTROL SYSTEM UPGRADE	
		CONTROL SYSTEM OVERVIEW	
Operator: S.Landers	Date: 01/22/2010	Drawing No. DRP LADWP 273-10.01	Revision: 1

CASTAIC POWER PLANT
PLANT CONTROL NETWORK OVERVIEW

Terminal Bus

To HMIN-SW1 Drawing # LADPW 273-10.01

HMIN-SW5

HMIN-SW7

*1

UNIT #1 | UNIT #2 | UNIT #3 | UNIT #4 | UNIT #5 | UNIT #6

TRAINING SIMULATOR

TRAINER OIT

Training Controllers

TRN-SW1

From HMIN-SW3 Drawing # LADPW 273-10.01

Governor Controllers Primary / Backup

Governor OIT

Industrial Panel-Mount Workstation

TSOV OIT

TSOV Controllers Primary / Backup

Unit Controllers Primary / Backup

System Bus

From PCN-SW3 Drawing # LADPW 273-10.01

PCN-SW5

PCN-SW7

PCN-SW6

PCN-SW8

*1

From PCN-SW4 Drawing # LADPW 273-10.01

To PCN-SW1 Drawing # LADPW 273-10.01

To PCN-SW2 Drawing # LADPW 273-10.01

PCN-SW11

PCN-SW9

PCN-SW12

PCN-SW10

PSOV – South Portal Control House

PCN-SW16

PSOV Remote I/O

POWERHOUSE BUILDING 7

PCN-SW13

PCN-SW14

Unit 7 Benchboard Controllers Primary / Backup

4160kV Switchgear Relay (typical for 1 of 22)

Siemens 7SJ64

ELDERBERRY LAKE

Building

Outlet Tower

To Solar Powered Radio Repeater Site

See Plant Control Network Drwg# 273-10.03 for Detail

BALANCE OF PLANT

Balance of Plant Controllers Backup / Primary

BAGC INTERFACE

Backup PLC

4-Wire Interface

DNP 3.0

4-Wire line

ECC INTERFACE

Backup PLC

Primary PLC

4-Wire Interface

DNP 3.0

4-Wire line

EQUIPMENT LEGEND

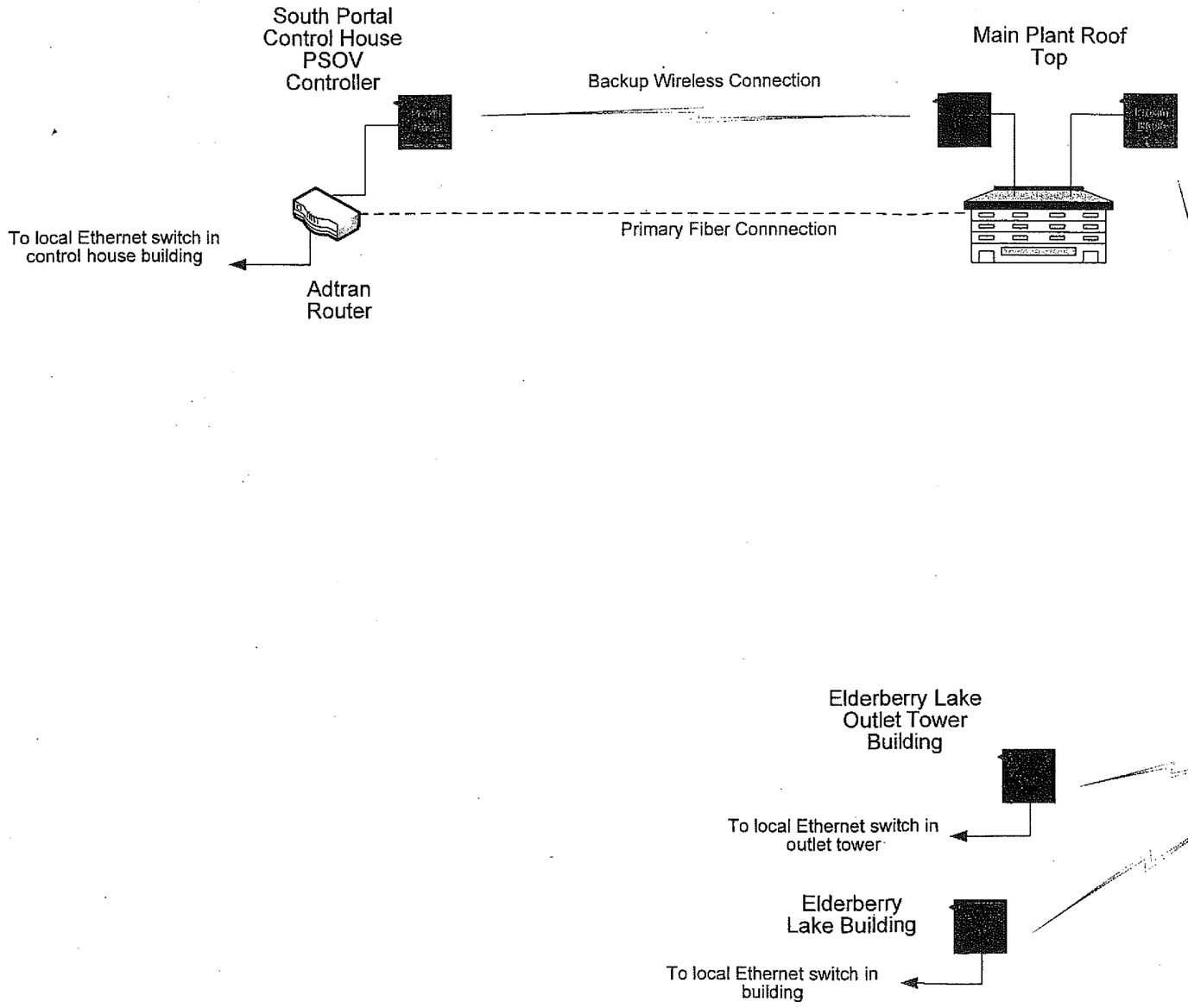
- RuggidComm industrial Ethernet Switch
- T1 line
- 4Wire line
- Fiber Optic Cable
- Serial RS232 Cable
- Ethernet CAT6 Cable
- Wireless Link

* Note

*1 Ethernet bus shown for simplicity. Each network element connected to Ethernet switches via dedicated Cat-6 Cable.

		LADWP RFP273-10 CASTAIC POWER PLANT CONTROL SYSTEM UPGRADE	
		CONTROL SYSTEM OVERVIEW	
Operator: S.Landers	Date: 01/22/2010	Drawing No. DRP LADWP 273-10.02	Revision: 1

CASTAIC POWER PLANT
WIRELESS NETWORK OVERVIEW



NOTES:

Refer to Plant Control Network Drwg# 273-10.01for detail of radio's Ethernet connection to System Bus.

Radio & Fiber connections for South Portal redundant link terminate in System Bus Communication Rack Router

Wireless Communication equipment located in main plant terminal room CCS2

EQUIPMENT LEGEND

- Proxim 8100 Base Radio
- Proxim 8100 Subscriber Radio
- Wireless Link
- Fiber Optic Cable
- Ethernet CAT6 Cable

		LADWP RFP273-10 CASTAIC POWER PLANT CONTROL SYSTEM UPGRADE	
		WIRELES NETWORK OVERVIEW	
Operator: G Conley	Date: 01/26/2010	Drawing No. DRP LADWP 273-10.03	Revision: 0

CASTAIC POWER PLANT
Unit Detail (Typical)

To Adjacent Unit's Fiber Optic System Bus Rings

Industrial Ethernet Switches

System Bus: Supports IEC61850, ModbusTCP

* Note

Ethernet bus shown for simplicity. Each network element connected to Ethernet switches via dedicated Cat-6 Cable.

EL 1577'-0"

Primary

Backup

Local Unit I/O Rack 1

SEL-2440

UNIT CONTROL

Local Unit I/O Rack 2

Hardwired

EL 1562'-3"

Remote I/O Rack 1

Remote I/O Rack 2

Panel 3 Generator/ Motor

Remote I/O Rack 1

Remote I/O Rack 2

Remote I/O Rack 3

Panel 3A (RTD's)

EL 1464'-6"

EXCITATION SYSTEM

Basler ECS-2100 Controller (redundant)

Hardwired

Siemens 7SJ80

EL 1486'-0"

EL 1577'-0"

EL 1562'-3"

EL 1464'-6"

AUTOMATIC SYNCHRONIZATION

Siemens 7VE63

Siemens 7SJ64

Bus 1

Bus 2

Existing 230kV Bay Controllers

EL 1577'-0"

Remote I/O Rack 1

Panel 4C Turbine Pit

EL 1445'-0"

Industrial Panel-Mount Workstation

OIT

Backup

Primary

Local I/O Rack 1

TSOV CONTROL

Panel 4B

OIT

Primary

GOVERNOR CONTROL

Backup

Hardwired

Siemens 7SJ80

21

Siemens 7SJ64

24

22

23

4160 KV BREAKER BAY CONTROLLER

CABLING LEGEND

- Fiber Patch Panel
- Ethernet Fiber
- Profibus Fiber
- Profibus Copper
- Ethernet CAT6 Cable

LADWP RFP273-10
CASTAIC POWER PLANT
CONTROL SYSTEM UPGRADE

Typical Unit Drawing

Operator:	Date:	Drawing No.	Revision:
G Copley	01/26/2010	DRP LADWP 273-10.04	

EXHIBIT H
PRICING

LOS ANGI ES DEPARTMENT OF WATER A POWER
CASTAIC POWER PLANT CONTROL SYSTEM UPGRADE
EXHIBIT H - PRICING

1. Pricing shall be on a lump-sum, line item basis.
2. Pricing for each item shall include all services, equipment, work, hardware, software, firmware, and appurtenances specified and necessary or beneficial, directly or indirectly associated with the item, or necessary to comply with the requirements of the Agreement Documents and to provide complete and functional controls and equipment protection systems.
3. Pricing for each item shall include all costs directly or indirectly associated with the item, including but not limited to planning, scheduling, engineering, design, programming, fabrication, procurement, assembly, shot testing, shipment, handling, installation, checkout, commissioning, and field testing of the item and associated items or necessary to comply with the requirements of the Agreement Documents and to provide complete and functional controls and equipment protection systems.
4. Pricing for each item shall be complete, including but not limited to labor, materials, products, equipment, overhead costs, general and administrative costs, financing costs, taxes, fees, duties, escalation, and profit.
5. In the event LADWP elects to reduce Contractor's scope by amendment of change order, the prices paid for specific eliminated or reduced Task Items(or portions thereof) shall be eliminated or reduced, and the prices paid for all associated Task Items shall be reduced proportionally. For example, if LADWP elects to eliminate the Unit 1 controller system, the price paid for "Units 1,3,4, and 5 Controller Systems" shall be reduced by 25%. Additionally, the price paid for "Project Management and Administration" and other similar general items shall be reduced proportionally to the reduction in the Total Agreement Price not including the general items.

EXHIBIT I
PAYMENT SCHEDULE

EXHIBIT I
SYSTEMS INTEGRATED, LP
LADWP CASTAIC POWER PLANT CONTROL SYSTEM UPGRADE
PRELIMINARY PROGRESS PAYMENT SCHEDULE

BID ITEM	DESCRIPTION	TOTAL	INTERVAL	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11
1	Project Management & Admin	$ 443,100	5/1/2010 - 4/1/2013	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308
2	Submittals	$ 232,125	5/1/2010 - 8/31/2010	$ 58,031	$ 58,031	$ 58,031	$ 58,031						
3	Plant Control System Integration	$ 277,550	10/1/2011 - 12/31/2012										
4	Training	$ 299,500	10/1/2011 - 12/31/2012										
5	Elderberry Lake Control System	$ 157,029	10/1/2012 - 12/31/2012										
6	Units 1,3,4, & 5 Unit Controls	$ 482,098	10/1/2011 - 12/31/2012										
7	Units 2 & 6 Controls Upgrades	$ 180,477	4/1/2011 - 12/31/12										
8	Units 1,3,4, & 5 Governor Upgrades	$ 662,187	10/1/2011 - 12/31/2012										
9	Units 2 & 6 Governor Upgrades	$ 491,839	4/1/2011 - 12/31/12										
10	Units 1,3,4 & 5 TSOV Control Systems	$ 383,298	10/1/2011 - 12/31/2012										
11	Units 2 & 6 TSOV Control Systems Upgrades	$ 181,067	4/1/2011 - 12/31/12										
12	Balance of Plant Control Systems	$ 1,406,761	10/1/2010 - 6/30/2011						$ 156,307	$ 156,307	$ 156,307	$ 156,307	$ 156,307
13	Pump Start Control System	$ 254,039	10/1/2010 - 6/30/2011						$ 28,227	$ 28,227	$ 28,227	$ 28,227	$ 28,227
14	ECC Control System	$ 241,929	10/1/2011 - 1/31/2011						$ 60,482	$ 60,482	$ 60,482	$ 60,482	
15	Control Room HMI Systems	$ 271,567	10/1/2011 - 12/31/2012						$ 30,174	$ 30,174	$ 30,174	$ 30,174	$ 30,174
16	Unit 7 Interim Interface	$ 145,950	10/1/2011 - 12/31/2012										
17	Local HMI Systems	$ 439,499	10/1/2011 - 12/31/2012										
18	Control Room Furniture	$ 83,790	10/1/2012 - 4/1/2013										
19	Historian	$ 48,000	10/1/2012 - 4/1/2013										
20	Networks & Communication Systems	$ 129,096	10/1/2010 - 6/30/2011						$ 14,344	$ 14,344	$ 14,344	$ 14,344	$ 14,344
21	UPS	$ 69,620	10/1/2010 - 6/30/2011						$ 7,736	$ 7,736	$ 7,736	$ 7,736	$ 7,736
22	Field Devices & Instrumentation	$ 133,053	10/1/2011 - 12/31/2012										
23	Spare Parts	$ 418,950	10/1/2012 - 4/1/2013						$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 13,515
24	Warranty	$ 698,250	5/1/2010 - 4/1/2013						$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 22,524
25	Miscellaneous	$ 2,171,615	5/1/2010 - 4/1/2013									$ 90,484	$ 90,484
26	Application Program Conversion	$ 187,500	5/1/2010 - 4/1/2011	$ 15,625	$ 15,625	$ 15,625	$ 15,625	$ 15,625	$ 15,625	$ 15,625	$ 15,625	$ 15,625	$ 15,625
27	HMI Conversion												
28	Simulator	$ 502,292	10/1/2012 - 4/1/2013										
	SUBTOTALS	$ 10,992,181		**$ 85,965**	**$ 85,965**	**$ 85,965**	**$ 85,965**	**$ 27,933**	**$ 361,241**	**$ 361,241**	**$ 361,241**	**$ 451,725**	**$ 391,243**

EXHIBIT I
SYSTEMS INTEGRATED, LP
LADWP CASTAIC POWER PLANT CONTROL SYSTEM UPGRADE
PRELIMINARY PROGRESS PAYMENT SCHEDULE

BID ITEM	DESCRIPTION	TOTAL	INTERVAL	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11
1	Project Management & Admin	$ 443,100	5/1/2010 - 4/1/2013	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308
2	Submittals	$ 232,125	5/1/2010 - 8/31/2010										
3	Plant Control System Integration	$ 277,550	10/1/2011 - 12/31/2012								$ 18,503	$ 18,503	$ 18,503
4	Training	$ 299,500	10/1/2011 - 12/31/2012								$ 19,967	$ 19,967	$ 19,967
5	Elderberry Lake Control System	$ 157,029	10/1/2012 - 12/31/2012										
6	Units 1,3,4, & 5 Unit Controls	$ 482,098	10/1/2011 - 12/31/2012								$ 32,140	$ 32,140	$ 32,140
7	Units 2 & 6 Controls Upgrades	$ 180,477	4/1/2011 - 12/31/12		$ 8,594	$ 8,594	$ 8,594	$ 8,594	$ 8,594	$ 8,594	$ 8,594	$ 8,594	$ 8,594
8	Units 1,3,4, & 5 Governor Upgrades	$ 662,187	10/1/2011 - 12/31/2012								$ 44,146	$ 44,146	$ 44,146
9	Units 2 & 6 Governor Upgrades	$ 491,839	4/1/2011 - 12/31/12		$ 23,421	$ 23,421	$ 23,421	$ 23,421	$ 23,421	$ 23,421	$ 23,421	$ 23,421	$ 23,421
10	Units 1,3,4 & 5 TSOV Control Systems	$ 383,298	10/1/2011 - 12/31/2012								$ 25,553	$ 25,553	$ 25,553
11	Units 2 & 6 TSOV Control Systems Upgrades	$ 181,067	4/1/2011 - 12/31/12		$ 8,622	$ 8,622	$ 8,622	$ 8,622	$ 8,622	$ 8,622	$ 8,622	$ 8,622	$ 8,622
12	Balance of Plant Control Systems	$ 1,406,761	10/1/2010 - 6/30/2011	$ 156,307	$ 156,307	$ 156,307	$ 156,307						
13	Pump Start Control System	$ 254,039	10/1/2010 - 6/30/2011	$ 28,227	$ 28,227	$ 28,227	$ 28,227						
14	ECC Control System	$ 241,929	10/1/2011 - 1/31/2011										
15	Control Room HMI Systems	$ 271,567	10/1/2011 - 12/31/2012	$ 30,174	$ 30,174	$ 30,174	$ 30,174						
16	Unit 7 Interim Interface	$ 145,950	10/1/2011 - 12/31/2012								$ 9,730	$ 9,730	$ 9,730
17	Local HMI Systems	$ 439,499	10/1/2011 - 12/31/2012								$ 29,300	$ 29,300	$ 29,300
18	Control Room Furniture	$ 83,790	10/1/2012 - 4/1/2013										
19	Historian	$ 48,000	10/1/2012 - 4/1/2013										
20	Networks & Communication Systems	$ 129,096	10/1/2010 - 6/30/2011	$ 14,344	$ 14,344	$ 14,344	$ 14,344						
21	UPS	$ 69,620	10/1/2010 - 6/30/2011	$ 7,736	$ 7,736	$ 7,736	$ 7,736						
22	Field Devices & Instrumentation	$ 133,053	10/1/2011 - 12/31/2012								$ 8,870	$ 8,870	$ 8,870
23	Spare Parts	$ 418,950	10/1/2012 - 4/1/2013	$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 13,515
24	Warranty	$ 698,250	5/1/2010 - 4/1/2013	$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 22,524
25	Miscellaneous	$ 2,171,615	5/1/2010 - 4/1/2013	$ 90,484	$ 90,484	$ 90,484	$ 90,484	$ 90,484	$ 90,484	$ 90,484	$ 90,484	$ 90,484	$ 90,484
26	Application Program Conversion	$ 187,500	5/1/2010 - 4/1/2011	$ 15,625	$ 15,625								
27	HMI Conversion												
28	Simulator	$ 502,292	10/1/2012 - 4/1/2013										
	SUBTOTALS	$ 10,992,181		**$ 391,243**	**$ 431,880**	**$ 416,255**	**$ 416,255**	**$ 179,468**	**$ 179,468**	**$ 179,468**	**$ 367,677**	**$ 367,677**	**$ 367,677**

EXHIBIT I
SYSTEMS INTEGRATED, LP
LADWP CASTAIC POWER PLANT CONTROL SYSTEM UPGRADE
PRELIMINARY PROGRESS PAYMENT SCHEDULE

BID ITEM	DESCRIPTION	TOTAL	INTERVAL	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12
1	Project Management & Admin	$ 443,100	5/1/2010 - 4/1/2013	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308
2	Submittals	$ 232,125	5/1/2010 - 8/31/2010										
3	Plant Control System Integration	$ 277,550	10/1/2011 - 12/31/2012	$ 18,503	$ 18,503	$ 18,503	$ 18,503	$ 18,503	$ 18,503	$ 18,503	$ 18,503	$ 18,503	$ 18,503
4	Training	$ 299,500	10/1/2011 - 12/31/2012	$ 19,967	$ 19,967	$ 19,967	$ 19,967	$ 19,967	$ 19,967	$ 19,967	$ 19,967	$ 19,967	$ 19,967
5	Elderberry Lake Control System	$ 157,029	10/1/2012 - 12/31/2012										$ 52,343
6	Units 1,3,4, & 5 Unit Controls	$ 482,098	10/1/2011 - 12/31/2012	$ 32,140	$ 32,140	$ 32,140	$ 32,140	$ 32,140	$ 32,140	$ 32,140	$ 32,140	$ 32,140	$ 32,140
7	Units 2 & 6 Controls Upgrades	$ 180,477	4/1/2011 - 12/31/12	$ 8,594	$ 8,594	$ 8,594	$ 8,594	$ 8,594	$ 8,594	$ 8,594	$ 8,594	$ 8,594	$ 8,594
8	Units 1,3,4, & 5 Governor Upgrades	$ 662,187	10/1/2011 - 12/31/2012	$ 44,146	$ 44,146	$ 44,146	$ 44,146	$ 44,146	$ 44,146	$ 44,146	$ 44,146	$ 44,146	$ 44,146
9	Units 2 & 6 Governor Upgrades	$ 491,839	4/1/2011 - 12/31/12	$ 23,421	$ 23,421	$ 23,421	$ 23,421	$ 23,421	$ 23,421	$ 23,421	$ 23,421	$ 23,421	$ 23,421
10	Units 1,3,4 & 5 TSOV Control Systems	$ 383,298	10/1/2011 - 12/31/2012	$ 25,553	$ 25,553	$ 25,553	$ 25,553	$ 25,553	$ 25,553	$ 25,553	$ 25,553	$ 25,553	$ 25,553
11	Units 2 & 6 TSOV Control Systems Upgrades	$ 181,067	4/1/2011 - 12/31/12	$ 8,622	$ 8,622	$ 8,622	$ 8,622	$ 8,622	$ 8,622	$ 8,622	$ 8,622	$ 8,622	$ 8,622
12	Balance of Plant Control Systems	$ 1,406,761	10/1/2010 - 6/30/2011										
13	Pump Start Control System	$ 254,039	10/1/2010 - 6/30/2011										
14	ECC Control System	$ 241,929	10/1/2011 - 1/31/2011										
15	Control Room HMI Systems	$ 271,567	10/1/2011 - 12/31/2012										
16	Unit 7 Interim Interface	$ 145,950	10/1/2011 - 12/31/2012	$ 9,730	$ 9,730	$ 9,730	$ 9,730	$ 9,730	$ 9,730	$ 9,730	$ 9,730	$ 9,730	$ 9,730
17	Local HMI Systems	$ 439,499	10/1/2011 - 12/31/2012	$ 29,300	$ 29,300	$ 29,300	$ 29,300	$ 29,300	$ 29,300	$ 29,300	$ 29,300	$ 29,300	$ 29,300
18	Control Room Furniture	$ 83,790	10/1/2012 - 4/1/2013										$ 11,970
19	Historian	$ 48,000	10/1/2012 - 4/1/2013										$ 6,857
20	Networks & Communication Systems	$ 129,096	10/1/2010 - 6/30/2011										
21	UPS	$ 69,620	10/1/2010 - 6/30/2011										
22	Field Devices & Instrumentation	$ 133,053	10/1/2011 - 12/31/2012	$ 8,870	$ 8,870	$ 8,870	$ 8,870	$ 8,870	$ 8,870	$ 8,870	$ 8,870	$ 8,870	$ 8,870
23	Spare Parts	$ 418,950	10/1/2012 - 4/1/2013	$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 13,515
24	Warranty	$ 698,250	5/1/2010 - 4/1/2013	$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 22,524
25	Miscellaneous	$ 2,171,615	5/1/2010 - 4/1/2013	$ 90,484	$ 90,484	$ 90,484	$ 90,484	$ 90,484	$ 90,484	$ 90,484	$ 90,484	$ 90,484	$ 90,484
26	Application Program Conversion	$ 187,500	5/1/2010 - 4/1/2011										
27	HMI Conversion												
28	Simulator	$ 502,292	10/1/2012 - 4/1/2013										$ 71,756
	SUBTOTALS	$ 10,992,181		**$ 367,677**	**$ 367,677**	**$ 367,677**	**$ 367,677**	**$ 367,677**	**$ 367,677**	**$ 367,677**	**$ 367,677**	**$ 367,677**	**$ 510,603**

EXHIBIT I
SYSTEMS INTEGRATED, LP
LADWP CASTAIC POWER PLANT CONTROL SYSTEM UPGRADE
PRELIMINARY PROGRESS PAYMENT SCHEDULE

BID ITEM	DESCRIPTION	TOTAL	INTERVAL	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	TOTAL
1	Project Management & Admin	$ 443,100	5/1/2010 - 4/1/2013	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 12,308	$ 443,100
2	Submittals	$ 232,125	5/1/2010 - 8/31/2010							$ 232,125
3	Plant Control System Integration	$ 277,550	10/1/2011 - 12/31/2012	$ 18,503	$ 18,503					$ 277,550
4	Training	$ 299,500	10/1/2011 - 12/31/2012	$ 19,967	$ 19,967					$ 299,500
5	Elderberry Lake Control System	$ 157,029	10/1/2012 - 12/31/2012	$ 52,343	$ 52,343					$ 157,029
6	Units 1,3,4, & 5 Unit Controls	$ 482,098	10/1/2011 - 12/31/2012	$ 32,140	$ 32,140					$ 482,098
7	Units 2 & 6 Controls Upgrades	$ 180,477	4/1/2011 - 12/31/12	$ 8,594	$ 8,594					$ 180,477
8	Units 1,3,4, & 5 Governor Upgrades	$ 662,187	10/1/2011 - 12/31/2012	$ 44,146	$ 44,146					$ 662,187
9	Units 2 & 6 Governor Upgrades	$ 491,839	4/1/2011 - 12/31/12	$ 23,421	$ 23,421					$ 491,839
10	Units 1,3,4 & 5 TSOV Control Systems	$ 383,298	10/1/2011 - 12/31/2012	$ 25,553	$ 25,553					$ 383,298
11	Units 2 & 6 TSOV Control Systems Upgrades	$ 181,067	4/1/2011 - 12/31/12	$ 8,622	$ 8,622					$ 181,067
12	Balance of Plant Control Systems	$ 1,406,761	10/1/2010 - 6/30/2011							$ 1,406,761
13	Pump Start Control System	$ 254,039	10/1/2010 - 6/30/2011							$ 254,039
14	ECC Control System	$ 241,929	10/1/2011 - 1/31/2011							$ 241,929
15	Control Room HMI Systems	$ 271,567	10/1/2011 - 12/31/2012							$ 271,567
16	Unit 7 Interim Interface	$ 145,950	10/1/2011 - 12/31/2012	$ 9,730	$ 9,730					$ 145,950
17	Local HMI Systems	$ 439,499	10/1/2011 - 12/31/2012	$ 29,300	$ 29,300					$ 439,499
18	Control Room Furniture	$ 83,790	10/1/2012 - 4/1/2013	$ 11,970	$ 11,970	$ 11,970	$ 11,970	$ 11,970	$ 11,970	$ 83,790
19	Historian	$ 48,000	10/1/2012 - 4/1/2013	$ 6,857	$ 6,857	$ 6,857	$ 6,857	$ 6,857	$ 6,857	$ 48,000
20	Networks & Communication Systems	$ 129,096	10/1/2010 - 6/30/2011							$ 129,096
21	UPS	$ 69,620	10/1/2010 - 6/30/2011							$ 69,620
22	Field Devices & Instrumentation	$ 133,053	10/1/2011 - 12/31/2012	$ 8,870	$ 8,870					$ 133,053
23	Spare Parts	$ 418,950	10/1/2012 - 4/1/2013	$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 13,515	$ 418,950
24	Warranty	$ 698,250	5/1/2010 - 4/1/2013	$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 22,524	$ 698,250
25	Miscellaneous	$ 2,171,615	5/1/2010 - 4/1/2013	$ 90,484	$ 90,484					$ 2,171,615
26	Application Program Conversion	$ 187,500	5/1/2010 - 4/1/2011							$ 187,500
27	HMI Conversion									$ -
28	Simulator	$ 502,292	10/1/2012 - 4/1/2013	$ 71,756	$ 71,756	$ 71,756	$ 71,756	$ 71,756	$ 71,756	$ 502,292
	SUBTOTALS	$ 10,992,181		**$ 510,603**	**$ 510,603**	**$ 138,930**	**$ 138,930**	**$ 138,930**	**$ 138,930**	**$ 10,992,181**

EXHIBIT J
SITE ACCESS SECURITY

Site Access Security

1. As a requirement, the contractor/vendor personnel seeking access to LADWP facilities must undergo a Federal, State, and local seven-year background check; LADWP must be in receipt of a letter that attests that such a check was performed; and that no derogatory information was ascertained for the contractor/vendor personnel listed in the letter. Please see "Background Check Certification" form attached. Contractors/vendors requiring unescorted access to Critical Cyber Assets at a facility must also attend cyber security awareness training and be maintained on the list of authorized personnel, as required by NERC Cyber Security CIP-004-1 Requirement 4.

2. The Contractor shall (1) perform the required background checks of all designated principals, employees and/or subcontractors of the Contractor; and (2) not assign principals, employees and/or subcontractors of the Contractor convicted of any felony or offense of moral turpitude, or for whom other derogatory information has been found pursuant to criteria set forth in this Agreement or any attachment hereto (including, without limitation, the attachment entitled "Background Check Certification," if attached), shall result in irreparable harm to LADWP and, at LADWP's option, the immediate termination for breach of contract without opportunity to cure, without liability on the part of LADWP.

   Contractor agrees to submit a statement along with any invoices or billing associated with this Agreement which certifies that all work performed under this Agreement at critical facilities as designated by LADWP to Contractor was conducted by persons for whom background checks have been conducted and who do not have disqualifying background information in their histories pursuant to this section.
   Contractor is advised that submission of a false claim for payment to LADWP may subject Contractor to liability under the California False Claims Act (Cal. Gov't Code Sec. 12650 *et seq.*). In addition, any failure to comply with the background procedures as required by this section may be considered in connection with future contracting opportunities with LADWP. The following specific language in the invoices/bills is acceptable: "Contractor certifies that all work performed for which this invoice/bill is submitted which required access to critical facilities as designated by LADWP was performed by persons for whom background checks have been conducted, and for whom no disqualifying information (including felonies, offenses of moral turpitude, and other disqualifying criteria, if any, as specified in the Agreement between Contractor and LADWP) has been found."

   None of the remedies available to LADWP under this section shall preclude LADWP from any other remedies available in law or equity to compensate it for damages caused by the contractor's failure to comply with this section.

BACKGROUND CHECK CERTIFICATION

On behalf of _____(name of vendor), _____ (name of company performing screening services) has performed background checks on the individuals named below. The background checks consisted of the following components:

1. Social Security Number (SSN) Trace:
   a. Validates the SSN based on issuance data published by the Social Security Administration (not a work eligibility verification).
   b. Provides independent address history going back at least 7 years; sources include multiple commercial databases, including header information from three credit bureaus.

2. Expanded Criminal History Search (search for felony and misdemeanor records in all jurisdictions of known employment and residence in the past seven years (includes State, County, and Federal levels):
   a. Includes direct source searches (State, County, and Federal Courts) in all known jurisdictions where the subject has lived or worked in the past seven years. The entire Federal District Court level is automatically covered with the exception of four appeals courts.

3. Auxiliary National Criminal Index (ANCI)
   a. Includes over 180 million felonies, misdemeanors, infractions, and sex offender records. Data sources from over 50 states, plus the District of Columbia, Puerto Rico, and Guam, consist of one or more of the following: County Court indexes, State Administrative and police repositories, State Department of Corrections, and sex offender registries.

4. Office of Foreign Asset Control (OFAC) Watch List:
   a. A list of over 5,000 known terrorists, national drug traffickers, specially designated and block persons as identified by the OFAC, a Department of the United States (U.S.) Department of Treasury.
   b. Based on U.S. foreign trade policy and national security goals, persons on the list should not be engaged in economic or commercial activities in the U.S.

NO DEROGATORY INFORMATION WAS FOUND ON THE FOLLOWING INDIVIDUALS:

_____ _____ _____

_____ _____
Person Performing Screening Services Date

_____ _____ _____
Executive Management of Company Date Name of the Company