080009-EI

REDACTED

Thermal Equipment Incorporated (TEI)
Contract #342253

Executive Summary
October 1, 2007

CMP ____
COM ____
CTR ____
ECR _l_
GCL ____
OPC ____
RCA ____
SCR ____
SGA ____
SEC ____
OTH ____

Moisture Separator Reheaters (MSRs)

Progress Energy

DOCUMENT NUMBER-DATE 03239 MAR 22 08

FPSC-COMMISSION CLERK

PEF-NCR-02242

TEI Contract Summary

Contents:

- Scope of Work
- Bid Price Comparison
- Negotiated Savings/Discount
- Payment Milestones
- Performance Guarantees
- Performance Guarantees Based on MWe
- Warranty
- Delivery Liquidated Damages
- Limits of Liability
- Project Review Team

Progress Energy

PEF-NCR-02243

TEI Contract Summary

Scope of Work:

Contractor shall provide the necessary management, personnel, material and facilities (except as specified to be furnished by Owner) and do all things necessary or incidental to the design, engineering, fabrication, testing, furnishing, delivery to Owner, of four Moisture Separator Reheaters (MSRs) with two stages of reheat.

Comparison of New & Current MSRs

	New	Current
No. of Tubes	8,144 (1018x8)	4,368 (546x8)
Heat Transfer Surface	315,496 (39,437x8)	144,032 (18,004x8)
Chevron	Stainless Steel*	Carbon Steel

* Improved moisture removal

Progress Energy

PEF-NCR-02244

TEI Contract Summary
Bid Price Comparison (000s):

	Alstom	Siemens
Equipment	[redacted]	[redacted]
Insulation	[redacted]	[redacted]
Install	[redacted]	[redacted]
Shipping	[redacted]	[redacted]
Total	[redacted]	[redacted]

REDACTED

CONFIDENTIAL

Progress Energy

PEF-NCR-02245

TEI Contract Summary

Negotiated Savings/Price (000s):

CONFIDENTIAL

	Bid	Negotiated Price
Equipment	[redacted]	
Warranty		
Shipping		
Total:		

REDACTED

Progress Energy

TEI Contract Summary
Payment Milestones:

CONFIDENTIAL

Milestone Date	Payment Milestone	% of Total Selling Price	Payment Amount (000's)
Sep 2007	• Net 60 after order of MSR • Verification Tube Strip material has been ordered for Owner	[redacted]	[redacted]
Dec 2007	• Engineering Design Package- Complete		
Mar 2008	• Material Receipt provided showing Tube Strip inventoried at Valtimet • Tube production: September – October 2008 • True Finning: December 2008 – February 2009		
Oct 2008	• Forgings arrive TEI	REDACTED	
Dec 2008	• Major materials arrive and TEI begins fabrication		
Jan 2009	• TEI receives tubes		
Jun 2009	• MSR Vessels are readied for shipping		
Jul 9, 2009	• MSR Vessels arrive at Crystal River site, offloaded by TEI and are received without damage		
Dec 2009	• Provisional Acceptance – or – 120 days after installation completion, whichever is shorter		

Progress Energy

TEI Contract Summary

CONFIDENTIAL

Performance Guarantees:

Load / Parameter	[redacted] REDACTED			
	Max Expected	Guaranteed	Max Expected	Guaranteed
TTD L.P. -F°	[redacted]			
TTD H.P. -F°	REDACTED			
ΔP -PSID				
M.S. Eff. -%				

Note 1: Tolerances for measurement of performance parameters will be as follows.

Overall TTD: There will be a 1°F tolerance, so that the penalty starts at 11 F° and the penalty is to be calculated on "whole" degrees, as measurements will be rounded down to a whole integer.

ΔP: There will be a quarter pound tolerance, so that the penalty starts at 6.25 PSI

M.S.E.: Tolerance for M.S.E. will be reviewed and mutually approved at a later date. Instruments readings will be rounded to the nearest integer.

Note 2: Performance will be measured after the 2009 outage and the 2011 outage. Performance Guarantees will be paid as applicable after each outage but not twice for the same issue.

Note 3: Expect at least 8.0 MWe improvement due to new MSRs. Performance Guarantees penalize up to 2.7 MWe loss and provide no incentive for MWe above the expected 8.0.

Progress Energy

TEI Contract Summary

Performance Guarantees

CONFIDENTIAL

[redacted]

REDACTED

[redacted]

REDACTED

[redacted]

Progress Energy

PEF-NCR-02249

TEI Contract Summary

Delivery Liquidated Damages:

No. of Days Beyond September 1, 2009	Liquidated Damages per Day
1-5	[redacted] REDACTED
6-11	
12-21	

Note: Delivery is scheduled for July 30, 2009
Outage start date is September 26, 2009

Progress Energy

PEF-NCR-02250

TEI Contract Summary

Warranty:

CONFIDENTIAL

Warranty Period:

[redacted] REDACTED [redacted]

Corrective Measures:

[redacted] REDACTED [redacted]

Recurring Corrective Measure*:

[redacted] REDACTED [redacted]

* Corrective Measure taken to correct the same warranty problem for three (3) times during the Warranty Period (or any extension thereof under the preceding paragraph) hereinafter "Recurring Corrective Measures."

Progress Energy

PEF-NCR-02251

TEI Contract Summary
Warranty continued:

CONFIDENTIAL

[redacted]

REDACTED

[redacted]

TEI Contract Summary
Limits of Liability:

CONFIDENTIAL

- The liability of Contractor (excluding indemnity obligation of Contractor) [redacted]

REDACTED

REDACTED

TEI Contract Summary:
Project Review Team

Project Manager	Ted Williams
Project Technical Lead	Scott Deahna
Legal	Dave Conley
Tax	Betsy Dorset
Audit	Loyd Graves
Contracts	Tony Owen
Executive Sponsor	Danny Roderick

Progress Energy

TEi THERMAL ENGINEERING INTERNATIONAL
MSR TECHNOLOGY AND ADVANCED PROGRAMS DIVISION

10375 Slusher Drive
Santa Fe Springs, CA. 90670
Phone: 323-838-1150
Fax: 323-838-6454
msr@thermalengint.com

September 14, 2007

Progress Energy Florida, Inc
Raleigh, NC

Attention: Tony Owen

Subject: **CRYSTAL RIVER MSRs**
CONTRACT – VARIOUS ITEMS

Reference: TEI Proposal 07-M062

Dear Mr. Owen:

This letter confirms the various items discussed on the telephone earlier this afternoon:

GC-31 – Page 26 of 44

- Change – Engineering Design Package Complete – To December 2007
- Change – TEI receives tubes – To January 2009

GC-32 – Page 28 of 44 Subcontracting And Assignment

- Contractor shall have the right to subcontract Fabrication Workscope with prior notice to Owner. Any such subcontracted work will meet all related and applicable specification requirements and would only be subcontracted to TEI's approve suppliers with previous MSR experience. Subcontracting any work will not relieve Contractor of responsibility for the performance of work in accordance with the Terms and Conditions of this Contract and any amendments executed by both parties.

GC-36 – page 33 of 44

Note: Tolerance for the measurement of performance parameters will be as follows:

Overall TTD: There will be a 1°F tolerance, so that the penalty starts at 11 F° and the penalty is to be calculated on "whole" degrees, as measurements will be rounded down to a whole integer.

ΔP: There will be a quarter pound tolerance, so that the penalty starts at 6.25 PSI.

M.S.: Tolerance to be determined.

TEi

<u>**GC-36 – Page 34 of 44**</u>

B. Delivery Liquidated Damages

Insert – *"at discretion of Owner"* for Owner.

Tony, these are all the items we discussed and TEI is ready to execute this contract next week

Sincerely,

THERMAL ENGINEERING INTERNATIONAL
MSR Technology & Advanced Programs Division

Laurence Harma
Senior Contracts Manager

LH:no/07-745

- MSE = 1% = 0.25 MWE or 2.7/0.25 = 11 % MSE in cap or $125,000/% MSE

Performance Guarantee disposition:

The performance parameters will be measured during the 2009 outage. If the MSR's meet the Performance Guarantee values for TTD, Delta P and MSE then no payment will be with held. A parent Company Guarantee will be provided by Contractor to cover potential Performance Guarantee payments following the 2011 refueling outage.

If the Performance Guarantees are not met as a result of testing following the 2009 refueling outage, the appropriate L.D.s will be paid. In 2011, the final Performance Guarantee testing will be completed and if warranted L.D.s will be paid or remedied as noted above.

B. Delivery Liquidated Damages

For each day of unexcused delay in the delivery of the Work past the Equipment Delivery Date, Contractor will pay Owner as liquidated damages and not as a penalty, in accordance with the table below not to exceed one million three hundred and fifty thousand dollars ($1,350,000).

RE-INSERT

Deleted: at the discretion of Owner

No. of Days beyond September 1, 2009	Liquidated Damages per Day
1-5	$10,000
6-11	$50,000
12-21	$100,000

It is understood and agreed that Owner's damage for late delivery would be difficult to determine and that these amounts are a reasonable estimate of Owner's expected damages for late delivery. Any amounts not promptly paid by Contractor may be set off against any amount owed by Owner to Contractor.

Deleted: Performance Testing

MSR performance data will be collected and evaluated in conjunction with ASME PTC 6 . turbine performance test to be conducted within eight (8) weeks of reaching full power.

GC - 37 WARNING REGARDING SITE WORK

The Contractor is hereby advised that the generation, transmission and/or distribution of electrical energy involve the handling of a natural force which, when uncontrolled, is inherently hazardous to life and property. The Contractor is further hereby advised that, due to the nature of the Work to be performed hereunder, other hazardous or dangerous conditions (not necessarily related to the inherent danger of electricity) may also be involved in the Work. Accordingly, prior to the commencement of any Work at the Site, the Contractor shall inspect the Site specifically to ascertain the actual and potential existence and extent of any hazardous or dangerous conditions, and instruct the Contractor's employees, agents, and Subcontractors with respect to said conditions and the safety measures to be taken in connection therewith. During the course of the Work, the Contractor shall take all such measures as may be deemed necessary or advisable to protect and safeguard the person and property of the Contractor's and of the general public against all hazardous conditions as the same arise.

GC - 38 NOT USED

MSR performance data will be collected and evaluated in conjunction with ASME PTC 6 turbine performance test to be conducted within eight (8) weeks of reaching full power following the 2009 and 2011 refueling outages.

Performance Guarantee Parameters:

Parameter \ Load	2009 2625 MWe Max Expected	2009 2625 MWe Guaranteed	2011 3030 MWe Max Expected	2011 3030 MWe Guaranteed
TTD L.P. -F°	12	13	12	13
TTD H.P. -F°	6.5	8	9	10
ΔP -PSID	4.7	5	5.3	6
M.S. Eff. -%	99	98	99	98

Note: Tolerances ~~None~~ ADD

Performance Guarantee Parameters used for the calculation of the LDs are the numerical averages for the four (4) MSR vessels.

Performance Guarantee liquidated damages, if applicable, will be measured and applied during the 2009 and 2011 outages. The final position on Performance Guarantees and applied liquidated damages will be determined by performance measured during the 2011 refueling outage. Performance Guarantee liquidated damages are calculated as follows:

- For each one (1) F° H.P. reheaters above 10 F° (overall TTD) $ 75,000
- For each one (1) PSI of MSR vessel above 6 PSI (ΔP) $ 375,000
- For each one (1) % of M.S. efficiency below 98 % (MS%) $ 125,000

Deleted: "Equipment Delivery Date" is July 09, 2009, the actual date that the last component of the Work is delivered to the temporary storage; the "transporter" located along side the Site's rail spur, east of the Plant, complete with no apparent shipping damage.¶

Deleted: The Contactor guarantees the following

Deleted: n

Deleted: ¶

Deleted: Instruments readings will be rounded to the nearest integer

Deleted: 50

Deleted: 100

Deleted: 75

Performance Guarantee calculation derivations:

For each additional Megawatt Electrical, or portion there of, that the MSR system inhibits delivery, a performance guarantee L.D. of five hundred thousand dollars ($500,000) will be charged to contractor, up to a maximum amount of one million, three hundred and fifty thousand dollars ($1,350,000). The derivation of the dollar amount assigned to each performance parameter would be as follows:

Assumptions:

- Performance Guarantee L.D. Cap of $1,350,000
- Value of 1 megawatt electrical is worth $500,000
- Therefore the "Megawatt Cap" is 2.7 megawatts electrical

- TTD = 1° F = 0.15 MWE or 2.7/0.15 = 17.55° F of TTD in cap or $75,000/°F TTD
- ΔP = 1 PSI = 0.75 MWE or 2.7/0.75 = 3.6 Δ PSI in cap or $375,000/PSI

TABLE 1: Payment Milestones

Milestone Date	Payment Milestones	% of Total Selling Price	Payment Amount
2007			
September	– Net 60 after order of MSR – Verification Tube Strip material has been ordered for Owner	10%	$1,350
November	– Engineering Design Package - Complete	10%	$1,350
2008			
March	– Material receipt provided showing Tube Strip inventoried at Valtimet – Tube production September – Oct. 2008 – True Finning Dec.2008 – Feb. 2009	10%	$1,350
October	– Forgings arrive TEI	10%	$1,350
December	– Major materials arrive and TEI begins fabrication	10%	$1,350
2009			
February	– TEI receives tubes	5%	$675
June	– MSR Vessels are readied for shipping	10%	$1,350
July 9th	– MSR Vessels arrive at Crystal River site and Owner Takes Receipt	15%	$2,025
December	– Provisional Acceptance – or – 120 days after installation completion without attempting ascension to 100% power, whichever is occurs first.	20%	$2,700

CHANGE TO DECEMBER

CHANGE TO JANUARY

Deleted: ,

Deleted: offloaded by TEI and are received without damage

Deleted: shorter

The above rates include all payroll taxes, fringe benefits, overhead, and profit to the Contractor for providing any personnel.

Deleted: these

Plant Access Training and Radiation Worker Training are included in the Contract lump sum price. Owner will pay for initial training but will not pay for any re-training required as a result of Contractor employee's failure to satisfactorily complete the initial training.

Deleted: or will be paid in accordance with this Section of the Contract.

Deleted: under the Compensation Section.

B. Sales and Use Taxes

Contractor assumes exclusive liability for all sales or use taxes applicable to any materials, supplies, equipment or tools purchased, rented, leased, used or otherwise consumed by Contractor in conjunction with the performance of the Work.

Owner holds a "Florida Steam Tax Exemption Affidavit." This certificate exempts Owner from Florida sales or use tax on purchases of all qualified property and/or labor.

direct overhead on employees. Each time sheet must be signed by Owner's Designated Representative. If any special equipment has been used, the invoice must also specify the equipment used, hours of usage, and rate of reimbursement for use. On-site labor, off-site labor, material, and equipment costs must appear separately on the invoice.

Subject to the above conditions, payments will be made not later than thirty (30) days after receipt of Contractor's invoice. The final payment shall be invoiced by the Contractor and payment shall be made not later than thirty (30) days after receipt of the invoice and all of the following have been completed:

Deleted: A deduction of no more than ten percent (10%) shall be retained from the amount invoiced, except the invoice for retention.

Deleted: Retention

Deleted: as part of the final payment

1. All Work has been completed and accepted, including outstanding punch list items, final cleanup, testing, demobilization, and receipt of all required documentation by Owner.

2. A correct invoice covering the Work has been presented to Owner.

3. Any Quality Assurance documentation required by the Contract has been submitted and approved by Owner.

Deleted: 3. A properly executed Release from Contractor, included as an attachment, together with any other requested affidavits or receipts, have been provided to Owner. ¶
¶

D. Overbillings/Offsets/Credits/Refunds

Owner may charge and collect interest from the Contractor on any overbillings, offsets, credits or refunds that may become due to Owner under this Contract. Interest shall be paid at the rate of the average prime rate of interest as listed in the Wall Street Journal Money Rates Section. Interest shall cover the period of time from the date the overpayment, error or basis for refund or offset occurred to the date the amount is paid. The Contractor may be notified of the overbilling by credit memorandum or by invoice. Payment of the total overbilling, offset, credit or refund plus interest shall become due to Owner immediately upon Contractor's receipt.

GC - 32 SUBCONTRACTING AND ASSIGNMENT

~~Contractor shall not sublet any portion of the Work or assign the Contract without first submitting the proposed subcontract or assignment to Owner's Designated Representative and receiving written consent from Owner's Designated Representative to subcontract or assign, which consent shall not be unreasonably withheld. Any assignment without the consent of Owner shall be void. A request to sublet or assign must contain the name and location of individuals or firms to whom Work will be sublet or to whom the Contract is to be assigned, information on the qualifications and experience of those individuals or firms to perform the Work, and an estimate of the cost of the Work to be performed by the Subcontractor or assignee. The general terms and conditions of this Contract and any Contract amendment regarding the Work to be performed must be incorporated into and attached to any subcontract or assignment. Consent to subletting or assignment will not relieve Contractor of responsibility for the performance of Work in accordance with the terms and conditions of this Contract and any amendments executed by both parties.~~

Re write

GC-33 INDEMNIFICATION

To the maximum extent permitted by applicable law, Contractor shall indemnify and defend Owner (including its parent, subsidiary and affiliate companies), its officers, employees, agents, and any other party with an ownership interest in the premises, from and against all liability, loss, costs, claims, damages, expenses, judgments, and awards, whether or not covered by insurance, arising or claimed to have arisen:

Avg of Half Vessel

TEi ***THERMAL ENGINEERING INTERNATIONAL***
MSR TECHNOLOGY AND ADVANCED PROGRAMS DIVISION

10375 Slusher Drive
Santa Fe Springs, CA. 90670
Phone: 323-838-1150
Fax: 323-838-6454
msr@thermalengint.com

September 5, 2007

1,350,000 @ 500k/mw
Cap = 2.7 megawatt

Progress Energy Florida, Inc
Raleigh, NC

Attention: Tony Owen

Subject: **CRYSTAL RIVER MSRs**
EQUIPMENT GUARANTEE PARAMETERS

Reference: TEI Proposal 07-M062

10%

Dear Mr. Owen:

To answer your questions from last week on the relationship between TEI equipment guarantee parameters and the generation of MWe, we offer the following three relationships:

TTD:	The overall Terminal Temperature Difference (TTD)			77k
	1°F = .15 MWe	6° = 1 mw 6.5x2.7 = 17.55	2	
ΔP:	The Pressure Drop across the MSR Vessel			375k
	1 PSI = .75 MWe	56 PSID 2.7/.75 3.6	2	~~[illegible]~~ k
MSE:	The Moisture Separation Efficiency 1350/ =		2	122k
	1 % = .25 MWe	2.7/.25 = 11		

At this time, Progress Energy should review the three relationships of TEI's guarantee to MWe production so that we can finalize Paragraph GC-36 in the next few days.

Best regards,

THERMAL ENGINEERING INTERNATIONAL
MSR Technology & Advanced Programs Division

If not met refund some monies.

Laurence Harma
Senior Contracts Manager

Out layer by how much

LH:no/07-722

Cc: Scott Deahna

PEF-NCR-02261

Owen, Tony

From: Deahna, Scott T.
Sent: Wednesday, September 05, 2007 10:33 AM
To: Owen, Tony; Williams, Ted E.
Subject: Crystal River MSRs / Equipment Guarantee Parameters Comments

Tony,

The MSR performance sensitivity to megawatts is identified. Ted's previous thought was a loss of 2 megawatts attributable to MSR performance should "trigger" a hardware remedy. I spoke to Larry Harma last Thursday and Clem Tam yesterday. TEI agrees in principle with the concept of equipment inspection and remedy if a performance deficiency is identified. You or Larry can draft the appropriate language.

The contract performance guarantee section should identify the tested parameters are an "average of the four MSR vessel performance". However, if any one vessel performance is an out liar, then the performance deficiency of that MSR shall be evaluated by the contractor even if the 2 MW trigger is not met.

I understand the only additional open item is a preliminary list of engineering deliverables by TEI.

Scott.

-----Original Message-----
From: Owen, Tony
Sent: Wednesday, September 05, 2007 9:44 AM
To: Deahna, Scott T.; Williams, Ted E.
Subject: FW: Crystal River MSRs / Equipment Guarantee Parameters

Info requested. The next step is deciding what a Megawatt is worth.

Tony
-----Original Message-----
From: NOkamoto@thermalengint.com [mailto:NOkamoto@thermalengint.com]
Sent: Wednesday, September 05, 2007 9:44 AM
To: Owen, Tony
Cc: Deahna, Scott T.; CTam@thermalengint.com; LHarma@thermalengint.com
Subject: Crystal River MSRs / Equipment Guarantee Parameters

Mr. Owen:
Please see attached letter from Larry Harma (Equipment Guarantee Parameters).
Thank you,

Nicki
Executive Assistant
Communications Center
Thermal Engineering International
MSR Technology & Advanced Programs Division
10375 Slusher Drive
Santa Fe Springs, CA 90670-3748
P: 323.838.1150
F: 323.838.6454
Email: msr@thermalengint.com

PEF-NCR-02262

TEi THERMAL ENGINEERING INTERNATIONAL
MSR TECHNOLOGY AND ADVANCED PROGRAMS DIVISION

10375 Slusher Drive
Santa Fe Springs, CA. 90670
Phone: 323-838-1150
Fax: 323-838-6454
msr@thermalenglnt.com

November 29 2007

Progress Energy Service Co. LLC
100 E. Davie Street (TPP-08)
Raleight, NC 27601

Attention: Mr. Adrien Surin

Subject: **RFP NO. AS-12007**
For Supplying Two (2) Secondary Plant Component Cooling Water Heat Exchanger (Nos. SCHE-1A/1B) And Two (2) Condensate Feedwater Heaters (LP-3A/B) For Crystal River Nuclear Power Station

Reference: TEI Proposal 06-M088

Dear Mr. Surin:

TEI is pleased to submit its proposal, in response to your RFP No. AS-12007. We trust that we have adequately covered all aspects of your request.

Should you require additional information, please contact us. We look forward to continuing to be of service to Progress Energy on this very important betterment project.

Very truly yours,

THERMAL ENGINEERING INTERNATIONAL
MSR Technology & Advanced Programs Division

A.L. Yarden
President

ALY:no/07-923

TEi

Document Number: 07-924
Proposal Number: 07-M088

A PROPOSAL TO FURNISH

SECONDARY SERVICES CLOSED CYCLE COOLING (SC) HEAT EXCHANGERS

For

CRYSTAL RIVER NUCLEAR POWER STATION
UNIT #3

Submitted

To

PROGRESS ENERGY SERVICE COMPANY, LLC
100 E. DAVIE STREET (TPP-08)
RALEIGH, NC 27601

By

THERMAL ENGINEERING INTERNATIONAL (USA), Inc. (TEI)
10375 SLUSHER DRIVE
SANTA FE SPRINGS, CA 90670-3748

A.L. Yarden
President, MSR Technology
& Advanced Programs Division

November 28, 2007

TEi

TABLE OF CONTENTS

TEi

TEi

1.0 INTRODUCTION

Progress Energy Service Company (PESC) is planning to replace a total of two (2) Secondary Plant Component Closed Cycle Cooling (SC) Heat Exchangers (HXGs) for the Crystal River Nuclear Power Station (CR) Unit #3. The original SC HXGs were provided by Struthers Industries, Inc. (now owned by TEI). Due to the power uprate, new HEXs are needed to replace the existing HXGs, in order to withstand the increased heat duty.

Recently, TEI successfully replaced four (4) CCW HXGs for Kori Nuclear Power Plant, Units #3 and #4 with Titanium tubes. The turnkey job included design, fabrication of the HXGs per ASME Section III requirements, field installation of the apparatus and the performance test. All the above operations were done in time and with one hundred percent customer satisfaction. In addition, TEI has received a contract to provide four (4) TPCW HXGs to San Onofre Nuclear Generation Station (SONGS) by mid-2009.

Since TEI's experience is still fresh (2004), in conjunction with our partner shop SeDae Kisan (SDK) in Korea, it is obvious we can do it again to PESC'S expectation.

Following are few special features to highlight TEI's special design.

2.0 SPECIAL FEATURES

2.1 Fouling Factors on Tubeside

Fouling is time-related, especially in heat transfer equipment. Although the fouling factor listed in TEMA or other HXG design books is based on years of experience and data from operation equipment, we find based on our experience that for a new material – for example titanium – the fouling factor should be reduced. In SONGS' specification, a fairly conservative cleanliness factor of 0.9 is applied. Our experience shows that the corrosion and erosion resistant properties of Titanium are primarily due to the formation of a hard, tenacious surface oxide film, mainly Titanium dioxide. The film reforms in oxidizing condition when mechanically damaged. It protects the surface from impingement, erosion and physical damage. It also resists chloride pitting and crevice corrosion by marine microbes. Since Titanium tubes resist corrosion, erosion, fouling and scaling, they can virtually eliminate tubeside fouling. However, in offered design, a cleanliness factor of 0.9

PEF-NCR-02267

is still used. This implies that the new HXGs will have much better thermal performance than expected.

2.2 Explosive Cladding

Titanium can only be welded to titanium; this is a well known characteristics. When specifying the Titanium tube material in the HXG and with the welded tube joint to the tubesheet, there is only one option – welded to a Titanium layer which is metallurgically bound to the carbon steel tubesheet.

Then the tubesheet is machined and drilled to the tolerance. After completely tubing the HXG, the tube-to-tubesheet joints then are welded by TEI-developed welding procedures. TEI has utilized this design and manufacture for many non-safety and safety related HXGs and surface condensers, and has proven the reliability of this technology.

2.3 Tube Diameter

TEI proposes that the new SC HXGs have the same tube diameter of 1" O.D. with 22 BWG With the same tube diameter as the original HXG, CR can still utilize the existing tube cleaning system.

2.4 Mechanical Design of the New HXGs

The new SC HXGs are utilizing the same "no tube in window" design. With this design, TEI is able to fit the tube into the new shell which is only 1" larger in outside diameter and has the same length as the existing HXGs. Additionally, since TEI is the OEM and owns all the drawings, it is easy for us to fabricate the HXGs to meet the existing connections without any trouble or concern. In doing so, PESC can rest assured that the new HXGs will fit the existing envelop without any interference concerns.

TEi

3.0 THERMAL AND MECHANICAL DESIGN

TEI utilizes the latest version of HTRI program to design the thermohydraulics of the SC HXGs. HTRI is well known for its conservative and precise thermal correlations especially in the area of single-phase heat transfer processes. TEI has been a member of HTRI for many years. Our engineering knowledge is original and fundamental and as such cannot be copied by others.

In HXG design, thermohydraulic and mechanical designs are typically in one which cannot be separated. The mechanical design is to convert the thermal correlation into a workable equipment which will perform under different operating condition to meet the requirement of the system. A good mechanical design will not only prevent any potential hazard but also take into account the possible difficult situation such as installation. TEI has performed similar type of work in other products and gained wide experience. If PESC selects TEI as a Supplier,PESC could be assured of the high quality and the prompt work schedule.

4.0 MANUFACTURING

TEI is proposing to utilize three options of manufacturing sites. The first one is TEI's own shop at Joplin, Missouri. The advantage of Joplin is that the site is located in the USA which allows PESC's inspectors relatively easy travel. The second one is our partner-shop (SeDae) in Korea. The advantage is they have fabricated four (4) Section III CCW HXGs two years ago for Kori 3&4. The third one is our affiliated shop (ARSOPI) located in Portugal, who is fabricating 8 MSR vessels for Almaraz NPS and 4 LP Feedwater Heaters for KRSKO NPS. All three shops are fully qualified with good workmanship and with ASME Section VIII Code Stamp and ISO 9000 Certificates.

However, SeDae is a qualified pressure vessel manufacturer who owns additional Section III, Class 1, 2 and 3 Certificates of N, NA, NPT. Over time, SDK has developed and qualified its welding procedures, NDE procedures and manufacturing procedures and has incorporated them into the Q.A. manual. In the proposed work, SeDae will utilize its capabilities of N-Stamp qualification to its full extent in performing the shop work.

TEI MSR Division is a world class heat exchanger manufacturer specialized in the nuclear power plant and has years of experience in designing, manufacturing, installing and operating a variety of HXGs. One of TEI's prominent specialties is to deal with the complicated installation work where a limited maneuvering space is available. Therefore, special developed design and fabrication procedures are needed to surmount the difficulties of the installation. However, these procedures shall not degrade the integrity of the provided equipment as well as the required outage schedule.

5.0 PROPOSED OFFER

In this offer, TEI will provide a complete unit of SC HXG. The new HXG has similar shell diameter to the existing one and meets all the requirements of PESC, such as seismic, tube vibration, thermohydraulic, latest ASME Code and TEMA, etc. All the large bore connecting nozzles are matching the existing connections. Internals of the channel will have coating on the surface of carbon steel. Please refer to the attached data sheet and outline drawings for the offer of total replacement.

In responding to PESC's RFP, TEI has basically followed the outline drawing shown in the specification to generate the new design which is single pass on both shellside and tubeside. Also, the configuration of the front and rear channel attachment to the tubesheet is similar to the existing SC HXGs. However, the channel flange attachment to the tubesheet can be eliminated due to the Titanium cladding on the tubesheet face.

TEI has attached this optional design of a similar job without the attachment flange to the tubesheet flange. This approach could totally eliminate the spare channel assembly. If PESC is interested to do so, TEI will definitely provide an alternative later.

TEi

6. COMMERCIAL INFORMATION

The following Sections 6.1 through 6.11 constitute a valid TEI commercial proposal to furnish PESC with all required hardware, Q.A. documents, engineering analysis and reports in full compliance with your specifications, industry standards, and other governing documents. The scope and features of the design are described in more detail within the technical portion of this proposal and in the attached mechanical outline drawings.

6.1 Selling Prices

6.1.1 Proposal

[redacted]

REDACTED

TEi

6.2 **Taxes**

The above quoted prices do not include any applicable local sales or use taxes.

6.3 **Delivery**

Delivery is FOB Crystal River NPS. However, PESC is responsible to unload the SC HXGs.

6.4 **Validity**

This proposal is valid for 90 days from its issue date. This date will specifically protect the quoted prices and the scheduled delivery as shown.

6.5 **Terms and Conditions**

TEI and PESC will mutually agree on terms and conditions and all other provisions.

6.6 **Terms of Payment**

CONFIDENTIAL

[redacted] REDACTED [redacted]

6.7 **Special Condition of Sale - Delays and Damages**

[redacted]

REDACTED

CONFIDENTIAL

PEF-NCR-02272

6.8 **Adjustment To Selling Prices**

CONFIDENTIAL

[redacted]

REDACTED

[redacted]

6.9 **Warranty**

[redacted]

REDACTED

[redacted]

CONFIDENTIAL

PEF-NCR-02273

TEi

6.10 **Force Majeure**

The Company shall not be in breach of the Contract as a result of any delay in performing its obligations if such delay is due to strikes or other labor troubles, inability to obtain raw materials, components, supplies, or fuel, for any reason, including default of suppliers or subcontractor, or any other cause which is beyond the reasonable control of the Company, whether of a similar or dissimilar nature and whether or not existing or foreseeable on the date of the Contract or on the scheduled date of commencement of the work. Should any such delay occur, the time for the performance of the Company's obligations shall be extended by a period of time equal to the length of the delay plus such additional time as is reasonably necessary to enable the Company to resume performance of its obligations.

Within a reasonable time after the Company becomes aware of a cause entitling it to an extension of time in accordance with the foregoing paragraph, the Company shall give notice thereof to the Purchaser. The Company shall use reasonable efforts to minimize the delay but shall not be required to subcontract work or to work additional hours for which premium time is payable or to schedule additional work shifts if such subcontracting, additional hours or shifts would not have been required to meet the schedule except for such delay, unless the Purchaser directs that it be done and agrees to pay all additional charges with respect thereto and provided that the work directed to be performed is not prohibited by any applicable labor contract or law.

6.11 **Limitation of Liability**

[redacted]

REDACTED

TEi

7.0 ATTACHMENTS

7.1 Outline Drawing

[redacted]

REDACTED

REDACTED

REV:	DESCRIPTION	DRAWN BY	CHK BY	APPD BY
A	INITAIL ISSUE	C 11/29/07		

THIRD ANGLE PROJECTION

FINISH SURFACE ✓

WORKING TOLERANCE UNLESS OTHERWISE SPECIFIED

FRACTIONS	DECIMALS	ANGLES
0 TO 4'-0" ±1/8" 4' TO 7'-0" ±3/16" OVER 7'-0" ±1/4"	X = ±.1 XX = ±.03 XXX = ±.015	±1/2°

TEi THERMAL ENGINEERING INTERNATIONAL

MOISTURE SEPARATOR REHEATER DIVISION

CUSTOMER:

JOB NUM:

TITLE: OUTLINE DRAWING

DWG NUM: 07-M088-SC-010B

REV: A

PEF-NCR-02277

CONFIDENTIAL

TEi

7.2 Specification Sheet

TEi

HEAT EXCHANGER SPECIFICATION SHEET

US Units

		Job No.	
ıstomer	PROGRESS ENERGY	Reference No.	CR3-M-###
Address		Proposal No.	07-M088
Plant Location	CRYSTAL RIVER #3	Date	11/20/2007 Rev A
Service of Unit	SECONDARY SERVICE HEAT EXCHANGER	Item No.	SCHE-1A & -1B
Size	57 x 498 inch Type AEL Horz.	Connected In	1 Parallel 1 Series
Surf/Unit (Gross/Eff)	15645.1 / 15503.8 ft2 Shell/Unit 1	Surf/Shell (Gross/Eff)	15645.1 / 15503.8 ft2

PERFORMANCE OF ONE UNIT

Fluid Allocation		Shell Side		Tube Side	
Fluid Name		DM WATER		SEA WATER	
Fluid Quantity, Total	lb/hr	5947600		8178000	
Vapor (In/Out)		0.0	0.0	0.0	0.0
Liquid		5947600	5947600	8178000	8178000
Steam		0.0	0.0	0.0	0.0
Water		5947600	5947600	0.0	0.0
Noncondensables		0.0	0.0	0.0	0.0
Temperature (In/Out)	F	115.00	100.00	90.00	101.75
Specific Gravity		0.9885	0.9918	1.0212	1.0212
Viscosity	cP	0.5938	0.6916	0.7300	0.7300
Molecular Weight, Vapor					
Molecular Weight, Noncondensables					
Specific Heat	Btu/lb-F	0.9978	0.9987	0.9270	0.9270
Thermal Conductivity	Btu/hr-ft-F	0.3685	0.3660	0.3592	0.3592
Latent Heat	Btu/lb	0.0000	0.0000	0.0000	0.0000
Inlet Pressure	psia	0.000		0.000	
Velocity	ft/sec	3.13		5.09	
Pressure Drop, Allow/Calc	psi	18.000	13.706	3.300	3.181
Fouling Resistance (min)	ft2-hr-F/Btu	90% CLEAN		90% CLEAN	

Heat Exchanged Btu/hr	89053665	MTD (Corrected)	11.5 F
Transfer Rate, Service	500.63 Btu/ft2-hr-F	Clean 561.92 Btu/ft2-hr-F	Actual 505.73 Btu/ft2-hr-F

CONSTRUCTION OF ONE SHELL

		Shell Side	Tube Side	Sketch (Bundle/Nozzle Orientation)
Design/Test Pressure	psig	125 /	15 /	
Design Temperature	F	130	120	
No Passes per Shell		1	1	(SEE DWG 07-M088-SC-010B)
Corrosion Allowance	inch			
Connections Size & Rating	In inch	1 @ 24"	1 @ 30"	
	Out inch	1 @ 24"	1 @ 30"	
	Intermediate			

Tube No. 1440 OD 1 inch	Thk(Avg) 0.028 inch	Length 41.5 ft	Pitch 1.25 inch Layout 30
Tube Type Plain		Material TITANIUM-GRADE 2	
Shell SA-516-70 ID 57 inch	OD inch	Shell Cover	N/A
Channel or Bonnet		Channel Cover	SA-516-70
Tubesheet-Stationary	SA-516-70 W/ TITANIUM CLAD	Tubesheet-Floating	N/A
Floating Head Cover		Impingement Plate	YES
Baffles-Cross Type NTIW-SEG.	%Cut (Diam) 15.0	Spacing(c/c) 82.25	Inlet 82.25 inch
Baffles-Long N/A	Seal Type	N/A	
Supports-Tube 2 PER SPAN	U-Bend N/A	Type N/A	
Bypass Seal Arrangement N/A	Tube-Tubesheet Joint		
Expansion Joint	Type		
Rho-V2-Inlet Nozzle 5315.57 lb/ft-sec2	Bundle Entrance 2392.80	Bundle Exit 1707.50 lb/ft-sec2	
Gaskets-Shell Side	Tube Side		
-Floating Head			
Code Requirements		TEMA Class	
Weight/Shell 44181.6	Filled with Water 102063	Bundle 11374.8 lb	

Remarks: 1" TUBES
(1) SPARE CHANNEL

PEF-NCR-02278

TEi

7.3 MSR Installation List

Please refer to LP-3 Feedwater heater attachment.

HEAT EXCHANGER SPECIFICATION SHEET

Y U B A H E A T T R A N S F E R

US Units

		Job No.	
Customer	PROGRESS ENERGY	Reference No. AS-12007	by AD
Address		Proposal No.	QH-6026-07
Plant Location	CRYSTAL RIVER STATION, UNIT 3	Date 11/21/2007	Rev
Service of Unit	Secondary Closed Cooling Water Heat Exchangers	Item No. E-1AB	(tag no. SCHE-1A/1B)
Size	64 x 528 Type AEL Horz.	Connected In	1 Parallel 1 Series*
Surf/Unit (Gross/Eff) 33176 / 32756 ft2	Shell/Unit 2*	Surf/Shell (Gross/Eff) 16588 / 16378 ft2	

PERFORMANCE OF ONE SHELL

Fluid Allocation		Shell Side		Tube Side	
Fluid Name		CLOSED COOLING WATER		SEA WATER	
Fluid Quantity, Total	lb/hr	6000000 (12,000 GPM)		8000000 (16,000 GPM)	
Vapor (In/Out)					
Liquid		6000000	6000000	8000000	8000000
Steam					
Water		6000000	6000000	8000000	8000000
Noncondensables					
Temperature (In/Out)	F	115.00	100.00	90.00	101.24
Specific Gravity		0.9906	0.9939	0.9955	0.9933
Viscosity	cP	0.5845	0.6811	0.7609	0.6721
Molecular Weight, Vapor					
Molecular Weight, Noncondensables					
Specific Heat	Btu/lb-F	0.9983	0.9982	0.9989	0.9987
Thermal Conductivity	Btu/hr-ft-F	0.3680	0.3621	0.3575	0.3624
Latent Heat	Btu/lb				
Inlet Pressure	psia				
Velocity	ft/sec	3.5		5.1	
Pressure Drop, Allow/Calc	psi	18	15	3.30	3.10
Fouling Resistance (min)	ft2-hr-F/Btu	90% clean		90% clean	

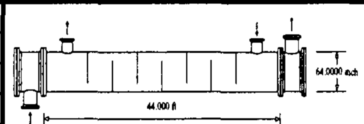
Heat Exchanged Btu/hr 89841118 MTD (Corrected) 11.7 F

Transfer Rate, Service 469.00 Btu/ft2-hr-F Clean 511.37 Btu/ft2-hr-F Actual 511.37 Btu/ft2-hr-F

CONSTRUCTION OF ONE SHELL

			Shell Side	Tube Side
Design/Test Pressure		psig	125 / code	15 & F.V. / code
Design Temperature		F	130 / 40	120 / 40
No Passes per Shell			1	1
Corrosion Allowance		inch		
Connections	In	inch	30" BW	30" 125# R.F.
Size &	Out	inch	30" BW	30" 125# R.F.
Rating	Intermediate			

Sketch (Bundle/Nozzle Orientation)



Tube No. 1440 OD 1.0 inch Thk(Avg) 0.0280 inch Length 44.000 ft Pitch 1.2500 inch Layout 30

Tube Type Plain Material TITANIUM-GRADE 2 (SB-338 GR 2)

Shell	ID 64 inch OD 65 inch	Shell Cover	N/A
Channel or Bonnet	CS with epoxy lining.	Channel Cover	CS w/ epoxy coating; hinged
Tubesheet-Stationary	CS with Titanium Cladding.	Tubesheet-Floating	N/A
Floating Head Cover	N/A	Impingement Plate	STAINLESS STEEL.

Baffles-Cross CS Type NTIW-SEG. %Cut (Diam) 21.3 Spacing(c/c) 65"

Baffles-Long N/A Seal Type N/A

Supports-Tube CS U-Bend N/A Type

Bypass Seal Arrangement N/A Tube-Tubesheet Joint Seal welded & roller expanded

Expansion Joint N/A Type

Rho-V2-Inlet Nozzle 5169.86 lb/ft-sec2 Bundle Entrance 1122.11 Bundle Exit 885.58 lb/ft-sec2

Gaskets-Shell Side N/A Tube Side Non-asbestos

-Floating Head N/A

Code Requirements ASME SEC VIII, DIV 1, TEMA & HEI TEMA Class C

Weight/Shell 57,000 Filled with Water 118,200 Bundle 44,200 lb

Remarks: Two supports per span. Shell relief valves.

*There are 2 shells total: 1 in service and 1 in stand-by.

Sacrifical anodes on channel cover.

Quick opening manway in channel cover. Channel heads to be shipped separately.

PEF-NCR-02279

Yuba
Heat
Transfer LLC

2121 N. 161st East Avenue
Tulsa, OK 74116
918 234 -6000
Fax 918 234-3345
www.yuba.com

A Connell
Limited Partnership
Company

Kanti Shah
Manager of Estimating /
Sr. Sales Engineer
Phone: 918-234-5535
Fax: 918-234-3345
Email: Shahk@Yuba.com

Yuba

October 18, 2007

Progress Energy Service Company
100 E. Davie Street (TPP-08)
Raleigh, NC 27601

Attention: Mr. Adrien Surin - Sourcing Specialist – NGG Major Projects

Reference: AS-12007
Feedwater Heater & Heat Exchanger Replacement
Crystal River Nuclear plant Unit 3
Yuba Quote QH–6026-07

Gentlemen:

We are pleased to submit our proposal in response to your November 09, 2007 Inquiry. Thank you for selecting Yuba as one of your potential suppliers. Our response to your inquiry represents our best efforts in selecting the design that best suits your needs and using only those designs that have been proven in many applications.

DATA

Data describing the proposed equipment (Yuba Feedwater Heater Specification Sheets, dated 11/26/07 and HX dated 11/21/07) has been included for your evaluation and review. We have included technical data and recommended practices for the equipment we are quoting. The design information and recommended practices are the result of knowledge gained during the production of over 6000 feedwater heaters in an environment of continuous improvement and learning. Design and materials of construction shall comply with applicable code and specification requirements for the construction and manufacture of such equipment.

SCOPE OF WORK

Our scope of work includes design, fabrication, testing, preparation for shipment, and delivery of subject equipment. Our scope does not include any work for erection or commissioning at site. Assistance from a Yuba Field Service Engineer is available upon request at our published rates (Attached)

CONFIDENTIAL

PRICE

[redacted]

REDACTED

[redacted]

PEF-NCR-02280

Yuba
Heat
Transfer LLC

2121 N. 161st East Avenue
Tulsa, OK 74116
918 234-6000
Fax 918 234-3345
www.yuba.com

A Connell
Limited Partnership
Company

Kanti Shah
Manager of Estimating /
Sr. Sales Engineer
Phone: 918-234-5535
Fax: 918-234-3345
Email: Shahk@Yuba.com

CONFIDENTIAL

Yuba

[redacted]

REDACTED

ACCESSORIES
Tube side and shell side relief valves are included in our offering.

VALIDITY
Our prices are firm and valid until December 14, 2007. Should your evaluation extend beyond this date, Yuba will verify material costs and provide updated pricing and delivery.

DELIVERY
We will deliver subject equipment FOB job site by 6/15/2009 as required.

TERMS AND CONITIONS
Sample contract and terms are for service contract, we are supplying complete equipment so we have not reviewed and not applicable to our equipment. We will be glad to provide our comments if you have different T & C for equipment.
We have attached our standard terms of sale for your consideration.

PAYMENT TERMS
[redacted]

REDACTED

EXCEPTIONS AND CLARIFICATIONS TO SPECIFICATIONS
Please refer our response on addendum No. 2 an updated table of conformance in accordance with final version of the specification "Specification for replacement of low pressure closed feedwater heaters and SC for extended power uprate" Our offer is based on this final specification because some requirement for HX has been deleted.

DRAWINGS
Setting plan drawings, which provide complete details on purchaser's connections and supports, will be scheduled for submittal within 60 days after notification of award. We are requesting Progress Energy to limit two (2) weeks turnaround on review of setting plan drawing. We will be more than happy to discuss this matter at your convenience.
Should any modifications be desired, drawing submittal will be based on receipt of complete engineering details at the factory.

PEF-NCR-02281

Yuba
Heat
Transfer LLC

2121 N. 161st East Avenue
Tulsa, OK 74116
918 234 -6000
Fax 918 234-3345
www.yuba.com

A Connell
Limited Partnership
Company

Kanti Shah
Manager of Estimating /
Sr. Sales Engineer
Phone: 918-234-5535
Fax: 918-234-3345
Email: Shahk@Yuba.com

Yuba

Shop detail drawings are considered proprietary in nature and are not submitted. Only a certified setting plan will be transmitted for review. Detailed drawings are always available for review in our Tulsa office where they can be discussed at length with the product engineer assigned to the project.

We will provide the following drawings in the instruction manual for your plant personnel's use:

1. Gasket schedule.
2. Tube layout.
3. Sketch showing location of supports and baffles.

Yuba will submit drawings in electronic format where available. Documents not available in electronic format will be transmitted in paper form.

Yuba's drawings will be per our standard AutoCAD guidelines.

ISO 9001

We would like to highlight that Yuba is certified to ISO 9001. We feel that this is a significant step in the continuous improvement process of our Yuba organization and that this will certainly be a benefit to you in our working together to the successful completion of this project.

We appreciate this opportunity to be of service to you on this project. Should we be of additional assistance during your bid evaluation, please feel free to contact us

We look forward working with you on this project.

Very truly yours,

Kanti Shah

Kanti Shah

cc: Sam R. Naifeh – Vice President of Sales
Direct Dial: 918-234-5503

PEF-NCR-02282

From: Kanti Shah [ShahK@yuba.com]
Sent: Friday, December 07, 2007 3:26 PM
To: Deahna, Scott T.
Cc: Williams, Ted E.; Owen, Tony; Surin, Adrien; Sexton, Larry J.; Sam Naifeh
Subject: RE: Yuba Proposal # QH-6026-07 Review Questions and Clarifications Update
Gentlemen:

Please find our response to your question in attached document.

For welded Titanium tubes, we will comply all requirements per SB-338-Gr2 only.

For seamless tube we are checking on Ultrasonic testing.(UT).

We do not have response from our supplier regarding price as "buy now".

Thank you for interest in Yuba products.

Best Regards

Kanti Shah
Manager of Estimating / Sr. Sales Engineer

YUBA HEAT TRANSFER LLC
2121 N 161St E AVE
Tulsa OK 74116
Phone: 918-234-5535
Fax: 918-234-3345
Email: shahk@yuba.com

From: Deahna, Scott T. [mailto:Scott.Deahna@pgnmail.com]
Sent: Thursday, December 06, 2007 9:43 AM
To: Deahna, Scott T.; Bill Maniss; Kanti Shah
Cc: Williams, Ted E.; Owen, Tony; Surin, Adrien; Sexton, Larry J.
Subject: Yuba Proposal # QH-6026-07 Review Questions and Clarifications Update

Gentlemen,

The SC cooler tubes shall be in accordance with the attached ASME SB-338 specification for seamless and welded titanium tubes.
Progress Energy prefers seamless tubes as proposed by Yuba.
Section 11, Nondestructive Tests states seamless tubes require ultrasonic testing (UT) not electromagnetic (EC) testing.
The permissible variation in tube dimensions is provided in section 12 and table 5.
Yuba should agree to all requirements of ASME SB-338 for seamless tubes.

Thank You,

PEF-NCR-02283

Scott.

-----Original Message-----
From: Deahna, Scott T.
Sent: Wednesday, December 05, 2007 7:17 PM
To: 'Bill Maniss'; 'Shahk@yuba.com'
Cc: Williams, Ted E.; Owen, Tony; Surin, Adrien; Sexton, Larry J.
Subject: Yuba Proposal # QH-6026-07 Review Questions and Clarifications

Bill / Kanti,

Thank You for your timely proposal. I have reviewed your proposal and request your response to the attached technical questions and clarifications.

Thank You,
Scott Deahna
Lead Engineer, Major Projects Group
Crystal River Unit 3 (SA2)
Progress Energy
15760 W. Power Line Street
Crystal River, FL 34428
(352) 563-2943, x4234
cell: (352) 464-7487
scott.deahna@pgnmail.com

-

PEF-NCR-02284

Technical Review of Yuba Proposal QH-6026-07, dated 11/30/07, and Thermal Engineering International Proposal 06-M088, dated 11/29/07.

Technical Review completed by: Scott T. Deahna on 12/07/07.
The proposals are for the replacement of two (2) feedwater heaters (CDHE-3A/B) and two (2) secondary plant component cooling heat exchangers (SCHE-1A/1B). The heat exchangers are being replaced to support the CR3 extended power uprate project. Progress Energy issued Request for Proposal # AS-12007 on 11/09/07. Draft equipment specifications for the replacement heat exchangers were included with the RFP. A table of conformance to the specification was included with the RFP. The vendor proposals were due on 11/30/07.

Summary of Proposals Submitted:

- The Yuba proposal QH-6026-07 provided the better overall technical design offering. The Yuba proposal includes seamless tubes. The TEI proposal includes seam welded tubes (per telecom w/ Jay Wu). Both types are acceptable per ASME SB-338. Seamless tubes are more expensive.
- Both vendor proposals were complete and were submitted on time.
- Both vendors submitted complete table of conformance to the equipment specifications.
- Both vendors met the technical requirements of the specification. Some exceptions were taken to the specification. None of the exceptions taken to the specification were of technical or commercial significance.
- The feedwater heater designs submitted by both vendors were essentially technically equivalent.
- The Yuba SC heat exchanger design provided more heat exchange surface area than the TEI design.
- The Yuba SC heat exchanger design meets the maximum dimensional requirements.
- The Yuba SC heat exchanger design provides additional cooling capacity compared to the TEI design.

SC Cooler Design Characteristic Comparison:

Characteristic:	Yuba Proposal:	TEI Proposal:
Tube Bundle Size	64" x 528"	57" x 498"
Eff. Surface	16,378 Sq. Ft.	15,503 Sq. Ft.
Heat Exchanged	89,842,118 Btu/Hr.	89, 053,665 Btu/Hr.
Heat Transfer Rate	511.37 Btu/Sq.Ft.-Hr.-F	505.73 Btu/Sq.Ft.-Hr.-F
Vessel Size	65" OD x ????	58" OD x 49'-11" L
Tubes (Titanium, SB-338 GR2)	1440, 1"OD, 0.028"wall, 44'long	1440, 1"OD, 0,028" wall, 41.5'long
Design Pressure / Temp Shell	125 psig / 130F	125 psig / 130F
Design Pressure / Temp Tubes	15 psig / 120F	15 psig / 120F
Vessel Weight	57,000 Lbs.	44,182 Lbs.

Feedwater Heater Design Characteristic Comparison:

Characteristic:	Yuba Proposal:	TEI Proposal:
Tube Bundle Size	57" x 546"	58" x 539"
Eff. Surface	17,300 Sq. Ft.	17,088 Sq. Ft.
Heat Exchanged	295,281,000 Btu/Hr.	294,281,000 Btu/Hr.
Heat Transfer Rate	1139 Btu/Sq.Ft.-Hr.-F	1165 Btu/Sq.Ft.-Hr.-F
TTD / DCA	5F / 10F	5F / 10F
Vessel Size	58" OD x 52'-10" OAL	59" OD x 52'-3" OAL
Tubes (SA-668-TP304L)	1000, 0.75", 0.035", 45'-6"	997, 0.75", 0.035", 45'
Design Pressure / Temp Shell	75 psig / 280F	50 psig / 300F
Design Pressure / Temp Tubes	400 psig / 280F	400 psig / 300F
Vessel Weight	60,400 Lbs.	60,000 Lbs.

Yuba
Heat
Transfer LLC

2121 N. 161st East Avenue
Tulsa, OK 74116
918 234 -6000
Fax 918 234-3345
www.yuba.com

A Connell
Limited Partnership
Company

Kanti Shah
Manager of Estimating /
Sr. Sales Engineer
Phone: 918-234-5535
Fax: 918-234-3345
Email: Shahk@Yuba.com

Yuba

Δ$

December 06, 2007

seamless —
welded —
welded (up front payment)

[redacted] REDACTED

Progress Energy Service Company
100 E. Davie Street (TPP-08)
Raleigh, NC 27601

Attention: Mr. Adrien Surin - Sourcing Specialist – NGG Major Projects

Reference: AS-12007
Feedwater Heater & Heat Exchanger Replacement
Crystal River Nuclear plant Unit 3
Yuba Quote QH–6026-07

Gentlemen:

Per our conversation we are pleased to provide our offering for welded seam Titanium tubes per SB-338-GR2 for SC. Welded tubes will meet all Code requirements regardless of specification requirement. LP heater tube requirement stays unchanged.

Following offered price is based on buying tubes now and paying for same to avoid escalation.

PRICE

[redacted] REDACTED

VALIDITY
Our prices are firm and valid until December 14, 2007. Should your evaluation extend beyond this date, Yuba will verify material costs and provide updated pricing and delivery.

PAYMENT TERMS
Yuba offers the following progress payments:

[redacted] REDACTED

Yuba
Heat
Transfer LLC

2121 N. 161st East Avenue
Tulsa, OK 74116
918 234 -6000
Fax 918 234-3345
www.yuba.com

A Connell
Limited Partnership
Company

Kanti Shah
Manager of Estimating /
Sr. Sales Engineer
Phone: 918-234-5535
Fax: 918-234-3345
Email: Shahk@Yuba.com

Yuba

Except as expressly modified herein, all other stated terms and conditions remain unchanged.

We appreciate this opportunity to be of service to you on this project. Should we be of additional assistance during your bid evaluation, please feel free to contact us

We look forward working with you on this project.

Very truly yours,

Kanti Shah

Kanti Shah

cc: Sam R. Naifeh – Vice President of Sales
Direct Dial: 918-234-5503

PEF-NCR-02287

Yuba Heat Transfer Proposal # QH-6026-07 Review Questions and Clarifications:

Yuba Heat Transfer Proposal # QH-6026-07, Feedwater Heater & SC Heat Exchanger Replacement for CR3, Dated October 17, 2007.

Please respond or acknowledge the following items pertaining to your proposal and the Progress Energy (PE) bid specification table of conformance exception items.

1) Is the manufacturing quality assurance record submitted to the purchaser?

2) The proposal states vessel outline drawings will be submitted within 60 days of award. Does Yuba agree the CDHE-3A / 3B nozzles should be able to remain in the existing location? Does Yuba agree the SCHE-1A / 1B nozzles should be able to remain in the existing location except for the tube side sea water connections due to the vessel length increase?

3) What is the SCHE-1A / 1B estimated total length? The SCHE-1A / 1B spec sheet indicates 30" BW connections on the shell side. Does Yuba agree these should be 24" BW?

4) Can Yuba install lifting trunions in the vertical orientation on SCHE-1A / 1B? There is a field interference with horizontal orientated trunions.

Table of Conformance Exception Items for SCHE-1A / 1B:

1) 1.1.2.4; Channel Head Epoxy Coating. PE does not accept the coal tar epoxy and will specify a Belzona epoxy product. Is this acceptable to Yuba?

2) 3.2.1; Cathodic Protection. Yuba is not providing. PE would like a zinc anode installed in the channel heads. Is this acceptable to Yuba?

3) 3.2.2; Tube Cleaning System Limits. Yuba will not provide this information. Accepted by PE.

4) 3.2.6; Yuba is providing a carbon steel tubesheet with titanium clad. Tube ends will be welded to the cladding. PE may require epoxy coating on the tube sheet. Is this acceptable to Yuba?

5) 3.2.7; SA-516-70 shell material is accepted by PE.

6) 3.2.8; Stainless Steel impingement plate at the shell inlet is accepted by PE.

7) 3.2.10; Dissimilar materials in the channel and channel cover (including bolting) shall be electrically isolated by gaskets or non- conducting washers to prevent galvanic erosion. Is this acceptable to Yuba?

8) 3.2.10; PE requests channel cover hinges rather than davits. Is this acceptable to Yuba?

9) 3.2.10; A 20" bolted opening on the channel cover is accepted by PE.

10) 3.6.2; Required Tube Tolerances. Yuba takes exception to the bid specification specific tube measurement tolerance criteria, stating the tube critical characteristics "will be per code". Provide specific code requirement that Yuba will use for the QC of the 1 inch titanium tubes.

11) 3.7.2-5; Seamless tubes will be provided. Accepted by PE.

12) 3.9.15-20; NDE of Tubes – Dimensional Measurements. Describe Yuba's QC program for tube dimensional measurements verification (acceptance criteria per 3.6.2 above).

13) 3.9.22-46; NDE of Tubes – ECT and UT. Yuba states the tubes will be eddy current tested per code. No UT is required for seamless tubes. Provide specific code requirement that Yuba will use for the ECT of the 1 inch titanium tubes. No UT is accepted by PE.

14) 3.9.47; Tube Chemical and Mechanical Testing. PE will accept submittal of the tube supplier material certification. Is this acceptable to Yuba?

15) 3.9.49; Tube Pressure Testing. What tube pressure testing procedure will Yuba use?

16) 4.9; Bill of Materials. Shop detailed part drawings are not required. PE requests a bill of materials indicating the material specification used for each major part. Is this acceptable to Yuba?

17) 6.3; Subcontractor Approval. Yuba shall be responsible for subcontractor quality control. PE requests Yuba provide a list of subcontractors and their responsibilities after placement of order. Subcontractor approval by PE is not required prior to placement of order. (PE contracts group to acknowledge this item).

<u>Table of Conformance Exception Items for CDHE-3A / 3B:</u>

1) 1.3; Insulation is by PE. Insulation clips may need to be installed on the shell by Yuba as stated in 3.7.13.1. Will Yuba provide stainless steel vent orifice plates?

2) 3.2.13-16; Vessel Seismic Qualification is not required by PE.

3) 3.7.6.4; Tubes to be welded to tubesheet and hydraulically expanded is accepted by PE.

4) 3.7.9.1 and 3.7.9.2; Yuba has an "X" in the conform column. Does Yuba conform "C" to these items?

5) 3.9.2.4; Hydrostatic test exception note is accepted by PE.

6) 3.9.4.3; Finish machining exception note is accepted by PE. Spec states it is not required for LP heaters.

Yuba Heat Transfer Proposal # QH-6026-07 Review Questions and Clarifications:

Yuba Heat Transfer Proposal # QH-6026-07, Feedwater Heater & SC Heat Exchanger Replacement for CR3, Dated October 17, 2007.

Please respond or acknowledge the following items pertaining to your proposal and the Progress Energy (PE) bid specification table of conformance exception items.

1) Is the manufacturing quality assurance record submitted to the purchaser?
Yuba response: Yes

2) The proposal states vessel outline drawings will be submitted within 60 days of award. Does Yuba agree the CDHE-3A / 3B nozzles should be able to remain in the existing location? Does Yuba agree the SCHE-1A / 1B nozzles should be able to remain in the existing location except for the tube side sea water connections due to the vessel length increase?
Yuba response: We are confident that we can keep same but due to increase in length we can not say 100% until we make layout and setting plan drawing.

3) What is the SCHE-1A / 1B estimated total length? The SCHE-1A / 1B spec sheet indicates 30" BW connections on the shell side. Does Yuba agree these should be 24" BW?
Yuba response: Yes typo error, we will correct datasheet.
Yuba response: We will comply per specification SB-338-G2.

4) Can Yuba install lifting trunions in the vertical orientation on SCHE-1A / 1B? There is a field interference with horizontal orientated trunions.
Yuba response: Yes we can install conventional vessel lift lugs.

Table of Conformance Exception Items for SCHE-1A / 1B:

1) 1.1.2.4; Channel Head Epoxy Coating. PE does not accept the coal tar epoxy and will specify a Belzona epoxy product. Is this acceptable to Yuba? Yuba response: It is OK, there will be additional cost.
2) 3.2.1; Cathodic Protection. Yuba is not providing. PE would like a zinc anode installed in the channel heads. Is this acceptable to Yuba? Yuba response: Yes, there will be some additional cost.

3) 3.2.2; Tube Cleaning System Limits. Yuba will not provide this information. Accepted by PE.

4) 3.2.6; Yuba is providing a carbon steel tubesheet with titanium clad. Tube ends will be welded to the cladding. PE may require epoxy coating on the tube sheet. Is this acceptable to Yuba?
Yuba response: TI clad on TS will cover wetted surface, with gasket surface on the clad . We do not recommend epoxy coating the TI clad.

5) 3.2.7; SA-516-70 shell material is accepted by PE.

6) 3.2.8; Stainless Steel impingement plate at the shell inlet is accepted by PE.

7) 3.2.10; Dissimilar materials in the channel and channel cover (including bolting) shall be electrically isolated by gaskets or non- conducting washers to prevent galvanic erosion. Is this acceptable to Yuba?

Yuba response: Yes, we need to do some research and may be some added cost

8) 3.2.10; PE requests channel cover hinges rather than davits. Is this acceptable to Yuba?
Yuba response:Yes

9) 3.2.10; A 20" bolted opening on the channel cover is accepted by PE.

10) 3.6.2; Required Tube Tolerances. Yuba takes exception to the bid specification specific tube measurement tolerance criteria, stating the tube critical characteristics "will be per code". Provide specific code requirement that Yuba will use for the QC of the 1 inch titanium tubes.
Yuba response: We will comply per specification SB-338-G2.

11) 3.7.2-5; Seamless tubes will be provided. Accepted by PE.

12) 3.9.15-20; NDE of Tubes – Dimensional Measurements. Describe Yuba's QC program for tube dimensional measurements verification (acceptance criteria per 3.6.2 above).
Yuba response: We will comply per specification SB-338-G2.

13) 3.9.22-46; NDE of Tubes – ECT and UT. Yuba states the tubes will be eddy current tested per code. No UT is required for seamless tubes. Provide specific code requirement that Yuba will use for the ECT of the 1 inch titanium tubes. No UT is accepted by PE.

14) 3.9.47; Tube Chemical and Mechanical Testing. PE will accept submittal of the tube supplier material certification. Is this acceptable to Yuba? Yuba response: Yes

15) 3.9.49; Tube Pressure Testing. What tube pressure testing procedure will Yuba use? Yuba response: Hydro test tube & shell side at DP x 1.3 per Code

16) 4.9; Bill of Materials. Shop detailed part drawings are not required. PE requests a bill of materials indicating the material specification used for each major part. Is this acceptable to Yuba?
Yuba response: Yes

17) 6.3; Subcontractor Approval. Yuba shall be responsible for subcontractor quality control. PE requests Yuba provide a list of subcontractors and their responsibilities after placement of order. Subcontractor approval by PE is not required prior to placement of order. (PE contracts group to acknowledge this item). Yuba response: OK. Thank you

<u>Table of Conformance Exception Items for CDHE-3A / 3B:</u>

1) 1.3; Insulation is by PE. Insulation clips may need to be installed on the shell by Yuba as stated in 3.7.13.1. Will Yuba provide stainless steel vent orifice plates? Yuba response: Yes, if required

2) 3.2.13-16; Vessel Seismic Qualification is not required by PE.

3) 3.7.6.4; Tubes to be welded to tubesheet and hydraulically expanded is accepted by PE.

4) 3.7.9.1 and 3.7.9.2; Yuba has an “X” in the conform column. Does Yuba conform “C” to these items?
Yuba response: Yes

5) 3.9.2.4; Hydrostatic test exception note is accepted by PE.

6) 3.9.4.3; Finish machining exception note is accepted by PE. Spec states it is not required for LP heaters.

The American Society of Mechanical Engineers

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CERTIFICATE OF AUTHORIZATION

This certificate accredits the named company as authorized to use the indicated symbol of the American Society of Mechanical Engineers (ASME) for the scope of activity shown below in accordance with the applicable rules of the ASME Boiler and Pressure Vessel Code. The use of the Code symbol and the authority granted by this Certificate of Authorization are subject to the provisions of the agreement set forth in the application. Any construction stamped with this symbol shall have been built strictly in accordance with the provisions of the ASME Boiler and Pressure Vessel Code.

COMPANY:

Yuba Heat Transfer
2121 N. 161st East Avenue
Tulsa, Oklahoma 74116

SCOPE:

Manufacture of pressure vessels at the above location and field sites controlled by the above location

AUTHORIZED: **May 2, 2007**

EXPIRES: **June 4, 2010**

CERTIFICATE NUMBER: **11,178**

Chairman of The Boiler
And Pressure Vessel Committee

Director, Accreditation and Certification

Certificate of Registration

QUALITY MANAGEMENT SYSTEM - ISO 9001:2000

This is to certify that:

Yuba Heat Transer L.L.C.
2121 NO. 161ST East Ave
Tulsa
Oklahoma
74116
USA

Holds Certificate No: **FM 57812**
and operates a Quality Management System which complies with the requirements of ISO 9001:2000 for the following scope:

The design, marketing and manufacture of heat transfer equipment.

For and on behalf of BSI:

Gary L Pearson

President, BSI Management Systems (Americas)

Originally registered: **02/16/2001** Latest Issue: **06/26/2006** Expiry Date: **06/25/2009**

BSI Management Systems

PEF-NCR-02294

CERTIFICATE OF INSURANCE

DATE (MM/DD/YY): 10/01/07

PRODUCER 617-330-1005
Wells Fargo Insurance Services
Northeast, Inc.
125 Summer St-16th FL
Boston, MA 02110

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

INSURED
Connell Limited Partnership
Yuba Heat Transfer
One International Place
Boston, MA 02110

COMPANIES AFFORDING COVERAGE

COMPANY	
A	Ace American Insurance
B	Ace American Insurance
C	St. Paul Fire & Marine
D	

COVERAGES

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED, NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

CO LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFF. DATE (MM/DD/YY)	POLICY EXP. DATE (MM/DD/YY)	LIMITS	
A	GENERAL LIABILITY X COMM. GENERAL LIABILITY CLAIMS MADE X OCCUR OWNER'S & CONTRACT'S PROT X Brd.Fm Vndrs	XSLG20559299	10/01/07	10/01/08	GENERAL AGGREGATE	1750000
					PROD-COMP/OP AGG.	1750000
					PERS. & ADV. INJURY	750000
					EACH OCCURRENCE	750000
					FIRE DAMAGE (One Fire)	250000
					MED EXP (Any one person)	5000
B	AUTOMOBILE LIABILITY ANY AUTO X ALL OWNED AUTOS X SCHEDULED AUTOS X HIRED AUTOS X NON-OWNED AUTOS X COMP. $250 X COLL. $250	ISAH07961364	10/01/07	10/01/08	COMBINED SINGLE LIMIT	1000000
					BODILY INJURY (Per person)	
					BODILY INJURY (Per accident)	
					PROPERTY DAMAGE	
	GARAGE LIABILITY ANY AUTO				AUTO ONLY-EA ACCIDENT	
					OTHER THAN AUTO ONLY: EACH ACCIDENT	
					AGGREGATE	
C	EXCESS LIABILITY X UMBRELLA FORM OTHER THAN UMBRELLA FORM	QK01201676	10/01/07	10/01/08	EACH OCCURRENCE	5000000
					AGGREGATE	5000000
B	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY THE PROPRIETOR/ PARTNERS/EXECUTIVE OFFICERS ARE: X INCL / EXCL	WLRC44004264	10/01/07	10/01/08	X STATUTORY LIMITS	
					EACH ACCIDENT	1000000
					DISEASE-POLICY LIMIT	1000000
					DISEASE-EACH EMPL.	1000000
	OTHER					

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS
RE: EVIDENCE OF INSURANCE

CERTIFICATE HOLDER

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE COMPANY, ITS AGENTS OR REPRESENTATIVES.

AUTHORIZED REPRESENTATIVE

ACORD 25-S (7/93)

Yuba
Heat
Transfer LLC

2121 N. 161st East Avenue
Tulsa, OK 74116
918 234-6000
Fax 918 234-3345
www.yuba.com

A Connell
Limited Partnership
Company

Yuba

REFERENCES

NUCLEAR PLANT		
Russ Wenzel	NPPD - COOPER NUCLEAR	402-825-5747
Jeffrey Marion	EXELON-PEACH BOTTOM	717-456-4696
Peter Omaggioi	AMERGEN-TMI	717-948-8290
Charlie Zalewski	NMC-DUANE ARNOLD	319-851-7331
Gray Boughman	PPL-SUSQUEHANNA	610-774-7673
Bill Cote	EXELON-DRESDEN	815-416-2138

FOSSIL PLANT		
Alan Tennant	Allegheny Energy	724-830-5460
Joe Shelton	Southern Company Service	205-992-7177
Doug Zahn	Keyspan	516-545-6281
Patrick Clarke	Tampa Electric Company	813-228-4656
Leon Gertsch	Mid American Energy	712-277-5245

YUBA HEAT TRANSFER
PARTIAL INSTALLATION LIST FOR NUCLEAR POWER PLANTS

JOB #	CUSTOMER	STATION	UNIT	ITEM	SQ FT	ID	# U-TUBE	OD	LENGTH	P	TYPE	DESIGN TUBE	DESIGN SHELL	MATERIAL	SHIP DATE	MW (ea unit)	INSTALLATION	FIELD SERVICE SUPERVISION
04H203-1A	EXELON NUCLEAR POWER	PEACH BOTTOM	3	EH-1ABC	17221	74	1087	3/4	39'0"	2	HCNUEMW	700	50	SA-688-TP304(.05MC)	06-05			
04H183-1A	AMERGEN	THREE MILE ISLAND	1	EH-5AB	24,413	75	1426	3/4	41'11"	2	HUEMW	725	50	SA-688-TP304(.05MC)	04-05			
03H119-2A	ENTERGY NUCLEAR	VERMONT YANKEE	1	EH-2A&B	13976	59	1453	5/8	27'11"	2	HUHSMW	2000	180	SA-688-TP316	02-04			
03H119-1A	ENTERGY NUCLEAR	VERMONT YANKEE	1	EH-1A&B	15047	56	1432	5/7	30'8"	1	HUHSMW	2000	325	SA-688-TP315	01-04			
03H110-1	OMAHA PUBLIC POWER DIST	FT CALHOUN	1	EH-5A/B	11,615	55	797	3/4	35'10"	2	HUEMW	700	320	SA-688-TP304(.05MC)	08-03		X	X
02H965-1	CONSTELLATION NUCLEAR	NINE MILE POINT	1	EH-3	11529	52	958	5/8	35'8"	2	HUHSMW	600	75	SA-688-304L	10-02			X
01H939-2	EXELON NUCLEAR	PEACH BOTTOM	2	EH-3	17,727	67	1340	3/4	32'2"	2	HUEMW	700	75	SA-688-TP304 (.05MC)	05-02		X	X
01H939-1	EXELON NUCLEAR	PEACH BOTTOM	2	EH-2	19,326	71	1298	3/4	36'4"	2	CNHUEMW	700	50	SA-688-TP304 (.05MC)	05-02		X	X
00H862-1	ENTERGY SERVICES, INC	NINE MILE POINT	5	EH-6	22,105	64	1251	3/4	43'6"	2	HUEMW	600	50	SA-688-304 (.05MC)	01-01			X
00H865-1	ENTERGY NUCLEAR GENERATIN	PILGRIM NUCLEAR	1	EH-3	17,375	61	1435	5/8	35'7"	2	HUEMW	600	75	SA-688-304L	03-01			
99H826-3	ENTERGY SERVICES, INC	NINE MILE POINT	4	EH-5	14,710	57	1087	3/4	33'1"	2	HUEMW	600	50	SA-556-C2	04-00			
99H826-2	ENTERGY SERVICES, INC	NINE MILE POINT	1	EH-2	1,802	34	274	3/4	16'0"	4	HUB	400	150	SA-688-304 (.05MC)	04-00			
99H826-1	ENTERGY SERVICES, INC	NINE MILE POINT	2	EH-2	3,437	43	490	3/4	16'10"	4	HUHLKB	2550	300	SA-688-304 (.05MC)	04-00			
99H817-1	ENTERGY SERVICES, INC	RIVER BEND	1	EH-1B	21,168	72	2199	5/8	27'7"	2	HUHSMW	2000	400	SA-688-304 (.05MC)	02-00			
98H764-1	NIAGARA MOHAWK POWER	NINE MILE POINT	1	EH-3AB	11,529	52	958	5/8	35'-8"	2	HUHSMW	600	75	SA-688-304L	02-99	641		
98H748-1	BOSTON EDISON CO	PILGRIM		EH-1	18,817	65	1025	3/4	45'5"	2	HCNUEMW	600	50	SA-688-304L	10-98			
96H600-3	NEW YORK POWER AUTHORITY	JAMES A. FITZPATRICK		EH-5	22,189	68	1312	3/4	41'9"	2	HUEMW	800	250	SA-688-304L	04-97			
96H600-2	NEW YORK POWER AUTHORITY	JAMES A. FITZPATRICK		EH-5	22,189	68	1312	3/4	41'9"	2	HUEMW	800	250	SA-688-304L	08-97			
96H600-1	NEW YORK POWER AUTHORITY	JAMES A. FITZPATRICK		EH-1AB	20,775	66	1215	3/4	41'2"	2	HUEMW	800	50	SA-688-304L	07-97	883		
94H389	ENTERGY SERVICES, INC	ARKANSAS	1	EH-1AB	29,530	78	2444	5/8	35' 1"	2	HUHSMW	1350	600	SA-688-316 (.035MC)	01-95			
94H377	NORTHEAST UTILITIES	MILLSTONE	3	EH-5C	15,826	59	1143	5/8	41' 0"	2	HCNUB	700	50	SA-268-439	11-94			
93H230	ENTERGY SERVICES, INC	NINEMILE	4	EH-2	13,953	59	1357	5/8	30' 1"	2	HUHMW	4850	360	SA-688-304N (.05MC)	10-93	383.4		
91H934	VERMONT YANKEE NUCLEAR PO	VERNON		EH-3AB	15,132	58	1215	5/8	36' 10"	2	HUHSMW	600	100	SA-688-304L	12-91			X
89H625	LOUISIANA POWER & LIGHT	NINEMILE	3	EH-2	4,400	39	453	3/4	28' 9"	2	HUMW	2500	250	SA-688-304	10-89			
89H625	LOUISIANA POWER & LIGHT	NINEMILE	3	EH-1	5,142	39	498	5/8	30' 7"	2	HUMW	2500	525	SA-688-304	10-89			
87H330	VIRGINIA ELECTRIC & POWER	SURRY	1 & 2	EH-4ABCD	15,291	57	1340	5/8	33' 6'	2	VCDUEM	750	50	SA-688-304 (.05MC)	07-87			X
87H330	VIRGINIA ELECTRIC & POWER	SURRY	1 & 2	EH-3ABCD	15,648	57	1520	5/8	30' 0"	2	VCDUEM	750	110	SA-688-304 (.05MC)	12-87	848		X
87H330	VIRGINIA ELECTRIC & POWER	SURRY	1 & 2	EH-2ABCD	16,820	60	1558	5/8	31' 6"	2	VCDUEM	750	225	SA-688-304 (.05MC)	12-87	848		X
87H330	VIRGINIA ELECTRIC & POWER	SURRY	1 & 2	EH-1ABCD	30,215	71	2642	5/8	33' 1"	2	VCUDHM	2000	475	SA-688-304 (.05MC)	12-87	848		X
85H182	VIRGINIA ELECTRIC & POWER	SURRY	N 1	EH-6AB	15,945	65	1520	5/8	30' 8"	2	HCNUEHMW	750	50	SA-688-304 (.05MC)	07-86			
85H182	VIRGINIA ELECTRIC & POWER	SURRY	N 1	EH-5AB	12,645	55	1328	5/8	27' 9"	2	HCNUEHMW	750	50	SA-688-304 (.05MC)	04-86			
85H181	PACIFIC GAS & ELECTRIC	DIABLO CANYON	2	EH-3ABC	14,320	56	1538	5/8	27' 0"	2	HUEH	850	100	SA-268-439	04-86			X
85H181	PACIFIC GAS & ELECTRIC	DIABLO CANYON	2	EH-4ABC	17,010	60	1709	5/8	28' 11"	2	HUEH	850	50	SA-268-439	05-86	1119		X
85H181	PACIFIC GAS & ELECTRIC	DIABLO CANYON	2	EH-2ABC	14,120	53	1035	5/8	33' 5"	2	HUEH	850	200	SA-268-439	05-86	1119		X
85H181	PACIFIC GAS & ELECTRIC	DIABLO CANYON	2	EH-1ABC	27,350	78	2996	3/4	25' 10"	2	HUH	2100	450	SA-268-439	05-86	1119		X

YUBA HEAT TRANSFER
PARTIAL INSTALLATION LIST FOR NUCLEAR POWER PLANTS

JOB #	CUSTOMER	STATION	UNIT	ITEM	SQ FT	ID	# U TUBE	OD	LENGTH	P	TYPE	DESIGN TUBE	DESIGN SHELL	MATERIAL	SHIP DATE	MW (ea unit)	INSTALLATION	FIELD SERVICE SUPERVISION
85H180	PACIFIC GAS & ELECTRIC	DIABLO CANYON	1	EH-4ABC	17,010	60	1709	5/8	28' 11"	2	HUEH	850	50	SA-268-439	06-86	1119		X
85H180	PACIFIC GAS & ELECTRIC	DIABLO CANYON	1	EH-3ABC	14,320	56	1538	5/8	27' 0"	2	HUEH	850	100	SA-268-439	05-86	1084		X
85H180	PACIFIC GAS & ELECTRIC	DIABLO CANYON	1	EH-2ABC	14,120	53	1035	5/8	33' 5"	2	HUEH	850	200	SA-268-439	05-86	1084		X
85H180	PACIFIC GAS & ELECTRIC	DIABLO CANYON	1	EH-1ABC	27,350	78	2996	3/4	25' 10"	2	HUH	2100	450	SA-268-439	05-86	1084		X
85H986	LOUISIANA POWER & LIGHT	NINEMILE	5	EH-3	19,575	72	1462	5/8	39' 4"	2	HUEH	600	180	SA-688-304 (.05MC)	09-85			
83H815	ARKANSAS POWER & LIGHT	NUCLEAR ONE	2	EH-2AB	15,130	79	2268	3/4	18' 8"	2	HUH	1300	400	SA-688-304L	09-83	942		
83H815	ARKANSAS POWER & LIGHT	NUCLEAR ONE	2	EH-1AB	13,435	74	2224	5/8	16' 9"	2	HUH	1300	600	SA-688-304L	09-83	942		
83H815	ARKANSAS POWER & LIGHT	NUCLEAR ONE	2	EH-7A	23,600	67	1347	3/4	43' 1"	2	HUH	800	50	SA-688-304 (.05MC)	11-83	942		
83H815	ARKANSAS POWER & LIGHT	NUCLEAR ONE	2	EH-6AB	16,195	60	1164	3/4	34' 0"	2	HUH	800	50	SA-688-304 (.05MC)	11-83	942		
83H815	ARKANSAS POWER & LIGHT	NUCLEAR ONE	2	EH-5AB	19,145	63	1340	3/4	34' 10"	2	HUH	800	100	SA-688-304 (.05MC)	11-83	942		
83H815	ARKANSAS POWER & LIGHT	NUCLEAR ONE	2	EH-4AB	13,010	55	1022	3/4	31' 1"	2	HUH	800	150	SA-688-304 (.05MC)	11-83	942		
83H815	ARKANSAS POWER & LIGHT	NUCLEAR ONE	2	EH-3AB	14,025	57	1097	3/4	31' 2"	2	HUH	800	300	SA-688-304 (.05MC)	11-83	942		
82H702	NIAGARA MOHAWK POWER	NINEMILE	1 N	EH-1	8,535	44	830	5/8	30' 4"	2	HUH	2000	200	SA-688-304L	12-82			
80H515	NIAGARA MOHAWK POWER	NINEMILE	1 N	EH-1	8,535	44	830	5/8	30' 4"	2	HUH	2000	200	SA-688-316L	02-81			
79H412	FLORIDA POWER & LIGHT	ST LUCIE	N	EH-4AB	20,067	75	1974	5/8	29' 3"	2	HUB	750	300	SA-688-304	05-80			X
79H412	FLORIDA POWER & LIGHT	ST LUCIE	N	EH-3AB	14,639	59	938	5/8	38' 3"	2	HUB	750	75	SA-688-304	01-80	850		X
79H412	FLORIDA POWER & LIGHT	ST LUCIE	N	EH-2AB	15,103	63	1478	3/4	29' 7"	2	HUB	750	50	SA-688-304	01-80	850		X
79H412	FLORIDA POWER & LIGHT	ST LUCIE	N	EH-1AB	20,739	67	1164	5/8	43' 9"	2	HUB	750	50	SA-688-304	01-80	850		X
79H412	FLORIDA POWER & LIGHT	ST LUCIE	N	EH-5AB	24,325	71	2193	5/8	32' 2"	2	HUM	1875	424	SA-688-304L	01-80	850		X
79H411	FLORIDA POWER & LIGHT	ST LUCIE	N	EH-4AB	20,067	75	1974	5/8	29' 3"	2	HUB	750	300	SA-688-304	01-80	850		X
79H411	FLORIDA POWER & LIGHT	ST LUCIE	N	EH-3AB	14,639	59	938	5/8	38' 3"	2	HUB	750	75	SA-688-304	11-79	890		X
79H411	FLORIDA POWER & LIGHT	ST LUCIE	N	EH-2AB	15,103	63	1478	3/4	29' 7"	2	HUB	750	50	SA-688-304	11-79	890		X
79H411	FLORIDA POWER & LIGHT	ST LUCIE	N	EH-1AB	20,739	67	1164	5/8	43' 9"	2	HUB	750	50	SA-688-304	11-79	890		X
79H411	FLORIDA POWER & LIGHT	ST LUCIE	N	EH-5AB	24,325	71	2193	3/4	32' 2"	2	HUM	1875	424	SA-688-304L	11-79	890		X
78H251	TENNESSEE VALLEY AUTHORITY	YELLOW CREEK	2 N	EH-4ABC	11,760	57	773	1	31' 9"	2	HUEH	660	115	SA-249-304	11-80	1375		
78H251	TENNESSEE VALLEY AUTHORITY	YELLOW CREEK	2 N	EH-3ABC	12,575	60	830	7/8	31' 7"	2	HUEH	660	275	SA-249-304	03-80	1375		
78H251	TENNESSEE VALLEY AUTHORITY	YELLOW CREEK	2 N	EH-2ABC	22,365	77	2294	7/8	27' 11"	2	HUH	2200	355	SA-249-304	03-80	1375		
78H251	TENNESSEE VALLEY AUTHORITY	YELLOW CREEK	2 N	EH-1ABC	22,085	75	2308	5/8	27' 4"	2	HUH	2200	545	SA-249-304	03-80	1375		
78H250	TENNESSEE VALLEY AUTHORITY	YELLOW CREEK	1 N	EH-8ABC	12,835	70	675	5/8	40' 2"	2	HUEH	660	50	SA-249-304	03-80	1375		
78H250	TENNESSEE VALLEY AUTHORITY	YELLOW CREEK	1 N	EH-7ABC	19,475	70	1217	7/8	39' 3"	2	HUEH	660	50	SA-249-304	07-79	1375		
78H250	TENNESSEE VALLEY AUTHORITY	YELLOW CREEK	1 N	EH-6ABC	13,825	65	641	3/4	39' 8"	2	HUEH	660	50	SA-249-304	06-79	1375		
78H250	TENNESSEE VALLEY AUTHORITY	YELLOW CREEK	1 N	EH-5ABC	12,550	58	580	1	40' 0"	2	HUEH	660	65	SA-249-304	07-79	1375		
78H250	TENNESSEE VALLEY AUTHORITY	YELLOW CREEK	1 N	EH-4ABC	11,760	57	773	1	31' 9"	2	HUEH	660	115	SA-249-304	07-79	1375		
78H250	TENNESSEE VALLEY AUTHORITY	YELLOW CREEK	1 N	EH-3ABC	12,575	60	830	7/8	31' 7"	2	HUEH	660	275	SA-249-304	07-79	1375		
78H250	TENNESSEE VALLEY AUTHORITY	YELLOW CREEK	1 N	EH-2ABC	21,760	75	2217	7/8	28' 2"	2	HUH	2000	355	SA-249-304	09-80	1375		

YUBA HEAT TRANSFER
PARTIAL INSTALLATION LIST FOR
NUCLEAR POWER PLANTS

JOB #	CUSTOMER	STATION	UNIT	ITEM	SQ FT	ID	# U-TUBE	OD	LENGTH	P	TYPE	DESIGN TUBE	DESIGN SHELL	MATERIAL	SHIP DATE	MW (ea unit)	INSTALLATION	FIELD SERVICE SUPERVISION
78H250	TENNESSEE VALLEY AUTHORITY	YELLOW CREEK	1 N	EH-1ABC	21,435	73	2237	5/8	27' 6"	2	HUH	2000	545	SA-249-304	09-80	1375		
76H108	BOSTON EDISON CO	PILGRAM NUCLEAR S	2 N	EH-6AB	23,350	86	3191	5/8	20' 4"	2	HUH	1600	600	SA-249-304	12-77			
76H108	BOSTON EDISON CO	PILGRAM NUCLEAR S	2 N	EH-5AB	31,445	97	4279	5/8	20' 2"	2	HUH	1600	350	SA-249-304	12-77			
75H935	PUBLIC SERVICE CO OF INDIANA	MARBLE HILL	2 N	EH-1ABC	13,710	57	1201	5/8	33' 8"	2	HUEH	850	50	SA-249-304	08-76			
75H935	PUBLIC SERVICE CO OF INDIANA	MARBLE HILL	2 N	EH-2ABC	15,075	58	797	5/8	46' 11"	2	HUEH	850	50	SA-249-304	05-80	1100		
75H935	PUBLIC SERVICE CO OF INDIANA	MARBLE HILL	2 N	EH-3ABC	13,200	53	767	3/4	42' 7"	2	HUEH	850	50	SA-249-304	04-80	1100		
75H935	PUBLIC SERVICE CO OF INDIANA	MARBLE HILL	2 N	EH-4ABC	12,615	55	673	3/4	39' 7"	2	HUEH	850	125	SA-249-304	05-80	1100		
75H935	PUBLIC SERVICE CO OF INDIANA	MARBLE HILL	2 N	EH-5AB	22,290	78	1842	7/8	29' 3"	2	HUEH	850	275	SA-249-304	05-80	1100		
75H935	PUBLIC SERVICE CO OF INDIANA	MARBLE HILL	2 N	EH-6AB	28,110	82	2037	3/4	33' 3"	2	HUEH	850	400	SA-249-304	07-80	1100		
75H935	PUBLIC SERVICE CO OF INDIANA	MARBLE HILL	2 N	EH-7AB	30,830	87	3583	3/4	24' 2"	2	HUH	2400	550	SA-249-304L	06-80	1100		
75H934	PUBLIC SERVICE CO OF INDIANA	MARBLE HILL	1 N	EH-6AB	28,110	82	2037	5/8	33' 3"	2	HUEH	850	400	SA-249-304	07-80	1100		
75H934	PUBLIC SERVICE CO OF INDIANA	MARBLE HILL	1 N	EH-5AB	22,290	78	1842	3/4	29' 3"	2	HUEH	850	275	SA-249-304	03-79	1100		
75H934	PUBLIC SERVICE CO OF INDIANA	MARBLE HILL	1 N	EH-4ABC	12,615	55	673	3/4	39' 7"	2	HUEH	850	125	SA-249-304	04-79	1100		
75H934	PUBLIC SERVICE CO OF INDIANA	MARBLE HILL	1 N	EH-3ABC	13,200	53	767	7/8	42' 7"	2	HUEH	850	50	SA-249-304	03-79	1100		
75H934	PUBLIC SERVICE CO OF INDIANA	MARBLE HILL	1 N	EH-2ABC	15,075	58	797	3/4	46' 11"	2	HUEH	850	50	SA-249-304	03-79	1100		
75H934	PUBLIC SERVICE CO OF INDIANA	MARBLE HILL	1 N	EH-1ABC	13,710	57	1201	3/4	33' 8"	2	HUEH	850	50	SA-249-304	03-79	1100		
75H934	PUBLIC SERVICE CO OF INDIANA	MARBLE HILL	1 N	EH-7AB	30,830	87	3583	5/8	24' 2"	2	HUH	2400	500	SA-249-304L	01-79	1100		
74H854	PUBLIC SERVICE E&G OF NJ	HOPE CREEK	2 N	LP-5ABC	18,740	68	1091	5/8	42' 2"	2	HUHSMW	850	225	SA-249-304	03-76			
74H854	PUBLIC SERVICE E&G OF NJ	HOPE CREEK	2 N	LP-4ABC	18,880	68	1091	3/4	42- 6"	2	HUHSMW	850	125	SA-249-304		1117		
74H854	PUBLIC SERVICE E&G OF NJ	HOPE CREEK	2 N	LP-3ABC	25,575	77	1638	3/4	46' 1"	2	HUHSMW	850	75	SA-249-304	07-78	1117		
74H854	PUBLIC SERVICE E&G OF NJ	HOPE CREEK	2 N	LP-2ABC	16,790	64	1091	5/8	37' 11"	2	HUHSMW	850	50	SA-249-304	06-78	1117		
74H854	PUBLIC SERVICE E&G OF NJ	HOPE CREEK	2 N	LP-1ABC	16,310	67	1091	3/4	36' 8"	2	HUHSMW	850	50	SA-249-304	10-77	1117		
74H854	PUBLIC SERVICE E&G OF NJ	HOPE CREEK	2 N	HP-6ABC	17,755	64	1816	3/4	28' 5"	2	HUHSMW	1800	425	SA-249-304	08-77	1117		
74H853	PUBLIC SERVICE E&G OF NJ	HOPE CREEK	1 N	LP-5ABC	18,740	68	1091	5/8	42' 2"	2	HUHSMW	850	225	SA-249-304	08-78	1117		
74H853	PUBLIC SERVICE E&G OF NJ	HOPE CREEK	1 N	LP-4ABC	18,880	68	1091	3/4	42' 6"	2	HUHSMW	850	125	SA-249-304	10-77	1117		
74H853	PUBLIC SERVICE E&G OF NJ	HOPE CREEK	1 N	LP-3ABC	25,575	77	1638	3/4	46' 1"	2	HUHSMW	850	75	SA-249-304	08-77	1117		
74H853	PUBLIC SERVICE E&G OF NJ	HOPE CREEK	1 N	LP-2ABC	16,790	64	1091	5/8	37' 11"	2	HUHSMW	850	50	SA-249-304	08-77	1117		
74H853	PUBLIC SERVICE E&G OF NJ	HOPE CREEK	1 N	LP-1ABC	16,310	67	1091	3/4	36' 8"	2	HUHSMW	850	50	SA-249-304	12-76	1117		
74H853	PUBLIC SERVICE E&G OF NJ	HOPE CREEK	1 N	HP-6ABC	17,755	64	1816	3/4	28' 5"	2	HUHSMW	1800	425	SA-249-304	10-76	1117		
74H836	COMMONWEALTH EDISON CO	BRAIDWOOD	1 N	EH-6AB	28,110	82	2037	5/8	33' 3"	2	HUEH	850	400	SA-249-304	11-78	1225		
74H836	COMMONWEALTH EDISON CO	BRAIDWOOD	1 N	EH-5AB	22,270	78	1842	3/4	29' 3"	2	HUEH	850	275	SA-249-304	06-77	1225		
74H836	COMMONWEALTH EDISON CO	BRAIDWOOD	1 N	EH-3ABC	13,200	53	767	3/4	42' 7"	2	HUEH	850	50	SA-249-304	11-77	1225		
74H836	COMMONWEALTH EDISON CO	BRAIDWOOD	1 N	EH-2ABC	15,075	58	797	3/4	46' 11"	2	HUEH	850	50	SA-249-304	09-77	1225		
74H836	COMMONWEALTH EDISON CO	BRAIDWOOD	1 N	EH-1ABC	13,710	57	1201	3/4	33' 8"	2	HUEH	850	50	SA-249-304	11-77	1225		
74H836	COMMONWEALTH EDISON CO	BRAIDWOOD	1 N	EH-4ABC	12,615	55	673	5/8	39' 7"	2	HUEH	850	125	SA-249-304	05-77	1225		

YUBA HEAT TRANSFER
PARTIAL INSTALLATION LIST FOR
NUCLEAR POWER PLANTS

JOB #	CUSTOMER	STATION	UNIT	ITEM	SQ FT	ID	# U-TUBE	OD	LENGTH	P	TYPE	DESIGN TUBE	DESIGN SHELL	MATERIAL	SHIP DATE	MW (ea unit)	INSTALLATION	FIELD SERVICE SUPERVISION
74H836	COMMONWEALTH EDISON CO	BRAIDWOOD	1 N	EH-7AB	30,830	87	3583	5/8	24' 2"	2	HUH	2400	550	SA-249-304	07-77	1225		
74H835	COMMONWEALTH EDISON CO	BYRON	2 N	EH-6AB	28,110	82	2037	5/8	33' 3"	2	HUEH	850	400	SA-249-304	12-77	1225		X
74H835	COMMONWEALTH EDISON CO	BYRON	2 N	EH-5AB	22,290	78	1842	3/4	29' 3"	2	HUEH	850	275	SA-249-304	04-78	1225		X
74H835	COMMONWEALTH EDISON CO	BYRON	2 N	EH-4ABC	12,615	55	673	3/4	38' 7"	2	HUEH	850	125	SA-249-304	06-78	1225		X
74H835	COMMONWEALTH EDISON CO	BYRON	2 N	EH-3ABC	13,200	53	767	7/8	42' 7"	2	HUEH	850	50	SA-249-304	04-78	1225		X
74H835	COMMONWEALTH EDISON CO	BYRON	2 N	EH-2ABC	15,075	58	797	3/4	46' 11"	2	HUEH	850	50	SA-249-304	04-78	1225		X
74H835	COMMONWEALTH EDISON CO	BYRON	2 N	EH-1ABC	13,710	57	1201	3/4	33' 8"	2	HUEH	850	50	SA-249-304	04-78	1225		X
74H835	COMMONWEALTH EDISON CO	BYRON	2 N	EH-7AB	30,830	87	3583	7/8	24' 2"	2	HUH	2400	550	SA-249-304	03-78	1225		X
74H834	COMMONWEALTH EDISON CO	BYRON	1 N	EH-6AB	28,110	82	2037	5/8	33' 3"	2	HUEH	850	400	SA-249-304	07-78	1225		
74H834	COMMONWEALTH EDISON CO	BYRON	1 N	EH-5AB	22,290	78	1842	3/4	29' 3"	2	HUEH	850	275	SA-249-304	08-77	1225		
74H834	COMMONWEALTH EDISON CO	BYRON	1 N	EH-4ABC	12,615	55	673	3/4	39' 7"	2	HUEH	850	125	SA-249-304	04-77	1225		
74H834	COMMONWEALTH EDISON CO	BYRON	1 N	EH-3ABC	13,200	53	767	7/8	42' 7"	2	HUEH	850	50	SA-249-304	06-77	1225		
74H834	COMMONWEALTH EDISON CO	BYRON	1 N	EH-2ABC	15,075	58	797	3/4	46' 11"	2	HUEH	850	50	SA-249-304	09-77	1225		
74H834	COMMONWEALTH EDISON CO	BYRON	1 N	EH-1ABC	13,710	57	1201	3/4	33' 8"	2	HUEH	850	50	SA-249-304	06-77	1225		
74H834	COMMONWEALTH EDISON CO	BYRON	1 N	EH-7AB	30,830	87	3583	5/8	24' 2"	2	HUH	2400	550	SA-249-304	05-77	1225		
74H831	MISSISSIPPI POWER & LIGHT	GRAND GULF	2 N	EH-4ABC	12,995	55	779	5/8	41' 0"	2	HUEH	800	50	SA-249-304	11-75			
74H831	MISSISSIPPI POWER & LIGHT	GRAND GULF	2 N	EH-3ABC	11,930	56	779	3/4	37' 6"	2	HUEH	800	50	SA-249-304	11-78	1250		
74H831	MISSISSIPPI POWER & LIGHT	GRAND GULF	2 N	EH-2ABC	13,245	56	821	3/4	39' 10"	2	HUEH	800	50	SA-249-304	12-78	1250		
74H831	MISSISSIPPI POWER & LIGHT	GRAND GULF	2 N	EH-1ABC	6,960	50	416	3/4	30' 9"	2	HUEH	800	50	SA-249-304	11-78	1250		
74H831	MISSISSIPPI POWER & LIGHT	GRAND GULF	2 N	EH-6AB	40,560	98	4059	3/4	28' 3"	2	HUH	2200	400	SA-249-304	12-78	1250		
74H831	MISSISSIPPI POWER & LIGHT	GRAND GULF	2 N	EH-5AB	32,750	87	3770	5/8	24' 4"	2	HUH	2200	150	SA-249-304	12-78	1250		
74H830	MISSISSIPPI POWER & LIGHT	GRAND GULF	1 N	EH-4ABC	12,995	55	779	5/8	41' 0"	2	HUEH	800	50	SA-249-304	01-79	1250		
74H830	MISSISSIPPI POWER & LIGHT	GRAND GULF	1 N	EH-3ABC	11,930	56	779	3/4	37' 6"	2	HUEH	800	50	SA-249-304	02-76	1250		
74H830	MISSISSIPPI POWER & LIGHT	GRAND GULF	1 N	EH-2ABC	13,245	56	821	3/4	39' 10"	2	HUEH	800	50	SA-249-304	01-76	1250		
74H830	MISSISSIPPI POWER & LIGHT	GRAND GULF	1 N	EH-1ABC	6,960	50	416	3/4	30' 9"	2	HUEH	800	50	SA-249-304	12-75	1250		
74H830	MISSISSIPPI POWER & LIGHT	GRAND GULF	1 N	EH-6AB	40,560	98	4059	1	28' 3"	2	HUH	2200	400	SA-249-304	11-75	1250		
74H830	MISSISSIPPI POWER & LIGHT	GRAND GULF	1 N	EH-5AB	32,750	87	3770	5/8	24' 4"	2	HUH	2200	150	SA-249-304	11-76	1250		
73H800	GULF STATES UTILITIES	RIVER BEND	1 N	EA-8AB	1,800	32	474	3/4	14' 6"	1	HUEHMW	600	50	SA-249-304 (.05MC)	12-74			X
73H800	GULF STATES UTILITIES	RIVER BEND	1 N	EA-7AB	1,780	32	474	1	14' 5"	1	HUEHMW	600	100	SA-249-304 (.05MC)	11-78	991		X
73H800	GULF STATES UTILITIES	RIVER BEND	1 N	EH-6AB	20,775	71	1700	1	35' 10"	2	HUEHMW	600	50	SA-249-304 (.05MC)	11-78	991		X
73H800	GULF STATES UTILITIES	RIVER BEND	1 N	EH-5AB	22,310	65	1671	5/8	39' 3"	2	HUEHMW	600	50	SA-249-304 (.05MC)	11-78	991		X
73H800	GULF STATES UTILITIES	RIVER BEND	1 N	EH-4AB	18,000	61	1369	5/8	35' 2"	2	HUEHMW	600	100	SA-249-304 (.05MC)	11-78	991		X
73H800	GULF STATES UTILITIES	RIVER BEND	1 N	EH-3AB	14,210	94	966	5/8	36' 1"	2	HUEHMW	600	150	SA-249-304 (.05MC)	11-78	991		X
73H800	GULF STATES UTILITIES	RIVER BEND	1 N	EH-2AB	22,380	71	1428	3/4	38' 3"	2	HUEHMW	600	275	SA-249-304 (.05MC)	10-78	991		X
73H800	GULF STATES UTILITIES	RIVER BEND	1 N	EH-1AB	20,835	72	2172	3/4	27' 7"	2	HUHSMW	2000	400	SA-249-304 (.05MC)	10-78	991		X

YUBA HEAT TRANSFER
PARTIAL INSTALLATION LIST FOR
NUCLEAR POWER PLANTS

JOB #	CUSTOMER	STATION	UNIT	ITEM	SQ FT	ID	# U-TUBE	OD	LENGTH	P	TYPE	DESIGN TUBE	DESIGN SHELL	MATERIAL	SHIP DATE	MW (ea unit)	INSTALLATION	FIELD SERVICE SUPERVISION
73H769	NORTHEAST UTILITIES	MILESTONE	3 N	EH-6ABC	19,385	63	1374	5/8	41' 10"	2	HUEH	700	50	SA-249-304	12-73	317.25		
73H769	NORTHEAST UTILITIES	MILESTONE	3 N	EH-5ABC	16,500	59	1163	5/8	42' 1"	2	HUEH	700	50	SA-249-304	04-76	1209		
73H769	NORTHEAST UTILITIES	MILESTONE	3 N	EH-4ABC	11,240	61	644	5/8	43' 4"	2	HUEH	700	75	SA-249-304	01-76	1209		
73H769	NORTHEAST UTILITIES	MILESTONE	3 N	EH-3ABC	16,920	64	933	3/4	44' 11"	2	HUEH	700	125	SA-249-304	12-75	1209		
73H769	NORTHEAST UTILITIES	MILESTONE	3 N	EH-2ABC	13,905	60	666	3/4	44' 4"	2	HUEH	700	200	SA-249-304	12-75	1209		
73H769	NORTHEAST UTILITIES	MILESTONE	3 N	EH-1ABC	25,380	70	1838	7/8	40' 6"	2	HUH	1800	500	SA-249-304	12-75	1209		
73H768	NIAGARA MOHAWK POWER	NINEMILE	2 N	EH-4ABC	10,895	96	668	3/4	40' 5"	2	HUB	800	125	SA-249-304 (.05MC)	03-78	1100		X
73H768	NIAGARA MOHAWK POWER	NINEMILE	2 N	EH-5ABC	16,105	64	980	5/8	40' 5"	2	HUEH	800	270	SA-249-304 (.05MC)	03-78	1100		X
73H768	NIAGARA MOHAWK POWER	NINEMILE	2 N	EH-3ABC	15,295	54	1013	3/4	45' 0"	2	HUEH	800	75	SA-249-304 (.05MC)	03-78	1100		X
73H768	NIAGARA MOHAWK POWER	NINEMILE	2 N	EH-2ABC	18,165	68	1125	5/8	48' 1"	2	HUEH	800	50	SA-249-304 (.05MC)	10-78	1100		X
73H768	NIAGARA MOHAWK POWER	NINEMILE	2 N	EH-1ABC	18,030	69	1114	5/8	48' 2"	2	HUEH	800	50	SA-249-304 (.05MC)	11-78	1100		X
73H768	NIAGARA MOHAWK POWER	NINEMILE	2 N	EH-6ABC	21,395	66	1675	5/8	37' 6"	2	HUH	2200	400	SA-249-304 (.05MC)	03-78	1100		X
71H650	GEORGIA POWER CO	EDWIN I HATCH	N2	EH-5AB	15,870	69	966	5/8	34' 4"	2	HUEHH	600	225	SA-249-304	04-73	85		
71H650	GEORGIA POWER CO	EDWIN I HATCH	N2	EH-4AB	14,555	71	711	7/8	37' 8"	2	HUEHH	600	125	SA-249-304	12-72	850		
71H650	GEORGIA POWER CO	EDWIN I HATCH	N2	EH-3AB	22,760	76	1930	1	34' 6"	2	HUEHH	600	100	SA-249-304	10-72	850		
71H650	GEORGIA POWER CO	EDWIN I HATCH	N2	EH-2AB	24,880	83	2244	5/8	32' 2"	2	HUEHH	600	100	SA-249-304	10-72	850		
71H650	GEORGIA POWER CO	EDWIN I HATCH	N2	EH-1AB	12,235	75	879	5/8	28' 11"	2	HUEHH	600	100	SA-249-304	12-72	850		
71H650	GEORGIA POWER CO	EDWIN I HATCH	N2	EH-6AB	24,560	76	2375	5/8	31' 0"	2	VCUUH	2000	400	SA-249-304	09-72	850		
71H649	JERSEY CENTRAL POWER & LIGH	FORKED RIVER	N1	EH-5AB	19,565	72	925	5/8	44' 8"	2	HUEHH	900	250	SA-249-304	11-72	850		
71H649	JERSEY CENTRAL POWER & LIGH	FORKED RIVER	N1	EH-4AB	24,885	73	1296	7/8	47' 5"	2	HUEHH	900	125	SA-249-304	10-76	38.4		
71H649	JERSEY CENTRAL POWER & LIGH	FORKED RIVER	N1	EH-3ABC	16,529	61	864	3/4	50' 5"	2	HUEHH	900	50	SA-249-304	10-76	38.4		
71H649	JERSEY CENTRAL POWER & LIGH	FORKED RIVER	N1	EH-2ABC	21,575	64	987	3/4	54' 4"	2	HUEHH	900	50	SA-249-304	07-76	38.4		
71H649	JERSEY CENTRAL POWER & LIGH	FORKED RIVER	N1	EH-1ABC	12,415	62	864	3/4	35' 4"	2	HUEHH	900	50	SA-249-304	09-76	38.4		
71H649	JERSEY CENTRAL POWER & LIGH	FORKED RIVER	N1	EH-6ABC	24,770	68	1924	7/8	37' 10"	2	HUH	2150	550	SA-249-304	05-77	38.4		
71H615	PHILADELPHIA ELECTRIC	LIMERICK	2 N	EH-5ABC	18,730	68	1962	5/8	27' 8"	2	HUEHH	700	217	SA-249-304L	03-73			
71H615	PHILADELPHIA ELECTRIC	LIMERICK	2 N	EH-4ABC	17,405	69	1795	5/8	28' 2"	2	HUEHH	700	125	SA-249-304L	08-73	1161.5		
71H615	PHILADELPHIA ELECTRIC	LIMERICK	2 N	EH-3ABC	22,495	74	1802	5/8	36' 7"	2	HUEHH	700	75	SA-249-304L	08-73	1161.5		
71H615	PHILADELPHIA ELECTRIC	LIMERICK	2 N	EH-2ABC	20,220	71	1638	5/8	36' 4"	2	HUEHH	700	50	SA-249-304L	06-73	1161.5		
71H615	PHILADELPHIA ELECTRIC	LIMERICK	2 N	EH-1ABC	12,535	70	583	5/8	39' 8"	2	HUEHH	700	50	SA-249-304L	10-73	1161.5		
71H615	PHILADELPHIA ELECTRIC	LIMERICK	2 N	EH-6ABC	22,160	69	2341	5/8	27' 4"	2	HUH	2100	425	SA-249-304L	06-73	1161.5		
71H614	PHILADELPHIA ELECTRIC	LIMERICK	1 N	EH-5ABC	18,730	68	1962	5/8	27' 8"	2	HUEHH	700	200	SA-249-304L	01-74	1161.5		
71H614	PHILADELPHIA ELECTRIC	LIMERICK	1 N	EH-4ABC	17,405	69	1795	5/8	28' 2"	2	HUEHH	700	125	SA-249-304L	12-72	1161.5		
71H614	PHILADELPHIA ELECTRIC	LIMERICK	1 N	EH-3ABC	22,495	74	1802	5/8	36' 7"	2	HUEHH	700	75	SA-249-304L	09-72	1161.5		
71H614	PHILADELPHIA ELECTRIC	LIMERICK	1 N	EH-2ABC	20,220	70	1638	5/8	36' 4"	2	HUEHH	700	50	SA-249-304L	08-72	1161.5		
71H614	PHILADELPHIA ELECTRIC	LIMERICK	1 N	EH-1ABC	12,535	70	583	5/8	39' 8"	2	HUEHH	700	50	SA-249-304L	08-72	1161.5		

YUBA HEAT TRANSFER
PARTIAL INSTALLATION LIST FOR
NUCLEAR POWER PLANTS

JOB #	CUSTOMER	STATION	UNIT	ITEM	SQ FT	ID	# U-TUBE	OD	LENGTH	P	TYPE	DESIGN TUBE	DESIGN SHELL	MATERIAL	SHIP DATE	MW (ea unit)	INSTALLATION	FIELD SERVICE SUPERVISION
71H614	PHILADELPHIA ELECTRIC	LIMERICK	1 N	EH-6ABC	22,160	69	2341	1	27' 4"	2	HUH	2100	425	SA-249-304L	12-72	1161.5		
70H553	MILLSTONE POIP CO	MILLSTONE	N 2	EH-6AB	15,835	69	1140	3/4	34' 0"	2	HUEHH	650	50	ADMIRALTY SB-395	07-71	565		
70H553	MILLSTONE POIP CO	MILLSTONE	N 2	EH-5AB	16,360	63	1140	3/4	35' 2"	2	HUEHH	650	50	ADMIRALTY SB-395	02-72	863		
70H553	MILLSTONE POIP CO	MILLSTONE	N 2	EH-4AB	14,370	61	1140	3/4	30' 8"	2	HUEHH	650	75	ADMIRALTY SB-395	07-71	863		
70H553	MILLSTONE POIP CO	MILLSTONE	N 2	EH-3AB	9,990	58	1140	3/4	21' 0"	2	HUEHH	650	150	ADMIRALTY SB-395	07-71	863		
70H553	MILLSTONE POIP CO	MILLSTONE	N 2	EH-2AB	22,535	74	1620	3/4	33' 10"	2	HUEHH	650	225	90-10 CuNi	07-71	863		
70H553	MILLSTONE POIP CO	MILLSTONE	N 2	EH-1AB	23,005	76	2658	3/4	24' 8"	2	HUH	1700	450	80-20 CuNi	07-71	863		
69H535	FLORIDA POWER & LIGHT	HUTCHINSON	1	EH-3AB	12,620	60	1072	3/4	28' 8"	2	HUB	750	75	ADMIRALTY SB-395	03-71			
69H535	FLORIDA POWER & LIGHT	HUTCHINSON	1	EH-2AB	12,925	63	1072	3/4	29' 5"	2	HUB	750	50	ADMIRALTY SB-395	07-71	850		
69H535	FLORIDA POWER & LIGHT	HUTCHINSON	1	EH-1AB	18,965	67	1072	3/4	43' 8"	2	HUB	750	50	ADMIRALTY SB-395	07-71	850		
69H535	FLORIDA POWER & LIGHT	HUTCHINSON	1	EH-4AB	18,510	72	1532	3/4	29' 2"	2	HUB	750	300	90-10 CuNi	07-71	850		
69H535	FLORIDA POWER & LIGHT	HUTCHINSON	1	EH-5AB	21,800	71	1531	5/8	34' 8"	2	HUMWTR	1875	425	90-10 CuNi	07-71	850		
69H518	LOUISIANA POWER & LIGHT	NINEMILE	5	EH-6	19,535	62	1112	5/8	43' 5"	1	HUEHH	600	500	SA-556-C2	05-71			
69H518	LOUISIANA POWER & LIGHT	NINEMILE	5	EH-5	14,790	55	1026	3/4	35' 5"	2	HUEHH	600	50	SA-556-C2	05-71			
69H518	LOUISIANA POWER & LIGHT	NINEMILE	5	EH-4	14,040	55	1026	3/4	33' 7"	2	HUEHH	600	700	SA-556-C2	05-71			
69H518	LOUISIANA POWER & LIGHT	NINEMILE	5	EH-3	21,800	71	1680	3/4	38' 0"	2	HUEHH	600	180	SA-556-C2	05-71			
69H518	LOUISIANA POWER & LIGHT	NINEMILE	5	EH-7	14,545	56	981	3/4	44' 0"	2	HUEHH	600	50	SA-249-304	05-71			
69H508	CONSUMERS POWER CO	MIDLAND	2	EH-2AB	15,205	54	1816	5/8	42' 6"	2	HSE	450	50	SA-249-304	02-72	550		
69H508	CONSUMERS POWER CO	MIDLAND	2	EH-1AB	14,235	57	1704	3/4	42' 5"	2	HSE	450	50	SA-249-304	02-72	852		
69H508	CONSUMERS POWER CO	MIDLAND	2	EH-5AB	17,655	66	1716	5/8	30' 0"	2	HUH	1300	450	SA-249-304	02-72	852		
69H508	CONSUMERS POWER CO	MIDLAND	2	EH-4AB	21,750	75	1903	5/8	33' 5"	2	HUH	1300	225	SA-249-304	02-72	852		
69H496	CAROLINA POWER & LIGHT	BRUNSWICK	1	EH-3AB	13,030	52	1076	5/8	35' 11"	2	HUEHH	500	100	SA-249-304L	10-70			
69H496	CAROLINA POWER & LIGHT	BRUNSWICK	1	EH-2AB	16,255	63	1522	5/8	31' 0"	2	HUEHH	500	50	SA-249-304L	01-72	815		
69H496	CAROLINA POWER & LIGHT	BRUNSWICK	1	EH-1AB	17,380	68	1627	5/8	31' 1"	2	HUEHH	500	50	SA-249-304L	01-72	815		
69H496	CAROLINA POWER & LIGHT	BRUNSWICK	1	EH-5AB	24,045	69	2006	5/8	35' 2"	2	HUH	1700	550	SA-249-304L	01-72	815		
69H496	CAROLINA POWER & LIGHT	BRUNSWICK	1	EH-4AB	32,580	82	2332	5/8	41' 0"	2	HUH	1700	400	SA-249-304L	05-72	815		
69H495	CAROLINA POWER & LIGHT	BRUNSWICK	2	EH-3AB	13,030	52	1076	5/8	35' 11"	2	HUEHH	500	100	SA-249-304L	05-72	815		
69H495	CAROLINA POWER & LIGHT	BRUNSWICK	2	EH-2AB	16,255	63	1522	5/8	31' 0"	2	HUEHH	500	50	SA-249-304L	01-71	815		
69H495	CAROLINA POWER & LIGHT	BRUNSWICK	2	EH-1AB	17,380	68	1627	5/8	31' 1"	2	HUEHH	500	50	SA-249-304L	01-71	815		
69H495	CAROLINA POWER & LIGHT	BRUNSWICK	2	EH-5AB	24,045	69	2006	5/8	35' 2"	2	HUH	1700	550	SA-249-304L	01-71	815		
69H495	CAROLINA POWER & LIGHT	BRUNSWICK	2	EH-4AB	32,580	82	2332	5/8	41' 0"	2	HUH	1700	400	SA-249-304L	05-71	815		
69H476	FLORIDA POWER CORP	CRYSTAL RIVER	3	EH-1AB	21,680	70	1494	3/4	42' 5"	2	HUEHH	400	50	SA-249-304L	09-69	205		
69H476	FLORIDA POWER CORP	CRYSTAL RIVER	3	EH-2AB	13,860	55	800	3/4	42' 11"	2	HUEHH	400	50	SA-249-394 (.05Mc)	06-70	860		
69H476	FLORIDA POWER CORP	CRYSTAL RIVER	3	EH-5AB	26,865	78	1580	5/8	41' 10"	2	HUEHH	400	290	SA-249-304 (.05MC)	06-70	860		
69H476	FLORIDA POWER CORP	CRYSTAL RIVER	3	EH-3AB	13,550	53	773	3/4	43' 9"	2	HUEHH	400	50	SA-249-304 (.05MC)	06-70	860		

YUBA HEAT TRANSFER
PARTIAL INSTALLATION LIST FOR
NUCLEAR POWER PLANTS

JOB #	CUSTOMER	STATION	UNIT	ITEM	SQ FT	ID	# U-TUBE	OD	LENGTH	P	TYPE	DESIGN TUBE	DESIGN SHELL	MATERIAL	SHIP DATE	MW (ea unit)	INSTALLATION	FIELD SERVICE SUPERVISION
69H476	FLORIDA POWER CORP	CRYSTAL RIVER	3	EH-6AB	29,160	79	2212	5/8	38' 1"	2	HUH	1600	600	SA-249-304 (.05MC)	06-70	860		
69H475	GEORGIA POWER CO	EDWIN I HATCH	N1	EH-4AB	14,220	71	1256	5/8	27' 7"	2	HUEHH	600	125	SA-249-304	06-70	860		
69H475	GEORGIA POWER CO	EDWIN I HATCH	N1	EH-3AB	21,870	76	1836	3/4	34' 11"	2	HUEHH	600	75	SA-249-304	11-70	850		
69H475	GEORGIA POWER CO	EDWIN I HATCH	N1	EH-2AB	24,180	83	2230	5/8	31' 6"	2	HUEHH	600	50	SA-249-304	11-70	850		
69H475	GEORGIA POWER CO	EDWIN I HATCH	N1	EH-1AB	12,130	74	1174	5/8	25' 2"	2	HUEHH	600	50	SA-249-304	11-70	850		
69H475	GEORGIA POWER CO	EDWIN I HATCH	N1	EH-5AB	25,270	76	2400	5/8	30' 6"	2	VCUUH	2000	300	SA-249-304	11-70	850		
69H469	NEW YORK POWER AUTHORITY	JAMES A. FITZPATRIC	N	EH-6AB	25,314	73	2260	5/8	32' 7"	2	HUEHH	2100	400	SA-249-304	08-69			X
69H469	NEW YORK POWER AUTHORITY	JAMES A. FITZPATRIC	N	EH-5AB	21,045	67	1240	5/8	41' 8"	2	HUEHH	800	250	SA-249-304	03-71	849		X
69H469	NEW YORK POWER AUTHORITY	JAMES A. FITZPATRIC	N	EH-2AB	34,610	90	2470	3/4	41' 3"	2	HUEHH	800	50	SA-249-304	03-71	849		X
69H469	NEW YORK POWER AUTHORITY	JAMES A. FITZPATRIC	N	EH-1AB	20,720	66	1236	5/8	41' 2"	2	HUEHH	800	50	SA-249-304	10-70	849		X
69H469	NEW YORK POWER AUTHORITY	JAMES A. FITZPATRIC	N	EH-4AB	20,554	81	1270	3/4	39' 10"	2	HUEHH	800	150	SA-249-304	10-70	849		X
68H438	BALTIMORE GAS & ELECTRIC	CALVERT CLIFFS	2	EH-9AB	12,750	53	796	3/4	39' 7"	2	HUB	700	50	SA-249-304L	05-70	789		
68H438	BALTIMORE GAS & ELECTRIC	CALVERT CLIFFS	2	EH-8ABC	10,630	49	818	3/4	38' 6"	2	HUB	300	50	SA-249-304L	12-70	914.35	X	X
68H438	BALTIMORE GAS & ELECTRIC	CALVERT CLIFFS	2	EH-7ABC	11,430	54	880	5/8	38' 10"	2	HUB	300	50	SA-249-304L	09-70	914.35	X	X
68H438	BALTIMORE GAS & ELECTRIC	CALVERT CLIFFS	2	EH-11AB	21,430	70	1800	5/8	34' 10"	2	HUB	700	150	SA-249-304L	09-70	914.35	X	X
68H438	BALTIMORE GAS & ELECTRIC	CALVERT CLIFFS	2	EH-10AB	11,460	51	796	5/8	35' 6"	2	HUB	700	75	SA-249-304L	12-70	914.35	X	X
68H438	BALTIMORE GAS & ELECTRIC	CALVERT CLIFFS	2	EH-12AB	30,115	71	2006	5/8	44' 1"	2	HUMW	1500	450	SA-249-304L	12-70	914.35	X	X
68H437	BALTIMORE GAS & ELECTRIC	CALVERT CLIFFS	1	EH-5AB	22,520	71	1804	5/8	36' 8"	2	HUB	700	225	SA-249-304L	12-70	914.35		
68H437	BALTIMORE GAS & ELECTRIC	CALVERT CLIFFS	1	EH-4AB	11,975	65	840	5/8	35' 2"	2	HUB	700	125	SA-249-304L	06-70	914.35		
68H437	BALTIMORE GAS & ELECTRIC	CALVERT CLIFFS	1	EH-3AB	17,095	57	1278	3/4	39' 6"	2	HUB	700	75	SA-249-304L	06-70	914.35		
68H437	BALTIMORE GAS & ELECTRIC	CALVERT CLIFFS	1	EH-2ABC	13,715	55	1010	5/8	40' 2"	2	HUB	300	50	SA-249-304L	06-70	914.35		
68H437	BALTIMORE GAS & ELECTRIC	CALVERT CLIFFS	1	EH-1ABC	10,250	60	892	5/8	35' 7"	2	HUB	300	50	SA-249-304L	04-70	914.35		
68H437	BALTIMORE GAS & ELECTRIC	CALVERT CLIFFS	1	EH-6AB	23,840	68	1922	3/4	36' 2"	2	HUMW	1500	475	SA-249-304L	04-70	914.35		
68H416	COMMONWEALTH EDISON CO	ZION	2	EH-5ABC	16,460	64	1060	5/8	38' 4"	2	HUB	650	225	SA-249-304L	04-70	446		
68H416	COMMONWEALTH EDISON CO	ZION	2	EH-4ABC	9,965	50	717	3/4	34' 3"	2	HUB	650	100	SA-249-304L	02-71	1098		
68H416	COMMONWEALTH EDISON CO	ZION	2	EH-3ABC	14,185	55	832	3/4	42' 4"	2	HUB	650	50	SA-249-304L	02-71	1098		
68H416	COMMONWEALTH EDISON CO	ZION	2	EH-2ABC	14,230	57	796	3/4	44' 5"	2	HUB	650	50	SA-249-304L	02-71	1098		
68H416	COMMONWEALTH EDISON CO	ZION	2	EH-1ABC	17,535	64	1535	3/4	33' 3"	2	HUB	650	50	SA-249-304L	02-71	1098		
68H416	COMMONWEALTH EDISON CO	ZION	2	EH-6ABC	25,025	70	1926	5/8	37' 2"	2	HUMW	2000	45	SA-249-304L	02-71	1098		
67H394	COMMONWEALTH EDISON CO	ZION	1	EH-5ABC	16,460	64	1060	5/8	38' 4"	2	HUB	650	225	SA-249-304L	08-70	531		
67H394	COMMONWEALTH EDISON CO	ZION	1	EH-4ABC	10,095	51	759	3/4	32' 8"	2	HUB	650	100	SA-249-304L	08-70	1098		
67H394	COMMONWEALTH EDISON CO	ZION	1	EH-3ABC	14,185	55	832	3/4	42' 2"	2	HUB	650	50	SA-249-304L	08-70	1098		
67H394	COMMONWEALTH EDISON CO	ZION	1	EH-2ABC	14,230	57	796	3/4	44' 5"	2	HUB	650	50	SA-249-304L	03-70	1098		
67H394	COMMONWEALTH EDISON CO	ZION	1	EH-1ABC	17,535	64	1535	3/4	33' 3"	2	HUB	650	50	SA-249-304L	03-70	1098		
67H394	COMMONWEALTH EDISON CO	ZION	1	EH-6ABC	25,025	70	1926	3/4	37' 2"	2	HUMW	2000	450	SA-249-304L	03-70	1098		

YUBA HEAT TRANSFER
PARTIAL INSTALLATION LIST FOR
NUCLEAR POWER PLANTS

JOB #	CUSTOMER	STATION	UNIT	ITEM	SQ FT	ID	# U-TUBE	OD	LENGTH	P	TYPE	DESIGN TUBE	DESIGN SHELL	MATERIAL	SHIP DATE	MW (ea unit)	INSTALLATION	FIELD SERVICE SUPERVISION
67H391	LOUISIANA POWER & LIGHT	NINEMILE	4	EH-7	14,545	56	981	5/8	44' 0"	2	HUEHH	600	50	SA-249-304	04-69			
67H391	LOUISIANA POWER & LIGHT	NINEMILE	4	EH-6	19,535	62	1112	5/8	43' 5"	2	HUEHH	600	50	SA-210	04-69			
67H391	LOUISIANA POWER & LIGHT	NINEMILE	4	EH-5	14,790	55	1026	3/4	35' 5"	2	HUEHH	600	50	SA-210	04-69			
67H391	LOUISIANA POWER & LIGHT	NINEMILE	4	EH-4	14,040	55	1026	3/4	33' 7"	2	HUEHH	600	70	SA-210	04-69			
67H391	LOUISIANA POWER & LIGHT	NINEMILE	4	EH-3	21,800	71	1680	3/4	38' 0"	2	HUEHH	600	180	SA-210	04-69			
66H318	COMMONWEALTH EDISON CO	QUAD CITIES	2	EH-3ABC	13,640	64	1250	5/8	26' 4"	4	HUB	450	75	SA-249-304	05-67	93.86		X
66H318	COMMONWEALTH EDISON CO	QUAD CITIES	2	EH-2ABC	16,480	78	1604	3/4	24' 9"	4	HUB	450	50	SA-249-304	11-68	828		X
66H318	COMMONWEALTH EDISON CO	QUAD CITIES	2	EH-1ABC	12,725	68	1250	3/4	24' 7"	4	HUB	450	50	SA-249-304	11-68	828		X
66H318	COMMONWEALTH EDISON CO	QUAD CITIES	2	EH-4ABC	11,550	47	910	5/8	37' 6"	2	VCDUMW	1800	150	SA-249-304	11-68	828		X
66H298	COMMONWEALTH EDISON CO	QUAD CITIES	1	EH-1ABC	12,725	68	1250	3/4	24' 7"	4	HUB	450	50	SA-249-304	12-66			
66H298	COMMONWEALTH EDISON CO	QUAD CITIES	1	EH-3ABC	13,640	64	1250	5/8	26' 4"	4	HUB	450	75	SA-249-304	12-67	828		
66H298	COMMONWEALTH EDISON CO	QUAD CITIES	1	EH-2ABC	16,480	78	1604	3/4	24' 9"	4	HUB	450	50	SA-249-304	12-67	828		
66H298	COMMONWEALTH EDISON CO	QUAD CITIES	1	EH-4ABC	11,550	47	910	5/8	37' 6"	2	VCDUMW	1900	150	SA-249-304	12-67	828		
66H277	COMMONWEALTH EDISON CO	ATOMIC DRESDEN	3	EH-2ABC	16,480	78	1604	3/4	24' 9"	4	HUB	450	50	SA-249-304L	12-66			X
66H277	COMMONWEALTH EDISON CO	ATOMIC DRESDEN	3	EH-3ABC	13,640	64	1250	5/8	26' 4"	4	HUB	450	75	SA-249-304L	10-67	810		X
66H277	COMMONWEALTH EDISON CO	ATOMIC DRESDEN	3	EH-1ABC	12,725	68	1250	3/4	24' 7"	4	HUB	450	50	SA-249-304L	10-67	810		X
66H277	COMMONWEALTH EDISON CO	ATOMIC DRESDEN	3	EH-4ABC	11,550	47	910	5/8	37' 6"	2	VCDUMW	1900	150	SA-249-304L	10-67	810		X
65H265	COMMONWEALTH EDISON CO	ATOMIC DRESDEN	2	EH-1ABC	12,725	68	1250	3/4	24' 7"	4	HUB	450	50	SA-249-304	05-66			
65H265	COMMONWEALTH EDISON CO	ATOMIC DRESDEN	2	EH-3ABC	13,640	64	1250	5/8	26' 4"	4	HUB	450	75	SA-249-304	10-66	810		
65H265	COMMONWEALTH EDISON CO	ATOMIC DRESDEN	2	EH-2ABC	16,480	78	1604	3/4	24' 9"	4	HUB	450	50	SA-249-304	10-66	810		
65H265	COMMONWEALTH EDISON CO	ATOMIC DRESDEN	2	EH-4ABC	11,550	47	910	3/4	37' 6"	2	VUMW	1900	150	SA-249-304	10-66	810		
64H191	FLORIDA POWER & LIGHT	TURKEY POINT	2	EH-5	6,447	45	677	3/4	23' 2"	2	HUB	460	175	ADMIRALTY SB-395	08-66	402		X
64H191	FLORIDA POWER & LIGHT	TURKEY POINT	2	EH-4	6,102	41	536	3/4	27' 10"	2	HUB	460	100	ADMIRALTY SB-395	05-66	759.97		X
64H191	FLORIDA POWER & LIGHT	TURKEY POINT	2	EH-3	4,696	40	536	3/4	21' 2"	2	HUB	460	50	ADMIRALTY SB-395	05-66	759.97		X
64H191	FLORIDA POWER & LIGHT	TURKEY POINT	2	EH-2	5,477	40	536	3/4	25' 0"	2	HUB	460	50	ADMIRALTY SB-395	05-66	759.97		X
64H191	FLORIDA POWER & LIGHT	TURKEY POINT	2	EH-1	8,995	45	845	3/4	31' 3"	2	HUB	460	50	ADMIRALTY SB-395	05-66	759.97		X
64H191	FLORIDA POWER & LIGHT	TURKEY POINT	2	EH-7	17,355	50	900	5/8	47' 10"	2	HUMW	4200	700	SA-106-C	05-66	759.97		X
64H191	FLORIDA POWER & LIGHT	TURKEY POINT	2	EH-6	11,700	51	900	3/4	31' 10"	2	HUMW	4200	350	SA-106-C	05-66	759.97		X
64H190	FLORIDA POWER & LIGHT	TURKEY POINT	1	EH-5	6,447	45	677	3/4	23' 2"	2	HUB	460	175	ADMIRALTY SB-395	05-66	759.97		
64H190	FLORIDA POWER & LIGHT	TURKEY POINT	1	EH-4	6,102	41	536	3/4	27' 10"	2	HUB	460	100	ADMIRALTY SB-395	05-65	759.97		
64H190	FLORIDA POWER & LIGHT	TURKEY POINT	1	EH-3	4,696	40	536	3/4	21' 2"	2	HUB	460	50	ADMIRALTY SB-395	05-65	759.97		
64H190	FLORIDA POWER & LIGHT	TURKEY POINT	1	EH-2	5,477	49	536	3/4	25' 0"	2	HUB	460	50	ADMIRALTY SB-395	05-65	759.97		
64H190	FLORIDA POWER & LIGHT	TURKEY POINT	1	EH-1	8,995	45	845	3/4	31' 3"	2	HUB	460	50	ADMIRALTY SB-395	05-65	759.97		
64H190	FLORIDA POWER & LIGHT	TURKEY POINT	1	EH-7	17,355	50	900	5/8	47' 10"	2	HUMW	4200	700	SA-106-C	05-65	759.97		
64H190	FLORIDA POWER & LIGHT	TURKEY POINT	1	EH-6	11,700	51	900	3/4	31' 10"	2	HUMW	4200	350	SA-106-C	05-65	759.97		

YUBA HEAT TRANSFER
PARTIAL INSTALLATION LIST FOR
NUCLEAR POWER PLANTS

JOB #	CUSTOMER	STATION	UNIT	ITEM	SQ FT	ID	# U-TUBE	OD	LENGTH	P	TYPE	DESIGN TUBE	DESIGN SHELL	MATERIAL	SHIP DATE	MW (ea unit)	INSTALLATION	FIELD SERVICE SUPERVISION
64H189	FLORIDA POWER CORP	CRYSTAL RIVER	1	EH-2	8,536	47	862	3/4	29' 0"	2	HUB	400	150	ADMIRALTY SB-395	05-65	759.97		
64H189	FLORIDA POWER CORP	CRYSTAL RIVER	1	EH-1	6,986	48	783	5/8	26' 1"	2	HUB	400	150	ADMIRALTY SB-395	12-64	441		
64H189	FLORIDA POWER CORP	CRYSTAL RIVER	1	EH-4	6,924	41	562	5/8	30' 5"	2	VCDUB	400	150	ADMIRALTY SB-395	12-64	441		
64H189	FLORIDA POWER CORP	CRYSTAL RIVER	1	EH-3	6,100	44	646	3/4	22' 11"	2	VCDUB	400	150	ADMIRALTY SB-395	12-64	441		
64H189	FLORIDA POWER CORP	CRYSTAL RIVER	1	EH-7	12,527	47	1105	5/8	33' 5"	2	VCDUMW	3200	750	MONEL SB-163	12-64	441		
64H189	FLORIDA POWER CORP	CRYSTAL RIVER	1	EH-6	9,047	47	1105	5/8	23' 7"	2	VCDUMW	3200	300	MONEL SB-163	12-64	441		

<u>QUALITY ASSURANCE PROGRAM</u>

The Quality Assurance Department of Yuba Heat Transfer Division is responsible for implementing and verifying the performance of the Company's quality program. The quality program is to ensure that the equipment produced meets the requirements of the applicable codes, standards and specifications.

The Q.C. Manager is responsible for the administration of the quality program and implementation of the provisions of the Company's Quality Assurance Manual. He reports directly to the President of the Company and is Chairman of the Material Review Board.

All phases of quality assurance planning, inspection, non-conformances, document control and instrument and gauge calibration are performed in accordance with formal instructions contained in the applicable Quality Assurance Manual.

A Shop-Traveler System is employed on each job to assure that inspections required by the fabrication drawings are made. Verification of each inspection point is made by signing the inspection point on the proper traveler by properly qualified personnel.

Personnel involved in inspection are trained, tested and certified to perform non-destructive testing. A program of continuous training, retesting and upgrading of inspection personnel is in effect.

A formal non-conformance system is in effect. Any non-conformities are recorded and dispositioned by the Material Review Board, or their delegates. The non-conformance report form will indicate the non-conformity, the cause, the disposition and the corrective action. In addition, it will indicate that the disposition has been executed by having a qualified inspector sign the form.

A file of quality assurance records is maintained for each item manufactured. This file contains mill test reports and material certifications, and any special metallurgical or other test results. Upon completion of the job, these files are properly packaged, labeled and retained until such time as the applicable specification, code or codes, require them to be submitted to the purchaser.

Yuba
Heat
Transfer LLC

2121 N. 161st East Avenue
Tulsa, OK 74116
918 234-6000
Fax 918 234-3345
www.yuba.com

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INTERNAL CLEANLINESS PRACTICES EMPLOYED

All internal parts, except for tubes and machined surfaces, are cleaned by blasting with steel grit down to clean metal.

Support plates, etc., are coated with a solution of SYN #1, or equal, to inhibit rust prior to assembly. If rust inhibitors are prohibited by customer's specification, the internal parts are cleaned with a solvent of Lift-Away, DR-60 or equal.

Parts made in advance of the time needed for final assembly are carefully placed on pallets and stored on wall shelves or wire baskets in a special area away from the production floor.

On final assembly, all components are inspected and cleaned as required. Particular attention is given to those areas of shells and channel assemblies where debris could be lodged. Hydrotest covers are on all openings at the time of final assembly. This prevents foreign materials entering the unit during final assembly and test.

When welding of tubes-to-tubesheet is required, special procedures as discussed in the resumes of tube-to-tubesheet attachment; welded tube-to-tubesheet joints are employed.

Hydrotests are conducted with clean water, which contains rust inhibitors when required. By special agreement, on stainless steel tube application we can perform hydrotests with demineralized water.

Test covers are designed to attach to the outside of nozzles and are removed with nozzles in the down position so that no spatter or other debris enters the heater during the test cover removal. All openings are immediately capped to assure internal cleanliness.

VIBRATION

Our desuperheaters are designed for resistance to vibration by controlling the unsupported tube spans and steam velocities in such a way as to limit the maximum tube deflection due to periodic forces transmitted from the flowing fluid. Our method of analysis was developed by Joseph Sebald and is employed in the design of various types of heat exchangers having steam on the shellside, as well as in surface condensers. Our criteria is somewhat more conservative than the widely used Connors Fluidelastic Whirling Analysis.

If analysis is required by customer specifications, for the most severe flow condition, such as that caused by the bypassing of an adjacent heater, the velocities within the bundle, as well as those in the inlet and outlet areas, are limited to values that would maintain vibration amplitudes within a fraction of the tube ligaments. Localized high velocity regions, caused by maldistribution of flow, are prevented by proper arrangement of the baffles.

Subcooler designs are such that there is a wide margin between the tube natural frequency and that of the fluctuating fluid forces at the most severe flow condition. The tube natural frequencies are calculated in accordance with the latest TEMA Edition, whereas the forcing frequencies are evaluated by the Chen Method. The central spans and the inlet and the exit areas are examined.

In the condensing zone, vibration potentials are avoided by limiting the velocity in the area between the bundle and the shell; as well as the escape velocities from the steam and drains nozzles. U-bend supports are employed in the tube rows with larger bend diameters. In any case, the unsupported spans are within the limits specified by HEI.

AIR VENTING

Most heaters presently installed were built with semi-support plate-type tube supports that permitted axial flow of steam through the bundle, causing non-condensable gases to accumulate at the ends of the steam travel where air vents were located. This type of venting system has not been as successful in recent years as it originally was. This is due to a number of factors, among them, the introduction of the short-type subcooling zone. This type of zone requires that drains flow toward the tubesheet, while most of the steam flow through the shell and bundle is away from the tubesheet.

As a result, steam and drains pressure losses are additive. To prevent a high water level at the end of the shell, steam pressure loss had to be limited to one or two inches of water, requiring low steam velocities around the bundle. The use of low steam velocities is inconsistent with venting systems that require reasonably high steam velocities for effectiveness. In addition, this type of venting system was subject to steam-by-passing of the vent connection, reducing vent flows from the bundle where the non-condensables tended to accumulate. Added to these problems, volatile feedwater treatment found widespread use, leading to concentration of ammonia, which dissolves the protective oxide coating on non-ferrous alloys, accelerating corrosion, causing copper deposition in other parts of the system and inducing stress-corrosion cracking at relatively low stress levels.

Modern designs require full-length, centrally located vent ducting, similar to that used in exhaust condensers. This design requires that the vent duct penetrate the tube field to prevent by-passing of steam through pass lanes. Special attention must be paid to the method of steam admission to the vent duct since the pressure gradient inside of the duct must be opposite to that outside of the bundle. Improper attention to the flow design problems can result in vent flows that are away from the off-take pipe. Normally, the gradient at the center of the bundle is opposite to that outside the bundle, resulting from differences in condensation rates between the two ends of a heater. There are many variables that influence these gradients. Good design requires that steam be metered into the vent ducting to assure positive control of the vent flows.

REV	DESCRIPTION	DATE	Yuba Heat Transfer CLEANING PRIOR TO WELDILNG Page 1 of 1	

Prior to overlaying tubesheet, clean thoroughly with an acceptable cleaning solution and blow dry with clean shop air.

Before inserting tubes in tubesheet, the tubesheet, tube holes and the end of tubes shall be thoroughly cleaned with cleaning solution and blown dry with clean shop air.

Spray tube holes with an acceptable cleaning solution and blow dry with clean air. It may be necessary to some cases to brush the holes using a brush soaked in an acceptable cleaning solution.

Acceptable cleaning solutions are specified in E1562.1-55.

PREPARED BY	DATE	APPROVED BY	RELEASE	
WBM	8/80	TRH	8/80	YUBA HEAT TRANSFER

Yuba
Heat
Transfer LLC

2121 N. 161st East Avenue
Tulsa, OK 74116
918 234-6000
Fax 918 234-3345
www.yuba.com

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TUBE CLEANING WITH FELT PLUGS

A. When specified on the detail drawings, felt plugs are to be blown through the tubing ID in accordance with this procedure. The operation is to take place prior to closing the channel for hydrostatic testing of the channel.

B. The purpose for using felt plugs is to assure the interior of the tube is free of dirt and dust and is in a condition of cleanliness comparable to that received from the tubing supplier. The acceptance criteria for plugs blown at the completion of fabrication will be plugs that have been blown through the ID of 5 different tubes upon receipt from the tubing supplier.

C. The procedure for blowing felt plugs is as follows:

1. Purge tubing ID with clean, oil-free air.
2. Obtain the number and size of white tube plugs specified on the Bill of Material.
3. Obtain a tube layout of the unit.
4. Immediately prior to inserting the plug into the tube, the plug shall be soaked in "Lift-Away", manufactured by DuBois Chemical Company.
   a. An acceptable alternate to "Lift-Away" is Dubl-Chek DR-60 Remover, manufactured by Sherwin Corporation.
   b. Because of it's flammable characteristics, acetone is <u>not</u> to be used as a solvent.
5. Starting in the upper half of the tubesheet, place plugs in each of the tubes in the first row. Do only one row at a time. The tube layout will tell you how many tubes are in a row. Blow the plugs in the first row. Count the plugs blown from the first row. The count of plugs from the first row must equal the number of tubes shown on the tube layout. If you have lost a plug or portion of a plug, that loss is confined to that row. You must locate the lost plug(s) before proceeding to the next row.
6. Proceed to the next row, repeating the above operation, until all rows are done.
7. If the specification calls for a comparison with plugs from the as received tubes from the vendor, proceed as follows using one plug blown at a time.
8. Insert plugs and blow through tubing using clean, dry, oil-free air.
9. Immediately following, blow a clean, dry, felt plug through the tube using clean, dry, oil-free air.
10. Compare plug to standard plugs obtained upon receipt of tubing.

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918 234 -6000
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SUMMARY OF TUBE-TO-TUBESHEET ATTACHMENT

Rough machined forgings are ultrasonic tested at the mill or on receipt at our shop. When the tubesheet and channel barrel are integral, the tubesheet and corner radius are also color contrast liquid penetrant tested.

The face of the tubesheet is thoroughly cleaned. The forging is preheated.

The tubesheet is overlaid with carbon, stainless steel, Inconel, or Monel depending on the tube material to be applied. Overlay is applied by a submerged arc strip process with each layer being cleaned before starting the next layer.

Final overlay is machined, and the overlay is ultrasonic tested.

Tube holes are drilled, using one of four tape-controlled gun drills.

Two tube hole grooves are machined in the base metal, when required.

Tube holes are chamfered on the face. This chamfer is contained within the final pass of the overlay material and does not extend to underlying passes.

Tube holes are chamfered at the rear of the tubesheet and tie-rod holes are drilled and tapped.

Supports, nozzles, the skirt section and shrouds are welded in place.

Using a controlled atmosphere furnace, to prevent scale formation, the assembly is post weld heat treated.

The face of the tubesheet and tube holes are mechanically cleaned to be sure of basic cleanliness in these areas.

Final cleaning of tube holes with Dubl-Check is accomplished prior to insertion of tubes.

Note: The practice outlined above is based on metallurgical research and experience in attaching tubes-to-tubesheets. It is subject to modification should there be further improvements in the art.

Note: Carbon steel overlay is normally used on tubesheets when carbon steel tubes are to be welded.

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WELDED TUBE-TO-TUBESHEET JOINTS

Tube-to-tubesheet attachments are made in an enclosure. Any air used for cleaning or blowdown is clean and dry.

The enclosed area in which the welding is done is cleaned each shift in which work has been done. All tools, hoses, etc., used in the tube-to-tubesheet weld area are cleaned.

Tube holes and tubes ends are thoroughly cleaned with a solvent. Any scale or adherent surface contamination on tubes is removed from the OD and ID in the weld affected zone prior to cleaning.

Tubes are inserted with ends extended beyond the face of the tubesheet. Tube ends are cleaned with a solvent and dried with clean air. Tubes are then positioned in the approximate final location and the entire face of the tubesheet again washed and dried with clean, dry air. Tubes are finally positioned in the tubesheet.

Filler rod used in the welding process is thoroughly cleaned. All argon used in the Heliarc welding process is passed through a dryer.

The weld affected zone is preheated in accordance with the tube-to-tubesheet welding procedure.

Tube ends are welded with manual or automatic GTAW process, with or without the addition of filler metal. Tube welds are air soap tested prior to rolling.

Tubes are rolled; starting back of the weld affected zone in the area of the tube hole grooves and extending to the required depth. Rolling is accomplished with an electronically controlled tube expanding machine. Tube welds are dye checked after rolling.

A full shellside hydrostatic test is performed. Test pressure is maintained for specified periods of time. These tests are recorded, if required, and the charts kept as a permanent part of the engineering file.

After the channel closure has been made up, a tubeside hydrostatic test is performed and recorded as outlined above.

The shell and tubeside hydrostatic tests are performed in accordance with the requirements of the ASME Code.

Note: The practice outlined above is based on metallurgical research and experience in the attachment of tube-to-tubesheets. It is subject to modification should there be further improvements in the arts.

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HYDROSTATIC TESTS ON FEEDWATER HEATERS

CODE HYDRO TESTS

The purpose of a hydrostatic test is to insure that the design, materials and fabrication methods provide a safe structure. Despite the safeguards employed, deficiencies in any one of these areas can lead to catastrophic failure. Close visual inspection is not required during the time the heater is being pressurized to, or held at, hydrotest pressure and personnel should not be present in areas adjacent to the vessel until the vessel has been found structurally sound.

A. Yuba Quality Assurance Department is to make arrangements for the Authorized Inspection to witness hydrostatic test, as required, based on testing sequence and holding times given below.

B. Use clean clear city tap water on both shellside and tubeside of heater, unless demineralized water is specified on the "Preparation for Shipment" drawing.

C. When specified on the "Preparation for Shipment" drawing, a pressure recording chart is to be used for information. Calibrated pressure gauges are to be used for all tests and are the basis for acceptance of the pressure test. Quality Assurance is responsible for checking the calibration of the pressure gauges.

D. When specified on the "Preparation for Shipment" drawing, add rust inhibitor to the test water.

E. Prepare the heater and test area for testing in accordance with the job prints and Q. A. procedures.
   1. Caution: The venting of air at ALL high points must be checked *immediately* prior to any hydrotest. As the vessel water temperature increases because of being in the plant, air may be released from the water. It must be vented.

F. Apply shellside hydrotest, leaving access to tubeside for inspection of tube ends as follows:
   1. Fill the shellside with water. Care is to be exercised to assure that the exchanger has been properly vented to remove air from the system. Open vents must be located at the high point of the shellside during the filling operation.

   2. Bring the shellside test pressure up to the specified psig and hold for a minimum of 30 minutes. Yuba Quality Assurance department will witness the pressure gauge for any sign of decrease in pressure during the holding time.

   3. Reduce test pressure to .77 x test pressure and hold for four hours. (See Note 1).

Yuba
Heat
Transfer LLC

2121 N. 161st East Avenue
Tulsa, OK 74116
918 234-6000
Fax 918 234-3345
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4. Yuba Quality Assurance department will inspect the face of the tubesheet and the shell exterior for leaks. Leakage of temporary gaskets installed for the purpose of conducting the hydrostatic test and which will be replaced later, may be permitted unless the leakage exceeds the capacity to maintain the system test pressure for the required amount of time.

5. Reduce test pressure to zero.

G. Assembly partition cover plate and tubeside closure and apply tubeside hydrostatic test as follows:

1. Fill the tubeside with water. Care is to be exercised to assure that the exchanger has been properly vented to remove air from the system. Open vents should be located at the high point of the tubeside during the filling operation.

2. Bring the tubeside test pressure up to the specified psig and hold for a minimum of 30 minutes. Yuba Quality Assurance department will witness the pressure gauge for any sign of decrease in pressure during the holding time.

3. Reduce the test pressure to zero.

4. Bring tubeside pressure up to .77 x test pressure (2nd cycle).

5. Reduce tubeside pressure to zero.

6. Bring tubeside pressure up to .77 x test pressure (3rd cycle).

7. Reduce tubeside pressure to zero.

8. Bring tubeside pressure up to .77 x test pressure and hold for four hours (4th cycle). (See Note 1).

9. Yuba Quality Assurance department will inspect the channel exterior for leaks. Leakage of temporary gaskets installed for the purpose of conducting the hydrostatic test and which will be replaced later, may be permitted unless the leakage exceeds the capacity to maintain the system test pressure for the required amount of time.

10. Reduce test pressure to zero.

H. Remove test covers and proceed with fabrication.

Note 1: If test pressure hold time exceeds 4 hours, reduction to design pressure is only required for a long enough period of time to permit inspection for leakage.

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Transfer LLC

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HOT AIR DRYING PROCEDURE

The feedwater heater, or heat exchanger, is to be dried using the procedure listed below and the hot air drying system. The hot air drying is comprised of an air heater, appropriate duct work and required flow directors.

The heating of internal parts occurs by refluxing water contained within the shell. The water, boiling under vacuum conditions, vaporizes and condenses on the cold tubing; gradually heating the internal parts. For low pressure boiling and condensation, it is important that practically all air be removed initially. Small amounts of air seriously interfere with low temperature condensing heat transfer. Because the shell side will be non-vented, the application of too much heat can generate excessive pressure. This is not likely to occur, as our major problem is to obtain enough heat to generate low pressure vapor. However, the internal supply of water is sufficient to over-pressure the shell if enough heat is available. For this reason, the pressure must be monitored and either the heat removed or the system vented if over-pressuring starts to occur.

Hydrostatic tests are conducted with water. Allowable water chemistry and inhibitors areas mutually agreed.

Units are drained shell side and tube side.

All connections are sealed. Weld-end nozzles have heads or plate covers adequately bolted, using studs tack welded to the nozzle barrels. Gaskets under covers are non-asbestos type material.

Vacuum-pressure gauges and valved vacuum-nitrogen filled connections are installed at suitable locations on both shell side and tube side.

The vacuum is pulled both shell side and tube side to an equivalent saturation temperature approximately 10° F. below the temperature of the vessel walls, as measured on external surfaces. This is done to flash test water in the units and effect as much moisture removal as possible.

Note: If temperature conditions in the shop require heating of units to obtain an approximately 10° F. differential temperature between vessel walls and the equivalent saturation temperature of the vacuum pulled, hot air not to exceed 250° F at connections is circulated through both the shell side and the tube side. Connections left open to accomplish this heating provide proper natural flow for the removal of moist air. A type of heater is employed to assure that no products of combustion enter the feedwater heater. The vacuum is pulled first on the shell side with heater air continuing to be circulated through the tube side.

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Heat
Transfer LLC

2121 N. 161st East Avenue
Tulsa, OK 74116
918 234-6000
Fax 918 234-3345
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HOT AIR DRYING PROCEDURE

The vacuum pump will continue to run 15 minutes after the proper vacuum has been reached.
While under vacuum, nitrogen is applied to both the shell side and the tube side and the nitrogen atmosphere brought up to a pressure of approximately 14 pig. After the vessel has cooled to ambient temperature, the nitrogen pressure is checked several times to be sure seals at connections are tight.

Units are shipped under approximately 10 pig nitrogen pressure with the pressure gauge-nitrogen fill tap assemblies in place. It is recommended that the nitrogen pressure be checked immediately on arrival and periodically during storage prior to erection at the jobsite, to assure nitrogen pressure in the units does not fall below 5 pig.

The practice outlined above is subject to modification should there be further improvements in the art.

> Note: Recent experience on cycles which employ full flow condensate polishing indicates no rust preventative should be used unless special provision for cleaning the shell sides of closed feedwater heaters is applied. Rust preventatives in drains have coated the resins, necessitating costly replacement. All of the details stated above, except for the use of inhibitor in the hydrotest water, would still apply.

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Fax 918 234-3345
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PRE-INSTALLATION STORAGE OF FEEDWATER HEATERS

CAUTION: A PRESSURE GAUGE ON A FEEDWATER HEATER INDICATES THE VESSEL IS FILLED WITH NITROGEN GAS FOR SHIPPING. ALL PERSONNEL MUST BE CAUTIONED NOT TO PUT THEIR HEAD INTO THE VESSEL OPENINGS TO INSPECT THE INTERIOR. NITROGEN IS COLORLESS AND ODORLESS AND SUFFOCATION COULD TAKE PLACE WITHOUT THE SENSES PROVIDING AN ALARM.

The feedwater heaters should be thoroughly inspected for shipping damage as soon as they arrive. Heaters with an internal nitrogen atmosphere have pressure gauges to show internal pressure on both shell (steam) and tube (water) side. Heaters are shipped under 10 psig nitrogen pressure. If the nitrogen pressure has fallen below 5 psig during shipment, it should be restored to 10 psig.

Heaters should be stored on cribbing and not in contact with the ground. Horizontal heaters should rest on their supports. Vertical heaters with no supports should be chocked to prevent turning. The end of the vessel with the feedwater nozzles should be at least one inch lower than the other end to prevent condensate from lying in the tubes.

Drainage points, such as plugs or nozzle covers, should be at the lowest point.

Heaters shipped without a nitrogen blanket should have the lowest nozzle cover, or plug, loosened to permit drainage. An unpressurized heater will breathe during daily temperature changes and moisture taken in will condense. This condensate must be given a way to drain.

Heaters with a nitrogen atmosphere, once positioned, should be "blown down" by loosening a plug or nozzle cover at the low point and allowing any condensate to escape from each side of the heater. Caution is to be exercised when loosening the plug, or cover, because the feedwater heater is pressurized. Personnel should not have any portion of their body in direct line with the plug or cover. The opening should be immediately resealed. The loss of nitrogen will be very slight.

Nitrogen blanketed heaters should be inspected on a regular basis. If the pressure falls below 3 psig, it should be restored to 10 psig. Minor leaks can be stopped by a slight uniform tightening of cover bolts or by tightening the threaded bar plugs in couplings. Note that the ends of nozzles prepared for welded connections have a gasket seating surface only 1/16" wide. This can cut through gaskets if the cover is over-tightened.

CONFIDENTIAL

[redacted]

REDACTED

DWN.	QUANTITY SHOWN FOR ONE VESSEL, <u>ONE</u> VESSEL(S) REQ'D	TITLE LP CHANNEL AND PASS PARTITION	
CKD.	Yuba LLC		
APP.			
DATE	P.O. BOX 3158 TULSA, OKLAHOMA 74101	DWG.	REV. 0

REVISIONS

PEF-NCR-02320

[redacted]

REDACTED

DWN	QUANTITY SHOWN FOR ONE VESSEL, ONE VESSEL(S) REQ'D	FEEDWATER HEATER CENTRAL VENTING SYSTEM
CKD		
APP	Yuba A Connell Limited Partnership Company	DWG. PEF-NCR-02321
DATE	PO BOX 3158 TULSA, OKLAHOMA 74101	REV 0

CONFIDENTIAL

[redacted]

REDACTED

PEF-NCR-02322

DWN DK		TITLE IMPINGEMENT PLATE
CKD	Yuba A CONNELL LIMITED PARTNERSHIP COMPANY	
APP	P.O. BOX 3158 TULSA, OKLAHOMA 74101	DWG
DATE		REV 0

REVISIONS

CONFIDENTIAL

[redacted]

REDACTED

REVISIONS

DWN.	QUANTITY SHOWN FOR ONE VESSEL, ONE VESSEL(S) REQ'D	TITLE DETAIL OF STANDARD U-BEND SUPPORT	
CKD.	Yuba LLC P.O. BOX 3158 TULSA, OKLAHOMA 74101		
APP.		DWG.	REV. 0
DATE 4/18/06			

PEF-NCR-02323

[redacted]

REDACTED

REVISIONS

DWN. DK	CONFIDENTIAL	TITLE	
CKD.		BUNDLE SKIDS	
APP.	Yuba A CONNELL LIMITED PARTNERSHIP COMPANY		
DATE	P.O. BOX 3158 TULSA, OKLAHOMA 74101	DWG	REV. 0

PEF-NCR-02324

[redacted]

REDACTED

QUANTITY SHOWN FOR ONE VESSEL, ONE VESSEL(S) REQ'D	STANDARD TOLERANCES FOR NOZZLES & SUPPORT LOCATIONS - ENGLISH UNITS
Yuba A Connell Limited Partnership Company	PEF-NCR-02325

[redacted]

REDACTED

AMD CHECKED BY AMD DATE 11/26/07	Yuba	PEF-NCR-02326 CONFIDENTIAL	FOR SCHEMATIC PURPOSES ONLY NOT FOR CONSTRUCTION DIMENSIONS ARE APPROXIMATE	SCHEMATIC OUTLINE DWG. HEATER LP FEEDWATER HEATER NO. 3 A/B PROJECT PROGRESS ENERGY PROPOSAL NO: QH-6026-07 REV 0

Y U B A   H E A T   T R A N S F E R

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FEEDWATER HEATER SPECIFICATION SHEET

	CUSTOMER: PROGRESS ENERGY	DATE: 11/26/2007
		CUST.INQ.NO:
	ADDRESS:	CUSTOMER ORDER NO:
	PLANT LOCATION: CRYSTAL RIVER	PROP. NO.: QH-6026-07
		JOB NO:
1	SERVICE OF UNIT: LOW PRESSURE HEATER	ITEM: LP-3 A/B
2	SIZE: 57-546 TYPE: U-TUBE	ENGR: AMD
3	SURFACE PER SHELL (SQ. FT) EFFECTIVE: 17,300	GROSS: 18,367
4	NO.OF SHELLS PER UNIT: 2 NO. OF UNITS: 1	POSITION: HORIZONTAL

PERFORMANCE OF ONE SHELL

		SHELL SIDE		TUBE SIDE
5	FLUID CIRCULATED	STEAM	DRAINS	FEEDWATER
6	TOTAL FLUID ENTERING LB/HR	302,170	-----	4,381,791
7	INLET ENTHALPY BTU/LB	1161.2		174.2
8	OUTLET ENTHALPY BTU/LB	184.0		241.6
9	INLET TEMPERATURE °F	277.4	(277.4 SAT)	205.8
10	OUTLET TEMPERATURE °F	215.8		272.4
11	OPERATING PRESSURE PSIA	47.2		123.3
12				
13	NUMBER OF PASSES	CONDENSING & SUBCOOLING		2
14	VELOCITY FT/SEC			8.1 @ SG =1
15	PRESSURE DROP PSI	DESUP -----	SUBCL 2.6	15.0

		HEAT TRANSFERRED BTU/HR	SURFACE SQ.FT	LMTD °F	HT TRANS.RATE BTU/HR/ SQ. FT / °F	BAFFLE PITCH	REF TEMPERATURE DIFFERENCE
16	DESUPERHEATING	------					°F
17	CONDENSING	276,388,000	15767	24.0	730		TTD 5.0
18	DRAIN COOLING	18,893,000	1533	30.1	409		DCA 10.0

CONSTRUCTION--EACH SHELL

		SHELLSIDE	TUBESIDE
19	DESIGN PRESSURE PSIG	75 & FULL VAC	400
20	TEST PRESSURE PSIG	CODE	CODE
21	DESIGN TEMPERATURE °F	SHELL 280 SKIRT 280	280

22	MINIMUM DESIGN METAL TEMP. (°F) SHELLSIDE 60. TUBESIDE 60.
23	TUBES SA-688-TP304L NO.U's 1000 OD 3/4" .035" Avg LENGTH 45'- 6" STR
24	SHELL STEEL ID: 57 TUBE PITCH: 15/16" TRIANGULAR
25	SHELL COVER STEEL--WELDED TO SHELL SHELL SKIRT STEEL
26	CHANNEL (SR) STEEL CHANNEL COVER STEEL
27	TUBE SHEET STEEL IMPINGEMENT PLATE STAINLESS STEEL
28	SUPPORT PLATES STEEL ZONE BAFFLES STEEL
29	SHROUDS-DSH ------- SUBCOOLER STEEL
30	TYPE JOINTS-SHELLSIDE WELDED TUBE SIDE ELLIPTICAL
31	GASKETS-SHELL ----------- CHANNEL W / 20" MANWAY
32	CONNECTIONS: STEAM INLET 2 - 20" W.E. DRAINS INLET ----- W.E.
33	DRAINS OUTLET 12" W.E. EMERGENCY DRN ----- W.E.
34	FEEDWATER INLET 18" W.E. OUTLET 18" W.E.
35	CODE REQUIREMENTS ASME 2004 SECTION VIII, DIVISION 1 w/ 2006 ADDENDA
36	WEIGHTS (LB) SHELL AND BUNDLE 60,400 BUNDLE 44,500 FULL OF WATER 114,400
37	SHELL SAFETY VALVE BY YUBA TUBE SIDE RELIEF VALVE BY YUBA
38	SHELL GAUGE GLASS BY PURCHASER
39	REMARKS: Tubes Welded and hydraulically expanded into Tubesheet.
40	Shell Roller Supports Provided
41	50 Installed spare tubes included, not counted as effective surface
42	
43	
44	

MAX UNSSUPORTED SPAN= 36

PEF-NCR-02327

Technical Review of Yuba Proposal QH-6026-07, dated 11/30/07, and Thermal Engineering International Proposal 06-M088, dated 11/29/07.

Technical Review completed by: Scott T. Deahna on 12/07/07.
The proposals are for the replacement of two (2) feedwater heaters (CDHE-3A/B) and two (2) secondary plant component cooling heat exchangers (SCHE-1A/1B). The heat exchangers are being replaced to support the CR3 extended power uprate project. Progress Energy issued Request for Proposal # AS-12007 on 11/09/07. Draft equipment specifications for the replacement heat exchangers were included with the RFP. A table of conformance to the specification was included with the RFP. The vendor proposals were due on 11/30/07.

Summary of Proposals Submitted:

- The Yuba proposal QH-6026-07 provided the better overall technical design offering. The Yuba proposal includes seamless tubes. The TEI proposal includes seam welded tubes (per telecom w/ Jay Wu). Both types are acceptable per ASME SB-338. Seamless tubes are more expensive.
- Both vendor proposals were complete and were submitted on time.
- Both vendors submitted complete table of conformance to the equipment specifications.
- Both vendors met the technical requirements of the specification. Some exceptions were taken to the specification. None of the exceptions taken to the specification were of technical or commercial significance.
- The feedwater heater designs submitted by both vendors were essentially technically equivalent.
- The Yuba SC heat exchanger design provided more heat exchange surface area than the TEI design.
- The Yuba SC heat exchanger design meets the maximum dimensional requirements.
- The Yuba SC heat exchanger design provides additional cooling capacity compared to the TEI design.

SC Cooler Design Characteristic Comparison:

Characteristic:	Yuba Proposal:	TEI Proposal:
Tube Bundle Size	64" x 528"	57" x 498"
Eff. Surface	16,378 Sq. Ft.	15,503 Sq. Ft.
Heat Exchanged	89,842,118 Btu/Hr.	89, 053,665 Btu/Hr.
Heat Transfer Rate	511.37 Btu/Sq.Ft.-Hr.-F	505.73 Btu/Sq.Ft.-Hr.-F
Vessel Size	65" OD x ????	58" OD x 49'-11" L
Tubes (Titanium, SB-338 GR2)	1440, 1"OD, 0.028"wall, 44'long	1440, 1"OD, 0,028" wall, 41.5'long
Design Pressure / Temp Shell	125 psig / 130F	125 psig / 130F
Design Pressure / Temp Tubes	15 psig / 120F	15 psig / 120F
Vessel Weight	57,000 Lbs.	44,182 Lbs.

Feedwater Heater Design Characteristic Comparison:

Characteristic:	Yuba Proposal:	TEI Proposal:
Tube Bundle Size	57" x 546"	58" x 539"
Eff. Surface	17,300 Sq. Ft.	17,088 Sq. Ft.
Heat Exchanged	295,281,000 Btu/Hr.	294,281,000 Btu/Hr.
Heat Transfer Rate	1139 Btu/Sq.Ft.-Hr.-F	1165 Btu/Sq.Ft.-Hr.-F
TTD / DCA	5F / 10F	5F / 10F
Vessel Size	58" OD x 52'-10" OAL	59" OD x 52'-3" OAL
Tubes (SA-668-TP304L)	1000, 0.75", 0.035", 45'-6"	997, 0.75", 0.035", 45'
Design Pressure / Temp Shell	75 psig / 280F	50 psig / 300F
Design Pressure / Temp Tubes	400 psig / 280F	400 psig / 300F
Vessel Weight	60,400 Lbs.	60,000 Lbs.

Yuba Heat Transfer Division
2121 North 161st East Avenue Tulsa, Oklahoma 74116
Manufacturer's Record of Welder Qualification Test
GTAW Process

Welder: David Logue **Check Number:** 3735 **Stamp Number:** ID **Test Date:** 3/15/04

Welding Process / Type:	GTAW - Manual
Welding Procedure Specification (WPS):	YA-4259
Joints/Backing QW-402:	GTAW with backing, welder qualified for GTAW with backing.
Base Metal QW-403:	P-51 plate (SB-265 Grade 2), 1/4" thick used for test. Welder is qualified for P-51 through P-53, and P-61 through P-462 base metals in production. Welder is qualified for joining plate, shapes, and pipe of 2-7/8" OD and larger diameter.
Filler Metal QW-404:	ERTi-2, F-51 bare solid wire used for test, with 5/32" GTAW deposited. (Weld made with and without the addition of weld filler metal). Welder is qualified for F-No. 51 thru F-54 wires. Welder is qualified for 5/16" max. deposit thickness with the GTAW process, and is qualified both with or without the addition of weld filler metal.
Position QW-405:	Tested in 3G position. Welder is qualified for 1G, 3G, 1F, 2F, and 3F positions with the GTAW process.
Gas Type QW-408:	For GTAW process, Argon, Welding Grade used for shielding gas, and for gas backing. Welder is qualified to weld groove welds with inert gas backing, and is qualified for all fillet welds.
~~**Electrical Characteristics QW-409:**~~	~~DCSP (GTAW)~~

Qualification Test Results:

Test coupon welded in the 3G position, visually inspected and submitted for radiography.

1. **Visual Examination:** Satisfactory per QW-302.4
2. **Radiography:** Acceptable. M. Wright, LII Radiographer
   Test conducted by: Yuba Heat Transfer

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance in accordance with the requirements of ASME Section IX.
Organization: Yuba Heat Transfer Division

By: [signature] Date: 3-15-04

PEF-NCR-02329

Yuba Heat Transfer
ASME IX Welding Procedure Specification (WPS)
Weldspec for Windows

WPS record number	YA-3773 Revision 10	Qualified to	ASME Section IX and Section VIII, Division 1
Date	10/27/04	Company name	Yuba Heat Transfer
Supporting PQR(s)	76255; 150-82; 37-89; 04-01; 10-01; 14-04		
Reference docs.	ASME Section VIII, Division 1; ASME Section IX with Latest Mandatory Addenda		

Scope	SMAW/SAW of P-1 materials, As-welded, and with PWHT Groove, fillet, no PWHT (As-welded), impact testing, with PWHT
Joint	Joint details for this welding procedure specification in: Production drawings, Engineering specifications

BASE METALS (QW-403)

Type	Carbon steel (P1)	P-no. 1	Grp-no. 2
Welded to	Carbon steel (P1)	P-no. 1	Grp-no. 2
Backing:	Base metal or weld metal	P-no. 1	Grp-no. 2
Retainers	Nonmetallic (Neutral Flux) may be used		
Notes	See pages 2, 3, and 4		

THICKNESS RANGE QUALIFIED (in.)

	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
Complete pen.	3/16	1-1/2	3/16	8
Impact tested	5/8	1-1/2	5/8	8
Partial pen.	3/16	1-1/2	3/16	8
Fillet welds	No Min.	1-1/2	No Min.	8

DIAMETER RANGE QUALIFIED (in.)

	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
Pipe/Nozzle	10 NPS	No Max.	10 NPS	No Max.

FILLER METALS (QW-404)

THICKNESS RANGE QUALIFIED (in.)

	SFA	Classification	F-no.	A-no.	Chemical analysis or Trade name	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
SMAW	5.1	See Page 3	4	1	Hobart,McKay,AtomArc,or equal	No min.	1-1/2	No min.	8
SAW	5.17	F7A2-EM12K	6	1	Lincoln, ESAB, or equal	No min.	1-1/2	No min.	8
Flux	5.17	F7A2; F7P0	6	N/A	Lincoln960, ESAB429, or equal	- Required -			
Sup. filler	-	-	-	-	-	- None -			

Flux type	Neutral flux
Flux from recrush. slag	No

WELDING PROCEDURE

		SMAW	SAW
Welding process		SMAW	SAW
Type		Manual	Machine
Preheat temperature	(°F)	100F; See page 2	100F; See page 2
Maximum interpass temperature	(°F)	500F	500F
Filler metal size	(in.)	1/8, or 5/32	3/32, 1/8, 5/32, 3/16
Layer number		1 or 2	1, 2, or balance of layers deposited
Position of groove		All	Flat or Horizontal
Weld progression		Vertical up	-
Current/polarity		DCEP (reverse polarity)	DCEP (reverse polarity)
Amperes		110-190	See page 3
Volts		17 to 19	See page 3
Travel speed	(in./min)	7 or more (impact tested mat'l)	See page 3
Maximum heat input	(kJ/in.)	31.2 (impact tested mat'l)	91.0 (impact tested mat'l)
Wire feed type		-	Cold wire
Wire feed speed	(in./min)	-	Adjust for amps/volts/travel speed
String or weave		Stringer or Slight Weave	Stringer
C.T.W.D	(in.)	-	N/A
Multi/Single pass per side		Multiple passes (for impacts)	Multiple passes
Multiple or single layer		-	Multiple layer
Oscillation		-	None
Multi/single electrode		-	Single electrode
Electrode angle	(deg.)	-	80 to 90 degrees from weld axis
Maximum pass thickness	(in.)	3/16	1/4
Weld deposit chemistry		A-1 per QW-442	A-1 per QW-442
Notes		See Pages 2, 3, and 4	See Pages 2, 3, and 4

PEF-NCR-02330

Yuba Heat Transfer
ASME IX Welding Procedure Specification (WPS)
Weldspec for Windows

WPS record number Date	YA-3773 Revision 10 10/27/04	Qualified to Company name	ASME Section IX and Section VIII, Division 1 Yuba Heat Transfer

PREHEAT TABLE

Applicable standard	
ASME Section VIII Div. 1	100F minmum preheat shall be established prior to welding any thickness less than 1" (impact tested materials). 200F minimum preheat shall be established prior to welding thickness of 1" or more (all materials). 70F preheat is permitted only for non-impact tested materials which are less than 1" thick.

POST WELD HEAT TREATMENT (QW-407)

Temperature (°F)	1100 - 1200	Time (hrs)	Per UCS-56	Type	Below lower transf. temp.
Heating rate (°F/hr)	Per UCS-56	Method	Furnace or resistance		
Cooling rate (°F/hr)	Per UCS-56	Method	Slow cool		
Notes	Max. qualified time is 6 hrs & 15 min. (for impacts) See design drawings for PWHT requirements.				

TECHNIQUE (QW-410)

Supplementary MF control	None
Peening	Not used
Surface preparation	Grit blast, brush, grind, or machine
Initial/interpass cleaning	Brushing, Chipping, and Grinding
Back gouging method	Air carbon arc and grind to sound weld/base metal

NOTES

See pages 3 and 4 for notes.

Welding Engineer

Name	Signature
Donald L. Underwood	Donald L. Underwood
Date	
10/27/04	

Yuba Heat Transfer
ASME IX Welding Procedure Specification (WPS)
Weldspec for Windows

WPS record number	YA-3773 Revision 10	Qualified to	ASME Section IX and Section VIII, Division 1
Date	10/27/04	Company name	Yuba Heat Transfer

This procedure is qualified for joining P-1 Group 2 materials with impact testing either as-welded or with PWHT. This procedure can also be used for joining non-impact tested P-1 Gr 1 or 2 materials. This procedure is limited to use for vessels with an MDMT of -20F or higher.

SMAW- E7018 can be used if the parts being joined do not require Charpy testing, but when welding impact tested materials only E7018-1 electrodes shall be used.

SAW Flux/Wire combinations - Use an EM12K wire, such as Lincoln L-61, ESAB Spoolarc 81, or equal EM12K wire. Flux shall be an F7P0/F7A2 classification, such as Lincoln 960, ESAB 429, or equal neutral flux.

>>> WELDING NON-IMPACT TESTED MATERIALS --- AMP / VOLT / TRAVEL SPEED RANGES --- If the job bill of materials does not identify either item to be joined as requiring Charpy testing, the welder may use the following ranges:

> **SMAW** may be used within the following limits-
200 amps max.
21 volts max.
adjust travel speed for welding conditions

> **SAW** limits for amps/volts are the same as for impact tested materials (see below), but travel speeds can be adjusted for welding conditions.

>>> WELDING IMPACT TESTED MATERIALS --- AMP / VOLT / TRAVEL SPEED LIMITS --- When the job bill of materials indicates either part being joined at the weld as requiring Charpy testing, the following limits shall be followed for welding the impact tested parts.

> **SMAW** shall shall be used within the following limits-
190 amps max.*
19 volts max.*
7 inches per minute minimum travel speed *

* Some adjustment in these values can be made by the welder provided the heat input limit for SMAW (31,200 Joules per Inch) is not exceeded by using the following formula:

$$\frac{\text{Amps X Volts X 60}}{\text{Travel Speed (in. per min.)}} = \text{Heat Input in Joules/Inch (not to exceed 31,200 Joules per Inch)}$$

> **SAW** shall be used within the following limits-
3/32 or 1/8 diameter wire
550 amps max.**
32 volts max.**
12 inches per minute minimum travel speed **

5/32 diameter wire
650 amps max.**
35 volts max.**
15 inches per minute minimum travel speed **

3/16 diameter wire
750 amps max.**
36 volts max.**
18 inches per minute minimum travel speed **

or, 3/16 diameter wire
900 amps max.**
36 volts max.**
22 inches per minute minimum travel speed **

WPS record number	YA-3773 Revision 10	Qualified to	ASME Section IX and Section VIII, Division 1
Date	10/27/04	Company name	Yuba Heat Transfer

** Adjustments can be made by the operator provided the heat input for SAW (91,000 Joules per inch) is not exceeded by using the following formula:

$$\frac{\text{Amps X Volts X 60}}{\text{Travel Speed (in. per min.)}} = \text{Heat Input in Joules/Inch (not to exceed 91,000 Joules per inch)}$$

Other Notes:

All welding shall be protected from wind, rain, and other harmful weather conditions which may affect weld quality.

Nonmetallic retainers, such as SAW neutral flux backing, may be used when needed for backing the joint for SAW welding. Where joints are welded from both sides, the first pass shall be backgouged and ground to sound metal before welding the second side.

All surfaces to be welded shall be dry and substantially free of mill scale, oil, grease, dirt, paint, galvanizing, and other contaminants. Surfaces to be welded shall be cleaned of all oil, rust, scale, paint, grease, and other deleterious foreign material for at least 1" from the weld joint preparation. An approved solvent can be used to remove oil or grease residues. Some approved solvents are DR-60, Acetone, and Isopropyl Alcohol-keep solvents away from sparks or flame, store only in approved cabinets. Machine, grind, or grit blast to remove rust or scale.

The preheat requirements shall apply to all welding, including tack welding, and the welding of any temporary attachments. Preheat shall also be established for thermal cutting and gouging operations. Maintain the preheat a minimum of 3 inches on either side of the weld joint. When a preheat of 200F or more is required, the weld joint shall be completed with no intermediate cooling, except that cooling under an insulating blanket is permitted. If Oxy-fuel torches are used for preheating, the torch tip shall be appropriate for the work – a "rosebud" is acceptable, but do not use a cutting or welding tip for preheating.

The weld shall be completed evenly, by depositing approximately equal layers around the weld joint - block welding is not permitted.

Peening shall not be used. The use of pneumatic tools (chipping or scaling gun) is not considered peening, and is permitted.

Cracks or other weld defects shall be completely removed by grinding to sound metal prior to depositing additional weld metal. Each layer of weld shall be visually checked by the welder, and shall be smooth and free of slag inclusions, porosity, excessive undercut, cracks, and lack of fusion prior to beginning the next weld layer. In addition, the final layer shall be sufficiently free of coarse ripples, nonuniform bead patterns, high crown and deep ridges to permit the performance of any required inspections or examinations. All arc strikes, starts, and stops shall be confined to the welding groove or shall be removed by grinding.

Tack welds shall either be completely removed, or the starting and stopping ends shall be prepared by grinding or filing for incorporation into the weld.

Temporary attachments shall be removed and the areas finished smooth and flush, inspected visually, and examined by Magnetic Particle or Liquid Penetrant method.

SMAW process can be used for tacking, sealing gaps, or placing reinforcement before welding with the SAW process. As an option, an SMAW root pass may be deposited prior to welding with SAW, then the root shall be backgouged and/or ground to sound metal prior to welding the backside with SAW.

Run on/off tabs shall be used wherever possible.

All weld joints shall have a minimum of two passes.

Each weld shall be stamped with the welder's unique identification stamp adjacent to the weld at intervals of 3 feet or less, when the material thickness is 1/4" or more.

orig.

3 1-9-80/ZH

2 10-26-77/ZH E-41

SH No. 1 of 2

1 5/23/77/RW.

[redacted] YUBA HEAT TRANSFER [redacted]

P.O. BOX 3158 - TULSA, OKLAHOMA 74101 - (918) 234-6000 - TLX 492464

PROCEDURE QUALIFICATION RECORD No. 76255 DATE: 7-15-76 2 5-24-77/RW

WELDING PROCEDURE SPEC. No. YA-3035 (Rev. 14, 11/24/80)

WELDING PROCESS(ES): SMAW

TYPES: Manual

BASE METALS: Material Spec. SA 516 Type or Grade 70

P No. 1 To P No. 1, Thk. 3", Range 3/16"-6", Dia. NA

FILLER METALS: Weld Metal Analysis A No. 1, Electrode Size 3/16

Filler Metal F No. 4, SFA Spec. 5.1 (E-7018)

Others: NA

POSITION: 1G, Weld Progression Flat Other NA

PREHEAT: Preheat Temp. 200°F, Interpass Temp 200°F - 500°F

Others: NA

POSTWELD HEAT TREATMENT: Temperature SR @ 1100°F

Time 5 Hours Other NA

GAS: Type NA, Composition NA, Flow Rate NA Other NA

FLUX: Type NA Other NA

ELECTRICAL CHARACTERISTICS: Current DC, Polarity RP

Amps. 250, Volts 22-26 1, Travel Speed 8 IPM, Other NA

TECHNIQUE: String or Weave Bead String, Oscillation NA

Multipass or Single Pass Multipass, Single or Multiple Electrode Single

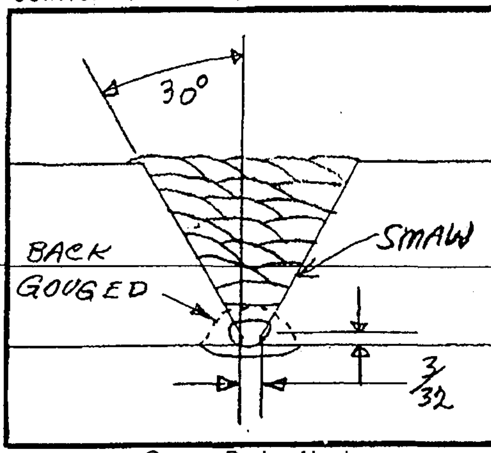
ADDITIONAL INFORMATION: NA

RADIOGRAPHIC RESULTS: (UW-51 of Sect. 8 per Table UW-12)- SATISFACTORY 2

TENSILE TEST (QW-150)

SPECIMEN NO.	WIDTH	DIA. 2	AREA	ULTIMATE TOTAL LOAD LB.	ULTIMATE UNIT STRESS PSI	CHARACTER OF FAILURE & LOCATION
1		.503	.1987	14,150	71,208	*1 WMD
2		.503	.1987	14,100	70,957	*1 WMD
3		.504	.1995	14,475	72,555	*1 WMD
4		.504	.1995	14,200	71,176	*1 WMD
5		.503	.1987	15,400	77,499	*1 WMD
6		.505	.2003	15,400	76,886	*1 WMD

JOINTS: 1/2: Max. Bead Thk.



Groove Design Used

GUIDED BEND TESTS *1 WELD METAL DUCTILE

TYPE AND FIGURE NO.	RESULT	TYPE AND FIGURE NO.	RESULT
1. SideBend	- No Fissures 2	5. SideBend	- No Fissures 2
2. SideBend	- No Fissures	6. SideBend	- No Fissures
3. SideBend	- No Fissures	7. SideBend	- No Fissures
4. SideBend	- No Fissures	8. SideBend	- No Fissures

IMPACT TEST — CHARPY (UG—84, SA—370)

Location	Type	Impact Energy (ft. lbs.)	Temperature °F	Impact Values Foot Pounds
Weld Top	A	120	0° & -20	(NB,NB,NB) (NB,NB,NB)*
Weld 3/4	A	120	0° & -20	(NB,NB,NB) (NB,NB,NB)
HAZ Top	A	120	0° & -20	(50,50,63) (56,44,40)
HAZ 3/4	A	120	0° & -20	(54,67,65) (59,45,52)
BM	A	120	0° & -20	(56,51,59) (41,34,25)

* NB - No Break

HARDNESS TEST (EQUIVALENT BHN 3000 KG LOAD)

LOCATION	HARDNESS
Weld Top	162
Weld Bottom	157
HAZ - Top	162
HAZ - Bottom	167
Cap	163

Welder's Name Beaver, R. F. Clock No. #1237 Stamp No. GN

Test conducted by: YHTC Lab. Test No. 76255 per D. Langford

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Sect. 9, ASME Code.

Signed Yuba Heat Transfer Corporation

By Ray Wildorf

Date 7-15-76

PEF-NCR-02334

Yuba Heat Transfer
ASME IX Procedure Qualification Record (PQR)
Weldspec for Windows

PQR record number Date	04-01 Revision 1 3/15/06	WPS record number Company name Welding standard	YA-3773 Revision 2 Yuba Heat Transfer

BASE METALS (QW-403)

	Product form	Specification (type or grade)	P no.	Grp-no.	Size	Sch.	Thick. (in.)	Dia. (in.)
	Plate	SA-516 (70)	1	2	-	-	1.5	-
Welded to:	Plate	SA-516 (70)	1	2	-	-	1.5	-
and tested:	Without PWHT, With PWHT, With impacts, With hardness							
Notes	Without PWHT, with PWHT, with impact testing, with hardness testing							

POST WELD HEAT TREATMENT (QW-407)

Temperature (°F)	1175	Time (hrs)	5	Type	Below lower transf. temp.
Heating rate (°F/hr)	400	Method	Furnace		
Cooling rate (°F/hr)	500	Method	Insulating blankets		
Notes	PWHT specimen test results on Sherry Lab Report 2001030363				

JOINTS (QW-402)

Joint design	Double-V-groove
Backing:	Back-gouged & welded
Retainers	Nonmetallic (neutral flux)
Groove angle (deg.)	60
Root opening (in.)	0
Root face (in.)	.062

JOINT BACKGOUGED/WELDED

NEUTRAL FLUX BACKING
LINCOLN 960

AFTER WELDING

WELDING PROCESSES

Welding process	SAW
Type	Machine

FILLER METALS (QW-404)

SFA specification	5.17
AWS classification	EM12K
Filler metal F-number	6
Weld metal A-number	1
Filler metal nominal composition	Not Recorded
Filler metal trade name	Lincoln L-61
Filler metal size (in.)	3/16
Deposited thickness (in.)	1.5
Maximum pass thickness (in.)	.375"
Weld deposit chemistry	Not Recorded
Flux AWS specification	5.17
Flux AWS classification	F7A2
Flux nominal composition	Not Recorded
Flux trade name	Lincoln 960
Flux type	Neutral flux
Flux from recrushed slag	No
Supplemental filler metal	None used
Supplemental filler metal vol. (ft³)	None used

POSITION (QW-405)

Position of groove	1G
Weld progression	-

PREHEAT (QW-406)

Preheat temperature (°F)	150
Maximum interpass temperature (°F)	500

ELECTRICAL (QW-409)

Filler metal size (in.)	3/16
Amperes	600 - 900
Volts	30 - 36
Travel speed (in./min)	16 - 25
Maximum heat input (kJ/in.)	121.5
Current/polarity	DCRP
Wire feed type	Cold wire
Wire feed speed (in./min)	As Required

TECHNIQUE (QW-410)

String or weave	Stringer
C.T.W.D (in.)	Not Recorded
Oscillation	None
Multi/single electrode	Single electrode
Electrode angle (deg.)	Not Recorded
Multi/Single pass per side	Multiple passes
Multiple or single layer	Multiple layer
Peening	Not used
Initial/interpass cleaning	Brushing and Grinding
Back gouging method	Air carbon arc

PEF-NCR-02335

Yuba Heat Transfer

ASME IX Procedure Qualification Record (PQR) - Test results (as welded)

Weldspec for Windows

PQR record number	04-01	Revision 1	WPS record number	YA-3773 Revision 2
Date	3/15/06		Company name	Yuba Heat Transfer
			Welding standard	

TENSILE TESTS (QW-150)

Reduced section

Specimen number	Width (in.)	Thickness (in.)	Area (in^2)	Ultimate total load (lb)	Ultimate unit stress (psi)	Type of failure and location
A-Top	.770	.742	0.5713	45000	78800	Ductile-Weld
A-Bottom	.770	.680	0.5236	41300	78900	Ductile-Base Metal
B-Top	.768	.693	0.5322	42000	78900	Ductile-Base Metal
B-Bottom	.772	.703	0.5427	43650	80400	Ductile-Base Metal

Comments: 2 sets (top/bottom) of reduced section tension tests per QW-151.1 and QW-462.1(a)

GUIDED BEND TESTS (QW-160)

Type of test	Acceptance criteria	Result	Comments
4 transverse side bends per QW-161.1 and QW-462.2	QW-163	Acceptable	see - ASME IX - QW-451.1

Comments: Tests conducted on specimens in the As-welded condition; Sherry Lab Report 2001030359.

TOUGHNESS TESTS (QW-170)

Specimen number	Notch location	Notch type	Specimen size (in.) x (in.)	Test temperature (°F)	Impact values (ft lb)	Impact values (% Shear)	Impact values (Mils)	Drop weight break
1	Base Metal	Charpy V	0.394 x 0.394	-20	35	20	31	n/a
2	Base Metal	Charpy V	0.394 x 0.394	-20	36	20	33	n/a
3	Base Metal	Charpy V	0.394 x 0.394	-20	13	10	14	n/a
4	HAZ	Charpy V	0.394 x 0.394	-20	56	30	43	n/a
5	HAZ	Charpy V	0.394 x 0.394	-20	69	35	57	n/a
6	HAZ	Charpy V	0.394 x 0.394	-20	80	45	60	n/a
7	Weld Metal	Charpy V	0.394 x 0.394	-20	34	20	34	n/a
8	Weld Metal	Charpy V	0.394 x 0.394	-20	51	25	46	n/a
9	Weld Metal	Charpy V	0.394 x 0.394	-20	70	35	63	n/a

Comments: Tests conducted on specimens in the As-welded condition; Sherry Lab Report 2001030359.

HARDNESS TEST

Type (Scale)	Distance from surface	SA-516 (70)	HAZ	Weld	HAZ	SA-516 (70)
BHN		150, 150, 150	190, 185, 180	185, 165, 147		

Comments: Tests conducted on specimens in the As-welded condition; Sherry Lab Report 2001030359.

CERTIFICATION

Welder's name	ID Number	Stamp number		
Jim Davis	3830	CK	Mechanical testing by	Sherry Laboratories-Midstates
			Laboratory test number	Sherry Lab Report 2001030359
			Test file number	PQR 04-01; Lab Req. 22-2001
			Tests conducted by	Larry Pate

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Welding Engineer

Name	Signature
Donald L. Underwood	
Date	
3/15/06	

PEF-NCR-02336

Yuba Heat Transfer

ASME IX Procedure Qualification Record (PQR) - Test results (PWHT)

Weldspec for Windows

PQR record number	04-01	Revision 1	WPS record number	YA-3773	Revision 2
Date	3/15/06		Company name	Yuba Heat Transfer	
			Welding standard		

TENSILE TESTS (QW-150) Reduced section

Specimen number	Width (in.)	Thickness (in.)	Area (in²)	Ultimate total load (lb)	Ultimate unit stress (psi)	Type of failure and location
A-Top	.757	.727	0.5503	40300	73200	Ductile-Weld
A-Bottom	.757	.656	0.4966	36750	74000	Ductile-Weld
B-Top	.756	.730	0.5519	40300	73000	Ductile-Weld
B-Bottom	.757	.645	0.4883	36400	74600	Ductile-Base Metal

Comments: 2 sets (top/bottom) of reduced section tension tests per QW-151.1 and QW-462.1(a)

GUIDED BEND TESTS (QW-160)

Type of test	Acceptance criteria	Result	Comments
4 transverse side bends per QW-161.1 and QW-462.2	QW-163	Acceptable	see - ASME IX - QW-451.1

Comments: Tests conducted on PWHT specimens; Sherry Lab Report 2001030363.

TOUGHNESS TESTS (QW-170)

Specimen number	Notch location	Notch type	Specimen size (in.) x (in.)	Test temperature (°F)	Impact values (ft lb)	(% Shear)	(Mils)	Drop weight break
1	Base Metal	Charpy V	0.394 x 0.394	-20	38	30	28	N/A
2	Base Metal	Charpy V	0.394 x 0.394	-20	13	20	14	N/A
3	Base Metal	Charpy V	0.394 x 0.394	-20	19	20	20	N/A
4	HAZ	Charpy V	0.394 x 0.394	-20	136	85	77	N/A
5	HAZ	Charpy V	0.394 x 0.394	-20	142	85	83	N/A
6	HAZ	Charpy V	0.394 x 0.394	-20	122	80	82	N/A
7	Weld Metal	Charpy V	0.394 x 0.394	-20	128	90	83	N/A
8	Weld Metal	Charpy V	0.394 x 0.394	-20	94	80	73	N/A
9	Weld Metal	Charpy V	0.394 x 0.394	-20	71	70	64	N/A

Comments: Tests conducted on PWHT specimens; Sherry Lab Report 2001030363.

HARDNESS TEST

Type (Scale)	Distance from surface	SA-516 (70)	HAZ	Weld	HAZ	SA-516 (70)
BHN		140, 146, 146	167, 179, 167	149, 156, 149		

Comments: Tests conducted on PWHT specimens; Sherry Lab Report 2001030363.

CERTIFICATION

Welder's name	ID Number	Stamp number		
Jim Davis	3830	CK	Mechanical testing by	Sherry Laboratories-Midstates
			Laboratory test number	Sherry Lab Report 2001030363
			Test file number	PQR 04-01; Lab Req. 22-2001
			Tests conducted by	Larry Pate

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Welding Engineer

Name	Signature
Donald L. Underwood	
Date	
3/15/06	

Yuba Heat Transfer

ASME IX Procedure Qualification Record (PQR) - Additional information

Weldspec for Windows

PQR record number	04-01	Revision 1	WPS record number	YA-3773	Revision 2
Date	3/15/06		Company name	Yuba Heat Transfer	
			Welding standard		

Test conducted for additional Flux/Wire combination using Lincoln L-61 with Lincoln 960 Flux.

This revision:
- correlates test results for as-welded and PWHT specimens
- corrects joint root opening (QW-402.10, nonessential variable)
- adds that neutral flux was used as a non-metallic retainer (QW-402.11, nonessential variable)
- adds that filler metal nominal composition is not recorded [wire is A-1 (QW-442) and wire classification is reported (QW-404.5)]
- adds that actual weld deposit chemistry is not recorded [wire is A-1 (QW-442), and wire classification is reported (QW-404.5)]
- adds that flux nominal composition was not recorded [an alloy flux is not used for this test (QW-404.10)].
- corrects lowest amperage used during test welding (typographical error, should be 600 amps, not 400 amps)

Yuba Heat Transfer

ASME IX Procedure Qualification Record (PQR)

Weldspec for Windows

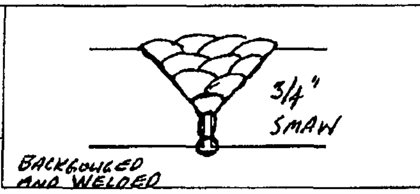
PQR record number Date	14-04 Revision 0 5/20/04	WPS record number Company name Welding standard	YA-3740 Revision 8 Yuba Heat Transfer ASME Section IX and Section VIII, Division 1

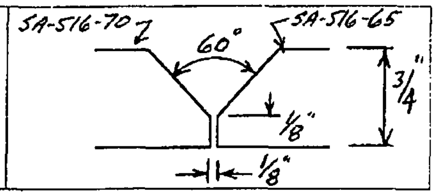
BASE METALS (QW-403)

	Product form	Specification (type or grade)	P no.	Grp-no.	Size	Sch.	Thick. (in.)	Dia. (in.)
	Plate	SA-516 (65)	1	1	-	-	.750	-
Welded to:	Plate	SA-516 (70)	1	2	-	-	.750	-
and tested:	Without PWHT, With impacts, With hardness							
Notes	SMAW of P-1 Group 1 to P-1 Group 2, As-welded Condition							

JOINTS (QW-402)

Joint design	Single-V-groove
Backing:	None
Retainers	None
Groove angle (deg.)	60
Root opening (in.)	.125
Root face (in.)	.125





WELDING PROCESSES

Welding process	SMAW
Type	Manual

FILLER METALS (QW-404)

SFA specification	5.1
AWS classification	E7018
Filler metal F-number	4
Weld metal A-number	1
Filler metal nominal composition	Fe, Mn, Si
Filler metal trade name	ESAB Atom Arc
Filler metal size (in.)	5/32
Deposited thickness (in.)	.750
Maximum pass thickness (in.)	3/16
Weld deposit chemistry	See Page 3

POSITION (QW-405)

Position of groove	3G
Weld progression	Vertical Up

PREHEAT (QW-406)

Preheat temperature (°F)	70F
Maximum interpass temperature (°F)	500F

ELECTRICAL (QW-409)

Filler metal size (in.)	5/32
Amperes	250
Volts	23
Travel speed (in./min)	7
Maximum heat input (kJ/in.)	49.2857
Current/polarity	DCEP (reverse polarity)

TECHNIQUE (QW-410)

String or weave	Both(see pg3 for width limit)
Multi/Single pass per side	Single and Multiple passes
Peening	Not used
Initial/interpass cleaning	Machine/Grind, Chip, brush
Back gouging method	Air carbon arc and grind

Yuba Heat Transfer

ASME IX Procedure Qualification Record (PQR) - Test results (as welded)

Weldspec for Windows

PQR record number Date	14-04 Revision 0 5/20/04	WPS record number Company name Welding standard	YA-3740 Yuba Heat Transfer ASME Section IX and Section VIII, Division 1	Revision 8

TENSILE TESTS (QW-150) — Reduced section

Specimen number	Width (in.)	Thickness (in.)	Area (in²)	Ultimate total load (lb)	Ultimate unit stress (psi)	Type of failure and location
A	0.748	0.699	0.5229	43000	82200	Ductile-Base Metal
B	0.750	0.701	. 0.5258	43100	82000	Ductile-Base Metal
Comments	Sherry Lab Report 2004050250					

GUIDED BEND TESTS (QW-160)

Type of test	Acceptance criteria	Result	Comments
4 transverse side bends per QW-161.1 and QW-462.2	QW-163	Acceptable	see - ASME IX - QW-451.1
Comments	Sherry Lab Report 2004050250		

TOUGHNESS TESTS (QW-170)

Specimen number	Notch location	Notch type	Specimen size (in.) x (in.)	Test temperature (°F)	Impact values (ft lb)	(% Shear)	(Mils)	Drop weight break
1	Weld Metal	Charpy V	10mm x 10mm	-32F	74	50	50	NA
2	Weld Metal	Charpy V	10mm x 10mm	-32F	67	45	48	NA
3	Weld Metal	Charpy V	10mm x 10mm	-32F	86	55	59	NA
4	P-1 Gr1 HAZ	Charpy V	10mm x 10mm	-32F	14	25	22	NA
5	P-1 Gr1 HAZ	Charpy V	10mm x 10mm	-32F	42	35	30	NA
6	P-1 Gr1 HAZ	Charpy V	10mm x 10mm	-32F	26	30	22	NA
7	P-1 Gr2 HAZ	Charpy V	10mm x 10mm	-32F	41	35	30	NA
8	P-1 Gr2 HAZ	Charpy V	10mm x 10mm	-32F	60	45	42	NA
9	P-1 Gr2 HAZ	Charpy V	10mm x 10mm	-32F	37	35	29	NA
Comments	Sherry Lab Report 2004050250							

HARDNESS TEST

Type (Scale)	Distance from surface	SA-516 (65)	HAZ	Weld	HAZ	SA-516 (70)
BHN (Converted from Rockwell)	Surface	159, 153, 153	200, 200, 210	195, 200, 200	205, 205, 216	156, 153, 153
Comments	Sherry Lab Report 2004050250					

CERTIFICATION

Welder's name	ID Number	Stamp number		
Brad Silkey	361	BS	Mechanical testing by Laboratory test number Test file number Tests conducted by	Sherry Laboratories-Midstates 2004050250 PQR 14-04; Yuba Lab Req. 53-2004 Carol Judd and Jim Hill

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Welding Engineer

Name	Signature
Donald L. Underwood	
Date	
5/20/04	

Yuba Heat Transfer

ASME IX Procedure Qualification Record (PQR) - Additional Information

Weldspec for Windows

PQR record number	14-04	Revision 0	WPS record number	YA-3740	Revision 8
Date	5/20/04		Company name	Yuba Heat Transfer	
			Welding standard	ASME Section IX and Section VIII, Division 1	

Sherry Lab Report 2004050250 Weld Deposit Chemistry Analysis (Weight %):

Carbon, 0.06
Manganese, 1.48
Phosphorus, 0.008
Sulfur, 0.008
Silicon, 0.46
Copper, 0.07
Nickel, 0.03
Chromium, 0.03
Molybdenum, 0.01

Analysis conducted on weld surface by OE method.

Bead width when weaving was limited to a maximum of 3 X electrode diameter, both stringer beads and weave beads were used when welding the test plates.

Test plates welded on one side, joint was backgouged, and a single pass was placed on the backside.

PEF-NCR-02341

YUBA HEAT TRANSFER
P.O. Box 3158 Tulsa, Oklahoma

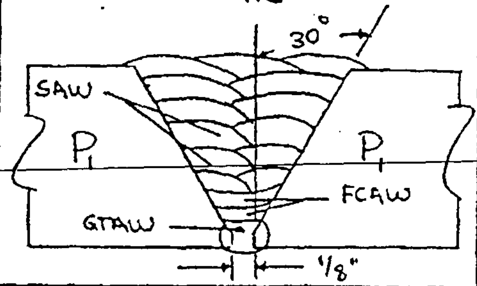
PROCEDURE QUALIFICATION RECORD No. 150-82 DATE 7-30-82
WELDING PROCEDURE SPEC. No. YA-3773
WELDING PROCESS(ES) GTAW, FCAW, SAW
TYPES: Semi-Automatic & Machine Welding
BASE METALS: Material Spec. 516 Type or Grade 70
P No. 1 gr. 2 To P No. 1 gr. 2, Thk. 2", Range 3/16 - 8" Dia. NA
FILLER METALS: Weld Analysis A No. 1 Electrode Size: 3/32, .045, 1/8
Filler Metal F No. 6, 6, 6 SFA Spec. 5.18, 5.20, 5.17
Others: AWS ER70S-2, E71T-1, EM12K F70-EM12K
POSITION: GTAW-3G, FCAW-3G, Weld Progression Uphill-36 Other SAW-1G
PREHEAT: Preheat Temp. 150 °Min., Interpass Temp 350 °F. Max.
Others: *1 FCAW transfer mode: Globular *1 Supp. filler or powdered filler: None
POSTWELD HEAT TREATMENT: Temperature 1100 °F.
Time 1 hr per inch (2 hrs) Other
GAS: Type AR, CO2, Composition 99.99%, Flow Rate 35 CFH Other
FLUX: Type H-800 (Hobart) Other
ELECTRICAL CHARACTERISTICS: Current DC, Polarity GTAW-SP, FCAW & SAW RP
Amps. 100, 170, 500 Volts 15, 24, 30 Travel Speed 2½ ipm, 7ipm, 16ipm, Other
TECHNIQUE: String or Weave Bead GTAW & SAW - String Oscillation NA
Multipass or Single Pass Multipass, Single or Multiple Electrode Single
ADDITIONAL INFORMATION: Manual welding done in the 3G position to satisfy QW409.1 for CVN
*1 Max. pass thk. 3/8". GTAW backing or trailing gas: None

TENSILE TEST (QW-150) *1 Recertified 12-7-99 Tim Morris

Specimen No.	Dia.	Thick	Area	Ultimate Total Load LB.	Ultimate Unit Stress PSI	Character Of Failure & Location
1 Top	.507		.202	15,700	77,723 *	BM Duc.
2 Top	.510		.204	15,975	78,309 *	BM Duc.
3 Bot	.506		.201	16,100	80,100 *	BM Duc.
4 Bot	.507		.202	15,950	78,960 *	WM Duc.

JOINTS: Globular transfer

DEPOSITED WELD METAL
GTAW = .125"
FCAW = .375"
SAW = 1.5"



Groove Design Used

GUIDED BEND TESTS (QW-160)

Type And Figure No.	Result	Type And Figure No.	Result
1 Side	Satisfactory		
2 Side	Satisfactory		
3 Side	Satisfactory		
4 Side	Satisfactory		

IMPACT TEST - CHARPY (UG - 84 SA - 370)

Location	Type	Impact Energy ft/lb)	Temp. °F	Impact Values Foot Pounds		
Top Weld	A	264 ft/lb	0°	55	52	49
3/4T Weld	A	264 ft/lb	0°	27	25	39
HAZ	A	264 ft/lb	0°	39	46	41

Hardness Test
(EQUIVALENT BHN 3000 KG LOAD)

Location	Hardness
Base Metal	126,128,128,130
Weld Metal	148,145,145,157
HAZ	148,148,157,160

® 3-30-01

Welder's Name Hudson, Holcomb, Digg Clock No. 2407, 990, 526 Stamp No. HK, AE, AB
Test Conducted by: Yuba Heat Transfer Corp Lab Test No. ~~150-82~~ 146-82 per Bob Hildebrandt

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Sect. 9, ASME Code.

Signed Yuba Heat Transfer PEF-NCR-02342

Date 7/30/82 LAB By Tim Morris

® REPORT NUMBER CORRECTED. 3-30-01

* CORRECTED ULTIMATE UNIT STRESS FIGURES 10-21-98 Recertified by Tim Morris

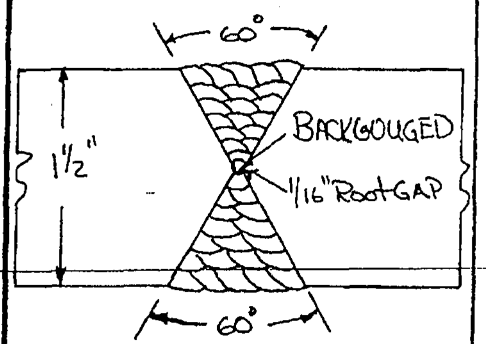
YUBA HEAT TRANSFER
P.O. Box 3158 Tulsa, Oklahoma (918) 234-6000

PROCEDURE QUALIFICATION RECORD No. 037-89 DATE 3-9-89
WELDING PROCEDURE SPEC. No. YA-3740
WELDING PROCESS(ES) SHIELDED METAL ARC WELDING
TYPES: MANUAL
BASE METALS: Material Spec. SA-516-70 to SA-516-70 Type or Grade Normalized Fine
P No. 1 Gr.2 To P No. 1 Gr.2 , Thk. 1½" , Range 5/8" - 8" Dia. NA
FILLER METALS: Weld Analysis A No. 1 Electrode Size: 1/8" Ø
Filler Metal F No. 4 SFA Spec. 5.1
Others: AWS Classification E7018-1
POSITION: 3G , Weld Progression Vertical-up Other
PREHEAT: Preheat Temp. 200°F , Interpass Temp 500°F
Others: No preheat maintenance after completion of weldment.
POSTWELD HEAT TREATMENT: Temperature S.R. @ 1150°F
Time 5 hrs. UP 266°F/hr. DOWN 334°F/hr. Other
GAS: Type NA , Composition NA , Flow Rate NA Other
FLUX: Type NA Other
ELECTRICAL CHARACTERISTICS: Current DC , Polarity REVERSE
Amps. 120 Volts 26 Travel Speed 6 IPM , Other
TECHNIQUE: String or Weave Bead String Oscillation None
Multipass or Single Pass Multipass , Single or Multiple Electrode Single
ADDITIONAL INFORMATION: Max. pass thk: 1/4" Max. J/in qualified: 31,200

TENSILE TEST (QW-150)

Specimen No.	Dia.	Thick	Area	Ultimate Total Load LB.	Ultimate Unit Stress PSI	Character Of Failure & Location
		NOT	REQUI	RED PER QW-	401.3 This P	QR ran to
		sati	sfy S	upplemental	Essential V	ariables
		and	UG-84	for CVN'S.	Ref. PQR 76	255

JOINTS:



Groove Design Used

GUIDED BEND TESTS (QW-160)

Type And Figure No.	Result	Type And Figure No.	Result
	NOT REQUIRED	PER QW-401.3	

IMPACT TEST - CHARPY (UG - 84 SA - 370)

Location	Type	Impact Energy ft/lb)	Temp. °F	Impact Values Foot Pounds
WELD	A	264	-50°	68,46,45
HAZ	A	264	-50°	40,35,40

Hardness Test
(EQUIVALENT BHN 3000 KG LOAD)

Location	Hardness

Welder's Name J. Bennett Clock No. 1142 Stamp No. GP
Test Conducted by: Metlab Lab Test No. 037-89 per Dan Lawson

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Sect. 9, ASME Code.

Signed YUBA HEAT TRANSFER DIV.

Date 3-9-89 By [signature]

PEF-NCR-02343

23

MANUFACTURER'S RECORD OF WELDING OPERATOR QUALIFICATION TESTS
MACHINE WELDING (QW-361.2)

Welder Name Logue, David #3735 Stamp No. ID

Using WPS No. YA-3296 Rev ____ Date ____

VARIABLE	USED FOR QUALIFICATION	QUALIFICATION RANGE
PROCESS	SAW	SAW
PROCESS TYPE	MACHINE	MACHINE
VISUAL CONTROL	DIRECT	DIRECT
AUTO ARC VOLTAGE CONTROL	N/A	N/A
JOINT TRACKING	MANUAL	MANUAL or AUTOMATIC
POSITION	1G	1G
CONSUMABLE INSERT	NONE	WITH OR WITHOUT
BACKING	WELD METAL OR FLUX	WITH BACKING ONLY

GUIDED BEND TEST RESULTS QW-462.2(a), QW-462.3(a), QW-462.3(b)

TYPE AND FIG. NO.	RESULT

RADIOGRAPHIC TEST RESULTS (QW-305)
(For alternative qualification of groove welds by radiography)

RADIOGRAPHIC RESULTS SATISFACTORY PER ALLEN CASH / LEVEL 111

TEST CONDUCTED BY YUBA HEAT / Tim Morris LAB. TEST NO. N/A

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Organization YUBA HEAT TRANSFER DIV.

Date 8-18-88 By Tim Morris

PEF-NCR-02344

Yuba Heat Transfer

ASME IX Welding Procedure Specification (WPS)

Weldspec for Windows

WPS record number	YA-3387 Revision 27	Qualified to	ASME Section IX and Section VIII, Division 1
Date	3/16/06	Company name	Yuba Heat Transfer
Supporting PQR(s)	035-89; 036-89; 24-92; 43-96; 65-96		
Reference docs.	ASME Section VIII, Division 1; ASME Section IX with Latest Mandatory Addenda		

Scope	FCAW P-1 Materials, As-Welded or with PWHT Groove, fillet, no PWHT (As-welded), with PWHT
Joint	*Joint details for this welding procedure specification in:* Production drawings, Engineering specifications

BASE METALS (QW-403)

Type	Carbon steel (P1)	P-no. 1	Grp-no. 1 or 2
Welded to	Carbon steel (P1)	P-no. 1	Grp-no. 1 or 2
Backing:	Back-gouged & welded	P-no. 1	Grp-no. -
Retainers	None		
Notes	See Pages 2 and 3		

THICKNESS RANGE QUALIFIED (in.)

	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
Complete pen.	0.188	1.5	0.188	8
Impact tested	-	-	-	-
Partial pen.	0.188	1.5	0.188	8
Fillet welds	No min.	1.5	No min.	8

DIAMETER RANGE QUALIFIED (in.)

	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
Nominal pipe size	No min.	No max.	No min.	No max.

FILLER METALS (QW-404)

THICKNESS RANGE QUALIFIED (in.)

	SFA	Classification	F-no.	A-no.	Chemical analysis or Trade name	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
FCAW	5.20	E70T-1 or E71T-1	6	1	Any E70T-1 or E71T-1 wire	No min.	1.5	No min.	8
Sup. filler	-	-	-	-	-	- None -			

WELDING PROCEDURE

Welding process	FCAW
Type	Semi-automatic
Preheat temperature (°F)	See page 2 for preheat
Maximum interpass temperature (°F)	500F
Filler metal size (in.)	.045, 1/16
Layer number	All
Position of groove	All
Weld progression	Vertical up (when applicable)
Current/polarity	DCEP (reverse polarity)
Amperes	See Page 3
Volts	See Page 3
Travel speed (in./min)	Adjust for amps/volts/conditions
Maximum heat input (kJ/in.)	Not limited
Wire feed speed (in./min)	See Page 3
Arc transfer mode	Globular
Shielding: Gas type	CO2
Flow rate (cfh)	35 to 50
Trailing: Gas type	None
Flow rate (cfh)	
Backing: Gas type	None
Flow rate (cfh)	
String or weave	Stringer or Weave
Orifice/gas cup size	5/8 (.045); 5/8 or 3/4 (1/16)
C.T.W.D (in.)	5/8-3/4 (.045); 3/4-1 (1/16)
Multi/Single pass per side	Single or Multiple passes
Maximum pass thickness (in.)	Less than 1/2
Weld deposit chemistry	A-1 per QW-442
Notes	See Pages 2 and 3

Yuba Heat Transfer

ASME IX Welding Procedure Specification (WPS)

Weldspec for Windows

WPS record number	YA-3387 Revision 27	Qualified to	ASME Section IX and Section VIII, Division 1
Date	3/16/06	Company name	Yuba Heat Transfer

PREHEAT TABLE

Applicable standard	
ASME Section VIII Div. 1	70F minmum preheat shall be established prior to welding any thickness less than 1". 200F minimum preheat shall be established prior to welding thickness of 1" or more. See Page 3 and WS 1.00-4 for other preheat information.

POST WELD HEAT TREATMENT (QW-407)

Temperature (°F)	1100F - 1250F	Time (hrs)	See Notes Below	Type	Below lower transf. temp (P-1 mat'l)
Heating rate (°F/hr)	See Notes Below	Method	Furnace or resistance		
Cooling rate (°F/hr)	See Notes Below	Method	Still air		
Notes	See job drawings for PWHT requirements				

TECHNIQUE (QW-410)

Peening	Not used
Surface preparation	Grit blast, brush, grind, or machine
Initial/interpass cleaning	Brushing, Chipping, and Grinding
Back gouging method	Air carbon arc and grind to sound weld/base metal

NOTES

PWHT of P-1 Materials -
For materials up to 2 inches thick, hold at PWHT temperature for 1 hour per inch (15 minutes minimum).
For materials over 2 inches thick, hold at PWHT temperature for 2 hours plus 15 minutes for each additional inch over 2 inches.
Above 800F the rate of heating shall not exceed 400F per hour divided by the maximum metal thickness, but in no case more than 400F per hour.
Above 800F the rate of cooling shall not exceed 500F per hour divided by the maximum metal thickness, but in no case more than 500F per hour.
The rates of heating and cooling need not be less than 100F per hour, unless directed otherwise by the job drawings.
Below 800F the vessel may be allowed to cool in still air.

See page 3.

Welding Engineer

Name	Signature
Donald L. Underwood	Donald L. Underwood
Date	
3/16/06	

Yuba Heat Transfer

ASME IX Welding Procedure Specification (WPS)

Weldspec for Windows

WPS record number	YA-3387 Revision 27	Qualified to	ASME Section IX and Section VIII, Division 1
Date	3/16/06	Company name	Yuba Heat Transfer

See job drawings and Weld Joint Design Standards WS 1.00-10 or H2-9 for weld joint designs and root spacing (gap) requirements.

E70T-1 wires may be used for welding in flat or horizontal positions, but for other positions use E71T-1 wires.

Joints that will are to be welded from one side only shall have the root placed with GTAW process (YA-3030). Where joints are welded from both sides, the first pass shall be backgouged and ground to sound metal before welding the second side. As an option, the root pass may be placed with SMAW (YA-3035) or FCAW (YA-3387) provided the root is backgouged and ground to sound metal before welding the backside. FCAW may also be used for fillet welds, partial penetration groove welds, or groove welds which are welded from one side only when the joint is backed with A-1/P-1 weld metal or base metal.

All welding shall be protected from wind, rain, and other harmful weather conditions which may affect weld quality. All surfaces to be welded shall be dry and substantially free of mill scale, oil, grease, dirt, paint, galvanizing, and other contaminants. Surfaces to be welded shall be cleaned of all oil, rust, scale, paint, grease, and other deleterious foreign material for at least 1" from the weld joint preparation. An approved solvent can be used to remove oil or grease residues. Some approved solvents are Sherwin DR-60 liquid penetrant cleaner, acetone, and isopropyl alcohol. Keep solvents away from open sparks or flame and store only in approved cabinets. Machine, grind, or grit blast to remove rust or scale.

The preheat requirements shall apply to all welding, including tack welding, and the welding of any temporary attachments. Preheat shall also be established for thermal cutting and gouging operations. Maintain the preheat a minimum of 3 inches on either side of the weld joint (WS 1.00-4). When a preheat of 200F or more is required, the weld joint shall be completed with no intermediate cooling, except that cooling under an insulating blanket is permitted. When oxy-fuel torches are used only for preheating the tip should be appropriate for the work --- in other words, for the application of preheat prior to welding a "rosebud" or heating tip should be used. It is not recommended to use a cutting tip for general preheat application since the tip focuses heat in a small area and could damage material.

The weld shall be completed evenly, by depositing approximately equal layers around the weld joint - block welding is not permitted.

Peening shall not be used. The use of pneumatic tools (chipping or scaling gun) is not considered peening, and is permitted.

Cracks or other weld defects shall be completely removed by grinding to sound metal prior to depositing additional weld metal. Each layer of weld shall be visually checked by the welder, and shall be smooth and free of slag inclusions, porosity, excessive undercut, cracks, and lack of fusion prior to beginning the next weld layer. In addition, the final layer shall be sufficiently free of coarse ripples, nonuniform bead patterns, high crown and deep ridges to permit the performance of any required inspections or examinations. All arc strikes, starts, and stops shall be confined to the welding groove or shall be removed by grinding.

Tack welds shall either be completely removed, or the starting and stopping ends shall be prepared by grinding or filing for incorporation into the weld.

Temporary attachments shall be removed and the areas finished smooth and flush, inspected visually, and examined by Magnetic Particle or Liquid Penetrant method.

All weld joints shall have a minimum of two passes.

Each weld shall be stamped with the welder's unique identification stamp adjacent to the weld at intervals of 3 feet or less, whenever the material thickness is 1/4" or more.

FCAW Amp/Volt/Wire Feed Ranges:

For .045 diameter wire -
140 to 280 amps
24 to 31 volts
180 to 520 inches per minute wire feed speed

For 1/16 diameter wire -
200 to 350 amps
25 to 33 volts
120 to 350 inches per minute wire feed speed

PEF-NCR-02347

YUBA HEAT TRANSFER
P.O. Box 3158 Tulsa, Oklahoma (918) 234-6000

PROCEDURE QUALIFICATION RECORD No. 035-89 DATE 3-22-89
WELDING PROCEDURE SPEC. No. YA-3779
WELDING PROCESS(ES) FLUX CORED ARC WELDING (FCAW)
TYPES: SEMIAUTOMATIC
BASE METALS: Material Spec. SA-516-70 to SA-516-70 Type or Grade Normalized-fine
P No. 1 GR.2 To P No. 1 GR.2 , Thk. 1/2" *1, Range 3/8" - 3/4" Dia. NA
FILLER METALS: Weld Analysis A No. E71T-1 Electrode Size: .045" Ø
Filler Metal F No. 6 SFA Spec. 5.20
Others: AWS Classification: E71T-1 Kobe wire Kobelco Frontiarc-711
POSITION: 3G , Weld Progression Vertical-up Other
PREHEAT: Preheat Temp. 70°F , Interpass Temp 500°F
Others: No preheat maintenance after completion of weldment.
POSTWELD HEAT TREATMENT: Temperature S.R. @ 1150°F
Time 5 hrs. Up 400°F/hr Down 500°F/hr. Other
GAS: Type CO_2 , Composition 99.995% , Flow Rate 30 CFH Other
FLUX: Type NA Other
ELECTRICAL CHARACTERISTICS: Current DC , Polarity RP
Amps. 140 Volts 21 Travel Speed 5 IPM , Other
TECHNIQUE: String or Weave Bead 1/2" max. weave Oscillation None
Multipass or Single Pass Multipass , Single or Multiple Electrode Single
ADDITIONAL INFORMATION: Max. bead thk: 1/4" Max. J/in qualified: 35,280 Supplemental or supplementary powdered filler: None Globular transfer Trailing gas: None
Contact stickout: 3/4"

TENSILE TEST (QW-150)

Specimen No.	WIDTH ~~Dia.~~	Thick	Area	Ultimate Total Load LB.	Ultimate Unit Stress PSI	Character Of Failure & Location
1	.757	.485	3671	26,890	73,250	BM Ductile
2	.753	.485	3652	26,920	73,713	BM Ductile

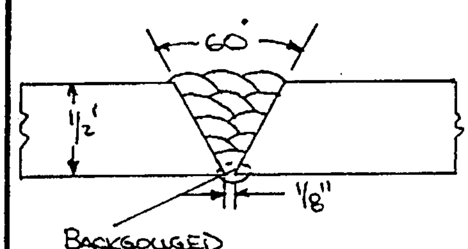
GUIDED BEND TESTS (QW-160) QW462.2

Type And Figure No.	Result	Type And Figure No.	Result
1	Satisfactory		
2	Satisfactory		
3	Satisfactory		
4	Satisfactory		

IMPACT TEST - CHARPY (UG - 84 SA - 370)

Location	Type	Impact Energy ft/1b)	Temp. °F	Impact Values Foot Pounds
*1 Weld	A	264	-25°	58, 58, 77
*1 HAZ	A	264	-25°	104,101,113

JOINTS:



~~*1 CVN qualification was ran~~ on 3/8" thk. plate per parameters used on 1/2" plate WPS qualificat

Groove Design Used

Hardness Test
(EQUIVALENT BHN 3000 KG LOAD)

Location	Hardness
Weld	207,187,187
HAZ	143,149,163
Base	128,131,134

Welder's Name J. Bennett Clock No. 1142 Stamp No. GP
Test Conducted by: Metlab Lab Test No. 035-89 045-89 per Dan Lawson

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Sect. 9, ASME Code.

Signed YUBA HEAT TRANSFER DIV.
Date 3-22-89 By Tim Morris

PEF-NCR-02348

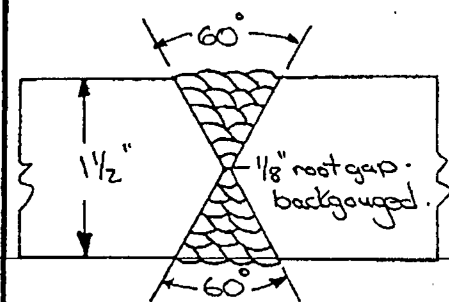
YUBA HEAT TRANSFER
P.O. Box 3158 Tulsa, Oklahoma (918) 234-6000

PROCEDURE QUALIFICATION RECORD No. 036-89 DATE 3-22-89
WELDING PROCEDURE SPEC. No. YA- 3779
WELDING PROCESS(ES) FLUX CORED ARC WELDING (FCAW)
TYPES: SEMIAUTOMATIC
BASE METALS: Material Spec. SA-516-70 to SA-516-70 Type or Grade Normalized-fine
P No. 1 GR.2 To P No. 1 GR.2 , Thk. 1½" , Range 5/8"-8" Dia. NA
FILLER METALS: Weld Analysis A No. E71T-1 Electrode Size: .045" Ø
Filler Metal F No. 6 SFA Spec. 5.20
Others: AWS Classification E7 T-1 Kobe wire Kobelco Frontiarc -711
POSITION: 3G , Weld Progression Vertical-up Other ----
PREHEAT: Preheat Temp. 200°F , Interpass Temp 500°F
Others: No preheat maintenance after completion of weldment.
POSTWELD HEAT TREATMENT: Temperature S.R.@ 1150°F
Time 5 hrs. Up 100°F/hr Down 100°F/hr. Other
GAS: Type CO_2 , Composition 99.995% , Flow Rate 30 CFH Other
FLUX: Type NA Other
ELECTRICAL CHARACTERISTICS: Current DC , Polarity RP
Amps. 140 Volts 21 Travel Speed 5 IPM , Other
TECHNIQUE: String or Weave Bead 1/2" Max. weave Oscillation None
Multipass or Single Pass Multipass , Single or Multiple Electrode Single
ADDITIONAL INFORMATION: Max. bead thk. 1/4" Max. J/in qualified: 35,280
Supplemental or supplementary powdered filler: None Globular transfer.
Trailing gas: None Contact stickout: 3/4"

TENSILE TEST (QW-150)

Specimen No.	WIDTH Dia.	Thick	Area	Ultimate Total Load LB.	Ultimate Unit Stress PSI	Character Of Failure & Location
1	.758	1.501	1.138	91,800	80,668	BM Ductile
2	.760	1.485	1.129	92,900	82,285	BM Ductile

JOINTS:



Groove Design Used

GUIDED BEND TESTS (QW-160)QW462.2

Type And Figure No.	Result	Type And Figure No.	Result
1	Satisfactory		
2	Satisfactory		
3	Satisfactory		
4	Satisfactory		

IMPACT TEST - CHARPY (UG - 84 SA - 370)

Location	Type	Impact Energy ft/lb)	Temp. °F	Impact Values Foot Pounds
Weld	A	264	-25°	20,59,66
HAZ	A	264	-25°	68,82,84

Hardness Test
(EQUIVALENT BHN 3000 KG LOAD)

Location	Hardness
Weld	159,170,192
HAZ	174,156,192
Base	146,149,140

Welder's Name J. Bennett Clock No. 1142 Stamp No. GP
Test Conducted by: Metlab Lab Test No. 036-89 041-89 per Dan Lawson

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Sect. 9, ASME Code.

Signed YUBA HEAT TRANSFER DIV.

Date 3-22-89 By Tim Morris

PEF-NCR-02349

YUBA HEAT TRANSFER

P.O. Box 3158 Tulsa, Oklahoma (918) 234-6000

PROCEDURE QUALIFICATION RECORD No. 24-92 DATE 1-23-92

WELDING PROCEDURE SPEC. No. 3889

WELDING PROCESS(ES) FLUX CORED ARC WELDING

TYPES: SEMIAUTOMATIC

BASE METALS: Material Spec. SA-516-70 to SA-516-70 Type or Grade Normalized

P No. 1 Gr.2 To P No. 1 Gr.2, Thk. 1½" - 3/8", Range *1 Dia. N/A

FILLER METALS: Weld Analysis A No. 1 Electrode Size: .045" Ø

Filler Metal F No. 6 SFA Spec. SFA-5.20

Others: AWS Classification: E71T-1 (Kobe wire)

POSITION: 1G, Weld Progression N/A Other

PREHEAT: Preheat Temp. 200°F min., Interpass Temp 500°F max.

Others:

POSTWELD HEAT TREATMENT: Temperature AS WELDED CONDITION

Time N/A Other

GAS: Type CO_2, Composition 100%, Flow Rate 35 CFH Other

FLUX: Type N/A Other

ELECTRICAL CHARACTERISTICS: Current DC, Polarity Reverse

Amps. 190 Volts 26 Travel Speed 10 ipm, Other

TECHNIQUE: String or Weave Bead String Oscillation none

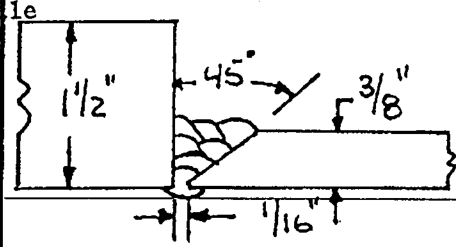
Multipass or Single Pass Multipass, Single or Multiple Electrode Single

ADDITIONAL INFORMATION: *1 Thick member range 5/8" - unlimited thk. Thin member: 3/8" - 3/4" per QW-202.4(2) Deposited weld metal range: 3/4" max. J/in. qualified: 37,050 Max. pass thk. 3/16" Tubular wire, Globular transfer. Supplemetal filler: None Trailing gas: None

TENSILE TEST (QW-150)

Specimen No.	WIDTH DIA.	Thick	Area	Ultimate Total Load LB.	Ultimate Unit Stress PSI	Character Of Failure & Location
1	.774	.358	.266	21,000	79,000	3/8"base-ductile
2	.750	.353	.264	20,900	79,000	3/8"base-ductile

JOINTS:



Groove Design Used

GUIDED BEND TESTS (QW-160)

Type And Figure No.	Result	Type And Figure No.	Result
1	Satisfactory		
2	Satisfactory	QW-462.2(a)	
3	Satisfactory		
4	Satisfactory		

IMPACT TEST - CHARPY (UG - 84 SA - 370)

Location	Type	Impact Energy ft/lb)	Temp. °F	Impact Values Foot Pounds
Weld	A	240	-25°F	42,52,48
3/8" HAZ	A	240	-25°F	110,107,102
1½" HAZ	A	240	-25°F	76,54,44

Hardness Test (EQUIVALENT BHN 3000 KG LOAD)

Location	Hardness
Weld	195,172,176
3/8" HAZ	172,165,195
1½" HAZ	167,205,222

Welder's Name D. Schweitzer Clock No. 3420 Stamp No. BW

Test Conducted by: Midstates Lab Test No. 24-92 per Bill Vesely

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Sect. 9, ASME Code.

Signed YUBA HEAT TRANSFER DIV.

Date 1-23-92 By Vern Morris

PEF-NCR-02350

YUBA HEAT TRANSFER DIVISION

P.O. BOX 3156 - TULSA, OKLAHOMA 74101 - (918) 234-6000 - TLX 492464

PROCEDURE QUALIFICATION RECORD No. 43-96 DATE 3-19-96

WELDING PROCEDURE SPEC. No. YA- 4072

WELDING PROCESS(ES) FCAW

TYPES: Semi-automatic

BASE METALS: Material Spec. SA-516-70 Norm to SA-516-70 Q&T Type or Grade Norm. to Q&T

P No. 1 Gr.2 To P No. 1 Gr.2, Thk. 3/8", Range 3/8" min. Dia. N/A

FILLER METALS: Weld Analysis A No. E-71T-1 Electrode Size: .045" Ø

Filler Metal F No. 6 SFA Spec. 5.20

Others: • AWS Classification: E71T-1 Kobelico Frontiarc-711 only Flux-cored wire

POSITION: 3G, Weld Progression Vertical-up Other

PREHEAT: Preheat Temp. 70 deg.F min., Interpass Temp 500 deg.F max.

Others: Supplemental filler or powdered filler: None

POSTWELD HEAT TREATMENT: Temperature As Welded Condition

Time N/A Other

GAS: Type CO2, Composition 100%, Flow Rate 30 CFH Other

FLUX: Type N/A Other

ELECTRICAL CHARACTERISTICS: Current DC, Polarity RP

Amps. 140 Volts 21 Travel Speed 5 IPM, Other

TECHNIQUE: String or Weave Bead Weave Oscillation

Multipass or Single Pass Multipass, Single or Multiple Electrode Single

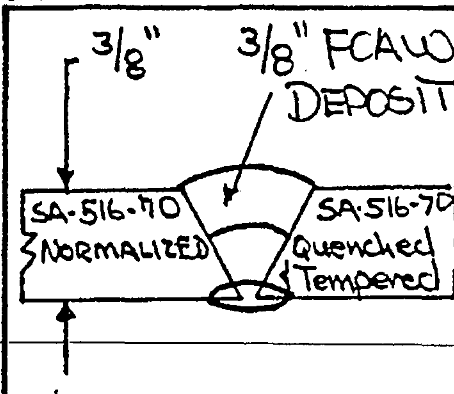
ADDITIONAL INFORMATION: Max. J/in. qualified: 35,280, Globular transfer, Trailing gas: None

Max. pass thk.: 1/4"

TENSILE TEST (QW-150)

Specimen No.	Dia.	Thick	Area	Ultimate Total Load LB.	Ultimate Unit Stress PSI	Character Of Failure & Location
	See POR 65-96 for tensiles and bends. This POR was qualified for Supplementary Essential Variables only per QW-401.3.					

JOINTS:



Groove Design Used

GUIDED BEND TESTS (QW-160)

Type And Figure No.	Result	Type And Figure No.	Result

IMPACT TEST - CHARPY (UG - 84 SA - 370)

Location	Type	Impact Energy ft/lb)	Temp. °F	Impact Values Foot Pounds
Weld	A	264	-25	77,66,73
516-70 Normalized	A	264	-25	58,66,67
516-70 Q&T	A	264	-25	79,76,86

Hardness Test (EQUIVALENT BHN 3000 KG LOAD)

Location	Hardness

Welder's Name D. Schwitzer Clock No. 3420 Stamp No. E0

Test Conducted by: Sherry Lab. Lab Test No. 43-96 per Dan Lawson

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Sect. 9, ASME Code.

Signed YUBA HEAT TRANSFER DIV.

Date 3-19-96 By Tim Morris

PEF-NCR-02351

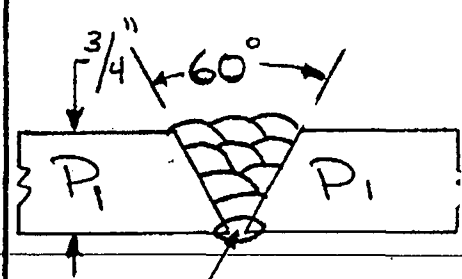
YUBA HEAT TRANSFER DIVISION
P.O. BOX 3158 - TULSA, OKLAHOMA 74101 - (918) 234-6000 - TLX 492464

PROCEDURE QUALIFICATION RECORD No. 65-96 DATE 3-19-96
WELDING PROCEDURE SPEC. No. YA-4072
WELDING PROCESS(ES) FCAW
TYPES: Semi-automatic
BASE METALS: Material Spec. SA-516-70 to SA-516-70 Type or Grade
P No. 1 To P No. 1, Thk. 3/4", Range 3/16"-1½" Dia.
FILLER METALS: Weld Analysis A No. E71T-1 Electrode Size: .045" Ø
Filler Metal F No. 6 SFA Spec. 5.20
Others: • AWS Classification: E71T-1 Kobelico Frontiarc 711
POSITION: 1G, Weld Progression N/A Other
PREHEAT: Preheat Temp. 70 deg.F min., Interpass Temp 500 deg.F max.
Others: No preheat maintenance after completion of weldment.
POSTWELD HEAT TREATMENT: Temperature As Welded Condition
Time N/A Other
GAS: Type CO2, Composition 100%, Flow Rate 30 CFH Other
FLUX: Type N/A Other
ELECTRICAL CHARACTERISTICS: Current DC, Polarity RP
Amps. 140 Volts 21 Travel Speed Manual, Other
TECHNIQUE: String or Weave Bead String Oscillation None
Multipass or Single Pass Multipass, Single or Multiple Electrode Single
ADDITIONAL INFORMATION: Max. bead thk.: 1/4" Supplemental filler or powdered filler metal: None Globular transfer Trailing gas: None

TENSILE TEST (QW-150)

Specimen No.	Width Dia.	Thick	Area	Ultimate Total Load LB.	Ultimate Unit Stress PSI	Character Of Failure & Location
1	.766	.703	.5385	46,000	85,420	Pl-ductile
2	.744	.719	.5349	45,500	85,063	Pl-ductile

JOINTS:



BACKGOUGED

Groove Design Used

GUIDED BEND TESTS (QW-160)

Type And Figure No.	Result	Type And Figure No.	Result
1	Satisfactory		
2	Satisfactory	Side Bends	per QW-462.2
3	Satisfactory		
4	Satisfactory		

IMPACT TEST - CHARPY (UG - 84 SA - 370)

Location	Type	Impact Energy ft/lb)	Temp. °F	Impact Values Foot Pounds

Hardness Test
(EQUIVALENT BHN 3000 KG LOAD)

Location	Hardness

Welder's Name J. Caughran Clock No. 3120 Stamp No. CN
Test Conducted by: Sherry Labs. Lab Test No. 65-96 per Dan Lawson

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Sect. 9, ASME Code.

Signed YUBA HEAT TRANSFER DIV.

Date 3-19-96 By Tim Morris

PEF-NCR-02352

WLR603 QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS

(See QW-301, Section IX, ASME Boiler Pressure Vessel Code)

5-23-03

STAMP CHANGED FROM GQ TO ID ON 4-6-00

Welder Name D LOGUE Check No. 3735 Stamp No. ID

Using WPS No. YA-3387

the above welder is qualified for the following ranges

Variable	Record Actual Values Used in Qualification	Qualification Range
Process	FCAW	FCAW GMAW
Process Type	SEMI	SEMI
Backing(metal, weld metal, flux, etc.(QW-402))	WELD METAL	BACKING ONLY
Material Spec. (QW-403)	P1 to P1	P1-P11 to P1-P11
Thickness		
Groove	.864	MAX TO BE WELDED
Fillet	N/A	MAX TO BE WELDED
Diameter		
Groove	6.000	> or = 2.875
Fillet	N/A	ALL DIAMETERS
Filler Metal (QW-404)		
Spec. No.	SFA 5.20	SFA 5.9, 5.18, 5.20, 5.22, 5.28
Class	E71T-1	Per SFA listed above
F-No.	6	6
Position (QW-405)	6G	ALL
Weld Progression (QW-410)	VERTICAL UP	VERTICAL UP
Gas Type (QW-408)	CO2	ALL
Electrical Characteristics (QW-409)		
Current	DC	DC
Polarity	RP	RP SP
Qualification Comments:		

Guided Bend Test Results QW-462.2(a), QW-462.3(a), QW-462.3(b)

Type and Fig no.	Result
VISUAL EXAM PER QW-302,4 SATISFACTORY	

Radiographic Test Results (QW-304 & QW-305)

For alternative qualification of groove welds by radiography

Radiographic Results: SATISFACTORY PER ALLEN CASH LEVEL III

Test Conducted by YHTD Laboratory - Test No. N/A

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Sections IX of the ASME Code.

Organization YUBA HEAT TRANSFER

Date 03/01/95 By Tim Morris

(Detail of record of tests are illustrative only and may be modified to conform to the type and number of test required by the Code)

NOTE: Any essential variables in addition to those above shall be recorded.

PEF-NCR-02353

Yuba - Ecolaire

2121 North 161st East Avenue, Tulsa, Oklahoma 74116

ASME IX Welding Procedure Specification (WPS)

Weldspec for Windows

WPS record number	YA-3887 Revision C	Qualified to	ASME Section IX
Date	5/4/06	Company name	Yuba - Ecolaire
Supporting PQR(s)	12-04; 108-86; 05-92		
Reference docs.	ASME Section IX with Latest Mandatory Addenda		

Scope	GTAW of P-51 materials Groove, fillet, no PWHT (As-welded)
Joint	Joint details for this welding procedure specification in: *Production drawings, Engineering specifications*

BASE METALS (QW-403)

Type	Titanium (P51)	P-no. 51	Grp-no.
Welded to	Titanium (P51)	P-no. 51	Grp-no.
Backing:	Base metal or weld metal	P-no. 51	Grp-no. -
Retainers	None		
Notes	See pages 2 and 3; See 4 and 5 for tube welding		

THICKNESS RANGE QUALIFIED (in.)

	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
Complete pen.	0.063	2.75	-	-
Impact tested	-	-	-	-
Partial pen.	0.063	2.75	-	-
Fillet welds	no min.	2.75	-	-

DIAMETER RANGE QUALIFIED (in.)

	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
Nom. pipe/tube size	no min.	no max.	-	-

FILLER METALS (QW-404)

THICKNESS RANGE QUALIFIED (in.)

	SFA	Classification	F-no.	A-no.	Chemical analysis or Trade name	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
GTAW	5.16	see page 3	51	NA	Unibraze or equal (see page 3)	no min.	1.390	-	-
Cons. insert	-	-	-	-	-	- None -			
Flux	-	-	-	-	-	- None -			

WELDING PROCEDURE

Welding process	GTAW
Type	Manual
Preheat temperature (°F)	50F
Maximum interpass temperature (°F)	250F
Tungsten size (in.)	1/16, 3/32, or 1/8
Tungsten type	SFA 5.12 EWTh-2
Filler metal size (in.)	1/16 or 3/32
Layer number	All
Position of groove	All
Weld progression	Vertical up when applicable
Current/polarity	DCEN (straight polarity)
Amperes	130 max.
Volts	19 max.
Travel speed (in./min)	4 minimum
Maximum heat input (kJ/in.)	37.05
DC pulsing current	None
Shielding: Gas type	Argon, Welding Grade (SG-A)
Shielding: Flow rate (cfh)	30 to 35
Trailing: Gas type	None required (Argon if used)
Trailing: *Flow rate* (cfh)	20 to 30 (if used)
Backing: Gas type	Argon, Welding Grade (SG-A)
Backing: Flow rate (cfh)	20, (see page 3)
String or weave	Stringer or Weave
Orifice/gas cup size	12 or larger
Multi/Single pass per side	Single or Multiple passes
Weld deposit chemistry	Per SFA-5.16
Notes	See pages 2 and 3

Yuba - Ecolaire

2121 North 161st East Avenue, Tulsa, Oklahoma 74116

ASME IX Welding Procedure Specification (WPS)

Weldspec for Windows

WPS record number	YA-3887 Revision C	Qualified to	ASME Section IX
Date	5/4/06	Company name	Yuba - Ecolaire

PREHEAT TABLE

Applicable standard	
ASME Section IX	50F preheat, do not preheat to over 100F prior to welding. Allow weld to cool to below 250F prior to placing next weld bead. The weld and base metal must be kept covered (blanketed) with Argon inert gas shielding at all times while above 800F to prevent contamination by the atmosphere.

TECHNIQUE (QW-410)

Closed or out-of-chamber	Out-of-chamber
Peening	Not used
Surface preparation	Grind or machine, and clean with approved solvent prior to welding
Initial/interpass cleaning	Brush and/or Grind--Use only clean stainless steel wire brushes
Back gouging method	None

NOTES

Weld and base metal must be kept covered with Argon inert gas shielding until below 800F to prevent contamination by the atmosphere.

Use additional fixtures or trailing shields to establish and maintain Argon shielding on weld and base metal to prevent contamination.

Acceptable weld and base metal colorations are bright silver to light straw yellow.

Weld or heat affected zone colors of dark yellow, blue, grey, or white indicate contamination and are not acceptable.

See Page 3 for more notes. Also see pages 4 and 5 for tube-to-tubesheet welding.

Welding Engineer

Name	Signature
Donald L. Underwood	Donald L. Underwood
Date	
5/4/06	

PEF-NCR-02355

WPS record number	YA-3887	Revision C	Qualified to	ASME Section IX
Date	5/4/06		Company name	Yuba - Ecolaire

NOTE: When welding Grade 2 Titanium use ERTi-2 wire. When welding Grade 1 Titanium, either ERTi-1 or ERTi-2 can be used.

All grinding discs and stainless steel wire brushes shall be new, and shall not have been previously used on any metals other than titanium.

Cleaning rags shall be clean and lint free.

Clean white cotton gloves shall be worn while cleaning and handling titanium materials.

Prior to welding, all weld preparations shall be:
- machined or ground to remove any discoloration,
- cleaned with an approved solvent such as acetone, isopropyl alcohol, methanol, or DR-60 liquid penetrant solvent/cleaner,
- conduct final cleaning using demineralized water and a clean rag,
- allow surfaces to dry completely

Clean white cotton gloves shall be used/worn during welding - after weld consumables have been cleaned, DO NOT touch them with bare hands.

Clean all weld filler materials with an approved solvent (see above), and then wipe each piece of wire with a clean rag prior to use - keep material clean.

Filler metal must be added to the weld without dipping it in/out of the Argon shielding gas - KEEP THE END OF WELD WIRE IN THE SHIELDING GAS - every time the wire is removed from the puddle and shielding gas coverage the end of the wire shall be trimmed 1/2" to remove the contaminated portion before it can be used again.

All titanium base metal and weld metal must be kept in Argon inert gas shielding until it cools to less than 800F prior to contact with atmosphere to prevent contamination....if there is no discoloration then the gas shielding is adequate.

Adequate gas coverage will result in a bright silver weld deposit, with no discoloration of the adjacent base metal, the appearance of other colors in the weld or heat affected zone indicates contamination and welding shall be stopped until the problem can be corrected.

Any weld deposits or base metal exhibiting the following colors shall be completely removed by grinding -- dark straw yellow, blue, grey, or white.

Acceptable colors for weld deposit and heat-affected-zones are silver-to-light straw yellow.

Shielding gas, trailing shield gas, or gas backing shall be Argon, Welding Grade (99.995%, -40F max. dew point), classified in ASME Section II Part C as SG-A.

When gas backing is needed, purge for a minimum of 10 volume changes prior to welding. To close the root of open root welds the gas flow may be reduced to 4 - 7 cfh prior to closing, then increased to 20 cfh after the root is closed.

When making fillet or other attachment welds on titanium materials that are less than 1/4" thick, a gas purge on the backside is required.

For tube-to-tubesheet welding, see pages 4 and 5.

PEF-NCR-02356

Yuba Heat Transfer Division

Division of Connell Limited Partnership
P.O. Box 3158, Tulsa, Oklahoma 74101

WPS Number YA-3887 **Rev.** C **Date:** 5-4-06 **Supporting PQR:** 108-86; 05-92; 12-04 **Page 4**

Welding Process (QW-250):		**Joints (QW-402):**	
GTAW	Manual	Groove Design QW-402.1	See page 5
		Backing	P-51 tubesheet
		Root Spacing	Roll to contact
		Retainers	None used
		Tube Diameter	1.04" to 0.85"
		Tube Wall Thickness	0.024" to 0.028"
Base Metals (QW-403):		**Filler Metals (QW-404):**	
P-Number/Group Number	P-51 Clad tubesheet	SFA Number	SFA-5.16 when needed
to P-Number/Group Number	P-51 Tube	Filler Size	1/16" when needed
Ligament (min)	Per Design drawing	F-Number	F-51
Tubesheet Thickness	1-1/4" or greater	A-Number	None assigned
Thickness Range (tube)	.024" to .028"	AWS Classification	ERTi-2 (see page 3)
		Addition or Deletion of Filler	Yes and no
		Preplaced Metal Insert	None used
		Filler Metal Product Form	Bare solid wire (when used)
		Max. Weld Metal Thickness	1.390" maximum
Position (QW-405)		**Preheat (QW-406)**	
Positions	Tube horizontal and Tubesheet vertical	Preheat (min)	50 F minimum
		Interpass (max)	200 F maximum
Progression	Vertical up or down	Preheat Maintenance	None required
PWHT (QW-407)		**Gas (QW-408)** Comp. & Flow	
Holding Temperature Range	None required; As-welded	Shielding, Backing, Trail Gas	Argon, welding grade
Max. Hold Time	None required; As-welded		Flow rate: 25 to 35 CFH
Electrical Char. (QW-409):		**Technique (QW-410)**	
Max. Heat Input		String or Weave Bead	String or slight weave
Polarity	DC straight polarity	Cup or Nozzle Size	12 or larger
Voltage	14-19 volts	Oscillation	None used
Amperage	75-110 amps	Multiple or Single Pass per Side	Single pass
Pulsing Current	Not used	Single or Multiple Electrodes	Single
Electrode Size	3/32" or 1/8" dia.	Closed to Out Chamber	Out of chamber
Electrode Type	EWTh-2	Electrode Spacing	Not applicable
Travel Speed	Manual	Manual or Automatic	Manual
		Method of Cleaning	*See Below*
		Method of Backgouging	Not required
		Peening	Not permitted

Notes:
Surfaces to be welded shall be steam and/or solvent cleaned and protected from contamination. Approved solvents are acetone or isopropyl alcohol. All tube holes and tube ends shall be solvent cleaned prior to pushing. Tubes may be expanded prior to welding. If tubes are expanded, the tubesheet face and all tube ends shall be thoroughly cleaned and protected from contamination prior to tube welding. The weld area shall be protected from contamination during the entire welding operation. Base metal to be welded shall not be touched with bare hands after final cleaning. If accidentally touched, clean the surface again as directed above. Clean white cotton gloves should be worn while welding. Clean, stainless steel wire brushes may be used for surface cleaning in addition to solvent cleaning. Do not touch filler metal with bare hands or fingers. Clean all filler metal prior to use with an approved solvent. If filler is used, clip the contaminated end from the wire each time it is withdrawn prior to depositing additional filler in weld. Maintain argon shielding gas flow on the weld until it has cooled sufficiently to prevent contamination in air (cooled well below 800F). Weld color shall be bright silver. Contact Welding Engineer or Weld Technician if weld is discolored. See Page 5 for additional direction.

5-4-06

Welding Engineer, YHTD Date

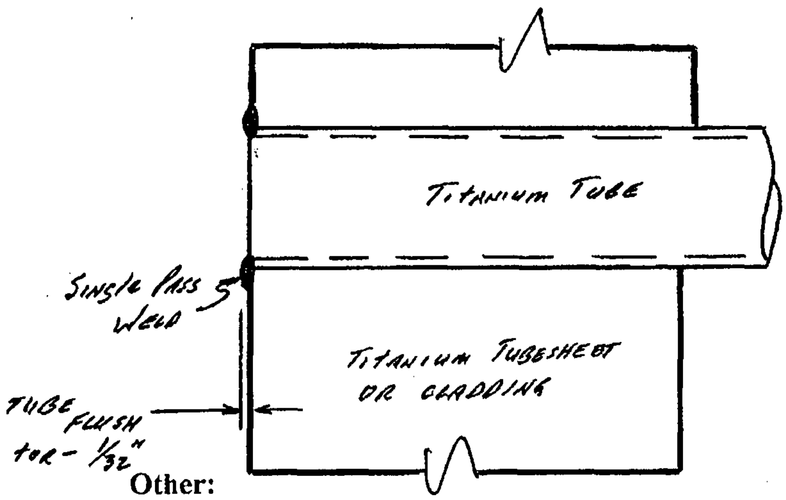
PEF-NCR-02357

Yuba Heat Transfer Division

Division of Connell Limited Partnership
P.O. Box 3158, Tulsa, Oklahoma 74101

WPS Number YA-3887 Rev. C Date: 5/4/06 PQR: 108-86; 05-92; 12-04 Page 5

Joint Detail:



Other:

High frequency arc initiation required. Use foot pedal with arc decay to terminate arc.

Terminate the arc on the weld and hold gas coverage (trailing shield) until the weld has cooled sufficiently below 800 degrees F to avoid discoloration (contamination).

Seal welds are to be made as single pass autogenous (no filler added) welds. However, filler may be used by the welder when needed to fix pinholes (or other defects) seen while welding, or as needed for repairs. When the weld requires the addition of filler metal, it should be added continuously without intermittent dipping wire in and out of the weld. Filler metal removed from the gas shielding will be contaminated, and shall be cut back at least 1/2" to remove and discard the contaminated wire end before the remainder of the wire can be used in the weld.

Finished weld color should be bright silver- Contact the Welding Engineer or Weld Technician if weld is discolored for directions concerning cleaning or repair.

[signature] 5-4-06

Welding Engineer, YHTD Date

Yuba Heat Transfer

P.O. Box 3158, Tulsa, Oklahoma 74101

ASME IX Procedure Qualification Record (PQR)

Weldspec for Windows

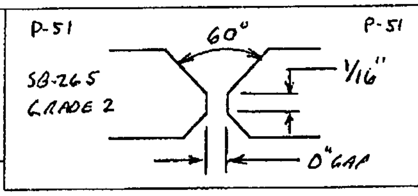
PQR record number	12-04	Revision 0	WPS record number	YA-4259	Revision 1
Date	4/27/04		Company name	Yuba Heat Transfer	
			Welding standard	ASME Section IX and Section VIII, Division 1	

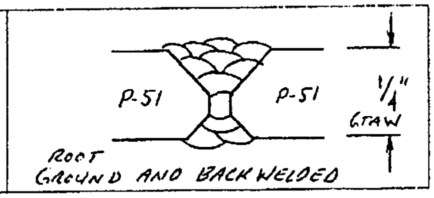
BASE METALS (QW-403)

	Product form	Specification (type or grade)	P no.	Grp-no.	Size	Sch.	Thick. (in.)	Dia. (in.)
	Plate	SB-265 (2)	51		-	-	.250	-
Welded to:	Plate	SB-265 (2)	51		-	-	.250	-
and tested:	Without PWHT							
Notes	GTAW of P-51 Materials, As-welded condition							

JOINTS (QW-402)

Joint design		Single-V-groove
Backing:		None
Retainers		None
Groove angle	(deg.)	60
Root opening	(in.)	0
Root face	(in.)	.062





WELDING PROCESSES

Welding process	GTAW
Type	Manual

FILLER METALS (QW-404)

SFA specification		5.16
AWS classification		ERTi-2
Filler metal F-number		51
Weld metal A-number		NA
Filler metal nominal composition		Titanium (see SFA-5.16)
Filler metal trade name		Robinson Unibraze ERTI-2
Filler metal size	(in.)	1/16
Deposited thickness	(in.)	.250
Maximum pass thickness	(in.)	1/16
Weld deposit chemistry		Per SFA-5.16

POSITION (QW-405)

Position of groove	3G
Weld progression	

PREHEAT (QW-406)

Preheat temperature	(°F)	70F
Maximum interpass temperature	(°F)	300F

GAS (QW-408)

Shielding gas:	Type		Argon, Welding Grade
	Flow rate	(cfh)	30 to 35
Trailing gas:	Type		None
	Flow rate	(cfh)	-
Backing gas:	Type		Argon, Welding Grade
	Flow rate	(cfh)	30 to 35

ELECTRICAL (QW-409)

Filler metal size	(in.)	1/16
Amperes		130
Volts		19
Travel speed	(in./min)	4
Maximum heat input	(kJ/in.)	37.05
Tungsten size	(in.)	3/32
Tungsten type		SFA 5.12 EWTh-2
Current/polarity		DCEN (straight polarity)
DC pulsing current		None

TECHNIQUE (QW-410)

String or weave	Stringer and Weave
Orifice/gas cup size	12 and 14
Multi/Single pass per side	Multiple passes
Closed or out-of-chamber	Out-of-chamber
Peening	Not used
Initial/interpass cleaning	Brushing and Grinding
Back gouging method	None

Yuba Heat Transfer

P.O. Box 3158, Tulsa, Oklahoma 74101

ASME IX Procedure Qualification Record (PQR) - Test results (as welded)

Weldspec for Windows

PQR record number	12-04 Revision 0	WPS record number	YA-4259 Revision 1
Date	4/27/04	Company name	Yuba Heat Transfer
		Welding standard	ASME Section IX and Section VIII, Division 1

TENSILE TESTS (QW-150) Reduced section

Specimen number	Width (in.)	Thickness (in.)	Area (in²)	Ultimate total load (lb)	Ultimate unit stress (psi)	Type of failure and location
A	0.767	0.264	0.2025	13740	67900	Ductile-Base Metal
B	0.760	0.260	0.1976	13480	68200	Ductile-Base Metal

Comments: Sherry Lab Report 2004040438

GUIDED BEND TESTS (QW-160)

Type of test	Acceptance criteria	Result	Comments
2 transverse face bends per QW-161.2 and QW-462.3(a)	QW-163	Acceptable	see - ASME IX - QW-451.1
2 transverse root bends per QW-161.3 and QW-462.3(a)	QW-163	Acceptable	see - ASME IX - QW-451.1

Comments: Sherry Lab Report 2004040438

CERTIFICATION

Welder's name	ID Number	Stamp number		
Brad Silkey	361	BS	Mechanical testing by	Sherry Laboratories-Midstates
			Laboratory test number	2004040438
			Test file number	PQR 12-04; Yuba Lab Req. 50-2004
			Tests conducted by	Caroll Judd, Sherry Laboratories

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Welding Engineer

Name	Signature
Donald L. Underwood	
Date	
4/26/04	

Weldspec 4.20.002
Catalog n° PQR00115

PEF-NCR-02360

[redacted]

YUBA HEAT TRANSFER [redacted]

P.O. BOX 3158 - TULSA, OKLAHOMA 74101 - (918) 234-6000 - TLX 492464

PROCEDURE QUALIFICATION RECORD No. 108-86 DATE 9/12/86

WELDING PROCEDURE SPEC. No. YA-3653

WELDING PROCESS(ES) GAS TUNGSTEN ARC WELDING (GTAW)

TYPES: Manual

BASE METALS: Material Spec. SB-265 *2 Type or Grade 2

P No. 51 To P No. 51, Thk. BM-1 3/8" *1, Range 3/16"-2 3/4" *1

FILLER METALS: Weld Analysis A No. NA Electrode Size: EWTh-2 1/8" Ø

Filler Metal F No. 51 SFA Spec. 5.16

Others: •AWS Classification ER Ti-1

POSITION: 1G, Weld Progression NA Other

PREHEAT: Preheat Temp. 70°F, Interpass Temp 300°F max.

Others: No preheat maintenance after welding

POSTWELD HEAT TREATMENT: Temperature As welded

Time NA Other NA

GAS: Type Argon, Composition 99.995%, Flow Rate 30CFH Other

Trailing gas: Argon @ 10CFH w/ 2" Ø circular nozzle extension

ELECTRICAL CHARACTERISTICS: Current DC, Polarity SP

Amps. 110 & 130 Volts 18 & 19 Travel Speed Manual, Other

TECHNIQUE: String or Weave Bead Slight weave & string Oscillation 5/16" max wide

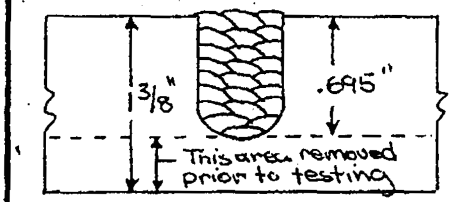
Multipass or Single Pass Multipass, Single or Multiple Electrode Single

ADDITIONAL INFORMATION: *1 Deposited weld metal= .695" Range- 1.390" max.
Vacume atmosphere- none Cleanliness per page 2 of WPS.

TENSILE TEST (QW-150)

Specimen No.	Dia.	Thick	Area	Ultimate Total Load LB.	Ultimate Unit Stress PSI	Character Of Failure & Location
1	1.033	.695	.718	49,800	69,500	WM-ductile
2	1.005	.695	.698	49,500	71,000	WM-ductile

JOINTS: Max. pass thk. 1/8"



.230" weld deposited by each welder.

Groove Design Used

GUIDED BEND TESTS (QW-160)

Type And Figure No.	Result	Type And Figure No.	Result
1	no indications		
2	no indications	Transverse side bends per	
3	no indications	QW 462.2	
4	no indications		

IMPACT TEST - CHARPY (UG - 84 SA - 370)

Location	Type	Impact Energy ft/lb)	Temp. °F	Impact Values Foot Pounds

Hardness Test
(EQUIVALENT BHN 3000 KG LOAD)

Location	Hardness
Base metal	165,172,162
HAZ	180,200,185
Weld metal	135,132,141

Welder's Name B. Shook, R. Davis, D. Duncan Clock No. 3408, 3468, 3486

Test Conducted by: Midstates Lab. Lab Test No. 108-86 per Bill Vesely

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Sect. 9, ASME Code.

*2 Corrected typo 12-14-99 Recertified by Tim Morris

Signed Yuba Heat Transfer Div.

Date 9/15/86 By Timothy Morris

PEF-NCR-02361

Y U B A   H E A T   T R A N S F E R

P.O. Box 3458 Tulsa, Oklahoma

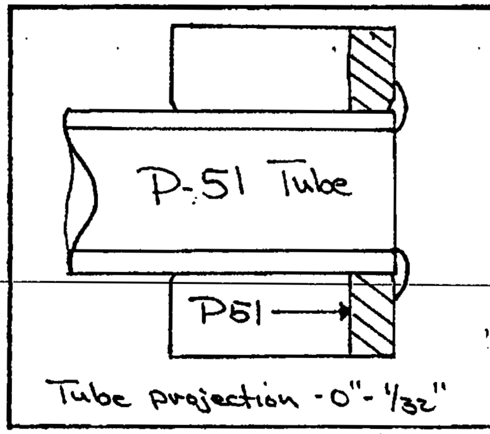
ROCEDURE QUALIFICATION RECORD No. 05-92 DATE 1 -6-92
ELDING PROCEDURE SPEC. No. YA-3887
ELDING PROCESS(ES) GAS TUNGSTEN ARC WELDING
YPES: MANUAL
ASE METALS: Material Spec. SB-265 to SB-338 Type or Grade Gr.2 to Gr.2
No. 51 To P No. 51, Thk. *1, Range *1 Dia. *1
ILLER METALS: Weld Analysis A No. N/A Electrode Size 3/32" EWTh-2
iller Metal F No. N/A SFA Spec. N/A
thers: AUTOGENOUS WELD
OSITION: Tube-horz,T/sheet-vert, Weld Progression circular Other
REHEAT: Preheat Temp. 60°F min., Interpass Temp 200°F max.
thers:
OSTWELD HEAT TREATMENT: Temperature AS WELDED CONDITION
ime N/A Other
AS: Type Argon, Composition 99.995%, Flow Rate 25 CFH Other
LUX: Type N/A Other
LECTRICAL CHARACTERISTICS: Current DC, Polarity Straight
mps. 100 Volts 16, Travel Speed manual, Other
ECHNIQUE: String or Weave Bead String Oscillation None
ultipass or Single Pass Single, Single or Multiple Electrode Single
DDITIONAL INFORMATION: *1 TUBESHEET THK: 1½" (13) tubes welded for qualification; (52) weld faces examined. Tube dia. .945" + - .0945" Tube wall: .026" + - .0026" .30" ligament

1. Liquid Penetrant tested per ARTICLE 9-2 SEC. V111, DIV 2
   No reportable indications - Satisfactory
2. Visual examination at 10X magnification - No reportable indications - Satisfactory
3. Minimum Tube to tubesheet Leak Path 96%
   Satisfactory

Tongue bend test: Fracture in tube base metal
Vickers hardness test: See page 2 of PQR

4. Minimum shear path: All greater than 100%.

JOINTS:



Groove Design Used

Welder's Name Dan Duncan Clock No. 3486 Stamp No. DO
Test Conducted by: Metlab Lab Test No. 05-92 per Dan Lawson

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Sec. 8, Div. 2, Art. F3

Signed YUBA HEAT TRANSFER DIV.

Date 1-6-92 PEF-NCR-02362 By Tim Morris

METLAB Testing Services, Inc.

6825 East 38th Street Tulsa, Oklahoma 74145
(918) 664-7767

MLTS 92-017

January 6, 1992

Yuba Heat Transfer Division
P. O. Box 3158
Tulsa, OK 74101

Attention: Mr. Tim Morris

COUPON DESCRIPTION: YA3887, GTAW, Titanium Tube-to-Tubesheet Coupon, Lab Req. 05-92

TONGUE BEND TEST - WELD NO. 14

Result: Satisfactory with fracture in tube base metal.

VICKERS MICROHARDNESS, 5 KG LOAD, ASTM-E92

Tube No.	Vickers Hardness, Average Value for 3 Readings: Weld	Clad	Difference
11	150	124	26
11	148	124	24
12	163	124	39
12	167	124	43
13	167	124	43
13	173	125	48

STANDARD TERMS OF SALE

1.0 DELIVERY

Unless otherwise stated, all shipments are F.O.B. Yuba designated factory (Domestic) or Ex-Works per Incoterms 2000 (International). No export crating is included unless specifically stated.

2.0 WARRANTY

(a) Yuba warrants that all goods of its manufacture contained in the equipment delivered to the original Buyer by Yuba shall conform to the written specifications of Buyer when Yuba has undertaken the responsibility for the design of the equipment and shall be free from defects in material or workmanship under normal use and service for a period of twelve (12) months following the initial operation of the equipment or eighteen (18) months following shipment, FOB Yuba's designated factory, whichever occurs first. Any warranty for material and equipment furnished under a stock or parts order is limited in duration to not later than three (3) months after shipment.

(b) Yuba makes no warranty with respect to parts or materials of the equipment, which are manufactured by others. Yuba's warranty only covers the replacement or repair of the parts or materials and not the labor to remove and install the parts or materials. Yuba will not be responsible for any material selection. Any parts or materials not manufactured by Yuba are sold only under such warranty as the manufacturer gives to Yuba. Yuba makes no guaranty as to the enforceability of such warranty but shall use reasonable efforts to assist Buyer in asserting a claim under such warranty of the manufacturer. Yuba shall have no warranty liability when defects or non-performance are caused by abrasion, corrosion, stress corrosion, erosion or fouling, whether due to incorrect water chemistry, (including chlorides) or improper operation, installation or maintenance or otherwise

(c) Buyer's exclusive remedy is to secure repair or replacement, at Yuba's option, of any portion of the equipment of its manufacture, which, upon prior inspection by Yuba, shall prove to have been defective. Upon notification by Buyer, Yuba will either request that the parts or materials be returned F.O.B. Yuba's designated plant or Yuba may elect to make inspection at Buyer's plant. Parts or materials found defective by Yuba during such warranty period will be replaced F.O.B. Yuba's designated factory.

(d) The provisions of this warranty shall not apply to equipment which has been subject to accident, overloading, misuse or negligence by Buyer, its agent, employees, contractors or invitees, or which have been installed, maintained, repaired, or altered by other than Yuba in any way so as, in the reasonable judgment of Yuba, to affect adversely its performance and condition, nor to the replacement of parts required for normal maintenance services, nor to deterioration due to normal wear and tear. **THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**

(e) This warranty is contingent upon the Buyer obtaining the services of Yuba's Service Representative/Consultant for inspection of the fully erected equipment, observation of hydro-test, and release for operation.

3.0 LIMITATION OF LIABILITY

[redacted] REDACTED [redacted]

PEF-NCR-02364

CONFIDE AL

STANDARD TERMS OF SALE

[redacted]

REDACTED

4.0 DISCLAIMER OF CONSEQUENTIAL DAMAGES

[redacted]

REDACTED

5.0 FORCE MAJEURE

(a) Yuba shall not be liable for loss or damage for delays in delivery, or delays in failure to manufacture, erect or install, due to causes beyond its reasonable control, including but without limitation, acts, orders or requests of civil or military authority, acts of God (weather, etc.), acts or omissions of Buyer, strikes, labor difficulties, labor or material shortages, fire, flood, explosions or other casualties, wars or civil disturbances, insurrections or riots, breakage or accident to machinery or equipment and failure or delays of others or subcontractors in delivering materials. In the event of any such delay, all dates shall be extended by the amount thereof. Yuba will give notice to Buyer with an estimate of length of delay.

6.0 PAYMENTS AND PRICE

[redacted]

REDACTED

7.0 SUSPENSION, DELAY, OR TERMINATION FOR CONVENIENCE

(a) In the event Purchaser suspends, delays or terminates this contract for the convenience of the Purchaser, Yuba shall have the right to continue manufacturing all line items in flow in Yuba's Manufacturing Pull System at the time of receipt of written notification by Purchaser of the Suspension, Delay or Termination for Convenience. Purchaser further agrees to provide inspection as specified under the terms of the contract for completion of these items (includes providing Inspection for all Witness and/or Hold Points), and to pay

STANDARD TERMS OF SALE

Yuba in accordance with the contract terms when the items are completed. Yuba will provide Purchaser a list of those items to be completed at the time of notification by Purchaser of the Suspension, Delay or Termination for Convenience.

8.0 GENERAL

(a) This contract is not assignable by Buyer in whole or in part without the prior written consent of Yuba.

(b) All stenographic and clerical errors are subject to correction without liability. All claims for errors in shipment or invoice must be made within ten (10) days after receipt of material.

(c) Material may not be returned by Buyer except with the written consent of Yuba first obtained. Returned material must be prepaid.

(d) Title and risk of loss to all equipment sold shall pass to Buyer upon Yuba's delivery to carrier at point of shipment (whether or not Yuba pays any part of the freight) or if Yuba stores the equipment for the account of the Buyer at Yuba's designated facility, then title and risk of loss shall pass to Buyer at the time of storage.

(e) All drawings and designs supplied by Yuba shall belong to Yuba, be maintained in confidence and be returned upon request. No drawings are submitted for Buyer's approval unless specifically stated in this Agreement.

(f) Buyer shall procure at its expense all permits required to commence and complete work.

(g) Yuba will not accept back charges for work performed by others upon, or in conjunction with, Yuba equipment unless Yuba gives prior written authorization.

(h) Neither Buyer or any affiliated company, surety, or assignee shall have the right to set off against any amounts which may become payable to Yuba under this contract or otherwise, for amounts which the Yuba may allegedly or in fact owe Yuba or any affiliated company, surety or assignee whether arising under this contract or otherwise.

9.0 CHANGES

(a) Buyer agrees not to make changes to the equipment, specifications or to the delivery schedule as set forth in Yuba's proposal without the prior written consent of Yuba.

10.0 TAXES

(a) In the event that Yuba may be required to pay any excise, sales or use taxes, foreign income withholding taxes, duties or other charges or increases upon the manufacture, sale or transportation of the equipment sold not now specifically included in the price set forth in Yuba's proposal, Buyer shall reimburse Yuba for same.

11.0 ENTIRE AGREEMENT

(a) No statement of agreement, oral or written, made prior to or at the signing hereof, shall vary or modify the written terms hereof. Neither party shall claim any modification, waiver or release from any provision by mutual agreement unless such agreement is in writing signed by the other party. No modification or addition to this contract shall be affected by the acknowledgment or acceptance by Yuba of any purchase order or other documents submitted by Buyer containing additional or different terms or conditions.

12.0 APPLICABLE LAW

(a) This contract and the respective rights and obligations of the parties shall be governed by and construed according to the laws of the State of Oklahoma.

STANDARD TERMS OF SALE

(b) The application of the provisions of the United Nations Convention on Contracts for the International Sale of Goods are expressly excluded by the terms of this Agreement.

13.0 SERVICE CONNECTION INTERFACE INFORMATION

Buyer and Yuba acknowledge that Yuba's schedules are contingent upon timely submittal of service connection interface information from Buyer. Buyer shall provide Yuba with finalized service connection information within eight (8) weeks of order award or sooner.

14.0 Engineering Service

(a) Upon request, Yuba may provide engineering and/or technical information about its products and their uses, and if feasible may provide personnel to assist Buyer in effecting field installation and/or field service. Such information, service, or assistance so provided, whether with or without charge, shall be advisory only and Buyer agrees to hold Yuba harmless from claims for loss from any cause resulting from such advisory or service activity.

<u>Alstom Proposal #SD22007, CR3 Turbine Generator Retrofit 5/15/07 Review Meeting Open Items</u>

Alstom to provide proposal amendment letter by 06/01/07.

Generator field <u>installation schedule</u> is 75 days, including 45 days for generator rotor rewind in shop.

- Generator rotor replacement is required to improve the 75 day schedule and to increase MVA rating to 1200MVA. Generator rotor replacement will be 2011. Requested Alstom to price new rotor vs. rewind rotor.

<u>Include in proposal at no additional cost:</u>

- 2007 open and close of HP turbine and generator to be R&D by Alstom.
- 57"LSB LP turbine inner cylinder solution. Evaluate the effectiveness of the 57" blades versus the 47" blades including cost and output.
- Laser alignment of entire train, including generator alignment and generator frame foot loading.
- Stripping/replacement of all bearing pedestal oil seals.
- Rebabbitting HP and LP turbine bearings due to new rotor journals.
- Machining of all HP Turbine cylinder interface locations as needed to install new parts.

<u>Additional Information Requested:</u>

- Support system requirements for water cooled stator skid and static excitation system.
- Control Room impacts for water cooled stator skid and static excitation system (voltage regulator).
- Provide Installation "Division of Responsibilities".
- Provide "single point of contact" internal to Alstom that will be responsible for contract negotiation.
- Finalize review and approval of PE's latest language (understand that all have agreed to this language)

<u>Project Management:</u> PE desires "turn key" project management with minimal PE support responsibilities. Alstom stated "all support resources" were included in the cost estimate. Please provide summary of craft personnel number and skill sets that are to be provided based on our discussions. Please explain the basis for the personnel numbers identified on proposal pg. 546.

<u>Alstom Proposal # SD22007, CR3 EPU Turbine Generator Retrofit Meeting Notes, 05/15/07:</u>

<u>Proposal Summary:</u>
<u>HP Turbine</u>: replace in 2009 with partial arc, full impulse turbine design with 3% flow margin.
<u>LP Turbines</u>: replace in 2009 with 12.9M2 (47"LSB).
<u>Generator Stator</u>: mid-section replacement in 2009 with H2O inner cooled winding. Stator rating is 1173 MVA.
<u>Generator Rotor</u>: rewind rotor in 2009 at Richmond shop. Rotor winding is reused.
<u>Exciter:</u> replace in 2009 with static excitation system.
<u>Voltage Regulator:</u> included in static excitation system.
<u>Moisture Separator Reheaters:</u> replace MSR vessels in 2009.

<u>Cost:</u> Total estimated cost for above scope is REDACTED. Installation cost is estimated for T&M billing.

<u>Performance Guarantee:</u> 1075.8 MW @ 2.7 In Hg (12.9M2 LP turbine). Does not include MSR drain reroute.

<u>Outage Schedule:</u> 2009 outage schedule is 75 days for HP and LP turbine replacement, generator mid-section replacement and MSR replacement. Schedule driver is shop rewind of generator rotor (60 days, 45 days in shop).

<u>Optional Scope:</u> Generator Stator field rewind with H2O cooled winding. Stator core iron is not replaced.
Cost: total estimated cost reduced to REDACTED Generator Rating: stator rating reduced to 1162.5 MVA.
Schedule: 2009 outage schedule will not decrease due to off site rotor rewind.

<u>Meeting Summary Highlights:</u>

- Alstom proposal amendment letter requested by June 1, 2007.
- Generator rotor replacement is required to improve the 75 day schedule and to increase MVA rating to 1200MVA. Generator rotor replacement will be 2011. Requested Alstom to price new rotor vs. rewind rotor.
- Requested Alstom to consider 2007 open and close of HP turbine and generator to be R&D cost by them.
- Requested Alstom to quote 57"LSB LP turbine option.
- Support systems for water cooled stator skid and static excitation system are additional cost. Alstom requested to provide support system requirements.
- Control Room impacts for water cooled stator skid and static excitation system (voltage regulator) are additional cost. Alstom requested to provide control room impact details.
- Include laser alignment of entire train, including generator alignment and generator frame foot loading (pg.110).
- Include Re-striping all bearing pedestal oil seals.
- Include HP and LP turbine bearing be rebabbitted in base scope due to new rotor journals.
- Include machining of all HP Turbine cylinder interface locations as needed to install new parts.
- Need to provide Installation "Division of Responsibilities".

General Notes:

- HP Turbine and Generator must be opened in 2007 for field measurements. Is open and close cost included?

Re: Requested Alstom to consider this R&D cost to them.

- Evaluate performance of larger 16.8M2 (57"LSB) LP Turbine.

Re: Alstom presented performance curve for 47" and 57" LSB. 57" performs better below 2.7 In. Hg. Both perform the same above 2.7 In. Hg. Average benefit of 57" LSB is approximately 3MW/year. Cost is approximately $5,000,000 more. Note: the 57"LSB was installed at Diablo Canyon and performance was much better than expected.

- Heat balance indicates low feed water temperature between 2009 and 2011 (pg. 201, 207, 208). What is plant impact?

Re: Ted say's reactor is not affected. Lower feedwater temperature is in Alstom heat balance and would not be corrected for in a plant performance test. Areva would have to evaluate / model the Alstom heat balance for EPU.

- PE must verify generator frame 75 psi H2 pressure rating for generator stator rewind.

Re: This is responsibility of PE. Will need Siemens support to document.

- Support systems for water cooled stator skid and static excitation system are additional cost.

Re: Alstom requested to provide requirements. See engineering issues.

- Evaluate control room impact for new systems.

Re: Alstom requested to provide requirements. Pump controls and annunciator inputs.

Scope of Supply Comments:

HP Turbine: 7 stage, full impulse design

- New nozzle plates are fitted into existing nozzle box. Existing nozzle plates may need destructive removal. Is machining or repairs to the existing nozzle box included?

Re: Contingency repairs will be extra scope.

- New inner and outer glands are provided. New gland seals machined for rotor clearance. Are both inner and outer glands type 405 ss (pg. 19)?

Re: Alstom stated the HP turbine outer glands are **not** included. Proposal was in error. Inner glands are stainless steel.

Scope of Supply Comments:

- Governor pedestal stub shaft will be reused. Eccentricity run out will be corrected. Will a spacer be provided to correct axial position if needed?

Re: Yes, if needed based on field measurement.

LP Turbine: 10 stage, reaction design

- Inner cylinder is reused. Blade carriers are replaced. Discuss interface between new blade carriers and existing inner cylinder (pg. 37).

Re: Spring back seals. Pg. 50

- Blade carriers are ductile cast iron with 12% CR ring inlays. How is the ring inlays installed in the blade carriers (pg. 51)?

Re: keeper bolt at horizontal joint.

- L-0 blades have snubbers. Why not free standing?

Re: Improves vibration response characteristics.

Generator Mid-Section: 1173 MVA, Capability Curve pg. 77

- Verify main leads between stator and bushings are replaced. Not shown on pg. 75.

Re: Yes. Drawing in error.

- Discuss phase dropper and bushing connection installation (pg. 98 / 99).

Re: Interface between H2O cooled portion and H2 cooled portion of main lead.

Stator Water Skid:

- What are the plant requirements to support installation?

Re: Alstom to provide support system requirements. Cooling water 154 M3/hr (2500 KW), Demineralized water supply, Power supplies, Instrument and controls cabling, control room impacts include pump controls and annunciators. The support systems are not Alstom scope.

Generator Stator Rewind: 1162 MVA, Capability Curve pg. 121

- Scope includes core iron loop test (pg.117). What are the power supply requirements? Core loop test is not identified in testing section 2.4.3.29 (pg. 143).

Re: Core loop test is in scope. PE provides power 4160V, 1 phase, ???? Amps.
Alstom has core iron repair capability by insulation material injection up to 5 inches deep. Siemens el cid test data glitches are near surface issues.

Scope of Supply Comments:

Generator Rotor Rewind:

- Any repairs to rotor winding are included (pg. 156)

Re: Yes

- Siemens technical advisory TA 2005-001, Modification of rotor baffle assembly, must be included. May need to get parts from Siemens.

Re: Included. Alstom has parts.

- A bearing charge will not apply for shop balancing (pg. 154)

Re: Agreed.

- Asbestos abatement in the shop will not be extra cost (pg. 156)

Re: Agreed.

Static Excitation System:

- Generator bus supply through transformer rated at 7,500 amps @ 500volts.

Re: Yes

- Installation of new transformer (44,200 lbs), electrical cabinets and all electrical connections are included.

Re: Yes. Transformer foundation (if needed) is not included.

- What is the auxiliary power supply requirement for field flashing and is installation included?

Re: 480V, 3 phase, approx. amps (standard bus bkr) for field flashing. 2 x 480V, 3 phase for cabinet air conditioners, 2 x 125VDC control power.

- P400AVR digital voltage regulator. What is the control room impact of this system? Are control room modifications included?

Re: Control Room impact needs to be provided and is not included in scope.

- Pg. 171 states the collector is rated for 3,500 amps. Explain this rating compared to the generator excitation requirements.

Re: Typo error. Should be 7,500 amps.

- Pg. 172 and 177 states new collector assembly housing or modification of existing exciter housing. Is either of these options included?

Re: New housing is included in scope of supply.

- Pg. 178 and 179 indicate the collector assembly is cooled by ambient air and the ambient air limit is 45C (113F). Are air coolers an option?

Re: Possibly. Recommendation not made.

- Can the existing exciter air coolers be reused with the new collector assembly fan?

Re: Alstom can evaluate.

Include the following scope of supply at no additional cost:

- Include laser alignment of entire train, generator alignment and generator frame foot loading (pg.110).
- Include Re-striping all bearing pedestal oil seals.

Engineering Comments:

- Provide estimated megawatt output vs. condenser pressure curve for the 57" LSB (16.8M2) LP turbine. Include on curve provided for the 47" LSB (12.9M2) LP turbine provided in proposal (pg. 209).

Re: See pg. 2. Paul will email curve.

- 47" LSB LP turbine appears to choke at 2.2 In Hg. 47" LSB appears marginal for 1100 MWe output with 4 exhaust flows.

Re: Correct.

- Has a 57"LSB LP turbine been retrofitted into a Westinghouse turbine frame? References are on pg. 43.

Re: Diablo Canyon. Actual performance was much greater than predicted. Guaranteed 35 MW. Obtained 46 at unit 1 and 50 at unit 2.

- Why was a full impulse HP turbine design selected? Is design constrained due to reuse of existing inlet nozzle box?

Re: Standard design in Europe.

- Should HP and LP turbine bearing be rebabbitted due to new rotor journals?

Re: Request to include in proposal.

- Why is bearing 5 loaded greater than bearing 4 following retrofit (pg. 196)?

Re: Unknown at meeting.

- Pg. 538 discusses bearing pedestal modification for reinforcing brackets. What is expected? Are modifications required?

Re: Bearing strongback to withstand L-0 blade failure by using stronger bolts and heavier strongback if needed.

- Generator rotor rewind will reuse the existing rotor copper winding with new insulation. What is the rewound rotor current capacity rating?

Re: 7,720 Amps @ 75 psi H2 gas pressure.

- Generator mid-section replacement is rated at 1173 MVA. What is the rating limiting component? What is the excitation current required?

Re: Rotor is limiting above 1173 MVA. Excitation requirement is 6,770 amps @ max PF.

- Generator stator rewind is rated at 1162.5 MVA. Excitation current required is 6,845A (pg. 120). What is the rating limiting component? Pg. 119 states field measurement confirmation is required. What is the risk? The capability curve is shown on pg. 121. Why isn't the maximum power output at unity power factor on the curve?

Re: Stator core is limiting for 1162.5 MVA stator rewind.

- The generator stator rewind reuses the existing core iron as is. What engineering evaluations were performed to qualify reuse of the existing core iron?

Re: Engineering models were evaluated.

- Is a generator startup ventilation test requires for either generator options?

Re: A ventilation test is not required based on experience.

- What are the customer installation requirements for the stator cooling water skid and the static excitation system? Pg. 73 states the water skid and water tank control system is not included? What does this mean?

Re: The proposal statement in not applicable.

- What load rating will the lifting beam have?

Re: Design rating should be for generator rotor 360,000 lbs. Lifting slings are included.

Installation Comments:

- Installation schedule is estimated at 75 days (pg. 548). Generator scope is for mid-section replacement. Schedule driver is rotor rewind in shop (60 days, 45 days in shop). Any potential schedule improvement for rotor rewind?

Re: 45 days in shop for generator rotor rewind is best effort. Schedule improvement can only be gained by procuring a new rotor. A new rotor can not be fabricated in time for the 2009 outage. Generator rotor replacement would be 2011. The stator field rewind schedule is 35-42 days.

- Is machining of all HP Turbine cylinder interface locations included (pg. 8)?

Re: Need to include in scope.

- HP turbine exhaust bowl erosion repair is contingency extra cost item.

Re: Contingency repair item.

- Complete rotor train laser alignment is included.

Re: Need to include.

- Destructive removal of bolts is extra work (pg. 544).

Re: Alstom agreed to eliminate this as extra work item.

- New MSR insulation is included (pg. 539).

Re: Yes.

- Generator manways and cleaning of stator winding oil will not be extra work (pg. 544).

Re: Alstom agreed to eliminate this as extra work item.

- Heavy hauling is included (pg. 545).

Re: Yes.

- Pg. 545, discuss items relating to H2 coolers and turbine end bearing bracket.

Re: Alstom agreed to eliminate this as extra work item.

- Pg. 546, review personnel numbers identified on table.

Re: Asked Alstom to evaluate and explain the personnel numbers on the table.

- Discuss support resources required to be provided by PE.

Re: Alstom stated their installation cost estimate included all support resources. Need to provide "Division of Responsibilities".

Commercial Comments:

- Master Service agreement # 139805 open issue discussion.

Re: Alstom needs to provide name of person in Alstom who is responsible to negotiate contract.

- MSR material cost is REDACTED This appears excessive. Explain basis of cost.

Re: Alstom agrees it is high but can not cut the cost in half. Alstom can work with other MSR vendors.

- HP / LP Turbine material cost is REDACTED This appears high for LP turbine "blade carrier" solution and reuse of HP turbine nozzle box. Explain basis of cost.

Re: material cost / Euro / shop utilization. Larger LP turbine with inner cylinder was stated to be approximately REDACTED more.

- Would Alstom accept total project management responsibility if PE assigned required support labor to Alstom?

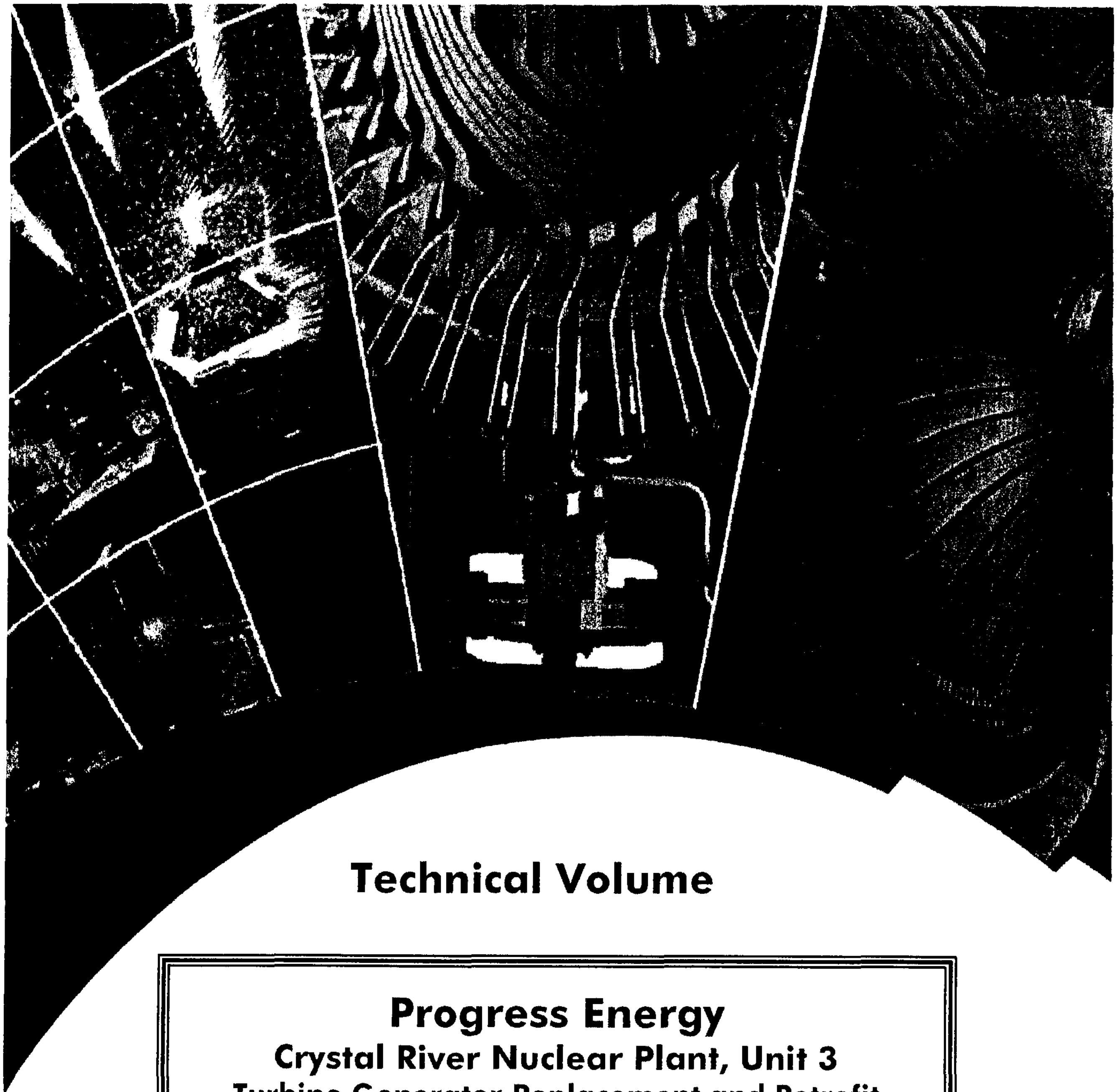
Re: alstom stated the estimated installation included all support resources.

- Proposal states installation is T&M billing. PE prefers fixed cost for total project scope.

Re: Can be fixed cost after a defined scope of work is established. PE can provide support resources.

Progress Energy Questions:

- EH tubing will be impacted by MSR replacement.
- Engineering Change and Work Order Package development.
- Radiological support and material decontamination contingency.
- O&M replacement of extraction pipe expansion joints?
- Any other turbine plant major equipment replacements must be integrated into turbine generator schedule for crane usage and logistics coordination.



Technical Volume

Progress Energy
Crystal River Nuclear Plant, Unit 3
Turbine Generator Replacement and Retrofit Project
Request No. SD22007
ALSTOM Power Ref: 844T0467

ALSTOM

Technical Volume

Technical Volume

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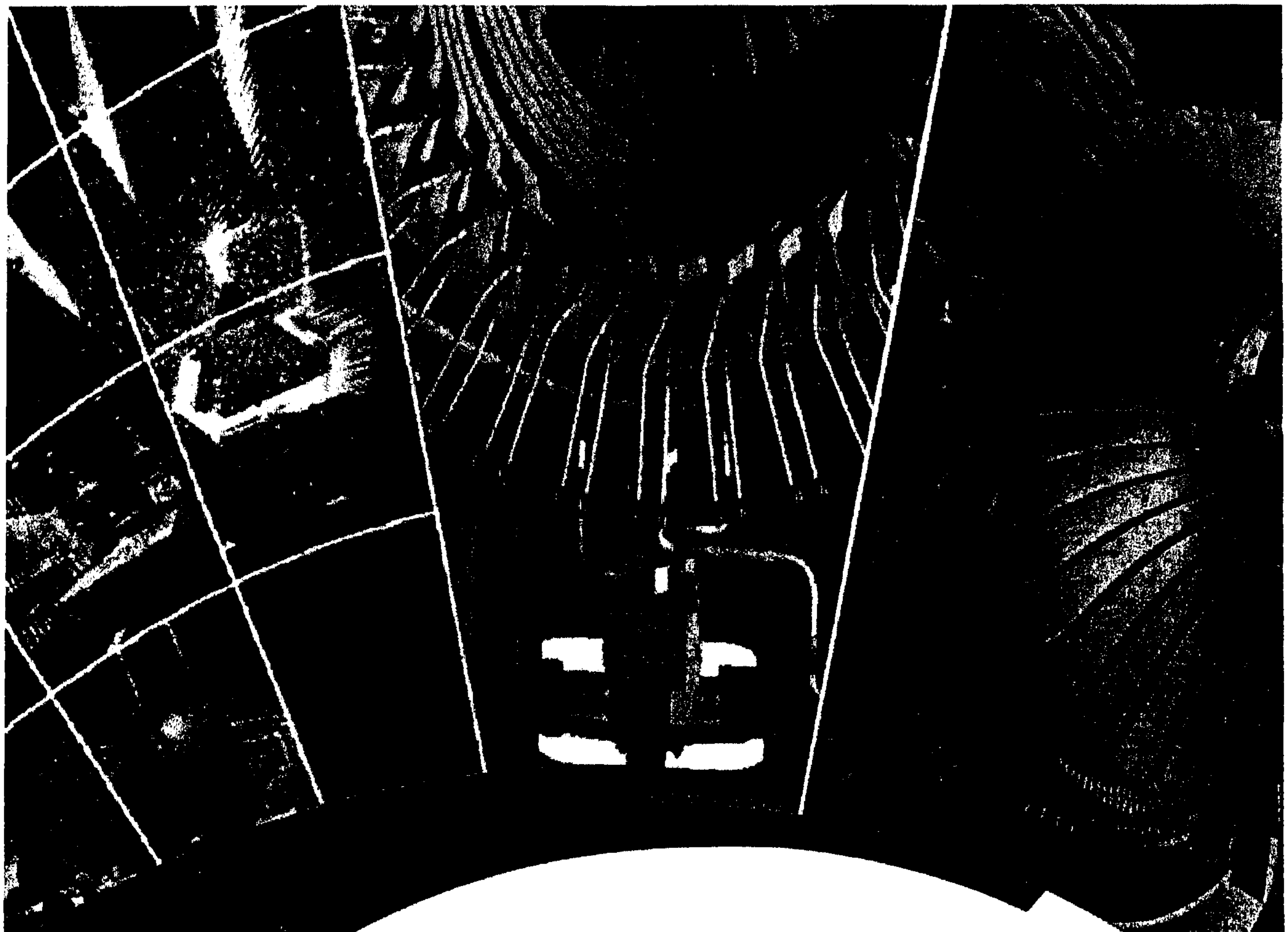

Technical Volume
Addendum No. 1

Progress Energy
Crystal River Nuclear Plant, Unit 3
Turbine Generator Replacement and Retrofit Project
Request No. SD22007
ALSTOM Power Ref: 844T0467

ALSTOM

PEF-NCR-02953

Addendum No.1 - Technical Volume

Addendum No.1 - Technical Volume

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Alstom Proposal # SD22007, CR3 EPU Turbine Generator Retrofit, Review Notes:

Proposal Summary:

HP Turbine: replace in 2009 with partial arc, full impulse turbine design with 3% flow margin.
LP Turbines: replace in 2009 with 12.9M2 (47"LSB).
Generator Stator: mid-section replacement in 2009 with H2O inner cooled winding. Stator rating is 1173 MVA.
Generator Rotor: rewind rotor in 2009 at Richmond shop. Rotor winding is reused.
Exciter: replace in 2009 with static excitation system.
Voltage Regulator: included in static excitation system.
Moisture Separator Reheaters: replace MSR vessels in 2009.

Cost: Total estimated cost for above scope is REDACTED [redacted] Installation cost is estimated for T&M billing.

Performance Guarantee: 1075.8 MW @ 2.7 In Hg (12.9M2 LP turbine). Does not include MSR drain reroute.

Outage Schedule: 2009 outage schedule is 75 days for HP and LP turbine replacement, generator mid-section replacement and MSR replacement. Schedule driver is shop rewind of generator rotor (60 days, 45 days in shop).

Optional Scope: Generator Stator field rewind with H2O cooled winding. Stator core iron is not replaced.
Cost: total estimated cost reduced to [redacted] REDACTED
Generator Rating: stator rating reduced to 1162.5 MVA.
Schedule: 2009 outage schedule will not decrease due to off site rotor rewind.

General Notes:

- HP Turbine and Generator must be opened in 2007 for field measurements. Is open and close cost included?
- Evaluate performance of larger 16.8M2 (57"LSB) LP Turbine.
- Heat balance indicates low feed water temperature between 2009 and 2011 (pg. 201, 207, 208). What is plant impact?
- PE must verify generator frame 75 psi H2 pressure rating for generator stator rewind.
- Support systems for water cooled stator skid and static excitation system are additional cost.
- Evaluate control room impact for new systems.

Scope of Supply Comments:

HP Turbine: 7 stage, full impulse design

- New nozzle plates are fitted into existing nozzle box. Existing nozzle plates may need destructive removal. Is machining or repairs to the existing nozzle box included?
- New inner and outer glands are provided. New gland seals machined for rotor clearance. Are both inner and outer glands type 405 ss (pg. 19)?
- Governor pedestal stub shaft will be reused. Eccentricity run out will be corrected. Will a spacer be provided to correct axial position if needed?

Scope of Supply Comments:

LP Turbine: 10 stage, reaction design

- Inner cylinder is reused. Blade carriers are replaced. Discuss interface between new blade carriers and existing inner cylinder (pg. 37).
- Blade carriers are ductile cast iron with 12% CR ring inlays. How are the ring inlays installed in the blade carriers (pg. 51)?
- L-0 blades have snubbers. Why not free standing?

Generator Mid-Section: 1173 MVA, Capability Curve pg. 77

- Verify main leads between stator and bushings are replaced. Not shown on pg. 75.
- Discuss phase dropper and bushing connection installation (pg. 98 / 99).

Stator Water Skid:

- What are the plant requirements to support installation?

Generator Stator Rewind: 1162 MVA, Capability Curve pg. 121

- Scope includes core iron loop test (pg.117). What are the power supply requirements?
- Core loop test is not identified in testing section 2.4.3.29 (pg. 143).

Installation Comments:

- Installation schedule is estimated at 75 days (pg. 548). Generator scope is for mid-section replacement. Schedule driver is rotor rewind in shop (60 days, 45 days in shop). Any potential schedule improvement for rotor rewind?
- Is machining of all HP Turbine cylinder interface locations included (pg. 8)?
- HP turbine exhaust bowl erosion repair is contingency extra cost item.
- Complete rotor train laser alignment is included.
- Destructive removal of bolts is extra work (pg. 544).
- New MSR insulation is included (pg. 539).
- Generator manways and cleaning of stator winding oil will not be extra work (pg. 544).
- Heavy hauling is included (pg. 545).
- Pg. 545, discuss items relating to H2 coolers and turbine end bearing bracket.
- Pg. 546, review personnel numbers identified on table.
- Discuss support resources required to be provided by PE.

Commercial Comments:

- Master Service agreement # 139805 open issue discussion.
- MSR material cost is REDACTED. This appears excessive. Explain basis of cost.
- HP / LP Turbine material cost is REDACTED This appears high for LP turbine "blade carrier" solution and reuse of HP turbine nozzle box. Explain basis of cost.
- Would Alstom accept total project management responsibility if PE assigned required support labor to Alstom?
- Proposal states installation is T&M billing. PE prefers fixed cost for total project scope.

Progress Energy Questions:

- EH tubing will be impacted by MSR replacement.
- Engineering Change and Work Order Package development.
- Radiological support and material decontamination contingency.
- O&M replacement of extraction pipe expansion joints?
- Any other turbine plant major equipment replacements must be integrated into turbine generator schedule for crane usage and logistics coordination.

Crystal River Unit 3 Extended Power Uprate Project, Turbine Generator Retrofit Proposal Evaluation

Progress Energy issued Crystal River Unit 3 (CR3) Turbine Generator Retrofit Request for Proposal # SD22007 on February 16, 2007. The request for proposal was issued to Siemens Power Generation, Alstom Power Systems, Mitsubishi Heavy Industries and Westinghouse Nuclear (Toshiba). The CR3 turbine generator was originally supplied by Westinghouse Power Generation (i.e. Siemens). The CR3 low pressure turbines were retrofit in 1996 with Brown Boveri (i.e. Alstom) turbines. CR3 Turbine Generator Retrofit Proposals were received from Siemens Power Generation (Siemens) and Alstom Power Systems (Alstom) on April 16, 2007.

The Siemens and Alstom proposals were very detailed. Proposal review meetings were held with both vendors to clarify scope details of each proposal. Both vendors amended their proposal based on the proposal review meeting clarifications. The Siemens proposal amendment letter was received on May 18, 2007. The Alstom proposal amendment letter was received on May 30, 2007.

The turbine generator retrofit bid specification (issued with RFP # SD22007) identified the expected main steam conditions and the expected turbine backpressure following the CR3 extended power uprate. The generator minimum operating capability was specified as 1080 MW concurrent with 430 MVAR lagging reactive power (i.e. 1162.5 MVA). The goal if the CR3 EPU is to produce 1080 MW at a turbine backpressure of 2.7 In. HGA. The CR3 turbine generator is to be retrofit during the 2009 plant steam generator replacement outage. The 2009 outage is expected to be approximately 72 days in duration.

The Siemens and Alstom proposals were evaluated based on the following criteria:

- HP and LP turbine material scope of supply and cost.
- Generator and Excitation System scope of supply and cost.
- Moisture Separator Reheater (MSR) scope of supply and cost.
- Electrical Output Guarantee.
- 2009 Outage Schedule Duration.
- Generator MVA rating.
- Total Project Cost.

Alstom Initial Proposal Summary:

- All hardware scope of supply requirements were met. The proposed LP turbines were small 13M2 exhaust annulus design with 47 inch last stage blades. The proposed small LP turbines negatively impact the performance guarantee by 4MW. The proposed generator stator rewind is a water cooled stator design. The proposed excitation system is a static exciter. The water cooled generator stator and static excitation system require new plant support systems to be installed at an estimated additional cost of [redacted] REDACTED
- The guaranteed electrical output is 1076 MW. The estimated cost of lost generation of 4 MW for the life of the rotors is [redacted] REDACTED based on replacement power costs of [redacted] /day for 1000MW and a 30 year rotor life. REDACTED
- The 2009 turbine generator retrofit schedule proposed by Alstom is 75 days driven by offsite generator rotor rewind. The 72 day outage schedule is impacted by an estimated additional 10 days at an estimated cost of REDACTED based on REDACTED replacement power cost.
- The generator will be rated at 1162.5 MVA, limited by reuse of the stator core iron which meets the minimum requirements, but allows no margin.
- The total project cost was evaluated substituting a competitors lower hardware cost.

The initial Alstom proposal did not support the 2009 outage schedule of 72 days. The Alstom proposal does not meet the desired electrical output of 1080 MW. The Alstom proposal provides a marginal generator capability rating of 1162.5 MVA due to reuse of the stator core iron.

Alstom amended their proposal to include larger LP turbines and a new generator rotor to address the electrical output and outage schedule issues.

<u>Alstom Amended Proposal Summary:</u>

- Hardware scope of supply revised to include larger 16.8M2 exhaust annulus design LP turbines with 57 inch last stage blades and a new generator rotor.
- The guaranteed electrical output is 1080 MW.
- The 2009 turbine generator retrofit outage schedule is 58 days.
- The generator will be rated at 1162.5 MVA, limited by reuse of the stator core iron.
- The total project cost was evaluated substituting a competitors lower hardware cost.

The amended Alstom proposal provides a marginal generator capability rating of 1162.5 MVA due to reuse of the stator core iron. To improve the generator capability rating a generator mid-section replacement is required. The Alstom proposal identified an additional cost of (REDACTED) to replace the generator mid-section to enable a generator capability rating of 1250MVA. The proposed Alstom water cooled stator winding and static excitation systems require additional new plant support systems to be installed at an estimated additional cost of [redacted]. The amended Alstom proposal turbine generator retrofit schedule is 58 days.
REDACTED

PROGRESS ENERGY
CRYSTAL RIVER UNIT 3
NUCLEAR POWER STATION
REPLACEMENT TURBINE GENERATOR
BID SPECIFICATION

RECORD OF REVISION

REV. NO.	CHANGE SECT/PARA.	DESCRIPTION/CHANGE AUTHORIZATION
00	N/A	Initial Issuance

In accordance with established procedures, the quality of this specification has been assured. Signatures certify that this specification was originated, checked and approved as noted below:

Prepared By:	Scott t. Deahna Scott Deahna	Date:	2/15/07
Prepared By:	M Gunning Mike Gunning	Date:	2-15-07
Reviewed By:	Ray Stewart Ray Stewart	Date:	2/15/07
Reviewed By:	Kent Smith	Date:	2/15/07
AREVA Approval:	B Devendorf Brad Devendorf	Date:	2/15/07
Progress Energy Approval:	Ted Williams Ted Williams	Date:	2/15/07

TABLE OF CONTENTS

TECHNICAL DOCUMENT

1.0 SCOPE

1.1 General

The Crystal River Unit 3 Nuclear Power Station (CR3), located near Crystal River, FL presently generates 903 MWe at 100% reactor power (2568 MWt).

CR3 is planning an "appendix K" feedwater flow measurement uncertainty recovery (MUR) uprate of 1.6% reactor power during the fall 2007 refueling outage. The CR3 steam generators will be replaced during the fall 2009 refueling outage. The fall 2009 refueling outage is expected to begin in September and will have a duration of approximately 80 days. CR3 is planning to implement an extended reactor power uprate of an additional 15.4% reactor power during the fall 2011 refueling outage. The total extended power uprate from present will be 17%.

The intent of the CR3 extended power uprate (EPU) project is to retrofit the low pressure turbines, moisture separator reheaters, generator and the exciter during the fall 2009 refueling outage. The high pressure turbine will be designed and retrofit during the fall 2011 refueling outage to support the reactor thermal uprated conditions. Based on current HP turbine governor valve positions, it is assumed that HP Turbine modifications are not necessary for the 1.6% MUR uprate.

Seller is requested to provide a proposal for replacement of the CR3 high pressure and low pressure turbines. The objective is to obtain a replacement steam path that produces the maximum power from the steam supplied by the steam generators after implementation of a 17 percent power uprate. A new steam path shall be defined as including both the fully assembled rotating parts as well as the adjacent stationary parts, as required. The replacement steam path should maintain or improve the existing unit's availability while addressing stress corrosion cracking in both the blade attachments and the disk and keyway areas, reducing erosion of turbine stationary parts and increasing the time between maintenance intervals. The replacement steam path shall consider the capability of the existing support systems and equipment to minimize the need to replace or modify the existing support systems, structures and components. The replacement high pressure turbine shall consider the capability to the plant integrated control system to control main steam header pressure based on the estimated governor control valve positions following retrofit.

Seller is requested to provide a proposal for replacement of the CR3 moisture separator reheaters (MSR's). The objective is to obtain replacement moisture separator reheaters that optimize the uprated turbine steam cycle conditions. The replacement MSR's shall consider maintaining the existing plant piping configuration including the turbine cross under and cross over piping.

Seller is requested to provide a proposal for generator / exciter capability uprate. The CR3 plant step up transformers will be rated at 1200 MVA. The uprated generator / exciter capability should closely match the step up transformer capability. Various generator stator uprate options should be submitted for consideration including rewinding with hydrogen inner cooled winding, rewinding with water cooled winding or a complete midsection replacement. The generator rotor forging is expected to be reused and rewound in the shop. An excited rotor spin balance is required. The exciter and voltage regulator shall be evaluated for modification or replacement to support the generator uprated capability.

Seller shall provide details of all field measurements required. Required field measurements should be identified as required to support final design or final machining. Required schedule for performing required field measurements shall be identified. Seller shall identify long lead time materials.

1.2 Objectives

The following objectives will apply to the design of the new turbine steam path and generator capability:

1.2.1 To provide a state-of-the-art turbine generator design that will maximize the electrical (MWe) output and reliability.
1.2.2 To contribute to a maximum overall availability and efficiency for the NSSS-turbine-generator combination.
1.2.3 To provide ease of maintenance and increase outage inspection intervals to a minimum of 10 years over a 40 year design life.
1.2.4 To provide minimum ISI intervals of 10 years.
1.2.5 To essentially eliminate Stress Corrosion Cracking (SCC) as a maintenance issue. This shall include all areas subject to SCC such as rotor bore, disk/wheel bore, blade root radii, blade attachment, etc.
1.2.6 To eliminate or severely reduce wear due to moisture erosion.
1.2.7 To provide a rated generator MVA capability that will have a minimum performance capability of 1080 MWe real power output while concurrently providing 430 MVAR overexcited reactive power.
1.2.8 To refurbish or replace the generator exciter and automatic voltage regulator to reliably support the uprated generator capability.
1.2.9 To provide moisture separator reheaters that maximize the performance of the uprated steam cycle.

1.3 Proposal Pricing

Purchaser has milestone to purchase rotor forgings and other long lead time materials during 2007 to support 2009 installation schedule.

Seller shall evaluate and present bid proposal pricing in the following formats:

1.3.1 Bid the following work scope separately:

a. High pressure turbine retrofit.
b. Low pressure turbine retrofit.
c. Generator stator and rotor rewind. Generator stator hydrogen (H2) inner cooled winding and water (H2O) cooled winding options should be provided.
d. Generator stator midsection replacement (optional scope).
e. Exciter / voltage regulator modification / replacement.
f. MSR vessel replacement
g. Turnkey Installation and commissioning service for proposed solution. Installation shall be performed in accordance with NRC 72 hour work week rule for nuclear power plant workers.

1.3.2 Combine the total work scope (proposed solution) in one bid.

1.4 QA Condition

The replacement turbine steam paths to be provided are classified as non nuclear safety related. Evaluation of any design basis requirements of rotating machinery will be required during the design phase.

1.5 Existing Configuration

1.5.1 Current Heat Balance Data:
The present CR3 plant heat balance (2584 MWt NSSS power) and future heat balance for the MUR uprate (2625 MWt NSSS power) is attached. The PEPSI heat balance model can be provided electronically to the seller upon request.

1.5.2 Thermal Power:
The CR3 NSSS is a B&W pressurized water reactor design with two once through steam generators (OTSG's). The NSSS thermal power is 2584 MWt. CR3 intends to submit a license amendment to operate at 2625 MWt NSSS power following the fall 2007 refueling outage and to operate at 3030 NSSS power following the fall 2011 refueling outage.

1.5.3 HP Turbine Model:
The CR3 high pressure turbine is a Westinghouse designed building block 296 (BB296), Serial Number 13-A-3511.

Nameplate Data: Guaranteed KW: 860 MW; Steam Inlet Pressure: 885 Psig; Steam Inlet Temperature: 567F, Steam Reheat Temperature: 505F; Exhaust Pressure: 2 in hg abs.
The high pressure turbine is a double flow element with one (impulse) control stage followed by eight stages of double reaction blading.

1.5.4 HP Turbine Steam Chests:
Four main steam headers carry main steam from the OTSG's to the two steam chests located on each side of the high pressure turbine. Each steam chest includes two throttle valves and two governor control valves. The four main steam headers enter the steam chests from below, on each end of the steam chest. The steam passes through the throttle valves, then the governor valves, before entering the high pressure turbine. The steam chest outlets are connected to the high pressure turbine casing through four inlet pipes. Two of the high pressure turbine steam inlet connections are in the base and two are in the cover of the outer cylinder. A steam header that runs under the HP turbine directly cross connects the two steam chests.

1.5.5 LP Turbine Model:
The CR3 low pressure turbines were originally Westinghouse designed building block 281 (BB281), Serial Number 13-A-3512 and 13-A-3513. The CR3 low pressure turbine steam paths were retrofit in 1996 with Asea Brown Boveri (ABB), model DS92, double flow, nine stage reaction turbines with 45 in LSB. A Reheat Stop Valve (RSV) and a Intercept Valve (IV) are located on each LP turbine steam lead. The RSV's and IV's are butterfly valves and function as open – close valves to isolate steam flow to the LP turbines.

1.5.6 Moisture Separator Reheater's (MSR's):
CR3 is equipped with four (4) MSR vessels. The CR3 moisture separator reheater were originally Westinghouse designed chevron type moisture separators with 2 stage reheat. Each reheat stage consisted of a 13, 650 Ft^2, two pass tube bundle.
The MSR tube bundles were replaced in 1988 with Thermal Engineering International (formerly Southwestern Engineering Co.) designed 18,000 Ft^2, four pass tube bundles.
The present MSR design conditions are:
MSR Shell: 265 Psig, 515F
HP Tube Bundle: 1050 Psig, 600F
LP Tube Bundle: 625 Psig, 500F

1.5.7 Generator Model:
The CR3 generator was originally a Westinghouse designed, 4 pole, H2 inner cooled, frame 126 x 275, S.O. 75P665, rated at 984MVA, 0.9PF, 1800 RPM, 22,000 volts, 3 phase, 60 cycles. The generator midsection was replaced in 1990 with a Siemens designed type THDD 170/70-18. The present generator is rated at 989.4 MVA, 22 KV, 25.965 KA, 60 Hz, 0.9 PF at 60 Psig H2 pressure, 46 C H2 cold gas temperature. The field rating is 500 volts and 6340 amps. The generator reactive capability is 430 MVar overexcited (lagging) at 0.9 PF. The generator rotor winding has 3 known shorts.

1.5.8 Exciter Model:
The CR3 exciter is a Westinghouse designed air cooled, double wheel, Mark II brushless exciter, frame A161C, S.O. 75P667, rated at 3500 KW, 500 volts, 7000 amps. The brushless exciter permanent magnetic generator (PMG) is directly connected to the exciter and is rated at 36KW, 125 volts, 420 cycles.

1.5.9 Voltage Regulator Model:

The excitation switchgear and automatic voltage regulating equipment is Westinghouse designed excitation switchgear with type WTA solid state regulator brushless excitation system.

Ratings:

Rated Generator MVA		989.40	MVA
Rated Generator Terminal Voltage		22.00	KV
Rated Generator Stator Amps		25.965	KA
PT Ratio		183	
CT Ratio		7000	
Generator Terminal Voltage at rated from PT		120.0	VAC
Generator Terminal Current at rated from CT		3.71	VAC
Shunt Ratio (Amps per 100mV)		200.00	Amps
Rated Exciter Field Current from Shunts		52.6	mV
Ceiling Current	129%	67.80	mV

1.6 Operating Conditions

The following table defines the present operational parameters and expected power uprate operational parameters for the extended power uprate project.

The 1.6 % Measurement Uncertainty Recovery Uprate (MUR) will be implemented in the R15 refueling outage scheduled to begin in November 2007. Installation of **Phase 1** is scheduled for the R16 refueling outage beginning in September 2009. Phase 1 will include installation of new LPT's, MSR's, Generator Rewind, and Feedwater Heaters. Installation of **Phase 2** is scheduled for the R17 refueling outage beginning in October 2011. Phase 2 will include installation of a new HPT and Remaining balance of plant modifications (main feedwater condensate and booster pumps, Turbine Bypass Valves, etc).

		Phase 1	Phase 2
Parameter	**Present Value**	**MUR Uprate**	**Extended Power Uprate (EPU)**
OTSG Thermal Power	2584 MW_{th}	2625 MW_{th}	3030 MW_{th}
OTSG Inlet Pressure	989.0 psia	1015.7 psia	1015 psia
OTSG Inlet Temperature	457.7 °F	458.4 °F	460 °F
OSTG Inlet Enthalpy	439.2 btu/lbm	440.0 btu/lbm	441.7 btu/lbm
OTSG Outlet Pressure	923.40 psia	923.4 psia	964 psia
OTSG Outlet Temperature	591.00 °F	594.5 °F	582 °F
OSTG Outlet Enthalpy	1250.4 btu/lbm	1250.0 btu/lbm	1237.4 btu/lbm
Main Feed Pump Discharge Pressure	1010 psia	1044.1 psia	1083 psia
Final Feedwater Flow	10.854 Mlb/hr	11.012 Mlb/hr	13.00 Mlb/hr
Turbine Throttle Pressure	902.72 psia	902.04 psia	930 psia
Turbine Throttle Flow	10.365 Mlb/hr	10.530 Mlb/hr	
Turbine Control Valve Positions: GV-1 GV-2 GV-3 GV-4	 45% (6.5 inches) 100% (14 inches) 100% (14 inches) 15% (2.25 inches)	TBD	TBD
Turbine Backpressure (Ref. HES condenser analysis report)	Design Point – 2.0 in hg abs. (seasonal range 1.5 – 3.5)	Design Point - 2.7 in hg abs. (seasonal range 1.5 – 3.5)	Design Point – 2.7 in hg abs. (seasonal range 2.0 – 4.0)

Refer to Attachment 10.1 for CR3 Turbine Generator Plant Operating Data from 01/31/2007.

Refer to Attachment 10.2 for CR-3 MUR Power Uprate PEPSE Analysis.
The CR3 PEPSI model can be electronically transmitted upon request.

CR3 Condenser Performance Analysis:
The EPU turbine back pressure design point should correspond with 75F circulating water inlet temperature. 75F circulating water inlet temperature is the CR3 seasonal average temperature.
A study was conducted by Heat Exchanger Systems Inc. to determine the condenser performance at the extended power uprate conditions. The objective of the study was to determine the condenser performance, specifically the condenser inlet pressure, for different operating conditions. The steam inlet flow was increased by 18% and the cooling water flow rate increased to give a tube velocity of 10ft/s, with equal flow in each water box. Cases were run for circulating water temperatures of 50°F, 70°F, 75°F, 88°F, and 95°F. A cleanliness factor of 0.9 was assumed.

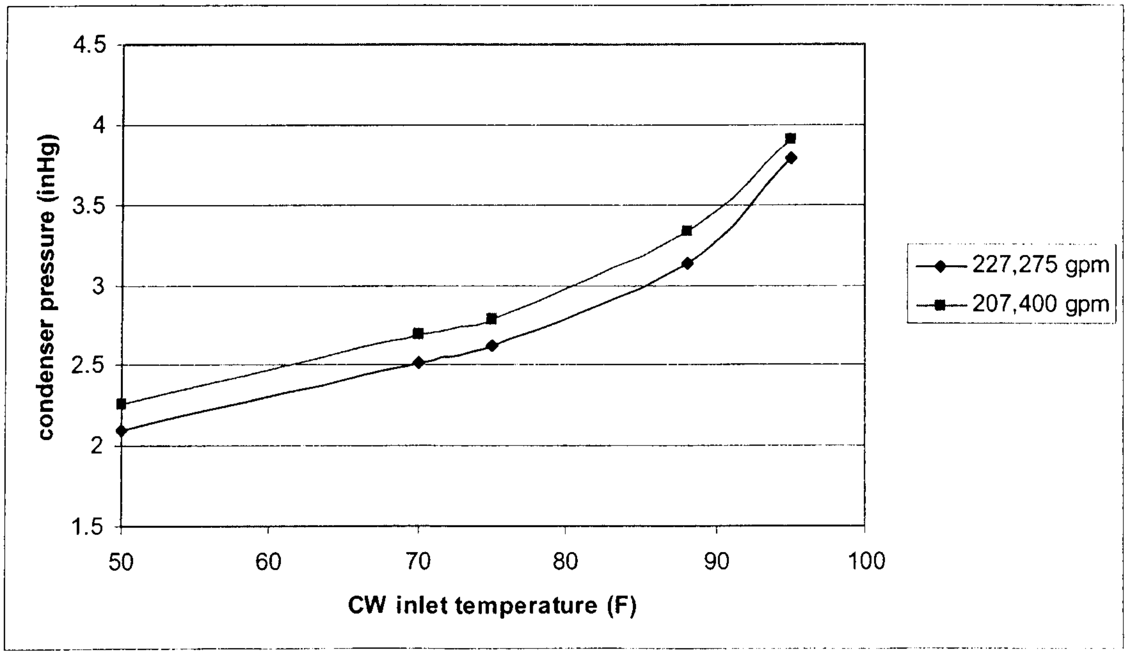
	LP Exhaust Flow (lb/hr)	LP Inlet Enthalpy (BTU/lb)	FWTB Flow (lb/hr)	FWTB Inlet Enthalpy (BTU/lb)
Original Case	5939619	1006	105870	1016
Present Study	7008750	1006	124926	1016

To obtain a circulating water flow rate in the tubes of 10 ft/sec, the inlet CW flow rate was initially set to 227,275 gpm per waterbox. The original study utilized CW flow rates of 160,000 gpm in waterboxes A and D, and 180,000 gpm in waterboxes B and C. A further series of runs were performed for a CW inlet flow of 207,400 gpm per waterbox.

The results of the calculations performed are summarized in Table 2.

Run	Inlet CW Temperature (F)	Offtake Pressure (inHg)	Condenser Back Pressure (inHg) (227,275 gpm)	Condenser Back Pressure (inHg) (207,400 gpm)
1	50	1.25	2.10	2.26
2	70	1.35	2.52	2.69
3	75	1.35	2.62	2.78
4	88	1.4	3.13	3.33
5	95	1.75	3.79	3.91

These results are presented graphically in Figure 1.



1.7 Scope of Supply

The scope of supply shall include, as determined by the seller, the following:

1.7.1 Turbine

The seller shall furnish the design, engineering, equipment, materials, fabrication and assembly, for the replacement of the high pressure and low pressure turbine steam path and associated equipment. Specify all necessary material and any other components requiring replacement for compatibility with the replacement steam path. The seller shall evaluate the feasibility of reusing existing equipment, controls, turbine supervisory instrumentation bearings and hood sprays. For the reused components, the Contractor shall provide written evaluations justifying the reuse of these components or provide new replacement components that are compatible with the new design.

a. HP Turbine and Steam Chests:

Assumptions:

i. Turbine valves, steam chests and HP turbine outer cylinder will be reused.

Scope:

i. One double flow HP rotor and rotating blades. Seller may propose impulse or reaction type steam path with partial arc or full arc control mode with 3% flow margin. See evaluation requirements below.
ii. Inner casings, blade rings and stationary blades.
iii. Nozzles and flow guides.
iv. Inner Gland seals with stainless steel housings.
v. Outer Gland seals and housings.
vi. Couplings and hydraulic coupling bolts.
vii. The turbine rotor shall include a center bore if required by Seller's design. If a center bore is required, it shall be included in the base scope of supply
viii. Any other components requiring replacement for compatibility with the replacement steam path.

Evaluations Required:

i. Seller shall estimate final governor valve position and impact to steam flow control. The CR3 plant integrated control system (ICS) controls main steam header pressure constant setpoint at all loads by adjusting steam flow to HP turbine.
ii. Bearing loading.
iii. Governor pedestal HP turbine stub shaft and control components.
iv. Outer cylinder bolting.

b. LP Turbines:

Assumptions:

i. Intercept valves, crossunder and crossover piping, outer cylinder and thrust bearing will be reused.

Scope:

i. Two double flow LP rotors and rotating blades.
ii. Inner casings, exhaust diffusers, blade rings and stationary blades.
iii. Gland seals and housings.
iv. Couplings and hydraulic coupling bolts.
v. Bull Gear.

vi. Makeup to extraction steam pipes.
vii. Any other components requiring replacement for compatibility with the replacement steam path.

Evaluations Required:
i. Bearing loading.
ii. Extraction steam pipe nozzles.
iii. Re-use of existing inner casing

1.7.2 Generator

Assumptions:
i. The CR3 minimum generator capability shall be 1080 Mwe real power concurrent with 430 Mvar overexcited reactive power capability.
ii. The stator core iron can be reused and rewound with either a hydrogen (H_2) inner cooled winding or a water (H_2O) cooled winding.
iii. The generator rotor forging and the 18-18 retaining rings can be reused. The generator rotor winding has three known shorts and shall be replaced.

Scope:
i. Stator rewind.
ii. Rotor rewind.
iii. Coupling and the hydraulic coupling bolts.
iv. Lead bushings.
v. Main lead current transformers.
vi. Generator monitoring systems (TBD).

Evaluations Required:
i. Evaluate an optional scope for generator mid-section replacement.
ii. Capability curve.
iii. Stator Core Iron.
iv. Maintaining a hydrogen (H_2) inner cooled stator winding or upgrading to a water (H_2O) cooled stator winding
v. Additional cooling requirements for uprated generator.
vi. Rotor coupling.
vii. H2 gland sealing design and upgrade.
viii. Neutral ground transformer and support systems

1.7.3 Excitation

Assumptions:
i. Exciter must be refurbished or replaced.
ii. WTA automatic voltage regulator should be replaced with digital voltage regulator including a Delta-P Omega power system stabilizer.

Scope:
i. Brushless or static exciter.
ii. Digital automatic voltage regulator with a Delta-P Omega power system stabilizer.

Evaluations Required:
i. Uprated generator excitation requirements.
ii. Exciter shaft requirements.

1.7.4 Moisture Separator Reheaters:

Four complete replacement moisture separator reheater vessels with two stages of reheat and four pass tube bundles shall be included in the Seller's scope of supply. MSR moisture separation and tube bundles should be designed to optimize the turbine steam cycle to achieve the best performance within the existing shell envelope. Existing nozzle configuration and piping should be reused to the extent possible. The MSR shall be designed in accordance with Electric Power Research Institute (EPRI) NP-3692 "Procurement and Operation Considerations for Moisture Separator Reheaters". 439 SS tube material shall be specified. MSR instrumentation package shall be included.

1.7.5 Instrumentation and Controls

The turbine AEH control system is expected to be reused. The AEH controller receives turbine demand input from the plant integrated control system or the operator and positions the governor control valves based on input demand. The turbine throttle valves are maintained full open when the unit is on line.

The turbine supervisory instrument system is a Bently Nevada 3300 system and is expected to be reused. Pickup mounting details will be provided by the buyer to support retrofit design. Each turbine generator bearing is monitored by X-Y (2 plane) dual probe vibration pickups. HP and LP turbine differential expansion, rotor thrust position and HP turbine governor pedestal expansion is monitored.

The generator stator is equipped with two rotor flux probes. The probe wiring exits the generator frame for connection to portable rotor flux monitoring equipment. Generator rotor flux probes will be reused or replaced.

The seller shall recommend new generator monitoring systems (rotor flux monitor, stator end turn vibration monitor, stator partial discharge monitor, etc) as appropriate. New generator monitoring systems should be priced and evaluated separately. The CR3 generator mid-section replacement was equipped with a stator end turn vibration monitoring system and a radio frequency monitoring system. The existing systems are obsolete or abandoned. An old style generator core condition monitor (Environment One) is still functioning.

The seller shall furnish all electrical components and associated auxiliary equipment required to support the turbine replacement, MSR replacement and generator modifications.

The seller shall furnish a MSR instrumentation package and a generator instrumentation package.

The seller shall evaluate existing electrical and control systems and interfaces to verify existing capabilities and compatibility. This shall specifically address the turbine speed control system (AEH Electro-Hydraulic Control System), as well as, auxiliary instrumentation and controls. Seller shall design the equipment to ensure that all of the interfacing systems, structures, and components shall be reused, if possible, and shall operate with minimal modification of the systems.

If the existing electrical and instrumentation/control systems are not usable, then, seller shall furnish all electrical components and associated auxiliary equipment required to support the turbine replacement, MSR replacement and generator modifications. Generator / Rotor monitoring instruments may require replacement or rescaling. The seller shall provide evaluation for buyer approval.

The Seller shall furnish all instrumentation including instrument piping / tubing, root valves, thermowells, and accessories required for the turbine generator and MSR replacement and or modification. The seller shall recommend any instrumentation upgrades considered appropriate.

If the Seller chooses to supply alternate control systems, the alternate systems shall be modern digital systems that fully meet U.S. nuclear industry requirements for scope of supply, redundancy and EPRI recommendations. The Seller shall completely describe any such offering.

All instrumentation provided shall be wired to terminal blocks in dust-tight and drip-proof terminal boxes (NEMA 4) accessible from outside the turbine-generator housing. Seller shall provide all wiring, raceway, terminal blocks, and junction boxes for these items.

All electrical conduit furnished by the Seller shall be rigid galvanized steel conduit supplied in ANSI standard sizes in nominal English units (inch sizes) at all Buyer/Seller terminal points. Rigid galvanized steel conduit furnished in accordance with IEC standards is acceptable for conduit within Seller's terminal points.

Each instrument connection to the main process lines shall be provided with an isolation (root) valve. Similarly, instrument vent/drain connections shall be also provided with an isolation valve. A valve or drain plug is not acceptable.

All instrumentation tubing and accessories supplied shall be stainless steel.

All thermocouples furnished shall be iron-constantan. All RTD's furnished shall be 100 ohm platinum. Any transmitters to be provided shall use a 4-20 ma signal range.

Where termination of Buyer's wiring is required, the Seller's wiring shall be connected to 600 volt barrier type molded terminal blocks for extension during installation at the plant site. Seller-to-Seller terminations shall be Seller's standard. Buyer's connections made on terminal blocks and on internal devices shall be by means of flanged spade or ring type insulation-gripping insulated terminals. Dedicated termination points shall be provided for connection of all cable shield drain wires. All thermocouple wiring shall be terminated on appropriate thermocouple type terminal blocks. Internal wiring shall have no splices in any circumstance, nor shall more than two wires be terminated on one terminal point. All terminal blocks shall be properly marked and identified, for all internal and external wiring. All cables shall be fire retardant.

Contacts for switches to be connected to Buyer's equipment (e.g. plant annunciator, plant computer system, plant supplied control room indicators, etc.) shall be double pole-double throw or equal, and rated for 125 VDC, 0.3 amperes inductive load minimum.

1.7.6 Evaluation of Existing Components

The Seller shall evaluate existing mechanical and electrical systems and interfaces to verify existing capabilities and compatibility. Seller shall design the equipment to ensure that all of the interfacing systems, structures, and components shall be reused, if possible, and shall operate with minimal modification of the systems, structures, and components. The evaluation shall include, but not limited to, the following:

a. Turbine Generator Foundation
b. Physical interface with Steam Chest and Governor valves
c. Steam Systems – Location, Size, and Compatibility
    i. HPT cross under piping to MSR

   ii. MSR cross over piping to LPT
   iii. Extraction steam nozzle sizes and locations
   iv. Gland seal steam
   v. Gland steam exhaust
d. Support Systems
   i. Turbine lube oil system
   ii. EHC– electro-hydraulic control system
   iii. Hood sprays
   iv. Generator seal oil system
e. Main Shaft and Bearings
   i. Couplings
   ii. Spool pieces
   iii. Bearing pedestals
   iv. Bearings
   v. Turning gear
   vi. Thrust bearing
   vii. HP turbine stub shaft and mechanical overspeed trip
f. Turbine Supervisory Instrumentation
g. Turbine Controller and Plant Integrated Control System Response
h. Generator Capability
i. Generator Cooling Requirements
j. Excitation System Requirements
k. MSR and Turbine Steam Cycle Performance

1.7.7 Engineering

The following Engineering and supporting calculations are expected after award of contract.

a. Analysis supporting 40-year design life
b. Design calculations
c. Overspeed trip and other set point changes
d. Design requirements for modifications to existing systems, structures, and components
e. Torsional response analysis
f. Critical speed calculations
g. Calculations supporting recalibration of all instrumentation and controls
h. Natural Frequency Calculations
i. Rotor lateral and torsional frequency response and loading transients
j. Missile probability analysis
k. Turbine deck laydown plan and floor loading analysis

1.7.8 Miscellaneous

a. The seller shall furnish all tools required for removal of existing equipment, installation of new and reused equipment and modification of retained systems, structures and components. This shall include, but not be limited to special customer tools as required for erection and maintenance of supplied equipment; lifting beams, hydraulic tools for assembly of inner casing flange bolts and couplings, tools for installation of balancing weights, tools required for maintenance (e.g. guiding elements, lifting slings, rigging equipment, etc.), and a set of power roller rotor stands for each rotor supplied.
b. Seller shall furnish and deliver all spare parts required during construction.
c. Shipment to the job site shall be the responsibility of the seller.

1.8 Scope of Supply by Others

1.8.1 Access to system design information. Identification of the required information is the seller's responsibility. The purchaser shall retrieve or duplicate necessary documents such as drawings, procedures, specifications, etc.
1.8.2 Modifications to existing mechanical systems, components including piping and hangers as required for the new installation.
1.8.3 Modifications to existing turbine control systems, instrumentation and electrical systems as required for compatibility with replacement equipment. Seller shall describe any such modifications as described in section 1.7.5
1.8.4 Modifications to existing generator interface systems and equipment such as generator cooling water supplies, generator busses, generator breakers, main transformers and protective relaying as required for compatibility with replacement equipment.
1.8.5 Any existing parts that require replacement as a result of disassembly of the existing components for final installation will be supplied by the owner.
1.8.6 Disposal of removed components that shall not be reused.
1.8.7 Operation personnel to perform shutdown, startup, draining, filling, isolation, and other normal. system operating functions.
1.8.8 Safety clearance and tagging of all equipment.
1.8.9 Removal, inspection, and installation of instrumentation.
1.8.10 Electric power, lighting, water, compressed air, and overhead crane facilities.
1.8.11 Removal and installation of insulation.
1.8.12 All electrical disconnects and terminations required to perform work.
1.8.13 Construction and removal of scaffolding.
1.8.14 Radiation protection technicians if required.
1.8.15 Unescorted access training for seller's personnel.
1.8.16 Preparation of post installation test procedures. Supply of test instrumentation. Performance of post installation tests and preparation of associated test reports.

1.9 Scope of Services

1.9.1 Design, fabrication, shipping, inspection and factory testing of equipment, including implementation of Quality Control procedures to ensure completed equipment satisfies the specification and design requirements.
1.9.2 Factory assembly of stationary components to validate dimensional and configuration interface with retained systems, structures and components.
1.9.3 Engineering and design for any required modification of interfacing or retained systems, structures and components.
1.9.4 Start-up testing and tuning of excitation system.
1.9.5 Drawings and manuals.
1.9.6 Calculation of heat balances and revision of the Thermal Kit.
1.9.7 Quality Assurance and Quality Control documentation.
1.9.8 Shipping and Handling
1.9.9 Review of post installation test procedures. Field support for post-installation tests and review of associated test reports.

1.10 Schedule

Seller shall provide expected equipment delivery schedules (lead times) and anticipated installation schedule durations.

1.11 Required Bid Documentation

Seller shall submit a complete proposal fully describing all of the proposed equipment and all services to be furnished. All documents shall be in English and in U.S. measurement units.

1.11.1 Technical product description including but not limited to rotor design, rotor design life, steam path design, susceptibility to stress corrosion cracking, erosion-corrosion resistance, materials of construction, inter-stage sealing, codes and standards.
1.11.2 Requirements for seller inspection of existing equipment including owner support required.
1.11.3 Provide separate Heat Balance Diagrams for the phase 1 installation and the phase 2 installation. Include a new guarantee diagram with the new MSR's, HP and LP turbine components.
1.11.4 Performance guarantee estimate.
1.11.5 Generator capability curve. Generator cooling requirements. Generator excitation requirements.
1.11.6 A list of all equipment and materials to be furnished including special tools and spare parts required for construction.
1.11.7 Outline drawings of the turbine-generator unit giving approximate weights, principal dimensions, and showing main piping connections.
1.11.8 Equipment warrantee information.
1.11.9 A project level milestone schedule including forging milestones and long lead time material requirements.
1.11.10 Proposed installation schedule that starts with the time when the turbine is taken off turning gear and ends with the time that it goes back on turning gear (i.e., days to install the equipment).
1.11.11 Additional optional scope of supply as defined by seller.
1.11.12 Identification and interfaces with remaining components.
1.11.13 The evaluation of retained interface components.
1.11.14 Specify any modifications required to existing equipment including but not limited to exhaust hoods/diffusers, packing casings, vacuum alarm, bearings, turbine lube oil system, and turbine supervisory instrumentation to allow installation of new equipment.
1.11.15 Recommended inspection interval for each major part (Rotor and Cylinder) including scope of inspection.
1.11.16 Provide details of the new component construction. The seller shall describe the materials proposed to be used for the major parts of the equipment, such as Rotors, Blades (all stationary and rotating rows), and Casings, to be supplied using either an ASTM designation or the closest ASTM designation. This shall include moisture erosion protection features for all new components.
1.11.17 Factory and field balancing of rotors and vibration standards used.
1.11.18 Steam chemistry/purity requirements.
1.11.19 Organizational structure of labor for turnkey installation including craft labor, supervision, technical direction and project management.
1.11.20 The seller shall provide recommended test methodologies including acceptance testing based on the alternative test as defined in the latest edition of ASME Performance Test Code PTC-6.
1.11.21 Absolute backpressure limitations including alarm values.
1.11.22 Performance effect of annual variation in condenser absolute backpressure. LSB exhaust loss curve and total exhaust loss curve.
1.11.23 Summary of retrofit experience with similar equipment and technology. Identify "first of a kind" scope.
1.11.24 Sellers service facilities that are applicable to the equipment covered in these specifications and their locations.
1.11.25 Recommended test procedure / tuning procedure for exciter and voltage regulator.

TECHNICAL DOCUMENT

1.12 Required Documentation After Award

No.	DESCRIPTION	PRIORITY	TYPE & QUANTITY	SUBMITTAL DUE DATE (WEEKS RFDE or PTS)
1	Thermal Kit	1	5 Copies or 1E	8 weeks RFDE
2	General Arrangement Drawing for the Turbine-Generator/MSR	2	5 Copies or 1E	8 weeks RFDE
4	Proposed turbine generator startup and operating procedures	2	5 Copies or 1E	8 weeks RFDE
5	Engineering Schedule	2	5 Copies or 1E	4 weeks RFDE
6	Procurement/Production / Shipping Schedule	2	5 Copies or 1E	8 weeks RFDE
7	Recommended Detailed Erection Sequence	4	5 Copies or 1E	4 weeks RFDE
8	QA Inspection and Test Schedule	3	5 Copies or 1E	4 weeks RFDE
9	Final Quality Control Documentation including Shop Test and Inspection Reports	3	5 Copies or 1E	2 weeks PTS
10	Generator Performance Data	3	5 Copies or 1E	18 months RFDE
11	Shipping List	4	5 Copies or 1E	12 weeks PTS
12	Spare Parts List - Erection & Commissioning	4	5 Copies or 1E	12 weeks PTS
13	Spare Parts List - Operational Spares	4	5 Copies or 1E	6 months PTS
14	Special Tools List	4	5 Copies or 1E	12 weeks PTS
15	P&IDs	2	5 Copies or 1E	4 weeks RFDE
16	Lube Oil Equipment Outline	2	5 Copies or 1E	6 weeks RFDE
17	Generator Stator Cooling Water Skid Outline	2	5 Copies or 1E	8 weeks RFDE
18	MSR Foundation Requirements	2	5 Copies or 1E	6 weeks RFDE
19	Gen. Stator Cooling Water Skid Foundation Requirements	2	5 Copies or 1E	8 weeks RFDE
20	Excitation System - General Arrangement	2	5 Copies or 1E	8 weeks RFDE
21	Excitation System - Foundation Requirements	2	5 Copies or 1E	8 weeks RFDE
22	Excitation System - Elementary & Connection Diagrams	2	5 Copies or 1E	12 weeks RFDE
23	Terminal Point Locations - Mechanical	2	5 Copies or 1E	8 weeks RFDE
24	Terminal Point Locations - Electrical	2	5 Copies or 1E	12 weeks RFDE
25	ASME Pressure Vessel Certifications	2	5 Copies or 1E	At Shipment
26	Generator Electrical Connection Details	2	5 Copies or 1E	16 weeks RFDE
27	Generator Neutral Grounding Cubicle Drawings	2	5 Copies or 1E	24 weeks RFDE

No.	DESCRIPTION	PRIORITY	TYPE & QUANTITY	SUBMITTAL DUE DATE (WEEKS RFDE or PTS)
28	Interconnecting Piping General Arrangement Drawings	2	5 Copies or 1E	12 weeks RFDE
29	Preliminary Instruction, Inspection and Maintenance Manuals	2	5 Copies	18 months RFDE
30	Final Instruction, Inspection and Maintenance Manuals including maintenance procedures.	3	10 Copies	6 months PTS
31	Erection Manuals	4	5 Copies	18 months RFDE
32	Max. Allowable Nozzle Loads	2	5 Copies or 1E	24 weeks RFDE
33	Weld End Details at Buyer/Supplier Terminal Points	2	5 Copies or 1E	16 weeks RFDE
34	Field Checkout Procedures	4	5 Copies or 1E	8 weeks PTS
35	Start-up Manual	4	5 Copies + 1E	12 months PTS
36	Supplier's standard reference material	2	5 Copies or 1E	4 weeks RFDE
37	Storage and Handling Procedures	4	5 Copies or 1E	12 months RFDE
38	Recommendations for Rigging and Handling Equipment	4	5 Copies or 1E	12 months RFDE
39	Generator Characteristic data and Phase Current Unbalance Calculation	2	5 Copies or 1E	18 months RFDE
40	Exciter model and tuning parameters for input to transmission PSS / E software	2	5 Copies or 1E	4 weeks RFDE
41	Foundation Drawings	2	5 Copies or 1E	4 weeks RFDE

1. RFDE – Release for detailed engineering PTS – Prior to shipment
2. Priority Code:

   Priority 1 - Critical for Owner's licensing activities

   Priority 2 - Critical for Buyer's plant

   Priority 3 - Required to verify compliance with specifications

   Priority 4 = Required for field installation

   Priority 5 = Required for field installations, operation and maintenance manuals
3. Type & Quantity = Type and number of copies of drawings/data required.

   R = Reproducible P = Print E = Electronic

2.0 DEFINITIONS

The following definitions shall apply to this specification:

Owner	-	Progress Energy
Purchaser	-	Owner Representative
Buyer	-	Owner Representative
Seller	-	Firm proposing to supply the subject equipment.
Supplier	-	Firm awarded the order for the subject equipment.
Contract	-	Equipment and Service Supply Contract
OSTG	-	Once Through Steam Generator
VWO	-	Valves Wide Open
STG	-	Steam Turbine Generator
TBD	-	To Be Determined
PWR	-	Pressurized Water Reactor

3.0 REFERENCES

3.1 Codes and Standards

Note that only recognized U.S. standards and equivalent International standards will be accepted. A list of applicable International codes and standards shall be submitted, in English, for Engineer's acceptance prior to use.

The design, fabrication, materials, workmanship, and testing of all equipment shall be in accordance with the buyer's standards and applicable codes. In the bid proposal, the Contractor shall identify all applicable codes and standards (with revision) to be utilized. In the event of an apparent conflict among standards, codes and this specification, the seller shall identify such conflict. The Seller shall obtain written resolution of such conflict from the purchaser prior to proceeding with work involving the conflict.

When standards are referenced in this specification without current or effective dates, the latest revision of the standard specification in effect as of the date of the Contract shall be considered applicable. Any modifications to the standard specifications included herein shall be with the express written approval of the purchaser.

3.1.1 Heat Exchange Institute (HEI)

a. Standards for Power Plant Heat Exchangers
b. Standards for Steam Surface Condensers

3.1.2 Standards of Tubular Exchanger Manufacturer's Association (TEMA)

3.1.3 Hydraulic Institute Standards

3.1.4 Electrical equipment shall be designed, constructed and tested in accordance with the following standards:

a. Institute of Electrical and Electronics Engineers (IEEE):

i. Standard General Principles for Temperature Limits in the Rating of Electrical Equipment and for Evaluation of Electrical Insulation, IEEE 1.

ii. Neutral Grounding Devices, IEEE 32.
iii. AC High Voltage Circuit Breakers, IEEE C37.013
iv. Generator Ground Protection Guide, IEEE C37.101
v. Recommended Practice for Testing Insulation Resistance of Rotating Machinery, IEEE 43
vi. Operation and Maintenance of Turbine Generators, IEEE 67
vii. Test Procedures for Polyphase Induction Motors and Generators, IEEE 112A.
viii. Test Code for Direct Current Machines, IEEE 113.
ix. Test Procedures for Single Phase Induction Motors, IEEE 114.
x. Test Procedures for Synchronous Machines, IEEE 115.
xi. Test Procedure for Carbon Brushes, IEEE 116.
xii. Speed governing of Steam Turbine, IEEE 122.
xiii. Standard Definitions for Excitation Systems for Synchronous Machine, IEEE 421.1
xiv. Guide for Identification, Testing, and Evaluation of the Dynamic Performance of Excitation Control Systems, IEEE 421.2.
xv. Guide for the Preparation of Excitation System Specifications, IEEE 421.4.
xvi. Requirements for Cylindrical Rotor Synchronous Generators, IEEE C50.13.
xvii. Standard for Flame Testing of Cables for Use in Cable Trays in Industrial and Commercial Occupancies, IEEE 1202.

b. American National Standards Institute (ANSI):

i. National Electric Safety Code, ANSI C2.
ii. Switchgear, ANSI C37.
iii. Definition of Electrical Terms, ANSI C42.
iv. General Requirements for Synchronous Machines, ANSI C50.10.
v. Transformers, ANSI C57.
vi. Measurements of Voltage in Dielectric Tests, ANSI C68.1.

c. National Electrical Manufacturers Association (NEMA):

i. Methods of Measurements of Radio Influence Voltage of High Voltage Apparatus, NEMA 107.
ii. Enclosures, NEMA 250.
iii. Industrial Control, NEMA 1CS1.
iv. Motors and Generators, NEMA MG1, MG2.
v. Electric Power Connectors, NEMA SG1.
vi. Power Circuit Breakers, NEMA SG4.
vii. Transformers, Regulators and Reactors, Section Entitled "Test Code for Measurement of Radio Influence Voltage Levels", NEMA TR1.
viii. General Purpose Wiring Devices, NEMA WD.

d. National Fire Protection Association (NFPA) Standard 70 – "National Electrical Code".

e. National Electric Reliability Counsel (NERC) Standard PRC-024-1."Generator Performance During Frequency and Voltage Excursions" (currently draft for review).

f. All electrical hardware shall be listed in the Factory Mutual Approval Guide or, if not listed in this guide, shall be Underwriters Laboratories listed.

3.1.5 Recommended Practices for the Prevention of Water Damage to Steam Turbines Used for Electric Power Generation, ANSI/ASME TDP-1.

3.1.6 Instrumentation, Systems, and Automation Society (ISA), Standards and Practices for Instrumentation.

3.1.7 Scientific Apparatus Makers Association (SAMA), PMC 22.1, Functional Diagramming of Instrument and Control Systems.

3.1.8 All work performed and materials provided by the Supplier shall be in accordance with Federal, State, County, and Municipal codes, laws, and ordinances of the place of installation.

3.1.9 International Code Council, International Building Code (IBC).

3.1.10 American Society of Civil Engineers (ASCE) Standard 7, Minimum Design Loads for Buildings and Other Structures.

3.1.11 Equipment and systems shall be in accordance with the rules and regulations of the US Federal Occupational Safety and Health Administration (OSHA) including 29CFR1910, General Industry Regulations and 29CFR1926 Construction Industry Regulations.

3.1.12 National Fire Protection Association (NFPA):

a. Fire Protection for Light Water Nuclear Power Plants, NFPA-803
b. Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders and Tanks, NFPA-55

3.1.13 USNRC - U.S. Nuclear Regulator Commission, Title 10 - Code of Federal Regulations, Regulatory Guides and Standard Review Plan, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, NUREG-0800, Draft Revision – April 1996.

3.1.14 ISO - 9001 or ANSI/ASQC Q91, Quality Systems-Model for Quality Assurance in Design/Development, Installation and Servicing

3.1.15 International Organization for Standards (ISO):

a. ISO 7919-2, Mechanical Vibration – Evaluation of Machine Vibration by Measurements on Rotating Shafts - Part 2: Land Based Steam Turbine and Generators
b. ISO Standard 10816-2, Mechanical Vibration – Evaluation of Machine Vibration by Measurements on Non-Rotating Parts - Part 2: Land Based Steam Turbine and Generators
c. ISO 3740, Acoustics – Determination of Sound Power Levels of Noise Sources – Guidelines for the Use of Basic Standards
d. ISO 3744, Acoustics – Determination of Sound Power Levels of Noise Sources – Engineering Method in an Essentially Free Field Over a Reflecting Plane
e. ISO 3746, Acoustics – Determination of Sound Power Levels of Noise Sources – Survey Method

3.1.16 American Concrete Institute (ACI):

a. Mass Concrete, ACI-207.1
b. Effects of Restraint, Volume Change and Reinforcement on Cracking of Mass Concrete, ACI-207.2
c. Cooling and Insulating Systems for Mass Concrete, ACI-207.4
d. Standard Specifications for Structural Concrete, ACI-301
e. Details and Detailing of Concrete Reinforcement, ACI-315
f. Building Code Requirements for Reinforced Concrete Structures, ACI-318
g. Recommendations for Design Beam-Column Joints in Monolithic Reinforced

Concrete Structures, ACI-352R

h. Recommendations for Design Slab-Column Joints in Monolithic Reinforced Concrete Structures, ACI-352.1R
i. Response of Concrete Buildings to Lateral Forces, ACI-442

3.1.17 American Society of Testing and Materials (ASTM):

a. Standard Methods and Definitions for Mechanical Testing of Steel Products, ASTM A-370.
b. Standard Test Method for Ultrasonic Examination of Turbine and Generator Steel Rotors, ASTM A-418
c. Standard Specification for Vacuum Treated Carbon and Alloy Steel Forgings for Turbine Rotors and Shafts, ASTM A-470
d. Standard Practice for the Design of Steam Turbine Generator Oil Systems, ASTM D-4248
e. Standard Guide for Radiographic Testing, ASTM E-94
f. Standard Reference for Radiographs for Heavy Wall Steel Castings, ASTM E-186
g. Standard Reference for Radiographs for Steel Castings up to Two Inches in Thickness, ASTM E-446
h. Standard Specification for Vacuum Treated Steel Forgings for Generator Rotors, Grade 6, 7 or 8, ASTM A-469
i. Standard Specification for Alloy Steel Forgings for Nonmagnetic Retaining Rings for Generators, ASTM A-289

3.1.18 American Society of Mechanical Engineers (ASME):

a. Boiler and Pressure Vessel Code, Section II, Materials
b. Boiler and Pressure Vessel Code, Section V, Nondestructive Examination
c. Boiler and Pressure Vessel Code, Section VIII, Division 1, Rules for Construction of Pressure Vessels
d. Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications
e. Unified Inch Screw Threads, UN and UNR Form, ASME B1.1
f. Pipe Threads, General Purpose, ASME B1.20.1
g. Forged Steel Fittings, Socket-Welding and Threaded, ASME B16.11
h. Butt welding Ends, ASME B16.25
i. Pipe Flanges and Flanged Fittings, ASME B16.5
j. Valves – Flanged, Threaded and Welding End, ASME B16.34
k. Orifice Flanges, ASME B16.36
l. Power Piping, ASME B31.1
m. Performance Test Code, PTC-6, Steam Turbines
n. Performance Test Code, PTC 6.1, Interim Test Code for an Alternative Procedure for Testing Steam Turbines
o. Performance Test Code, PTC 6S, Procedures for Routine Performance Test of Steam Turbines
p. Performance Test Code, PTC 12.4, Moisture Separator Reheaters
q. Performance Test Code, PTC 20.1, Speed and Load Governing Systems for Steam Turbine Generator Units.

3.1.19 American Institute of Steel Construction (AISC), Manual of Steel Construction

3.1.20 American Welding Society (AWS), D1.1, Structural Welding Code – Steel

3.1.21 United States Department of Commerce, National Institute of Standards and Technology (NIST), Special Publication 811, "Guide for the Use of the International System of Units (SI)".

3.1.22 HTRI, Heat Transfer Research Institute.

3.1.23 American Petroleum Institute (API):

a. Standard 610, Centrifugal, Rotary and Reciprocating Pumps.
b. Standard 674, Positive Displacement Pumps – Reciprocating.
c. Standard 675, Positive Displacement Pumps – Controlled Volume.
d. Standard 676, Positive Displacement Pumps – Rotary.

3.1.24 USNRC - U.S. Nuclear Regulator Commission, Draft Guide DG-1145, Combined License Applications for Nuclear Power Plants (LWR Edition) dated April 22, 2006.

3.2 Regulatory Requirements

3.2.1 Regulatory Guide 1.115, Protection against low-trajectory turbine missiles.

3.3 Documents

3.3.1 CR-3 MUR Power Uprate PEPSE Analysis attached.

4.0 DESIGN REQUIREMENTS

Note: See section 1.11 for bid-proposal documentation requirements.

4.1 Site Conditions

The CR3 turbine generator is enclosed in a turbine building. The turbine operating deck is at elevation 145 ft. The turbine building is not seismically qualified. The turbine building is equipped with a ventilation system. The turbine building ambient temperature does not exceed 120F.

The turbine building is equipped with one overhead crane rated at 185 ton.

4.2 Service Conditions

4.2.1 Normal Operations

The replacement turbines shall not impose any restrictions on the normal operation of the unit that are more restrictive than the standard operating recommendations when the unit is in good condition.

The LP turbine shall be designed with a normal operating backpressure of at least 5.5 inches of Hg (absolute).

4.2.2 Maintenance

The recommended intervals between turbine overhauls shall be at least 10 years. Specific operating surveillances are required to achieve this extended interval. The seller shall provide operating surveillance requirements and the scope of work typically required for inspections, minor overhauls, and major overhauls.

4.3 Technical Requirements

4.3.1 Turbine Performance Requirements

a. Phase 1 Installation: LPT, MSR, Generator Rewind Guarantee.

The Seller shall guarantee the turbine-generator gross electrical output (MW_e) uplift after installation of the turbine and MSR steam paths at 2625 MWt, backpressure, and makeup in accordance with the contract guarantee heat balance. This performance improvement results directly and exclusively from the scope of supply defined in this specification. The owner will be replacing feedwater heaters due to degradation and to support the extended power uprate during the same refueling outage. The new feedwater heaters will be sized for the maximum power uprate condition with the same design TTD and DCTD as indicated on the current CR3 heat balance.

Performance of remaining cycle components external to and not impacted by this scope of supply, such as stop valves, gland steam system, etc., shall remain materially unchanged from the pre- to the post- and as described in the guarantee heat balances is assumed.

The Seller shall provide a revised thermal kit for the revised turbine designs that includes the following but not limited to:

i. Heat Balance Diagrams with the new turbine and MSR components at VWO, 100% MWth (guarantee point), 75%, 50% and 25%. The baseline and guarantee HBD's will provide the basis for the thermal performance warranty.
ii. Net Heat Rate
iii. Turbine Expansion Line for each Heat Balance
iv. LP Turbine Base Expansion Line End Points
v. Extraction Stage Pressure vs. Flow
vi. Gland Leakages and Mechanical Losses
vii. Heat Rate and Load Correction Curves for: exhaust pressure, throttle pressure, throttle temperature, reheater TTD
viii. Turbine Stage Moisture Removal Effectiveness
ix. LP Turbine Exhaust Loss Curve
x. Generator Loss

b. Phase 2 Installation: HPT, Balance of Plant Modifications Guarantee

The Seller shall guarantee the turbine-generator gross electrical output (MW_e) uplift after installation of the HPT steam paths at 3030 MWt, backpressure, and makeup in accordance with the contract guarantee heat balance. This performance improvement results directly and exclusively from the scope of supply defined in this specification. The owner will be modifying the main feedwater pump, condensate and booster pumps, and other balance of plant systems and components as required to support the extended power uprate during the same refueling outage.

The Seller shall provide a revised thermal kit for the revised turbine designs that includes the following but not limited to:

i. Heat Balance Diagrams with the new HPT and balance of plant components at VWO, 100% MWth (guarantee point), 75%, 50% and 25%. The baseline and guarantee HBD's will provide the basis for the thermal performance warranty.
ii. Net Heat Rate
iii. Turbine Expansion Line for each Heat Balance
iv. HP Turbine expansion line end points
v. First Stage Pressure vs. Flow
vi. Extraction Stage Pressure vs. Flow
vii. Gland Leakages and Mechanical Losses
viii. Heat Rate and Load Correction Curves for: exhaust pressure, throttle pressure, throttle temperature, reheater TTD
ix. Turbine Stage Moisture Removal Effectiveness

c. Turbine Performance

The seller's heat balance shall be based on the operating parameters specified on the buyers heat balance for nominal full load conditions. Specific requirements for the design include HP turbine throttle pressure and temperature, HP turbine throttle enthalpy, HP turbine throttle flow, and final feedwater temperature. Values for feedwater heater performance at uprated conditions as well as extraction line pressure losses can also be obtained from the buyers heat balance. Values for MSR performance shall be provided by the seller based on the proposed new design.

The turbine shall be designed with a mass flow margin of 2% above the steam flow required to achieve the guaranteed output at the throttle pressure specified in the buyer's heat balance diagram for nominal 100% load to account for manufacturer's tolerances. In addition, the design shall allow for an additional 1% flow margin for the buyer for a **total of 3% flow margin**.

The turbine shall be capable of stable operation at 100% of rated steam flows and rated conditions with one or more low pressure turbine operating at choked flow conditions.

The turbine governor valves shall be capable of controlling stable main steam header pressure.

4.3.2 Generator Performance Requirements

The generator shall be designed to produce a minimum of 1080 MW real power concurrent with 430 MVAR overexcited reactive power at 100% reactor thermal output power. The ability to produce minimal power out put with 430 MVAR is required to ensure that the reactive power capability of the generator during the summer time operation is not limited.

The generator shall be suitable for operation at rated MVA, power factor, and frequency at ±5% of rated voltage in accordance with the standards of performance established for operation at normal rating. Permissible variation at the generator terminal voltage shall be in accordance with IEEE C50.13.

The maximum temperature rise for any generator component shall be in accordance with IEEE C50.13 for Class B. The total temperatures as determined by any of the methods given in ANSI/IEEE applicable Standards shall not exceed 110° C for the stator coils and for the field when operating at full loads, and over the full range of power factors.

The generator open circuit terminal voltage wave deviation factor shall not exceed 10% as defined by ANSI/IEEE standard.

Starting from stabilized temperature at rated conditions, the generator field windings shall be capable of operating at 130% of rated armature current for one minute in accordance with IEEE C50.13 standard requirements.

Starting from stabilized temperature and rated conditions, the generator field windings shall be capable of operating at 125% of rated load field voltage for one minute in accordance with IEEE C50.13 standard requirements.

The stator windings shall satisfactory withstand normal maintenance high potential tests without damage.

The generator shall be capable of continuous operation at any load up to its rated maximum out put and shall withstand all expected operating transients resulting from rapid load changes and transmission line fault conditions.

In accordance with IEEE C50.13, the generator shall be capable of withstanding without mechanical damage from any type of short circuit at its terminals for times not exceeding the short time thermal capabilities, when operating at rated voltage and power factor as well as 5% over voltage, provided the maximum phase current is limited by external means to a value which does not exceed the maximum phase current obtained from the three phase fault.

Generator Operating Frequency Requirements:
1) Must be able to withstand frequency excursions between 59.5 Hz and 60.5 Hz indefinitely
2) Must be able to withstand frequency excursions between 58.5 Hz and 59.5 Hz for 60 seconds
3) Must be able to withstand frequency excursion between 60.5 Hz and 61.8 Hz for 10 seconds
4) Must be able to withstand frequency excursions between 58.0 Hz and 58.5 Hz for 10 seconds
5) Must be able to withstand frequency excursions between 57.5 Hz and 58.0 Hz for 1 second

Generator Operating Voltage Requirements:

1) Must be able to withstand terminal voltages within +/- 5% of rated nominal voltage indefinitely
2) Must be able to withstand terminal voltage deviations between 5% and 10% (+/-) for 10 seconds

Generator Operating Overexcitation Requirements:
1) Must be able to withstand Volts per hertz conditions less than 116% (of generator nominal voltage and frequency) for 1.5 seconds
2) Generator overexcited stator currents less than 150% of nameplate rating for at least 5 seconds.

4.3.3 MSR Performance Requirements

Four complete replacement moisture separator reheater vessels with two stages of reheat and four pass tube bundles. MSR moisture separation and tube bundles should be designed to optimize the turbine steam cycle to achieve the best performance within the existing envelope. Existing vessel supports, nozzle configuration and piping should be reused to the extent possible.

4.3.4 Turbine Design Requirements

The seller shall identify every interface between the new steam flow path and the existing equipment where mating to existing parts is a consideration. The seller shall also identify components that cannot be utilized with the replacement design and which therefore must be replaced. Options shall be considered and other components recommended for replacement based on optimization of performance, component life, reduced maintenance and other operational measures as defined elsewhere in this Specification, as well as cost considerations.

All Equipment shall be designed for a minimum of 40 years of service with a 10-year minimum inspection interval.

The seller should consider inspection ports for bore scope inspection technique.

The seller shall cite experience and analytic bases that demonstrate satisfactory performance and long-term reliability for 40 plus years of trouble-free service. Any equipment that does not meet the 40-year design life shall be explicitly detailed in the Bid Proposal.

Erosion resistant materials shall be used in all areas susceptible to erosion, including turbine blading and nozzles. Moisture removal provisions and / or protective shields shall also be utilized where appropriate. Any blade coatings utilized in the wet steam of the LP turbine shall have demonstrated proven experience under conditions similar to those encountered in the CR3 turbine. Provisions shall be incorporated into the turbine design to minimize erosion of the HP turbine nozzle and the LP turbine inner casing. Specific features addressing this requirement shall be identified by seller.

To limit the overall probability that a turbine missile event will occur and cause unacceptable damage, turbine missiles shall be considered in the design of the turbine and turbine control system. seller shall provide a missile analysis report.

Lateral and torsional natural frequencies shall not coincide with harmonics of operating speeds, test speeds, and line frequency. Adequate damping shall be provided in the overall turbine generator design to minimize peaking at critical speeds. The seller shall provide the following information to the Buyer to address site specific characteristics:

a. Minimum separation of the lateral natural frequencies (critical speeds) of the complete turbine-generator assembly from operating and test speeds (above and below).
b. Separation between torsional natural frequencies of the complete turbine-generator shaft and anticipated exciting line frequencies under normal operating conditions or under upsets (e.g., loss of load or loss of generation on the system).

The blade frequencies of tuned modes shall be verified by testing in accordance with seller's standard practice. The calculation of blade frequencies should include the effect of centrifugal forces, metal temperatures, root fixity factors, and blade grouping devices (i.e., covers, lashing lugs, etc.). The seller shall provide Campbell diagrams for each stage.

The rotor couplings shall be integral with the shaft and shall be compatible with existing components. The couplings shall withstand shocks during operation, including generator short circuit and synchronizing out of phase without exceeding the minimum yield stress of the coupling or bolting. The rotor design shall minimize stress concentrations.

The Seller shall describe the method of rotor fabrication including whether a center bore is included and the reasons for including or not including the center bore.

Turbine rotor and blade materials and fabrication techniques shall have proven high resistance to Stress Corrosion Cracking (SCC). Effects of material strength, heat treatment, temper embrittlement of low alloy steels, and sensitization of stainless steels shall be considered.

At the time of manufacture, rotors shall be dynamically balanced at rotational speeds from 0 to 120 percent of rated speed on the manufacturer's test stand. Shaft vibration during final field operational runs shall not exceed ISO Standard 7919 Part 2 limits and ISO Standard 10816 Part 2 for non-rotating parts.

The seller shall provide the owner with the total loading imposed on the foundations by the components supplied.

The replacement rotors shall be designed to maximize practical compatibility with existing journal and thrust bearings. New bearings, if required, should be designed with adequate lubrication from the existing turbine lubricating oil system. If the existing lubricating oil system is inadequate, the seller shall propose modifications to the existing system.

The design shall also maintain the current frequency of Overspeed Protection system testing, the quarterly Main Turbine Valve testing and the Main Turbine Valve disassembly / inspection frequency.

The seller shall provide all connections required to perform an ASME Performance Test Code PTC 6, alternative test, on all seller's furnished equipment and piping. Seller is not responsible for PTC 6 connections in the owner's supplied piping.

4.3.5 Generator Design Requirements

It is expected that the most cost affective options are provided with the bid proposal for buyer consideration.

Generator design is an alternate synchronous speed rated according with the requirements of this specification and driven by the turbine described herein. The upgraded generator shall be of non salient pole design, with the existing cylindrical rotor and revolving field.

The seller shall identify every interface between the new rewind generator and the existing system/equipment. Components that cannot be utilized with the new design and which therefore must be replaced are to be identified for buyer approval.

A design evaluation of the existing generator design is required to determine if the proposed generator uprate can be accomplished with the existing hydrogen inner cooled cooling system or optional stator water cooled system will be required. It is expected that since the recommended operational limits is exceeding those as defined by the present capability curve is likely to have an impact on generator active components and corresponding auxiliaries.

The contractor shall identify all interface between the new generator winding and rotor upgrade and the existing equipment such as hydrogen cooling system, exciter, voltage regulator where these subsystems can be utilized. Options shall consider components recommended for replacement based on optimization of performances, component life cycle status, reduced maintenance, as well as cost effectiveness.

The stator and rotor insulation shall be of Class F per IEEE C50.13 with Class B temperature rise in accordance with this specification.

Evaluation shall be required to determine if the following replacement or refurbishment are warranted,

Generator retaining ring,
Generator main leads and High voltage bushings.
Hydrogen coolers with its control and supply system (Required design pressure)
Rotor collector rings,
Rotor field windings,
Current transformers,
Rotating Exciter and exciter field control (including cooling system)
Rotor coils end turns
Rotor retaining leads.
Generator surge protection and RF monitoring,

All temperature sensors shall be wired to the existing terminal blocks according to the existing layout, with similar number of sensors. Any recommendation for upgrading temperature sensors design/layout requires buyer approval.

Generator rewinding evaluation shall include an analysis of the existing grounding system. If the existing design and grounding condition can not be utilized a new grounding system shall be recommended for buyer approval.

If the seller recommends new generator retaining rings, the non magnetic material shall be 18Mn-18Cr type material.

An optional stator cooling system shall be considered if additional generator output power could be gained and analysis could show improvements in the generator performance.

In the bid proposal, the contractor shall cite experience and analytic bases that demonstrate satisfactory performance and long-term reliability for 40 plus years of trouble free services for the generator/subsystems. Any components that does not meet the 40 years expected design life shall be explicitly detailed in the bid proposal.

On site torsional vibration testing for the new upgraded turbine generator should be included if analysis deems necessary.

4.3.6 MSR Design Requirements

The MSRs shall be designed, fabricated, inspected and tested in accordance with HEI Standards for Power Plant Heat Exchangers and ASME Section VIII, Division 1. MSRs and drain tanks shall be certified to ASME Section VIII and shall be Code symbol stamped. The MSR shall be designed in accordance with Electric Power Research Institute (EPRI) NP-3692 "Procurement and Operation Considerations for Moisture Separator Reheaters".

Moisture separator reheater tube material shall be type 439 stainless steel. Tube-to-tubesheet joint shall be rolled and welded.

Seller shall specify MSR overpressure protection requirements in accordance with the requirements of ASME Section VIII. Relief valves shall be specified for overpressure protection on the Seller's piping or equipment in accordance with ASME Code requirements.

Minimum plate thickness for baffles and support plates shall be in accordance with HEI Standards for Power Plant Heat Exchangers. Bidder shall describe the minimum plate thickness for baffles and support plates in the proposal and provide evidence of acceptable experience thereof.

5.0 MATERIAL REQUIREMENTS

5.1 Materials

5.1.1 The seller shall specify materials selected for manufacture of the Equipment. The seller shall justify these materials for their respective applications as part of the Bid Proposal. The seller shall utilize materials that are resistant to stress corrosion cracking and erosion for use in the manufacture of the equipment.

5.1.2 The seller shall provide the proposed materials list, which shall designate the equipment material selection (i.e., ASTM designation, any supplements or equivalents), chemical composition and physical properties. Materials and equipment as determined by the seller and subject to the approval of buyer.

5.1.3 Materials used in the manufacture of the stationary parts, and the rotor and blades shall be consistent with current technology so as to provide the maximum amount of service under the specified service conditions.

5.1.4 The use of asbestos materials or materials containing asbestos shall not be permitted. The use of mercury or material containing mercury shall not be permitted. All nonmetallic materials in Supplier furnished piping systems shall be noted to the Engineer for review and comment.

5.1.5 Steam path components shall not be made of copper or copper based alloys such as bronze or brass. Steam path components shall not contain lead.

5.1.6 The seller shall identify, as a part of his bid, any parts with cobalt.

5.1.7 Turbine steam path structural materials shall have satisfactory proven experience with the main steam chemistry requirements specified herein.

5.2 Moisture Erosion Protection

5.2.1 Moisture erosion protection is required in all areas subject to erosion. The location and type of moisture erosion protection shall be identified and described. Where cladding is used, the type and extent of such cladding and its purpose shall be described. Where shot peening is used, the extent of such shot peening and its purpose shall be described. Where hard surfacing, such as flame hardening, induction hardening or material inserts is used, the extent of such hard surfacing and its purpose shall be described.

5.2.2 This moisture protection could include but not be limited to:

a. The leading edge of the high moisture stages free standing rotating blade rows.
b. The water removal provisions at every steam extraction location.
c. The horizontal and vertical joints and sealing surfaces of every stationary part where steam leakage can occur.
d. Other areas subject to moisture erosion such as casing surfaces, extraction nozzle connections and rotor sealing surfaces.

5.3 Piping

5.3.1 All piping furnished by the seller shall be provided in ASME standard sizes in nominal English units (inch sizes) at all buyer/seller terminal points. All weld end preparations, socket weld couplings, threaded connections (mechanical and electrical), flange sizes and ratings, at Buyer/Supplier terminal points shall comply with ASME standards in English units.

5.3.2 Seller's field erected piping shall be designed, fabricated, tested and inspected to ASME B31.1. Materials shall resist erosion/corrosion. A minimum corrosion allowance of 1/16" shall be provided for all carbon steel piping. The routing of the piping shall minimize the effects of erosion/corrosion.

6.0 INSPECTION AND TESTING

6.1 General

6.1.1 All of the castings and forgings used in the construction of this unit shall be of high quality and have the necessary casting processing, radiographic testing, magnetic particle inspections, and sonic testing performed that are outlined in the currently applicable ASTM specifications, or their equivalent.

6.1.2 All piping furnished by the seller shall be tested in accordance with ASME B31.1.

6.1.3 Safety relief valves shall be tested in accordance with ASME Code Section VIII.

6.1.4 All heat exchangers, tanks and pressure vessels, except the turbine casings, main steam piping and valves, reheat piping and valves, and the generator coolers, shall be hydrostatically tested in accordance with ASME Section VIII, shall be Code stamped and registered with the National Board. ASME Code Data Forms shall be submitted.

6.1.5 Shaft vibration during final field operational runs shall not exceed ISO Standard 7919 Part 2 limits and ISO Standard 10816 Part 2 for non-rotating parts.

6.1.6 Certified material test reports (CMTR) shall be provided by seller in accordance with the referenced codes and standards; for large cast steel components; for shafts for equipment over 100 HP; for heat exchanger heads, shell, tubesheets and tubes; for tank shells; for steam piping, valves and piping components; and for stainless steel piping, valves and components.

6.1.7 As a minimum for hardware, all materials, components, and welds shall be 100% visually inspected. The inspections shall be documented, performed by qualified inspectors, and performed before painting of the item. Acceptance shall be based upon the workmanship and inspection requirements in the codes and standards, such as ASTM, to which the item is made.

6.1.8 The contract price shall include all tests and inspections normally conducted by manufacturers, subcontractors, and material suppliers and all other tests and inspections which may be so specified herein.

6.1.9 Seller's weld testing procedures shall be defined in the Quality Procedures and shall satisfy applicable codes and standards. The weld testing program shall be administered by a welding inspector certified in compliance with the American Welding Society (AWS) or Engineer approved equal.

6.1.10 Seller shall conduct shop tests of the work as required to comply with applicable codes, to determine acceptability of workmanship and as specified including, but not limited to, the following:

a. Pressure testing or NDE of piping systems, pressure vessels and related equipment.
b. Testing of welded joints in accordance with applicable requirements.

6.2 Shop and Field Tests

6.2.1 Major rotating parts shall have chemical and physical analysis. Charpy impact tests and fracture appearance transition temperature (FATT) tests are required for turbine wheels and rotor materials.

6.2.2 Mechanical inspection for rotor shaft and body including: material chemical and physical properties tests, UT tests, magnetic particle and UT of bore (if applicable), and surface finish tests of slots.

6.2.3 The rotor and buckets shall be magnafluxed in accordance with Supplier's inspection and test plan.

6.2.4 The high pressure turbine casing shall be either hydrostatically tested or equivalent non-destructive examination (NDE).

6.2.5 Turbine Performance Acceptance Test

Turbine acceptance tests will be performed in accordance with the requirements of the latest edition of ASME Performance Test Code PTC-6 alternative test to determine the performance of the replacement turbine generator. Tests will be performed for Phase 1 and Phase 2 of the extended power uprate project. The performance test will be prepared and conducted by the Buyer. The Seller shall provide technical direction, assistance and witnessing of the acceptance test.

The buyer and seller will jointly determine the technical aspects of the acceptance tests with mutually agreed test methodology, procedures, and plans. The seller shall provide technical direction, assistance and witnessing of the acceptance tests. The owner prefers acceptance testing based on the "alternative" test as defined in PTC-6. The seller shall submit with the bid documentation, acceptable test methodologies for owner review including a recommendation based on the alternative test.

Primary flow will be measured using the owners installed Caldon Check Plus LEFM installed in the final feedwater section.

The unit will be considered accepted when the unit meets the guaranteed heat rate and output in accordance with the Contract.

6.2.6 Turbine and Generator rotor bore shall have UT bore inspection if applicable.

6.2.7 Rotors shall balanced and overspeed tested at not less than 120 percent of rated speed. Generator rotor shall be excited at rated speed to verify no winding shorts.

6.2.8 Measurement of cold resistance of stator and rotor windings.

6.2.9 Insulation resistance measurements.

6.2.10 Stator and Rotor dielectric test.

6.2.11 Generator rotor leakage test.

6.2.12 Exciter measurement of output voltage and output voltage adjustable range.

7.0 FABRICATION REQUIREMENTS

7.1 The seller is required to provide for approval at the owners discretion procedures, plans, and sequences of operation that will be utilized in manufacturing the equipment. The areas of manufacturing and fabrication that may be reviewed and require the owner's approval are forging, casting, machining, mechanical assembly, welding, weld repair, heat treatment, induction hardening, cleaning, nondestructive examination, testing, preparation for shipping (packaging) and shipping. The owner shall retain the right to include additional manufacturing and fabrication operation procedural review and approval after the initial review has been completed.

7.2 The buyer shall review and approve subcontractors to be used by the seller.

8.0 INSTALLATION REQUIREMENTS

8.1 The seller shall provide support of plant modification and planning packages that shall include, but not be limited to, installation drawings, installation instructions, welding information, bill of materials, etc.

8.2 The Seller shall provide instructions for balancing the equipment following the installation.

8.3 The Seller shall identify all lubricants and chemicals required for installation.

9.0 SHIPMENT

9.1 Preparation and Packaging for Shipment

9.1.1 Preparation and packaging for shipment shall be the responsibility of the seller.

9.1.2 All equipment shall be prepared for shipment in such a manner that quality and cleanliness will be maintained during shipment and prolonged storage prior to erection. Equipment and all components shall be adequately protected against damage during shipment.

9.1.3 All items subject to corrosion shall be suitably protected.

9.1.4 The seller shall identify all desiccants and inhibitors used for preservation during shipment and storage and their required replacement frequency.

9.1.5 Shipping expendable materials in contact with austenitic stainless steel or nickel alloys shall not contribute to corrosion during packaging, shipping or storage. Objectionable chemicals within the expendable materials are lead, mercury, chloride, fluoride, sulfur, copper and zinc. The seller shall submit an MSDS for each preservative chemical or material used to the purchaser.

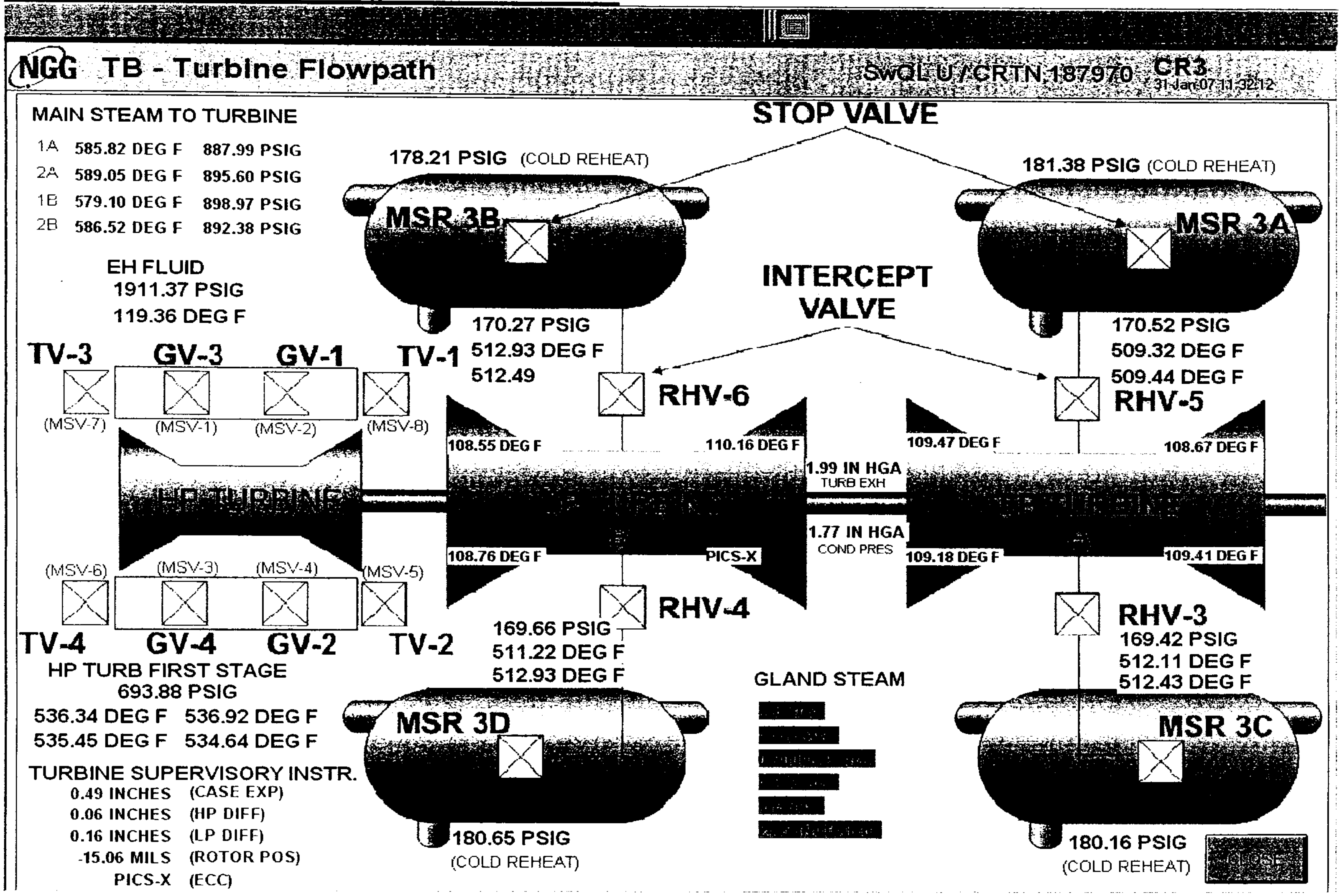
9.1.6 The center of gravity and/or lifting points for large and heavy equipment shall be identified.

9.2 Shipping Requirements

9.2.1 Shipping to the job site shall be the responsibility of the seller. Any special storage requirements shall be included with each shipment to which they are applicable.

9.2.2 Seller shall notify and/or indicate when component requires special considerations during shipment and shall take appropriate measures necessary during shipping and/or storage to prevent damage and/or deterioration of equipment and components.

CR3 Turbine Generator Operating Data from 01/31/2007



PEF-NCR-03071

CR3 REPLACEMENT TURBINE GENERATOR BID SPECIFICATION
Attachment 10.1

CR3 Turbine Generator Operating Data from 01/31/2007

CR3 Turbine Generator Computer Point data 01/31/2007		
E101	EXCITER FIELD BREAKER	CLOS
E102	VOLTAGE REG BASE ADJUST HIGH	NO
E103	VOLTAGE REG BASE ADJUST LOW	NO
E104	VOLTAGE REG VOLTAGE ADJUST HIGH	NO
E105	VOLTAGE REG VOLTAGE ADJUST LOW	NO
E106	VOLTAGE REG IN TEST	NO
E107	VOLTAGE REG IN RUN	YES
E108	VOLTAGE REG CONTROL SW ON COMP	NO
E202	UNIT 3 GENERATION (MW)	867.19 MWe
E203	UNIT 3 STATOR VOLTAGE (KV)	20.8862 kV
E204	UNIT 3 STATOR CURRENT (KILOAMPS)	24.3586 kA
E210	GENERATED MW TO ICS (MWT-1)	890.38 Mw
E211	GENERATED MW TO ICS (MWT-2)	897.71 Mw
E212	VOLTAGE REGULATOR BALANCE (VOLT)	0.0292969 Volts
G001	GEN BRG OIL DRAIN TNK VAPOR PRES	OK
G002	SEAL OIL DEFOAMING TANK LEVEL	OK
G003	AIR SIDE SEAL OIL PUMP	RUN
G004	AIR SIDE SEAL OIL PRESS	OK
G005	HYDROGEN SIDE SEAL OIL LEVEL	OK
G006	BACK UP SEAL OIL PUMP PRESS	OK
G007	HYDROGEN SIDE SEAL OIL PUMP	RUN
G008	AIR SIDE SEAL OIL BACK UP PUMP	OFF
G009	GENERATOR HYDROGEN SUPPLY PRESS	OK
G010	GEN CASING WATER DETECTOR	OK
G200	GENERATOR HYDROGEN PRESS	59.595 psig
G201	GENERATOR HYDROGEN PURITY (%)	98.047 %
G202	GENERATOR BEARING NO 7 MTL TEMP	165.768 Deg F
G203	GENERATOR BEARING NO 7 MTL TEMP	165.276 Deg F
G204	GENERATOR BEARING NO 8 MTL TEMP	152.631 Deg F
G205	GENERATOR BEARING NO 8 MTL TEMP	152.960 Deg F
G206	EXCITER BEARING NO 9 METAL TEMP	150.490 Deg F
G207	EXCITER BEARING NO 9 METAL TEMP	150.468 Deg F
G208	GEN BEARING NO 7 VIBR (MILS)	1.34766 mils
G209	GEN BEARING NO 8 VIBR (MILS)	2.44629 mils
G210	EXCITER BEARING NO 9 VIBR (MILS)	1.86035 mils
G211	H2 COOLER GAS INLET TEMP (C)	61.724 Deg C
G212	H2 COOLER A GAS OUTLET TEMP (C)	39.492 Deg C
G213	H2 COOLER B GAS OUTLET TEMP (C)	41.186 Deg C
G214	H2 COOLER C GAS OUTLET TEMP (C)	39.656 Deg C
G215	H2 COOLER D GAS OUTLET TEMP (C)	xxxxxx Deg C
G216	STATOR COIL DIS GAS TMP, RTD 1A	72.048 Deg C
G217	STATOR COIL DIS GAS TMP, RTD 2A	70.573 Deg C
G218	STATOR COIL DIS GAS TMP, RTD 3A	69.644 Deg C
G219	AVERAGE COLD GAS TEMPERATURE	41.022 Deg C
G222	RECTIFIER WHEEL COLD AIR TEMP(C)	25.830 Deg C
G223	AC EXCITER COLD AIR TEMP(C)	25.586 Deg C
G224	RECTIFIER WHEEL WARM AIR TEMP(C)	37.109 Deg C
G225	AC EXCITER WARM AIR TEMP(C)	40.186 Deg C
G228	STA SER XFMR TOP OIL TEMP(DEG C)	65.36 Deg C
G229	SU TRANS 4160V WIND TEMP (DEG C)	40.86 Deg C
G230	SU TRANS 6900V WIND TEMP (DEG C)	42.80 Deg C
G231	STARTUP TRNS TOP OIL TEMP(DEG C)	41.21 Deg C
G250	GENERATOR CONDITION MONITOR HIGH	79.431 %

CR3 REPLACEMENT TURBINE GENERATOR BID SPECIFICATION
Attachment 10.1

CR3 Turbine Generator Operating Data from 01/31/2007

CR3 Turbine Generator Computer Point data 01/31/2007		
T200	NO.6 EXTR HP TURB PRESS	474.285 psig
T201	NO.5 EXTR HP TURB PRESS	183.826 psig
T202	NO.4B EXTR LP TURB PRESS (PSIA)	75.3330 psia
T203	NO.3B EXTR LP TURB PRESS (PSIA)	42.4754 psia
T204	NO.2B EXTR LP TURB PRESS (PSIA)	16.2701 psia
T205	NO.1B EXTR LP TURB PRESS (PSIA)	6.2611 psia
T206	REHEATER D TO LP TURB B PRESS	170.272 psig
T207	REHEATER B TO LP TURB B PRESS	168.929 psig
T208	REHEATER C TO LP TURB A PRESS	169.051 psig
T210	NO.4A EXTR LP TURB PRESS (PSIA)	79.6801 psia
T211	NO.3A EXTR LP TURB PRESS (PSIA)	43.2386 psia
T212	NO.2A EXTR LP TURB PRESS (PSIA)	16.3312 psia
T213	NO.1A EXTR LP TURB PRESS (PSIA)	6.7373 psia
T214	LP TURBINE EXHAUST PRESS(IN-HGA)	2.04102 In HgA
T215	CONDENSER PRESS	1.69484 In HgA
T219	EH FLUID PRESS	1920.53 psig
T220	*STEAM SEAL SUPPLY DP	1.90801 In Wc
T221	LP TURB B EXHAUST HOOD TEMP	108.905 Deg F
T222	LP TURB B EXHAUST HOOD TEMP	110.435 Deg F
T223	LP TURB B EXHAUST HOOD TEMP	108.259 Deg F
T224	LP TURB B EXHAUST HOOD TEMP	108.259 Deg F
T226	HP TURB FIRST STAGE PRESS	696.32 psig
T227	2A Main Steam to Turb Temp	585.547 Deg F
T228	2A MAIN STEAM TO TURB PRESS	896.19 psig
T229	1A Main Steam to Turb Temp	589.289 Deg F
T230	1A MAIN STEAM TO TURB PRESS	891.80 psig
T231	1B MAIN STEAM TO TURB TEMP	578.833 Deg F
T232	1B MAIN STEAM TO TURB PRESS	900.00 psig
T233	2B MAIN STEAM TO TURB TEMP	586.872 Deg F
T234	2B MAIN STEAM TO TURB PRESS	894.58 psig
T239	TURBINE CASING EXPANSION	0.49 Inches
T240	LUBE OIL COOLER OIL INLET TEMP	143.903 Deg F
T241	LUBE OIL COOLER OIL INLET TEMP	145.883 Deg F
T242	BEARING OIL PRESS	17.9274 psig
T243	ROTOR ECCENTRICITY (MILS)	xxxxxx mils
T244	TURB DIFF EXPAN GEN END	0.15 Inches
T245	TURBINE VALVE POS (%)LOAD CTRL	176.613 %
T246	EH FLUID TEMP	118.855 Deg F
T249	TURBINE SPEED (RPM)	1799.56 RPM
T250	STEAM SEAL HEADER TEMP	257.790 Deg F
T251	STEAM SEAL HEADER PRESS	125.092 psig
T252	NORTH STEAM CHEST DEEP METL TEMP	576.758 Deg F
T253	NORTH STEAM CHEST DEEP METL TEMP	577.711 Deg F
T254	NORTH STEAM CHEST SHAL METL TEMP	508.849 Deg F
T255	NORTH STEAM CHEST SHAL METL TEMP	508.532 Deg F
T256	SOUTH STEAM CHEST DEEP METL TEMP	570.721 Deg F
T257	SOUTH STEAM CHEST DEEP METL TEMP	572.309 Deg F
T258	SOUTH STEAM CHEST SHAL METL TEMP	539.925 Deg F
T259	SOUTH STEAM CHEST SHAL METL TEMP	541.195 Deg F
T260	HP TURB BASE GOV END EXTR TEMP	472.422 Deg F
T261	HP TURB BASE GOV END EXTR TEMP	473.578 Deg F
T264	HP TURB COVER GOV END EXTR TEMP	469.779 Deg F

CR3 REPLACEMENT TURBINE GENERATOR BID SPECIFICATION
Attachment 10.1

CR3 Turbine Generator Operating Data from 01/31/2007

T265	HP TURB COVER GOV END EXTR TEMP	469.779 Deg F
T266	LP TURB A EXHAUST HOOD TEMP	109.221 Deg F

CR3 Turbine Generator Computer Point data 01/31/2007

T267	LP TURB A EXHAUST HOOD TEMP	109.556 Deg F
T268	LP TURB A EXHAUST HOOD TEMP	109.054 Deg F
T269	LP TURB A EXHAUST HOOD TEMP	109.723 Deg F
T270	HP TURB FIRST STAGE STEAM TEMP	536.959 Deg F
T271	HP TURB FIRST STAGE STEAM TEMP	537.277 Deg F
T272	HP TURB FIRST STAGE METAL TEMP	535.373 Deg F
T273	HP TURB FIRST STAGE METAL TEMP	535.373 Deg F
T274	HP TURB BASE MID METAL TEMP	528.712 Deg F
T275	HP TURB BASE MID METAL TEMP	527.443 Deg F
T276	HP TURB COVER MID METAL TEMP	540.449 Deg F
T277	HP TURB COVER MID METAL TEMP	539.498 Deg F
T282	LP TURB A FROM REHEATER A TEMP	509.322 Deg F
T283	LP TURB A FROM REHEATER A TEMP	509.956 Deg F
T284	LP TURB A FROM REHEATER C TEMP	511.224 Deg F
T285	LP TURB A FROM REHEATER C TEMP	511.858 Deg F
T286	LP TURB B FROM REHEATER B TEMP	512.809 Deg F
T287	LP TURB B FROM REHEATER B TEMP	512.492 Deg F
T288	LP TURB B FROM REHEATER D TEMP	511.858 Deg F
T289	LP TURB B FROM REHEATER D TEMP	512.809 Deg F
T290	THRUST BRG FRONT FLANGE MTL TEMP	152.966 Deg F
T291	THRUST BRG FRONT FLANGE MTL TEMP	xxxxxx Deg F
T292	THRUST BRG FRONT FLANGE MTL TEMP	153.130 Deg F
T293	THRUST BRG FRONT FLANGE MTL TEMP	xxxxxx Deg F
T294	THRUST BRG REAR FLANGE MTL TEMP	xxxxxx Deg F
T295	THRUST BRG REAR FLANGE MTL TEMP	148.025 Deg F
T296	THRUST BRG REAR FLANGE MTL TEMP	146.211 Deg F
T297	THRUST BRG REAR FLANGE MTL TEMP	148.519 Deg F
T298	HP TURB BEARING NO 1 METAL TEMP	158.720 Deg F
T299	HP TURB BEARING NO 1 METAL TEMP	158.391 Deg F
T300	HP TURB BEARING NO 2 METAL TEMP	161.182 Deg F
T301	HP TURB BEARING NO 2 METAL TEMP	162.450 Deg F
T302	LP TURB BEARING NO 3 METAL TEMP	173.421 Deg F
T303	LP TURB BEARING NO 3 METAL TEMP	173.585 Deg F
T304	LP TURB BEARING NO 4 METAL TEMP	173.911 Deg F
T305	LP TURB BEARING NO 4 METAL TEMP	173.094 Deg F
T306	LP TURB BEARING NO 5 METAL TEMP	186.961 Deg F
T307	LP TURB BEARING NO 5 METAL TEMP	186.636 Deg F
T308	LP TURB BEARING NO 6 METAL TEMP	166.548 Deg F
T309	LP TURB BEARING NO 6 METAL TEMP	166.712 Deg F
T310	LUBE OIL COOLER OIL OUTLET TEMP	118.241 Deg F
T311	LUBE OIL COOLER OIL OUTLET TEMP	118.908 Deg F
T312	HP TURB BEARING NO 1 VIBR (MILS)	0.712891 mils
T313	HP TURB BEARING NO 2 VIBR (MILS)	0.273438 mils
T314	LP TURB BEARING NO 3 VIBR (MILS)	1.22559 mils
T315	LP TURB BEARING NO 4 VIBR (MILS)	1.49414 mils
T316	LP TURB BEARING NO 5 VIBR (MILS)	0.639648 mils
T317	LP TURB BEARING NO 6 VIBR (MILS)	1.59180 mils
T322	ROTOR POSITION (MILS)	-14.575 mils
T323	TURB DIFF EXPAN GOV END	0.06 Inches

TG Case 1 - 2609 MWt, 0% TP, Tstm = 595F

103.04	DEG F	TT	(-123)	Condenser 'B' Hotwell Temperature
75.00	DEG F	TT	(307)	Condenser 'B' CW Temp C In
75.00	DEG F	TT	(309)	Condenser 'B' CW Temp D In
92.01	DEG F	TT	(204)	Condenser 'B' CW Temp Out
4033211.0	LBM/HR	WW	(237)	Condensate Pmp 1A Suction Flow
1.05	PSIA	PP	(237)	Condensate Pmp 1A Suction Pressure
103.25	DEG F	TT	(237)	Condensate Pmp 1A Suction Temp
71.24	BTU/LBM	HH	(237)	Condensate Pmp 1A Suction Enthalpy
0.0000	NO-UNITS	XX	(237)	Condensate Pmp 1A Suction Quality
260.00	PSIA	PP	(72)	Condensate Pmp 1A Discharge Pressure
103.50	DEG F	TT	(72)	Condensate Pmp 1A Discharge Temp
72.15	BTU/LBM	HH	(72)	Condensate Pmp 1A Discharge Enthalpy
-0.3746	NO-UNITS	XX	(72)	Condensate Pmp 1A Discharge Quality
4025408.1	LBM/HR	WW	(229)	Condensate Pmp 1B Suction Flow
1.04	PSIA	PP	(229)	Condensate Pmp 1B Suction Pressure
103.04	DEG F	TT	(229)	Condensate Pmp 1B Suction Temp
71.03	BTU/LBM	HH	(229)	Condensate Pmp 1B Suction Enthalpy
0.0000	NO-UNITS	XX	(229)	Condensate Pmp 1B Suction Quality
260.00	PSIA	PP	(401)	Condensate Pmp 1B Discharge Pressure
103.29	DEG F	TT	(401)	Condensate Pmp 1B Discharge Temp
71.94	BTU/LBM	HH	(401)	Condensate Pmp 1B Discharge Enthalpy
-0.3748	NO-UNITS	XX	(401)	Condensate Pmp 1B Discharge Quality
260.00	PSIA	PP	(79)	Gland Steam Condenser Inlet Press
103.39	DEG F	TT	(79)	Gland Steam Condenser Inlet Temp
72.05	BTU/LBM	HH	(79)	Gland Steam Condenser Inlet Enth
260.00	PSIA	PP	(80)	Gland Steam Condenser Outlet Press
104.42	DEG F	TT	(80)	Gland Steam Condenser Outlet Temp
73.07	BTU/LBM	HH	(80)	Gland Steam Condenser Outlet Enth
8058619.1	LBM/HR	WW	(79)	Gland Steam Condenser Flow
197.65	PSIA	PP	(922)	Gland Steam Condenser Stm Inlet Press
392.56	DEG F	TT	(922)	Gland Steam Condenser Stm Inlet Temp
1205.81	BTU/LBM	HH	(922)	Gland Steam Condenser Stm Inlet Enth
14.50	PSIA	PP	(216)	Gland Steam Condenser Stm Outlet Press
211.32	DEG F	TT	(216)	Gland Steam Condenser Stm Outlet Temp
179.48	BTU/LBM	HH	(216)	Gland Steam Condenser Stm Outlet Enth
8000.0	LBM/HR	WW	(922)	Gland Steam Condenser Stm Flow
0.0	LBM/HR	WW	(741)	LP Heater (CDHE) Bypass Flow
4029309.5	LBM/HR	WW	(87)	CDHE 1A Flow
260.00	PSIA	PP	(87)	CDHE 1A Pressure (In)
73.07	BTU/LBM	HH	(87)	CDHE 1A Enthalpy (In)
104.42	DEG F	TT	(87)	CDHE 1A Temperature (In)
247.05	PSIA	PP	(88)	CDHE 1A Pres to 2A
140.24	BTU/LBM	HH	(88)	CDHE 1A Enth to 2A
171.70	DEG F	TT	(88)	CDHE 1A Temp to 2A
280403.1	LBM/HR	WW	(840)	CDHE 1A Extr Flow (In)
7.12	PSIA	PP	(840)	CDHE 1A Extr Pres (In)
947.20	BTU/LBM	HH	(840)	CDHE 1A Extr Enth (In)
177.58	DEG F	TT	(840)	CDHE 1A Extr Temp (In)
0.8084	NO-UNITS	XX	(840)	CDHE 1A Extr Qual (In)
421940.5	LBM/HR	WW	(340)	CDHE 1A Drain Flow (In)
16.25	PSIA	PP	(340)	CDHE 1A Drain Pres (In)
150.55	BTU/LBM	HH	(340)	CDHE 1A Drain Enth (In)
182.52	DEG F	TT	(340)	CDHE 1A Drain Temp (In)
-0.0360	NO-UNITS	XX	(340)	CDHE 1A Drain Qual (In)
702348.5	LBM/HR	WW	(129)	CDHE 1A Drain Flow (Out)
4.04	PSIA	PP	(129)	CDHE 1A Drain Pres (Out)
83.22	BTU/LBM	HH	(129)	CDHE 1A Drain Enth (Out)
115.25	DEG F	TT	(129)	CDHE 1A Drain Temp (Out)
-0.0379	NO-UNITS	XX	(129)	CDHE 1A Drain Qual (Out)
230.72	PSIA	PP	(89)	CDHE 2A Pres to 3A
185.05	BTU/LBM	HH	(89)	CDHE 2A Enth to 3A
216.37	DEG F	TT	(89)	CDHE 2A Temp to 3A
196431.8	LBM/HR	WW	(820)	CDHE 2A Extr Flow (In)
17.83	PSIA	PP	(820)	CDHE 2A Extr Pres (In)
1016.61	BTU/LBM	HH	(820)	CDHE 2A Extr Enth (In)
221.92	DEG F	TT	(820)	CDHE 2A Extr Temp (In)
0.8573	NO-UNITS	XX	(820)	CDHE 2A Extr Qual (In)
225507.9	LBM/HR	WW	(320)	CDHE 2A Drain Flow (In)
39.73	PSIA	PP	(320)	CDHE 2A Drain Pres (In)

196.63	BTU/LBM	HH	(320)	CDHE 2A Drain Enth (In)
228.28	DEG F	TT	(320)	CDHE 2A Drain Temp (In)
-0.0419	NO-UNITS	XX	(320)	CDHE 2A Drain Qual (In)
421940.5	LBM/HR	WW	(127)	CDHE 2A Drain Flow (Out)
16.25	PSIA	PP	(127)	CDHE 2A Drain Pres (Out)
150.55	BTU/LBM	HH	(127)	CDHE 2A Drain Enth (Out)
182.52	DEG F	TT	(127)	CDHE 2A Drain Temp (Out)
-0.0360	NO-UNITS	XX	(127)	CDHE 2A Drain Qual (Out)
213.61	PSIA	PP	(90)	CDHE 3A Flow (Out)
239.48	BTU/LBM	HH	(90)	CDHE 3A Enth (Out)
270.18	DEG F	TT	(90)	CDHE 3A Temp (Out)
225495.6	LBM/HR	WW	(570)	CDHE 3A Extr Flow (In)
43.29	PSIA	PP	(570)	CDHE 3A Extr Pres (In)
1169.20	BTU/LBM	HH	(570)	CDHE 3A Extr Enth (In)
272.06	DEG F	TT	(570)	CDHE 3A Extr Temp (In)
0.9977	NO-UNITS	XX	(570)	CDHE 3A Extr Qual (In)
225507.9	LBM/HR	WW	(126)	CDHE 3A Drain Flow (Out)
39.73	PSIA	PP	(126)	CDHE 3A Drain Pres (Out)
196.63	BTU/LBM	HH	(126)	CDHE 3A Drain Enth (Out)
228.28	DEG F	TT	(126)	CDHE 3A Drain Temp (Out)
-0.0419	NO-UNITS	XX	(126)	CDHE 3A Drain Qual (Out)
4029309.5	LBM/HR	WW	(83)	CDHE 1B Flow (In)
260.00	PSIA	PP	(83)	CDHE 1B Pressure (In)
73.07	BTU/LBM	HH	(83)	CDHE 1B Enthalpy (In)
104.42	DEG F	TT	(83)	CDHE 1B Temperature (In)
247.05	PSIA	PP	(84)	CDHE 1B Pres to 2B
140.38	BTU/LBM	HH	(84)	CDHE 1B Enth to 2B
171.84	DEG F	TT	(84)	CDHE 1B Temp to 2B
281905.8	LBM/HR	WW	(183)	CDHE 1B Extr Flow (In)
7.14	PSIA	PP	(183)	CDHE 1B Extr Pres (In)
947.80	BTU/LBM	HH	(183)	CDHE 1B Extr Enth (In)
177.73	DEG F	TT	(183)	CDHE 1B Extr Temp (In)
0.8089	NO-UNITS	XX	(183)	CDHE 1B Extr Qual (In)
410565.4	LBM/HR	WW	(209)	CDHE 1B Drain Flow (In)
16.40	PSIA	PP	(209)	CDHE 1B Drain Pres (In)
149.55	BTU/LBM	HH	(209)	CDHE 1B Drain Enth (In)
181.53	DEG F	TT	(209)	CDHE 1B Drain Temp (In)
-0.0375	NO-UNITS	XX	(209)	CDHE 1B Drain Qual (In)
692476.6	LBM/HR	WW	(122)	CDHE 1B Drain Flow (Out)
4.14	PSIA	PP	(122)	CDHE 1B Drain Pres (Out)
82.86	BTU/LBM	HH	(122)	CDHE 1B Drain Enth (Out)
114.89	DEG F	TT	(122)	CDHE 1B Drain Temp (Out)
-0.0392	NO-UNITS	XX	(122)	CDHE 1B Drain Qual (Out)
230.72	PSIA	PP	(85)	CDHE 2B Pres to 3B
183.88	BTU/LBM	HH	(85)	CDHE 2B Enth to 3B
215.22	DEG F	TT	(85)	CDHE 2B Temp to 3B
190550.2	LBM/HR	WW	(182)	CDHE 2B Extr Flow (In)
17.90	PSIA	PP	(182)	CDHE 2B Extr Pres (In)
1013.81	BTU/LBM	HH	(182)	CDHE 2B Extr Enth (In)
222.11	DEG F	TT	(182)	CDHE 2B Extr Temp (In)
0.8543	NO-UNITS	XX	(182)	CDHE 2B Extr Qual (In)
220014.2	LBM/HR	WW	(208)	CDHE 2B Drain Flow (In)
39.97	PSIA	PP	(208)	CDHE 2B Drain Pres (In)
197.74	BTU/LBM	HH	(208)	CDHE 2B Drain Enth (In)
229.38	DEG F	TT	(208)	CDHE 2B Drain Temp (In)
-0.0411	NO-UNITS	XX	(208)	CDHE 2B Drain Qual (In)
410565.4	LBM/HR	WW	(116)	CDHE 2B Drain Flow (Out)
16.40	PSIA	PP	(116)	CDHE 2B Drain Pres (Out)
149.55	BTU/LBM	HH	(116)	CDHE 2B Drain Enth (Out)
181.53	DEG F	TT	(116)	CDHE 2B Drain Temp (Out)
-0.0375	NO-UNITS	XX	(116)	CDHE 2B Drain Qual (Out)
213.60	PSIA	PP	(86)	CDHE 3B Flow (Out)
236.93	BTU/LBM	HH	(86)	CDHE 3B Enth (Out)
267.69	DEG F	TT	(86)	CDHE 3B Temp (Out)
220002.8	LBM/HR	WW	(181)	CDHE 3B Extr Flow (In)
43.36	PSIA	PP	(181)	CDHE 3B Extr Pres (In)
1169.31	BTU/LBM	HH	(181)	CDHE 3B Extr Enth (In)
272.16	DEG F	TT	(181)	CDHE 3B Extr Temp (In)
0.9978	NO-UNITS	XX	(181)	CDHE 3B Extr Qual (In)
220014.2	LBM/HR	WW	(115)	CDHE 3B Drain Flow (Out)

39.97	PSIA	PP	(115)	CDHE 3B Drain Pres (Out)
197.74	BTU/LBM	HH	(115)	CDHE 3B Drain Enth (Out)
229.38	DEG F	TT	(115)	CDHE 3B Drain Temp (Out)
-0.0411	NO-UNITS	XX	(115)	CDHE 3B Drain Qual (Out)
8058619.1	LBM/HR	WW	(107)	Cond Flow to DeAerator FWHE-1
213.61	PSIA	PP	(107)	Cond Pres to DeAerator FWHE-1
238.21	BTU/LBM	HH	(107)	Cond Enth to DeAerator FWHE-1
268.93	DEG F	TT	(107)	Cond Temp to DeAerator FWHE-1
-0.1471	NO-UNITS	XX	(107)	Cond Qual to DeAerator FWHE-1
225141.9	LBM/HR	WW	(430)	Extr Flow to DeAerator FWHE-1
66.78	PSIA	PP	(430)	Extr Pres to DeAerator FWHE-1
1203.16	BTU/LBM	HH	(430)	Extr Enth to DeAerator FWHE-1
343.41	DEG F	TT	(430)	Extr Temp to DeAerator FWHE-1
1.0258	NO-UNITS	XX	(430)	Extr Qual to DeAerator FWHE-1
2727707.3	LBM/HR	WW	(114)	Drain Flow to DeAerator FWHE-1
182.89	PSIA	PP	(114)	Drain Pres to DeAerator FWHE-1
284.80	BTU/LBM	HH	(114)	Drain Enth to DeAerator FWHE-1
314.43	DEG F	TT	(114)	Drain Temp to DeAerator FWHE-1
-0.0739	NO-UNITS	XX	(114)	Drain Qual to DeAerator FWHE-1
11011491.0	LBM/HR	WW	(113)	Drain Flow out DeAerator FWHE-1
66.78	PSIA	PP	(113)	Drain Pres out DeAerator FWHE-1
269.48	BTU/LBM	HH	(113)	Drain Enth out DeAerator FWHE-1
299.77	DEG F	TT	(113)	Drain Temp out DeAerator FWHE-1
0.0000	NO-UNITS	XX	(113)	Drain Qual out DeAerator FWHE-1
5505745.5	LBM/HR	WW	(411)	FW Booster Pump 1A Suct Flow
66.78	PSIA	PP	(411)	FW Booster Pump 1A Suct Pres
330.00	PSIA	PP	(404)	FW Booster Pump 1A Disch Pres
300.08	DEG F	TT	(404)	FW Booster Pump 1A Disch Temp
270.28	BTU/LBM	HH	(404)	FW Booster Pump 1A Disch Enth
5505745.5	LBM/HR	WW	(412)	FW Booster Pump 1B Suct Flow
66.78	PSIA	PP	(412)	FW Booster Pump 1B Suct Pres
330.00	PSIA	PP	(403)	FW Booster Pump 1B Disch Pres
300.08	DEG F	TT	(403)	FW Booster Pump 1B Disch Temp
270.28	BTU/LBM	HH	(403)	FW Booster Pump 1B Disch Enth
0.0	LBM/HR	WW	(731)	FWHE-2A/2B Bypass Flow
5505745.5	LBM/HR	WW	(771)	FWHE-2A Flow (In)
330.00	PSIA	PP	(771)	FWHE-2A Pressure (In)
270.28	BTU/LBM	HH	(771)	FWHE-2A Enthalpy (In)
300.08	DEG F	TT	(771)	FWHE-2A Temperature (In)
322.03	PSIA	PP	(118)	FWHE-2A Pressure (Out)
348.50	BTU/LBM	HH	(118)	FWHE-2A Enthalpy (Out)
375.07	DEG F	TT	(118)	FWHE-2A Temperature (Out)
400497.9	LBM/HR	WW	(870)	FWHE-2A Extr Flow (In)
187.77	PSIA	PP	(870)	FWHE-2A Extr Pres (In)
1145.05	BTU/LBM	HH	(870)	FWHE-2A Extr Enth (In)
376.55	DEG F	TT	(870)	FWHE-2A Extr Temp (In)
0.9382	NO-UNITS	XX	(870)	FWHE-2A Extr Qual (In)
969522.2	LBM/HR	WW	(110)	FWHE-2A Drain Flow (In)
481.48	PSIA	PP	(110)	FWHE-2A Drain Pres (In)
376.01	BTU/LBM	HH	(110)	FWHE-2A Drain Enth (In)
400.60	DEG F	TT	(110)	FWHE-2A Drain Temp (In)
-0.0910	NO-UNITS	XX	(110)	FWHE-2A Drain Qual (In)
1370048.7	LBM/HR	WW	(236)	FWHE-2A Drain Flow (Out)
182.84	PSIA	PP	(236)	FWHE-2A Drain Pres (Out)
286.52	BTU/LBM	HH	(236)	FWHE-2A Drain Enth (Out)
316.09	DEG F	TT	(236)	FWHE-2A Drain Temp (Out)
-0.0718	NO-UNITS	XX	(236)	FWHE-2A Drain Qual (Out)
5505745.5	LBM/HR	WW	(770)	FWHE-2B Flow (In)
330.00	PSIA	PP	(770)	FWHE-2B Pressure (In)
270.28	BTU/LBM	HH	(770)	FWHE-2B Enthalpy (In)
300.08	DEG F	TT	(770)	FWHE-2B Temperature (In)
187.77	PSIA	PP	(165)	FWHE-2B Extr Pres (In)
1145.05	BTU/LBM	HH	(165)	FWHE-2B Extr Enth (In)
376.55	DEG F	TT	(165)	FWHE-2B Extr Temp (In)
0.9382	NO-UNITS	XX	(165)	FWHE-2B Extr Qual (In)
965801.1	LBM/HR	WW	(370)	FWHE-2B Drain Flow (In)
481.52	PSIA	PP	(370)	FWHE-2B Drain Pres (In)
374.21	BTU/LBM	HH	(370)	FWHE-2B Drain Enth (In)
398.94	DEG F	TT	(370)	FWHE-2B Drain Temp (In)
-0.0933	NO-UNITS	XX	(370)	FWHE-2B Drain Qual (In)

1357658.6	LBM/HR	WW	(108)	FWHE-2B Drain Flow (Out)
182.95	PSIA	PP	(108)	FWHE-2B Drain Pres (Out)
283.07	BTU/LBM	HH	(108)	FWHE-2B Drain Enth (Out)
312.76	DEG F	TT	(108)	FWHE-2B Drain Temp (Out)
-0.0760	NO-UNITS	XX	(108)	FWHE-2B Drain Qual (Out)
5505963.0	LBM/HR	WW	(790)	FWP 2A Suct Flow
330.00	PSIA	PP	(790)	FWP 2A Suct Pres
374.65	DEG F	TT	(790)	FWP 2A Suct Temp
348.06	BTU/LBM	HH	(790)	FWP 2A Suct Enth
-0.0696	NO-UNITS	XX	(790)	FWP 2A Suct Qual
1014.00	PSIA	PP	(101)	FWP 2A Disch Pres
376.12	DEG F	TT	(101)	FWP 2A Disch Temp
350.56	BTU/LBM	HH	(101)	FWP 2A Disch Enth
-0.2997	NO-UNITS	XX	(101)	FWP 2A Disch Qual
52547.3	LBM/HR	WW	(402)	FWPT A Steam Flow
183.26	PSIA	PP	(402)	FWPT A Steam Pressure
509.86	DEG F	TT	(402)	FWPT A Steam Temperature
1276.20	BTU/LBM	HH	(402)	FWPT A Steam Enthalpy
1.0931	NO-UNITS	XX	(402)	FWPT A Steam Quality
1.23	PSIA	PP	(198)	FWPT A Steam Exhaust Pres
108.70	DEG F	TT	(198)	FWPT A Steam Exhaust Temp
1014.24	BTU/LBM	HH	(198)	FWPT A Steam Exhaust Enth
0.9084	NO-UNITS	XX	(198)	FWPT A Steam Exhaust Qual
5505963.0	LBM/HR	WW	(791)	FWP 2B Suct Flow
330.00	PSIA	PP	(791)	FWP 2B Suct Pres
374.65	DEG F	TT	(791)	FWP 2B Suct Temp
348.06	BTU/LBM	HH	(791)	FWP 2B Suct Enth
-0.0696	NO-UNITS	XX	(791)	FWP 2B Suct Qual
1044.10	PSIA	PP	(405)	FWP 2B Disch Pres
376.08	DEG F	TT	(405)	FWP 2B Disch Temp
350.56	BTU/LBM	HH	(405)	FWP 2B Disch Enth
-0.3095	NO-UNITS	XX	(405)	FWP 2B Disch Qual
52547.3	LBM/HR	WW	(180)	FWPT B Steam Flow
183.26	PSIA	PP	(180)	FWPT B Steam Pressure
509.86	DEG F	TT	(180)	FWPT B Steam Temperature
1276.20	BTU/LBM	HH	(180)	FWPT B Steam Enthalpy
1.0931	NO-UNITS	XX	(180)	FWPT B Steam Quality
1.23	PSIA	PP	(197)	FWPT B Steam Exhaust Pres
108.70	DEG F	TT	(197)	FWPT B Steam Exhaust Temp
1014.24	BTU/LBM	HH	(197)	FWPT B Steam Exhaust Enth
0.9084	NO-UNITS	XX	(197)	FWPT B Steam Exhaust Qual
5505963.0	LBM/HR	WW	(800)	FWHE-3A Flow (In)
1014.00	PSIA	PP	(800)	FWHE-3A Pressure (In)
350.56	BTU/LBM	HH	(800)	FWHE-3A Enthalpy (In)
376.12	DEG F	TT	(800)	FWHE-3A Temperature (In)
1000.69	PSIA	PP	(120)	FWHE-3A Pressure (Out)
440.10	BTU/LBM	HH	(120)	FWHE-3A Enthalpy (Out)
458.54	DEG F	TT	(120)	FWHE-3A Temperature (Out)
535250.8	LBM/HR	WW	(860)	FWHE-3A Extr Flow (In)
484.57	PSIA	PP	(860)	FWHE-3A Extr Pres (In)
1210.58	BTU/LBM	HH	(860)	FWHE-3A Extr Enth (In)
470.82	DEG F	TT	(860)	FWHE-3A Extr Temp (In)
1.0077	NO-UNITS	XX	(860)	FWHE-3A Extr Qual (In)
234005.1	LBM/HR	WW	(109)	FWHE-3A Drain Flow (In)
862.61	PSIA	PP	(109)	FWHE-3A Drain Pres (In)
520.52	BTU/LBM	HH	(109)	FWHE-3A Drain Enth (In)
526.96	DEG F	TT	(109)	FWHE-3A Drain Temp (In)
0.0000	NO-UNITS	XX	(109)	FWHE-3A Drain Qual (In)
769287.7	LBM/HR	WW	(235)	FWHE-3A Drain Flow (Out)
481.48	PSIA	PP	(235)	FWHE-3A Drain Pres (Out)
359.81	BTU/LBM	HH	(235)	FWHE-3A Drain Enth (Out)
385.51	DEG F	TT	(235)	FWHE-3A Drain Temp (Out)
-0.1123	NO-UNITS	XX	(235)	FWHE-3A Drain Qual (Out)
5505963.0	LBM/HR	WW	(92)	FWHE-3B Flow (In)
1044.10	PSIA	PP	(92)	FWHE-3B Pressure (In)
350.56	BTU/LBM	HH	(92)	FWHE-3B Enthalpy (In)
376.08	DEG F	TT	(92)	FWHE-3B Temperature (In)
1030.79	PSIA	PP	(117)	FWHE-3B Pressure (Out)
439.85	BTU/LBM	HH	(117)	FWHE-3B Enthalpy (Out)
458.30	DEG F	TT	(117)	FWHE-3B Temperature (Out)

531530.1	LBM/HR	WW (159)	FWHE-3B Extr Flow (In)
484.57	PSIA	PP (159)	FWHE-3B Extr Pres (In)
1210.58	BTU/LBM	HH (159)	FWHE-3B Extr Enth (In)
470.82	DEG F	TT (159)	FWHE-3B Extr Temp (In)
1.0077	NO-UNITS	XX (159)	FWHE-3B Extr Qual (In)
234005.1	LBM/HR	WW (104)	FWHE-3B Drain Flow (In)
862.61	PSIA	PP (104)	FWHE-3B Drain Pres (In)
520.52	BTU/LBM	HH (104)	FWHE-3B Drain Enth (In)
526.96	DEG F	TT (104)	FWHE-3B Drain Temp (In)
0.0000	NO-UNITS	XX (104)	FWHE-3B Drain Qual (In)
765566.6	LBM/HR	WW (105)	FWHE-3B Drain Flow (Out)
481.52	PSIA	PP (105)	FWHE-3B Drain Pres (Out)
357.47	BTU/LBM	HH (105)	FWHE-3B Drain Enth (Out)
383.31	DEG F	TT (105)	FWHE-3B Drain Temp (Out)
-0.1154	NO-UNITS	XX (105)	FWHE-3B Drain Qual (Out)
915.26	MW	BKGRO (1)	GROSS GENERATION, MWe
11011926.03	LBM/HR	WW (103)	SG FEEDWATER FLOW, LBM/HR
10529959.76	LBM/HR	WW (9)	TURBINE THROTTLE FLOW, LBM/HR
2624.97	OPVB	OPVB (8)	PRI SIDE HEAT INPUT TO T/G, MWt
2608.97	OPVB	OPVB (9)	REACTOR CORE, MWt
1.02	OPVB	OPVB (10)	FRACTION FULL POWER
9786.50	OPVB	OPVB (12)	GROSS CYCLE HEAT RATE, BTU/KW-HR
9726.85	OPVB	OPVB (15)	GROSS REAC HEAT RATE, BTU/KW-HR
875.22	OPVB	OPVB (16)	NET GENERATOR POWER, MWE
2.13	OPVB	OPVB (101)	CONDENSER A PRESSURE, IN-HG
2.12	OPVB	OPVB (102)	CONDENSER B PRESSURE, IN-HG
0.82	NO-UNITS	EFFSEC(15)	LP TURBINE A EFFICIENCY (10-15)
0.82	NO-UNITS	EFFSEC(25)	LP TURBINE B EFFICIENCY (20-25)
24.10	DEL DEG F	TTDURH(203)	1ST STAGE REHEATER C TTD (203)
24.10	DEL DEG F	TTDURH(205)	1ST STAGE REHEATER B TTD (205)
24.10	DEL DEG F	TTDURH(207)	1ST STAGE REHEATER D TTD (207)
16.40	DEL DEG F	TTDURH(202)	2ND STAGE REHEATER A TTD (202)
16.40	DEL DEG F	TTDURH(204)	2ND STAGE REHEATER C TTD (204)
16.40	DEL DEG F	TTDURH(206)	2ND STAGE REHEATER B TTD (206)
16.40	DEL DEG F	TTDURH(208)	2ND STAGE REHEATER D TTD (208)
0.75	NO-UNITS	EFUMAC(405)	BFPT A (405) EFFICIENCY
0.75	NO-UNITS	EFUMAC(406)	BFPT B (406) EFFICIENCY
75.00	OPVB	OPVB (33)	AVE CIRC WATER TEMP IN, F
493753.07	FLOW COEF	FCBOWL(10)	LP A BOWL FLOW COEFFICIENT
493753.07	FLOW COEF	FCBOWL(20)	LP B BOWL FLOW COEFFICIENT
0.00	OPVB	OPVB (31)	STM VEL, X-OVER COND A TO B, FT/SEC
1439.24	FT	VECRTP(15)	SONIC VEL, X-OVER COND A TO B, FT/SEC
0.00	OPVB	OPVB (32)	STM VEL, X-OVER COND B TO A, FT/SEC
1439.00	FT	VECRTP(25)	SONIC VEL, X-OVER COND A TO B, FT/SEC
322.03	PSIA	PP (112)	FWHE-2B Pressure (Out)
347.62	BTU/LBM	HH (112)	FWHE-2B Enthalpy (Out)
374.25	DEG F	TT (112)	FWHE-2B Temperature (Out)
391830.7	LBM/HR	WW (165)	FWHE-2B Extr Flow (In)
11011926.0	LBM/HR	WWVSC (302)	Feed Flow (output component)
1015.73	PSIA	PPVSC (302)	Feed Pressure (output component)
458.42	DEG F	TTVSC (302)	Feed Temp (output component)
439.97	BTU/LBM	HH (103)	Feed Enthalpy (output stream)
-0.1622	NO-UNITS	XX (103)	Feed Quality (output stream)
0.9937	NO-UNITS	XX (23)	MSR 'A' Outlet Stm Quality
0.9937	NO-UNITS	XX (30)	MSR 'C' Outlet Stm Quality
0.9937	NO-UNITS	XX (37)	MSR 'B' Outlet Stm Quality
0.9937	NO-UNITS	XX (44)	MSR 'D' Outlet Stm Quality
340428000.0	OPVB	OPVB (44)	Total CW Flow (klbm/hr)
11011307.5	LBM/HR	WWVSC (301)	Steam Flow (input component)
923.40	PSIA	PPVSC (301)	Steam Pressure (input component)
594.50	DEG F	TTVSC (301)	Steam Temp (input component)
1253.40	BTU/LBM	HH (1)	Steam Enthalpy (input stream)
1.0853	NO-UNITS	XX (1)	Steam Quality (input stream)
116999.4	LBM/HR	WW (146)	Steam Flow to 2nd Stg (HP) Rhtr A
116999.4	LBM/HR	WW (147)	Steam Flow to 2nd Stg (HP) Rhtr C
116999.4	LBM/HR	WW (148)	Steam Flow to 2nd Stg (HP) Rhtr B
116999.4	LBM/HR	WW (149)	Steam Flow to 2nd Stg (HP) Rhtr D
10530509.8	LBM/HR	WW (6)	Steam Flow to throttle valves
902.04	PSIA	PP (6)	Steam Pressure to throttle valves
865.96	PSIA	PP (-8)	Steam Pressure after throttle valves

586.67	DEG F	TT	(-8)	Steam Temperature after throttle valves
1253.40	BTU/LBM	HH	(-8)	Steam Enthalpy after throttle valves
1.0827	NO-UNITS	XX	(-8)	Steam Quality after throttle valves
701.70	PSIA	PP	(10)	HP Turbine Gov Stg Shell Pressure
540.86	DEG F	TT	(10)	HP Turbine Gov Stg Shell Temperature
1235.65	BTU/LBM	HH	(10)	HP Turbine Gov Stg Shell Enthalpy
1.0477	NO-UNITS	XX	(10)	HP Turbine Gov Stg Shell Quality
10529959.8	LBM/HR	WW	(10)	HP Turbine 1st Stg Bowl Flow
510.08	PSIA	PP	(11)	HP Turbine 1st Stg Shell Pressure
476.11	DEG F	TT	(11)	HP Turbine 1st Stg Shell Temperature
1210.58	BTU/LBM	HH	(11)	HP Turbine 1st Stg Shell Enthalpy
1.0079	NO-UNITS	XX	(11)	HP Turbine 1st Stg Shell Quality
531530.1	LBM/HR	WW	(159)	HP Turbine 1st Stg Extr Flow to FWHE-3B
535250.8	LBM/HR	WW	(160)	HP Turbine 1st Stg Extr Flow to FWHE-3A
100113.7	LBM/HR	WW	(161)	HPT 1st Stg Extr Flow to 1st Stg Rhtr A
100113.7	LBM/HR	WW	(162)	HPT 1st Stg Extr Flow to 1st Stg Rhtr C
100113.7	LBM/HR	WW	(163)	HPT 1st Stg Extr Flow to 1st Stg Rhtr B
100113.7	LBM/HR	WW	(164)	HPT 1st Stg Extr Flow to 1st Stg Rhtr D
9062724.1	LBM/HR	WW	(16)	HP Turbine Last Stg Bowl Flow
197.65	PSIA	PP	(17)	HP Turbine Last Stg Shell Pressure
380.82	DEG F	TT	(17)	HP Turbine Last Stg Shell Temperature
1145.05	BTU/LBM	HH	(17)	HP Turbine Last Stg Shell Enthalpy
0.9370	NO-UNITS	XX	(17)	HP Turbine Last Stg Shell Quality
391830.7	LBM/HR	WW	(165)	HP Turbine 1st Stg Extr Flow to FWHE-2B
400497.9	LBM/HR	WW	(166)	HP Turbine 1st Stg Extr Flow to FWHE-2A
10454.0	LBM/HR	WW	(167)	HP Turbine Gland Steam Leakoff Flow
0.0	LBM/HR	WW	(213)	HPT Exhaust Flow (TDV,EXDT,RHDT) to Cond
2064985.4	LBM/HR	WW	(22)	MSR 'A' Inlet Flow
1948387.9	LBM/HR	WW	(23)	MSR 'A' Outlet Flow
192.74	PSIA	PP	(23)	MSR 'A' Outlet Pressure
1192.50	BTU/LBM	HH	(23)	MSR 'A' Outlet Enthalpy
378.72	DEG F	TT	(23)	MSR 'A' Outlet Temperature
116597.4	LBM/HR	WW	(174)	MSR 'A' Drain Flow
192.74	PSIA	PP	(174)	MSR 'A' Drain Pressure
352.21	BTU/LBM	HH	(174)	MSR 'A' Drain Enthalpy
378.72	DEG F	TT	(174)	MSR 'A' Drain Temperature
188.88	PSIA	PP	(24)	1st Stg Rhtr 'A' Outlet Pressure
1232.19	BTU/LBM	HH	(24)	1st Stg Rhtr 'A' Outlet Enthalpy
432.97	DEG F	TT	(24)	1st Stg Rhtr 'A' Outlet Temperature
1.0409	NO-UNITS	XX	(24)	1st Stg Rhtr 'A' Outlet Quality
100113.6880	LBM/HR	WW	(520)	1st Stg Rhtr 'A' Htg Stm Flow
504.98	PSIA	PP	(520)	1st Stg Rhtr 'A' Htg Stm Pressure
1210.58	BTU/LBM	HH	(520)	1st Stg Rhtr 'A' Htg Stm Enthalpy
475.06	DEG F	TT	(520)	1st Stg Rhtr 'A' Htg Stm Temperature
453.52	PSIA	PP	(230)	1st Stg Rhtr 'A' Htg Stm Drain Pressure
438.21	BTU/LBM	HH	(230)	1st Stg Rhtr 'A' Htg Stm Drain Enthalpy
457.07	DEG F	TT	(230)	1st Stg Rhtr 'A' Htg Stm Drain Temp
0.0000	NO-UNITS	XX	(230)	1st Stg Rhtr 'A' Htg Stm Drain Quality
187.00	PSIA	PP	(25)	2nd Stg Rhtr 'A' Outlet Pressure
1276.20	BTU/LBM	HH	(25)	2nd Stg Rhtr 'A' Outlet Enthalpy
510.56	DEG F	TT	(25)	2nd Stg Rhtr 'A' Outlet Temperature
1.0929	NO-UNITS	XX	(25)	2nd Stg Rhtr 'A' Outlet Quality
116999.4416	LBM/HR	WW	(146)	2nd Stg Rhtr 'A' Htg Stm Flow
884.00	PSIA	PP	(146)	2nd Stg Rhtr 'A' Htg Stm Pressure
1253.40	BTU/LBM	HH	(146)	2nd Stg Rhtr 'A' Htg Stm Enthalpy
589.15	DEG F	TT	(146)	2nd Stg Rhtr 'A' Htg Stm Temperature
862.61	PSIA	PP	(231)	2nd Stg Rhtr 'A' Htg Stm Drain Pressure
520.52	BTU/LBM	HH	(231)	2nd Stg Rhtr 'A' Htg Stm Drain Enthalpy
526.96	DEG F	TT	(231)	2nd Stg Rhtr 'A' Htg Stm Drain Temp
0.0000	NO-UNITS	XX	(231)	2nd Stg Rhtr 'A' Htg Stm Drain Quality
2064985.4	LBM/HR	WW	(29)	MSR 'C' Inlet Flow
1948387.9	LBM/HR	WW	(30)	MSR 'C' Outlet Flow
192.74	PSIA	PP	(30)	MSR 'C' Outlet Pressure
1192.50	BTU/LBM	HH	(30)	MSR 'C' Outlet Enthalpy
378.72	DEG F	TT	(30)	MSR 'C' Outlet Temperature
116597.4	LBM/HR	WW	(177)	MSR 'C' Drain Flow
192.74	PSIA	PP	(177)	MSR 'C' Drain Pressure
352.21	BTU/LBM	HH	(177)	MSR 'C' Drain Enthalpy
378.72	DEG F	TT	(177)	MSR 'C' Drain Temperature
188.88	PSIA	PP	(31)	1st Stg Rhtr 'C' Outlet Pressure

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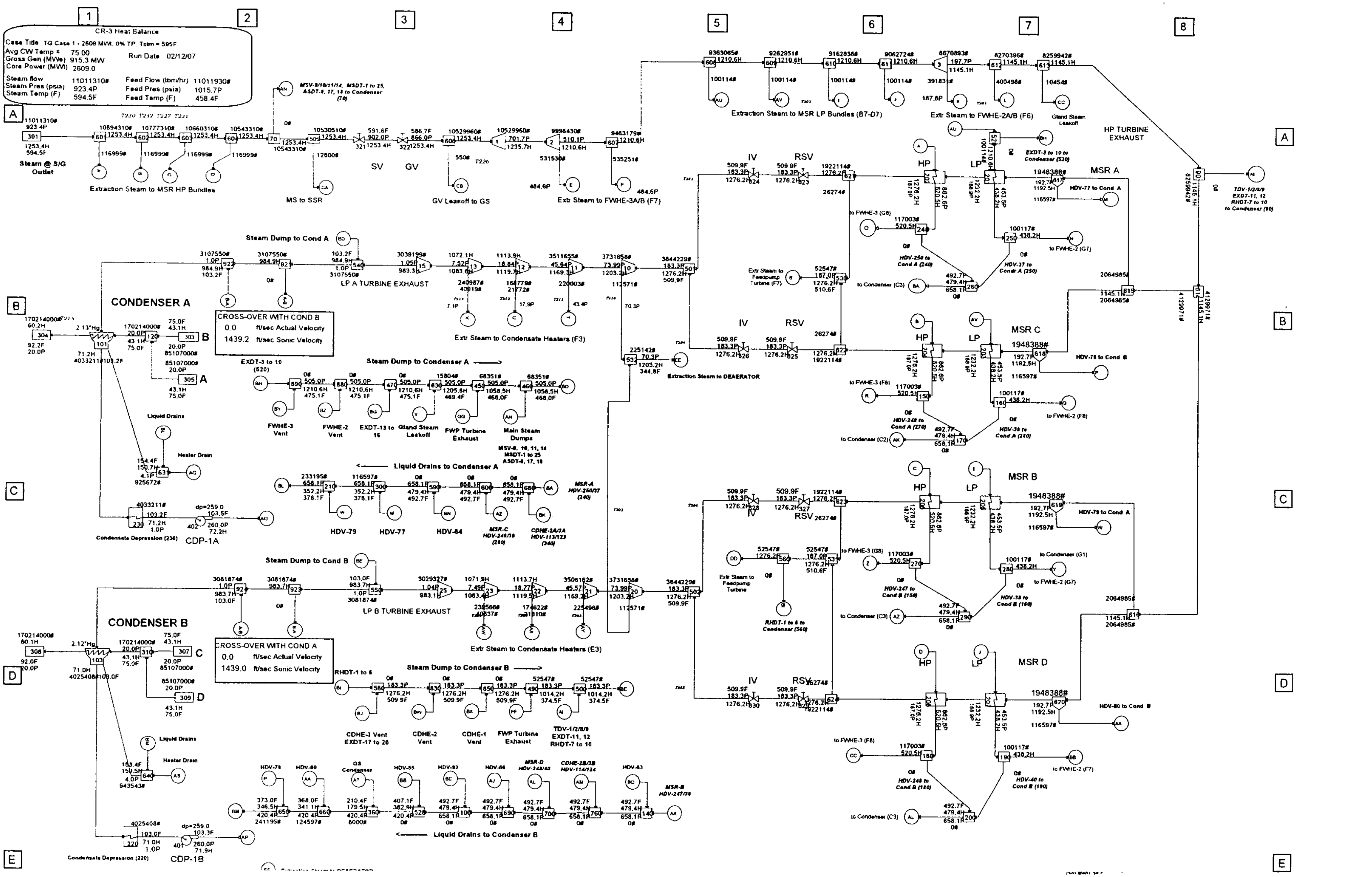
1232.19	BTU/LBM	HH	(31)	1st Stg Rhtr 'C' Outlet Enthalpy
432.97	DEG F	TT	(31)	1st Stg Rhtr 'C' Outlet Temperature
1.0409	NO-UNITS	XX	(31)	1st Stg Rhtr 'C' Outlet Quality
100113.6880	LBM/HR	WW	(162)	1st Stg Rhtr 'C' Htg Stm Flow
504.98	PSIA	PP	(162)	1st Stg Rhtr 'C' Htg Stm Pressure
1210.58	BTU/LBM	HH	(162)	1st Stg Rhtr 'C' Htg Stm Enthalpy
475.06	DEG F	TT	(162)	1st Stg Rhtr 'C' Htg Stm Temperature
453.52	PSIA	PP	(220)	1st Stg Rhtr 'C' Htg Stm Drain Pressure
438.21	BTU/LBM	HH	(220)	1st Stg Rhtr 'C' Htg Stm Drain Enthalpy
457.07	DEG F	TT	(220)	1st Stg Rhtr 'C' Htg Stm Drain Temp
0.0000	NO-UNITS	XX	(220)	1st Stg Rhtr 'C' Htg Stm Drain Quality
187.00	PSIA	PP	(32)	2nd Stg Rhtr 'C' Outlet Pressure
1276.20	BTU/LBM	HH	(32)	2nd Stg Rhtr 'C' Outlet Enthalpy
510.56	DEG F	TT	(32)	2nd Stg Rhtr 'C' Outlet Temperature
1.0929	NO-UNITS	XX	(32)	2nd Stg Rhtr 'C' Outlet Quality
116999.4416	LBM/HR	WW	(147)	2nd Stg Rhtr 'C' Htg Stm Flow
884.00	PSIA	PP	(147)	2nd Stg Rhtr 'C' Htg Stm Pressure
1253.40	BTU/LBM	HH	(147)	2nd Stg Rhtr 'C' Htg Stm Enthalpy
589.15	DEG F	TT	(147)	2nd Stg Rhtr 'C' Htg Stm Temperature
862.61	PSIA	PP	(219)	2nd Stg Rhtr 'C' Htg Stm Drain Pressure
520.52	BTU/LBM	HH	(219)	2nd Stg Rhtr 'C' Htg Stm Drain Enthalpy
526.96	DEG F	TT	(219)	2nd Stg Rhtr 'C' Htg Stm Drain Temp
0.0000	NO-UNITS	XX	(219)	2nd Stg Rhtr 'C' Htg Stm Drain Quality
2064985.4	LBM/HR	WW	(36)	MSR 'B' Inlet Flow
1948387.9	LBM/HR	WW	(37)	MSR 'B' Outlet Flow
192.74	PSIA	PP	(37)	MSR 'B' Outlet Pressure
1192.50	BTU/LBM	HH	(37)	MSR 'B' Outlet Enthalpy
378.72	DEG F	TT	(37)	MSR 'B' Outlet Temperature
116597.4	LBM/HR	WW	(620)	MSR 'B' Drain Flow
192.74	PSIA	PP	(620)	MSR 'B' Drain Pressure
352.21	BTU/LBM	HH	(620)	MSR 'B' Drain Enthalpy
378.72	DEG F	TT	(620)	MSR 'B' Drain Temperature
188.88	PSIA	PP	(38)	1st Stg Rhtr 'B' Outlet Pressure
1232.19	BTU/LBM	HH	(38)	1st Stg Rhtr 'B' Outlet Enthalpy
432.97	DEG F	TT	(38)	1st Stg Rhtr 'B' Outlet Temperature
1.0409	NO-UNITS	XX	(38)	1st Stg Rhtr 'B' Outlet Quality
100113.6880	LBM/HR	WW	(163)	1st Stg Rhtr 'B' Htg Stm Flow
504.98	PSIA	PP	(163)	1st Stg Rhtr 'B' Htg Stm Pressure
1210.58	BTU/LBM	HH	(163)	1st Stg Rhtr 'B' Htg Stm Enthalpy
475.06	DEG F	TT	(163)	1st Stg Rhtr 'B' Htg Stm Temperature
453.52	PSIA	PP	(233)	1st Stg Rhtr 'B' Htg Stm Drain Pressure
438.21	BTU/LBM	HH	(233)	1st Stg Rhtr 'B' Htg Stm Drain Enthalpy
457.07	DEG F	TT	(233)	1st Stg Rhtr 'B' Htg Stm Drain Temp
0.0000	NO-UNITS	XX	(233)	1st Stg Rhtr 'B' Htg Stm Drain Quality
187.00	PSIA	PP	(39)	2nd Stg Rhtr 'B' Outlet Pressure
1276.20	BTU/LBM	HH	(39)	2nd Stg Rhtr 'B' Outlet Enthalpy
510.56	DEG F	TT	(39)	2nd Stg Rhtr 'B' Outlet Temperature
1.0929	NO-UNITS	XX	(39)	2nd Stg Rhtr 'B' Outlet Quality
116999.4416	LBM/HR	WW	(148)	2nd Stg Rhtr 'B' Htg Stm Flow
884.00	PSIA	PP	(148)	2nd Stg Rhtr 'B' Htg Stm Pressure
1253.40	BTU/LBM	HH	(148)	2nd Stg Rhtr 'B' Htg Stm Enthalpy
589.15	DEG F	TT	(148)	2nd Stg Rhtr 'B' Htg Stm Temperature
862.61	PSIA	PP	(232)	2nd Stg Rhtr 'B' Htg Stm Drain Pressure
520.52	BTU/LBM	HH	(232)	2nd Stg Rhtr 'B' Htg Stm Drain Enthalpy
526.96	DEG F	TT	(232)	2nd Stg Rhtr 'B' Htg Stm Drain Temp
0.0000	NO-UNITS	XX	(232)	2nd Stg Rhtr 'B' Htg Stm Drain Quality
2064985.4	LBM/HR	WW	(43)	MSR 'D' Inlet Flow
1948387.9	LBM/HR	WW	(44)	MSR 'D' Outlet Flow
192.74	PSIA	PP	(44)	MSR 'D' Outlet Pressure
1192.50	BTU/LBM	HH	(44)	MSR 'D' Outlet Enthalpy
378.72	DEG F	TT	(44)	MSR 'D' Outlet Temperature
116597.4	LBM/HR	WW	(188)	MSR 'D' Drain Flow
192.74	PSIA	PP	(188)	MSR 'D' Drain Pressure
352.21	BTU/LBM	HH	(188)	MSR 'D' Drain Enthalpy
378.72	DEG F	TT	(188)	MSR 'D' Drain Temperature
188.88	PSIA	PP	(45)	1st Stg Rhtr 'D' Outlet Pressure
1232.19	BTU/LBM	HH	(45)	1st Stg Rhtr 'D' Outlet Enthalpy
432.97	DEG F	TT	(45)	1st Stg Rhtr 'D' Outlet Temperature
1.0409	NO-UNITS	XX	(45)	1st Stg Rhtr 'D' Outlet Quality
100113.7	LBM/HR	WW	(164)	1st Stg Rhtr 'D' Htg Stm Flow

504.98	PSIA	PP	(164)	1st Stg Rhtr 'D' Htg Stm Pressure
1210.58	BTU/LBM	HH	(164)	1st Stg Rhtr 'D' Htg Stm Enthalpy
475.06	DEG F	TT	(164)	1st Stg Rhtr 'D' Htg Stm Temperature
453.52	PSIA	PP	(226)	1st Stg Rhtr 'D' Htg Stm Drain Pressure
438.21	BTU/LBM	HH	(226)	1st Stg Rhtr 'D' Htg Stm Drain Enthalpy
457.07	DEG F	TT	(226)	1st Stg Rhtr 'D' Htg Stm Drain Temp
0.0000	NO-UNITS	XX	(226)	1st Stg Rhtr 'D' Htg Stm Drain Quality
187.00	PSIA	PP	(46)	2nd Stg Rhtr 'D' Outlet Pressure
1276.20	BTU/LBM	HH	(46)	2nd Stg Rhtr 'D' Outlet Enthalpy
510.56	DEG F	TT	(46)	2nd Stg Rhtr 'D' Outlet Temperature
1.0929	NO-UNITS	XX	(46)	2nd Stg Rhtr 'D' Outlet Quality
116999.4	LBM/HR	WW	(149)	2nd Stg Rhtr 'D' Htg Stm Flow
884.00	PSIA	PP	(149)	2nd Stg Rhtr 'D' Htg Stm Pressure
1253.40	BTU/LBM	HH	(149)	2nd Stg Rhtr 'D' Htg Stm Enthalpy
589.15	DEG F	TT	(149)	2nd Stg Rhtr 'D' Htg Stm Temperature
862.61	PSIA	PP	(227)	2nd Stg Rhtr 'D' Htg Stm Drain Pressure
520.52	BTU/LBM	HH	(227)	2nd Stg Rhtr 'D' Htg Stm Drain Enthalpy
526.96	DEG F	TT	(227)	2nd Stg Rhtr 'D' Htg Stm Drain Temp
0.0000	NO-UNITS	XX	(227)	2nd Stg Rhtr 'D' Htg Stm Drain Quality
52547.3	LBM/HR	WW	(402)	Extr Steam flow to FWPT 2A
52547.3	LBM/HR	WW	(180)	Extr Steam flow to FWPT 2B
1922114.3	LBM/HR	WW	(26)	Steam Flow to RSV 'A'
187.00	PSIA	PP	(26)	Pressure in to RSV 'A'
1276.20	BTU/LBM	HH	(26)	Enthalpy in to RSV 'A'
510.56	DEG F	TT	(26)	Temperature in to RSV 'A'
183.26	PSIA	PP	(-28)	Pressure out of IV 'A'
1276.20	BTU/LBM	HH	(-28)	Enthalpy out of IV 'A'
509.86	DEG F	TT	(-28)	Temperature out of IV 'A'
1922114.3	LBM/HR	WW	(33)	Steam Flow to RSV 'C'
187.00	PSIA	PP	(33)	Pressure in to RSV 'C'
1276.20	BTU/LBM	HH	(33)	Enthalpy in to RSV 'C'
510.56	DEG F	TT	(33)	Temperature in to RSV 'C'
183.26	PSIA	PP	(-35)	Pressure out of IV 'C'
1276.20	BTU/LBM	HH	(-35)	Enthalpy out of IV 'C'
509.86	DEG F	TT	(-35)	Temperature out of IV 'C'
3844228.6	LBM/HR	WW	(50)	Steam Flow in to LP Turbine 'A'
112571.0	LBM/HR	WW	(144)	LP Turb A 1st Stg Extr Flow to DeAerator
1203.16	BTU/LBM	HH	(144)	LP Turb A 1st Stg Extract Enthalpy
70.29	PSIA	PP	(144)	LP Turb A 1st Stg Extract Pressure
344.76	DEG F	TT	(144)	LP Turb A 1st Stg Extract Temperature
1.0248	NO-UNITS	XX	(144)	LP Turb A 1st Stg Extract Quality
220002.8	LBM/HR	WW	(181)	LP Turb A 2nd Stg Extr Flow to CDHE 3B
1169.31	BTU/LBM	HH	(181)	LP Turb A 2nd Stg Extract Enthalpy
43.36	PSIA	PP	(181)	LP Turb A 2nd Stg Extract Pressure
272.16	DEG F	TT	(181)	LP Turb A 2nd Stg Extract Temperature
0.9978	NO-UNITS	XX	(181)	LP Turb A 2nd Stg Extract Quality
190550.2	LBM/HR	WW	(182)	LP Turb A 3rd Stg Extr Flow to CDHE 2B
1013.81	BTU/LBM	HH	(182)	LP Turb A 3rd Stg Extract Enthalpy
17.90	PSIA	PP	(182)	LP Turb A 3rd Stg Extract Pressure
222.11	DEG F	TT	(182)	LP Turb A 3rd Stg Extract Temperature
0.8543	NO-UNITS	XX	(182)	LP Turb A 3rd Stg Extract Quality
281905.8	LBM/HR	WW	(183)	LP Turb A 4th Stg Extr Flow to CDHE 1B
947.80	BTU/LBM	HH	(183)	LP Turb A 4th Stg Extract Enthalpy
7.14	PSIA	PP	(183)	LP Turb A 4th Stg Extract Pressure
177.73	DEG F	TT	(183)	LP Turb A 4th Stg Extract Temperature
0.8089	NO-UNITS	XX	(183)	LP Turb A 4th Stg Extract Quality
1203.16	BTU/LBM	HH	(51)	LP Turbine 'A' 2nd Stg Bowl Enthalpy
1.0238	NO-UNITS	XX	(51)	LP Turbine 'A' 2nd Stg Bowl Quality
1169.31	BTU/LBM	HH	(52)	LP Turbine 'A' 3rd Stg Bowl Enthalpy
0.9968	NO-UNITS	XX	(52)	LP Turbine 'A' 3rd Stg Bowl Quality
1119.69	BTU/LBM	HH	(53)	LP Turbine 'A' 4th Stg Bowl Enthalpy
0.9631	NO-UNITS	XX	(53)	LP Turbine 'A' 4th Stg Bowl Quality
1083.59	BTU/LBM	HH	(54)	LP Turbine 'A' Last Stg Bowl Enthalpy
0.9448	NO-UNITS	XX	(54)	LP Turbine 'A' Last Stg Bowl Quality
1.05	PSIA	PP	(56)	LP Turbine 'A' Last Stg Exhaust Pressure
103.25	DEG F	TT	(56)	LP Turbine 'A' Last Stg Exhaust Temp
983.26	BTU/LBM	HH	(56)	LP Turbine 'A' Last Stg Exhaust Enthalpy
0.8810	NO-UNITS	XX	(56)	LP Turbine 'A' Last Stg Exhaust Quality
1922114.3	LBM/HR	WW	(40)	Steam Flow to RSV 'B'
187.00	PSIA	PP	(40)	Pressure in to RSV 'B'

1276.20	BTU/LBM	HH	(40)	Enthalpy in to RSV 'B'
510.56	DEG F	TT	(40)	Temperature in to RSV 'B'
183.26	PSIA	PP	(-42)	Pressure out of IV 'B'
1276.20	BTU/LBM	HH	(-42)	Enthalpy out of IV 'B'
509.86	DEG F	TT	(-42)	Temperature out of IV 'B'
1922114.3	LBM/HR	WW	(47)	Steam Flow to RSV 'D'
187.00	PSIA	PP	(47)	Pressure in to RSV 'D'
1276.20	BTU/LBM	HH	(47)	Enthalpy in to RSV 'D'
510.56	DEG F	TT	(47)	Temperature in to RSV 'D'
183.26	PSIA	PP	(-49)	Pressure out of IV 'D'
1276.20	BTU/LBM	HH	(-49)	Enthalpy out of IV 'D'
509.86	DEG F	TT	(-49)	Temperature out of IV 'D'
3844228.6	LBM/HR	WW	(60)	Steam Flow in to LP Turbine 'B'
112571.0	LBM/HR	WW	(145)	LP Turb B 1st Stg Extr Flow to DeAerator
1203.16	BTU/LBM	HH	(145)	LP Turb B 1st Stg Extract Enthalpy
70.29	PSIA	PP	(145)	LP Turb B 1st Stg Extract Pressure
344.76	DEG F	TT	(145)	LP Turb B 1st Stg Extract Temperature
1.0248	NO-UNITS	XX	(145)	LP Turb B 1st Stg Extract Quality
225495.6	LBM/HR	WW	(192)	LP Turb B 2nd Stg Extr Flow to CDHE 3A
1169.20	BTU/LBM	HH	(192)	LP Turb B 2nd Stg Extract Enthalpy
43.29	PSIA	PP	(192)	LP Turb B 2nd Stg Extract Pressure
272.06	DEG F	TT	(192)	LP Turb B 2nd Stg Extract Temperature
0.9977	NO-UNITS	XX	(192)	LP Turb B 2nd Stg Extract Quality
196431.8	LBM/HR	WW	(193)	LP Turb B 3rd Stg Extr Flow to CDHE 2A
1016.61	BTU/LBM	HH	(193)	LP Turb B 3rd Stg Extract Enthalpy
17.83	PSIA	PP	(193)	LP Turb B 3rd Stg Extract Pressure
221.92	DEG F	TT	(193)	LP Turb B 3rd Stg Extract Temperature
0.8573	NO-UNITS	XX	(193)	LP Turb B 3rd Stg Extract Quality
280403.1	LBM/HR	WW	(194)	LP Turb B 4th Stg Extr Flow to CDHE 1A
947.20	BTU/LBM	HH	(194)	LP Turb B 4th Stg Extract Enthalpy
7.12	PSIA	PP	(194)	LP Turb B 4th Stg Extract Pressure
177.58	DEG F	TT	(194)	LP Turb B 4th Stg Extract Temperature
0.8084	NO-UNITS	XX	(194)	LP Turb B 4th Stg Extract Quality
1203.16	BTU/LBM	HH	(61)	LP Turbine 'B' 2nd Stg Bowl Enthalpy
1.0238	NO-UNITS	XX	(61)	LP Turbine 'B' 2nd Stg Bowl Quality
1169.20	BTU/LBM	HH	(62)	LP Turbine 'B' 3rd Stg Bowl Enthalpy
0.9967	NO-UNITS	XX	(62)	LP Turbine 'B' 3rd Stg Bowl Quality
1119.49	BTU/LBM	HH	(63)	LP Turbine 'B' 4th Stg Bowl Enthalpy
0.9630	NO-UNITS	XX	(63)	LP Turbine 'B' 4th Stg Bowl Quality
1083.45	BTU/LBM	HH	(64)	LP Turbine 'B' Last Stg Bowl Enthalpy
0.9448	NO-UNITS	XX	(64)	LP Turbine 'B' Last Stg Bowl Quality
1.04	PSIA	PP	(66)	LP Turbine 'B' Last Stg Exhaust Pressure
103.04	DEG F	TT	(66)	LP Turbine 'B' Last Stg Exhaust Temp
983.15	BTU/LBM	HH	(66)	LP Turbine 'B' Last Stg Exhaust Enthalpy
0.8810	NO-UNITS	XX	(66)	LP Turbine 'B' Last Stg Exhaust Quality
3107550.2	LBM/HR	WW	(924)	Condenser 'A' Steam Flow
1.05	PSIA	PP	(924)	Condenser 'A' Steam Pressure
103.25	DEG F	TT	(924)	Condenser 'A' Steam Temperature
984.91	BTU/LBM	HH	(924)	Condenser 'A' Steam Enthalpy
0.8826	NO-UNITS	XX	(924)	Condenser 'A' Steam Quality
925671.5	LBM/HR	WW	(631)	Condenser 'A' Inlet Drain Flow
4.14	PSIA	PP	(631)	Condenser 'A' Inlet Drain Pressure
154.38	DEG F	TT	(631)	Condenser 'A' Inlet Drain Temperature
150.72	BTU/LBM	HH	(631)	Condenser 'A' Inlet Drain Enthalpy
1.05	PSIA	PP	(-111)	Condenser 'A' Hotwell Pressure
103.25	DEG F	TT	(-111)	Condenser 'A' Hotwell Temperature
75.00	DEG F	TT	(305)	Condenser 'A' CW Temp A In
75.00	DEG F	TT	(303)	Condenser 'A' CW Temp B In
92.16	DEG F	TT	(200)	Condenser 'A' CW Temp Out
3081874.4	LBM/HR	WW	(926)	Condenser 'B' Steam Flow
1.04	PSIA	PP	(926)	Condenser 'B' Steam Pressure
103.04	DEG F	TT	(926)	Condenser 'B' Steam Temperature
983.68	BTU/LBM	HH	(926)	Condenser 'B' Steam Enthalpy
0.8815	NO-UNITS	XX	(926)	Condenser 'B' Steam Quality
943543.4	LBM/HR	WW	(640)	Condenser 'B' Inlet Drain Flow
4.04	PSIA	PP	(640)	Condenser 'B' Inlet Drain Pressure
153.36	DEG F	TT	(640)	Condenser 'B' Inlet Drain Temperature
150.52	BTU/LBM	HH	(640)	Condenser 'B' Inlet Drain Enthalpy
1.04	PSIA	PP	(-123)	Condenser 'B' Hotwell Pressure



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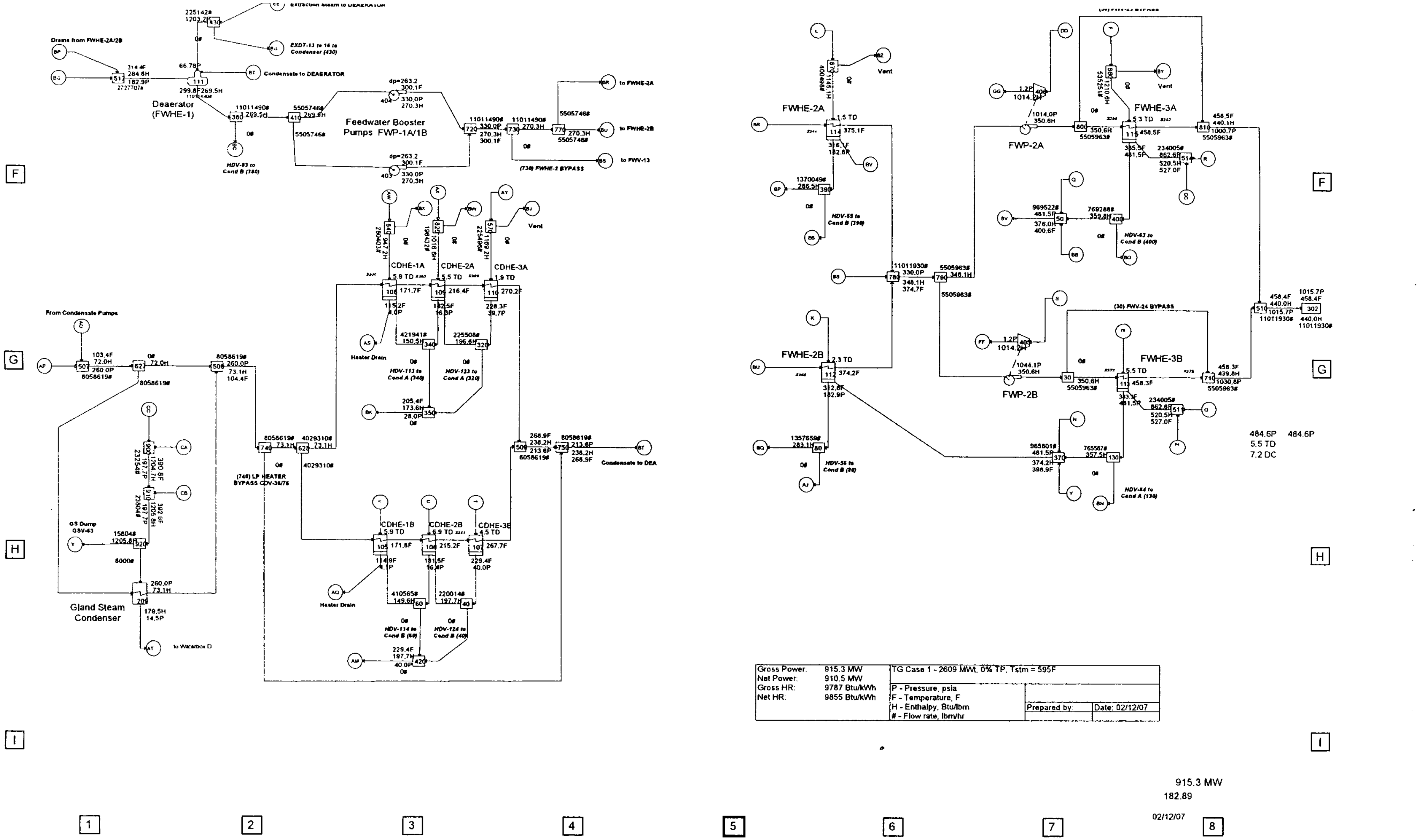
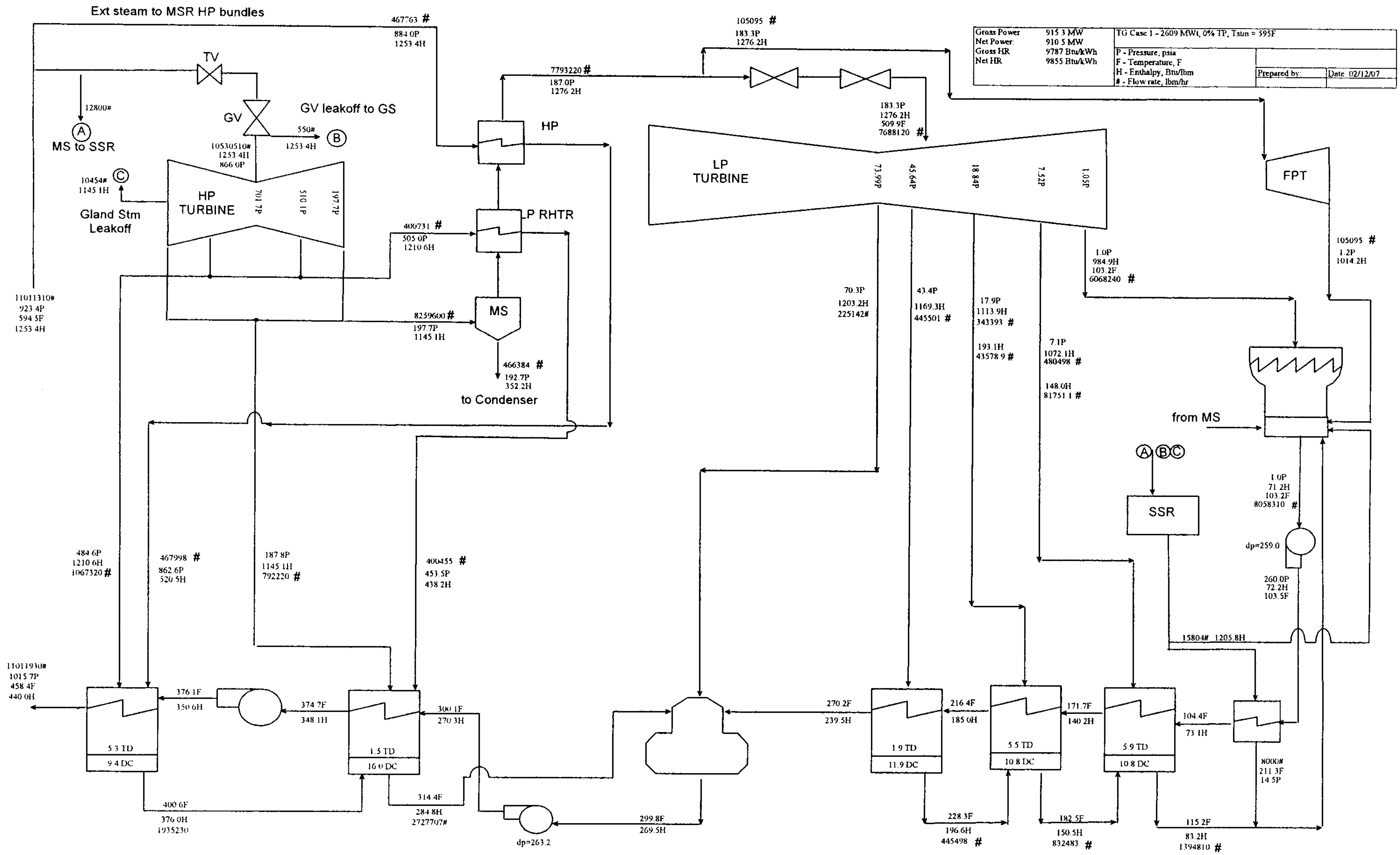
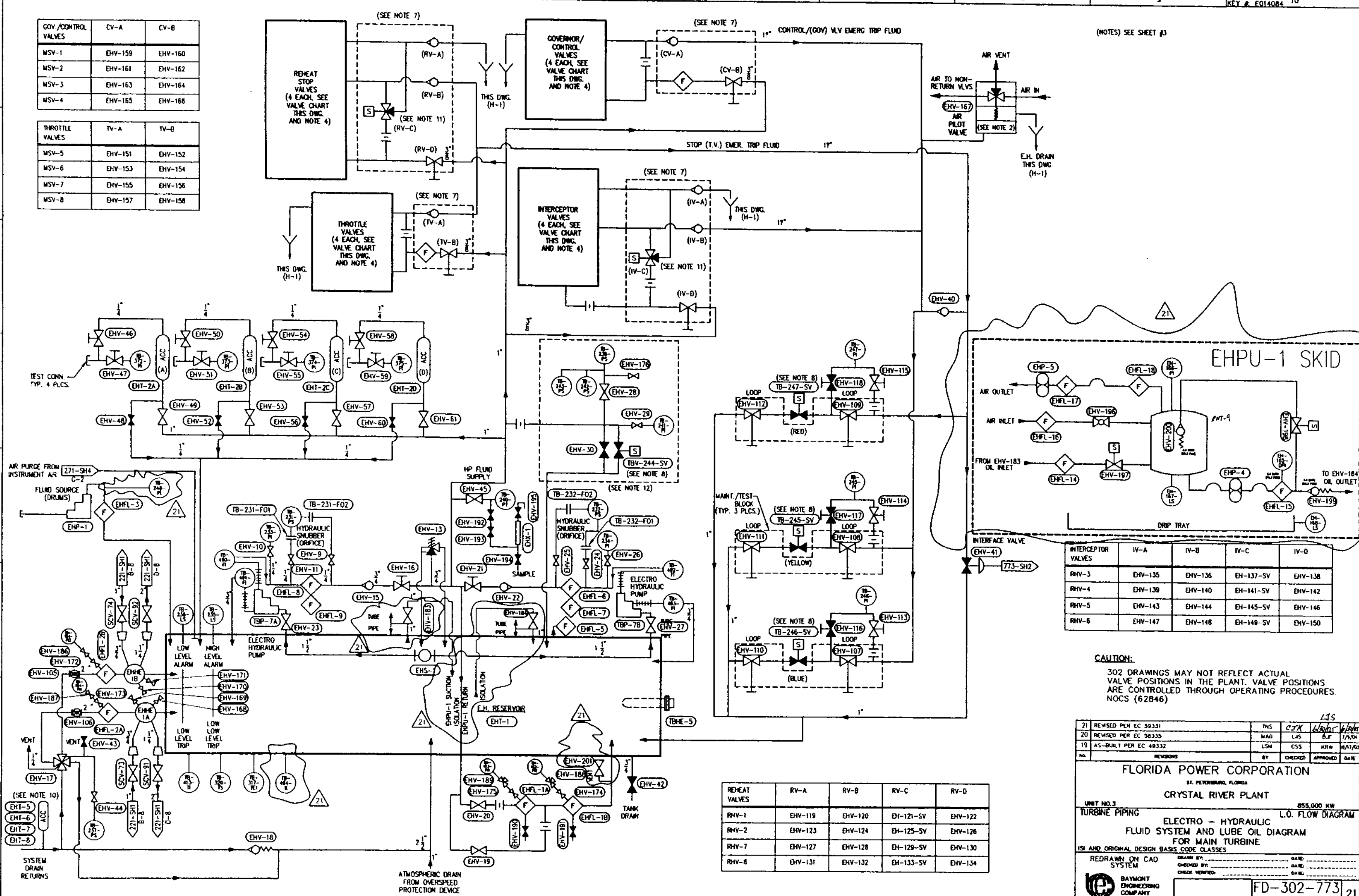

Deaerator
(FWHE-1)
Feedwater Booster
Pumps FWP-1A/1B
Drains from FWHE-2A/2B
Condensate to DEAERATOR
to FWHE-2A
to FWHE-2B
to FWV-13
(730) FWHE-2 BYPASS
CDHE-1A
CDHE-2A
CDHE-3A
Vent
Heater Drain
From Condensate Pumps
(740) LP HEATER BYPASS CDV-36/75
Condensate to DEA
CDHE-1B
CDHE-2B
CDHE-3B
Gland Steam
Condenser
to Waterbox D
FWHE-2A
FWHE-2B
FWHE-3A
FWHE-3B
FWP-2A
FWP-2B
(30) FWV-24 BYPASS
484.6P
5.5 TD
7.2 DC
Gross Power: 915.3 MW
Net Power: 910.5 MW
Gross HR: 9787 Btu/kWh
Net HR: 9855 Btu/kWh
TG Case 1 - 2609 MWt, 0% TP, Tstm = 595F
P - Pressure, psia
F - Temperature, F
H - Enthalpy, Btu/lbm
- Flow rate, lbm/hr
Prepared by:
Date: 02/12/07
915.3 MW
182.89
02/12/07
F
G
H
I
1
2
3
4
5
6
7
8



PEF-NCR-03086



GOV./CONTROL VALVES	CV-A	CV-B
MSV-1	EHV-159	EHV-160
MSV-2	EHV-161	EHV-162
MSV-3	EHV-163	EHV-164
MSV-4	EHV-165	EHV-166

THROTTLE VALVES	TV-A	TV-B
MSV-5	EHV-151	EHV-152
MSV-6	EHV-153	EHV-154
MSV-7	EHV-155	EHV-156
MSV-8	EHV-157	EHV-158

INTERCEPTOR VALVES	IV-A	IV-B	IV-C	IV-D
RHV-3	EHV-135	EHV-136	EH-137-SV	EHV-138
RHV-4	EHV-139	EHV-140	EH-141-SV	EHV-142
RHV-5	EHV-143	EHV-144	EH-145-SV	EHV-146
RHV-6	EHV-147	EHV-148	EH-149-SV	EHV-150

CAUTION:

302 DRAWINGS MAY NOT REFLECT ACTUAL VALVE POSITIONS IN THE PLANT. VALVE POSITIONS ARE CONTROLLED THROUGH OPERATING PROCEDURES. NOCS (62846)

REHEAT VALVES	RV-A	RV-B	RV-C	RV-D
RHV-1	EHV-119	EHV-120	EH-121-SV	EHV-122
RHV-2	EHV-123	EHV-124	EH-125-SV	EHV-126
RHV-7	EHV-127	EHV-128	EH-129-SV	EHV-130
RHV-8	EHV-131	EHV-132	EH-133-SV	EHV-134

NO.	REVISIONS	BY	CHECKED	APPROVED	DATE
21	REVISED PER EC 59331	THS	CJK	6/30/05	[illegible]
20	REVISED PER EC 56335	MAO	LJS	BJF	1/3/04
19	AS-BUILT PER EC 48332	LSM	CSS	KRW	[illegible]

FLORIDA POWER CORPORATION

ST. PETERSBURG, FLORIDA

CRYSTAL RIVER PLANT

UNIT NO.3 855,000 KW

TURBINE PIPING L.O. FLOW DIAGRAM

ELECTRO - HYDRAULIC FLUID SYSTEM AND LUBE OIL DIAGRAM FOR MAIN TURBINE

ISI AND ORIGINAL DESIGN BASIS CODE CLASSES

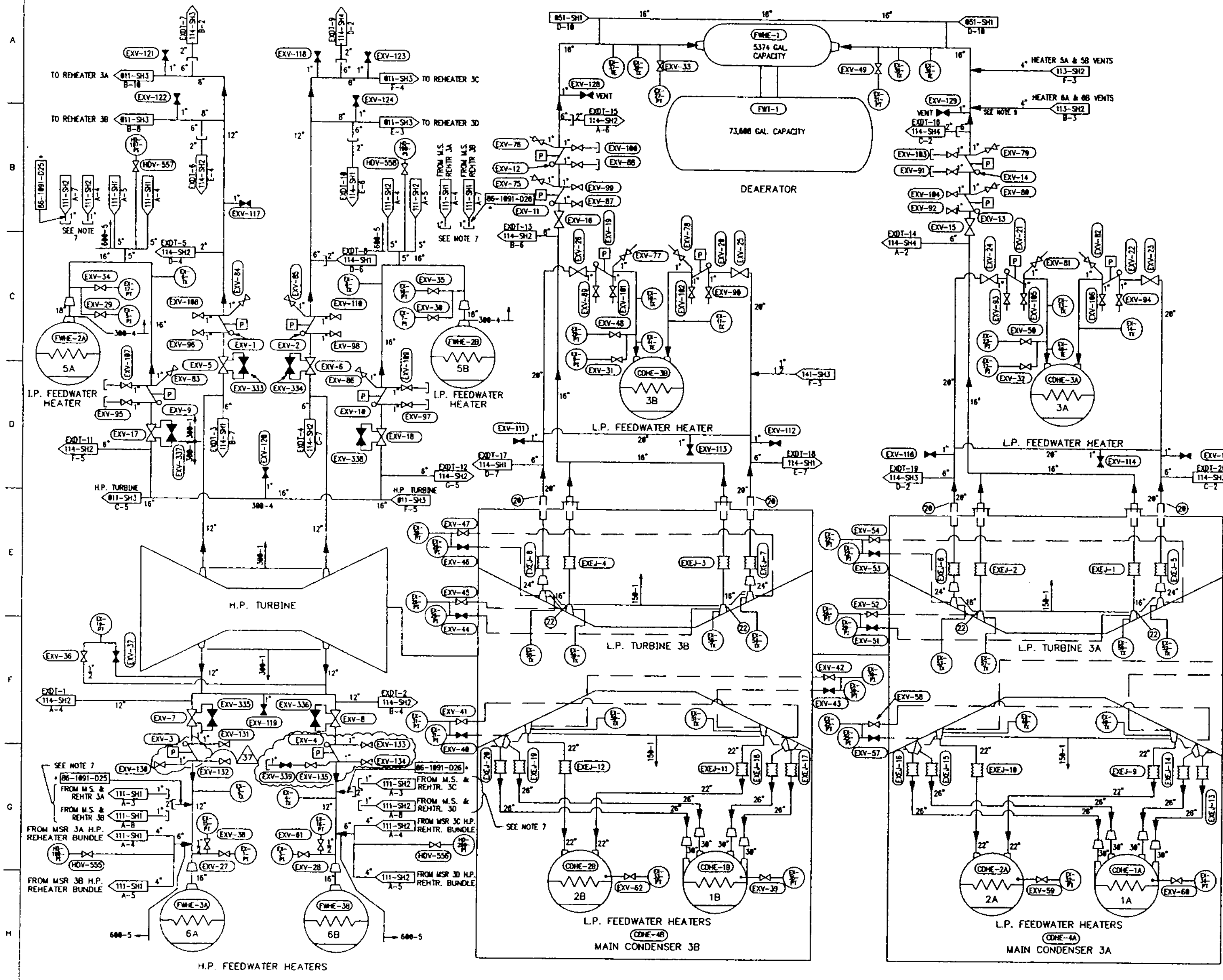
REDRAWN ON CAD SYSTEM

BAYMONT ENGINEERING COMPANY

FD-302-773 | SHEET 01 OF 03 | 21

D-9-8

PEF-NCR-03087



NOTES:

1. EXDT - STEAM TRAP IDENTIFICATION ON MATERIAL LIST.
2. (#) DENOTES FOSTER WHEELER CONN. POINT ON CONDENSER.

   FOSTER WHEELER CORP. REFERENCE DRAWINGS:
   93-817-5-102 CONDENSER 3A
   93-817-5-100 CONDENSER 3B
3. ALL PIPING SEISMIC CLASS III S III AND B31.1 PIPING CODE
4. OMITTED
5. L.P. FEEDWATER HEATER DRAIN LINES ARE SHOWN ON DRAWING P-304-124.
6. OMITTED
7. ABANDONED LINE
8. "•" DENOTES VENDOR DRAWING FROM SOUTHWESTERN ENGINEERING COMPANY.
9. MAR 93-05-02-01 AUTHORIZES INSTALLATION OF CHROM-MOLY PIPING IN THIS LINE.

CAUTION:

302 DRAWINGS MAY NOT REFLECT ACTUAL VALVE POSITIONS IN THE PLANT. VALVE POSITIONS ARE CONTROLLED THROUGH OPERATING PROCEDURES. NOCS (62846)

NO.	REVISIONS	BY	CHECKED	APPROVED	DATE
37	REVISED PER EC 51899	LSM	CSS	KRW	[illegible]
36	REVISED PER DCN 01-064	MAD	TDF	KRW	3/12/01
35	REVISED PER DCN 00-056	MAD	KLM	GKO	4/26/00

FLORIDA POWER CORPORATION

ST. PETERSBURG, FLORIDA

CRYSTAL RIVER PLANT

UNIT NO.3 855,000 KW

TURBINE PIPING EX. SYSTEM FLOW DIAGRAM

EXTRACTION STEAM

ISI AND ORIGINAL DESIGN BASIS CODE CLASSES

REDRAWN ON CAD SYSTEM

DRAWN BY: R.D.F. DATE: 02-23-01

CHECKED BY: R.E.K. DATE: 05-04-01

CHECK VERIFIED: R.W.B. DATE: 05-04-01

BAYMONT ENGINEERING COMPANY

SCALE

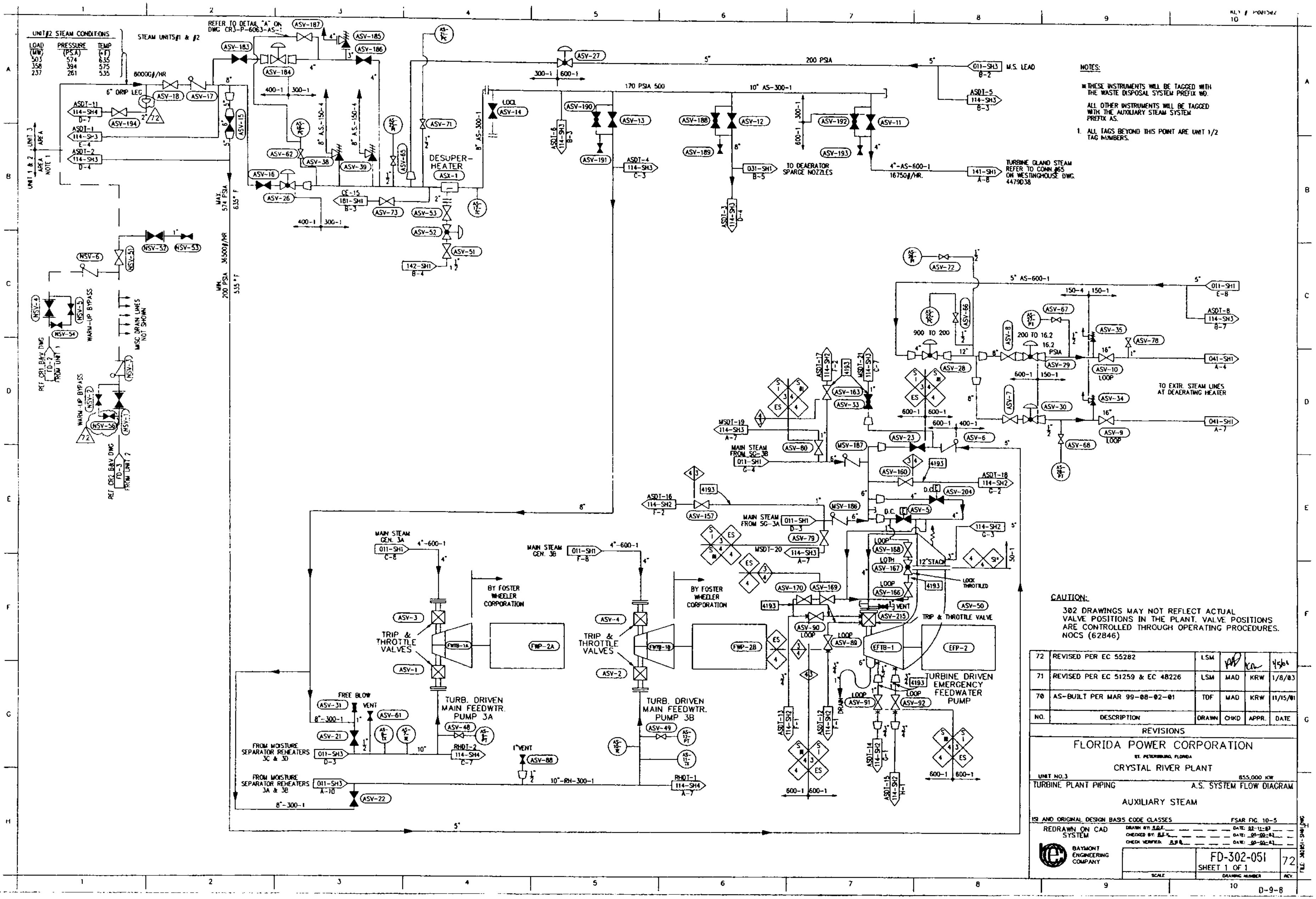
DRAWING NUMBER: FD-302-041 SHEET 01 OF 01

REV. 37

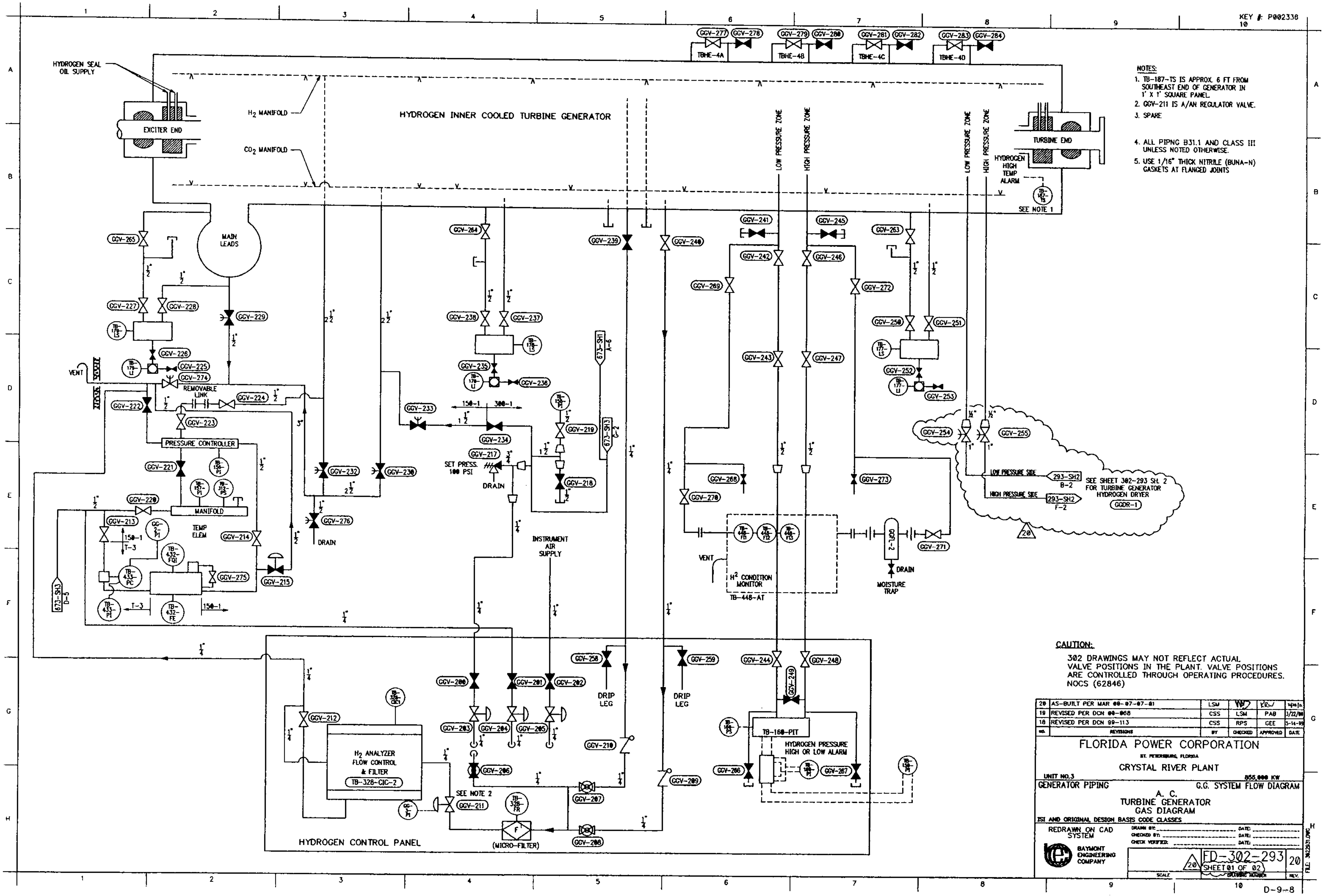
FILE: 302041-SH01.DWG

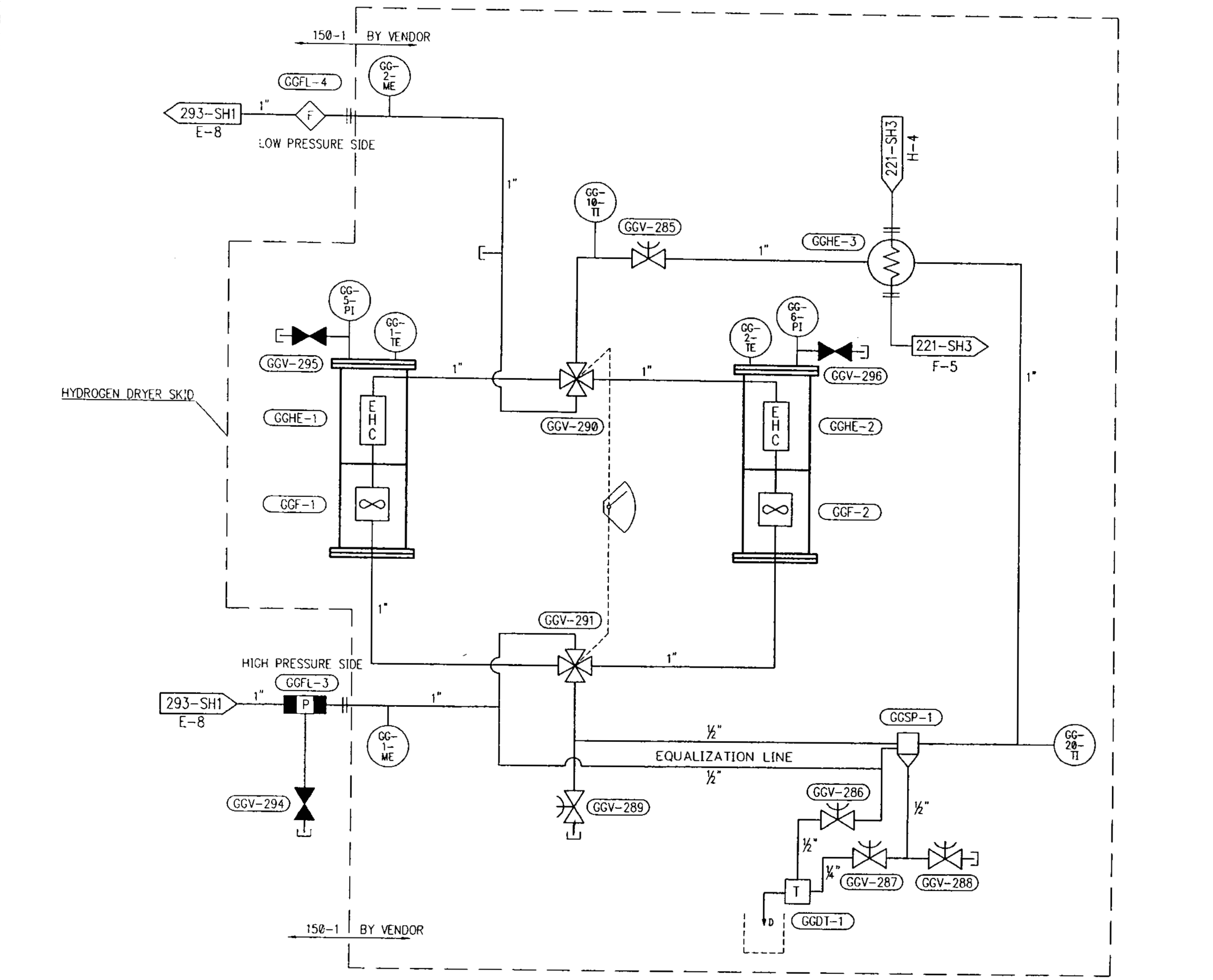
D-9-8

PEF-NCR-03088



PEF-NCR-03089


KEY #: P002338
HYDROGEN SEAL OIL SUPPLY
EXCITER END
H_2 MANIFOLD
CO_2 MANIFOLD
HYDROGEN INNER COOLED TURBINE GENERATOR
TURBINE END
MAIN LEADS
LOW PRESSURE ZONE
HIGH PRESSURE ZONE
HYDROGEN HIGH TEMP ALARM
SEE NOTE 1
NOTES:
1. TB-187-TS IS APPROX. 6 FT FROM SOUTHEAST END OF GENERATOR IN 1' X 1' SQUARE PANEL.
2. GGV-211 IS A/AN REGULATOR VALVE.
3. SPARE
4. ALL PIPNG B31.1 AND CLASS III UNLESS NOTED OTHERWISE.
5. USE 1/16" THICK NITRILE (BUNA-N) GASKETS AT FLANGED JOINTS
PRESSURE CONTROLLER
MANIFOLD
TEMP ELEM
REMOVABLE LINK
VENT
DRAIN
SET PRESS. 100 PSI
INSTRUMENT AIR SUPPLY
H^2 CONDITION MONITOR
TB-448-AT
MOISTURE TRAP
LOW PRESSURE SIDE
HIGH PRESSURE SIDE
SEE SHEET 302-293 SH. 2 FOR TURBINE GENERATOR HYDROGEN DRYER
DRIP LEG
TB-160-PIT
HYDROGEN PRESSURE HIGH OR LOW ALARM
H_2 ANALYZER FLOW CONTROL & FILTER
TB-328-CIC-2
SEE NOTE 2
(MICRO-FILTER)
HYDROGEN CONTROL PANEL
CAUTION:
302 DRAWINGS MAY NOT REFLECT ACTUAL VALVE POSITIONS IN THE PLANT. VALVE POSITIONS ARE CONTROLLED THROUGH OPERATING PROCEDURES. NOCS (62846)
20 AS-BUILT PER MAR 00-07-07-01
19 REVISED PER DCN 00-068
18 REVISED PER DCN 99-113
FLORIDA POWER CORPORATION
ST. PETERSBURG, FLORIDA
CRYSTAL RIVER PLANT
UNIT NO.3
855,000 KW
GENERATOR PIPING
G.G. SYSTEM FLOW DIAGRAM
A. C. TURBINE GENERATOR GAS DIAGRAM
ISI AND ORIGINAL DESIGN BASIS CODE CLASSES
REDRAWN ON CAD SYSTEM
BAYMONT ENGINEERING COMPANY
FD-302-293
SHEET 01 OF 02
20
D-9-8



CAUTION:

302 DRAWINGS MAY NOT REFLECT ACTUAL VALVE POSITIONS IN THE PLANT. VALVE POSITIONS ARE CONTROLLED THROUGH OPERATING PROCEDURES. NOCS (62846)

NO.	REVISIONS	BY	CHECKED	APPROVED	DATE
1	ISSUED AS-BUILT PER MAR 00-07-07-01, FCN 1	LSM	WD	KRW	[illegible]

FLORIDA POWER CORPORATION
ST. PETERSBURG, FLORIDA
CRYSTAL RIVER PLANT
UNIT NO.3 855,000 KW
GENERATOR PIPING G.G. SYSTEM FLOW DIAGRAM

A. C.
TURBINE GENERATOR
GAS DIAGRAM

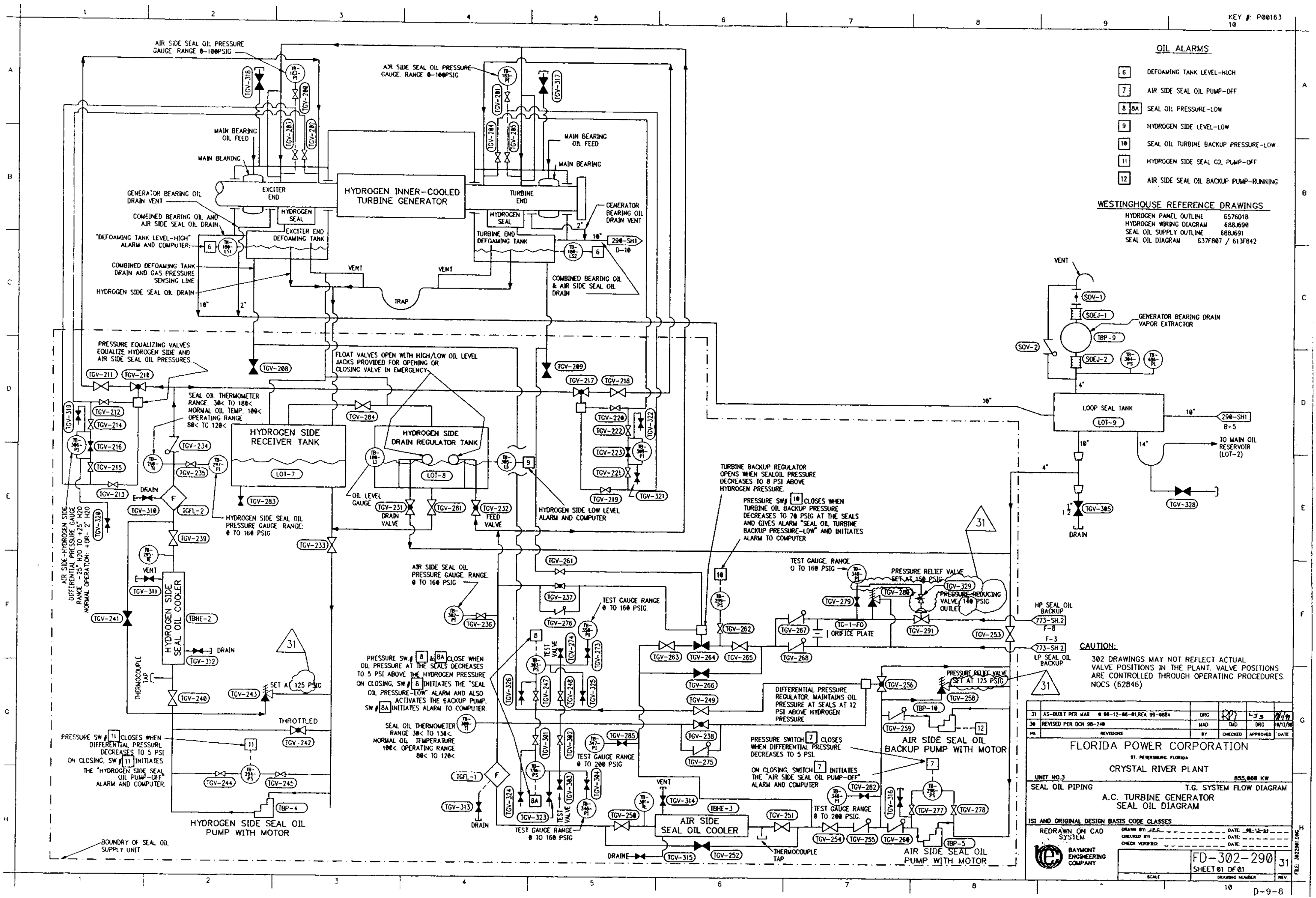
ISI AND ORIGINAL DESIGN BASIS CODE CLASSES

REDRAWN ON CAD SYSTEM
DRAWN BY: DATE:
CHECKED BY: DATE:
CHECK VERIFIED: DATE:
BAYMONT ENGINEERING COMPANY

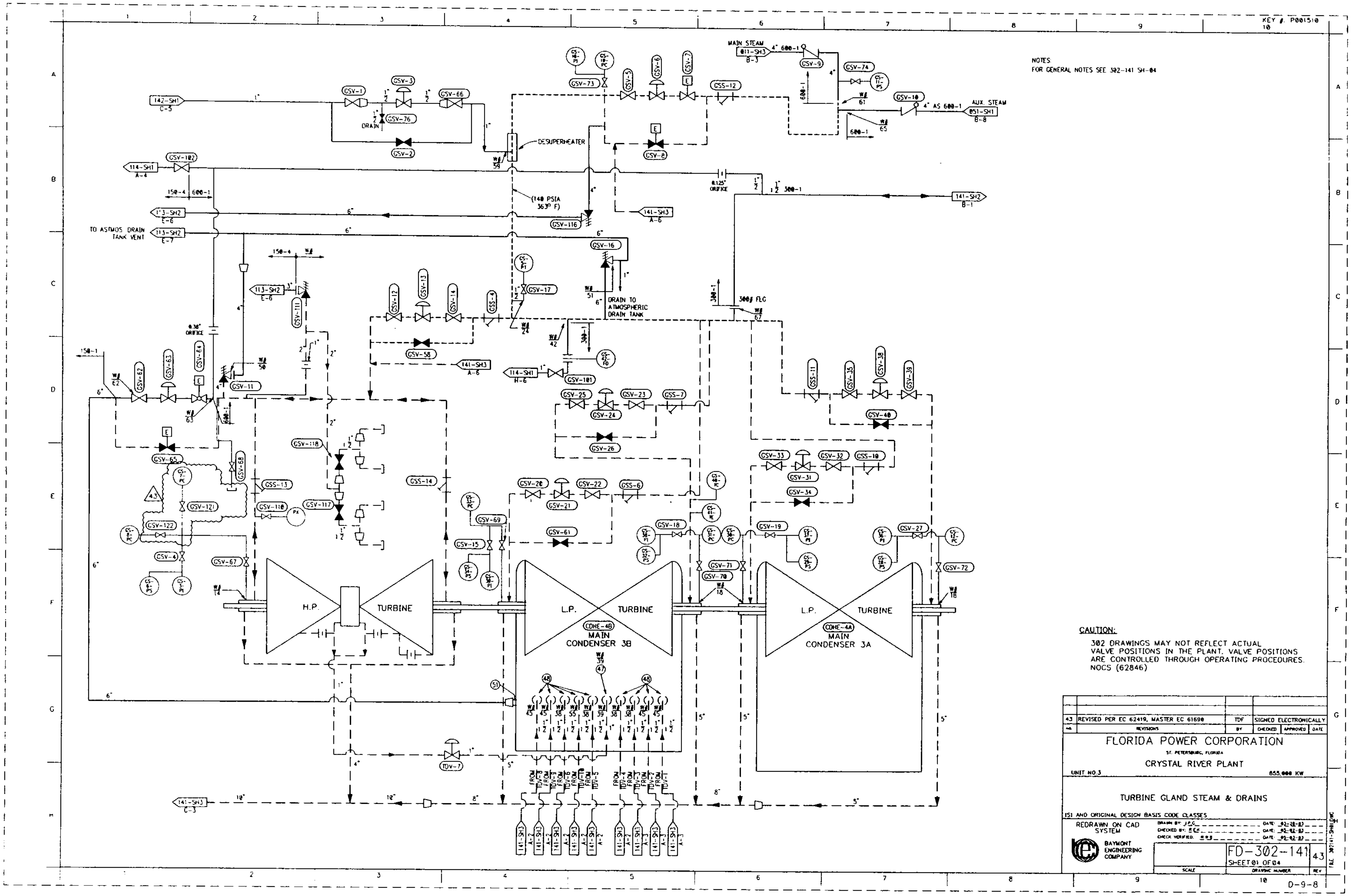
SCALE | DRAWING NUMBER: FD-302-293 SHEET 02 OF 02 | REV. 1

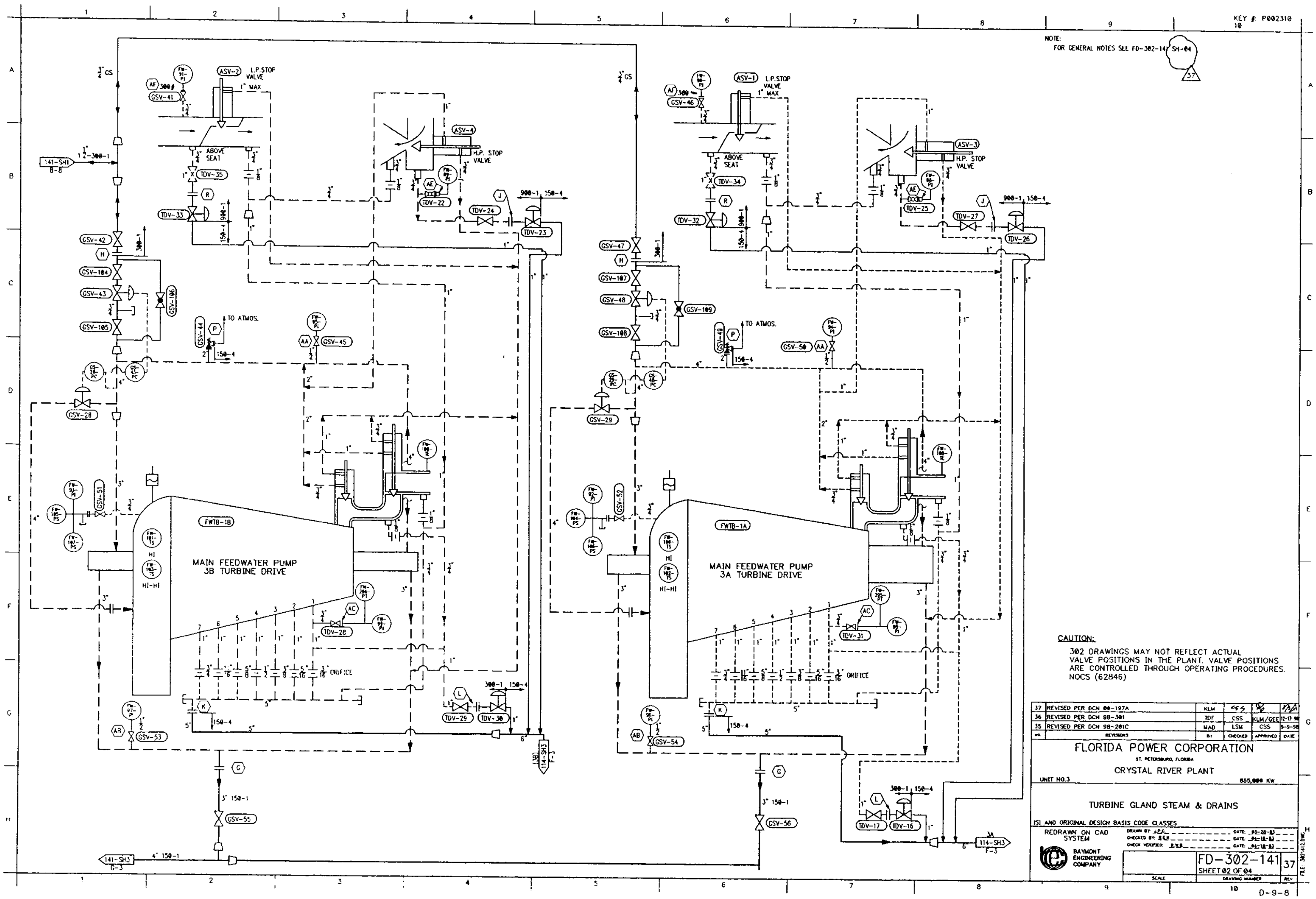
FILE: 3022932.DWG

PEF-NCR-03091

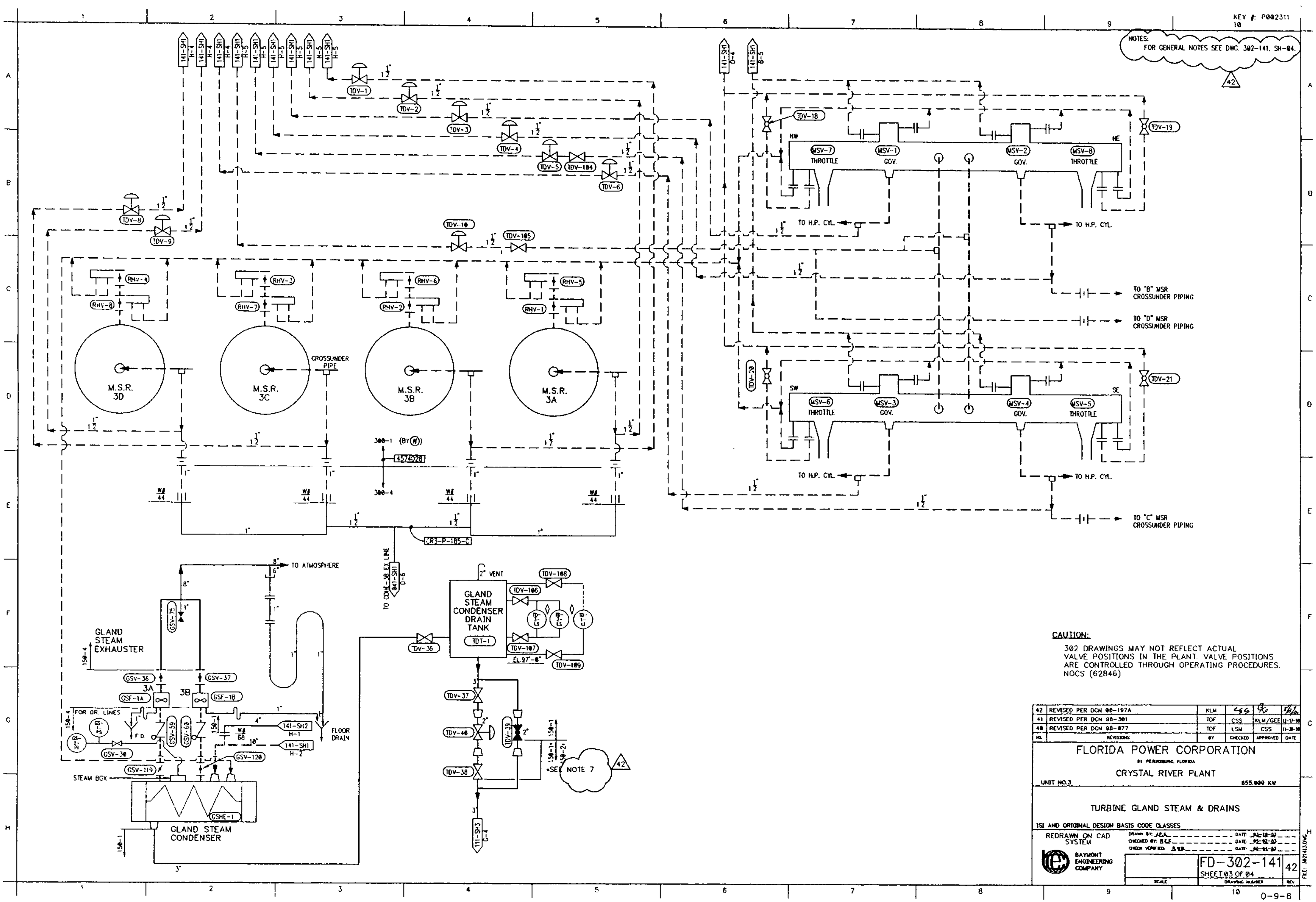


PEF-NCR-03092


KEY #. P001510
NOTES
FOR GENERAL NOTES SEE 302-141 SH-04
MAIN STEAM
AUX. STEAM
DESUPERHEATER
(140 PSIA 363° F)
TO ASTMOS DRAIN TANK VENT
DRAIN TO ATMOSPHERIC DRAIN TANK
0.125" ORIFICE
0.30" ORIFICE
300# FLG
H.P.
TURBINE
L.P.
TURBINE
CDHE-4B
MAIN CONDENSER 3B
CDHE-4A
MAIN CONDENSER 3A
CAUTION:
302 DRAWINGS MAY NOT REFLECT ACTUAL VALVE POSITIONS IN THE PLANT. VALVE POSITIONS ARE CONTROLLED THROUGH OPERATING PROCEDURES. NOCS (62846)
43 REVISED PER EC 62419, MASTER EC 61690
SIGNED ELECTRONICALLY
FLORIDA POWER CORPORATION
ST. PETERSBURG, FLORIDA
CRYSTAL RIVER PLANT
UNIT NO.3
855,000 KW
TURBINE GLAND STEAM & DRAINS
ISI AND ORIGINAL DESIGN BASIS CODE CLASSES
REDRAWN ON CAD SYSTEM
BAYMONT ENGINEERING COMPANY
FD-302-141
SHEET 01 OF 04
43
D-9-8

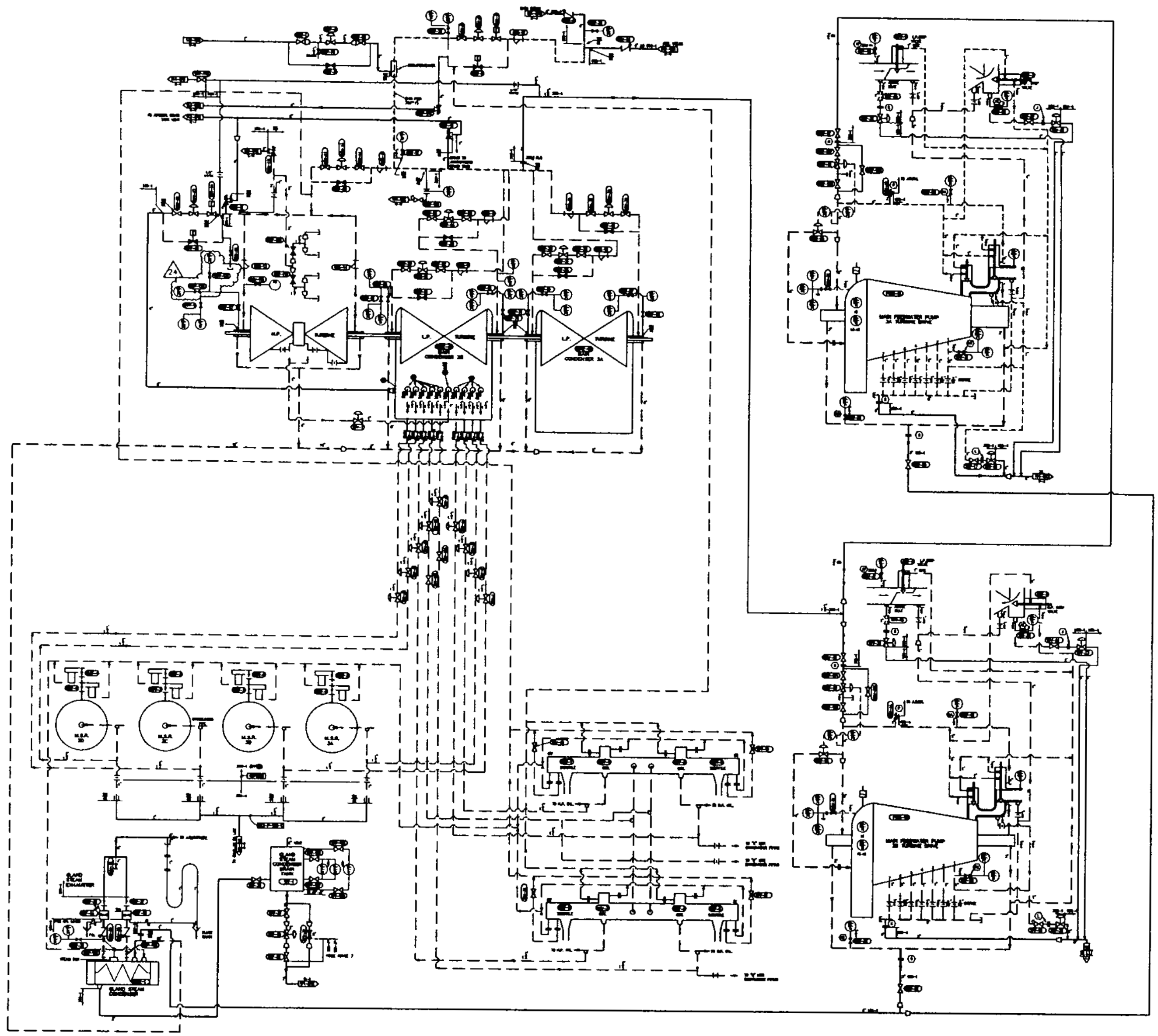


PEF-NCR-03094



PEF-NCR-03095

KEY #: P002312



NOTES:

1. ◯ DENOTES FOSTER WHEELER CONN. POINT ON CONDENSER. FOSTER WHEELER CORP. REFERENCE DWGS. 93-817-5-102, CONDENSER 3A 93-817-5-100, CONDENSER 3B
2. * THESE INSTRUMENTS WILL BE TAGGED WITH THE FEEDWATER SYSTEM PREFIX, FW. ALL OTHER INSTRUMENTS WILL BE TAGGED WITH THE TURBINE GLAND STEAM SYSTEM PREFIX, GS
3. ⬡ DENOTES DE LAVAL CONN. POINT
4. DENOTES WESTINGHOUSE CONN. POINT
5. ◊ THESE INSTRUMENTS WILL BE TAGGED WITH THE TURBINE DRAINS SYSTEM PREFIX TD.
6. ALL PIPING ON FD-302-141 IS B31.1,SIL
7. ORIGINAL PIPING SPEC. IS 150-1. FITTINGS ARE TO BE REPLACED WITH 304SS (150-2) FOR EROSION-CORROSION RESISTANCE WHEN NECESSARY (MAY INCLUDE UP TO 12" PIPING ON EITHER SIDE ALSO.)

CAUTION:

302 DRAWINGS MAY NOT REFLECT ACTUAL VALVE POSITIONS IN THE PLANT. VALVE POSITIONS ARE CONTROLLED THROUGH OPERATING PROCEDURES. NOCS (62846)

NO.	REVISIONS	BY	CHECKED	APPROVED	DATE
24	REVISED PER EC 62419. MASTER EC 61690	TDF	SIGNED ELECTRONICALLY		

FLORIDA POWER CORPORATION

ST. PETERSBURG, FLORIDA

CRYSTAL RIVER PLANT

UNIT NO.3 855,000 KW

TURBINE GLAND STEAM & DRAINS

ISI AND ORIGINAL DESIGN BASIS CODE CLASSES

REDRAWN ON CAD SYSTEM

BAYMONT ENGINEERING COMPANY

DRAWN BY: JEQ DATE: 03-28-85

CHECKED BY: DATE:

CHECK VERIFIED: DATE:

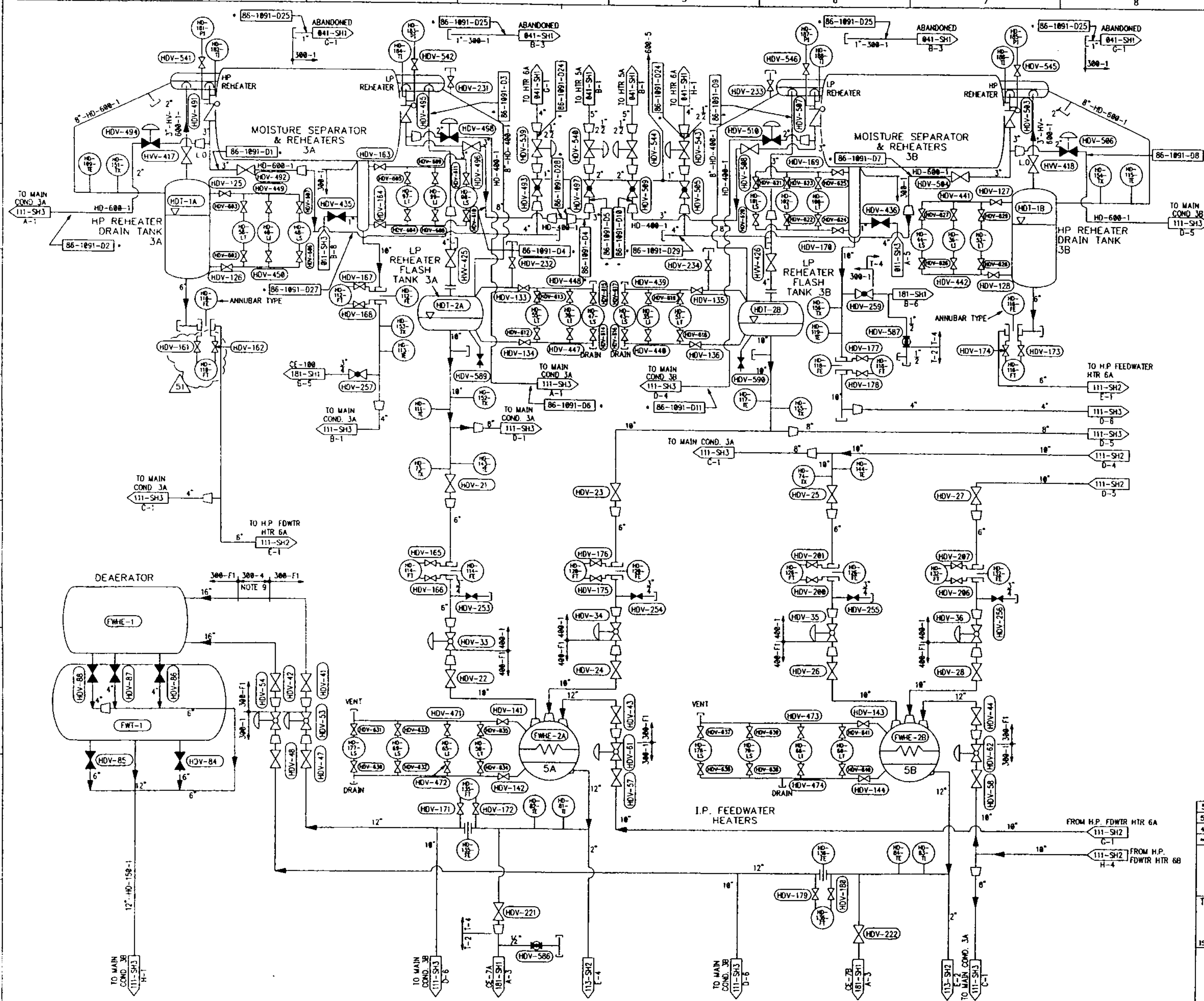
SCALE	DRAWING NUMBER	REV.
COMPOSITE	FD-302-141 SHEET 04 OF 04	24

FILE: 302141-SH04.DWG

D-9-8

PEF-NCR-03096

KEY #: P001506



NOTES:

1. ◯ DENOTES F-W CONN. POINT
2. REF F-W DWGS.
   93-817-5-102 CDSER 3A
   93-817-5-100 CDSER 3B
3. ALL PIPING ON THIS DRAWING IS B31.1,S-III
4. "•" DENOTES ISOMETRIC VENDOR DRAWINGS FROM SOUTHWESTERN ENGINEERING COMPANY. (CONTAIN MATERIAL SPEC. INFO.) ALSO SEE SOUTHWESTERN ENGINEERING COMPANY DRAWINGS 86-1091-SK1 THROUGH 86-1091-SK7
5. HDV-499,501,511,513,523,525,535,AND 537 ARE ADMINISTRATIVELY CONTROLLED AT 50% OPEN (5 TURNS)
6. HDV-497,509,521,AND 533 ARE ADMINISTRATIVELY CONTROLLED 20% OPEN (2 TURNS ± TURN)
7. HDV-493,505,517,AND 529 ARE ADMINISTRATIVELY CONTROLLED 40% OPEN (4 TURNS ± TURN)
8. VALVES LISTED IN NOTES 5,6 AND 7 ABOVE ARE NOT TO BE ADJUSTED WITHOUT NUCLEAR ENGINEERING/SOUTHWESTERN ENGINEERING APPROVAL.
9. 2' VERTICAL SECTION OF PIPING BETWEEN THE 16" TEES IS CHROME MOLY P22 SCH80.

CAUTION:

302 DRAWINGS MAY NOT REFLECT ACTUAL VALVE POSITIONS IN THE PLANT. VALVE POSITIONS ARE CONTROLLED THROUGH OPERATING PROCEDURES. NOCS (62846)

NO.	REVISIONS	BY	CHECKED	APPROVED	DATE
51	AS-BUILT PER TEMP EC 52145	LSM	[illegible]	[illegible]	[illegible]
50	AS-BUILT PER TEMP EC 52145	LSM	CSS	LJS	4/16/03
49	REVISED PER EC 48591	MAD	LSM	KRW	6/17/02

FLORIDA POWER CORPORATION

ST. PETERSBURG, FLORIDA

CRYSTAL RIVER PLANT

UNIT NO.3 855,000 KW

TURBINE PLANT PIPING H.D. SYSTEM FLOW DIAGRAM

LOW PRESSURE & HIGH PRESSURE FEEDWATER HEATER DRAINS (AND VENTS)

ISI AND ORIGINAL DESIGN BASIS CODE CLASSES

REDRAWN ON CAD SYSTEM

DRAWN BY: D.F.R. DATE: 03-20-03
CHECKED BY: R.F.A. DATE: 04-13-03
CHECK VERIFIED: R.W.B. DATE: 04-13-03

BAYMONT ENGINEERING COMPANY

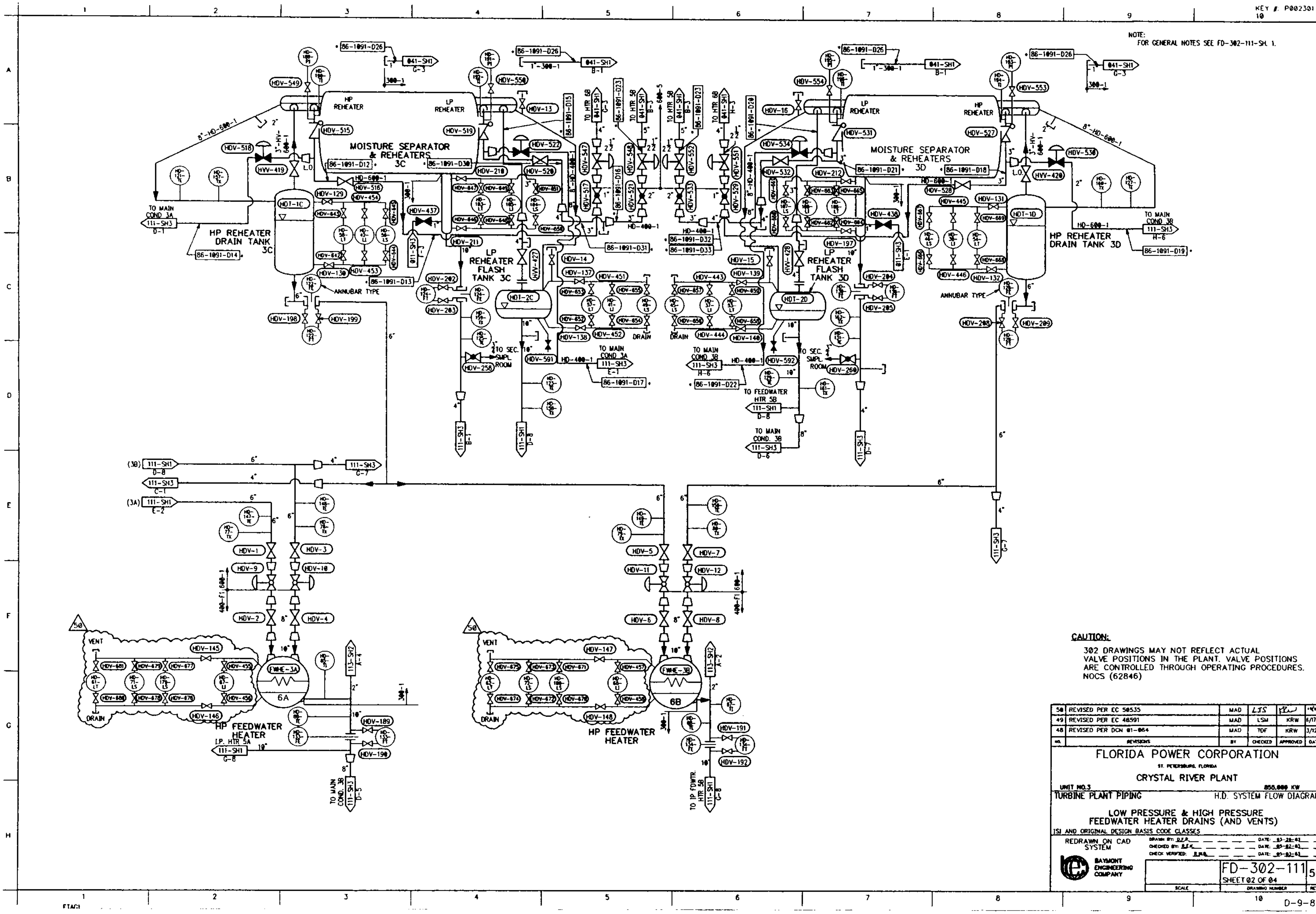
SCALE

DRAWING NUMBER: FD-302-111 SHEET 01 OF 04

REV. 51

FILE: 302111.DWG

PEF-NCR-03097



CAUTION:

302 DRAWINGS MAY NOT REFLECT ACTUAL VALVE POSITIONS IN THE PLANT. VALVE POSITIONS ARE CONTROLLED THROUGH OPERATING PROCEDURES. NOCS (62846)

NO.	REVISIONS	BY	CHECKED	APPROVED	DATE
50	REVISED PER EC 58535	MAD	LJS		
49	REVISED PER EC 48591	MAD	LSM	KRW	6/17/02
48	REVISED PER DCN 01-064	MAD	TDF	KRW	3/12/01

FLORIDA POWER CORPORATION
ST. PETERSBURG, FLORIDA

CRYSTAL RIVER PLANT

UNIT NO.3 — 855,000 KW

TURBINE PLANT PIPING — H.D. SYSTEM FLOW DIAGRAM

LOW PRESSURE & HIGH PRESSURE FEEDWATER HEATER DRAINS (AND VENTS)

ISI AND ORIGINAL DESIGN BASIS CODE CLASSES

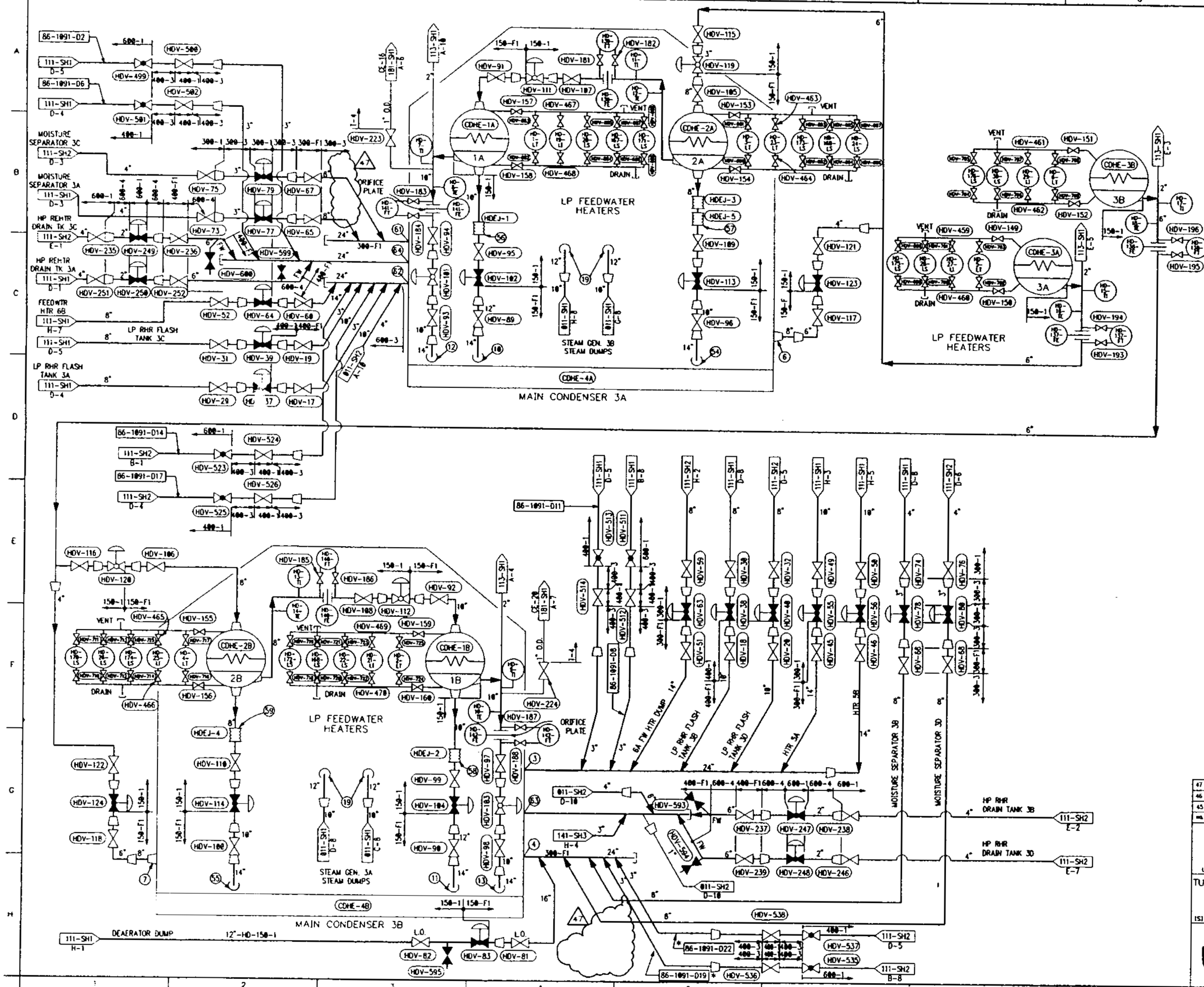
REDRAWN ON CAD SYSTEM

BAYMONT ENGINEERING COMPANY

FD-302-111 — SHEET 02 OF 04 — REV. 50

D-9-8

PEF-NCR-03098



NOTE:
FOR GENERAL NOTES SEE FD-302-111-SH. 1.

CAUTION:

302 DRAWINGS MAY NOT REFLECT ACTUAL VALVE POSITIONS IN THE PLANT. VALVE POSITIONS ARE CONTROLLED THROUGH OPERATING PROCEDURES. NOCS (62846)

NO.	REVISIONS	BY	CHECKED	APPROVED	DATE
47	REVISED PER EC 52435	LSM	CSS	KRW	4/14/04
46	REVISED PER EC 48501	MAD	LSM	KRW	6/17/02
45	AS-BUILT PER MAR 00-06-04-01	LSM	SRB	KRW	10/29/01

FLORIDA POWER CORPORATION
ST. PETERSBURG, FLORIDA
CRYSTAL RIVER PLANT
UNIT NO.3 855,000 KW

TURBINE PLANT PIPING H.D. SYSTEM FLOW DIA.
LOW PRESSURE & HIGH PRESSURE
FEEDWATER HEATER DRAINS (AND VENTS)
ISI AND ORIGINAL DESIGN BASIS CODE CLASSES

REDRAWN ON CAD SYSTEM
DRAWN BY: D.F.R. DATE: 03-28-03
CHECKED BY: R.F.F. DATE: 04-11-03
CHECK VERIFIED: R.H.B. DATE: 04-11-03
BAYMONT ENGINEERING COMPANY

SCALE | DRAWING NUMBER: FD-302-111 SHEET 03 OF 04 | REV. 47

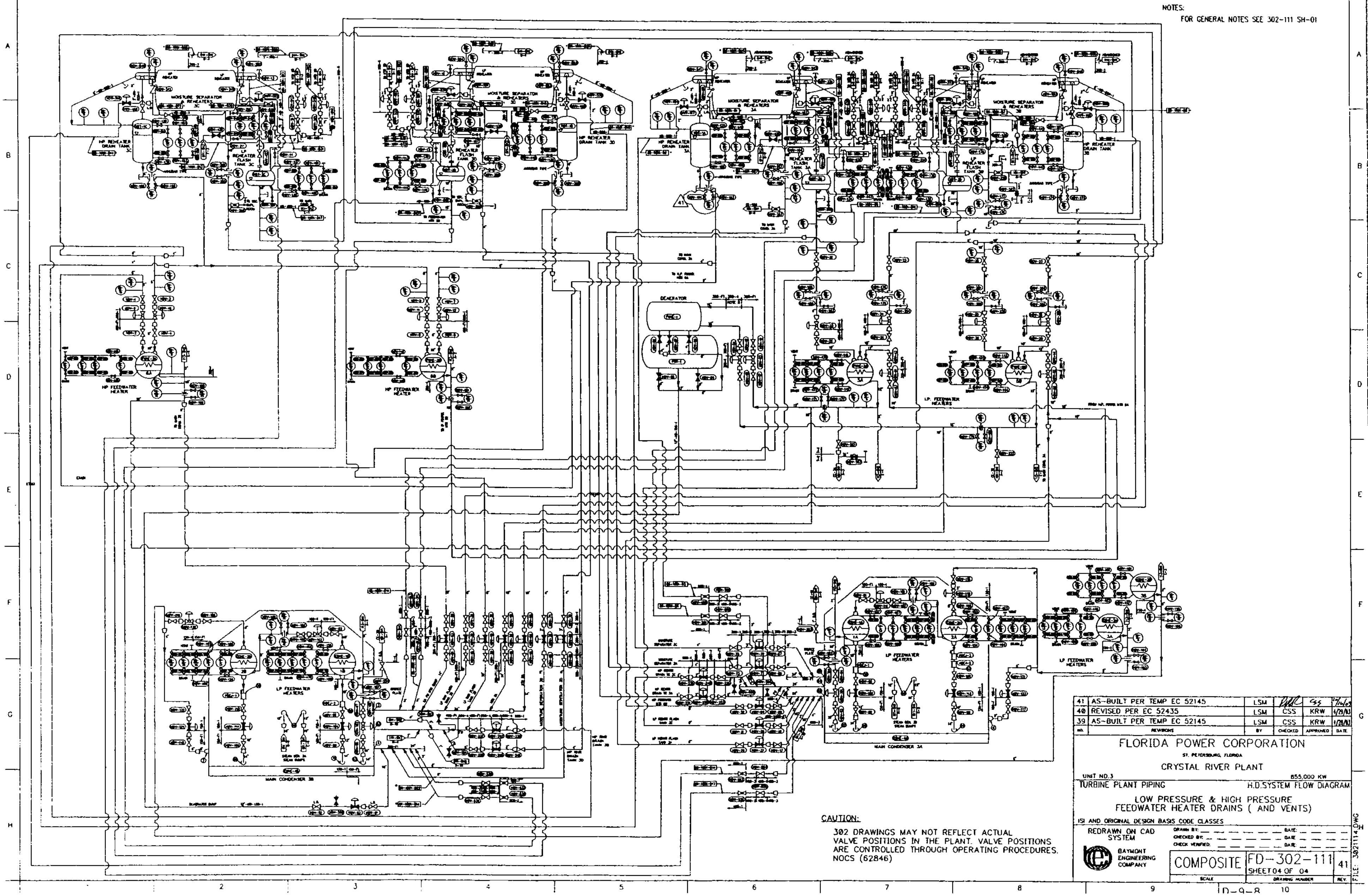
FILE: 30211113.DWG

D-9-B

PEF-NCR-03099

KEY #: P00230310

NOTES:
FOR GENERAL NOTES SEE 302-111 SH-01



CAUTION:
302 DRAWINGS MAY NOT REFLECT ACTUAL VALVE POSITIONS IN THE PLANT. VALVE POSITIONS ARE CONTROLLED THROUGH OPERATING PROCEDURES. NOCS (62846)

NO.	REVISIONS	BY	CHECKED	APPROVED	DATE
41	AS-BUILT PER TEMP EC 52145	LSM	[illegible]	CSS	12/16/05
40	REVISED PER EC 52435	LSM	CSS	KRW	4/29/03
39	AS-BUILT PER TEMP EC 52145	LSM	CSS	KRW	4/28/03

FLORIDA POWER CORPORATION
ST. PETERSBURG, FLORIDA
CRYSTAL RIVER PLANT
UNIT NO.3 855,000 KW
TURBINE PLANT PIPING H.D.SYSTEM FLOW DIAGRAM
LOW PRESSURE & HIGH PRESSURE FEEDWATER HEATER DRAINS (AND VENTS)
ISI AND ORIGINAL DESIGN BASIS CODE CLASSES
REDRAWN ON CAD SYSTEM
DRAWN BY: DATE:
CHECKED BY: DATE:
CHECK VERIFIED: DATE:
BAYMONT ENGINEERING COMPANY

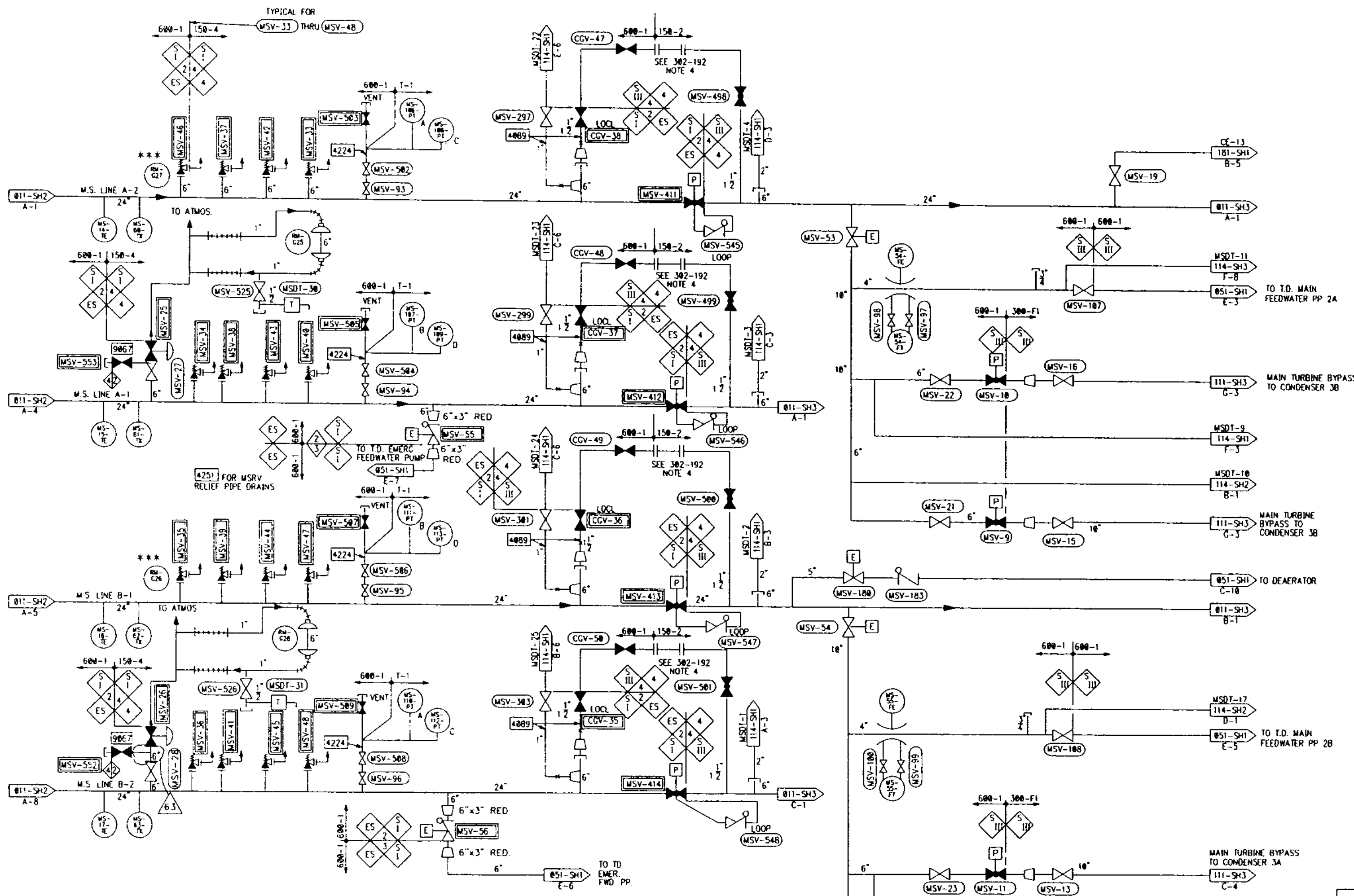
SCALE	DRAWING NUMBER	REV.
COMPOSITE	FD-302-111 SHEET 04 OF 04	41

FILE: 3021114.DWG

ID-9-8 10

PEF-NCR-03100

KEY #: P001499



NOTES:

1. SEE THESE ISO'S FOR F.W. DOC ON 24" MS LINES, X-RAY PLUGS

3535 , 3536 , 3537 , 3538

2. FOR PENETRATION CONTAINMENT ISOLATION CONFIGURATION SEE REF. DWG'S 315-105, 315-106, 315-107, 315-201, 315-314, 315-316, 315-318, 315-320, 315-427, 315-428

*** THESE GAMMA DETECTORS MONITOR THE MAIN STEAM LINES BUT ARE NOT PHYSICALLY CONNECTED

CAUTION:

302 DRAWINGS MAY NOT REFLECT ACTUAL VALVE POSITIONS IN THE PLANT. VALVE POSITIONS ARE CONTROLLED THROUGH OPERATING PROCEDURES. NOCS (62846)

NO	REVISIONS	BY	CHECKED	APPROVED	DATE
63	AS-BUILT PER EC 61022	LSM			

FLORIDA POWER CORPORATION

ST. PETERSBURG, FLORIDA

CRYSTAL RIVER PLANT

UNIT NO.3 855,000 KW

TURBINE PLANT PIPING M.S & R.H. SYSTEM FLOW DIAGRAM

MAIN & REHEAT STEAM

ISI AND ORIGINAL DESIGN BASIS CODE CLASSES FSAR FIG. 10-4(1OF4)

REDRAWN ON CAD SYSTEM

DRAWN BY: C.W DATE: 01-20-03

CHECKED BY: R.E.K. DATE: 05-04-03

CHECK VERIFIED: R.W.B DATE: 05-04-03

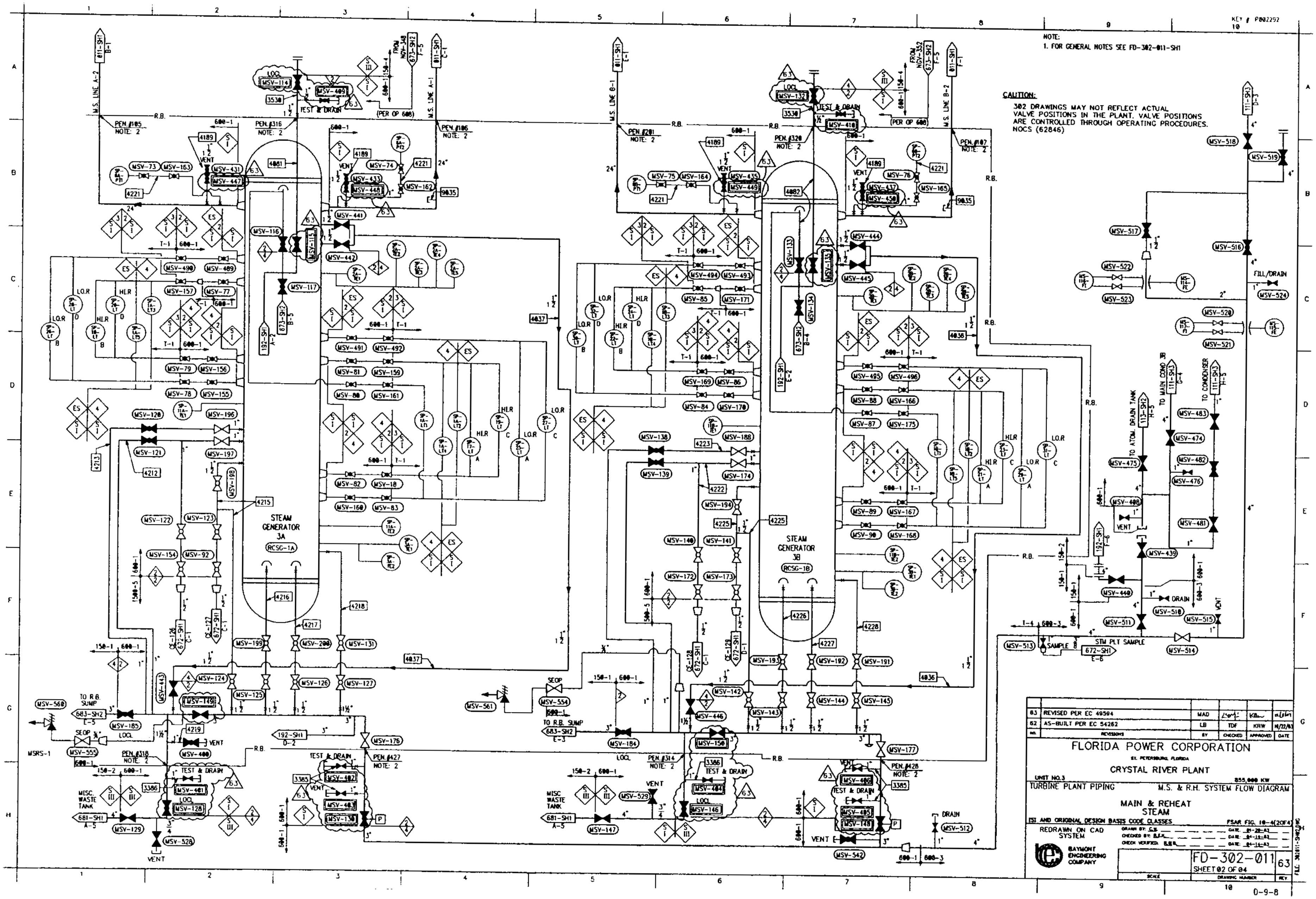
BAYMONT ENGINEERING COMPANY

SCALE	DRAWING NUMBER	REV.
	FD-302-011 SHEET 01 OF 04	63

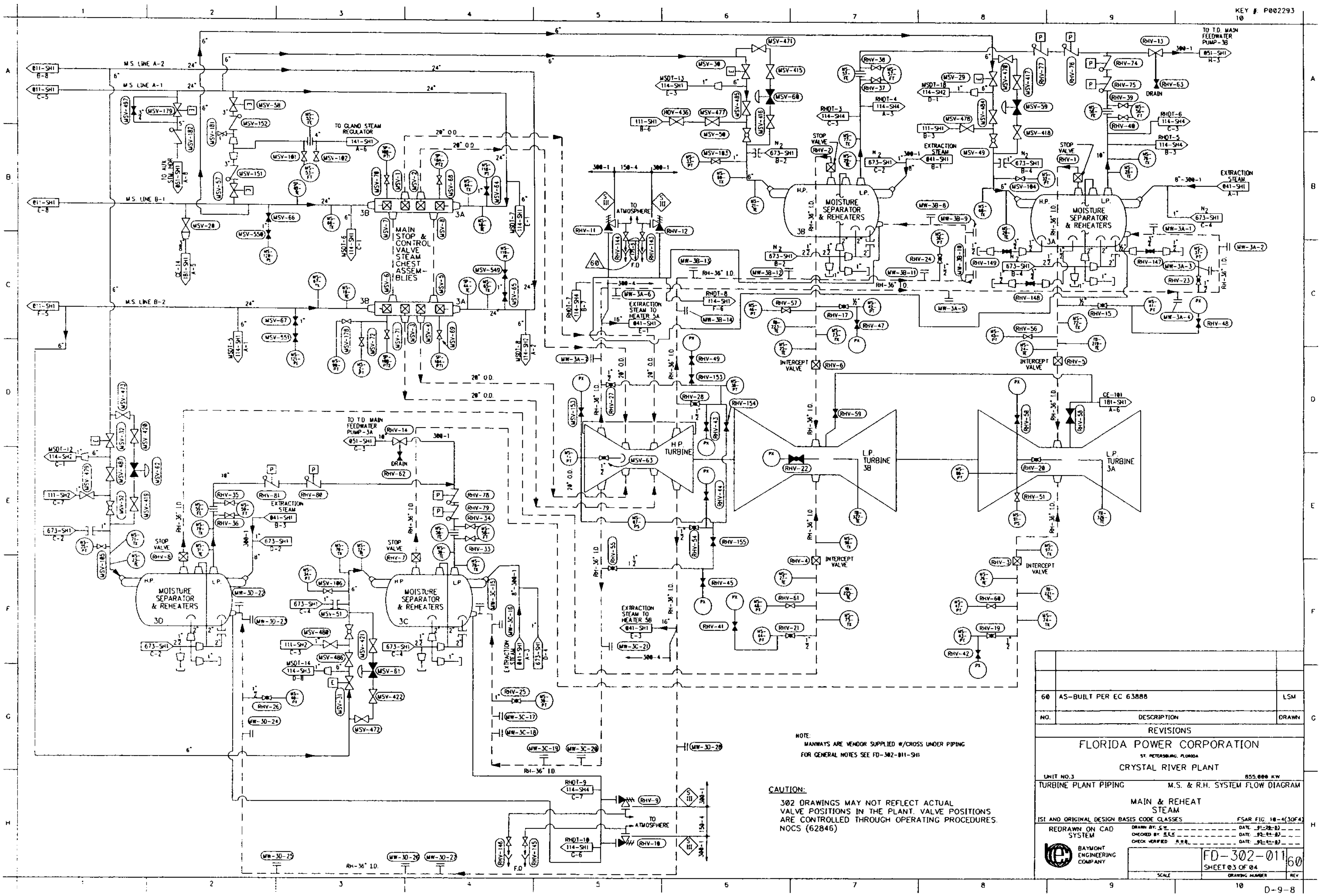
FILE 302011-SH01.DWG

D-9-8

PEF-NCR-03101

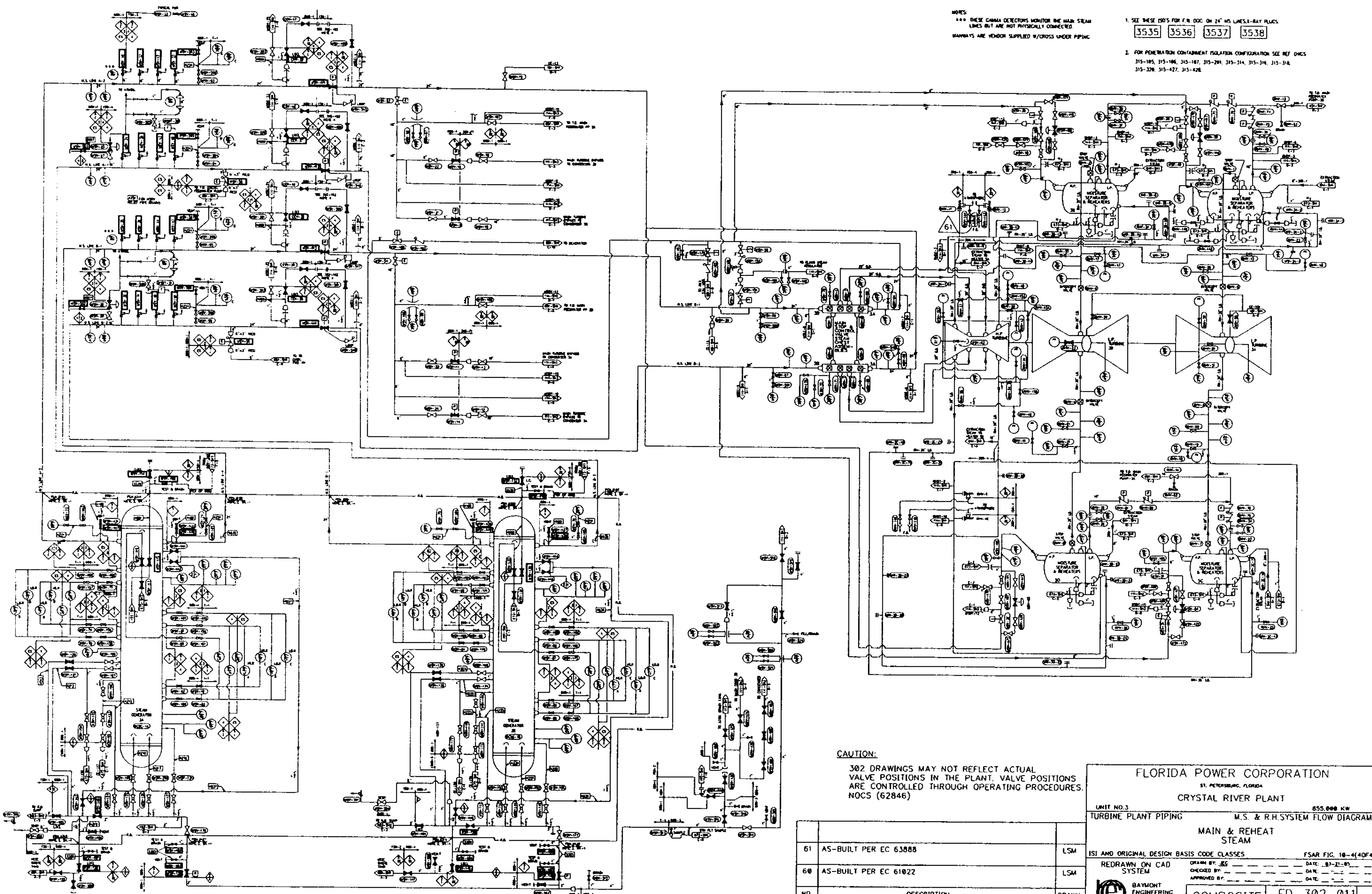


PEF-NCR-03102



PEF-NCR-03103

KEY NO. P002294



NOTES:
*** THESE GAMMA DETECTORS MONITOR THE MAIN STEAM LINES BUT ARE NOT PHYSICALLY CONNECTED.
MANWAYS ARE VENDOR SUPPLIED W/CROSS UNDER PIPING

1. SEE THESE ISO'S FOR F.N. DOC. ON 24" MS LINES,X-RAY PLUGS. 3535 3536 3537 3538
2. FOR PENETRATION CONTAINMENT ISOLATION CONFIGURATION SEE REF DWGS 315-105, 315-106, 315-107, 315-201, 315-314, 315-316, 315-318, 315-320, 315-427, 315-428

CAUTION:

302 DRAWINGS MAY NOT REFLECT ACTUAL VALVE POSITIONS IN THE PLANT. VALVE POSITIONS ARE CONTROLLED THROUGH OPERATING PROCEDURES. NOCS (62846)

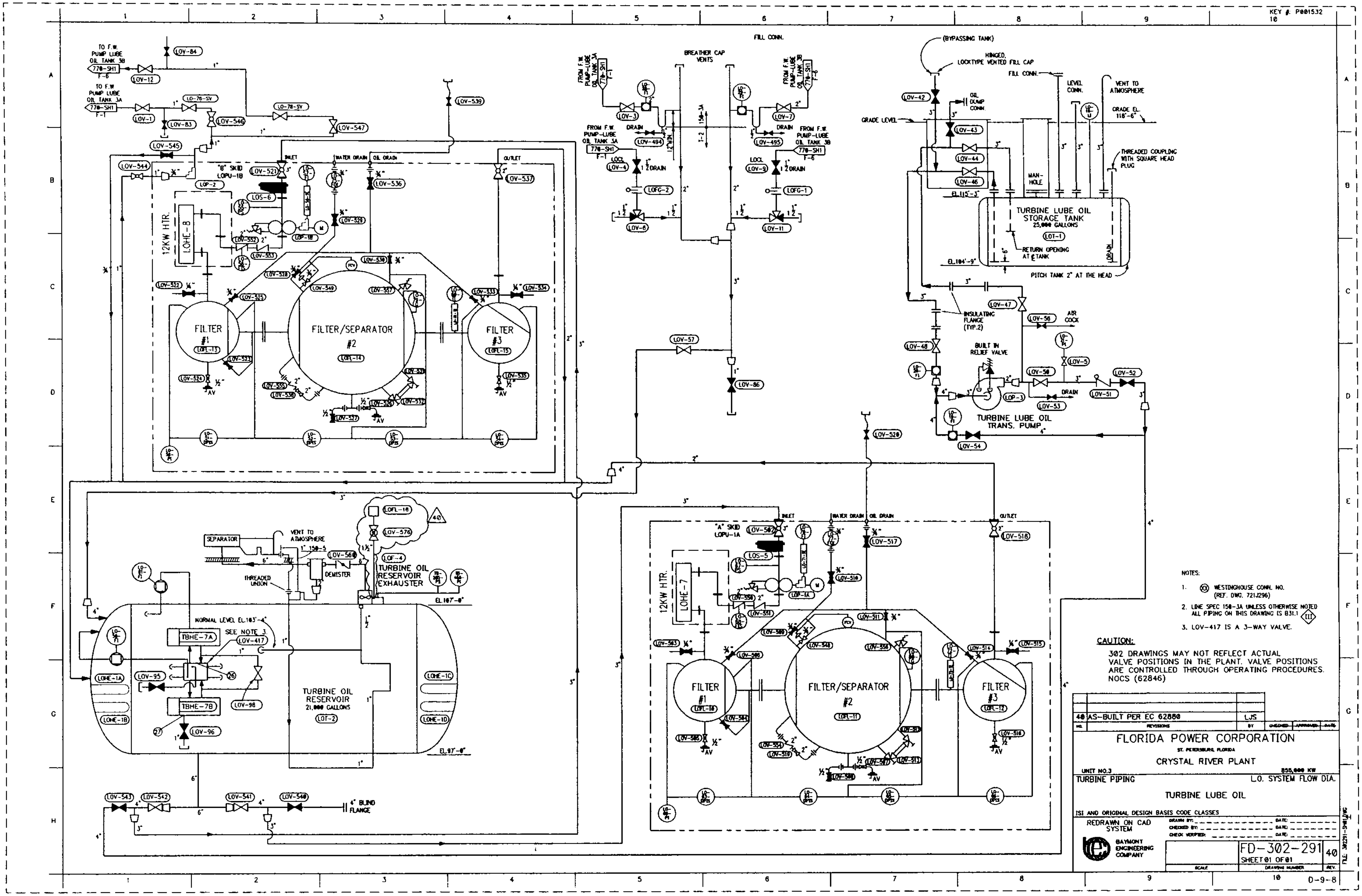
NO.	DESCRIPTION	DRAWN
61	AS-BUILT PER EC 63888	LSM
60	AS-BUILT PER EC 61022	LSM

REVISIONS

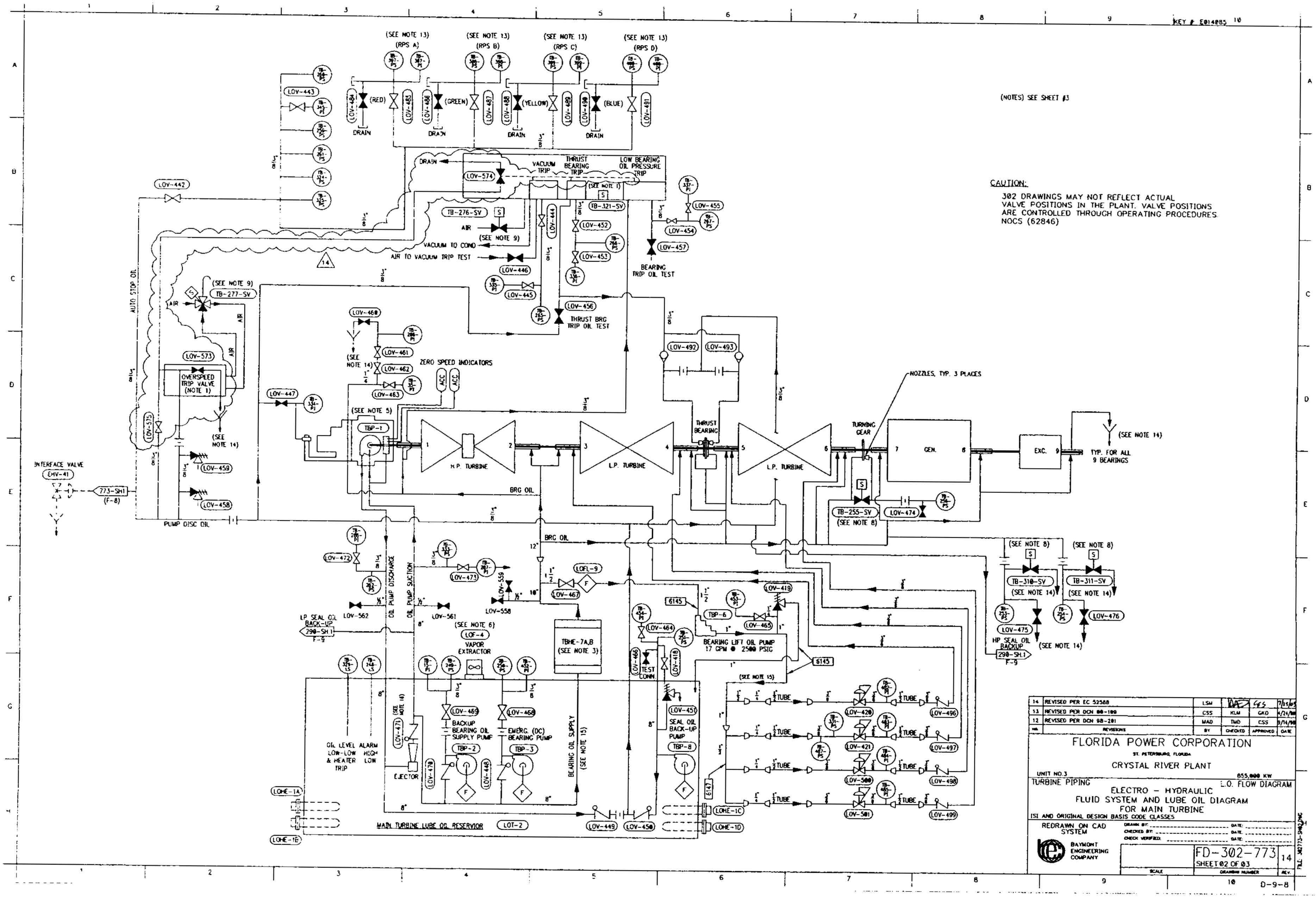
FLORIDA POWER CORPORATION
ST. PETERSBURG, FLORIDA
CRYSTAL RIVER PLANT
UNIT NO.3 855,000 KW
TURBINE PLANT PIPING M.S. & R.H.SYSTEM FLOW DIAGRAM
MAIN & REHEAT STEAM
ISI AND ORIGINAL DESIGN BASIS CODE CLASSES FSAR FIG. 10-4(4OF4)
REDRAWN ON CAD SYSTEM
DRAWN BY: JEG DATE: 03-21-05
CHECKED BY: DATE:
APPROVED BY: DATE:
BAYMONT ENGINEERING COMPANY
COMPOSITE | FD-302-011 SHEET 04OF 04 | 61
SCALE | DRAWING NUMBER | REV

D-9-8

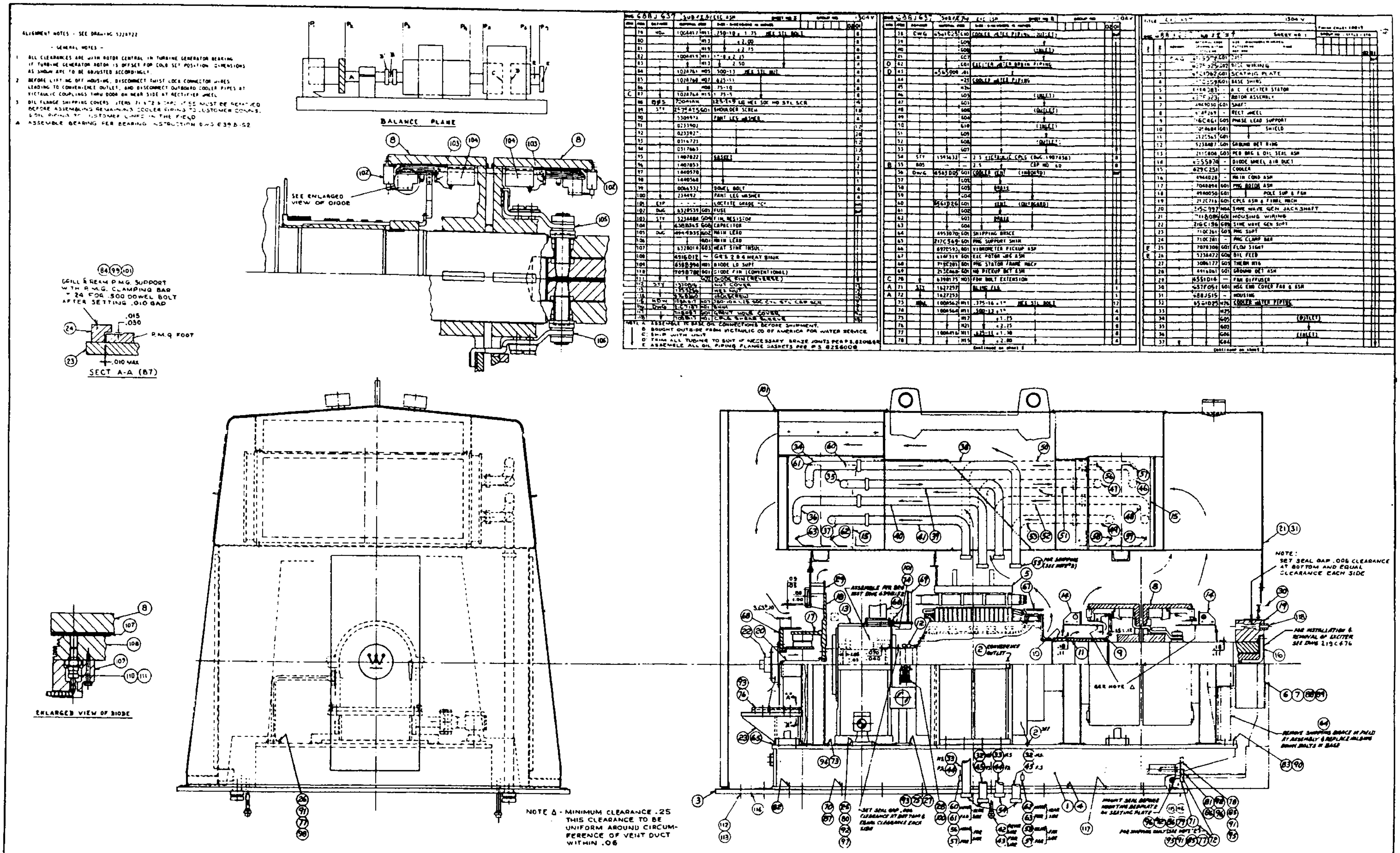
PEF-NCR-03104



PEF-NCR-03105



PEF-NCR-03106



REVISION "0"

Dwg. 688J637-4 Brushless Exciter Assembly **FIG. 1**

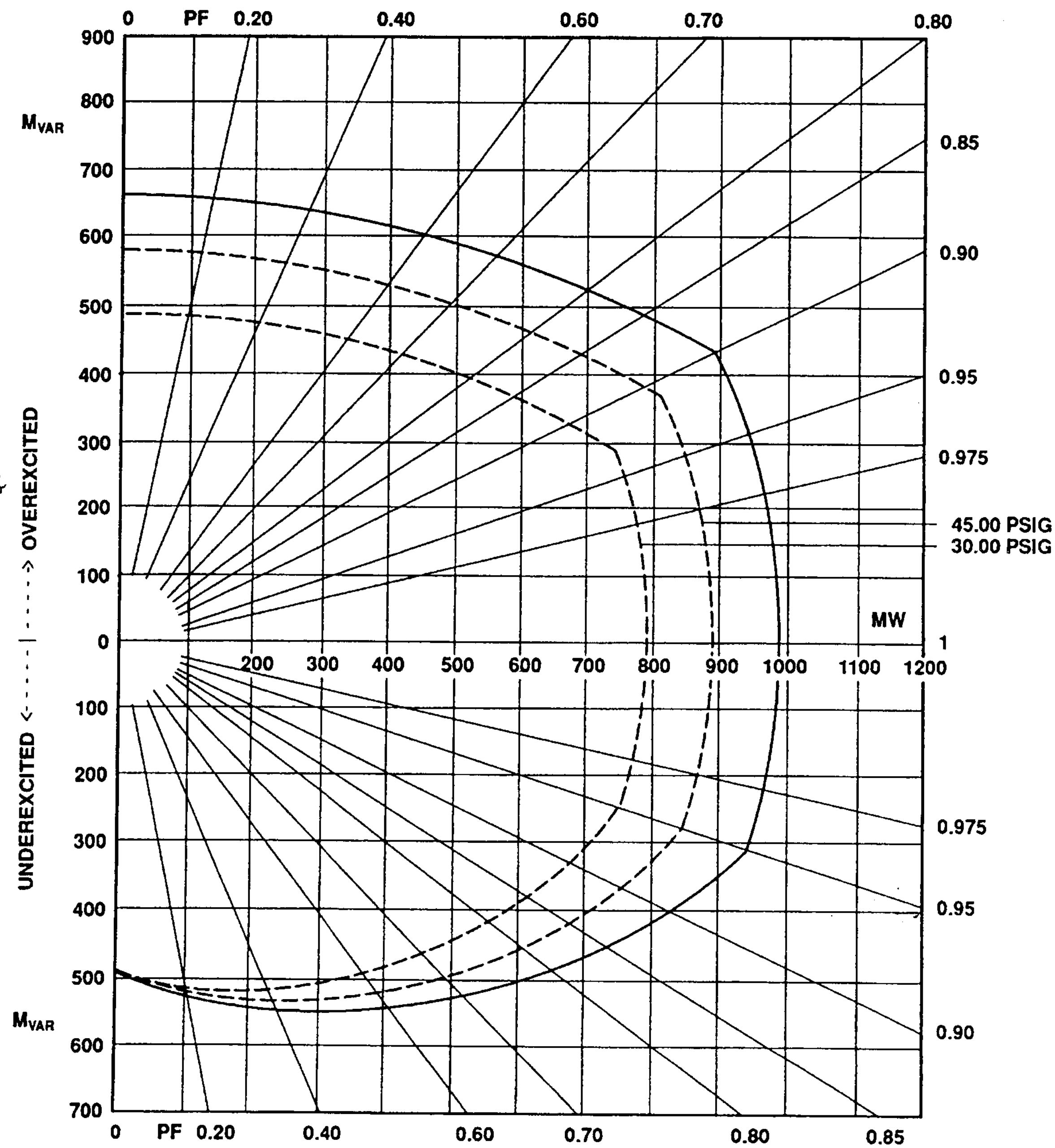
PEF-NCR-03107

SIEMENS

Reactive Capability Curve

GENERATOR-TYPE: THDD 170/70-18

RATED GENERATOR OUTPUT	S_N	=	989.400	MVA
RATED ARMATURE VOLTAGE	U_X	=	22.000	kV
RATED ARMATURE CURRENT	I_N	=	25.965	kA
RATED FREQUENCY	F_X	=	60.0	Hz
POWER FACTOR	PF	=	0.900	
RATED H2-PRESSURE	P_E	=	60.00	PSIG



LAGGING

PRINTED IN U.S.A.

SIEMENS

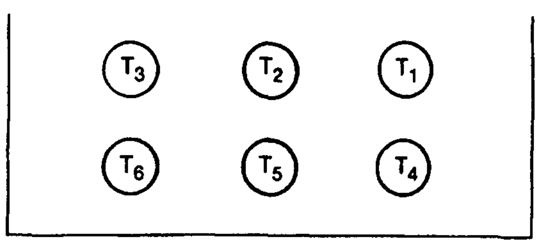
General Information
Technical Data

Job name	Crystal River 3	Job No.	12- 7459
Generator type	THDD 170/70-18	Serial No.	12 7459
Main exciter type	Existing	Serial No.	12 - E5
Pilot exciter type	Existing	Serial No.	12 - E7

Apparent power	S_N	989,4		MVA
Voltage	U_N	22 ± 5%		kV
Current	I_N	25,965		kA
Field voltage	U_f	500		V
Field current	I_f	6340		A
Power factor	P.F.	0,9		
Frequency	f_N	60		Hz
Speed	n_N	1800		rpm
Hydrogen gauge pressure	P_g	60		psig
Phase sequence		T_1 T_2 T_3	Connection	Y
Direction of rotation		Clockwise/looking at drive end		
Class of insulation		Stator F		
		Rotor -		
Excitation system		-		

Stator with two-layer lap winding			
Cooling gas	H_2	Cold gas temperature 46 (115)	°C (F°)
Cooling gas volumetric flow	V	≈ 61	m^3/s

Terminal arrangement (Top view)



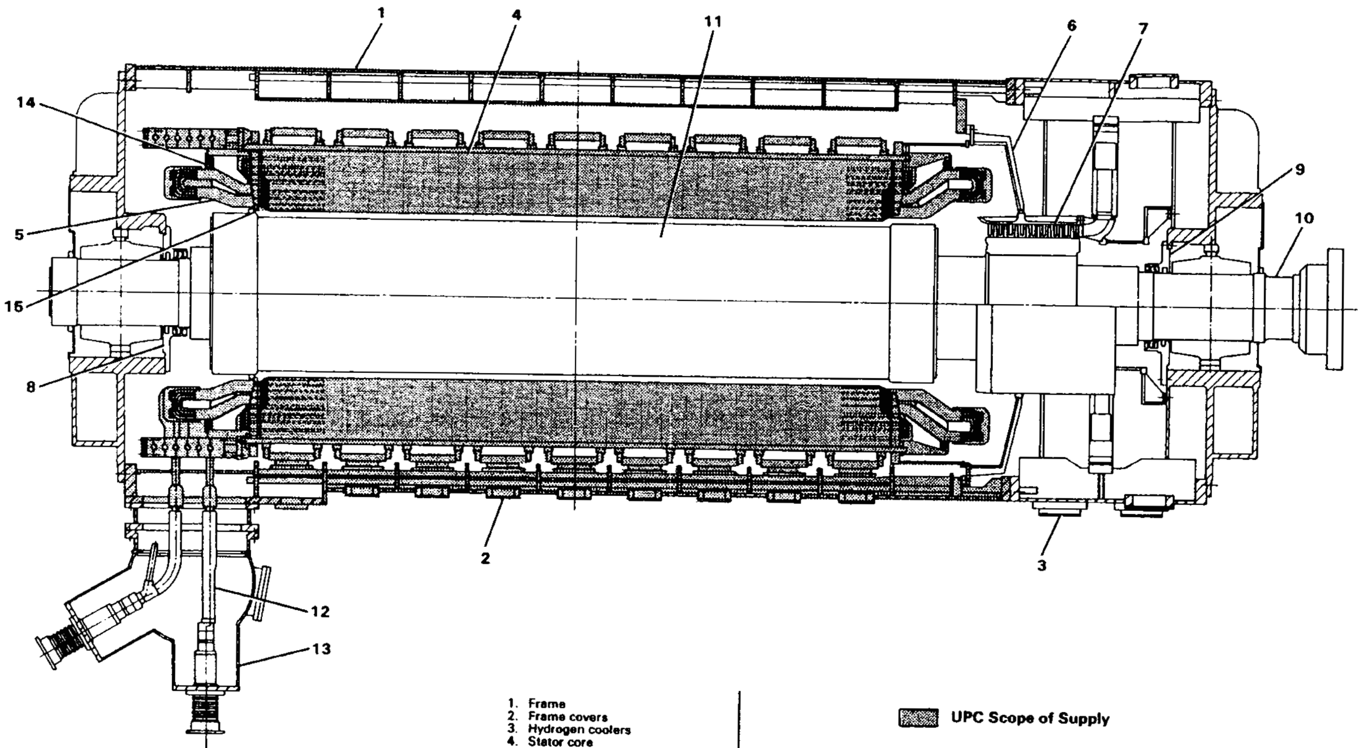
Exciter end

Siemens Power Corporation

REVISION "0"

2.7-1710-7459/1
0890

PEF-NCR-03109



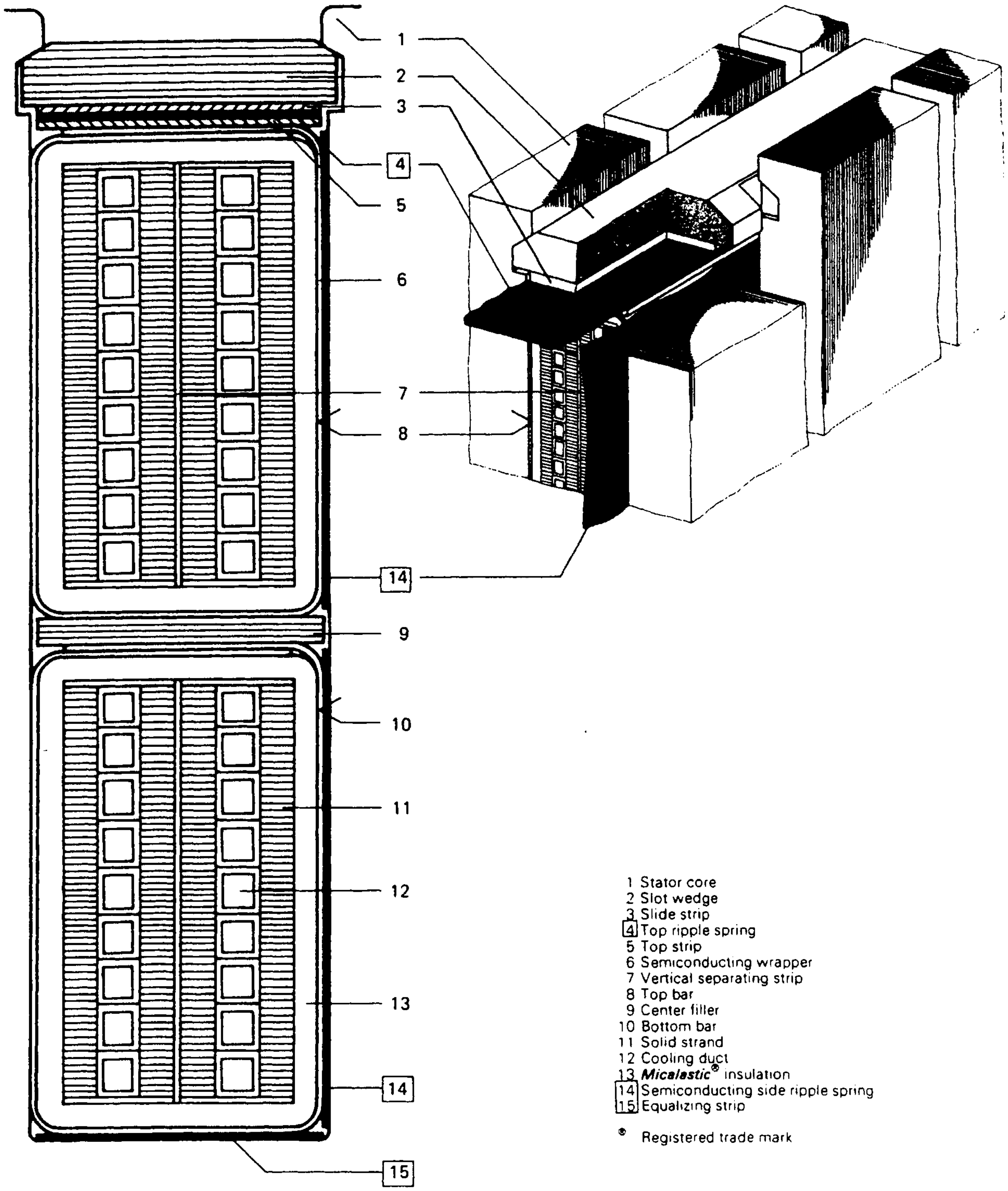
1. Frame
2. Frame covers
3. Hydrogen coolers
4. Stator core
5. Stator winding
6. Blower shroud support assembly
7. Blower
8. Gland seal, bearing & brackets
9. Gland seal, bearing & brackets
10. Shaft
11. Rotor
12. Main leads
13. Main lead box
14. Vibrometer pickup
15. Air gap baffle

UPC Scope of Supply

REVISION "0"

2.1-1040-7459/1
UPC 1189

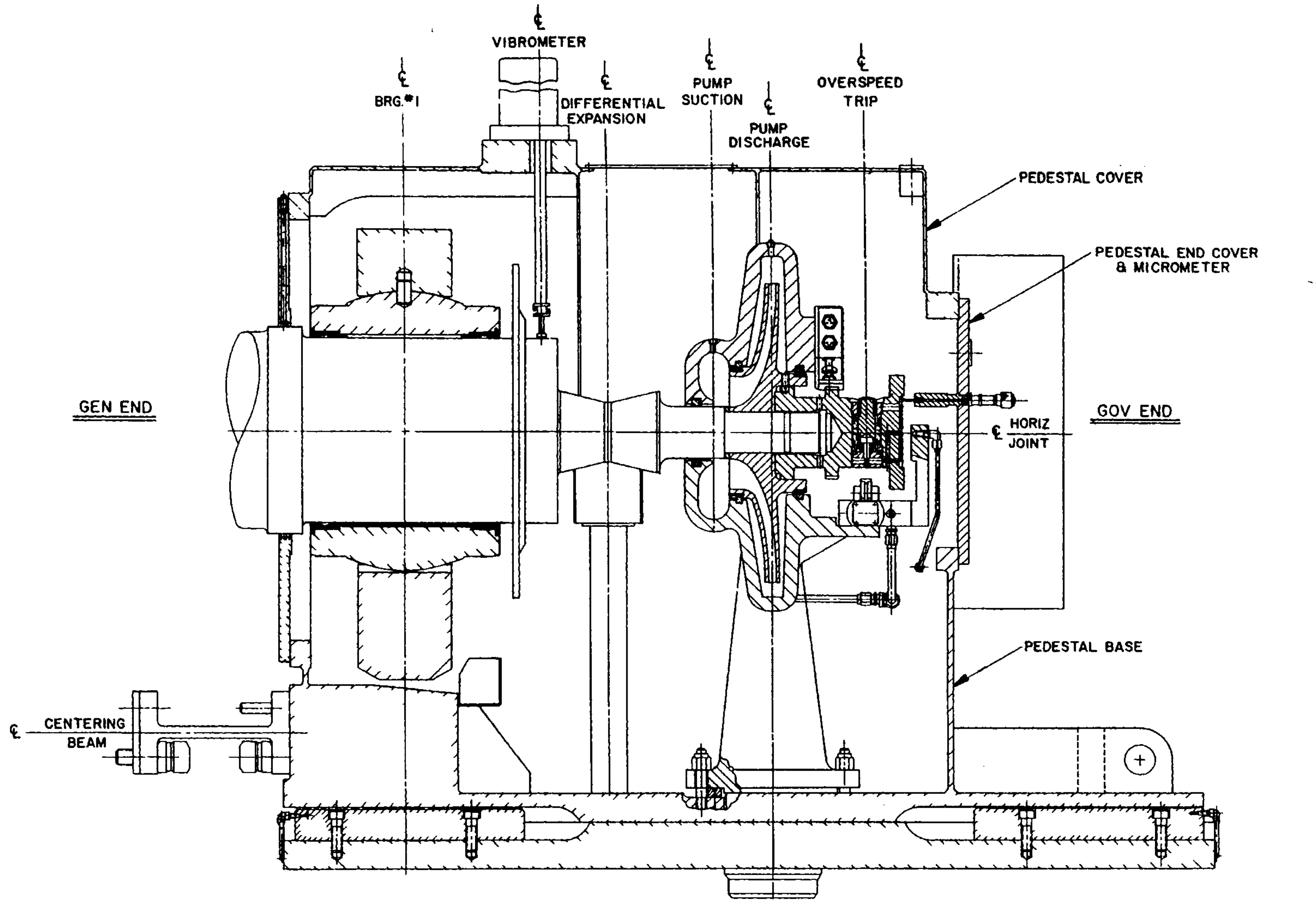
PEF-NCR-03110



1 Stator core
2 Slot wedge
3 Slide strip
4 Top ripple spring
5 Top strip
6 Semiconducting wrapper
7 Vertical separating strip
8 Top bar
9 Center filler
10 Bottom bar
11 Solid strand
12 Cooling duct
13 ***Micalastic***® insulation
14 Semiconducting side ripple spring
15 Equalizing strip

® Registered trade mark

REVISION "0"

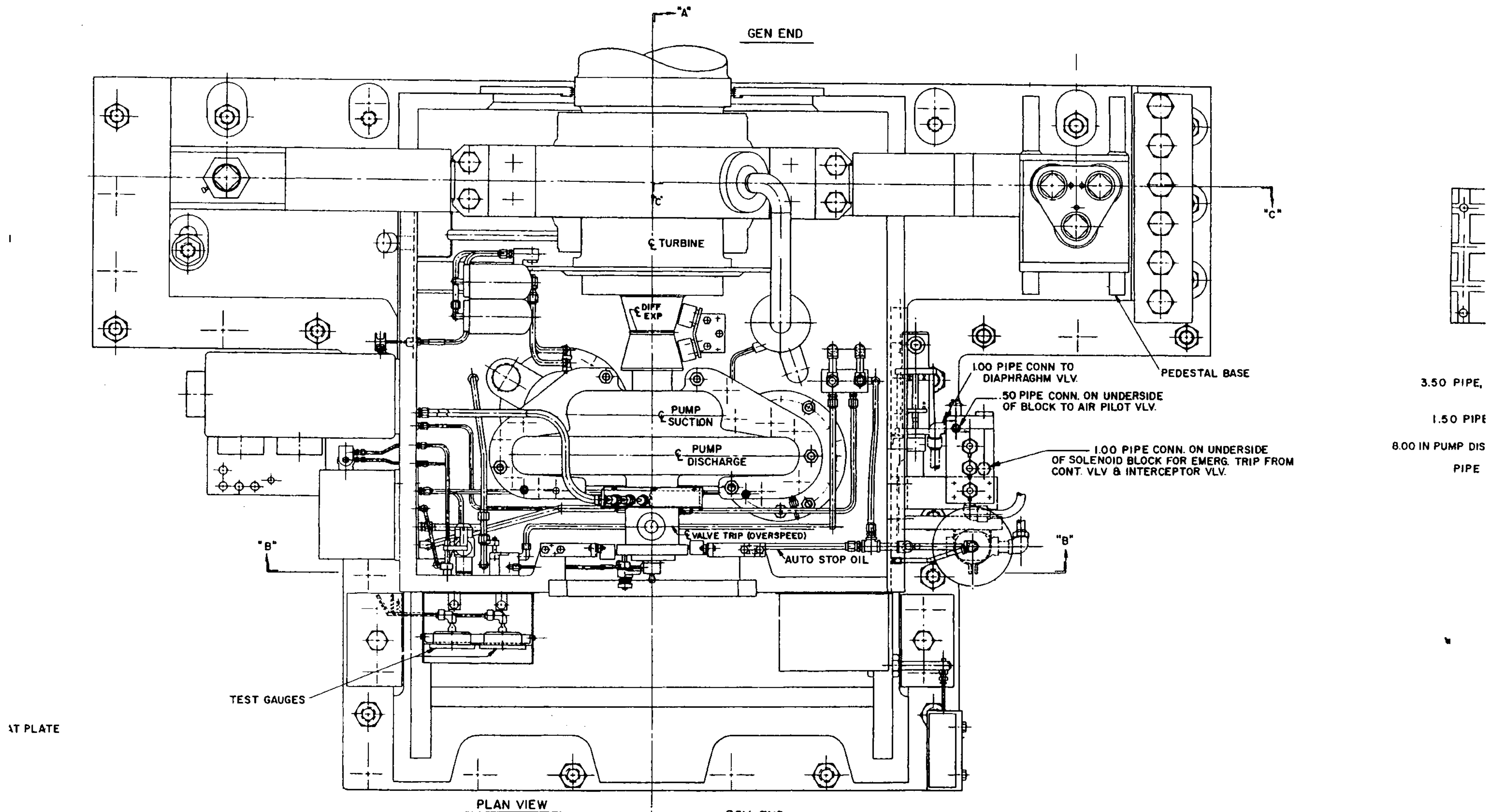


SECTION "A"-"A"

REVISION "O"

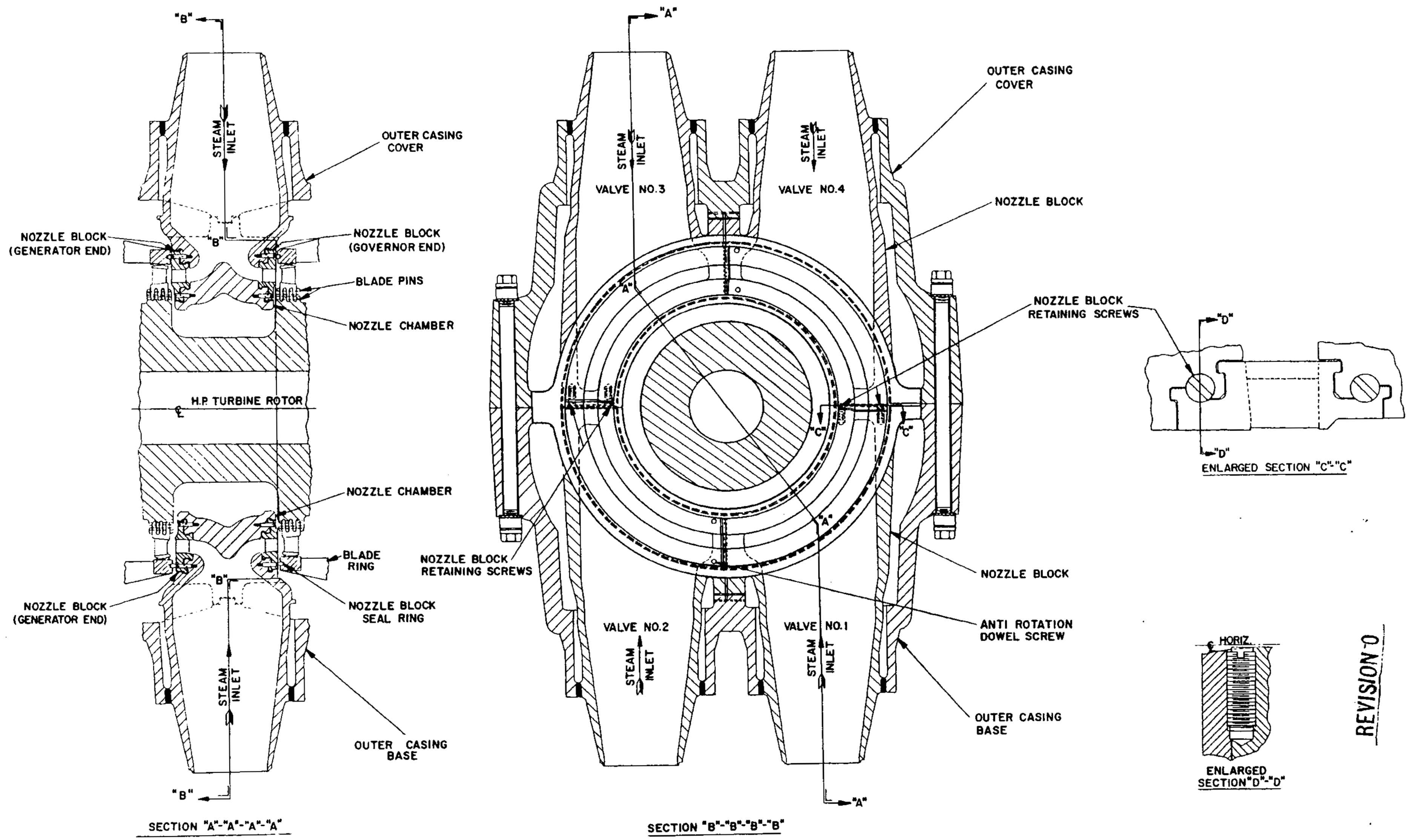
PEF-NCR-03112

Bearing, Pedestal Assembly
725-J-333



PLAN VIEW
(WITH COVER REMOVED)

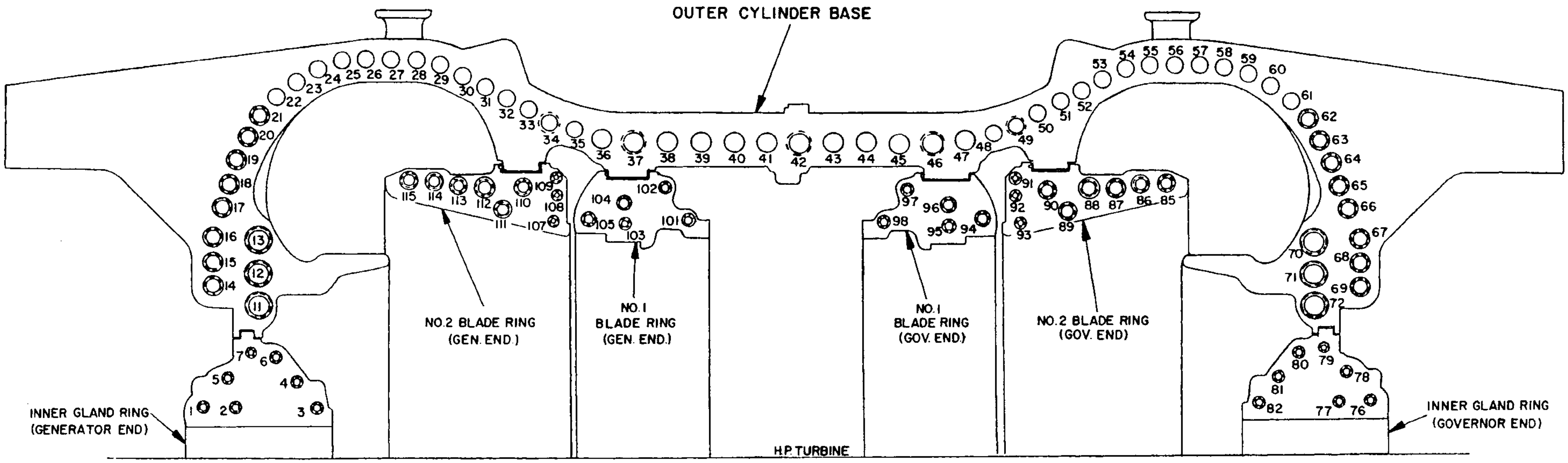
PEF-NCR-03113



REVISION 0

Figure 1
I.L. 1250-4021

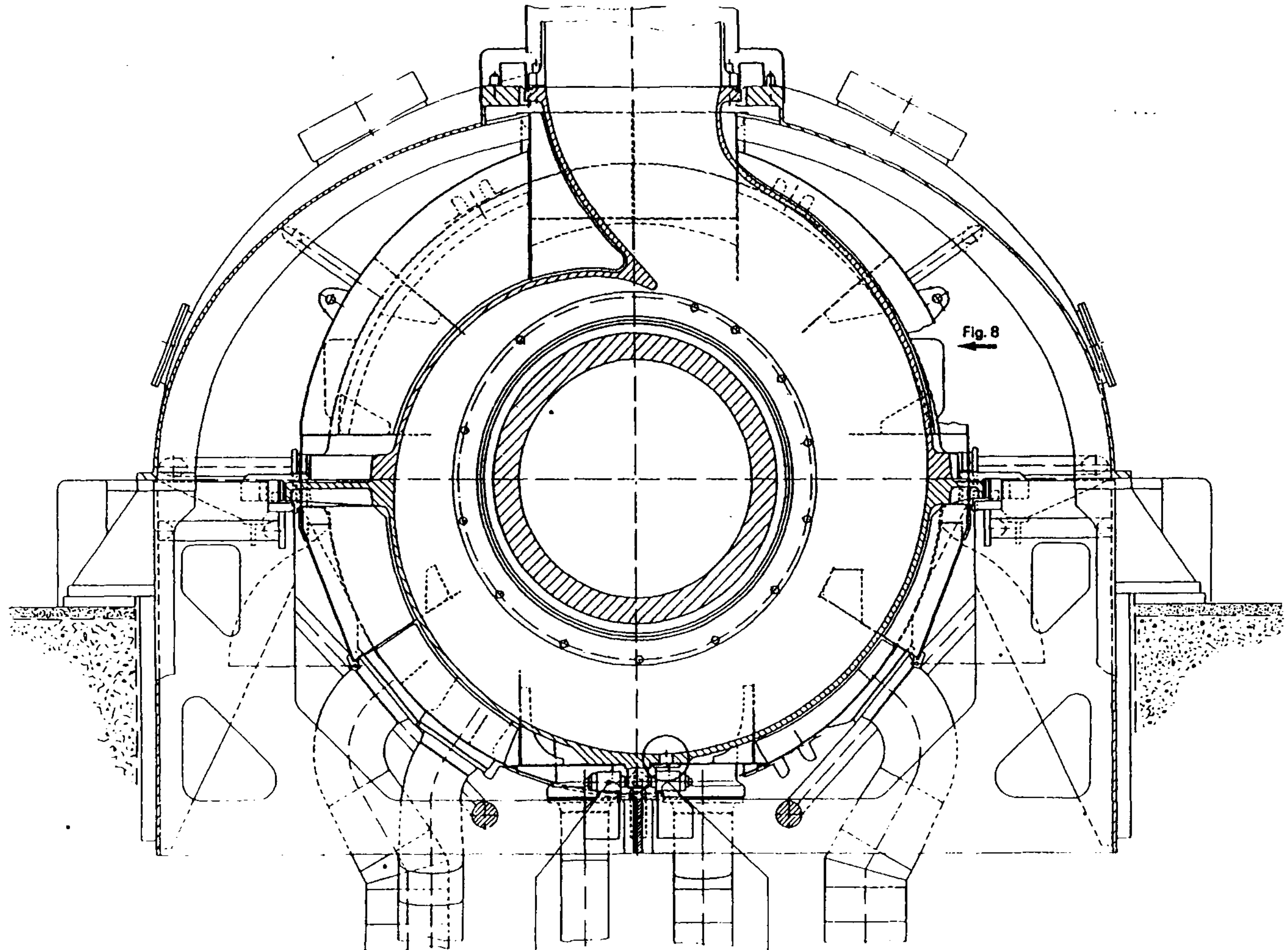
PEF-NCR-03114



REVISION "0"

Cylinder Flange Bolting Diagram
725-J-355

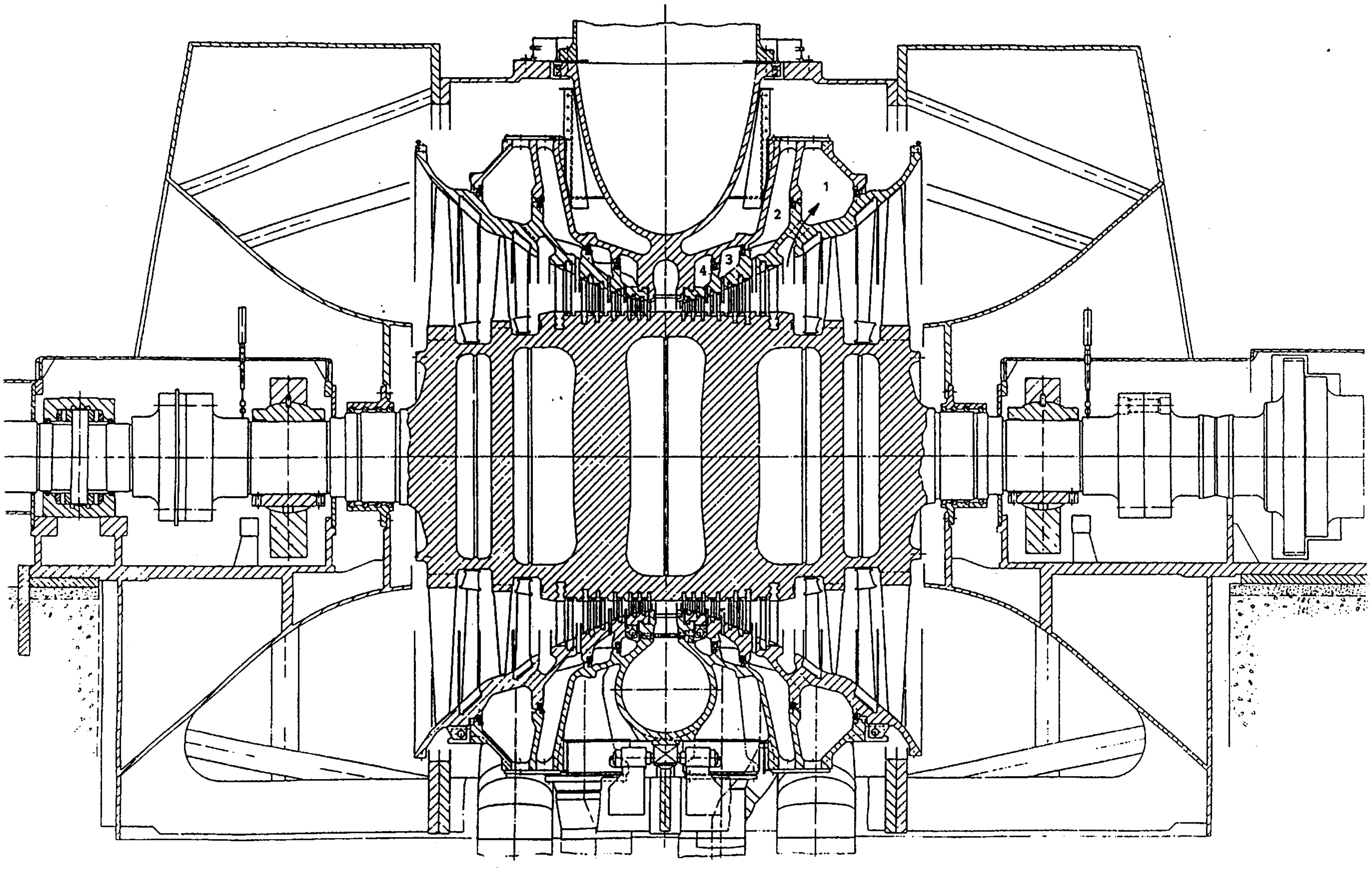
BBC
BROWN BOVERI



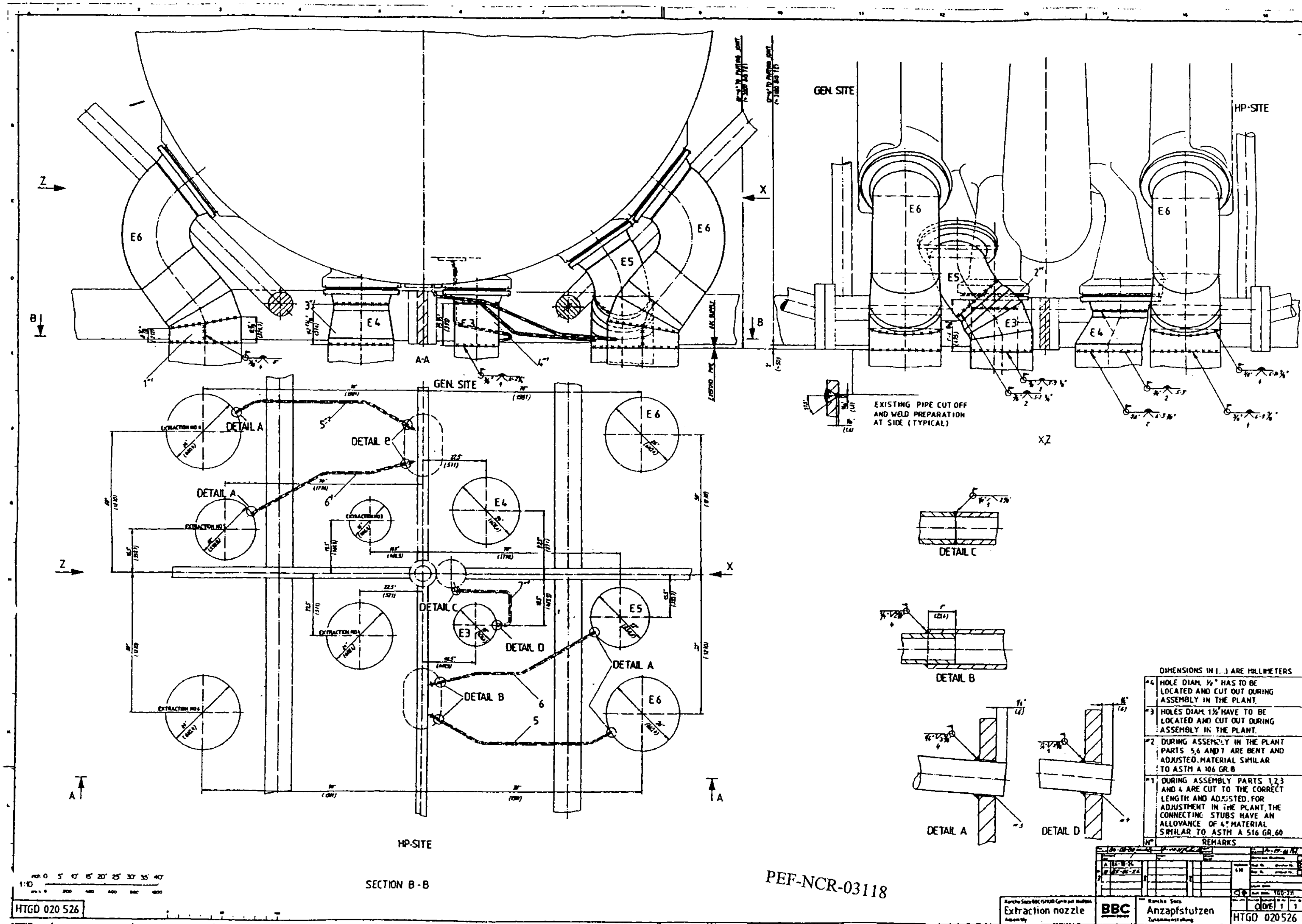
HTGD 690 367

ANNEX 3
HTGD 338 458

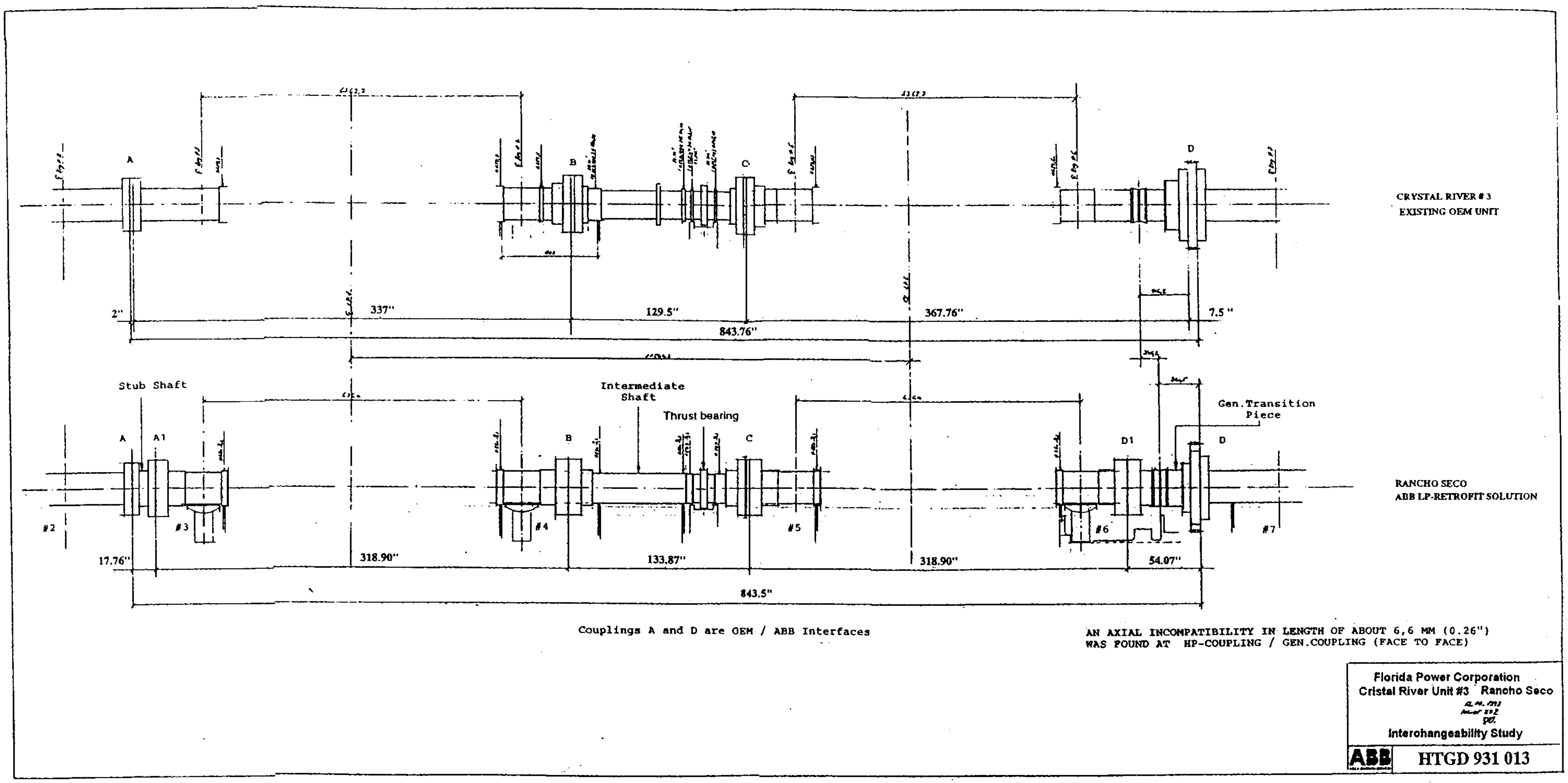
PEF-NCR-03116



PEF-NCR-03117



PEF-NCR-03118


CRYSTAL RIVER # 3
EXISTING OEM UNIT
A
B
C
D
2"
337"
129.5"
367.76"
7.5"
843.76"
Stub Shaft
Intermediate Shaft
Thrust bearing
Gen. Transition Piece
A
A1
B
C
D1
D
#2
#3
#4
#5
#6
#7
RANCHO SECO
ABB LP-RETROFIT SOLUTION
17.76"
318.90"
133.87"
318.90"
54.07"
843.5"
Couplings A and D are OEM / ABB Interfaces
AN AXIAL INCOMPATIBILITY IN LENGTH OF ABOUT 6,6 MM (0.26")
WAS FOUND AT HP-COUPLING / GEN.COUPLING (FACE TO FACE)
Florida Power Corporation
Cristal River Unit #3 Rancho Seco
Interchangeability Study
ABB
HTGD 931 013

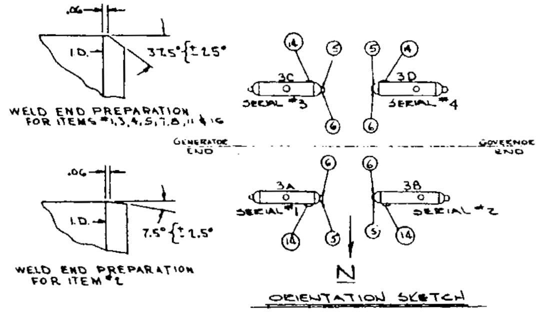
ITEM	SIZE	DESCRIPTION	REMARKS
1	42" I.D.	CYCLE STEAM INLET (SHELL SIDE)	1.75 WALL
2	40" I.D.	CYCLE STEAM OUTLET (SHELL SIDE)	.75 WALL
3	6" DIA.	HEATING STEAM INLET (HIGH PRESS) (TUBE SIDE)	SCH.40 W.E.
4	6" DIA.	HEATING STEAM OUTLET (HIGH PRESS)	SCH.40 W.E.
5	3" DIA.	DRAIN TANK EQUALIZING VENT (HIGH PRESS)	SCH 40 W.E.
6	1" S.W.	EXCESS STEAM VENT (HIGH PRESS)	3000# S.W.
7	8" DIA.	HEATING STEAM INLET (LOW PRESS)	SCH. 40 W.E.
8	8" DIA.	HEATING STEAM OUTLET (LOW PRESS)	SCH. 40 W.E.
9	3" DIA.	DRAIN TANK EQUALIZING VENT (LOW PRESS)	SCH 40 W.E.
10	1" S.W.	EXCESS STEAM VENT (LOW PRESS) (TUBE SIDE)	3000# S.W.
11	10" DIA.	SHELL DRAIN (SHELL SIDE)	SCH.40 W.E.
12	4-1" S.W.	LEVEL CONTROL CONNS (SHELL SIDE)	3000# S.W.
13	2-16" DIA.	MANWAY (TUBE SIDE)	
14	8"Sq.-.5 K	SUPPORT PAD (SEE ORIENTATION SKETCH FOR LOCATION)	
15	3-2" SW	NITROGEN INLETS	3000# SW
16	10" DIA.	EXTR. CONN. TO BOILER FEED PUMP TURBINE	SCH. 40 W.E.
17	12 SQ.x2.75	CROSSOVER PIPE SUPPORT	

WEIGHTS

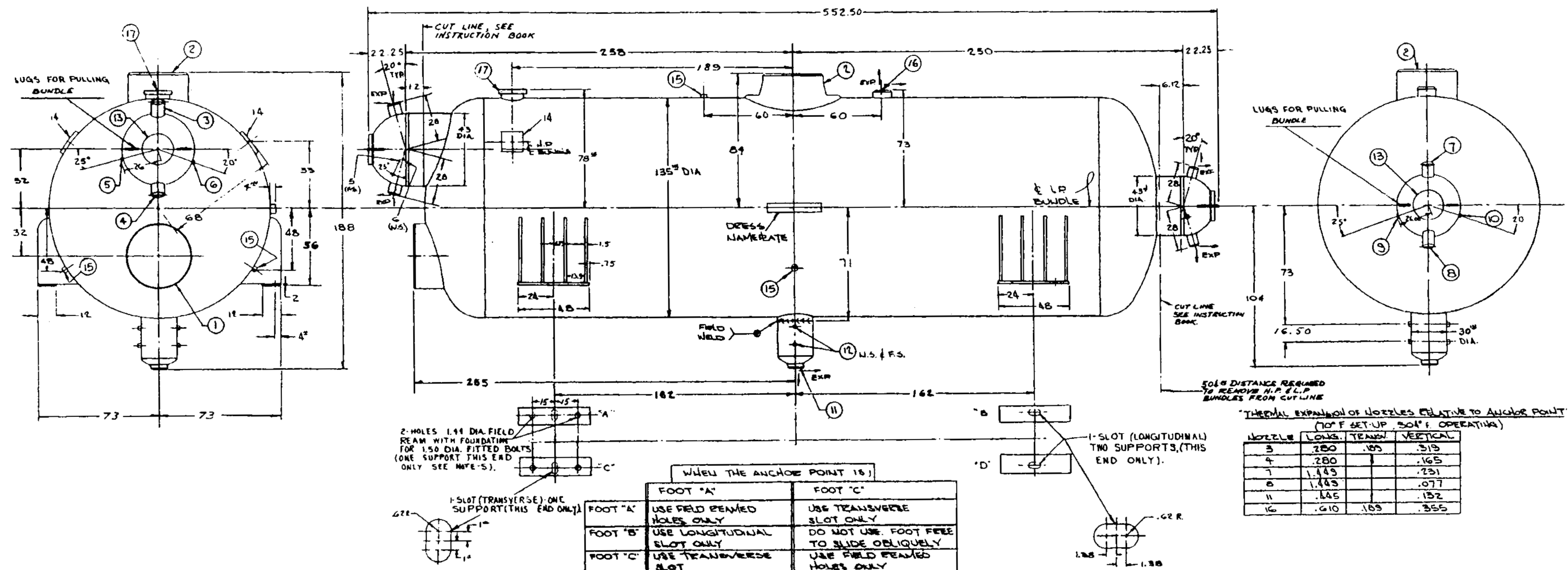
DRY ---------------------- 165,000
TUBE BUNDLE/HEAD (ONE) ----- 27,500
OPERATING ----------------- 170,000
FLOODED ------------------ 310,000

DESIGN CONDITIONS

SHELL SIDE	PRESS. 265 P.S.I.G.	TEMP. 515 °F
TUBE SIDE (HP)	PRESS 1050 P.S.I.G.	TEMP. 600 °F
TUBE SIDE (L.P)	PRESS 625 P.S.I.G.	TEMP. 500 °F



NOTES
1. TOTAL AREA TO BE INSULATED IS 1600 SQ.FT. INSULATION CLIPS WILL BE SHO INSTALLED ON SHELL ENDS AND NOZZLES 12 IN. DIA. AND LARGER. INSL. ATIN MATERIALS TO BE IN ACCORDANCE WITH THE CROSSUNDER-CROSSOVER PIPE INSULATION DRAWING
2- ORIENTATION OF UNITS, SERIALIZATION, FOUNDATION DETAILS, AND LOADINGS ARE ON THE TURBINE GENERATOR OUTLINE DWG.
3- UNITS TO BE SHIPPED IN NORMAL HORIZONTAL POSITION
5- THE ANCHOR POINTS ARE LOCATED AT THE CYCLE STEAM INLET END OF THE UNIT AND ON THE SID ADJACENT TO THE TURBINES. FOUNDATION DETAILS ARE ON THE TURBINE GENERATOR OUTLINE DWG.
6- SHELL ACCESS IS AFFORDED BY MEANS OF A ADJACENT MANWAY IN THE CROSS UNDER PIPING
7- UNITS ARE DESIGNED, MANUFACTURED AND TESTED TO THE REQUIREMENTS OF SECTION VIII, DIV. 1 OF THE ASME CODE.



WHEN THE ANCHOR POINT IS:

	FOOT "A"	FOOT "C"
FOOT "A"	USE FIELD REAMED HOLES ONLY	USE TRANSVERSE SLOT ONLY
FOOT "B"	USE LONGITUDINAL SLOT ONLY	DO NOT USE. FOOT FREE TO SLIDE OBLIQUELY
FOOT "C"	USE TRANSVERSE SLOT	USE FIELD REAMED HOLES ONLY
FOOT "D"	DO NOT USE, FOOT FREE TO SLIDE OBLIQUELY	USE LONGITUDINAL SLOT

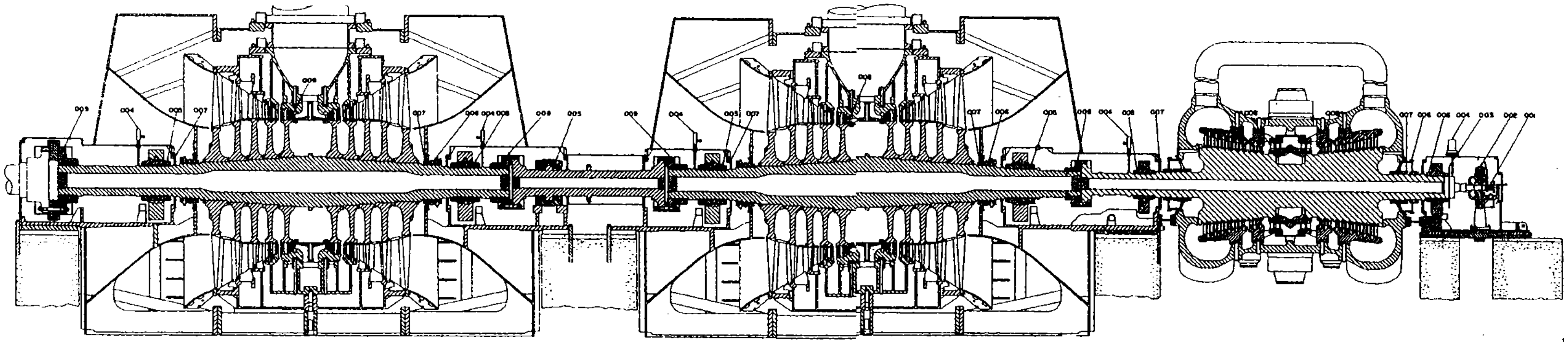
"THERMAL EXPANSION OF NOZZLES RELATIVE TO ANCHOR POINT"
(70° F SET-UP, 504° F OPERATING)

NOZZLE	LONG.	TRANSV.	VERTICAL
3	.280	.189	.319
4	.280		.165
7	1.449		.231
8	1.449		.077
11	.445		.132
16	.610	.189	.355

REVISION "0"

Figure
I.L. 1370-106

PEF-NCR-03120



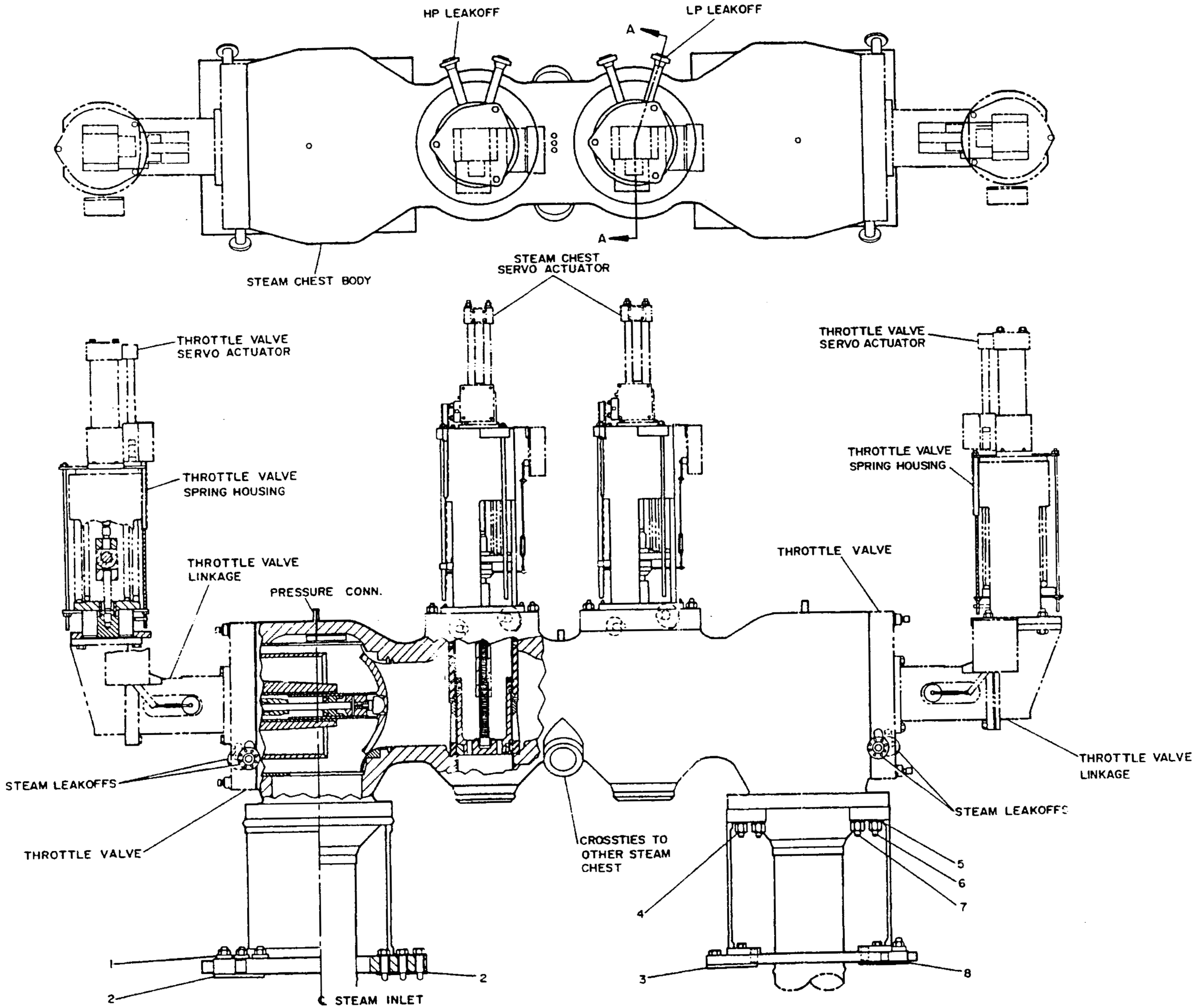
PART Nº	DESCRIPTION
001	OVERSPEED TRIP MECHANISM
002	MAIN OIL PUMP
003	ROTOR ZERO SPEED INDICATOR
004	VIBRATION RECORDER PICKUP (SUPPLY INST)
005	BEARING
006	GLAND
007	SEAL
008	BLADING
009	COUPLING

LONGITUDINAL SECTION- 858MW NSSS TURBINE
TANDEM-COMPOUND QUADRUPLE FLOW 1800 RPM
885PSIG-546F-505F-2.0 IN. Hg ABS
DWG/SUB Nº 683J320/1 S.O. 13A3511
FLORIDA PWR. CORP.——CRYSTAL RIVER Nº 3

REVISION 0

Longitudinal Section
683-1-320-1

PEF-NCR-03121



PEF-NCR-03122

Spec. Page #	Section Reference	C - Conform	X-Exception	A - Alternate	E - Enhance	No.	DESCRIPTION	PRIORITY	TYPE & QUANTITY	SUBMITTAL DUE DATE (WEEKS RFDE or PTS)	Comments
17	1.12			A		1	Thermal Kit	1	5 Copies or 1E	8 weeks RFDE	4 weeks PTS
			X			2	General Arrangement Drawing for the Turbine-Generator/MSR	2	5 Copies or 1E	8 weeks RFDE	This is not part of Siemens standard deliverables since the turbine generator configuration does not change.
				A		4	Proposed turbine generator startup and operating procedures	2	5 Copies or 1E	8 weeks RFDE	8 weeks PTS
		C				5	Engineering Schedule	2	5 Copies or 1E	4 weeks RFDE	
		C				6	Procurement/Production / Shipping Schedule	2	5 Copies or 1E	8 weeks RFDE	
				A		7	Recommended Detailed Erection Sequence	4	5 Copies or 1E	4 weeks RFDE	12 weeks RFDE
				A		8	QA Inspection and Test Schedule	3	5 Copies or 1E	4 weeks RFDE	6 weeks RFDE
		C				9	Final Quality Control Documentation including Shop Test and Inspection Reports	3	5 Copies or 1E	2 weeks PTS	
		C				10	Generator Performance Data	3	5 Copies or 1E	18 months RFDE	
				A		11	Shipping List	4	5 Copies or 1E	12 weeks PTS	6 weeks PTS
		C				12	Spare Parts List - Erection & Commissioning	4	5 Copies or 1E	12 weeks PTS	
				A		13	Spare Parts List - Operational Spares	4	5 Copies or 1E	6 months PTS	3 months PTS
		C				14	Special Tools List	4	5 Copies or 1E	12 weeks PTS	
				A		15	P&IDs	2	5 Copies or 1E	4 weeks RFDE	16 weeks RFDE
				A		16	Lube Oil Equipment Outline	2	5 Copies or 1E	6 weeks RFDE	8 weeks RFDE
			X			17	Generator Stator Cooling Water Skid Outline	2	5 Copies or 1E	8 weeks RFDE	not applicable
						18	MSR Foundation Requirements	2	5 Copies or 1E	6 weeks RFDE	Please refer to TEI Proposal
			X			19	Gen. Stator Cooling Water Skid Foundation Requirements	2	5 Copies or 1E	8 weeks RFDE	not applicable
		C				20	Excitation System - General Arrangement	2	5 Copies or 1E	8 weeks RFDE	
		C				21	Excitation System - Foundation Requirements	2	5 Copies or 1E	8 weeks RFDE	
		C				22	Excitation System - Elementary & Connection Diagrams	2	5 Copies or 1E	12 weeks RFDE	
		C				23	Terminal Point Locations -Mechanical	2	5 Copies or 1E	8 weeks RFDE	
		C				24	Terminal Point Locations -Electrical	2	5 Copies or 1E	12 weeks RFDE	
			X			25	ASME Pressure Vessel Certifications	2	5 Copies or 1E	At Shipment	The turbine generator is not considered a pressure vessel, ASME pressure vessel certification is not applicable.
		C				26	Generator Electrical Connection Details	2	5 Copies or 1E	16 weeks RFDE	
		C				27	Generator Neutral Grounding Cubicle Drawings	2	5 Copies or 1E	24 weeks RFDE	

Spec. Page #	Section Reference				C - Conform	X-Exception	A - Alternate	E - Enhance	No.	DESCRIPTION	PRIORITY	TYPE & QUANTITY	SUBMITTAL DUE DATE (WEEKS RFDE or PTS)	Comments
					C				28	Interconnecting Piping General Arrangement Drawings	2	5 Copies or 1E	12 weeks RFDE	Progress Energy to clarify which interconnecting piping drawings are required. Siemens will only supply hood spray piping arrangement drawing 6 months PTS.
					C				29	Preliminary Instruction, Inspection and Maintenance Manuals	2	5 Copies	18 months RFDE	
							A		30	Final Instruction, Inspection and Maintenance Manuals including maintenance procedures.	3	10 Copies	6 months PTS	3 months PTS
							A		31	Erection Manuals	4	5 Copies	18 months RFDE	3 months PTS
					C				32	Max. Allowable Nozzle Loads	2	5 Copies or 1E	24 weeks RFDE	
					C				33	Weld End Details at Buyer/Supplier Terminal Points	2	5 Copies or 1E	16 weeks RFDE	
							A		34	Field Checkout Procedures	4	5 Copies or 1E	8 weeks PTS	During Pre-Outage Planning
							A		35	Start-up Manual	4	5 Copies + 1E	12 months PTS	PTS
						X			36	Supplier's standard reference material	2	5 Copies or 1E	4 weeks RFDE	Clarification is required from Progress Energy.
					C				37	Storage and Handling Procedures	4	5 Copies or 1E	12 months RFDE	
					C				38	Recommendations for Rigging and Handling Equipment	4	5 Copies or 1E	12 months RFDE	
						X			39	Generator Characteristic data and Phase Current Unbalance Calculation	2	5 Copies or 1E	18 months RFDE	This is proprietary information, however,Siemens is willing to review this calculation with Progress Energy.
						X			40	Exciter model and tuning parameters for input to transmission PSS / E software	2	5 Copies or 1E	4 weeks RFDE	Further clarification required.
						X			41	Foundation Drawings	2	5 Copies or 1E	4 weeks RFDE	Siemens does not intend to modify foundations.

OPC

1ST POD

#1

080009

BATES NOS. PEF-NCR-03123 THROUGH PEF-NCR-03124

NON-RESPONSIVE

CR3 EPU Turbine Generator Bid Proposal Review:

Description:	**Siemens**	**Alstom:**	**Notes:**
Cost:	ltr.	ltr.	See Tony Owen Sheet
Performance Guarantee:	[redacted] REDACTED	[redacted]	Siemens LP Turbine 56" LSB (46" LSB optional, larger exhaust annulus has better performance). Alstom LP Turbine 47" LSB (57" LSB not offered).
Generator Rating:	1165 MVA using H2 inner cooled stator winding. Rating up to 1200 MVA possible (additional cost).	1173 MVA with H2O cooled mid-section replacement. 1162.5 MVA with H2O cooled stator rewind.	Both solutions meet minimum performance requirement. Siemens will replace core iron. Alstom field rewind does not replace core iron. Siemens states core iron replacement is required. Why is core iron OK with alstom winding?
Outage Schedule:	69 days. Includes LP's and generator rewind. Does not include MSR's.	75 days. Includes HP, LP's, MSR's and Gen mid-section replacement.	Siemens schedule needs improvement. Need 2009 turbine building integrated schedule. Consider TG project T&M?
Proposed Hardware:	HP Turbine (full arc, full reaction, replace in 2011). LP Turbines (46" LSB or 56" LSB). Generator H2 inner cooled field rewind including core iron replacement. Generator rotor to be replaced. New brushless exciter. Replacement MSR vessels by TEI. Digital Voltage Regulator (TCSA).	HP Turbine (partial arc, full impulse, replace in 2009). LP Turbines (47" LSB). Generator H2O cooled mid-section replacement or field rewind (core iron not replaced). Generator rotor sent out during outage for refurbishment. New Static excitation system.	Alstom requires HP Turbine and Generator to be opened for measurement during 15R. Estimated additional cost [redacted] Alstom LP turbine does not replace inner cylinder, stationary blade carriers are replaced. New stator cooling water skid and static excitation electrical cabinets must be installed. Siemens solution requires all generator heat load to be removed from H2 coolers. SC system impact is large.

Notes:

1) Generator H2 pressure must be increased from 60 psig to 75 psig. Seal Oil System is impacted.
   Recommend to evaluate Siemens Performance Plus H2 Seal Package.
2) Evaluate Siemens 56" LSB LP Turbine Rotor Weight to present.
3) Proposed post installation plant performance test must be negotiated. Recommend simplified plant performance test due to amount of plant changes.
4) Need a dead band for performance guarantee bonus / penalty.
5) Alstom water cooled stator does appear to provide generator rating improvement.
6) Need to review HP Turbine full arc control capability for ICS main steam pressure control. 3% flow margin if accurately designed should provide enough throttling.
7) Siemens proposal does not include generator bushing replacement (est[redacted] REDACTED for new bushins).

CONFIDENTIAL

SIEMENS
Westinghouse

PPL Susquehanna, LLC
Turbine Upgrade Project Moves Forward

February 2, 2001

On January 23, Frank Long, president, PPL Generation signed an agreement which keeps the turbine upgrade project moving forward. The agreement is for Siemens Westinghouse Power Corporation to design, manufacture, and install a turbine upgrade on Susquehanna Units 1 and 2. The turbine upgrades will improve service life, reduce maintenance, and increase each unit's efficiency by about 50 MWe. Craig Weeks, president, Siemens Westinghouse Global Service was the co-signer. Bob Byram, Bryce Shriver, and George Jones represented PPL Susquehanna at the signing.

After the signing, Bob Byram commented on the importance of this project for PPL and Susquehanna, "PPL is a growing company with generation being an important part of its growth strategy. This investment in Susquehanna reflects PPL's commitment to generation and its expectation of continually improving performance by SSES. These upgrades will add to our earnings contribution per share as soon as they go into service. However, only by us running safely and reliably will PPL derive the full benefit of this investment."

The plan is to install the first of the turbine upgrades during Unit 2's 11th RIO in the spring of 2003 and the second during Unit 1's 13th RIO in the spring of 2004. Detailed preplanning has already begun for the first installation. How PPL Susquehanna and Siemens Westinghouse are going to get from signed agreement to installation was the topic of a presentation at the signing.

As outlined in this presentation, the keys to the project's success include applying and improving on the lessons Siemens Westinghouse has learned from previous installations including their installations at Limerick 1 and 2. They will also apply lessons learned from our Unit 2 installation to Unit 1. It was further pointed out that the planning and scheduling necessary for the safe and timely installations of the upgrades will affect the whole plant. Integrating the necessary work will require teamwork extending across most work groups and upward to the executive level.

Siemens Westinghouse has committed several executives to the success of this project. The most visible will be Richard Green, the Siemens Westinghouse site project manager. Richard will be co-located with the integrated Susquehanna and Siemens Westinghouse team at Susquehanna.

This transaction was conducted through Enporion, Inc. Enporion, Inc. is a new electronic procurement exchange serving the electric and gas industries. PPL Corp. is one of the founding members of Enporion.

Headquartered in Orlando, Florida, Siemens Westinghouse Power Corporation was created in 1998 when Siemens acquired Westinghouse Power Generation. Siemens Westinghouse specializes in power plant systems, turnkey solutions, and services that include the manufacture, repair, replacement, and upgrade of steam-, gas- and hydroelectric generators. Siemens Westinghouse also manufactures power-plant control systems, emissions monitoring and control equipment, and fuel cells.

Press Release given to PPL Susquehanna, LLC Employees on February 2, 2001

Quality Assurance Program

[redacted]

REDACTED

SIEMENS

[redacted]

REDACTED

[redacted]

REDACTED

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PEF-NCR-03132

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PEF-NCR-03137

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CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

Siemens Power Generation

Headquarters: Erlangen - Bayern, DE (Worldwide) Orlando - FL, USA (Americas region)

Alpharetta - GA, USA Atlanta - GA, USA Berlin - Berlin, DE

Charlotte - NC, USA Duisburg - NRW, DE Erfurt - Thüringen, DE Fort Payne - AL, USA

Görlitz - Sachsen, DE Hamilton - ONT, CA Hengelo ND Houston - TX, USA

Karlsruhe - Baden-Württemberg, DE Mülheim - Nordrhein-Westfalen, DE

Newcastle-upon-Tyne, UK Offenbach - Hessen, DE Pittsburgh - PA, USA Trenton - NJ, USA

has been approved by Lloyd's Register Quality Assurance to the following Quality Management System Standards:

ISO 9001:2000, ANSI/ISO/ASQ Q9001-2000
DIN EN ISO 9001:2000

The Quality Management System is applicable to:

Design, Manufacture, Installation, Commissioning & Service of Steam Turbine, Combustion Turbine, Electric Generators, Turbo-compressors and Instrumentation & Control. Supply of Power Plant Equipment for Power Generation and Industrial Sector and Project Management. Research & Development, Design and Manufacture of Stationary Fuel Cells Generation Systems.

This certificate is valid only in association with the certificate schedule bearing the same number on which the locations applicable to this approval are listed.

Approval
Certificate No: UQA 0100412

Original Approval: November 20, 1992
Current Certificate: January 26, 2005
Certificate Expiry: August 31, 2007

H. Fink

Issued by LRQA, Inc. Houston

Deutscher Akkreditierungs Rat

TGA-ZM-02-91-00

UKAS QUALITY MANAGEMENT

001

ANAB ACCREDITED

PEF-NCR-03141

This document is subject to the provision on the reverse.

This approval is carried out in accordance with the LRQA assessment and certification procedures and monitored by LRQA.

Further clarifications regarding the scope of this certificate and the applicability of ISO 9001:2000 requirements may be obtained by consulting the organization.

CERTIFICATE SCHEDULE

Siemens Power Generation

Head Office	***Activities***
Siemens PG *Erlangen – Bayern, Germany*	*Headquarters, Worldwide.*
SWPC *Orlando - Florida, USA*	*Americas Region.*
Engineering	
Berlin – Berlin, Germany *Erlangen – Bayern, Germany* *Mülheim – Nordrhein-Westfalen, Germany* *Offenbach – Hessen, Germany* *Orlando – FL, USA* *Newcastle-upon-Tyne, UK*	*Design and Development of Steam and Combustion Turbines, Electric Generators & Auxiliaries.*
Alpharetta – GA, USA *Erlangen, Bayern, Germany* *Karlsruhe – Baden-Württemberg, DE*	*Design of Instrumentation and Controls and System Integration of Power Plant Equipment.*
Orlando – FL, USA	*Design & Development of New and Existing Power Generation Products and Services.*
Service Division	
Berlin – Berlin, Germany *Erlangen – Bayern, Germany* *Mülheim – Nordrhein-Westfalen, Germany* *Orlando – FL, USA*	*Installation, Field Service and Operation of Steam and Combustion Turbines and Electric Generators. Operation and Maintenance of Domestic and International Power Plants. Maintenance, Repair, Inspection & Test of Combustion Turbines & Technical Support Services. Manufacture, Assembly and Repair of Combustion Turbine, Components and Turbine/Generator Auxiliary Equipment & Components. Marketing & Project Management of Field Services, Parts, Repair, and Equipment & Power Plant Modernization & Upgrades.*

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CERTIFICATE SCHEDULE

Siemens Power Generation

Service Division

Penn Hall/Pittsburgh – PA, USA (Turbine Generator Services)	*Installation, Field Service and Operation of Steam and Combustion Turbines and Electric Generators.*
New Kensington – PA, USA	*New Kensington Storage Facility.*
Atlanta – GA, USA	*Central Tool & Instrument Facility.*
Operation and Maintenance, Orlando – FL, USA	*Operation and Maintenance of Domestic and International Power Plants Owned by Customers.*
Combustion Turbine Specialty Services Houston – TX, USA	*Maintenance, Repair, Inspection & Test of Combustion Turbines & Technical Support and Training Services.*
Houston Service Center, Houston – TX, USA	*Manufacture, Assembly and Repair of Combustion Turbine Components and Turbine/Generator Auxiliary Equipment & Components.*
Newcastle Newcastle-upon-Tyne, UK Beeston, Nottingham, UK (off site office)	*Manufacture, Assembly and Repair of Steam Turbine. Generators, Components and Turbine/Generator Auxiliary Equipment & Components. . Installation, Field Service, Maintenance, Repair, Technical Support and Inspection and Test of Steam and Combustion Turbines and Electric Generators.*

Project Management

Americas Region Orlando – FL, USA	*Installation, Construction, Commissioning and Project Management of Power Generation Projects – Scope Ranges from Equipment Only to Turnkey.*
Europe, Africa, Asia-Pacific Region Erlangen – Bayern, Germany Offenbach – Hessen, Germany	*Installation, Construction, Commissioning and Project Management of Power Generation Projects – Scope Ranges from Equipment Only to Turnkey.*

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CERTIFICATE SCHEDULE

Siemens Power Generation

Sales & Marketing

Americas Region *Orlando - FL, USA*	*Sales and Marketing of Power Generation Equipment.*
Europe, Africa, Asia-Pacific Region *Erlangen - Bayern, Germany* *Offenbach - Hessen, Germany*	*Sales and Marketing of Power Generation Equipment.*
Stationary Fuel Cells *Pittsburgh - PA, USA*	*Sales and Marketing Stationary Fuel Cells Power*

Manufacturing Operations

Berlin - Berlin, Germany *Charlotte - NC, USA* *Erfurt - Thüringen, Germany* *Fort Payne - AL, USA* *Hamilton - ONT, Canada* *Mülheim - Nordrhein-Westfalen, Germany*	*Manufacture and Factory Service of Steam and Combustion Turbines, Electric Generators.*

Supply Management

Alpharetta - GA, USA *Erlangen - Bayern, Germany* *Berlin - Berlin, Germany* *Mülheim - Nordrhein-Westfalen, Germany* *Orlando - FL, USA*	*Supply Management of Steam and Combustion Turbine and Electric Generator Components, Combustion Turbine ECONOPAC, Balance of Plant Equipment.*

Instrumentation & Control

Alpharetta - GA, USA *Erlangen - Bayern, Germany* *Karlsruhe - Baden-Württemberg, DE* *Offenbach - Hessen, Germany*	*Marketing & Sales, Supply of Instrumentation and Controls Systems, Systems Integration and Technology Solutions, Installation, Training Services, Service and Repair of Industrial Applications and, Call Center for Power Generation & Commercial Industry.*

Approval
Certificate No: UQA 0100412

Original Approval:	*November 20, 1992*
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CERTIFICATE SCHEDULE

Siemens Power Generation

Stationary Fuel Cells

Pittsburgh – PA, USA	*Research & Development, Design, Prototype Manufacture, Installation and Service of Stationary Fuel Cell Power Generation Systems.*

Industrial Applications

Duisburg – NRW, Germany	*Marketing & Sales, Research and Development, Design, Supply Management, Manufacture, Installation & Commissioning of Turbo-compressors. Project Management and Supply of Equipment for Power Generation and Compressor Solutions. Field Service, Maintenance, Repair & Inspection of Turbo-compressors. Manufacture, Assembly& Repair of Components and Auxiliary Equipment for Turbo-compressors. Modernization & Upgrades, Long Term Service Agreements, Asset Management and Training Service.*
Erlangen – Bayern, Germany	*Business Development, Product Development, Sales & Proposal, Design, Planning, Supply Management, Project Management, Shipment, Installation & Commissioning and Service for Power Plants for Industrial Applications.*
Görlitz – Sachsen, Germany	*Sales and Proposal, Research and Development, Design, Project Management, Supply Management, Manufacture of Steam Turbines packages and Condensers, including Auxiliary Equipment. Project Management and Supply of Equipment for Power Generation and Compressor Solutions. Supply Management, Manufacture, Assembly of Components and Auxiliary Equipment for Steam Turbines, Steam Turbine Packages and Condensers.*

Approval
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Original Approval:	*November 20, 1992*
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Certificate Expiry:	*August 31, 2007*

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CERTIFICATE SCHEDULE

Siemens Power Generation

Industrial Applications

Hengelo, The Netherlands	*Marketing, Design, Manufacturing of Turbomachinery, including the provision of an extensive range of turbomachinery related hardware, services, site-installation and supervision for hydrocarbon, petrochemical, chemical, oil & gas, electricity and co-generation industries.*
Trenton – NJ, USA	*Marketing & Sales, Design, Supply Management, Installation and Commissioning of Steam Turbines, Turbo-compressors and Industrial Power Plant. Project Management and Supply of Equipment for Power Generation and Compressor Solutions. Field Service, Maintenance, Repair & Inspection of Steam Turbines, Turbo-compressors, Gas Turbines, and Electric Generators/Drivers. Manufacture, Assembly & Repair of Components and Auxiliary Equipment for Steam Turbines, Gas Turbines, Turbo-compressors & Electric Generators/Drivers. Modernization & Upgrades, Long Term Service Agreements, Asset Management and Training Service.*
Houston Industrial Turbines -TX, USA	*Design, Development, Manufacture, Installation of New Products and the Provision for In-House Overhaul/Repair. Field Service Management, Spare Parts, and Refurbishment of Mobile, CHP and Complete Gas Turbine sets for Generating, Pumping and Compressor Drive Applications, in the Range of 1500 to 80,000 HP.*

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MPR
ASSOCIATES INC.
ENGINEERS

Limerick LP Turbine Replacement Rotors Proposed by Siemens Power Corporation Evaluation of Margin With Respect to Disk SCC

December 1995

Principal Contributors

L. E. Demick
J. Nichols

This enclosure includes confidential information which is proprietary to Siemens Power Corporation and should be handled accordingly.

Prepared for

PECO Energy Company
965 Chesterbrook Blvd., 63B-3
Wayne, PA 19087

MPR ASSOCIATES INC. ENGINEERS

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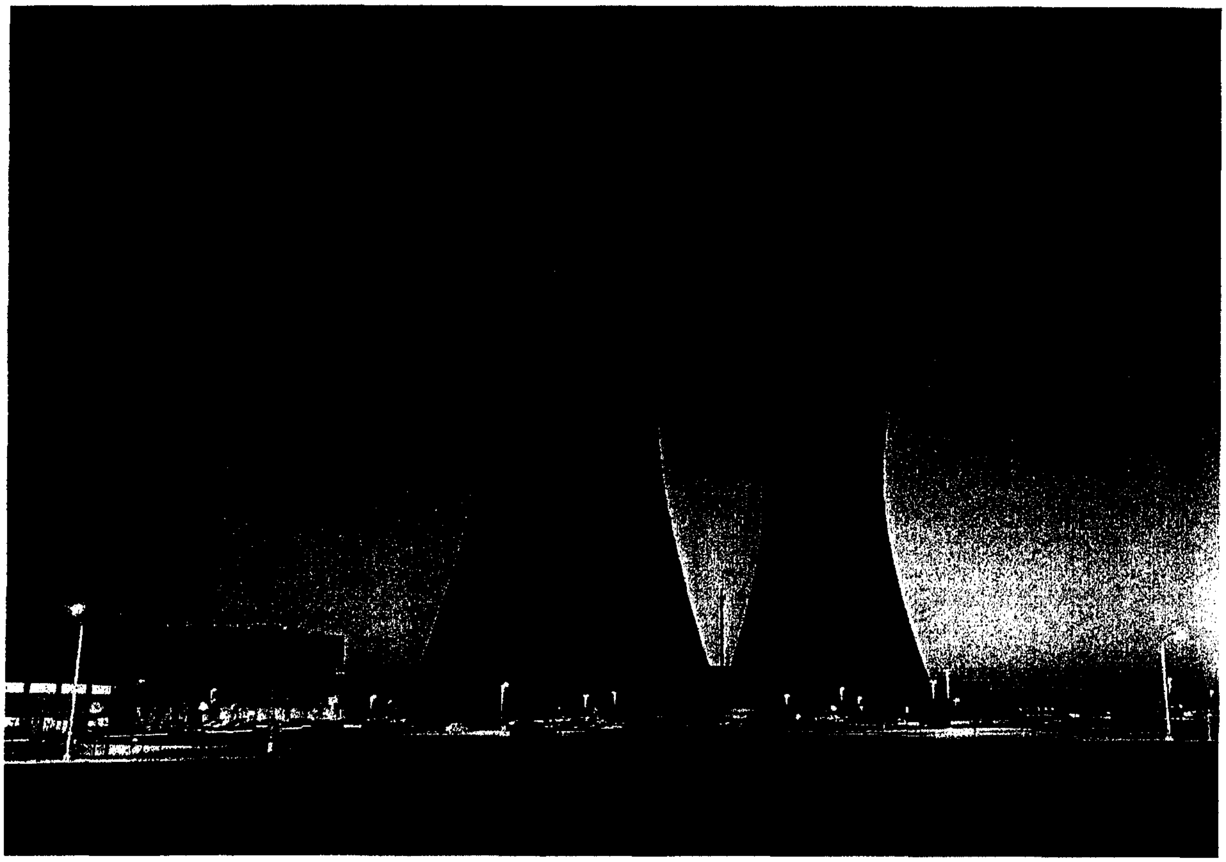
SIEMENS

PECo Energy Nuclear Steam Turbine Upgrade

Limerick Generating Station—Units 1 and 2

Siemens Retrofit Increases Efficiency and Reduces Maintenance Costs



In January 1996, Siemens Power Corporation won the bid to replace six low-pressure (LP) turbines, and two high-pressure (HP) turbines on Units 1 and 2 at PECo Energy's Limerick Generating Station. When the retrofitting work is completed in 1999, Limerick Generating Station, currently rated at 2,100 MW, will have an extra 80 MW of capacity from the two GE boiling water nuclear reactors. To date, this is the largest turbine retrofit project in Siemens Power Corporation's history.

The project will, according to PECo, provide the utility with a quality, long-term solution to stress corrosion problems which have plagued similar original equipment LP rotor units. The HP turbine replacement is being performed for the efficiency improvement. In addition, the retrofit will increase the plant's overall efficiency while reducing both short and long-term maintenance costs.

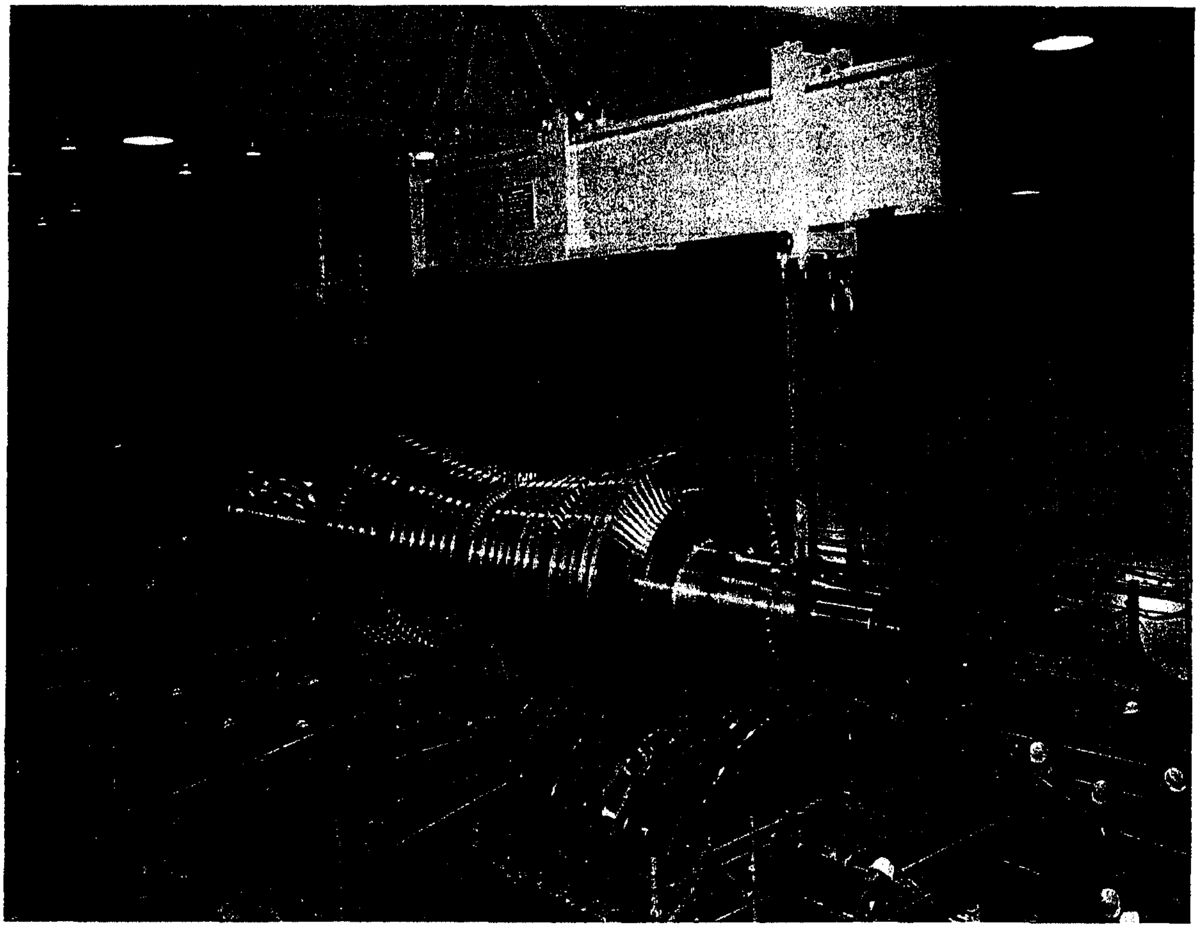
Also, PECo has contracted with SPC to perform maintenance work on the Unit #1 generator, that will be performed at the retrofit installation.

Currently, Siemens is conducting a series of extensive project planning surveys and site inspections to prepare for the project and to ensure that the job can be completed in the 42-day breaker to breaker outage planned for Unit 1, April 1998 and another outage planned for Unit 2 a year later.

SIEMENS

PECO Energy and Siemens Finish Major Steam Path Retrofit in Record Time

Outage Duration and Scope Sets New Nuclear Industry Standard



Installation of Siemens replacement HP turbine. Photo courtesy of Charles Pearloss

At 11:33 PM on May 21, Siemens Power Corporation's Fossil Division completed a record-setting outage with the replacement of the steam path for Limerick Generating Station's Unit 1. The turbine retrofit workscope, which began April 3rd and was completed 15 hours ahead of schedule, wraps up the first phase of a project that will ultimately help to ensure that PECO Energy Co. will maintain its competitive edge in the newly deregulated energy market.

"PECO Energy Co., Siemens, and a large group of outside contractors have set a new standard of excellence in the nuclear industry by replacing Unit One's four enormous turbines while refueling the reactor and doing maintenance on thousands of plant components and other systems," said PECO Vice President Jim von Suskil.

Siemens provided its state of the art turbine technology to replace the entire steam path of the existing 1168-MW General Electric unit. The project scope included the replacement of the single high-pressure and three low-pressure turbines, as well as performance of a generator stator rewedge and other repairs.

Robert Atkinson, PECO project manager added, "This was an outstanding accomplishment and a real tribute to Siemens and the quality effort performed by all of the personnel involved in the planning, design, component manufacturing and fabrication, installation and start-up activities associated with this project."

Atkinson also offered these interesting statistics associated with the turbine retrofit project:

- The size of this work scope (three LP Turbines, one HP Turbine, plus Generator rewedge/maintenance, all within an approximate 41 day work window) has established an industry record.
- This was the largest modification performed at Limerick Generating Station since the original plant construction.
- The actual duration, from "reactor scram" until "unit on turning gear," was approximately one hour shorter than the originally projected schedule of 41 days, 7 hours. This is despite an approximate 14-hour work delay due to ALERT issues.
- More than 500 people were involved with outage execution of the Turbine Retrofit work scope (not including the miscellaneous performance testing modifications) expending over 200,000 manhours.
- Approximately 1-1/2 miles of 1/4 inch stainless steel tracer test tubing were installed, along with 61 connections made to plant piping systems, in order to support the tracer testing which will be performed in late fall as part of the ASME Performance test of the turbines.
- Approximately 114 welds were made on steam inlet lines, extraction lines, and casing nozzles (sizes ranging from 10 inch through 42 inch diameter) with only 2 minor reworks required.

"Planning for this endeavor began shortly after the contract was signed in January 1996," stated Peter Hosbein, manager of steam turbine projects for Siemens Power Corporation. "We've had a group of engineers on site for the last eight months developing a detailed schedule with PECO. The Siemens schedule for the turbine replacements had over 1,450 activities. Through our world wide manufacturing organization, components were made in Germany and the US."

Thanks to the unique Siemens design and to achievement of extremely close tolerances on rotor alignment, the start up went very smoothly. With no balancing needed, the turbine went directly from turning gear to synchronization without a hitch. For some manufacturers this would be a notable achievement, but for a Siemens unit it is not at all out of the ordinary.

Siemens continues the manufacture of components for the Unit 2, which is scheduled for completion in May of 1999. The entire contract, which represents Siemens largest retrofit turbine order to date, will boost the capacity of this two-unit plant by more than 80 MW, and will extend Nuclear Regulatory Commission regulated turbine inspection intervals from six to ten years.

Siemens Power Corporation
Fossil Division Headquarters
1040 South 70th Street
Milwaukee, WI 53214
Tel: 414/475-3600
Fax: 414/475-4040
http://www.spcf.siemens.com

Printed in U.S.A.

Nuclear BB96/296 FA HP Modernization

Scope of supply

You have made the decision to extend the operating license of your nuclear power plant for another 20 to 30 years. To help you maximize the life extension, including the financial return on your investment, Siemens Power Generation offers comprehensive solutions for your long-term operating goals. One solution, the Siemens Nuclear High Pressure Full Arc modernization for BB96/296, is designed to increase operating plant generation through improved unit effectiveness.

The scope of this modernization includes:

- Monoblock HP rotor without thru-bore
- Latest technology double-flow optimized full reaction bladepath design
- Inlet admission ring
- New chrome steel inner cylinder
- Chrome steel blade rings
- L-Seal connection between inner and outer casings
- Multi-strip inter-stage seals over rotating and stationary blading.

A typical Siemens HP modernization encompasses design, manufacture and installation of the new bladepath. By eliminating the need for piping modifications and minimizing the modifications to the outer cylinder inlets, your new HP turbine bladepath can be installed during most standard reactor upgrades or refueling outages.

Siemens' track record in replacing this nuclear HP turbine is outstanding in the industry, with over 15 turbine elements of this design replaced to date.

No thru-bore HP rotor eliminates need for rotor bore examinations.

Customer benefits

The modernization of your HP bladepath can significantly improve the effectiveness of your nuclear power plant by increasing megawatt output and lengthening inspection intervals. When combined with primary-side modernizations, the Siemens HP upgrade can help extend plant operating life by as much as 30 years or more.

- Custom designed and engineered to your plant steam conditions
- Increased output includes minimizing flow margins
- Longer inspection intervals allow reduced maintenance costs (Siemens recommended inspection interval is 100,000 operating hours)
- Increased resistance to erosion
- Enables additional modifications to match many future primary side enhancements
- Ease of installation.

PEF-NCR-03168

Features

Our engineers custom-design your HP bladepath based on the exact steam conditions at your site and your engineering requirements. They work closely with you and the primary side reactor supplier to collect engineering requirements at the appropriate level of detail, and prepare the engineering packages for your design change documentation and safety requirements.

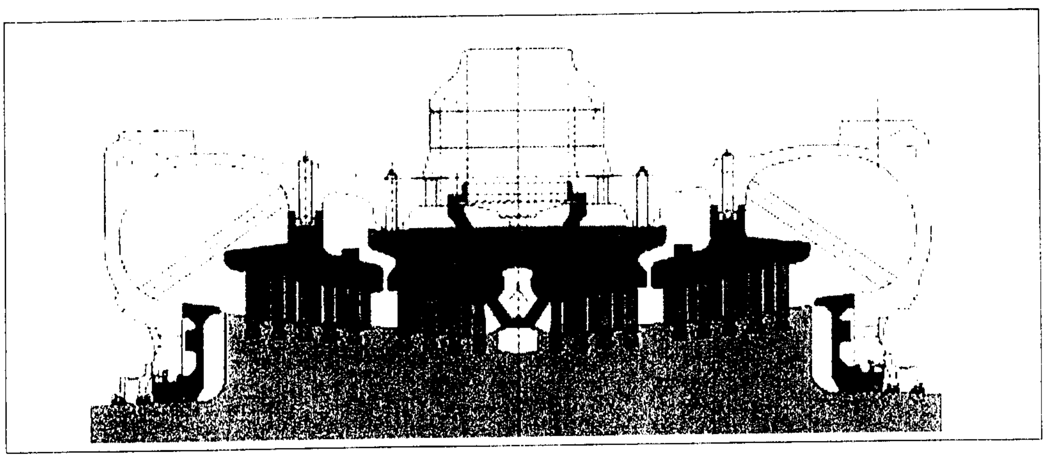
Our thorough engineering evaluation process can deliver the information you need along with the necessary drawings to support your required design change documentation.

A key feature of this product offering is the detailed information provided to support the operation and maintenance of your plant for the extended operating life.

Optional features:

- **Radial-fit hydraulic coupling bolts** eliminate "galling" in the existing body-fit coupling holes that can occur by utilizing hydraulically unloaded sleeves between the coupling and bolt. Quick bolt installation and removal is an added plus, helping to reduce outage duration.
- **Flow guide** can be supplied in lieu of inlet admission ring for certain applications.

For more information please contact your local Siemens sales representative.



Optimized full reaction bladepath design improves effectiveness of HP turbine element.

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Siemens Power Generation, Inc.
4400 Alafaya Trail
Orlando, FL 32826-2399, USA

Siemens AG
Power Generation
Freyeslebenstrasse 1
91058 Erlangen, Germany

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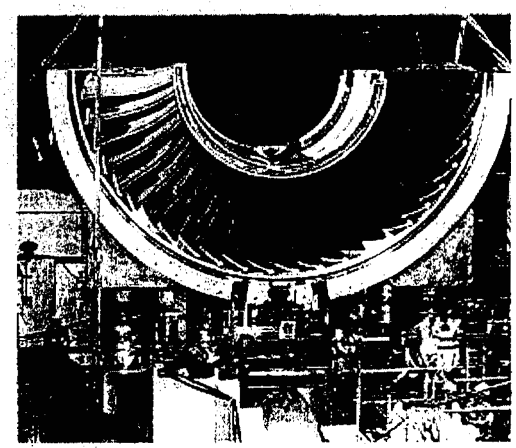
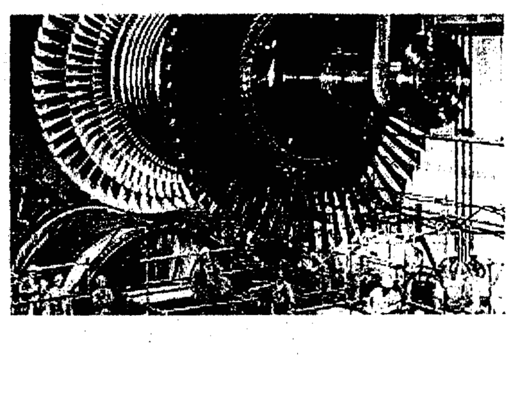
Magazine of the Siemens Power Generation Group

Turboservice

Fewer Inspections and More Megawatts through Turbine Retrofits at Nuclear Power Plant

Reprint from Power Journal
Issue 4/99





Turboservice

Fewer inspections and more megawatts through turbine retrofits at nuclear power plant

Disc cracking has been a problem in many large low-pressure disc-type turbine rotor designs. Instead of frequent and costly inspections, a retrofit rotor with a more robust design provides the safer and more cost-effective solution over the long term.

Low-pressure (LP) turbines for nuclear power plants often feature large rotors with shrink-fit discs. These shrinks yield high tensile stresses, and stress corrosion cracking of the disc has thus been a problem in many of such turbine rotor designs.

MICHAEL SMIAROWSKI

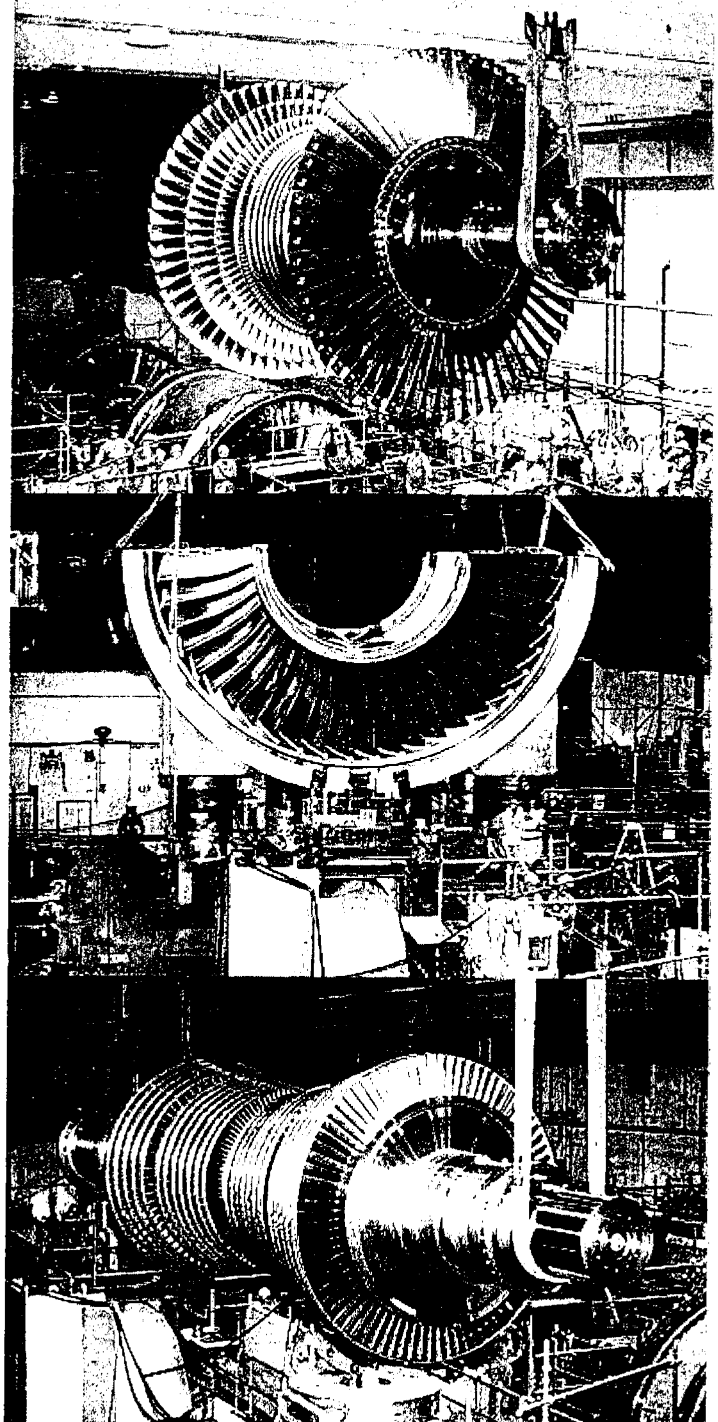
Once cracking is initiated, frequent and costly inspections or even repairs are required to prevent the cracking from progressing to the chance of a sudden disc burst and missile generation. This in turn could damage plant-safety-related equipment.

Turbine Retrofit is the Long-Term Solution

At Pottstown, Pennsylvania, PECO Energy (PECO) operates the Limerick Generating Station, a boiling water reactor plant with two units that went into commercial operation in 1986 and 1989, respectively. During routine maintenance inspections at Limerick, indications of stress corrosion cracking at the disc keyways and blade attachment dovetails were detected on the original LP turbine rotors. Long-term reliability and economical operation of the plant were thus put at serious risk. Additional long-term operational concerns included possible inner casing erosion and interstage diaphragm erosion.

PECO evaluated the alternatives for handling the problem: rotor repair as required, in-kind replacement, or upgraded replacement of rotors. It was concluded that an upgrade is the best solution to resolve the rotor stress corrosion cracking concerns over the long term. Additionally, the new casings required for the upgrade would be more erosion resistant and the station would achieve additional electrical output. To further increase unit efficiency and thus power output, PECO decided to replace the high-pressure (HP) steam paths, too.

In 1996, PECO awarded the Fossil Division of Siemens Power Corporation (now Siemens Westinghouse) a contract to retrofit the steam turbines at Limerick Generating Station. The contract called for turnkey replacement of the HP and three LP turbine rotors, and all stationary blading and inner casings of each unit.



In each of the two 1160-MW units at Limerick Nuclear Generating Station in the U.S., Siemens retrofitted the three low-pressure turbines, the high-pressure turbine and all stationary blading and inner casings. From top to bottom: new LP rotor, part of new LP stationary blading, new HP rotor.

PEF-NCR-03171

New LP Rotors with Longer Inspection Cycles

Siemens provided its 13m² turbine design, this figure referring to the approximate exhaust area of each LP flow. The retrofit turbines were designed to fit into the existing turbine bearings and operate with all the existing auxiliary systems.

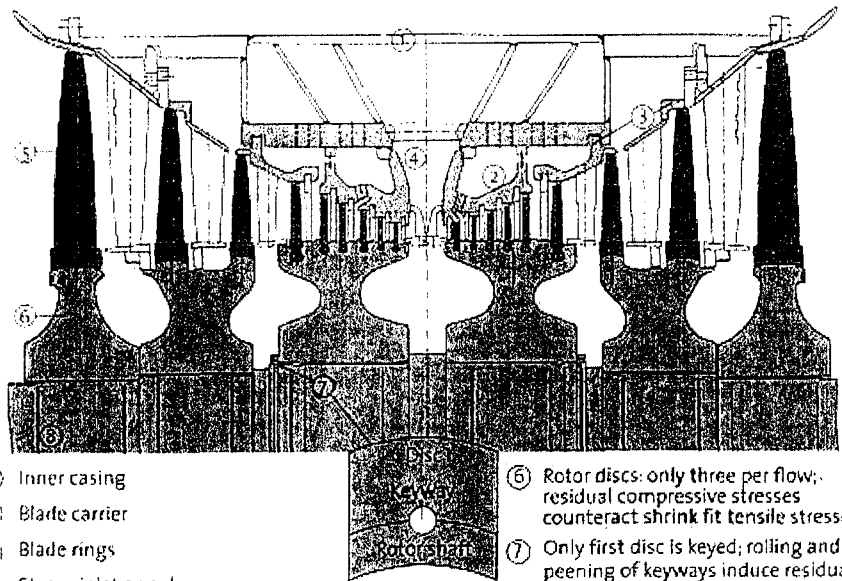
The new LP rotors feature the Siemens advanced disc design and were the first application in the U.S. of the three-discs-per-flow design. Both the rotor design and the manufacturing process reduce the probability of disc burst due to stress corrosion cracking in the following ways:

- Each rotor utilizes only three large discs per flow. (Earlier designs used four or more discs per flow.)
- Only the first disc is keyed to the rotor shaft.
- The keys are located on the downstream side of the disc. Here, the disc is hotter than the steam, reducing condensation and therefore contamination in the keyway area.
- There is no shrink in the area of the keyway, which reduces the overall stress levels. Instead there is a clearance of 1 mm which allows any moisture to quickly drain from the areas around the keys. The disc manufacturing processes are controlled to induce large residual compressive stress that counteracts the tensile stresses of the shrink fits.
- Rolling and shot peening of the keyways as well as of the blade attachment areas on both the disc and the individual blades further induce large residual compressive stresses.

Before awarding the contract, PECO commissioned a third party to review the Siemens design. Its analysis agreed that the Siemens disc design is less susceptible to stress corrosion cracking than other disc designs and that the forgings for the discs may also provide more thorough consistency in material properties than would be obtained in larger monobloc rotor forgings.

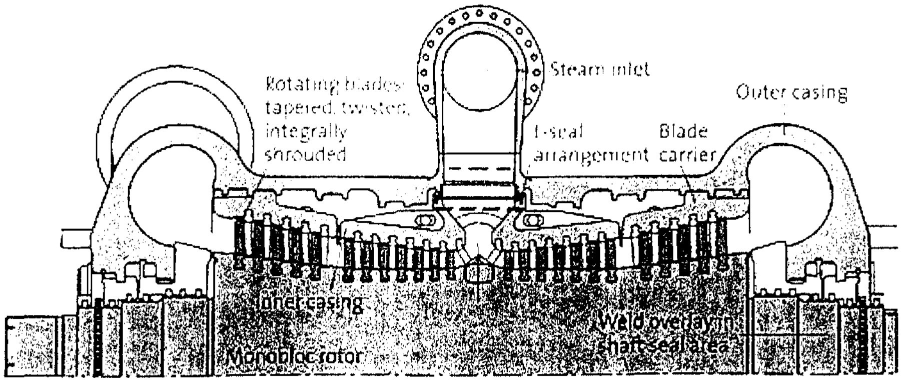
Siemens quantified new turbine inspection intervals for the new rotor design, which ensure compliance with the limit given by the Nuclear Regulatory Commission (NRC) for turbine missile generation. The NRC then approved extension of the turbine inspection and maintenance intervals from six to ten years (see box).

Low-pressure turbine cross section



① Inner casing
② Blade carrier
③ Blade rings
④ Steam inlet annulus
⑤ Rotating blades; first six rows integrally shrouded, last three rows freestanding
⑥ Rotor discs: only three per flow; residual compressive stresses counteract shrink fit tensile stresses
⑦ Only first disc is keyed; rolling and shot peening of keyways induce residual compressive stresses
⑧ Shrunk-on disc rotor

High-pressure turbine cross section



HP Turbines Further Increase Output

The original HP turbine was designed for partial-arc admission operation. A welded inlet

The new low-pressure turbine rotors are more resistant to stress corrosion cracking and require fewer inspections. Together with the new inner casings they were also a major contribution to the 80-MW total power output increase.

PEF-NCR-03172

Siemens Turbine Design Saves a Good Amount in Inspection Costs

According to the Nuclear Regulatory Commission (NRC) guidelines, turbine systems in U.S. nuclear power plants must be designed and maintained to ensure that the probability of generating a turbine missile is less that 10^{-5} per year. The NRC thus requires maintaining a Turbine System Maintenance (TSM) program, based on the manufacturer's calculation of missile generation probabilities.

The original missile generation analysis for the Limerick Nuclear Generation Station limited turbine inspection intervals to six years. The TSM program also included required intervals for performing in-service testing of valves: The main turbine stop and combined intermediate valves were tested once per week. The main turbine control valves were tested once per month.

Siemens provided an updated missile probability analysis to account for the new turbine design, which supported an initial rotor inspection interval of up to 100,000 hours. These results allowed PECO to increase their inspection intervals and valve testing frequency from six years and weekly valve testing to

- a ten-year inspection interval (87,600 operating hours) and
- a quarterly valve testing frequency.

The analysis methodology and the changes to the present TSM program were forwarded to the NRC. The revised TSM program was approved. No operating license change was required.

The NRC also noted "Siemens has used the same general blade root attachment for more than thirty years for both nuclear and fossil units. Some nuclear units are approaching 200,000 operating hours without blade attachment failures. This provides additional assurances that the modified Limerick Generation Station turbine rotors will perform in service as designed."

nozzle block ring weighing about 18 metric tons was integral to the existing HP outer casing. The new Siemens HP turbine utilizes a full-arc admission ring and required removal of this nozzle block. The steam admission ring consists of a ring forging that has blade profiles machined into it by electro-discharge machining (EDM) to achieve close tolerances.

With the exception of the inlet stage, the HP turbine utilizes all reaction blading. All blading of the monobloc rotor features the high-efficiency, advanced tapered and twisted design with integrally shrouded blades. A corrosion-resistant weld overlay on the shaft seal area on each end of the rotor improves the resistance to the erosion and corrosion effects of saturated steam.

The inner casing holds the first seven stationary blade stages per flow, and two blade carriers contain the remaining five stationary blade stages. The blade carriers replace the former interstage diaphragms and feature a design that minimizes interstage and tip leakage losses.

Sealing from the outer to inner casing is accomplished with an L-seal arrangement. This consists of an L-seal that is held in place with a 600-mm-diameter threaded ring on the inlet nozzles. In addition, the original HP outer casing required in-place modifications to accommodate the new components.

The main reason the HP steam path was replaced was due to the increased output (15 MW) gained from using advanced Siemens technology. Additional factors included increased reliability from new HP components, and having all steam path components matched and optimized to the overall steam conditions.

Keys to Success

To meet an aggressive installation schedule, an extension was added to the turbine building, which was used for handling the old and new turbine components and turbine tooling. Also, an additional turbine deck overhead crane and turbine building elevator were installed. A manufacturing facility located in Pottstown, approximately five miles from the site, was leased by Siemens for use as a component staging and pre-assembly facility and for some final manufacturing operations. For Unit #1 all LP casings, internals, and one of the rotors were shipped to this off-site facility. One LP rotor was used for fit-up on Unit #1 only, due to PECO's desire to ensure proper fit up. For Unit 2, this procedure was omitted and most pre-assembly work was performed at Siemens manufacturing facilities.

"It was recognized early on in the project that teamwork and communications were decisive," said Joe Smugeresky, PECO's Work Management Director for Limerick. "A solid team effort involving contingency planning is one of the reasons for the success of both of these projects."

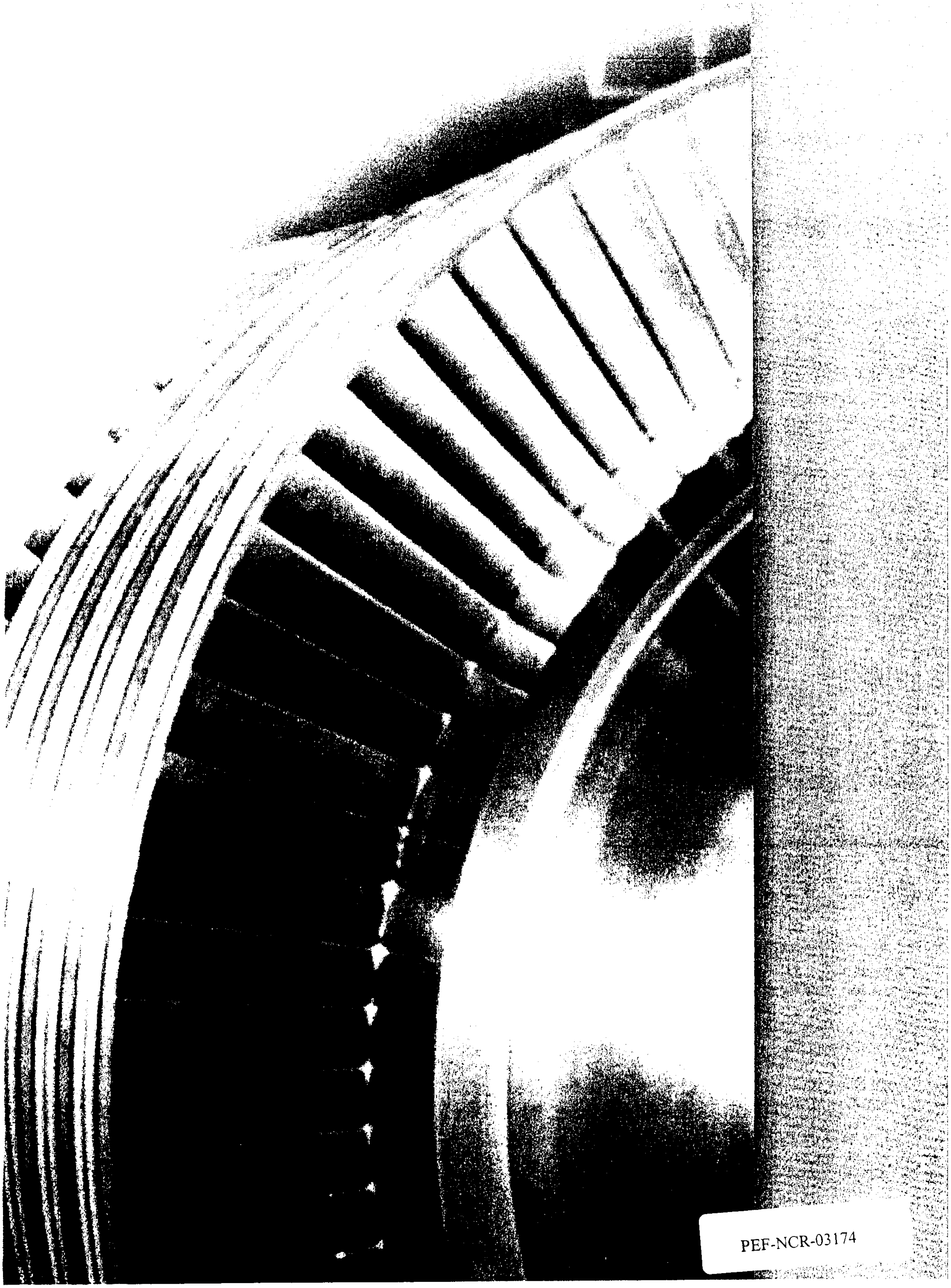
PECO Benefits from Retrofit and Short Installation Time

The Unit #1 retrofit outage was completed in the spring of 1998 and the plant returned to service after a 42-day installation outage. Said PECO Vice President Jim von Suskil, "PECO Energy Co., Siemens, and a large group of outside contractors have set a new standard of excellence in the nuclear industry by replacing Unit One's four enormous turbines while refueling the reactor and doing maintenance on thousands of plant components and other systems."

Unit #2 was retrofitted in the spring of 1999 after a 35.5-day outage. The retrofit turbines provided PECO with reliable machines with longer inspection cycles and with additional megawatt output.

Retrofit projects, such as the Limerick project, are viable options for nuclear power producers to consider when evaluating repair or replacement of turbine equipment. Often the increased electrical output achieved by the new technology provides the financial payback needed to justify the cost. Siemens having successfully retrofitted a non-OEM turbine at a BWR nuclear plant demonstrates that such options are possible and beneficial to plant owners. ■

Michael Smiarowski was project manager for the Limerick turbine upgrade project. He recently became Marketing Team Leader for turbine upgrade projects in nuclear plants.



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For further Information:
Siemens AG – Info-Service
KWU Ref KM1
P.O. Box 32 20
91050 Erlangen, Germany
Phone +49 9131 18-37 87
Fax: +49 9131 18-25 22

Siemens Westinghouse
Power Corporation
The Quadrangle
4400 Alafaya Trail
Orlando, FL 32826-2399 (USA)
Phone: +001 407 281-2000

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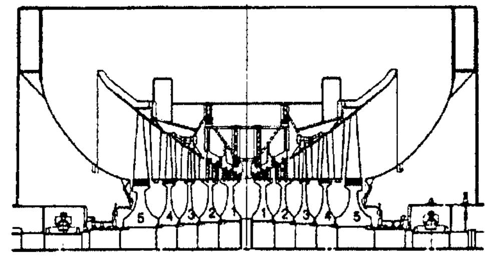
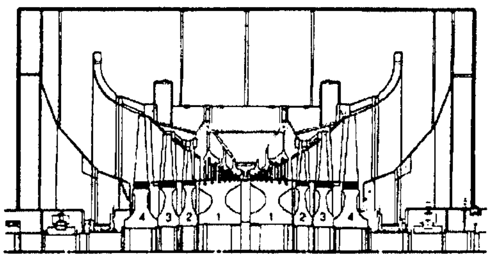
SIEMENS

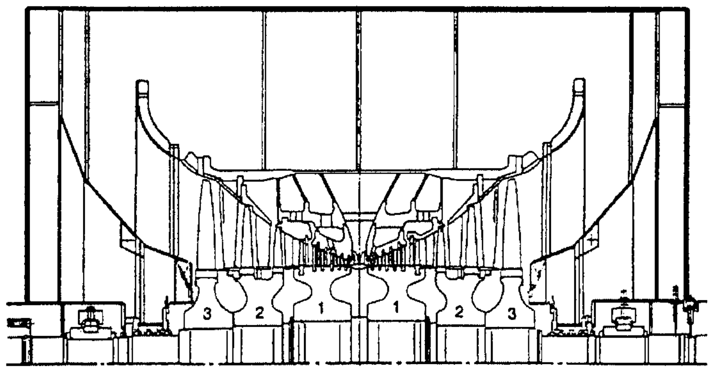
Replacement of Nuclear LP Turbine Rotors and Inner Casings



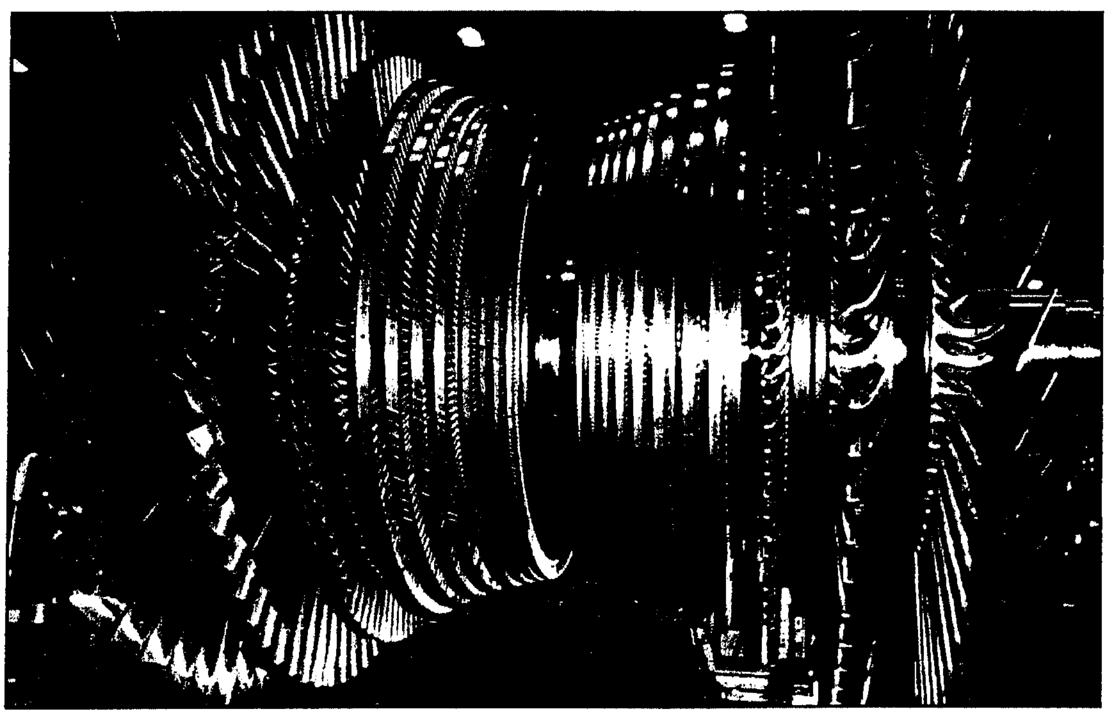
Ten-Disk Rotor – Since 1968



Eight-Disk Rotor – Since 1987



Six-Disk Rotor – Since 1995



for presentation at the

AMERICAN POWER CONFERENCE

CHICAGO, ILLINOIS, APRIL 1-3, 1997

PEF-NCR-03176

Authors

Mr. Heinrich Oeynhausen studied mechanical engineering at the State Engineering Academy in Essen. After graduating in 1971 he joined Kraftwerk Union where he worked as an engineer for applied mechanics for two years. After that, he continued his engineering studies at the Ruhr University, Bochum, and in 1977 became Scientific Assistant at the Institute for Mechanics. In 1981 he received his doctorate degree with a thesis on the stability of large clastoplastic deformations of thickwalled tubes under internal pressure and axial load. In 1984 he returned to Siemens/KWU and began working in the Steam Turbine Design Department, where he became manager in 1987. Mr. Oeynhausen was promoted in 1989 to head the subdivision of Steam Turbine Design. Since 1992 he has been Senior Director of the Siemens/KWU Steam Turbine Division with responsibility of all aspects of development, design, production and quality assurance.

Mr. Gerhard Roettger studied Mechanical Engineering at the Beuth Engineering Academy in Berlin. After graduation in 1957, he began employment with AEG in the Turbine Mechanical Engineering Department. In 1964 he was appointed Manager of the Turbine Calculation Section of the same Department. After Kraftwerk Union was founded, Mr. Roettger became Advisor for Development and Special Tasks in the Mechanical Engineering Department in 1974. He is engaged in Fracture Mechanic Computation and Probabilistic studies. Recently, Mr. Roettger was involved in developing design, forging and manufacturing methods to further improve the reliability of disk-type rotors leading to the introduction of the six-disk rotor design.

Mr. William E. Meade studied mechanical engineering at Oregon State University. After graduating in 1969 and a brief time working for the General Electric Company, he joined Allis Chalmers Power Systems in 1972 in the turbine-generator Product Service Division. Assigned as site manager for the installation of three prototype turbine-generator units for 400 MW, 650 MW fossil units and a 1305 MW nuclear unit, he was the lead turbine-generator start-up engineer on two new installations including a 650 MW fossil unit and a 1305 MW nuclear unit. He has been the site technical manager for 34 turbine-generator maintenance outages some with and some without labor contracts. He transferred to the failure analysis group in 1987 and evaluated turbine problems leading to predictive maintenance. In 1992 he transferred to his present position in service engineering and has been responsible for design control and manufacture of three large turbine upgrades including the six-disk LP rotor design.

Mr. Heinz Termuehlen studied mechanical engineering in Berlin. After graduating in 1958, he began employment with AEG, later Kraftwerk Union (KWU), in the Turbine Proposal and Project Department. In 1970 joined Allis-Chalmers Power Systems. In 1979 Mr. Termuehlen became Manager of Application Engineering with Utility Power Corporation in Bradenton, Florida. Presently he is Chief Engineer and Director of Product Planning for Siemens Power Corporation in Milwaukee, Wisconsin. Mr. Termuehlen is a member of ASME, IEEE, and ANS. In 1988, he was honored by being awarded the ASME Life Fellowship. He has presented several ASME, APC and IEEE papers, two of which were honored with the 1980 and 1988 Prime Movers Award. Mr. Termuehlen is a member of the ASME Power Division's Committee on Steam Turbines, and the International Representatives Committee, as well as the Industrial Committee of the American Power Conference.

Replacement of Nuclear LP Turbine Rotors and Inner Casings

Introduction

At the American Power Conference in 1994, we presented a paper about the success of the replacement project at the Grafenrheinfeld Nuclear Power Station. The replacement of turbine rotors and inner casings with the latest development in steam flow paths design increased the output of this 1300 MW unit by 45.3 MW.[1]

In the meantime, improved flow path designs have been utilized in nuclear LP turbines worldwide, including the Grand Gulf Power Plant in Mississippi. The success has not just been related to the thermodynamic performance improvement but also design improvements for most reliable operation, and the mitigation of stress corrosion cracking have been introduced.[2&3]

Since the first LP rotor and inner casing replacement at the Connecticut Yankee Power Station in 1987[4], further steps were taken to build the most harmonized LP turbine rotor and inner casing combination for nuclear power plants.

Disk-Type LP Turbine Rotor Design

Siemens has not experienced the extensive stress corrosion cracking of disk-type rotors, as it was reported by EPRI in 1982 for other suppliers of nuclear LP turbines. Because of the excellent nuclear power plant experience with disk-type rotors since 1972, there was never the need to introduce another unproven rotor design.[5] However, over the last 25 years, an evolutional process was applied leading from a ten (10)-disk over an eight (8)-disk to a six (6)-disk rotor design, as illustrated in **Figure 1**.

When, in the late 1960's, the first Siemens disk-type rotors for half-speed nuclear LP turbines were designed, operating experience from fossil units already existed, indicating that the proper shrink-fit design is critical for the successful long-term operation of such rotors.[6] At that time the ten-disk rotor was developed as a standard

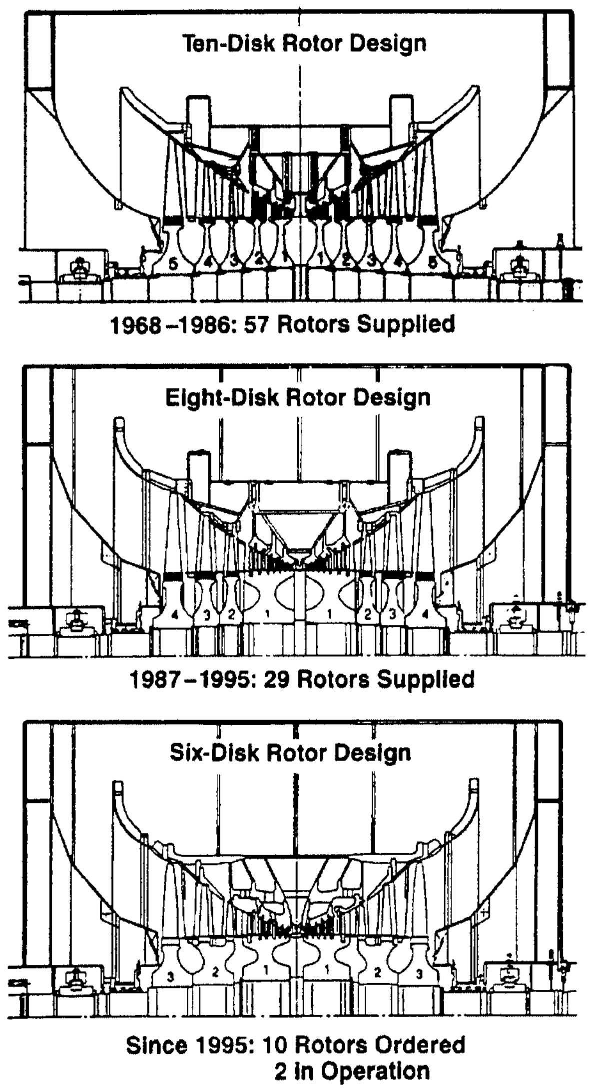


Figure 1. Evolution of Nuclear LP Turbine Design

rotor for nuclear half-speed turbines. A total of 57 rotors of this design were built with features making them highly resistent against stress corrosion cracking.[7] These features are illustrated in **Figure 2** and listed as follows:

- A larger than 1 mm (40 mils) gap between shaft and disks opens up the keyways and the circumferential stress relief groove to avoid crevice conditions.
- Large radius of the stress relief grooves at the shaft and the disks are designed to minimize stress concentrations.
- The shaft contour is specifically designed for the lowest high-cycle fatigue stressing caused by shaft bending.

After EPRI reported about other original equipment manufacturer's (OEM's) stress corrosion cracking problems, Siemens introduced eight-disk rotors with further improvements as shown in **Figure 3**, with their design, *forging and manufacturing modifications* being summarized as follows:

- compressive stresses in keyways
- compressive or low tensile surface stresses at the disk surface
- high fracture toughness within the disks low "Deep Seated" FATT)
- lower temperatures at all keyway locations

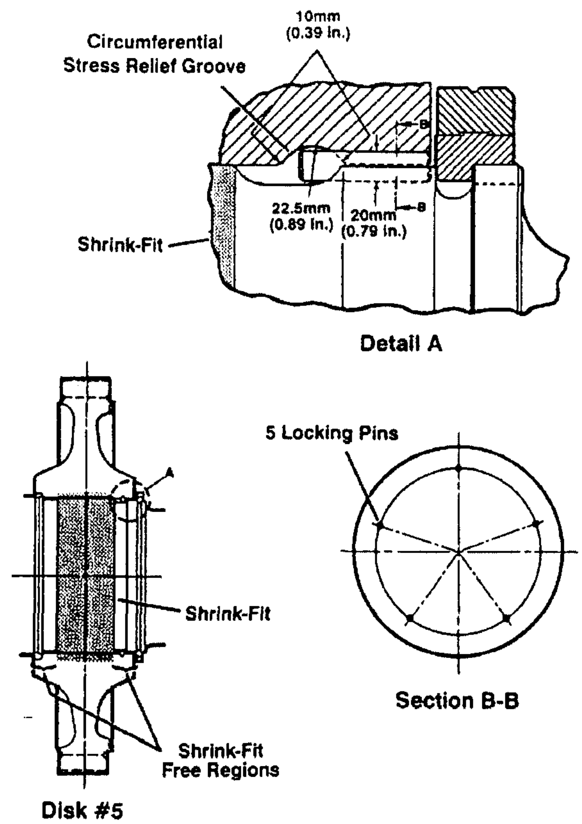


Figure 2. Shrink-Fit and Keyway Configuration of LP Turbine Disk #5

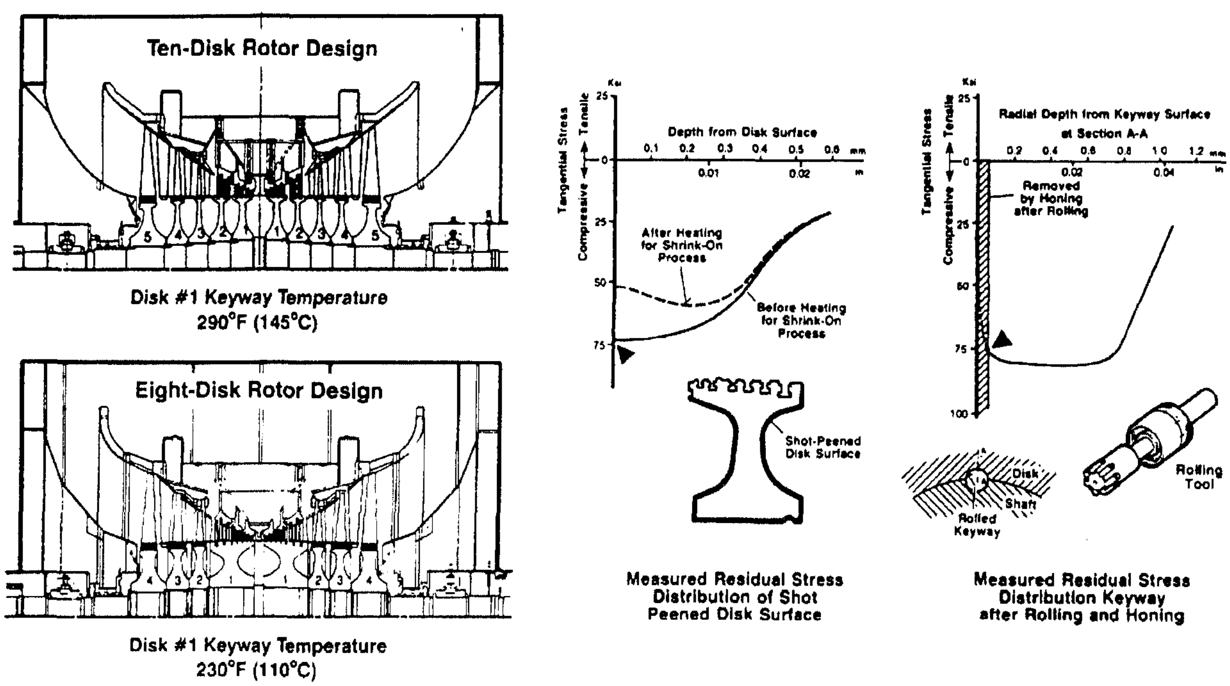


Figure 3. Improvements of LP Turbine Rotor with Introduction of Eight-Disk Rotor Design

As of today, 29 rotors of this design have been supplied.[8]

To further harmonize the nuclear disk-type rotor design, the six-disk rotor was introduced in 1995. This latest development was evolved from the previous ten-and eight-disk rotors to be used for all future new turbines and LP rotor replacement applications. Ten of the six-disk rotors have already been ordered to replace other OEM's LP turbine rotors.

Six-Disk Rotor Design

The evolutional development of the six-disk rotor from the eight-disk rotor is a logical step when comparing the two designs in **Figure 4**. The finite element grid shows that both rotors feature the same kind of blade attachments but different disk designs: The eight-disk rotor features

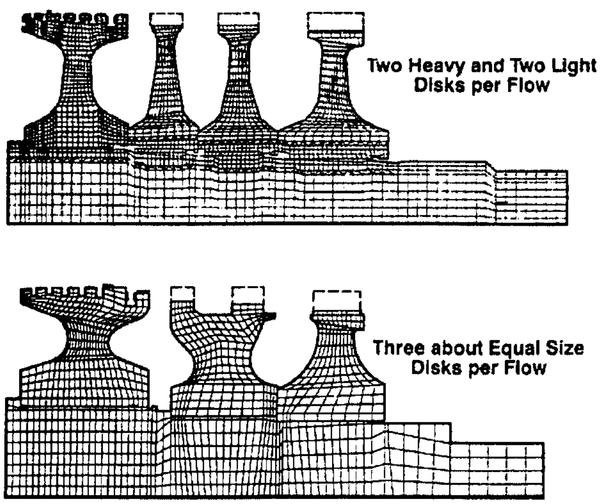


Figure 4. Finite Element Grids of Eight-Disk and Six-Disk Nuclear LP Turbine Rotors

two heavy (thick) and two slender (thin) disks per flow, whereas the six-disk rotor features three thick disks per flow. The similarity of the disk's operating conditions can best be seen in **Figure 5** in which the operating stresses of the six-disk rotor are plotted. The maximum tensile stressing by centrifugal and shrink fit forces in the shrink fit zones of all disks is with about 525 Mpa (76 Ksi) the same. These stresses are the finite element calculation results which do not include the residual compressive stress which are built into all three disks per flow.

A major feature in mitigating potential stress corrosion cracking has been to build compressive stresses into the disks during the disk heat treatment process. This technique has proven to be extremely successful with heavy or thick disks. With thick disks, compressive stresses can be built deep into the disk from the surface and have been measured at a depth of 30mm (1.2 inches). The finite element calculation results of local tangential stress levels are plotted for disks #1 in **Figure 6.** The first plot shows the stresses caused by the shrink fit and centrifugal forces at rated speed. The second plot reveals the build-in residual stress levels. Adding these two stress levels results in the third plot illustrating the actual operating stresses. Important is to note the low stress levels at the disk's surface to prevent potential stress corrosion cracking. Additional methods have also been developed and are applied to build compressive stresses into the blade attachment zones. The result reveals that high tensile stressing only occurs at the forging center which is not exposed to stress corrosion conditions. Since all disks of the six-disk rotor are thick disks, the example of the disk #1 is representative for the remaining disks.

Based on 25 years of experience and finite element evaluation of temperature and stress distribution, it was concluded that keying the last two disks per flow is not needed. The shrink-fit under steady-state temperature conditions is strong enough to keep the disks in place, even if they are exposed to about 10 times the rated operating moment or an overspeed in excess of 133%. Transient temperature conditions have only a minor effect on those last two disks per flow, since they are only exposed

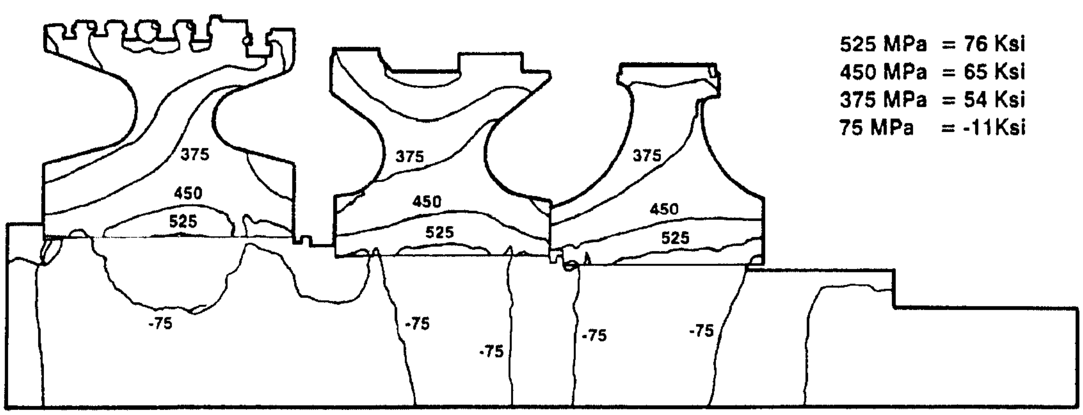


Figure 5. Tangential Stresses at Rated Speed Caused by Centrifugal Forces and Shrink-Fit of Six-Disk Rotor Design

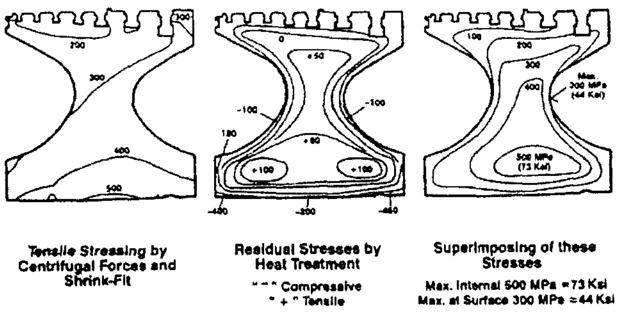


Figure 6. Tangential Stresses in Disks #1 of Six-Disk Rotors at Rated Speed

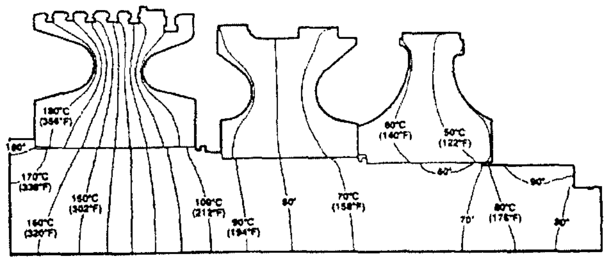


Figure 7. Isothermal Lines of Six-Disk LP Turbine Rotor

to low absolute temperatures (< 100°C or < 218°F), as shown in **Figure 7**. Transients can only occur in a small temperature range between these and the ambient temperature. However, the first disks per flow are exposed to higher operating temperatures and could possibly be exposed to larger temperature excursions especially at the upstream side. For this reason, it was decided not to eliminate the five keyways with keying pins of disks #1. The keyways of these disks feature the well-proven design which is not exposed to any tensile operating stresses because of the applied rolling and honing process. It is also an open design without crevice formation. The upstream side of the disk fit has been modified by the introduction of an angled inner diameter. This design will move any potential moisture or impurities out of the shrink-fit region. In addition, it provides a smaller transition to the shrink-fit in the disk center.

Eliminating the keyways on disks #2 and #3 also permits the designer to build the rotor shaft with smaller diameter steps between disks, resulting in a smaller inner diameter of disks #1 and #2, providing for a lower stressed shrink fit.

Introducing compressive stresses and reducing the effect of local stress risers has also been applied to the blade attachment and shaft of nuclear LP turbine rotors. Measures are applied to control any type of cracking, not only stress corrosion, but also high and low-cycle fatigue cracking.

Inner Casing Design

For building a LP turbine casing matching the rotor, the inner casing for the six-disk rotor features heavy casted inner casing sections as illustrated in **Figure 8**. The heavy disk #2 design could lead to heavier potential disk missiles penetrating the turbine casing. To mitigate this potential, the inner casing is built as a heavy barrier for preventing potential disk missile penetration.

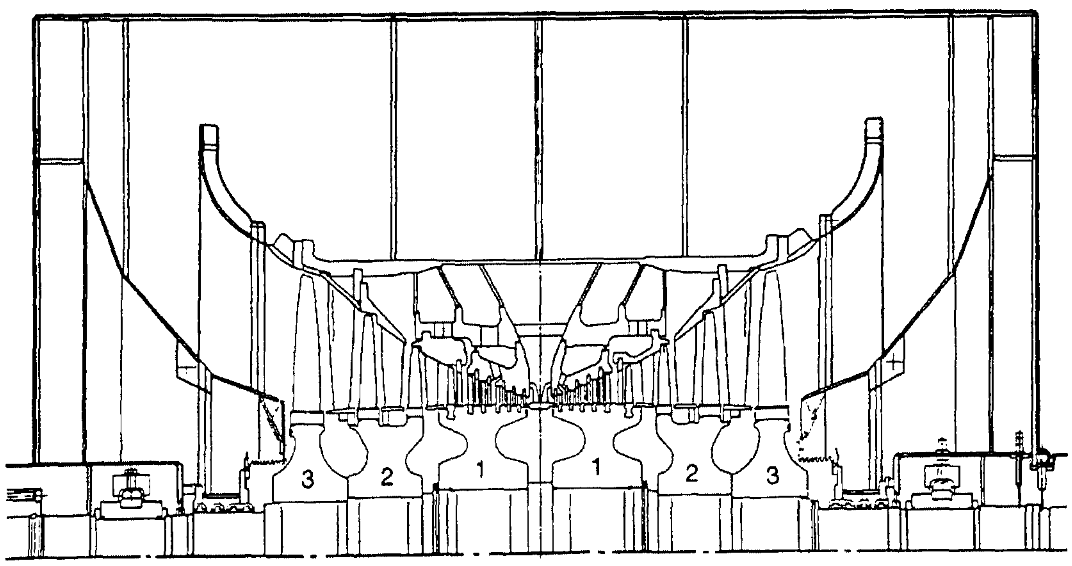


Figure 8. Six-Disk Nuclear LP Turbine Design

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Erosion-Corrosion and low-cycle fatigue could be a potential problem after long-term operation of inner casings. Based on experience the selection of proper materials such as high chromium steel for LP turbine inner casing materials has eliminated erosion-corrosion problems. The single shell inner casing with blade carriers and diaphragms is exposed to low-cycle fatigue cracking if not properly designed and manufactured. The example in **Figure 9** shows how low-cycle fatigue strength has been built into the inner casing. Evaluation of acceptable stress levels in its critical section such as the weld connections exposed to transient temperature conditions during unit start-ups was performed based on test results.

Operation and Maintenance

The six-disk rotor features a blade path design with the best possible thermodynamic performance. Typically, six to eight stages of integrally shrouded[9] and three stages of free-standing[10 & 11] blades are provided as depicted in **Figure 10**. The three-dimensional flow path design and the more effective interstage and shaft sealing systems have improved the performance of nuclear LP turbines by 4% in overall unit heat rate, which accounts for about 50 MW increase in output for a 1200 MW nuclear power plant.

Stress corrosion cracking has, for all practical purposes, been eliminated and the mean time between LP turbine inspections can be extended beyond the 100,000 operating hour threshold. As illustrated in **Figure 11**, the six-disk rotor provides sufficient space between the disks for good accessibility when performing a UT inspection. Having only six disks per rotor to inspect also reduces the inspection effort and time.

Conclusion

Presently, two of the ten ordered rotors have been in operation for 4,000 hours. Another two of those rotors are already shipped to a nuclear power plant in Spain.

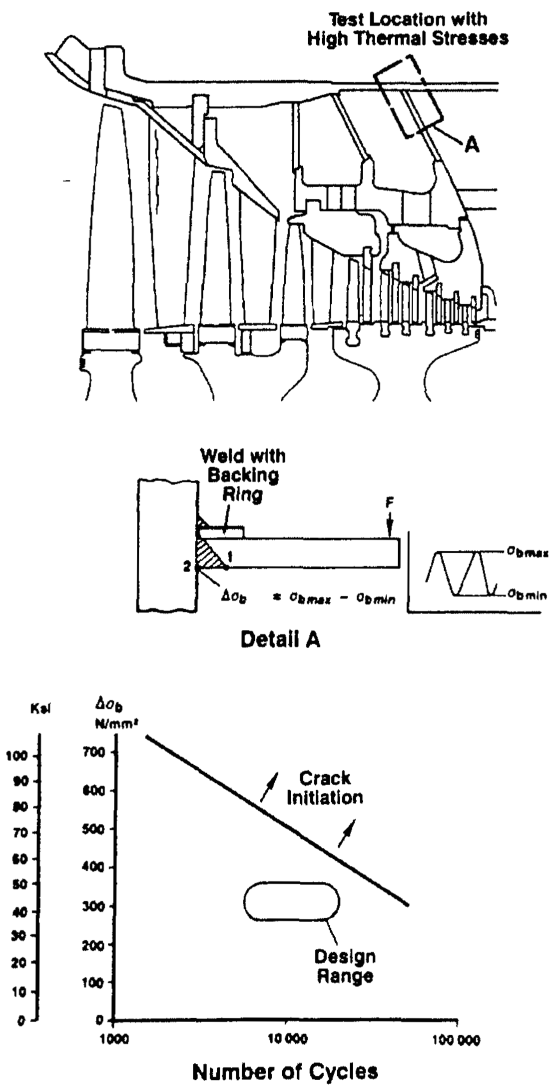

Figure 9. Low-Cycle Fatigue Test and Evaluation

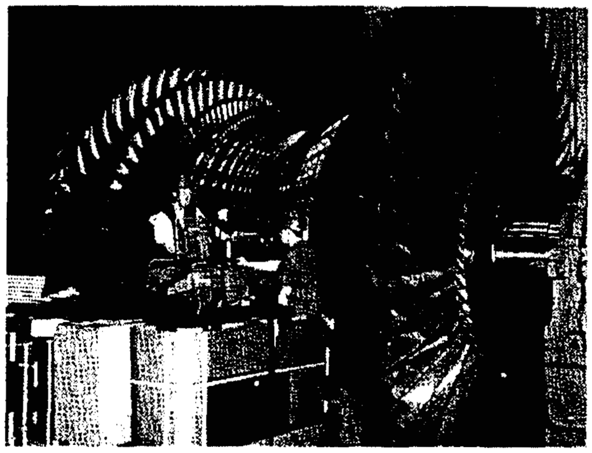

Figure 10. Six-Disk Nuclear LP Turbine Rotor with Integrally-Shrouded and Free-Standing Blades

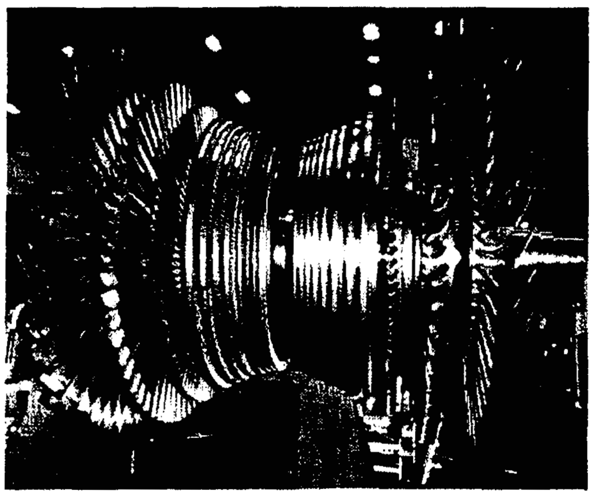

Figure 11. Bladed Six-Disk Nuclear LP Turbine Rotor with Access between Disks

PEF-NCR-03182

The latest evolutional step in designing the most reliable rotor and inner casing combination for nuclear LP turbines provides highest resistance against stress corrosion cracking. Together with the latest three dimensional flow path design features for stationary and rotating blading, an additional highest thermodynamic performance can be provided. For future new turbines and replacement applications, the six-disk rotor provides not only reliable long-term operation, but also requires a minimum of inspection and maintenance effort. Mean times between LP turbine inspections can be extended in excess of 100,000 operating hours.

The improved performance in regard to heat rate reduction and output increase by 4% over 1970 vintage nuclear LP turbine designs justifies a replacement of rotors in nuclear power plants based on the performance improvement alone, not even considering the large savings in O&M costs.

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Solutions

Service

Nuclear 13.9m^2 LP Advanced Disc Design

Scope of supply

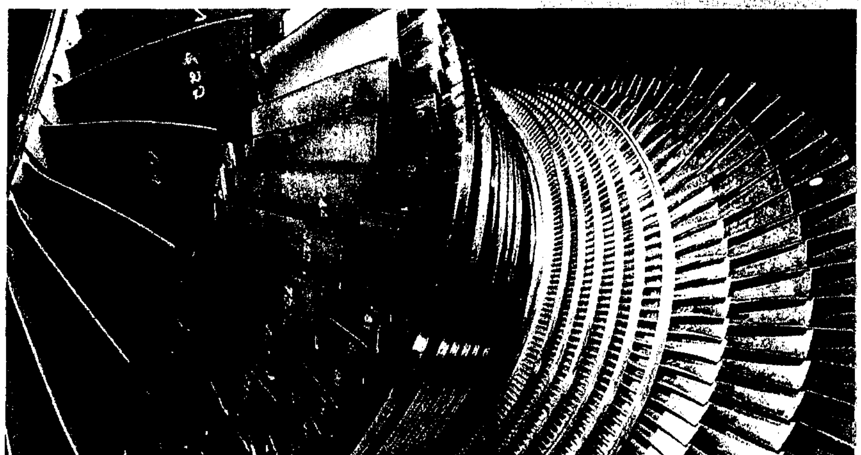
You have made the decision to extend the operating license of your nuclear power plant another 30 years or more. Your next decision is to determine what investments in plant equipment provide you with the safest and most reliable improvement throughout the extended operating period.

Siemens Power Generation offers the most comprehensive solutions to maximize your assets. We can, with your selected primary side supplier, optimize the cycle improvements in accordance with all engineering requirements. We can coordinate, or lead, the BOP condition analysis and integration effort. We also can support the modification of your technical documentation to incorporate design modifications per your plant format. Finally, our proven high efficiency bladepaths will help you reduce maintenance costs and increase electrical output for the life of the plant.

Our 13.9m^2 Siemens LP turbine features state-of-the-art design, technology and materials, with a 2.7 million-operating-hour track record of no disc stress corrosion cracking. This advanced disc LP design has been approved by the US Nuclear Regulatory Commission (NRC) for 10-year inspection intervals.

The typical 13.9m^2 scope includes:

- Fully bladed LP rotor with nominal 46-inch last row free-standing blades
- New one-piece inner cylinder fabrication with advanced design stationary blading
- Chrome steel materials in typical erosion areas
- Carbon steel and coated carbon steel in lower velocity areas.



The 13.9m^2 advanced design, for Siemens and select non-OEM units, features a 2.7 million-operating-hour track record of no disc stress corrosion cracking.

Customer benefits

Our 13.9m^2 LP turbine can maximize your life extension through:

- **Performance improvements** – ranging from 2% to 4% depending on cycle conditions
- **Improved reliability** – US Nuclear Regulatory Commission approved for 10-year inspection intervals
- **Greater erosion/corrosion protection** – advanced technology coupled with proper material selection for your specific operating conditions
- **Reduced maintenance costs** – 13.9m^2 LP meets NRC missile probability requirements, reducing future maintenance inspections
- **Minimized installation and inspection time** – one-piece inner cylinder enables faster and easier disassembly/reassembly for inspection
- **Application for select non-OEM units** – this proven design is the standard replacement for the BB81/BB281/BB381 LP family and has been installed on a number of General Electric nuclear LP turbines.

Features

Bladed LP rotor

Siemens' advanced disc design rotor incorporates a boreless shaft and three shrunk-on discs per end. Material selection, forging heat treatment and detailed design features are used to avoid stress corrosion/cracking found on other disc design rotors.

New, one-piece inner cylinder fabrication

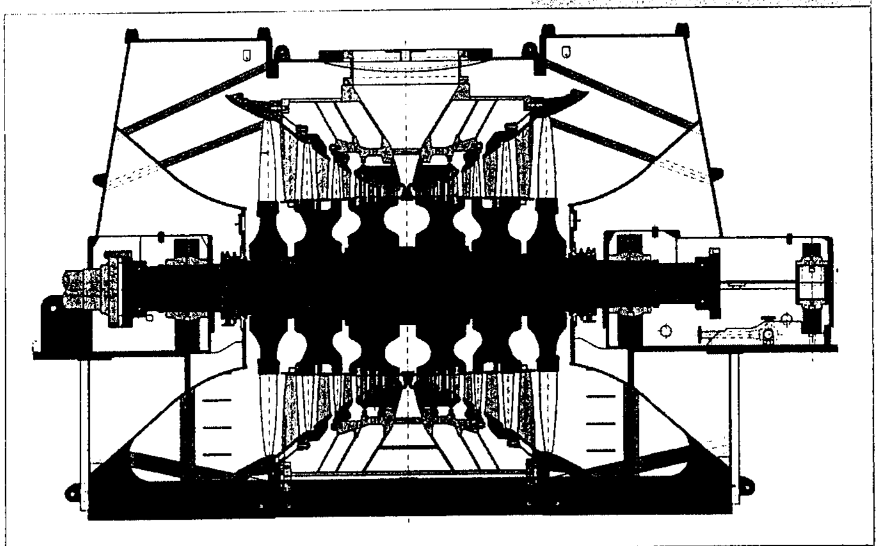
The LP inner cylinder fabrication is constructed of the appropriate grades of steel as needed for a target 40-year design life. Upgraded materials are available for high erosion environments, such as non-reheat BWR applications, in which more chrome steel content may be applied.

Advanced technology blading

- Integrally shrouded high efficiency blading in the early rotating and stationary stages
- Latest integral shrouded taper and twisted design high efficiency blading used in longer blades
- Low pressure section blading matched and tuned featuring the freestanding 46-inch last stage blades, giving an exhaust area of approximately 13.9m^2
- Moisture removal features in the forward-leaning last-stage stationary bowed blades, which facilitates even loading and flow distribution and helps reduce erosion on the L-0 rotating blades
- Leading edges of the LP freestanding rotating blades are flame hardened to further reduce moisture erosion.

References

This improved LP design is engineered for the Westinghouse BB81, BB280, BB281, BB381 and certain General Electric nuclear LP turbine designs.



Longitudinal section of modified LP with new internals.

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Siemens AG
Power Generation
Freyeslebenstrasse 1
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Siemens Scope for CR3 Turbine Generator Retrofit:

Description:
The Crystal River Unit 3 Nuclear Power Station (CR3) presently generates 903 MWe at 100% reactor power (2568 MWt). CR3 is planning to implement an extended reactor power uprate of 17% during the fall 2011 refueling outage. The CR3 steam generators will be replaced during the fall 2009 refueling outage. CR3 is also planning an "appendix K" feedwater flow measurement uncertainty recovery (MUR) uprate of approximately 1.6% reactor power during the fall 2007 refueling outage.

The scope of the CR3 extended power uprate (EPU) project is to retrofit the low pressure turbines, moisture separator reheaters, generator and the exciter during the fall 2009 refueling outage. The high pressure turbine will be designed and retrofit during the fall 2011 refueling outage to support the reactor thermal uprated conditions.

The detailed scope of work is based on the description of the Work as set forth in: i) the Siemens offer (Proposal Number TA02-280) dated April 13, 2007; ii) the Proposal Revision e-mail TA02-280-1 dated May 18, 2007; iii) Puneet Bahl's Installation Clarification e-mail and attachment dated June 4, 2007; iv) the requirements of this work authorization.

Schedule:
Siemens has proposed a 63 day clearance window for the 2009 refueling outage scope of work and a 25 day clearance window for the 2011 refueling outage scope of work.

The engineering document deliverable schedule shall be submitted for owner acceptance within 30 days of contract award.

The manufacturing schedule shall be submitted for owner acceptance within 60 days of contract award. Owner shall review detailed manufacturing schedule and identify Owner required witness points.

Siemens shall support Owners "engineering change process" and "work management process" as required, including attending engineering change design review meetings and work planning meetings.

Engineering:
Siemens shall perform and submit to Owner, a detailed retained component study which shall include all turbine generator support systems and a bearing loading evaluation.

Siemens shall perform and submit to Owner , a torsional vibration analysis model of the turbine generator rotor train for the 2009 configuration and the 2011 configuration. The torsional vibration analysis model report shall be submitted to the Nuclear Insurer (NEIL) by the Owner. Siemens shall resolve any NEIL requirements to support NEIL acceptance of the turbine generator torsional vibration analysis model.

Governor Valve Control Program Curves shall be provided to support the operation of the HP Turbine.

Siemens shall provide a lifting beam and slings designed to be capable of lifting all new turbine components supplied. The lifting beam shall be load tested and stamped with design load capability.

Complete new Turbine Generator Instruction Manuals (3 hard copies and 1 electronic copy), excluding AEH controller, shall be provided.

Performance Guarantee and Testing:
The 2009 performance guarantee (at 2.0 In. Hg. backpressure) and 2011 performance guarantee (at 2.7 In. Hg. backpressure) shall be determined based on updated CR3 plant heat balance calculation. The CR3 plant heat balance calculation shall be updated for final secondary plant design configuration and verified against actual plant performance following the 2007 measurement uncertainty recovery outage (i.e. at 2609 MWth.).

Plant performance testing shall be based on simplified ASME 6 procedure using test quality high accuracy instrumentation. Instrumentation Division of Responsibility (DOR) and Critical Test Corrections will be as mutually agreed on and as described in Siemens Amendment Offer dated May 18th, 2007.

Cycle isolation valve testing will be performed using the CR3 plant procedures and techniques (temperature differential and ultrasonic leak detection). Cycle isolation valve maintenance by PE will be by mutual agreement. Identified cycle isolation valve maintenance performed during the 2011 outage may result in a small recoverable loss that should be accounted for (if greater than 0.5 Mwe, but no greater than 1 MWe) by mutual agreement based on Plant Thermal Performance Report.

Installation Services:
Total Project Management: Siemens shall logistically manage all turbine deck work, crane usage and labor provided by PE to support turbine generator and MSR replacement project. PE to provide scaffolders, scaffolding materials, insulators, insulating materials, electricians, I&C, health physics. All other resources provided by Siemens.

Minor repairs that do not impact resources or resource loaded schedule shall be included.

LP Turbine laser alignment shall be performed during 2009 outage. The HP Turbine will not be opened in 2009 unless required to support alignment, at Siemens discretion. The HP turbine outer glands shall be removed to enable gland bore readings to support HP turbine alignment during the 2009 outage. The main oil pump shall be aligned during the 2009 outage. HP Turbine laser alignment shall be performed during 2011 outage. Generator Alignment and Frame Foot Loading shall be performed during 2009 outage. New Generator alignment shims shall be provided or fabricated as required. Existing generator shims shall be consolidated and replaced with new shims.

Generator service shall include lowering the main leads box 6 inches to clean the flange and to pump the pumping groove. A generator ventilation test shall be performed and adjustments made to ensure generator ventilation meet design requirements.

Turbine service shall include replacement of turbine valves during the 2009 and 2011 outage. 2TV's, 2GV's and 4 RSV's are scheduled to be replaced during the 2009 outage. 2TV's, 2GV's and 2IV's are scheduled to be replaced during the 2011 outage.

All material and equipment required to support performance of turbine lube oil flush shall be provided.

All rental equipment (trailers, portable crane, forklift, etc) required to support project shall be provided.

All consumables including craft labor PPE, per Division of Responsibilities, shall be supplied.

Chemical control shall be in accordance with CR3 plant procedures.

Siemens Scope of Material Supply:

High Pressure Turbine:

- Retrofit high pressure turbine shall be full reaction blading design with full arc steam admission.
- The steam path shall be designed with a 3% flow margin.
- Monoblock Rotor and Inner Cylinder with stainless steel Blade Carriers shall be supplied.
- Hydraulic Coupling Bolts shall be supplied and installed in the HP to LP turbine coupling with a new coupling spacer sized to axially position the HP rotor.
- The HP outer cylinder shall be reused and re-aligned as required.
- The Steam Lead Inlet Pipe Flanges shall be modified and new flexitalic gaskets installed.
- Stainless Steel Inner Glands Cases & Inner Gland Seal Rings sized for new rotor design clearance shall be supplied and installed.
- Outer Gland Seal Segments and bearing pedestal Oil Seal Strips shall be supplied, installed and final machined for the new rotor design clearances.
- The HP Turbine Bearings shall be rebabbitted.
- The existing extension shaft shall be refurbished at the Siemens Charlotte facility.

Low Pressure Turbines (Qty. 2):

- Retrofit low pressure turbines shall be advanced disc rotor design with 56 inch last stage blades and 18 square meter exhaust annulus.
- Fully Bladed Rotor and single piece Inner Cylinder with stainless steel Blade Carriers shall be supplied and installed with standard inner cylinder bolting.
- Outer Gland Housings and Bearing Pedestal Oil Seals shall be supplied and installed. Outer Gland Seal Segments and the bearing pedestal Oil Seal Strips shall be final machined for the new rotor design clearances.
- Exhaust Flow Guides and exhaust hood spray nozzles and piping shall be supplied and installed.
- The LP Turbine Bearings shall be rebabbitted with TEGO babbit.
- LP1 to LP2 Jackshaft shall be supplied and installed with new standard coupling bolts and new coupling covers. New coupling spacers, including bull gear, to be supplied and sized to axially position rotors to design requirements.
- LP Turbine SS Rupture Discs (lead free) shall be supplied and installed.

Generator (1200 MVA):

- The generator shall be rated at 1200 MVA. All replacement components shall be capable of supporting 1200 MVA capability.
- The generator H2 gas pressure shall be increased from 60 psig to 75 psig. A generator ventilation test shall be performed and adjustments made to ensure the generator H2 gas cooling capabilities meet design requirements.
- Supply and install all generator seal oil components required to support 75 psig H2 gas pressure. Seal oil system startup operation shall be documented to be in accordance with design requirements for 75 psig H2 gas pressure.
- Supply and install Hydrogen Inner Cooled RIGI-FLEX Winding. The stator winding shall include new Main Leads. Siemens shall be responsible for maintaining winding dryness. Winding shall be qualified by DC HI POT test.
- Supply and install Donut designed Stator Core. Core Iron Nitronic Through Bolts shall be supplied and installed. The new stator core shall be qualified by EL CID test and LOOP test.
- Supply and install Rewound Generator Rotor.

- Supply and install generator Blower Assembly.
- Supply and Install four (4) H2 Coolers.
- Supply and Install Main Lead Bushings and Current Transformers.
- Supply and install H2 Gland Seal Rings and H2 Gland Housing Seal Strips.
- Supply and install Bearing Oil Catcher and Outer Oil Seal Strips.
- All generator rotor seals shall be final machined for new rotor design clearance.
- Generator Bearings shall be rebabbitted.
- 24 hot gas RTD's, 4 cold gas RTD's, 2 warm gas RTD's, 2 rotor flux probes and 12 stator winding vibration probes shall be supplied and installed. All RTD's shall be duplex, 100 Ohm Platinum. New generator instrument terminal boards shall be supplied and installed. All new generator instrumentation shall be wired to the new terminal boards.

<u>Exciter:</u>

- Supply and install new Frame 12N Exciter assembly. New Exciter alignment shims shall be provided or fabricated as required.
- Exciter base electrical connections shall be compatible with existing field wiring and existing WTA voltage regulator.
- Supply and install new Exciter Housing including new Exciter Air Coolers. All cooler vent and drain tubing shall be stainless steel.

CORRECTIVE ACTION PROGRAM

[redacted]

REDACTED

[redacted]

[redacted]

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[redacted]

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CONFIDENTIAL

Progress Energy

June 26, 2007

John L. Gibson
Region Executive and Vice President Eastern US
Siemens Power Generation, Inc.
4400 Alafaya Trail, MC Q-1 302
Orlando, FL 32826

Dear John,

[redacted]

REDACTED

Progress Energy Service Company, LLC
P.O. Box 1551
Raleigh, NC 27602

CONFIDENTIAL

[redacted]

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[redacted]

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REDACTED

Sincerely,

Danny Roderick, Vice President
Nuclear Construction
Progress Energy Florida, Inc.

Accepted and agreed to without condition:
Siemens Power Generation, Inc

By: [illegible]

Title: Mgr. Contracts

Date: 6/27/07

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SIEMENS

DESIGN TECHNOLOGY

INTRODUCTION

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PEF-NCR-03301

Crystal River#3 New LP Rotor 18.0 m2(2009 outage) WB-11027 JDQ 3/28/2007	
HEAT FLOW DIAGRAM	SIEMENS AG POWER GENERATION

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DESIGNFILENAME : 070329jg.HUS JOB IDENTIFICATION : t D-958 FILENAME : C:\Data\qiuj\Project\nuclear\Crystal\296FA_18\070329jg.d

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PEF-NCR-03302

Crystal River#3 New HP Rotor with 18.0 m2LP (2011 outage) WB-11028 JDQ 3/28/2007	
HEAT FLOW DIAGRAM	SIEMENS AG POWER GENERATION

DESIGNFILENAME : 070322jq.AUS JOB IDENTIFICATION : dt D-958 FILENAME : C:\Data\qiuj\Project\nuclear\Crystal\oldHP_139\070328jq.

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Crystal River#3 New LP Rotor 13.9 m2 (2009 outage) WB-11029 JDQ 3/28/2007	
HEAT FLOW DIAGRAM	SIEMENS AG POWER GENERATION

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DESIGNFILENAME : 070322jq.RUS JOB IDENTIFICATION : dt D-95B FILENAME : C:\Data\qiuj\Project\nuclear\Crystal\295FA_139\070329jq.

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PEF-NCR-03304

Crystal River#3 New HP Rotor with 13.9 m2LP (2011 outage) WB-11030 JDQ 3/28/2007	
HEAT FLOW DIAGRAM	SIEMENS AG POWER GENERATION

CR3 Turbine Generator Retrofit Plant Performance Testing, Conference Call Notes, 05/16/07

Attendees:
PE: Ted Williams, Scott Deahna, Dario Zuloaga
Siemens: Dan Smith, Puneet Bahl, Al Battista, Jay Meyer, Dave Cavanaugh

Follow-up Items:

- The Siemens proposal "Electrical Output Guarantee" is based on the post 2011 electrical output only. A post 2009 performance test will be performed to document plant performance and to compare to the heat balance estimated electrical output. A test measurement uncertainty will not be applied to the 2009 measured and corrected megawatt output. The "electrical output guarantee" will be calculated as follows with provisions made to correct for 2011 maintenance recoverable cycle isolation losses as mutually agreed.

(Post 2009 MW corrected + (post 2011 MW corrected – pre 2011 MW corrected)) +/- (agreed uncertainty).

- Jay Meyer to provide Dario Zuloaga basis for 0.6% test uncertainty and to review test uncertainty for 2011 test.
- PE will test cycle isolation valves as described below. Cycle isolation valve maintenance by PE will be by mutual agreement not as required by Siemens.
- Siemens to reduce proposal cost for plant performance testing.

Summary:
General agreement was reached to perform a simplified ASME type plant performance test to assess the estimated turbine retrofit performance following the 2009 LP turbine / MSR / Steam Generator replacement and to assess the guaranteed performance following the 2011 HP turbine / reactor thermal uprate. PE and Siemens will work to obtain accurate plant heat balance model for EPU. Siemens can estimate the 2009 electrical output at 2.0 In. Hg. condenser pressure and the guaranteed 2011 electrical output at 2.7 In Hg condenser pressure. The bonus / penalty can be reduced from [redacted]/KW to [redacted]/KW. REDACTED CONFIDENTIAL

Primary test measurements to include: reactor thermal, feedwater flow (Caldon LEFM), electrical power, turbine backpressure (basket tips), turbine throttle pressure (at throttle valves), feedwater temperature, MSR TTD, MSR pressure drop, feed pump turbine steam flow (?).

Siemens proposes a 0.6% test uncertainty. Jay agreed to provide Dario the basis for this test uncertainty. PE would like a +/- approximately 5MW output band due to extensive plant modifications.

Discussion item: How to address 2 year cycle between 2009 LP retrofit and 2011 HP retrofit / EPU.

Post 2009 MW corrected test data will be compared to heat balance MW estimate for phase 1.
Siemens proposes to perform a pre 2011 test to determine the plant output change during the cycle. Although this change is expected to be small, the source of the change (i.e. LP turbine, cycle isolation, etc.) may not be known and may be outage recoverable (cycle isolation maintenance) during 2011. Identified cycle isolation maintenance recoverable losses are expected to be small, but should be accounted for based on mutual agreement.

Cycle Isolation: CR3 utilizes a plant procedure that measures temperature difference across cycle isolation valves. Ultrasonic leak detection is also utilized. The procedure is performed quarterly by the plant engineers. PE proposes to use these techniques to determine potential cycle isolation valve leakage. PE and Siemens will "mutually agree" to any cycle isolation valve maintenance to be performed by PE.

POTENTIAL SUB–SUPPLIER LIST

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[redacted]

Siemens Turbine Generator Power Uprate Retrofit Meeting **Sept. 12, 2006**

The Crystal River 3 Nuclear Power Station is considering a 17% reactor thermal (20% electrical) power uprate in 2011.
The unit steam generators will be replaced during an 85 day outage in 2009.
The present reactor thermal power is 2568MWt.
The present turbine throttle steam conditions are 10.5MPPH, 900 psig, 585F.
Turbine first stage pressure is approximately 700 psig.
The seasonal turbine backpressure ranges 1.5 - 3.2 IN HGA. The present backpressure design point is 2 IN HGA. I believe a new backpressure design point of 2.2 - 2.3 IN HGA will be recommended following analysis of the average operating backpressure and the cost of power.
The electric generator is H2 inner cooled (60 psig), 989 MVA, 0.9 PF. Frame 126 x 275.
CR3 presently generates 900 MW at 100% reactor power.

Recommended agenda:

- Review lead time requirements, budget estimates and estimated efficiency gains from new technology.
- Discuss Siemens HP Turbine retrofit technology. If HP turbine is retrofit during 2009, would increased throttling losses be expected to be greater than the technology efficiency gains for the one cycle of operation prior to the reactor thermal uprate?
- Discuss Siemens LP Turbine retrofit technology.
- Discuss Siemens Water Cooled Generator Stator retrofit technology. Is it possible to uprate a 989 MVA H2 inner cooled generator to >1100 MVA by increasing the H2 pressure, etc? What are the uprate limitations for H2 inner cooled machines?
- Discuss Siemens Exciter and Voltage Regulator retrofit technology.

<u>Siemens Proposal #SD22007, CR3 Turbine Generator Retrofit 5/3/07 Review Meeting Open Items</u>

Siemens to provide proposal amendment letter by 05/18/07.
Siemens to provide 1200 MVA generator component evaluation by 06/08/07.

Generator field installation schedule is 69 days, including 48 days for generator stator winding and core iron replacement working 24 x 7. Siemens to review generator schedule for potential improvement. If generator outage schedule does not fit inside revised plant steam generator replacement schedule, then evaluate stator midsection replacement. Siemens mentioned the possibility of a seed stator frame becoming available.

Include generator main lead bushing replacement in proposal.

Include in proposal at no additional cost:

- Replace generator H2 seal rings and seal strips on H2 gland, bearing oil catcher and outer oil seal.
- Generator Ventilation Testing. Add description of requirements.
- Complete rotor train center line laser alignment and generator frame foot loading alignment.
- Replacement of the HP turbine gland steam spillover control valve with larger capacity valve.
- Machining of the HP turbine steam lead inlet flanges for flexitalic gasket modification.
- Rebabbit HP turbine and generator bearings due to new rotor journals.
- New style LP turbine lead free rupture discs.
- Lowering of the generator leads box to clean and pump sealing groove.
- A complete new technical manual for the turbine generator (excluding the AEH controller volumes) and electronic spare parts catalog.
- Material to support lube oil flush.

Project Management: PE desires "turn key" project management with minimal PE support responsibilities. Siemens to provide millwrights, riggers, welders, pipe fitters, crane operators and winders. TEI may provide the craft to install the MSRs. Siemens overall project management to include control of additional support craft provided by PE (mechanics, electricians, I&C, scaffold, insulators, pipe fitters, health physics, laborers, confined space attendants, fire watch, etc.). This will eliminate any delays due to "support requirements by others". Siemens to discuss this concept with their contracts personnel and provide their position.

Proposal pricing includes REDACTED for ASME PTC 6 turbine performance testing. Following discussion the prevailing approach is not to perform a full ASME PTC 6 performance test. Consideration is to use the PTC 6 - 2004 Alternate Test. Key parameters will be megawatt output and reactor thermal. PE will have high accuracy instruments for feedwater flow, main steam pressure, main steam RTD's, condenser back pressure and high accuracy megawatt meters. This approach will reduce the price included to perform the full PTC 6.

Performance bonus / penalty clause should have a performance dead band. Review dollars tied to performance testing result. The fact that the multiple changes to the plant will make exact megawatt contribution from a single source difficult to evaluate. A deadband of +/- 0.7% (test accuracy) could be set to account for these uncertainties and then a bonus could be considered for megawatts achieved above that value.

Is replacement of the generator WTA voltage regulator required to support the 1200MVA generator rating excitation requirements? WTA power amp drawers are uprated from 200 amps to 300 amps. Are the power amp drawers fully redundant at 300 amps? Siemens to unbundle the Digital Voltage Regulator and price it separately. Provide basis for recommending the EMI / RFI hardened cabinets. Estimated cost for AVR replacement is REDACTED including installation and startup support.

Existing generator rotor must be returned to Siemens. Transportation costs are included in the current price to return the existing CR3 generator rotor back to Charlotte.

Siemens Proposal #SD22007, CR3 Turbine Generator Retrofit 5/3/07 Review Meeting Open Items

Shipping and Handling estimated costs are high. Heavy hauling on site is largest cost portion. Agree to review transportation and handling plan. Evaluate Mammoat (bundled contract) for on site heavy hauling.

The final Secondary Plant design configuration must be provided to Siemens to support turbine blade path design. This includes the MSR drains re-route and feed water heater specifications. Siemens to provide a date when the information is needed for the final turbine steam path design.

Siemens to evaluate the remaining turbine generator equipment and support systems for EPU impact. The basis for this cost [redacted] is the number of hours projected to perform the study. PE asked to re-consider the magnitude of this expense in light of all the other work required to define the turbine peripherals as baseline to the overall project.

Add generator "Performance Plus H2 Seal Package" to proposal. Document added advantage / benefit from purchasing this seal package. Identify large generators with performance plus seal installed.

Siemens will provide dehumidification for the generator and no delays of high pot testing due to winding moisture. Electrical Power required for generator core iron loop test will be by PE.

Generator instrumentation will include installation of two flux probes, fiber optic vibration probes and 24 Gas Discharge RTD's with new terminal boards. Flux probes and fiber optic vibration pickups will be monitored using portable test equipment. Include providing the required portable test equipment for monitoring. Partial discharge slot coupler pickups are not required.

The seal oil skid will be modified to support 75psi generator H2 pressure. Any modifications required to enable the seal oil skid to operate at this pressure is included in current price.

The Generator Neutral Transformer will be included in the Siemens electrical evaluation for 1200MVA generator short circuit conditions. Generator protective relay set points will be provided.

All LP cylinder alignment and installation features (material and modifications) to install new turbines are included in proposal.

All HP turbine cylinder steam seal surfaces will be checked and machined as necessary. This work is included in the current price.

The extra charge for traveling personnel was defined as the per diem and mobilization costs that could occur to bring in some of the Siemens "regular" craftsman similar to AREVA specialty welders. This will be further defined by Siemens.

Progress Energy access to the manufacturing facilities cannot be limited to just five visits for HP and LP turbines.

LP turbine construction "is final design dependent and Siemens reserves the right to make changes to the number and style of components noted above without impact to performance guarantee values." "Price" to be added to the statement.

Siemens Proposal # SD22007, CR3 EPU Turbine Generator Retrofit Meeting Notes from 05/03/07:

Purpose of the Meeting is to better understand the Technical and Commercial Provisions of the contract proposal, ensure that various studies and analysis remaining do not alter the cost of the proposal and convey the understanding that the schedule must be improved to perform EPUR within the SGR schedule.

Siemens Proposal Summary:
HP Turbine: replace in 2011 with full arc, full reaction turbine design with 3% flow margin.
LP Turbines: replace in 2009 with 13.9M2 (46"LSB) or 18M2 (56"LSB) turbines.
Generator Stator: field rewind stator in 2009 with H2 inner cooled winding, core iron is replaced. Stator rating is 1165MVA to be further evaluated to obtain 1200 MVA.
Generator Rotor: replace rotor in 2009 with new or rewound seed rotor. Rotor winding is re-designed for 1200 MVA.
Exciter: replace in 2009 with larger frame 12N exciter designed to support 1200 MVA generator rating.
Voltage Regulator: replace in 2009 with TCSA digital voltage regulator designed to support 1200 MVA generator rating.
Moisture Separator Reheaters: replace MSR vessels in 2009 with TEI supplied MSR's.

Performance Guarantee: 1082.9 MW @ 2.7 In Hg (18M2 LP turbine). Does not include MSR drain reroute.

Outage Schedule: 2009 schedule indicated 69 days for LP turbine replacement and generator stator rewind. MSR replacement is not included.

Meeting Summary Highlights:

- Siemens to provide proposal amendment letter by 05/18/07.
- Siemens to provide 1200 MVA generator component evaluation by 06/08/07.
- Field installation schedule is 69 days, including 48 days for generator stator winding and core iron replacement working 24 x 7. Ted asked for review to shorten schedule. Mike O'Leary feels much generator schedule improvement is probably not achievable. May need to evaluate cost of stator midsection replacement if outage schedule is not acceptable. Siemens mentioned the possibility of a seed stator frame becoming available.
- Generator core iron field replacement loop test requires 4160V, 850A, Single Phase power supply. The plant must provide this power supply.
- Generator Ventilation Testing is required. Must roll unit to ¼ and 1/3 speed with air in the generator. 8 pressure taps installed throughout generator. Must restore generator following test. This must be included in plant startup schedule. Can auxiliary steam supply main steam to roll turbine early?
- The High Pressure Turbine should be acceptable for operation during the 2009 to 2011 non-outage period.

Scope of Supply Comments:

- Verify the Generator Main Lead Bushings are the only material not included in proposal required to support generator 1165MVA rating.

Re: Shay Foley indicated that offer was based on all major equipment sized to perform at 1200MVA. This included the core iron, stator, exciter and rotor. The blower should capable of meeting the 1200mva rating with modification/adjustment. The engineering study to be completed by June 8th will verify the correct bushing sizing and cost. Cost estimate for the bushings is REDACTED. Commitment was not clearly made to include this cost in the current price.

- Proposal states generator rotor seal sizes may be impacted by new rotor. Include re-stripping the hydrogen gland bracket, bearing oil catcher and outer oil seals. Include replacing H2 seal rings or installing new performance plus H2 gland seals.

Re: Siemens agreed that the hydrogen seal rings and all seal strips should be replaced because the rotor was being replaced. Need to include replacing all generator rotor seals in the proposal. Inclusion of the new performance package was not affirmed. Siemens wants to sell this package but could not provide sufficient basis to move it from nice to have to required status. The conventional seal package will function at the higher 75 psi hydrogen pressure. The SC Cooling System should be based on ambient temperatures at 95 degrees Fahrenheit.

- All LP cylinder alignment and installation features (material and modifications) to install new turbines must be included. ABB LP turbine retrofit removed the lower diaphragm ring, adaptor pipe and modified the top adaptor ring. All material to connect the inner cylinder to the cross over tee piece must be included.

Re: Siemens agreed with this statement. A new top diaphragm ring is included in scope.

- The retrofit is considered a major project with enormous cost. As stated in your proposal the project will be well engineered and will address issues to assure long life and reliable operation. Therefore we expect the following to be included in the retrofit project:
- Replacement of the HP turbine gland steam spillover control valve with larger capacity valve.

Re: Initially Siemens rejected inclusion of this valve, but later Siemens agreed to include this valve in their proposal (and price).

- Machining of the HP turbine steam lead inlet flanges for flexitalic gasket modification.

Re: Machining of the steam lead inlet flanges for fitment of flexitalic gaskets (phonographic surface) will be included at current price.

- HP turbine exhaust bowl erosion protection (spray pro?).

Re: It has not been determined that erosion has occurred but the long maintenance intervals currently scheduled do not allow for degradation to be caught if it were initiated. Siemens reiterated that the superheated steam is much less erosion than wetter steam. The erosion protection remains a consideration for as a "contingency" but it will not be included in the current contract price.

- Rebabbit the HP turbine and generator bearings due to new rotor journals.

Re: Bearing babbit condition will be evaluated and rebabbiting will be performed as necessary. Request HP and Gen bearing rebabbit as base scope.

- New style LP turbine lead free rupture discs.

Re: Siemens has the new lead free, stainless steel rupture disc and will include in the proposal at current price.

- Lowering of the generator leads box to clean and pump sealing groove. (Seal Tite contains asbestos).

Re: Siemens will perform this work as part of the proposal. Current Transformers are lower mass and will lessen vibration.

Scope of Supply Comments Cont:

- New Rotor Lifting Beam. Certified for load rating? Include new lifting slings for rotors.

Re: Slings are included.

- Include a complete new technical manual for the turbine generator (excluding the AEH controller volumes) that includes residual equipment left installed after retrofit. Include electronic parts catalog. Proposal includes new technical manual leaflets only.

Re: Siemens complained about the amount of work and presented several issues with providing this. In the end they will provide a new manual.

- Review new generator instrumentation and monitoring systems. Include 2 flux probes and 2 PD slot couplers to be installed. These probes will most likely be monitored using hand held instruments. Is a new Environment One generator condition monitor (GCM) provided? How many stator hot gas RTD's are provided?

Re: Siemens will provide the two flux probes, fiber optic vibration probes and 24 Gas Discharge RTD's (12 coils with 2 monitoring points per coil). New terminal boards for instrumentation are included. Siemens recommends partial discharge bus couplers (IRUS) rather than slot couplers. A GCM is not included.

- Is stator end winding vibration monitoring recommended for a rigi-flex winding? Can FOVM probes be monitored using portable monitor? FOVM is optional scope in proposal.

Re: Rotor flux probes and FO vibration probes can be monitored using portable test equipment. These probes are recommended by Siemens. Siemens does not recommend partial discharge monitoring.

Engineering Comments:

- LP Turbine Rotor Weight for 18M2 Rotor is 350,000 lbs. LP rotor plus jackshaft weight loads bearing #4 and #5 over 300 psi. A bearing loading evaluation must be completed prior to award. Original BB281 LP rotors weight was 195,500 lbs.

Re: This is not considered to be an issue. Evaluation will not be completed prior to contract award. Siemens is confident bearing loading is acceptable.

- What is "TEGO" babbit for LP turbine bearing? Does it support higher loads or higher temperatures?

Re: This material will support higher loads and temperature. TEGO babbit is higher strength and is lead free. This material has been used on similar type frame supports.

- Complete Generator 1200 MVA rating evaluation and identify impact prior to award.

Re: This will be done by June 8th.

- Generator H2 Pressure increases to 75 psig. Qualifying the generator frame to 75 psig shall be performed prior to award.

Re: This will not be done prior to award. This was looked at initially and should be acceptable.

- Rotor train alignment is critical to reduce bearing stress and vibration. Proposal states alignment calculation is affected by rotor stiffness, bearing support structure movement and cylinder cover installation. Should a cylinder tops on / tops off alignment check be recommended since this will be the first BB281 frame the 18M2 LP turbines may be installed in?

Re: Complete center line, laser alignment will be done and included in the current price. The new Cantenary Curves will also require the alignment. Need to include generator frame foot loading in base scope to support generator realignment.

- Generator H2 pressure increase to 75 psig. Recommend implementing performance plus H2 seal package. Proposal should discuss benefit to seal oil system performance and H2 purity. Are modifications to existing seal oil system and system performance at higher pressure fully understood? Is seal oil backup system and existing pumps qualified for higher pressure?

Re: The seal oil skid is to be operated at 75psi generator H2 pressure. Any modifications required to allow the seal oil skid to operate at this pressure is included in current price.

- Is replacement of the WTA generator voltage regulator required to support the 1200MVA generator rating excitation requirements? WTA power amp drawers are uprated from 200 amps to 300 amps. Are the power amp drawers fully redundant at 300 amps?

Re: Siemens personnel in the meeting could not provide a definitive answer to this. Requires consultation with engineering Staff. The 300 amp drawers need to be verified @1200 MVA and single failure capability to ensure they will carry full excitation.

Engineering Comments Cont:

- Any plant control system main steam pressure control concerns with full arc HP turbine. Expect 3% flow margin to provide GV throttling to maintain steam flow control. Contingency for 4th governor valve lagging control acceptable?

Re: Siemens indicated that this should not matter and they do not anticipate TGV control problems with full arc control.

- Generator Neutral Transformer. Was it evaluated? Does it need replaced? Is it adequate for 1200MVA short circuit current ratings?

Re: It does not need to be replaced. The neutral transformer sees only five amps and only functions when there is a short circuit or fault condition. The neutral transformer does need to be analyzed for shorts and transients. This will be included in the Siemens electrical evaluation. Protective relay set points will also be provided.

- Are any generator main leads box structural enhancements recommended?

Re: No, the leads box will be lowered and the surfaces cleaned and inspected. The new CT's are lighter weight. Demounting the CT's is not recommended due to work scope and schedule impact.

- Instrument tubing / piping under generator needs evaluated. Some needs to be replaced. The H2 dryer (BAC50) piping should be enlarged?

Re: The tubing under the generator is not impacted by Siemens work scope. This will be PE responsibility.

- Provide H2 cooler configuration information.

Re: This is a "drop-in" vertical cooler that is included in the current price. Information on the new coolers will be provided. New coolers are lead free and incorporate all upgrades.

- CR3 turbine AEH control system still uses secondary power supply from exciter PMG. Is this acceptable for frame 12N exciter?

Re: This is acceptable and does not present a problem.

Installation Comments:

- Revise 2009 installation schedule to include MSR installation. Review schedule for installation options and cost impact to shorten schedule to approximately 60 days. Generator stator winding and core replacement schedule (48 days) does not agree with best performance (38 days) presented at the 2007 Siemens generator workshop.

Re: The MSR's can be included in the schedule without impact. They will require 21 days of parallel critical path. Problem is getting the overall schedule to fit into our outage schedule for SGR as noted above. Note: MSR insulation is not included. TEI can provide insulation and can install a lot of the new vessel insulation pre outage.

- Include a laser alignment of the entire train and plan on a generator alignment change. Turbine Generator Train Alignment does not appear to be included. Entire train realignment should be anticipated based on new rotor catenary curve. Entire rotor train alignment was changed during LP turbine retrofit (welded rotor design) in 1996. Proposal states generator re-alignment is not anticipated. HP turbine rotor to cylinder alignment needs to be addressed if HP cylinder move is needed. Alignment of HP turbine in 2009 vs. 2011?

Re: This was addressed above under the Engineering Comments Section. Siemens agreed to include.

- Installation support requirements and responsibilities by PE are extensive. Discuss capability of Siemens to provide additional labor jurisdictions or be assigned other craft labor through PE. PE desires to have Contractor project management responsible for directing all turbine deck operations.

Re: Siemens to provide millwrights, riggers, welders, pipe fitters and crane operators. TEI will provide the craft to install the MSRs. They were hesitant to accept responsibility for craft provided by PE (scaffolders, laborers, I&C, etc.). Siemens to discuss this concept with their contracts personnel and provide their position.

- Shipping and Handling estimated costs are high. Agree to review transportation and handling plan. Review rail delivery of Charlotte, NC shipments. Review overseas shipments to port of Tampa and rail or barge options to CR3. Evaluate Mammoat (bundled contract) for on site heavy hauling.

Re: Siemens to re-consider their shipping charges, especially re-think the use of the barge landing to avoid rail transportation. However, barge costs are greater than rail. They did state that blade removal and re-positioning after transportation (rail) would not be an issue. Heavy hauling on site is largest cost portion. Need to work with Mammoat.

- Siemens shall provide dehumidifier for generator and diesel generator for generator core iron loop test power requirements. No delay charges will apply to high pot test due to winding moisture issue.

Re: Siemens will provide dehumidification for the generator and no delays anticipated. Electrical Power for this work will be provided by the plant. Generator Core Iron Loop Test requires 4160V, ~3 MW at 850 amps (single phase).

- Are all HP turbine cylinder steam seal surfaces machined in the proposed field work scope of work?

Re: The seal surfaces will be checked and machined as necessary. This work is included in the current price.

Installation Comments Cont:

- Need to discuss lube oil flush setup and performance including material.

Re: This question led to discussion of the whereabouts of the jumpers required to bypass bearings on the lube oil flush. Siemens has responsibility for the flush and will bring in a skid if needed. Note: do not have notes on whether this is covered in the current price.

- Generator Ventilation Testing:

Re: Siemens added that they recommend a Generator Ventilation Testing. The generator would be turned at ¼ and 1/3 speed in air. The question of source/availability of the auxiliary steam from CR Units One and Two. Operational experience is needed to justify the test and the test will need to be included in the outage schedule and addressed relative to critical path. The test was performed as part of the 1990 mid-section replacement and orifices needed adjustment. Requirements include pressure taps in 8 areas back to a manifold. Questions arose regarding the availability of taps to be used and a manometer. We did not determine if this testing would be included in the current price.

Commercial Comments:

- Is the cost for a new rotor forging or a re-qualified rotor forging the same? The proposal does not include return of the existing generator rotor. What cost reduction would apply to return the existing generator rotor to Siemens?

Re: Siemens determined that the use of a seed rotor is more economical and the risk of this approach is low. A seed rotor has not been pre qualified. A new winding will be installed on the seed rotor. Transportation costs are included in the current price to return the existing CR3 generator rotor back to Charlotte. Warranty inclusions will be evaluated. Rotor rewind during the outage is not an option due to schedule.

- Overall project management to include control of additional craft (mechanics, crane operators, electricians, I&C, scaffold, insulators, pipe fitters, health physics, laborers, confined space attendants, fire watch, etc.). This will eliminate any delays due to "support requirements by others". PE desires "turn key" project management with minimal PE support responsibilities.

Re: Discussed above, Siemens to review this and provide feedback.

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- Proposal pricing includes REDACTED for ASME PTC 6 turbine performance testing. Siemens recommends a detailed PTC6 performance test based on PTC 6 - 1996 using group 1 and group 2 corrections. PE believes this will be extremely difficult to implement. Due to the extensive plant major component replacements over two refueling outages and the significant change in reactor power, it can be anticipated that a significant number of plant test data corrections would be required to correct performance to the calculated heat balance. Recommend reducing cost and scope of plant performance testing (review PTC6 – 2004 alternate test). Consider simple plant heat rate / output measurement test with minimal corrections (condenser pressure, etc.).

Re: Following discussion the prevailing approach is not to perform a full ASME PTC 6 performance test. Consideration is to use the 2004 Alternate Test. Key parameters will be megawatt output and heat rate. PE will have high accuracy instruments for feedwater flow, main steam pressure, main steam RTD's, condenser back pressure and the new high accuracy megawatt meters. This approach could save the REDACTED included in the price to perform the full PTC 6.

- Performance bonus / penalty clause should have a performance dead band. Review dollars tied to performance testing result.

Re: The fact that the multiple changes to the plant will make exact megawatt contribution from a single source difficult to evaluate, lends to the validity of considering a "deadband" between the performance guarantee and additional megawatts attributed to Siemens. This deadband of approximately +/- 0.7% (test accuracy) could be set to account for these uncertainties and then a bonus could be considered for megawatts achieved above that value. Siemens and PE to consider. Conference call needed to discuss this issue. 1080 MW x 0.007 = 7.56 MW.

- PE plans MSR drain reroute and other potential plant equipment changes that will affect the final plant heat balance calculation and electrical power output.

Re: The final Secondary Plant design configuration must be provided to Siemens to support turbine blade path design. This includes the MSR drain re-route and feed water heater specifications. Siemens to provide a date when the information is needed for the final turbine steam path design.

Commercial Comments Cont:

- Retained component engineering evaluations should be included. Pricing includes added [redacted] REDACTED

Re: Siemens to evaluate the remaining turbine generator equipment and support systems for EPU impact. The basis for this cost is the number of hours projected to perform the study. PE asked to re-consider the magnitude of this expense in light of all the other work required to define the turbine peripherals as baseline to the overall project.

- Need to include generator main lead bushing replacement in proposal.

Re: Discussed above.

CONFIDENTIAL

- Add "Performance Plus H2 Seal Package" to proposal.

Re: Discussed above, Siemens is to determine what added advantage we would receive from purchasing this seal package.

- Exciter replacement cost includes replacement of the automatic voltage regulator. Request to price replacement of the generator voltage regulator separately. Is replacement of the WTA cabinets with EMI / RFI hardened cabinets typical for the digital voltage regulator?

Re: Siemens will unbundle the Digital Voltage Regulator and price it separately. Also, provide basis for requesting the hardened cabinets. Estimated cost for AVR replacement is [redacted] REDACTED including installation and startup support.

- Proposal states extra charge for "traveling craft labor" personnel.

Re: The extra charge for traveling personnel was defined as the per diem and mobilization costs that could occur to bring in some of the Siemens "regular" craftsman similar to AREVA specialty welders. This will be further defined by Siemens.

- Badge training is T&M but should not exceed 3 days and should be completed in one trip. Personnel who do not qualify to obtain badge (unescorted access) will not be billed to PE.

Re: This was broken down into two categories: badging for Siemens full time employees and badging for personnel to be added form the Locals in Florida. It was suggested that PE send inprocessing personnel to Siemens to complete as much preliminary "Access" work as possible before they come on-site. Regarding the locals we will have to set some agreements in contract that reflect our expectations relative to badging including non-payment for failures.

- Progress Energy access to the manufacturing facilities cannot be limited to just five visits for HP and LP turbines. If we have issues or change in code requirements, we may require numerous visits.

Re: PE made it clear that access could not be limited.

Commercial Comments Cont:

- The engineering study to verify retained component compatibility with the replacement components is *currently* scheduled to be performed after the contract is let. This is unacceptable - the replacement components are being contracted to be compatible with the remaining equipment.

Re: Discussed above. Engineering studies will be after award.

- LP turbine construction "is final design dependent and Siemens reserves the right to make changes to the number and style of components noted above without impact to performance guarantee values." Price should be added to the statement.

Re: Siemens agree that it would be appropriate to add "price" to their statement.

- Under Scope of supply "Re-useable components and interfaces at site", the last statement states, any condition found to be in conflict of the expected condition would be addressed outside of this Scope of Supply. Examples of these conflicts should be provided and methods of resolution should be determined.

Re: Two examples noted in the discussion were the LP and HP cylinders. Siemens agreed to extend the list in order for PE to understand their concerns.

Progress Energy Items:

- MSR insulation is not included in MSR proposal. TEI discussion
- EH tubing will be impacted by MSR replacement. TEI discussion
- Engineering Change and Work Order Package development.

Re: Siemens will provide needed info and participate in design review meetings.

- Radiological support and material decontamination contingency. PE responsibility
- O&M replacement of extraction pipe expansion joints? The expansion joints should be inspected ands replaced only if needed.
- Any other turbine plant major equipment replacements must be integrated into turbine generator schedule for crane usage and logistics coordination. Agreed!
- PE to evaluate instrument tubing and small bore pipe under generator.
- Turbine foundation loading analysis update by PE.

Siemens Proposal # SD22007, CR3 EPU Turbine Generator Retrofit, Review Notes:

Proposal Summary:

HP Turbine: replace in 2011 with full arc, full reaction turbine design with 3% flow margin.
LP Turbines: replace in 2009 with 13.9M2 (46"LSB) or 18M2 (56"LSB) turbines.
Generator Stator: field rewind stator in 2009 with H2 inner cooled winding, core iron is replaced. Stator rating is 1165MVA to be further evaluated to obtain 1200 MVA.
Generator Rotor: replace rotor in 2009 with new or rewound seed rotor. Rotor winding is re-designed for 1200 MVA.
Exciter: replace in 2009 with larger frame 12N exciter designed to support 1200 MVA generator rating.
Voltage Regulator: replace in 2009 with TCSA digital voltage regulator designed to support 1200 MVA generator rating.
Moisture Separator Reheaters: replace MSR vessels in 2009 with TEI supplied MSR's.

Performance Guarantee: 1082.9 MW @ 2.7 In Hg (18M2 LP turbine). Does not include MSR drain reroute.

Outage Schedule: 2009 schedule indicated 69 days for LP turbine replacement and generator stator rewind. MSR replacement is not included.

Scope of Supply Comments:

- Verify the Generator Main Lead Bushings are the only material not included in proposal required to support generator 1165MVA rating.

- Proposal states generator rotor seal sizes may be impacted by new rotor. Include re-stripping the hydrogen gland bracket, bearing oil catcher and outer oil seals. Include replacing H2 seal rings or installing new performance plus H2 gland seals.

- All LP cylinder alignment and installation features (material and modifications) to install new turbines must be included. ABB LP turbine retrofit removed the lower diaphragm ring, adaptor pipe and modified the top adaptor ring. All material to connect the inner cylinder to the cross over tee piece must be included.

- The retrofit is considered a major project with enormous cost. As stated in your proposal the project will be well engineered and will address issues to assure long life and reliable operation. Therefore we expect the following to be included in the retrofit project:
    - Replacement of the HP turbine gland steam spillover control valve with larger capacity valve.
    - Machining of the HP turbine steam lead inlet flanges for flexitalic gasket modification.
    - HP turbine exhaust bowl erosion protection (spray pro?).
    - Rebabbit the HP turbine and generator bearings due to new rotor journals.
    - New style LP turbine lead free rupture discs.
    - Lowering of the generator leads box to clean and pump sealing groove.

- New Rotor Lifting Beam. Certified for load rating? Include new lifting slings for rotors.

- Include a complete new technical manual for the turbine generator (excluding the AEH controller volumes) that includes residual equipment left installed after retrofit. Include electronic parts catalog. Proposal includes new technical manual leaflets only.

- Review new generator instrumentation and monitoring systems. Include 2 flux probes and 2 PD slot couplers to be installed. These probes will most likely be monitored using hand held instruments. Is a new Environment One generator condition monitor (GCM) provided? How many stator hot gas RTD's are provided?

- Is stator end winding vibration monitoring recommended for a rigi-flex winding? Can FOVM probes be monitored using portable monitor? FOVM is optional scope in proposal.

Engineering Comments:

- LP Turbine Rotor Weight for 18M2 Rotor is 350,000 lbs. LP rotor plus jackshaft weight loads bearing #4 and #5 over 300 psi. A bearing loading evaluation must be completed prior to award. Original BB281 LP rotors weight was 195,500 lbs.
- What is "TEGO" babbit for LP turbine bearing? Does it support higher loads or higher temperatures?
- Complete Generator 1200 MVA rating evaluation and identify impact prior to award.
- Generator H2 Pressure increases to 75 psig. Qualifying the generator frame to 75 psig shall be performed prior to award.
- Rotor train alignment is critical to reduce bearing stress and vibration. Proposal states alignment calculation is affected by rotor stiffness, bearing support structure movement and cylinder cover installation. Should a cylinder tops on / tops off alignment check be recommended since this will be the first BB281 frame the 18M2 LP turbines may be installed in?
- Generator H2 pressure increase to 75 psig. Recommend implementing performance plus H2 seal package. Proposal should discuss benefit to seal oil system performance and H2 purity. Are modifications to existing seal oil system and system performance at higher pressure fully understood? Is seal oil backup system and existing pumps qualified for higher pressure?
- Is replacement of the WTA generator voltage regulator required to support the 1200MVA generator rating excitation requirements? WTA power amp drawers are uprated from 200 amps to 300 amps. Are the power amp drawers fully redundant at 300 amps?
- Any plant control system main steam pressure control concerns with full arc HP turbine. Expect 3% flow margin to provide GV throttling to maintain steam flow control. Contingency for 4th governor valve lagging control acceptable?
- Generator Neutral Transformer. Was it evaluated? Does it need replaced? Is it adequate for 1200MVA short circuit current ratings?
- Are any generator main leads box structural enhancements recommended?
- Instrument tubing / piping under generator needs evaluated. Some needs to be replaced. The H2 dryer (BAC50) piping should be enlarged?
- Provide H2 cooler configuration information.
- CR3 turbine AEH control system still uses secondary power supply from exciter PMG. Is this acceptable for frame 12N exciter?

Installation Comments:

- Revise 2009 installation schedule to include MSR installation. Review schedule for installation options and cost impact to shorten schedule to approximately 60 days. Generator stator winding and core replacement schedule (48 days) does not agree with best performance (38 days) presented at the 2007 Siemens generator workshop.

- Include a laser alignment of the entire train and plan on a generator alignment change. Turbine Generator Train Alignment does not appear to be included. Entire train realignment should be anticipated based on new rotor catenary curve. Entire rotor train alignment was changed during LP turbine retrofit (welded rotor design) in 1996. Proposal states generator re-alignment is not anticipated. HP turbine rotor to cylinder alignment needs to be addressed if HP cylinder move is needed. Alignment of HP turbine in 2009 vs. 2011?

- Installation support requirements and responsibilities by PE are extensive. Discuss capability of Siemens to provide additional labor jurisdictions or be assigned other craft labor through PE. PE desires to have Contractor project management responsible for directing all turbine deck operations.

- Shipping and Handling estimated costs are high. Agree to review transportation and handling plan. Review rail delivery of Charlotte, NC shipments. Review overseas shipments to port of Tampa and rail or barge options to CR3. Evaluate Mammoat (bundled contract) for on site heavy hauling.

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- Is the cost for a new rotor forging or a re-qualified rotor forging the same? The proposal does not include return of the existing generator rotor. What cost reduction would apply to return the existing generator rotor to Siemens?

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- Performance bonus / penalty clause should have a performance dead band. Review dollars tied to performance testing result.

- PE plans MSR drain reroute and other potential plant equipment changes that will affect the final plant heat balance calculation and electrical power output.

- Retained component engineering evaluations should be included. Pricing includes added $100,000.

- Need to include generator main lead bushing replacement in proposal.

- Add "Performance Plus H2 Seal Package" to proposal.

- Exciter replacement cost includes replacement of the automatic voltage regulator. Request to price replacement of the generator voltage regulator separately. Is replacement of the WTA cabinets with EMI / RFI hardened cabinets typical for the digital voltage regulator?

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- The engineering study to verify retained component compatibility with the replacement components is *currently* scheduled to be performed after the contract is let. This is unacceptable - the replacement components are being contracted to be compatible with the remaining equipment.

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Progress Energy Questions:

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- EH tubing will be impacted by MSR replacement.
- Engineering Change and Work Order Package development.
- Radiological support and material decontamination contingency.
- O&M replacement of extraction pipe expansion joints?
- Any other turbine plant major equipment replacements must be integrated into turbine generator schedule for crane usage and logistics coordination.

Quality Assurance Program

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TERMS & CONDITIONS

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OPC

1ST POD

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080009

BATES NOS. PEF-NCR-03339 THROUGH PEF-NCR-03382

REDACTED

OPC

1st POD

#2

080009

OPC
1st POD

#3

080009

OPC

1^{ST} POD

#3

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BATES NOS. PEF-NCR-03383 THROUGH PEF-NCR-03391

NON-RESPONSIVE

OPC
1ST POD

#3

080009

BATES NOS. PEF-NCR-03413 THROUGH PEF-NCR-03416

NON-RESPONSIVE

OPC
1ST POD

#3

080009

BATES NOS. PEF-NCR-03417 THROUGH PEF-NCR-03446

NON-RESPONSIVE

Rec'd by S&L - 11/14/07

Progress Energy

CONFIDENTIAL

Sargent & Lundy, LLC
Attention: Mr. John Regan
55 E. Monroe Street
Chicago, IL 60603

CONTRACT NO. 257117
WORK AUTHORIZATION NO. 26
EFFECTIVE NOVEMBER 12, 2007

[redacted]

REDACTED

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REDACTED

CONFIDENTIAL

Progress Energy

Sargent & Lundy, LLC
Attention: Mr. John Regan
55 E. Monroe Street
Chicago, IL 60603

CONTRACT NO. 257117, WORK AUTHORIZATION 26
AMENDMENT NO. 1
EFFECTIVE November 12, 2007

[redacted]

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[redacted]

[redacted]

REDACTED

[redacted]

MASTER CONTRACT

No. 257117

FOR

ENGINEERING SERVICES

BETWEEN

PROGRESS ENERGY SERVICE COMPANY, LLC
not in its individual capacity, but solely as agent for
PROGRESS ENERGY CAROLINAS, INC.
PROGRESS ENERGY FLORIDA, INC.

AND

SARGENT & LUNDY, L.L.C.

CONTRACT
FEB 0 1 2006
ACCEPTANCE

#257117

OPC
1ST POD

#3

080009

BATES NOS. PEF-NCR-
03465 THROUGH
PEF-NCR-03511

REDACTED

OPC
1ST POD

#3

080009

BATES NOS. PEF-NCR-03512 THROUGH PEF-NCR-03568

NON-RESPONSIVE

Sargent & Lundy LLC

H. Stephen Taylor
Project Manager
Phone: (312) 269-6371
FAX: (312) 269-2208
Email homer.s.taylor@sargentlundy.com

January 31, 2006
Letter No. SLCPL-2006-001

Progress Energy
All Stations

Master Contract No. 257117 for Engineering Services

Mr. Tony Owen
Supply Chain Management
Progress Energy, PEB6
410 S. Wilmington Street
Raleigh, North Carolina 27601

Dear Mr. Owen:

Enclosed please find the signed original subject contract for your files. If you have any questions, please call me.

Yours very truly,

H. S. Taylor

H. Stephen Taylor
Project Manager

HST:clm
Enclosure – Addressee Only
Copy:
File: DMS

GENERATION EQUIPMENT SUPPLY CONTRACT

CONFIDENTIAL

BETWEEN

PROGRESS ENERGY FLORIDA, INC.
(OWNER)

AND

YUBA HEAT TRANSFER, LLC
(CONTRACTOR)

FOR

TWO (2) LOW PRESSURE CLOSED FEEDWATER HEATERS (NOS. CDHE-3A/3B),

AND

TWO (2) SECONDARY SERVICES CLOSED CYCLE COOLING (SC) HEAT EXCHANGERS
(SCHE-1A/B)

FOR

CRYSTAL RIVER UNIT 3 NUCLEAR PLANT,

FEEDWATER HEAT EXCHANGER REPLACEMENT PROJECT

CRYSTAL RIVER, FLORIDA

CONFIDENTIAL

Contract No. 355217

Contract Requisition No. 734756

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BATES NOS. PEF-NCR-
03572 THROUGH
PEF-NCR-03695

REDACTED

CR No. 58857

CONFIDENTIAL

CONTRACT

PASSPORT NO. 44867

BETWEEN

CAROLINA POWER AND LIGHT

AND

FLORIDA POWER CORP.

AND

CALDON, INC.

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25	Work at or Associated With Nuclear Facilities
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27	Severability
28	Governing Law
29	Confidentiality; Use of Information
30	Public Communication
31	Nonwaiver
32	Merger

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REDACTED

Attachment A	Pricing
Attachment B	Performance Incentives
Attachment C	Not Used
Attachment D	Acknowledgment of OWNER Policies and Practices
Attachment E	Release From Contractor, Form No. 119-A
Attachment F	State of South Carolina, Department of Revenue, Nonresident Taxpayer Registration Affidavit Income Tax Withholding, Form I-312
Attachment G	Nuclear Worker Screening Requirements for Unescorted Access
Attachment H	Code of Ethics Acknowledgment Form

OPC

1ST POD

#3

080009

BATES NOS. PEF-NCR-03699 THROUGH PEF-NCR-03804

REDACTED

GENERATION EQUIPMENT SUPPLY CONTRACT

BETWEEN

PROGRESS ENERGY FLORIDA, INC.
(OWNER)

AND

THERMAL ENGINEERING INTERNATIONAL
(CONTRACTOR)

FOR

MOISTURE SEPARATOR REHEATERS,

FOR

CRYSTAL RIVER UNIT No. 3, ELECTRIC POWER UPRATE

CRYSTAL RIVER, FLORIDA

CONFIDENTIAL

Contract No. 342253

Contract Requisition No. 688663

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BATES NOS. PEF-NCR-03808 THROUGH PEF-NCR-03867

REDACTED

MASTER CONTRACT No. 101659

BETWEEN

PROGRESS ENERGY SERVICE COMPANY, LLC

Not in its individual capacity but solely as agent for

Progress Energy, Carolinas, Inc.,
also known as Carolina Power & Light Company
and Progress Energy, Florida, Inc.,
also known as Florida Power Corporation

AND

FRAMATOME ANP, INC.

GENERAL TERMS AND CONDITITONS
FOR FURNISHING EQUIPMENT AND SERVICES

Progress Energy Services Company, LLC
411 Fayetteville Street Mall
Raleigh, North Carolina 27602

CONFIDENTIAL

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SECTION 20. CONTRACTOR PERSONNEL MATTERS

[redacted]

SECTION 21. INSURANCE

A. Contractor's Insurance

B. Nuclear Protection

SECTION 22. INDEMNITY

SECTION 23. SECURITY

SECTION 24. FITNESS FOR DUTY

SECTION 25. LAWS AND PROJECT RULES

[redacted]

SECTION 26. WORK AT NUCLEAR FACILITIES

[redacted]

SECTION 27. SEVERABILITY

ATTACHMENTS:

OPC

1ST POD

#3

080009

BATES NOS. PEF-NCR-03872 THROUGH PEF-NCR-03965

REDACTED

FRAMATOME ANP

An AREVA and Siemens Company

FRAMATOME ANP, Inc.

September 2, 2003

Mr. Joseph J. Corey, Jr.
Supply Chain Management
Progress Energy Service Company, LLC
P. O. Box 1551 (PEB 2C3)
Raleigh, NC 27602

Re: Contract 101659 between Progress Energy and Framatome ANP, Inc.

Dear Mr. Corey:

Consistent with your letter of August 11, 2003, attached is one copy of Contract 101659 which has been signed on behalf of Framatome ANP, Inc. by Mr. Andrew Cook, Vice President of Sales and Marketing. We have retained the other fully-executed copy for our files.

Thank you for your personal efforts in finalizing this Contract. It was a pleasure working with you.

Very truly yours,

Thomas D. Corkran
Senior Counsel

CONFIDENTIAL

FRAMATOME ANP, Inc.
3315 Old Forest Road, P.O. Box 10935 – Lynchburg, VA 24506-0935
Tel.: 434-832-3000 Fax: 434-832-0622 www.us.framatome-anp.com

CONTRACT

PASSPORT NO. 3714
Amendment Number 1

COMPLETELY AMENDED AND RESTATED
PREVIOUS CONTRACT NO. XTA9000142
AND ITS AMENDMENTS 1 - 4

GENERAL SERVICES AGREEMENT

BETWEEN

CAROLINA POWER & LIGHT COMPANY

AND

THE ATLANTIC GROUP

CAROLINA POWER & LIGHT COMPANY
411 Fayetteville Street
Raleigh, North Carolina 27602

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PROJECT SPECIFICATIONS

REDACTED

SECTION 1. SCOPE OF CONTRACTOR OBLIGATIONS

REDACTED

OPC

1ST POD

#3

080009

BATES NOS. PEF-NCR-03971 THROUGH PEF-NCR-04074

REDACTED

Progress Energy

CONTRACT
AUG 08 2007
ACCEPTANCE

Mr. Keith Hollingsworth
President
The Atlantic Group
5500 Democracy Drive, Suite 140
Plano, TX 75024

CONTRACT NO. 3714
AMENDMENT NO. 53
EFFECTIVE JULY 15, 2007

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REDACTED

[redacted]

REDACTED

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Progress Energy

The Atlantic Group
5504 Democracy Drive
Suite 240
Plano, Texas 75024

Attention: Keith Hollingsworth

CONTRACT NO. 3714
AMENDMENTS NO. 55, 56, & 57
EFFECTIVE OCTOBER 1, 2007

[redacted]

REDACTED

Progress Energy Service Company, LLC
P.O. Box 1551
Raleigh, NC 27602

CONFIDENTIAL

265061

[redacted]

REDACTED

CONFIDENTIAL

265061

Attachment E
Contract No. 3714
Amendment No. 49

CRAFT WORK ORDER (CWO)

[redacted]

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Attachment E
Contract No. 3714
Amendment No. 49

CRAFT WORK ORDER (CWO)

[redacted]

REDACTED

Attachment E
Contract No. 3714
Amendment No. 49

CRAFT WORK ORDER (CWO)

[redacted]

REDACTED

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REDACTED

Attachment E
Contract No. 3714
Amendment No. 49

CRAFT WORK ORDER (CWO)

[redacted]

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PEF-NCR-04090

Progress Energy

THE ATLANTIC GROUP
5504 DEMOCRACY DRIVE
SUITE 240
PLANO, TX 75024

Attention: Keith Hollingsworth

CONTRACT NO. 3714
AMENDMENTS NO. 58, 59, 60 & 61
EFFECTIVE JANUARY 25, 2008

[redacted]

REDACTED

Progress Energy Service Company, LLC
P.O. Box 1551
Raleigh, NC 27602

#270362

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[redacted]

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8270362

PEF-NCR-04092

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#270362

OPC
1st POD

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OPC

1ST POD

#3

080009

BATES NOS. PEF-NCR-04094 THROUGH PEF-NCR-04299

NON-RESPONSIVE

Siemens

MASTER CONTRACT No. 145569

BETWEEN

PROGRESS ENERGY SERVICE COMPANY, LLC

Not in its individual capacity but solely as agent for

Progress Energy, Carolinas, Inc.,
also known as Carolina Power & Light Company
and Progress Energy, Florida, Inc.,
also known as Florida Power Corporation
and Progress Energy Ventures, Inc.

AND

SIEMENS POWER GENERATION, Inc.

GENERAL TERMS AND CONDITITONS
FOR FURNISHING EQUIPMENT AND SERVICES

Progress Energy Services Company, LLC
411 Fayetteville Street Mall
Raleigh, North Carolina 27602

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SECTION 20. CONTRACTOR PERSONNEL MATTERS

REDACTED

SECTION 21. INSURANCE

REDACTED

SECTION 22. INDEMNITY

SECTION 23. SECURITY

SECTION 24. FITNESS FOR DUTY

SECTION 25. LAWS AND PROJECT RULES

REDACTED

SECTION 26. WORK AT NUCLEAR FACILITIES

REDACTED

REDACTED

SECTION 27. SEVERABILITY

SECTION 28. INFORMATION TRANSFER, CONFIDENTIALITY, PROPRIETARY INFORMATION, AND INTELLECTUAL PROPERTY

SECTION 29. PUBLIC COMUNICATION

SECTION 30. FORCE MAJEURE

SECTION 31. REQUIREMENTS FOR CONTRACTOR FURNISHED EQUIPMENT

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SECTION 34. LIMITATION OF LIABILITY

SECTION 35. TRANSFER

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OPC

1ST POD

#3

080009

BATES NOS. PEF-NCR-04304 THROUGH PEF-NCR-04406

REDACTED

Crystal River #3
Electric Power Uprate – BOP Engineering

Executive Summary

AREVA Contract # 101659 - 093

October 18, 2007

Progress Energy

BOP Contract Summary: Contents

- Scope
- Contract Bidders
- Technical Evaluation
- Bid Price Comparison
- AREVA Negotiations and Royalty Agreement
- Negotiated Price
- Bidder Selection Basis
- Payment Milestones
- Limits of Liability
- Project review Team

BOP Contract Summary: Scope (Slide a)

- Computer Model Updates (equipment sizing)
  - PEPSE- heat rate modeling
  - FATHOM- hydraulic modeling
  - CHECWORKS- FAC modeling
- MSR Replacement (require larger units)
  - Equipment [redacted]
  - Installation / Insulation [redacted]
  - Expected MWe gain 8Mwe
  - Cost benefit ([redacted]M/yr, < 7 year payback)

BOP Contract Summary: Scope (Slide b)

- Belly Drain Heat Exchangers (recover heat)
  - Estimated Cost [redacted] REDACTED
  - 34MWth gain, 4MWe Recovery
  - Cost Benefit ([redacted]/yr < 2 years payback)

- Turbine Generator Upgrade (developing EC's)
  - Low Pressure Turbine (3% efficiency gain, 28MWe)
  - High Pressure Turbine (1% efficiency gain, 9Mwe)
  - Main Generator and Exciter (1200MVA, 430 MVAR, 0.93 pf)
  - Contract costs [redacted]
  - Cost Benefit 2009 at 2609 MWth ([redacted]yr < 8 yr payback)

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Progress Energy

BOP Contract Summary: Scope (Slide c)

- Deareator Bypass Line Addition (deaerator is too small for the increased flow)
  - Existing capability 11MPPH
  - EPU required capability 13MPPH
  - 19MWth loss to heating cycle
  - Chemistry acceptable maintained by Hydrazine
- Iso-phase Bus Duct Cooling System Upgrade
  - Existing capacity 308 KW
  - Existing heat load 250KW
  - 2009 at 940 MWe 305KW heat load (Marginal)
  - 2011 at1080 MWe 466 KW heat load (50% increase)
  - Provide redundant fan and cooler capability removes single point vulnerability of critical component

Progress Energy

PEF-NCR-04423

BOP Contract Summary: Scope (Slide d)

- Feedwater Heater and Drain Mods
  - Replace heaters CDHE3A and 3B
    - Existing FAC concerns, previous shell repairs and wall thinning, suspect tube leaks
  - Evaluate Existing balance of Heaters
    - TTD increase from 4-6 F to 8 F
    - Velocities increase to 5ft/s above HEI standards of 4ft/s
    - Implement Heat Exchanger Monitoring Program (FAC UT Shell/Nozzles and Tube EC)
  - Choke flow (PEPSI) FAC (CHECKWORKS)
    - Replacement of Valves HDV 101, 102, 103, 104
    - Replace Piping upstream of HDV 247, 248, 249, and 250

Progress Energy

PEF-NCR-04424

BOP Contract Summary: Scope (Slide e)

- Secondary Closed Cycle Cooling (capacity is limiting)
  - Replacement of Heat Exchangers
    - Existing capability 54MBTU/hr
    - EPU uprate to 75-80MBTU/hr
    - Replacement Heat Exchanger capability 75MBTU/hr
      - Limited in size by existing foot print and interferences
  - Maximization of the system
    - Replacement of SC Pumps and Motors
    - Increase Impeller and Motor to provide additional (20%) flow margin
- Circulating Water Pumps and Motors
  - Retain existing casing and columns replace impeller and motor
  - 22% flow increase to maintain condenser back pressure less than 4"Hg.
  - Also provides additional cooling flow SC system

Progress Energy

PEF-NCR-04425

BOP Contract Summary: Scope (Slide f)

- Condensate Pumps and Motors
  - Existing flow Margin of 1.5%
  - EPU requirements increase of 17%
  - New pumps and motors will provide 4% margin above EPU requirements
  - Direct Drive Digital control Single Failure Proof Control System.
    - Removes inefficiency of mag coupling
    - Reduces environmental noise hazard
    - Removes single point vulnerability

Progress Energy

BOP Contract Summary: Scope (Slide g)

- Feed Water Booster Pumps and Motors
  - Existing flow margin 9.4%, No margin for 17% EPU
  - Recommend maintain existing margin (10%) for feed water transients
  - Convert from 4160V to 6190V removes load from Aux XFMR low load tap (existing margin on low load tap < 15%, margin on high load tap > 35%)
- Condenser Performance and FIV calculations
  - Determination of Circ water flow rate and tube staking and baffle/impinge plate requirements
  - Condenser Baffle Plate Installation EC

Progress Energy

PEF-NCR-04427

BOP Contract Summary: Scope (Slide h)

- Electrical Distribution System calculations
  - Verify load center margin and protective relaying
- Mechanical Ultimate Heat Sink Calculations
  - Verify adequacy of ECCS heat exchangers and pumps (EDG margin impact)
- Turbine Building Structural Evaluation
  - Verify increased loading of LPT/HPT adequate for Turbine pedestal and floor loading evaluations for new MSRs and Heat Exchangers
- Turbine Building Internal Flooding
  - Increase Cir Water flow of 22%
- LAR Support

Progress Energy

BOP Contract Summary: Contract Bidders

- AREVA
  - Completed CR3 MUR
  - Performing CR3 NSSS
  - Team very capable of completing BOP and integrating complete study
  - Areva partnered with Worley Parsons, the Original A/E for CR3 BOP
- ENERCON
  - Conducted Waterford BOP
  - NSSS Set points only in conjunction with Westinghouse
- TCI
  - No real experience in the conduct of a similar study, helped to develop the Specification
  - Did not bid all Tasks

BOP Contract Summary: Technical Evaluation of Bid

Summary of Technical Evaluation

- Concern for Enercon not Understanding scope and increasing cost

CONFIDENTIAL REDACTED

  - Served as A/E for RNP's ISFI. Initial Bid [redacted] million, final cost [redacted] million
  - Waterford BOP – Requested 20% increase in funding to handle overruns. Ultimately eaten by Westinghouse
  - Enercon's price for the lead COLA was 2x our JVT. On numerous occasions our JVT has bailed out Enercon even after Enercon receiving additional funding.
  - TCI did not have any bench depth, plans to sub contract engineering support.

BOP Contract Summary: Technical Evaluation of Bid

Quality

[redacted]

REDACTED

BOP Contract Summary: Bid Price Comparison ($000's)

	AREVA	Enercon
Initial Bid	[redacted]	[redacted]
Bid Clarification - 1*	[redacted]	[redacted]
Bid Clarification – 2**	[redacted]	[redacted]

REDACTED

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*Bidders were asked to review organization, set scope, convert T&M work to Fixed Price electrical calculations, Condensate Speed Control Drives equipment, etc.

**Bidders were asked to review hours for Tasks 3 (T/G Mods) and 9 (Condensate Speed Drives) to determine their alignment with the Toshiba design reviews for the equipment.

Progress Energy

PEF-NCR-04432

BOP Contract Summary: AREVA Negotiations

Price Reduction

[redacted]

BOP Contract Summary: AREVA Negotiated Price ($000's)

Final Fixed Price	[redacted]
Potential Contingency (Max.)	
Maximum Royalty	
Evaluated Prices (full Royalty/no contingency)	
Evaluated Price (no Royalty/full contingency)	
Evaluated Price (1/2 Royalty/1/2contingency)	

[!] CONFIDENTIAL

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PEF-NCR-04434

BOP Contract Summary: Bidder Selection Basis

Technical

- AREVA has a proven track record with Progress for this work

[redacted]

Commercial

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Progress has ultimate control of Contingency Funding and should be able to control at the lower quartile.

[redacted]

Conclusion

REDACTED

AREVA is best from a Technical perspective and on average equal cost with opportunity [redacted]

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PEF-NCR-04435

BOP Contract Summary: Payment Milestones/Dis-incentive

Payment Milestones are designed to provide an incentive to complete scheduled work on time and a dis-incentive for failure to meet schedule.

BOP Contract Summary: Limit of Liability

[redacted]

REDACTED

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Progress Energy

BOP Contract Summary: Project Review Team

Project Manager	Ted Williams
Project Technical Lead	Scott Deahna
Legal	Dave Conley
Audit	Loyd Graves
Contracts Lead	Tony Owen
Executive Sponsor	Danny Roderick

Progress Energy

PEF-NCR-04438

Siemens Contract #145569

Work Authorization #50

Executive Summary

August 8, 2007

Turbine Generator Retrofit

Purchase & Installation

Progress Energy

Siemens Contract Summary:

Contents:

- Scope
- Schedule
- Comparison of Bid Price
- Negotiated Savings
- Comparison of BNP Pricing
- System Bundling
- Performance Incentives
- Warranty
- Liquidated Damages/Dis-Incentive
- Limits of Liability/Extension of Insurance
- 2009 Performance Guarantee
- 2011 Performance Guarantee
- 100 Day Performance Guarantee
- Project Review Team

Progress Energy

Siemens Contract Summary:
Scope of Work

Contractor shall provide all labor, supervision, materials, equipment, and tools to supply, replace and install the High Pressure Turbine Rotors, Low Pressure Turbine Rotors, Generator, and Exciter at Crystal River Unit #3.

Progress Energy

Siemens Contract Summary:
Project Schedule

- Siemens has a 63 day clearance window for the 2009 refueling outage scope of work and a 24 day clearance window for the 2011 refueling outage scope of work.
- The Project Schedule consists of three distinct schedules:
  - Engineering Deliverable Schedule
  - Manufacturing Schedule
  - Installation Schedule
- All three shall be submitted for owner review and approval within 60 days of contract award.

Progress Energy

PEF-NCR-04442

Siemens Contract Summary:
Comparison of Pricing from Bid Submittals ($000's)

Equipment Prices	Alstom	Siemens
HP & LP Turbines	[redacted]	[redacted]
Generator		
Exciter		REDACTED
Field Installation	REDACTED	
Total Cost	[redacted]	[redacted]

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Progress Energy

Siemens Contract Summary:
Negotiated Savings ($000's)

	Alstom	Siemens
Discounts	[redacted] REDACTED [redacted]	[redacted] REDACTED [redacted]
Price with Labor		
Bundled Discount		
Price after Discount		
Evaluated Added Scope		
• HP turbine gland steam spillover valve		
• Machining steam lead inlet flanges		
• Rotor lifting beam		
• Extended warranty		
• Extended property insurance		
Total Evaluated Price		

Siemens Contract Summary:

Corporate Bundling- 11 Rotors

[redacted]

REDACTED

[redacted]

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Progress Energy

PEF-NCR-04445

Siemens Contract Summary:
Performance Incentives ($000's)

Safety and Human Performance

	Incidents	Bonus	Rev. at Risk
Industrial – OSHA	0	[redacted]	
	1		
	$\geq$2		
Lost Time Accidents	0	REDACTED	
	1		
	$\geq$2		

Human Performance Index

Index	1.15	1.30	1.45	2	$\geq$2
Bonus	[redacted]				

Note: [redacted]

REDACTED

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Progress Energy

Siemens Contract Summary:
Warranty

[redacted]

REDACTED

[redacted]

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Siemens Contract Summary:
Liquidated Damages

[redacted]

REDACTED

[redacted]

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Siemens Contract Summary:
Limits of Liability

[redacted]

REDACTED

[redacted]

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Siemens Contract Summary:

2011 Delta Target Output – Performance Guarantee

[redacted]

REDACTED

[redacted]

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PEF-NCR-04451

Siemens Contract Summary:
100 Day Performance Guarantee

For 100 days of Continuous Operation Contractor places [redacted] at risk for each outage (2009, 2011)

- The 100 day period begins after completion of commissioning and Unit has reached 100% power
- The unit must be removed from services based on the Contractor's Instruction Manual

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Progress Energy

Siemens Contract Summary:
Project Review Team

Project Manager – Ted Williams

Project Technical Lead – Scott Deahna

Legal – Dave Conley

Tax – Paul Matthews

Financial – Gerry Dowd

Audit – Elwyn Wood

Contracts – Tony Owen

Executive Sponsor – Danny Roderick

Progress Energy

Siemens Contract Summary:

Negotiated Savings ($000's)

Discounts	Alstom	Siemens
Price with Labor	[redacted] REDACTED [redacted]	[redacted] REDACTED [redacted]
Bundled Discount		
Price after Discount		
Evaluated Added Scope • HP turbine gland steam spillover valve • Machining steam lead inlet flanges • Rotor lifting beam • Extended warranty • Extended property insurance		
Total Evaluated Price		

OPC

1ST POD

#4

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BATES NOS. PEF-NCR-04455 THROUGH PEF-NCR-04470

NON-RESPONSIVE

OPC

1st POD

#5

080009

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[redacted]

CR3 Up-rate Financial View

(in millions)	2006	2007	2008	2009	2010	2011	2012	Total
Approved BAP* (Adjusted for Financial View)	[redacted]							
Current Forecast (Revised IPP)	[redacted]							
Variance	[redacted]							

REDACTED

(in millions)	2006	2007	2008	2009	2010	2011	2012	Total
Loaded Budget Plan*	[redacted]							
Current Forecast (Revised IPP)	[redacted]							
Variance	[redacted]							

REDACTED

REDACTED

- 2008/2009 Projection
    - All major contracts now issued – Reconciling milestone payments
    - Increased material and labor costs
    - Removed transmission costs
    - Consolidated cooling tower costs with EPU
- Future Years
    - Reflecting known milestones and increased labor costs
    - POD cost increases due to circulating water flow rates

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*Notes: Approved BAP (Adjusted) and the Current IPP Forecast is based on a financial view budgetary estimate of direct cost plus 15% loadings. Loaded Budget Plan only available through 2010

NGG Nuclear Generation Group

Progress Energy

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[redacted]

REDACTED

[redacted]								
EPU	[redacted]							
Approved PA								
Current Forecast								
Variance								
POG								
Approved PA								
Current Forecast								
Variance								
Transmission								
Approved PA								
Current Forecast								
Variance								
Total Uprate Project								
Approved PA								
Current Forecast								
Variance								

REDACTED

- POG activity forecasted to be managed by NGG/EPU
- Studies indicate Transmission work may not be required

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[redacted]

REDACTED

[redacted]	[redacted]
Current Forecast	[redacted]
EPU	[redacted]
POD Uprate	[redacted]
Transmission	[redacted]
Total	[redacted]

REDACTED

- 2007 Projection Under-run of [redacted] REDACTED
  - Contract Studies for NSSS & BOP delayed past 2nd quarter, 2007

Approved PA Variance [redacted] REDACTED

- 2007 Actual YTD Spend vs. YE Projection
  - [redacted] Turbine Milestone Payments
  - Equipment Orders (MSRs, FWHEs, etc.)
  - Engineering Analysis
  - MUR
  - [redacted] YTD Spend

REDACTED

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- 2008 Over-run of [redacted] REDACTED
  - Turbine Generator Bid Higher than Feasibility Study
- Studies indicate Transmission work may not be required [redacted] REDACTED

NGG Nuclear Generation Group

Progress Energy

Progress Energy

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As of Oct '07

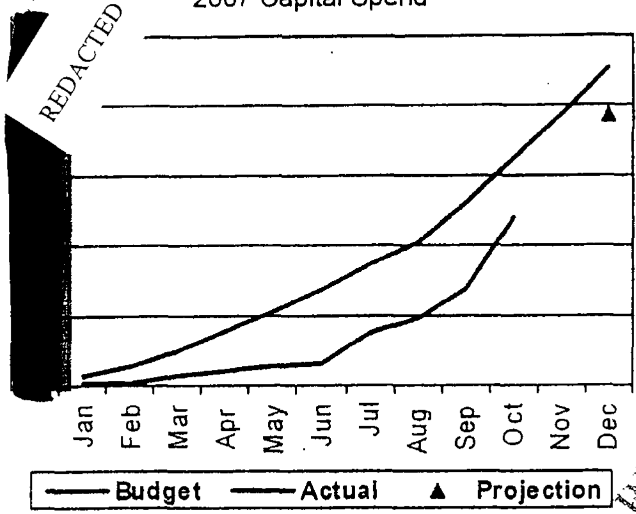
Crystal River Unit 3 Extended Power Uprate

Perform plant modifications that will provide Crystal River Unit 3 with the capability of producing an additional net 162 MW.

Cost

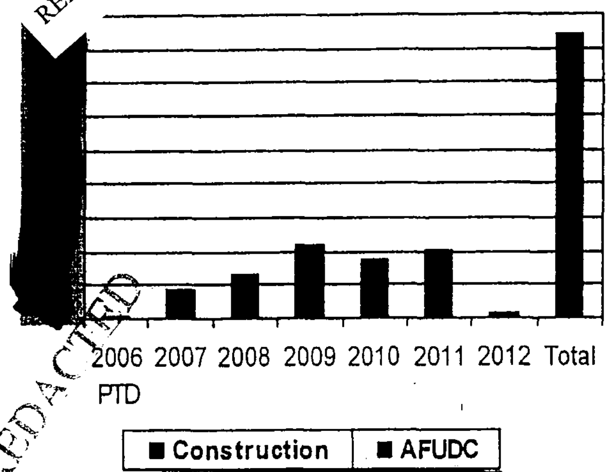
REDACTED

2007 Capital Spend



REDACTED

Total Project Cost by Year



REDACTED

REDACTED

Milestone Cost History ($ millions)	
Initial estimate (Dec '06)	[redacted]
Project to Date	[redacted]

REDACTED

- Project costs on target

Confidential

Schedule

15% Actual

In-Service Date December 2011

Project Authorization 2006

Plan 15%

Fall'07: Outage Add 11MW

Fall'09: Outage Add 25MW

Fall'11: Outage Add 126MW

- Measurement Uncertainty Recapture (MUR) Installation during Fall 2007 Refueling Outage – adds 11MW
- Power Uprate Installation during Fall 2009 Outage – adds 25MW
- Power Uprate Installation during Fall 2011 Outage – adds 126MW

Required Third Party Approvals

Issue/Impact

Issue	Impact/Action
• Cost management	• Firm price contracts for components being finalized through early 2008 • Contingency funding available for labor and materials price uncertainty
• Cost recovery	• Seek recovery under the Nuclear Cost Recovery Rule (filing in March, 2008)

PEF-NCR-04474

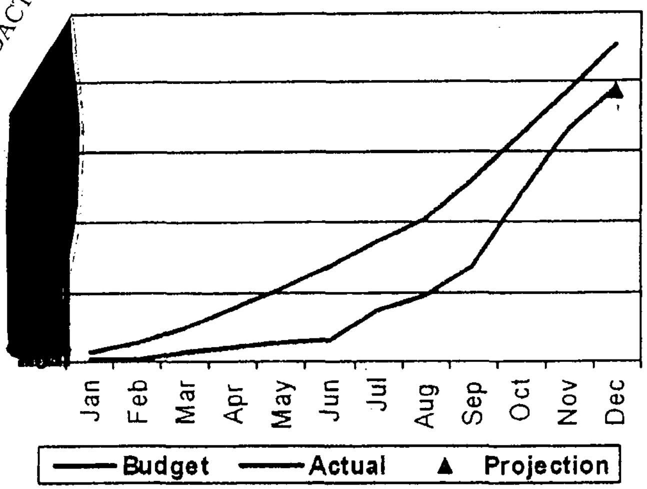
Progress Energy CONFIDENTIAL *As of Dec '07*

Crystal River Unit 3 Extended Power Uprate

Perform plant modifications that will provide Crystal River Unit 3 with the capability of producing an additional net 162 MW.

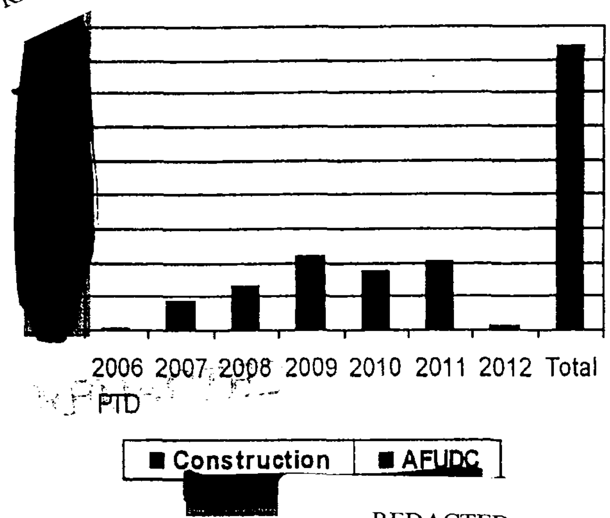
REDACTED

2007 Capital Spend



REDACTED

Total Project Cost by Year



REDACTED

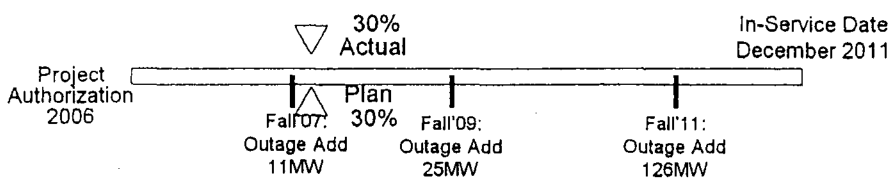
Milestone Cost History ($ millions)	
Initial estimate (Dec '06)	[redacted]
Project to Date	[redacted]

REDACTED

- Total Project costs on target

Confidential

Schedule



- Measurement Uncertainty Recapture (MUR) Installation during Fall 2007 Refueling Outage – adds 11MW; to be implemented Jan 2008
- Power Uprate Installation during Fall 2009 Outage – adds 25MW
- Power Uprate Installation during Fall 2011 Outage – adds 126MW

Issue/ Impact

Issue	Impact/ Action
• Cost management	• Firm price contracts for components being finalized through early 2008 • Contingency funding available for labor and materials price uncertainty
• Cost recovery	• Seek recovery under the Nuclear Cost Recovery Rule (filing in March, 2008)

PEF-NCR-04475

OPC
1st POD

#6

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OPC

1st POD

#7

080009

Crystal River Unit 3

Extended Power Uprate

Integrated Project Plan

MASTER NUMBER: 20058849

Sponsoring Business Unit:	Nuclear Projects and Construction
Funding Legal Entity:	Progress Energy Florida
Date Prepared:	January 29, 2008

Treasury Control No.	**20061181**

Key Project Contacts:

Role/Department/Group	Name	Phone No.
Sponsor, VP - NPC	Danny Roderick	240-4800
Major Projects Manager, EPU	Steve Huntington	240-4752
EPU Engineering Superintendant,	Ted Williams	240-4356
EPU Implementation Superintendant	TBD	
Regulatory	Dave Varner	240-4983
Project Financial Controls	Terry Hobbs	240-4746

PEF-NCR-04476

Plan Revision Control

Rev No.	Primary Author(s)	Revision Description	Rev Date
0	Ted Williams	Initial publication	3/18/2008
0	Mark Hickman	Initial Publication	3/18/2008

The following is required to be updated for significant revisions that impact any project cost +/- 5% for:

Project cost
Approved funding (to date)
Annual budget

Or Schedule changes that impact the resource plan

Review & Approval

This section contains formal sign-offs for both review & approval of the IPP. "Reviewing" applies to any party reviewing the IPP for accuracy & clarity, while "Approving" applies to those parties responsible for approving project milestone progression & funding.

Reviewing Party	Reviewing Position	Rev Reviewed	Signature	Date
T. Williams	Engineering Superintendant, EPU			00/00/00
D. Varner	Manager, Major Projects Support			
T. Hobbs	Manager, Major Projects Project Controls			
J. Terry	SGR Project Manager			
S. Huntington	Manager, Major Projects - EPU			
J. Franke	Director Site Operations CR3			
B. Cumbie	Crystal River Plant Manager- Fossil			
D. Roderick	VP, Nuclear Projects & Construction			

Approving Party	Approving Position	Rev Approved	Signature	Date
Tom Sullivan	VP, Treasurer & CRO			00/00/00
Jeff Corbett	Sr. VP Energy Delivery Carolinas			
Michael Lewis	Sr. VP Energy Delivery Florida			
Jeff Lyash	President and CEO, PGN Florida			
Lloyd Yeats	President & CEO PGN Carolinas			
John McArthur	Sr. VP Corporate Relations &General Counsel			
Mark Mulhern	Sr. VP Finance			
Paula Sims	Sr. VP Power			

Jim Scarola	Sr. VP & CNO			
Peter Scott	President &CEO Service Co., CFO PGN			
William Johnson	Chairman, CEO, and President PGN			

AGENDA

APPENDIX:

OPC

1st POD

#7

080009

BATES NOS. PEF-NCR 04481 THROUGH PEF-NCR-04501

REDACTED

[redacted]

REDACTED

[redacted]

APPENDIX

Definitions & Acronyms:

AIMS: Action Item Management System – A database developed to track internal action items of SGR project team members,

CAF: Containment Access Facility – The structure or area specifically designed to regulate the ingress and egress of radiation workers required to enter the containment building (also known as the reactor building) to accomplish work.

DTP: Detailed Task Plans – Specific plans (modeled after project plans) taken to the task level to provide details on specific tasks required to support the overall project to replace the steam generators.

EC: Engineering Change – A formal document developed by design engineering personnel that provides the technical and administrative controls to ensure modifications made the nuclear facility are compliant with all applicable Progress Energy requirements and the Code of Federal Regulations for nuclear facilities.

EPU: Extended Power Uprate – An increase in developed reactor power and electrical output derived from a combination of steam efficiencies, margin harvest, and reactor power increase.

ERP: Environmental Resource Permit – A permitting process required by state regulations to ensure activities are controlled within environmental standards.

INPO: Institute of Nuclear Power Operations – The organization specifically formed to provide oversight and support to commercial nuclear power stations.

ITS: Improved Technical Specifications – The licensing document that outlines the equipment required to remain operable for operation of the reactor in all modes of operation.

KPI: Key Performance Indicators – visual indicators that are used to provide insights that specific parameters key to the project success are measured and used by management to take corrective actions when these parameters are not s expected.

NBC: Net Benefit to Cost Ratio

NRC: Nuclear Regulatory Commission – The regulatory body that oversees safe operation of commercial nuclear facilities.

NSOC: Nuclear Security Operations Center – The structure that serves as the entry point and exit point for entry into the CR3 protected area.

OTSG/OTSG's: once through steam generators- heat exchangers designed to transfer heat from the reactor coolant system into steam used to drive the steam turbine in the generation of electricity.

QA: Quality Assurance – A specific function internal to the project, designed to ensure activities performed on the nuclear facility or components fabricated in support of operation of the nuclear facility meet the established requirements for quality.

RB: reactor building – one of three designed fission product barriers designed to protect the health and safety of the public from the release of reactor coolant system inventory during a postulated emergency.

SGR: Steam Generator Replacement – The acronym used to describe the project.

WBS: Work Breakdown Structure – The fundamental building block that defines the scope of the steam generator replacement project

Phase Project Authorization Form

[X] Initial	[ ] Revision (If Checked, enter revision no): ________	Phase: [X] Study [ ] Design [ ] Implement	
Project Title: CR3 Power Uprate - NGG		Prioritization Category: Initiative	
Department: Nuclear Generation Group	Location: Crystal River (CR3)	Charge To: ________	
EESY™ Record #: CR3-06-92200	Initiation Date 2006	Acctng System Phase #: 20058901	Acctng System Master Project #: 20058849
Account Class: O&M 0.0% Capital 100.0% Fuel 0.0%	[ ] Emergency	If Emergency, Authorized By: ________	
Project Manager: Terry, James	Project Sponsor: Roderick, Daniel	Benefit Assessment Date: June 1, 2010	

Schedule	[X] Outage Required	Study	Design	Implementation	Source of Funds: X Budget _ Other
	Start Date	October 1, 2006	October 1, 2007	June 1, 2007	
	End Date	December 1, 2007	[redacted]	[redacted]	Total Direct Cost
Direct Cost	2006	[redacted]			
	2007				
	2008				
	2009				
	2010				
	2011				
	Project Total				

		Before-Tax $
Will there be obsolete inventory as a result of the project that will require the write-off of inventory* If yes, enter $ value in the box	☐ Yes ☐ No	REDACTED
Will new inventory be added as a result of the project * If yes enter the $ value in the box.	☐ Yes ☐ No	

* Notify Business Unit Financial Services support, Manager, Property Plant and Materials Accounting, Director-Supply chain and CSO Salvage Group. Discuss in detail below.

Economic Analysis	B/C Ratio	NPV	Discounted Breakeven Year
[redacted]			

We, the undersigned, agree that the project assumptions are reasonable and key risks have been identified and accurately considered.

Approvals: Thresholds based on total project direct costs. All must sign in sequence.

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Approval Levels	Approval Signatures	Date	Approval Levels	Approval Signatures	Date
All 3 Phase Projects require these approvals	☑ Project Manager:	11/10/06	Project direct cost > $1M	☑ Senior Vice President	11/20/06
	☑ Project Sponsor:	11/10/06		☐ PEC or PEF President & CEO | Pres. - Progress Ventures | Exec. VP Diversified Ops:	
	☑ PRG Chairperson:	11/10/06		☑ Subsidiary Director or Progress Energy Service Co. Pres. & CEO | Subsidiary Director or Progress Energy, Inc Pres. & COO	12/8/06
	☑ Business Services Mgr. or Supervisor Financial Services:	11-10-06	Project direct cost > $5 M	☑ Subsidiary Treasurer or Progress Energy, Inc. Treasurer	12/6/06
Project direct cost > $250K	☑ Department Head - DH:	11/10/06		☑ Subsidiary Director or Progress Energy, Inc CFO:	12/7/06
	☐ Department Head - DH, Charge-By Org. (Required for facilities projects):			☑ Subsidiary Chairman or Progress Energy, Inc Chairman & CEO: Robert B McGehee	12/11/06

Return Original to PRG Administrator, who must maintain a file of the signed original: ________

Executed Lease Evaluation Form, FRM-SUBS-01110 must be attached to approval if the recommended project includes a lease.

Signatures as Subsidiary Directors or Officers based on legal entity sponsoring project.

Capital Planning and Control Review (Initial and Date): CLP 11/20/06

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FRM-SUBS-00690
Rev. 9 10/05

Report Generated: 11/10/2006 10:27:47AM

PEF-NCR-04504

Executive Summary:

Project Basic Information:

This Power Uprate Project will add 180 MWe of net generation output to the Crystal River Nuclear Plant

Recommendation and High Level Discussion:

A two phase approach will be used for this project for steam efficiencies and reactor power uprate for a total net generation increase of 180 MWe. Phase I will consist of optimization of mechanical equipment efficiencies that will result in a net generation increase of 40 MWe without additional fuel cost in 2009. This phase will provide for heat balance efficiencies, high pressure turbine optimization, low pressure turbine replacement, main generator rewind, and main steam re-heater replacement. Phase II will be a reactor power uprate that will result in an additional net generation increase of 140 MWe with increased fuel cost in 2011. This phase will provide for a change in license reactor power from 2,568 MWt to 3,010 MWt. The total net generation increase of 180 MWe is conservative for planning purposes and could be higher.

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The recommendation is to proceed with planning and implementation of Phase I and II for this project. This is based on the strategic fit for increased net generation in Florida and the steam efficiencies/nuclear fuel least cost alternative to provide 180 MWe of additional net generation with a favorable Benefit Cost Ratio.

Funding Requirements and Source:

This will be an NGG initiative capital project. POG and Transmission PPA's will be routed for approval separately. POG and Transmission costs are not included in this NGG PPA The total project cost is addressed in the Business Analysis Package.

Project Capital Allocation Metric Summary Table:

Economic Analysis	B/C Ratio	NPV	Discounted Break Even Year
[redacted]			

Cash Flow Graph:

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REDACTED

See attached Economic Analysis Report.

Strategic Fit (if applicable):

CR3 is a nuclear base load generation plant and a reactor power uprate will achieve increased net power production of 180 MWe realizing the economical benefits of nuclear fuel. This power uprate includes net generation increases of 40 MWe for steam efficiencies without fuel cost increases.

Key Risk Analysis:

[redacted]

Key Assumptions:

See Business Analysis Package

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FRM-SUBS-00690
Rev. 9 10/05

Report Generated: 11/10/2006 10:27:47AM

PEF-NCR-04505

Project Alternatives Analysis:

Alternatives Considered and Basis of Selection:

See Business Analysis Package

Consequences of Non-Authorization or Deferral:

Failure to realize the projected fuel savings and benefits associated with avoided capacity in part if deferred or entirely if not authorized.

Economic Analysis Detail:

Detailed Discussion of Results:

See Business Analysis Package

Scenario Analysis:

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See Business Analysis Package

Summary of Financial Indicators:

See Business Analysis Package

Major NPV Components:

See Business Analysis Package

Modeling Tool Used / Description of Changes / Approval:

EESY+ Version 5.8.2

Sensitivity Analysis Detail:

See Business Analysis Package

Regulatory Impact Analysis:

Implementation of Phase I and II will require FSAR and Tech Spec changes to our existing license. The study will provide for developing a regulatory approval plan.

Contracting and Procurement Strategy:

Change in Inventory Detail (either increasing due to new inventory needs or decreasing due to obsolescence):

Market Analysis:

Customer Analysis:

N/A

Competitor Analysis:

N/A

Non-Financial Considerations / Intangibles / Unquantified Financial Considerations / Other:

Co-owner participation may be an option for this project. This option will be pursued independently of this PA.

Integration and Project Performance Assessment Planning:

Organizational Requirements / Integration Issues:

This project will require support from plant Engineering, Licensing, Maintenance, Operations, Chemistry, and plant management. Support from off-site organizations will include NGG Engineering, NGG Fuels, Transmission, Fossil Engineering, and Corp. Strategic Planning. A temporary project team is in place for this project pending apprpoval of the permenant organization and will include representation from each key organization.

Project Objectives / Goals / Expected Benefits:

The project objective and goals are to effectively implement a power uprate strategy to increase the net generation from the Crystal River Nuclear Plant by 180MWe. This strategy provides the least cost alternative for this added net generation in Florida within the strategic generation plan.

Benefit Assessment Methodology, Schedule and Responsibility for Assessment:

Procurement and installation for the power uprate project will provide for increased net generation of 180 MWe from the Crystal River Nuclear Plant. The project will be completed by December 2011. The project manager will be responsible for the benefits assessment upon completion of each phase.

Responsibility for Assessment: Williams, Ted E.

Wrap-Up Conclusions and Recommendations (Pros & Cons):

The recommendation is to proceed with planning and implementation of Phase I and II for this project. This is based on the strategic fit for increased net generation in Florida and the steam efficiencies/nuclear fuel least cost alternative to provide 180 MWe of additional net generation. A decision to not implement this project will result in a lost opportunity for increasing net generation of 180 MWe using the nuclear least cost alternative for steam efficiencies and nuclear fuel.

Appendix A: Pro Forma Economic Analysis:

Appendix B: Pro Forma Financial Statements:

Other Appendices:

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Previous Phase Cost Status - Project View Costs

	Authorized Amount	Actual *	Variance $	Variance %
[redacted]				

Variance Explanation (if variance outside target range**):

REDACTED

* Use Projections as of PRG review data, if phase is not closed out.
** Variance for any Phase +/- 10% and greater than $20,000.

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Previous Phase Schedule Status - Project View Costs

[redacted]

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Progress Energy Florida

CR3 Power Uprate

Business Analysis Package

Sponsoring Business Unit:	NGG – CR3
Funding Legal Entity:	PEF
Date Prepared:	11-10-06

Key Project Contacts:

Role, Department/Group	Name	Phone #
Sponsor - CR3 - NGG	Danny Roderick	240-3219
Financial – CR3 - NGG	Don Taylor DFT 11-10-06	240-3165
Engineering – CR3 - NGG	Ted Williams	240-3886
Project Manager-CR3-NGG	Jim Terry	240-4321

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Table of Contents

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Executive Summary

Project Basic Information

Description: This Power Uprate Project will add 180 MWe of net generation output to the Crystal River Nuclear Plant

Location: Crystal River Unit 3

EESY Plus Project#: Record # CR3-06-92200 – Master Project # 20058849

Schedule: October 2006 – December 2011

Recommendation and High Level Discussion

A two phase approach will be used for this project for steam efficiencies and reactor power uprate for a total net generation increase of 180 MWe. Phase I will consist of optimization of mechanical equipment efficiencies that will result in a net generation increase of 40 MWe This phase would provide for heat balance efficiencies, high pressure turbine optimization, low pressure turbine replacement, main generator rewind, and main steam re-heater replacement. Phase II will be a reactor power uprate that will result in an additional net generation increase of 140 MWe in 2011. This phase would provide for a change in license reactor power from 2,568 MWt to 3,010 MWt. The total net generation increase of 180 MWe is conservative for planning purposes and could be higher. Phase II will also include water cooling upgrades due to increased heat rejection to the discharge canal. In addition, this phase will also include transmission grid modifications to accommodate distribution of the added 180 MWe output and address Crystal River 3 being the largest generator in Florida.

The recommendation is to proceed with planning and implementation of Phase I and II for this project. This is based on the strategic fit for reduction in total fuel costs in Florida and the steam efficiencies/nuclear fuel least cost alternative to provide 180 MWe of additional net generation with a favorable Benefit Cost Ratio. this project also addresses the Point of Discharge temperature issues that may have some cost split between proposed fuel adjustment clause and the environmental recovery clause. Cost shown in this Economic Analysis are for the total project cost.

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Funding Requirements and Source

REDACTED

Source:	2006	2007	2008	2009	2010	2011	Total
Direct Costs in $000's	[redacted]						

The project approval plan will consist of three separate Phased Project Authorizations (PPA). NGG-CR3 will do a PPA for the Phase I & II plant specific work scope with a total cost of $250 million. POG will provide a PPA for the Phase II water cooling upgrade in the amount of $88 million. Transmission will submit a PPA for the Phase II transmission grid upgrades in the amount of $89 million. When the PPA's are routed for approval, they will include the BAP as the overall project reference document. This strategy will keep the PPA's aligned with the total capital project budget allocated to the three separate departments. The Progress Energy project management organization will have representation from POG and Transmission to coordinate and provide oversight to their work scope's.

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This is the 3-Phase cash flow by department:

Direct Cost in $000's

	2006	2007	2008	2009	2010	2011	Total
NGG-CR3	[redacted]						
Study							
Design							
Implement							
Total							
POG	[redacted]						
Study							
Design							
Implement							
Total							
Transmission	[redacted]						
Study							
Design							
Implement							
Total							
Project Total							

REDACTED

The [redacted] million study phase will provide the plant specific project plan. Water cooling and transmission upgrades will be covered under those individual studies. This plan will include development of a detailed project schedule, task cost estimates, equipment specifications, license amendment plan, and permit review. The study will also provide the needed technical information for structuring a major component procurement strategy along with needed contracts for the implementation phase. In addition, the study will include a detailed review of "pinch points" to validate all the cost estimates.

Project Capital Allocation Metric Summary Table

Scenarios: Recommended Alternative

Metrics	Expected	Likely Best	Likely Worst
Benefit Cost Ratio (BC)	**1.66**	**2.91**	**0.93**
Net Present Value (NPV)	[redacted]		
Discounted Breakeven Year (DBEY)	**2022**	**2016**	**N/A**
Operational / Other Metrics			

REDACTED

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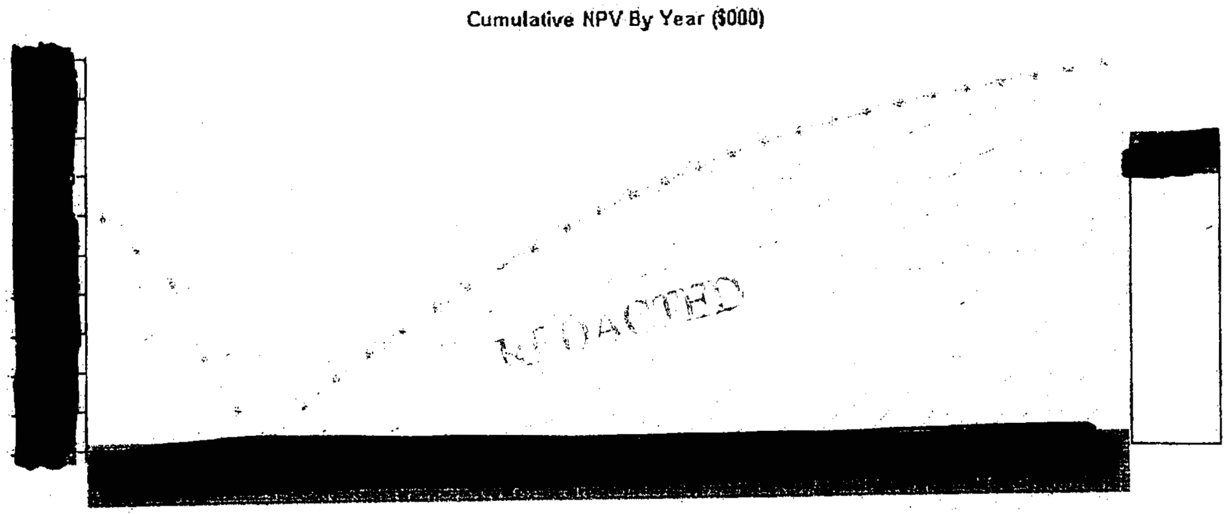
Cashflow Graph



Strategic Fit

CR3 is a nuclear base load generation plant and a reactor power uprate would achieve increased net power production of 180 MWe realizing the economical benefits of nuclear fuel. This power uprate provides the most effective way to reduce fuel costs by increasing the fuel mix of nuclear energy.

[redacted]

REDACTED

REDACTED

[redacted]

Key Assumptions

REDACTED

[redacted]

Escalated costs of the uprate and the spending curve are as follows (in $000's):

	2006	2007	2008	2009	2010	2011	Total cost
Phase I - Steam Efficiencies, $ 000's	[redacted]						
Phase II - Reactor Power change, $ 000's	REDACTED						
Phases I & II							

These numbers are the same for base and best case scenarios. For worst case scenario capital costs are increased by 10%.

Escalated Cooling and Transmission Upgrade costs are as follows for best case, base case and worst case scenarios:

Cooling, $000's	2008	2009	2010	2011	Total
Base case	[redacted]				
Worst case +20%	REDACTED				
Best case -20%					

Transmission, $000's	2007	2008	2009	2010	2011	Total
Base case	[redacted]					
Worst case +20%	REDACTED					
Best case -20%						

[redacted]

REDACTED

Project Alternative Analysis

[redacted]

REDACTED

Consequences of Non-Authorization or Deferral

[redacted]

REDACTED

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[redacted]

REDACTED

Scenario Analysis

[redacted]

REDACTED

Prosym July GFF , Two-Phase Uprate	BC Ratio	NPV ($000)	DBEY
Base case	[redacted]	[redacted]	[redacted]
Worst case	[redacted]	[redacted]	[redacted]
Best case	[redacted]	[redacted]	[redacted]

REDACTED

Summary of Financial Indicators

[redacted]

REDACTED

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Analysis based on EESY Plus coefficients, April GFF

Alternative	B/C Ratio	NPV, $000	DBEY	MW gain	Capital Cost $/kW
Phase 1, Steam Efficiencies	[redacted]				
Phases 1 and 2					

REDACTED

Analysis based on [redacted]

Alternative	B/C Ratio	NPV, $000	DBEY	MW gain	Capital Cost $/kW
Phase 1, Steam Efficiencies	[redacted]				
Phases 1 and 2					
Phase 1&2 without cooling towers					

REDACTED

Major NPV Components (based on July GFF)

($000's)

	Expected	Likely Best	Likely Worst
Capital – Uprate	[redacted]		
Capital – Transmission			
Capital – Cooling Towers			
Aux Power, Cooling towers			
O&M, Cooling Towers			
Fuel Savings – Uprate			
Fuel Savings – Avoided Derates			
Total NPV			

REDACTED

Modeling Tool Used / Description of Changes/ Approval

EESY+ Version 5.8.2

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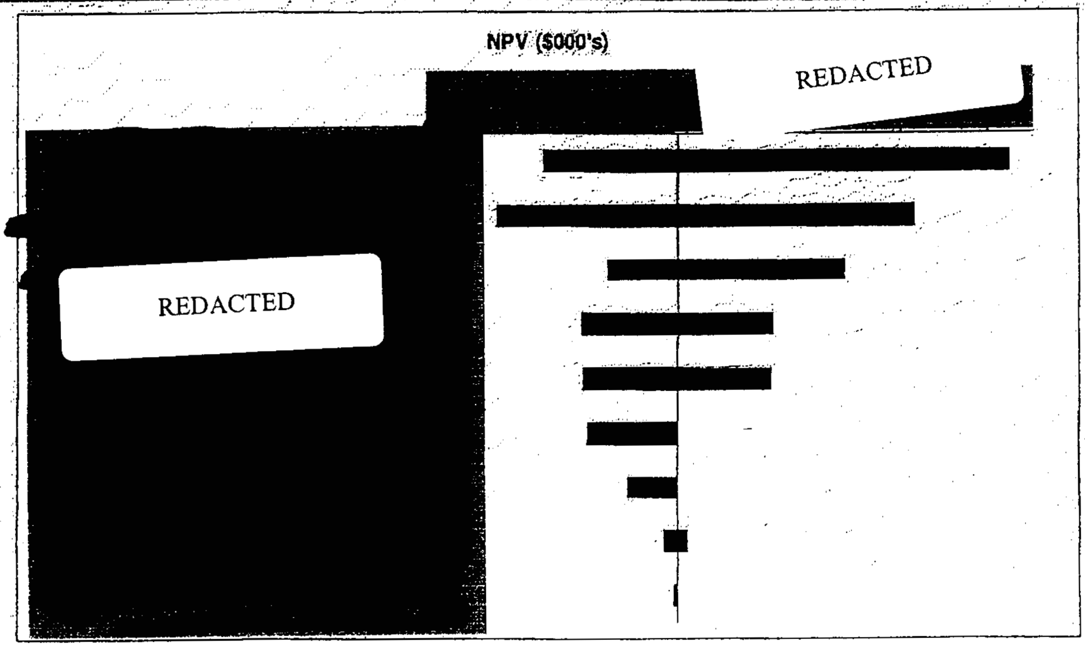
Sensitivity Analysis Detail

[redacted] REDACTED [redacted]



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PEF-NCR-04518

Operational Analysis Detail

[redacted] REDACTED [redacted]

Regulatory Impact Analysis

On September 22, 2006, PEF submitted the Crystal River Unit 3 (CR3) Uprate project to the Florida Public Service Commission for consideration. Due to the fact that this is an expansion of capacity of more than 75MW, a Determination of Need is required. In the case of the Uprate, the "Need" is primarily an economic one based on the extensive fuel savings the project will generate. PEF also requested an exemption from the bid rule on the grounds that the project meets all three elements of the bid rule's exemption provision in that it "will likely result in a lower cost supply of electricity to the utility's general body of ratepayers, increase the reliable supply of electricity to the utility's general body of ratepayers, and otherwise will serve the public welfare".

PEF further requested recovery of the project through the fuel clause. Recovery through the fuel clause can be supported due to the fact that this project is not being driven by a capacity need, but rather by the extensive fuel savings it will generate for the customer and the fact that the costs were not recognized or anticipated in the Company's last base rate proceeding. A hearing will be held before the Florida Public Service Commission on January 18, 2007, and the Commission decision on this issue is due on April 2, 2007. If the Commission denies recovery through the fuel clause, the Company will include these costs in its next base rate proceeding.

PEF will also be required to submit an application to the Nuclear Regulatory Commission (NRC) to get approval of the CR3 Uprate. The process for amending commercial nuclear power plant licenses and technical specifications related to power uprates is the same as the process used for other amendments; therefore, power uprate requests are submitted to the NRC as license amendment requests. The NRC has approved many similar uprate requests and PEF expects approval of our application.

The study will provide for developing a regulatory approval plan.

Contracting and Procurement Strategy

[redacted] REDACTED [redacted]

Change in Inventory Detail

[redacted] REDACTED [redacted]

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Market Analysis N/A

Non-Financial Considerations/ Intangibles/ Unquantified Financial Considerations / Other

[redacted]

REDACTED

Integration and Project Performance Assessment

[redacted]

REDACTED

Project Objectives/ Goals/ Expected Benefits

[redacted]

REDACTED

Benefits Assessment Methodology, Schedule and Responsibility for Assessment

[redacted]

REDACTED

Wrap-up, Conclusions and Recommendations

[redacted]

REDACTED

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Appendix A: Pro Forma Economic Analysis

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EESY-Plus Project Analysis Report

Record ID: 93980 / Alternative No: 27 / Expected Case

Soft Dollars Not Included

As Of: 10/18/2006

EESY Plus

[redacted]

REDACTED

[redacted]

REDACTED

Note: The * indicates the alternative that has been selected for prioritization.

NPV By Item ($000)

[redacted]

REDACTED

Summarized Free Cash Flow ($000)

Year 1 = 2006	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11+

[redacted]

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 AUTHORIZED COPY

Document title

Major Capital Projects - Integrated Project Plan

Document number

ADM-SUBS-00080

Applies to: Progress Energy Carolinas, Inc.; Progress Energy Florida, Inc.; Progress Energy Service Company, LLC

Keywords: administration; major projects; capital budget

1.0 APPLICABILITY

This procedure applies to Progress Energy operating companies and business units conducting non-routine, capital projects REDACTED in total project costs, referred to as 'Major Capital Projects' or 'Major Projects'. These projects are typically large, infrastructure projects within the Company (e.g., new generation, environmental programs, associated transmission, etc.).

2.0 PURPOSE

The purpose of this procedure is to govern the overall process flow and expectations for managing Major Projects. Each impacted operating company / business unit is required to integrate their respective project plans and business case analyses for funding approval at each major milestone throughout the project lifecycle.

3.0 GENERAL INFORMATION

This procedure is the governing document for authorizing Major Projects and is referenced in procedures ACT-SUBS-00335, Progress Energy Project Governance Policy, and ACT-SUBS-00261, Project Evaluation and Authorization. Each organization managing Major Projects is required to develop and maintain procedures for implementing this procedure.

Initial funding approval is granted by presentation to the Senior Management Committee (SMC). Subsequent funding approval is granted at each major milestone throughout the project lifecycle by presentation to the appropriate member of senior management and other constituents. The communication tool used to request authorization and obtain approval signatures is the Integrated Project Plan (IPP).

4.0 INTEGRATED PROJECT PLAN (IPP)

Major Projects can involve multiple operating companies / business units, each developing their own specific project plan (**Appendix No. 1**). Major Projects require the integration of project plans and information to summarize key touch points (**Appendix No. 2**). The IPP takes the place of the Business Analysis Package (BAP), but contains similar BAP elements referenced in procedure, ACT-SUBS-00271, Progress Energy Business Analysis Package.

The IPP is used to:

- Guide the Project Execution for all impacted operating companies / business units
- Provide an executive summary of each business unit-specific project plan
- Document project assumptions, constraints, and decisions
- Facilitate communication among stakeholders
- Define review and funding approval milestones
- Provide a baseline for progress measurement and project control
- Integrate other sub-plans developed to manage and identify the following:
  - Project scope
  - Major deliverables & milestone schedule

- Funding requirements
- Economic evaluations
- Assumptions and constraints
- Risk strategy
- Contracting / procurement strategy & supplier diversity
- Regulatory requirements
- External stakeholders requirements
- Internal stakeholders roles & responsibilities
- Resource allocation
- Project assurance
- Startup and integration
- Safety & environmental
- Communication planning
- Others, as determined by the project

4.1 IPP Development

The IPP is summarized using a template available by contacting Capital Planning & Control.

The business unit selects a coordinator to be the point contact to develop the IPP. The IPP Development Coordinator's role is to ensure timely submission of each IPP section and collaborates with Capital Planning & Control to schedule the funding approval meetings. The Coordinator schedules an IPP kick-off meeting with the project team and assigns sections (**Appendix No. 3**).

Upon receipt of each written section, the Coordinator assembles the IPP and submits internally for review and comment. Internal review meetings help to collaborate and expedite the review process. The section writers are responsible to ensure the accuracy and completeness of each section.

NOTE: During Project Initiation, elements of the IPP may not be fully identified. The expectation is that all IPP elements are completely identified and updated throughout the project lifecycle. The initial IPP for the first milestone is to provide adequate information to justify the funding amount requested.

5.0 PROJECT AUTHORIZATION

Project Authorization is governed by the procedure, ACT-SUBS-00261, Project Evaluation and Authorization. Major Projects require funding approval obtained by presentation to the SMC prior to any spending. The IPP and high-level presentation are the tools used to communicate the milestone funding requests.

5.1 Project Review Group (PRG) Approval

The project manager presents the IPP to the corresponding Project Review Group (PRG) for project evaluation and authorization, as applicable. During this meeting, the PRG reviews the IPP information, obtains clarification, and approves the project to be submitted for funding approval.

5.2 Senior Management Committee (SMC) Approval

Once approved by the PRG, the project manager submits the IPP to Capital Planning & Control for review and submittal to the SMC. Capital Planning & Control will schedule the SMC presentation.

The project manager and/or sponsor formally present the initial IPP to the SMC. The objective of this presentation is to obtain project authorization and funding approval for the first major milestone in the project lifecycle.

Prior to work beginning for the second and subsequent milestones, the IPP is updated and presented to appropriate members of senior management and other constituents for review and approval. This presentation outlines progress to-date and requests additional funding. This step is repeated throughout the project lifecycle for each major milestone.

5.3 Board of Directors Approval

Once approved by the SMC, Capital Planning & Control will coordinate a presentation for final approval to the Board of Directors. The presentation contents, timeframe, and presenters will be determined in coordination with Capital Planning & Control.

6.0 PROJECT MONITORING & CONTROL

The project manager and/or sponsor will present quarterly SMC updates reviewing status on all Major Projects. Capital Planning & Control will schedule and facilitate these review sessions.

Project Authorization Revision (PAR) requirements are detailed in Section 9 of procedure ACT-SUBS-00261, Project Evaluation and Authorization.

The expectation is each operating company / business unit involved with a Major Project develops appropriate monitoring systems ensuring identified project standards are being met, and appropriate corrective action is completed. Capital Planning & Control will facilitate communication between business units, operating company finance committees, the SMC, and Board of Directors, as needed.

7.0 PROJECT CLOSURE

Project Closure confirms acceptance of project deliverables by the Sponsor organization. For example, acceptance includes functional testing, punchlist item management, turnover, and financial closeout.

Major Projects require the completion of a Post Project Benefits Assessment (PPBA) as identified in Section 11 of procedure ACT-SUBS-00261, Project Evaluation and Authorization. The project manager and/or sponsor will present the PPBA to the SMC to determine whether the Company realized its intended benefits.

8.0 REFERENCES

ACT-SUBS-00335	–	Progress Energy Project Governance Policy
ACT-SUBS-00261	–	Project Evaluation and Authorization
ACT-SUBS-00271	–	Progress Energy Business Analysis Package
ADM-SUBS-00105	–	Project Assurance Program Policy
ADM-CAPX-00001	–	Project Assurance Program Manual
ADM-TRMX-00003	–	Transmission Department Project Management Procedure
CON-PPDX-00001	–	Execution of Large Construction Projects and Programs
NGGM-PM-0018	–	NGG Project Management Program Manual

APPENDIX No. 1 –
Elements of a Project Plan

Business unit-specific project plans contain, but are not limited to, the following elements. At the beginning of the project, some elements are not clearly defined. The expectation is during Project Planning; these elements are completed and continually updated during the project lifecycle.

Objectives –
The goals of the project identified as realistic, specific, measurable, time driven, and cost driven. Objectives at a minimum address safety, cost, schedule, and performance; defining success for the project.

Scope –
Clear definition of the work required and documented boundaries of the project consistent with objectives, including applicable specifications and standards. It is important for the Project Team, Project Sponsor, and key Stakeholders to understand and agree on the scope to minimize future misunderstandings.

Deliverables –
Tangible and verifiable tasks, actions, or items required to prove progress towards the objectives. These are also high-level milestones and elements developed from the Work Breakdown Structure.

Work Breakdown Structure (WBS) –
A WBS is a deliverable of the project that organizes and defines project activities to complete the entire project scope. The breakdown of larger tasks into smaller ones.

Schedule –
The planned dates for performing activities and meeting milestones. Activity durations and predecessors assist in preparing.

Budget & Cash Flow–
The estimated costs for resources identified for the project with anticipated timeframe the costs will incur.

Assumptions and Constraints –
Known assumptions or constraints that may impact project success. Constraints may be controllable or uncontrollable factors, resources, and conditions which restrict the team's approach. An example is environmental compliance dates.

Stakeholders –
Any individual, group, organization, or agency that can affect, or be affected by, the project. Examples include members of management (plant, department), senior management, employees, vendors, government leaders, media, and general public.

Roles and Responsibilities –
Roles and responsibilities of individual Project Team members, identifying who does what, when, and why.

Regulatory Strategy –
Strategy, plan, and schedule for ensuring regulatory recovery of costs, obtaining required regulatory permits and meeting regulatory reporting requirements. Discuss regulatory implications and actions to mitigate.

Procurement Strategy –
Approach for obtaining major equipment / material for the project in collaboration with Supply Chain Management.

Contracting and Supplier Strategy –
Approach to segregate scope and secure resources internally or externally for engineering, procurement, construction, start-up and commissioning. The strategy must follow applicable contract management procedures in collaboration with Supply Chain Management. It is essential that payment be based on production performance.

Resource Plan –
Internal and external resources required to execute the WBS per the proposed schedule with the proposed contracting strategy.

Risk Plan –
The identification, documentation, and contingency/mitigation of risks associated with WBS activities and tasks, including a thorough review of lessons learned from prior projects.

Lessons Learned –
The plan for how lessons learned from prior similar projects will be incorporated into this project and the mechanism for capturing lessons learned on the current project.

Quality Plan –
The identification of quality / technical standards and plan for how performance will be evaluated on a regular basis ensuring standards are followed. This includes identification of documents and analyses for review, hold/witness points for factory and field verification, and guidelines for quality assurance / control documentation.

Safety Plan –
Identification of responsibilities, contractor-specific safety requirements, medical treatment provisions, job safety analyses, inspections, training, reporting, and housekeeping.

Environmental Plan –
The permitting strategy and identification of site-specific responsibilities and contractor-specific requirements.

Security Plan –
Identification of security needs and how these needs and/or requirements will be met during the project.

Startup and Integration Plan –
Tasks, actions, responsibilities and documentation required to integrate the project into the operating organization. The integration plan addresses any interactions between projects and operating sites & the start-up and commissioning process.

Data Management Plan –
The process and infrastructure for electronic data management. This includes, but is not limited to, specification of data management tools, the document review process, records retention and management, and end deliverable transfer.

Communication and Reporting Plan –
How the project team will communicate, key meetings to be held (including critical project reviews and checkpoints), and definition of the specific performance indicators for the project. Indicators are of two types. (1) *Leading* Indicators are a project management tool for prediction and correction of issues before they impact overall project success. (2) *Scorecard* indicators are used to report project status to objectives to stakeholders.

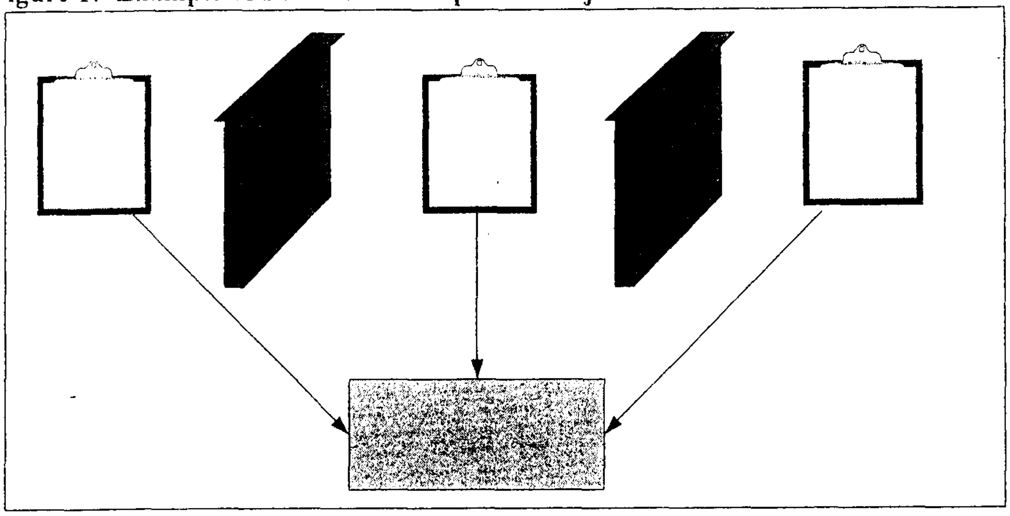
Change Management –
The agreed to process for initiating, evaluating, and dispositioning significant changes to project scope, schedule, budget, or functionality. It is important to consider internal and external change management. Project Team members and Project Sponsor are required to read and understand the change management process for the project.

Close-out Criteria –
Tasks, actions, expectations, and deliverables to be satisfied to complete the project. Developing a checklist prior to close-out assists in successfully closing out the project.

Project Assurance Plan –
Establish the methods where key stakeholders will work together ensuring key decisions made are prudent, documented, retrievable, and support the regulatory process for cost recovery. The Project Assurance organization coordinates plan development in accordance with the Project Assurance Program Manual.

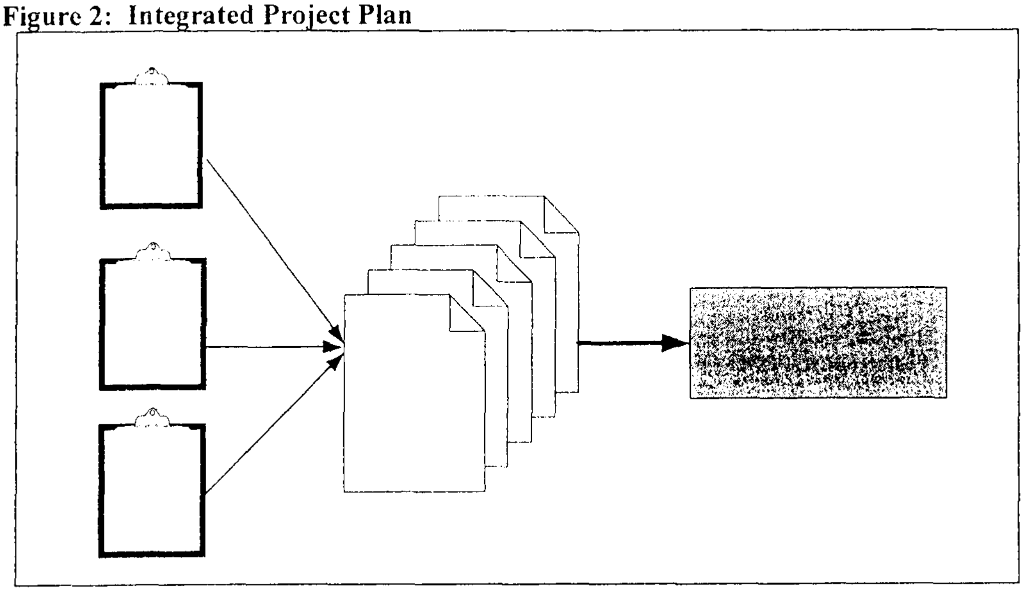
APPENDIX No. 2 –
Business Unit-Specific Project Plans vs. Integrated Project Plan

Figure 1: Example of Business Unit-Specific Project Plans



Projects can involve multiple business units. Typically, each business unit develops their own, unique project plan enabling it to execute its portion of the project. Generally, each plan identifies their project activities; however, the touch points between the other business units can sometimes be missed.

Figure 2: Integrated Project Plan



Major Projects, with their inherent risks, require the need to breakdown the walls between each business unit. Once each business unit develops its own project plan, the plans are summarized and integrated into an Integrated Project Plan (IPP). The template for the IPP is available from Capital Planning & Control.

The IPP is an executive summary document used to gain approval at each major milestone (i.e., critical decision point of the project). The project team updates the IPP during the project lifecycle and presents to the SMC for on-going funding approval at each milestone as defined in the IPP.

APPENDIX No. 3 – IPP Timeline & Roles/Responsibilities

Contact Capital Planning & Control for copy of below

Integrated Project Plan (IPP)
Timeline & Roles/Responsibilities

Timeline of Events	Due Date	Comments (expect 3-6 weeks to develop)
Kick-off meeting		Assign roles. Schedule to allow sufficient time to prepare IPP before funding meeting
Initial content due date		All sections due to IPP point contact (2-3 weeks after KO Meeting)
1st draft review period		3-5 business days to review & respond to point contact
Internal review meeting		Meeting with internal parties to discuss comments
Internal review final changes due		3-5 business days to revise & return to point contact
External review		3-5 business days to review & return to point contact
Internal sign-off complete		After incorporating all changes
External sign-off complete		This can be in the form of signature or email
Final draft available		IPP is ready to submit to SMC by Capital Planning & Control 1wk prior to presentation
Final Senior Management approval		Signatures obtained during SMC presentation meeting

Roles & Responsibilities - Writing IPP	Individuals	Comments
IPP Development Coordinator		Responsible for coordinating IPP sections
1.0 Project Overview / Recommendation		See template for details of information needed for each section. Upon completion, submit to IPP Development Coordinator, who assembles IPP into one document. The coordinator's main responsibility is to ensure the IPP is developed and submitted to Capital Planning & Control. The section writers are the experts and are responsible for ensuring accuracy and completeness of information.
2.0 Scope Statement		
3.0 Major Deliverable & Milestone Schedule		
4.0 Funding Requirements		
5.0 Economic Evaluation		
6.0 Assumptions & Constraints		
6.1 Risk Strategy		
6.2 Contracting & Procurement Strategy		
6.3 Regulatory Strategy		
7.0 External Stakeholders		
8.0 Internal Stakeholders		
9.0 Project Assurance Plan		
10.0 Communication Plan / Next Steps		
Others, as defined by project		As needed

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APPENDIX No. 3 – IPP Timeline & Roles/Responsibilities

Integrated Project Plan (IPP)
Timeline & Roles/Responsibilities

Roles & Responsibilities - Reviewers	Individuals	Title
Internal Reviewers (Project Team including Sponsor)		
External Reviewers (stakeholders internal to PGN, but external to the Business Unit)		

Crystal River Unit 3

Extended Power Uprate Project

Additional Cooling Capacity for the Discharge Canal

Project Plan

MASTER PROJECT NUMBER: 20058849

Revision History

Rev	Date	Signatures	
0	11/13/2007	Mark E. Hickman Mark Hickman, NGG Project Manager	Danny Roderick, NGG Project Sponsor
	11/7/2007	James M. Burleson James Burleson, POG Coordination Lead	Bernie Cumbie, POG Project Sponsor

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PEF-NCR-04533

Change Basis for Revision

Original Issue

Executive Summary

Progress Energy Florida (PEF) plans to increase the electrical power output of Crystal River 3 (CR3) in order to minimize customer cost and enhance shareholder value. Currently operating at a licensed core power level of 2568 MWt and 903 MWe, PEF intends to achieve a power uprate of approximately 17% at CR3 enabling the unit to safely operate at 3014 MWt and 1080 MWe. The CR 3 modifications to allow additional electrical power generation will be implemented in three stages over the course of three refueling outages. Each modification is described below.

- **Measurement Uncertainty Recapture (MUR)**

  This project installs new more accurate and precise feedwater flow measurement equipment. The new instrumentation will enable a power increase of approximately 1.6% or 14 MWe. Existing plant safety analyses will remain unchanged as the analyzed core power will not change.

  MUR implementation is scheduled for 2007, during Refueling Outage (RFO) 15.

- **Balance of Plant (BOP) Efficiency**

  The low pressure steam turbine and other BOP equipment will be replaced with more efficient equipment. The new BOP equipment will increase the thermal efficiency of the secondary side of the plant and create a potential increase in electrical power of greater than 30 MWe, with no change in thermal power.

  BOP equipment changeout is scheduled for 2009, during RFO 16.

- **Extended Power Uprate (EPU)**

  Numerous plant modifications and a significant Licensing effort will enable reactor thermal output to increase by 17% to a total power of 3014 MWt. The corresponding electrical power increase is approximately 1080 MWe. With increased electrical output, both the heat rejected by the CR3's Circulating Water System to the discharge canal and the rate of heat carried into the discharge canal will increase. The increase in thermal energy transfer is due to the increased energy delivered to the turbines and the increased circulating water flow through the condensers to remove the additional latent heat of condensation. Without mitigation of this additional heat rejection the operation of CR 1 and CR2 may be adversely impacted or the temperature of the discharge canal may increase above permitted levels. Therefore, additional cooling capacity (e.g. cooling towers) will be required to remove the heat generated from the CR3 EPU.

  The EPU modifications will be completed during RFO 17

- **Modular and Helper Cooling Towers**

  In order to minimize the derates of CR Units 1 or 2, due to excessive Discharge Canal water temperature, a portion of the Discharge Canal water is cooled by directing its flow through either a Helper or Modular Cooling Tower. The cooled Discharge Canal water then returns to the Discharge Canal were it mixes with other water that is flowing to the Gulf of Mexico. The Helper Cooling Towers are permanent Crystal River PEF plant systems while the Modular Cooling Towers are leased. The Modular Cooling Tower lease expires at the end of 2010.

Although the Modular Cooling Tower lease will expire, the need for the cooling performed by the Modular Cooling Towers remains. The logical approach to resolve the Discharge Canal cooling issue is to address both the need for additional cooling due the implementation of the Extended Power Uprate Project and the expiration of the Modular Cooling Tower lease at the same time. Therefore, this project includes the combined alternatives analysis of replacing the Modular Cooling Towers, the potential up grade of the Helper Cooling Towers to obtain maximum efficiency, and addition of cooling capability to support the EPU Project. The Study Phase of the Additional Cooling Capacity for the Discharge Canal Project will perform the Alternatives Analysis and develop a conceptual design of the recommended alternative. The Design Phase will convert the conceptual design into a final design. Then the Implementation Phase will construct the chosen alternative.

This document is the Project Plan for the Additional Cooling Capacity for the Discharge Canal Project, hereinafter called the Plan. The Plan focuses on the identification, selection, & installation of equipment to maintain the Discharge Canal's point of discharge (POD) water within acceptable parameters. The Plan identifies the project management strategies, tools, techniques and instructions necessary to safely achieve the additional cooling capacity goals and objectives while minimizing the Project's cost and risk. The project authorizations and management plans contained in this document include:

- A Project Mission Statement
- The Project Charter
- The Project's Scope, Schedule, Cost and Risk Management Plans
- The Project's Contract, Procurement and Quality Management Plans
- Human Resource and Communication Management Plans
- Safety, Human Performance and Environmental Management Plans

The Project will be monitored, controlled, and implemented using the existing Progress Energy Florida and Crystal River infrastructure of policies and procedures.

Acronyms

AIMS	Action Item Management System	NGG	Nuclear Generation Group
ALARA	As Low As Reasonably Achievable	NRC	Nuclear Regulatory Commission
ASME	American Society of Mechanical Engineers	NTM	Nuclear Task Management
BOP	Balance of Plant	NAS	Nuclear Application Software
CR3	Crystal River 3	NSSS	Nuclear Steam Supply System
CWP	Cooling Water Pump	OE	Operating Experience
DRB	Design Review Board	OMT	Outage Management Team
DTP	Detailed Task Plan	PEF	Progress Energy Florida
EC	Engineering Change	PM	Project Manager
EDBD	Engineering Design Bases Document	PI	Performance Indicator
EDG	Emergency Diesel Gènerator	PMT	Preventative Maintenance Test
EPU	Extended Power Uprate	PPA	Phased Project Authorization
HP	High Pressure	PRG	Project Review Group
HPT	High Pressure Turbine	QA	Quality Assurance
ICS	Integrated Control System	RAI	Request for Additional Information
KPI	Key Performance Indicator	RB	Reactor Building
LAR	License Amendment Request	RCP	Reactor Coolant Pump
LPT	Low Pressure Turbine	RPS	Reactor Protection System
MFP	Main Feed Pump	SPI	Schedule Performance Index
MSR	Moisture Separator Reheater	SSC	System, Structure or Component
MUR	Measurement Uncertainty Recapture	TBV	Turbine Bypass Valve
MUP	Make-up Pump	WBS	Work Breakdown Structure
MWE	Megawatts Electric	XFMR	Transformer
MWT	Megawatts Thermal	ZTEF	Zero Tolerance Equipment Failures
NCR	Nonconformance Report		

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Crystal River Unit 3

Power Uprate Project

Phase I:

Measurement Uncertainty Recapture

Project Plan

MASTER PROJECT NUMBER: 20058849

Revision History

Revision	Date	Project Manager	Project Sponsor
0	4/27/07	Ted Williams	Danny Roderick
1	10/03/07	Ted Williams	David Varner for Danny Roderick

Change Basis for Revision

Revision 1:

1. Pg. 3, Executive Summary, and throughout Project Plan: For consistency, changed 14 MWe to 12MWe per discussion with Ted Williams. This number ranged from 12 to 14 throughout the document. 12 MWe is the conservative value.
2. Pg. 4, Acronyms: Deleted "SCP Service Condensate Pump?" It was there with the question mark. Could find no basis to leave it there.
3. Pg. 5, 6, Table of Contents: Made changes so section/subsection names correspond with actual names in plan.
4. Pg. 7, 1.1, 2nd bullet: changed 26 MWe to 28 MWe per Ted Williams to be consistent and to ensure that the total increase is 40 MWe (12 + 28).
5. Pg. 8, 1.2, and throughout document: Where applicable, corrected procedure/manual names and numbers to actual names and numbers.
6. Pg. 8, 1.2, 3rd bullet at top of page: Per Ted Williams, changed classification of MUR project from "Medium for MUR REDACTED [redacted]" to "Large for MUR [redacted] REDACTED
7. Throughout document: Where specific plans are named that will be addressed only by sections in this Project Plan, changed wording to reflect that.
8. Pg. 9, 1.4 Mission Statement: Per Ted Williams concurrence, to the pyramid of best practices, added "Regulatory Compliance."
9. Pg. 26, 4.4.3: Changed "See Section 9.0." to "See Section 7.0 Procurement Management" to reflect correct section.
10. Throughout: Made many editorial and punctuation changes and corrections. Made many minor editorial changes for consistency (same word/term/number used in all occurrences, etc.).
11. Added new Section 15.0, Project Closure.

Executive Summary

Progress Energy plans to increase the electrical power output of Crystal River 3 in order to minimize cost to our customers and enhance shareholder value. Currently operating at a licensed core power level of 2568 MW_t and 903 MW_e, Crystal River 3 intends to achieve a power uprate of approximately 17%, enabling the plant to safely operate at 3014 MW_t and 1080 MW_e. The Crystal River 3 Power Uprate Project will be implemented in three phases over the course of three refueling outages. Each phase enumerated below contains definitive commercial and technical objectives:

- **Phase I – Measurement Uncertainty Recapture**

  Improvements in process instrument accuracy enable a power increase of approximately 1.6% or 12 MW_e to be attained. Existing plant safety analyses remain in effect as analyzed core power does not change.

  Phase I implementation is scheduled for 2007, during Refueling Outage (RFO) 15.

- **Phase II – Balance of Plant Efficiency**

  Replacement of low pressure turbines coincident with the planned steam generator replacement will increase the thermal efficiency of the secondary side of the plant to attain a 3% increase in electrical power or 28 MW_e, with no change in thermal power.

  Phase II implementation is scheduled for 2009, during RFO 16.

- **Phase III – Extended Power Uprate**

  Numerous plant modifications and a significant Licensing effort will enable reactor thermal output to increase by 17% to a total power of 3014 MW_t with a corresponding electrical output of approximately 1080 MW_e.

  Phase III Implementation is scheduled for 2011, following RFO 17.

This Project Plan focuses on Phase I – Measure Uncertainty Recapture. Identified herein are the project management tools, techniques and instructions necessary to achieve project goals and objectives while minimizing cost and risk. Management plans to implement work activities include:

- Project Vision, Mission Statement and Charter
- Scope, Schedule, Cost and Risk Management Plans (Addressed in sections in this Project Plan.)
- Contract, Procurement and Quality Management Plans (Addressed in sections in this Project Plan.)
- Resources and Communication Management Plans (Addressed in sections in this Project Plan.)
- Safety, Human Performance and Environmental Management Plans (Addressed in sections in this Project Plan.)

Based on Progress Energy Nuclear Generation Group procedures and management guidelines, this Project Plan incorporates operating experience and the best project management practices of the industry.

ACRONYMS

ADV	Atmospheric Dump Valves	MSR	Moisture Separator Reheater
AIMS	Action Item Management System	MUR	Measurement Uncertainty Recapture
ALARA	As Low As Reasonably Achievable	MUP	Make-up Pump
AMSAC	ATWS Mitigation Safety Actuation Circuitry	MW_e	Megawatts Electric
ASME	American Society of Mechanical Engineers	MW_t	Megawatts Thermal
ATWS	Anticipated Transient Without Scram	NCR	Nonconformance Report
AULD	Automatic Unit Load Demand	NGG	Nuclear Generation Group
BFP	Boiler Feed Pump	NRC	Nuclear Regulatory Commission
BOP	Balance of Plant	NTM	Nuclear Task Management
CDP	Condensate Pump	NAS	Nuclear Application Software
CR3	Crystal River 3	NSSS	Nuclear Steam Supply System
CWP	Cooling Water Pump	OE	Operating Experience
DRB	Design Review Board	OMT	Outage Management Team
DTP	Detailed Task Plan	PEPM	Progress Energy Project Manager
EC	Engineering Change	PI	Performance Indicator
EDBD	Engineering Design Bases Document	PMT	Preventative Maintenance Test
EDG	Emergency Diesel Generator	PPA	Phased Project Authorization
EPU	Extended Power Uprate	PRG	Project Review Group
FIDMS	Fixed In-Core Detector Monitoring System	QA	Quality Assurance
FWHE	Feedwater Heater Exchanger	RAI	Request for Additional Information
HB	Heat Balance	RB	Reactor Building
HP	High Pressure	RCP	Reactor Coolant Pump
HPT	High Pressure Turbine	RPS	Reactor Protection System
ICS	Integrated Control System	SPI	Schedule Performance Index
KPI	Key Performance Indicator	SSC	System, Structure or Component
LAR	License Amendment Request	TBV	Turbine Bypass Valve
LEFM	Leading Edge Flow Meter	WBS	Work Breakdown Structure
LOCA	Loss of Coolant Accident	XFMR	Transformer
LPT	Low Pressure Turbine	ZTEF	Zero Tolerance Equipment Failures
M&E	Mass & Energy		
MFP	Main Feed Pump		

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REDACTED

Crystal River Unit 3

Extended Power Uprate

Project Plan

MASTER PROJECT NUMBER 20058849

Revision History

Revision	Date	Project Manager	Project Sponsor
0	8/8/07	Ted Williams	Danny Roderick
	8/17/07	Ted Williams	Danny Roderick

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Change Basis for Revision

Original Issue

Executive Summary

Crystal River Unit 3 (CR3) was initially licensed to operate at a maximum core thermal power level of 2452 MWt. In Technical Specification Amendment 41, dated July 21, 1981, the NRC approved operation of CR3 up to 2544MWt. Subsequently, Amendment 205 was issued by the NRC in 2002 approving a steady-state maximum core power level increase to 2568 MWt. CR3 is currently licensed to operate up to 2568 MWt.

A Measurement Uncertainty Recapture (MUR) power uprate has been initiated and is scheduled for implementation, pending NRC approval, in December 2007. The MUR modifications will allow CR3 to operate up to 2609 MWt. In addition to the 2609 MWt MUR power uprate, CR3 is pursuing thermal efficiency improvements scheduled for implementation in 2009, and an Extended Power Uprate (EPU), expected to be 3014 MWt, scheduled for implementation in 2011. The two phases of the Crystal River 3 Power Uprate Project will be implemented in the refueling outages of 2009 and 2011. Each phase enumerated below contains definitive commercial and technical objectives:

- **Phase I – Balance of Plant Efficiency**

  Replacement of Low Pressure Turbines, Moisture Separator Reheaters (MSR), and Feedwater Heaters coincident with the planned steam generator replacement will increase the thermal efficiency of the secondary side of the plant to attain a 3% increase in electrical power or 28 MWe with no change in thermal power.

  Phase I implementation is scheduled for 2009, during 16R.

- **Phase II – Extended Power Uprate**

  Numerous plant modifications including new Condensate, Circulating Water and Feedwater Booster pumps/motors, along with and a significant Licensing effort, will enable reactor thermal output to increase by 17% to a total power of 3014 MWt with a corresponding electrical output of approximately 1080 MWe.

  Phase II Implementation is scheduled for 2011, following 17R.

This is the Project Plan for the Extended Power Uprate Project and focuses on phases I and II activities as listed above. Identified herein are the project management tools, techniques and instructions necessary to achieve project goals and objectives while minimizing cost and risk. Management plans to implement work activities include:

- Project Vision, Mission Statement and Charter
- Scope, Schedule, Cost and Risk Management Plans
- Contract, Procurement and Quality Management Plans
- Human Resource and Communication Management Plans
- Safety, Human Performance and Environmental Management Plans

Based on Progress Energy Nuclear Generation Group procedures and management guidelines, this Project Plan incorporates operating experience and the best project management practices of the industry.

ACRONYMS

16R	Refuel Outage 16	NGG	Nuclear Generation Group
17R	Refuel Outage 17	NRC	Nuclear Regulatory Commission
AIMS	Action Item Management System	NSSS	Nuclear Steam Supply System
ALARA	As Low As Reasonably Acceptable	O&M	Operations & Maintenance
CR3	Crystal River Unit 3	OE	Operating Experience
DSO	Director of Site Operations	PA	Project Authorization
EC	Engineering Change	PE	Progress Energy
EPU	Extended Power Uprate	PEF	Progress Energy Florida
ERP	Environmental Resource Permit	PI	Performance Indicator
FME	Foreign Material Exclusion	PM	Project Manager
FDEP	Florida Department of Environmental Protection	PMT	Project Management Team
HR	Human Resources	POD	Point of Discharge
I&C	Instrumentation & Controls	PPA	Phased Project Authorization
KPI	Key Performance Indicator	PPSA	Power Plant Siting Act
LAR	License Amendment Request	PRG	Project Review Group
MSR	Moisture Separator Reheaters	QA	Quality Assurance
MUR	Measurement Uncertainty Recapture	RFP	Request for Proposal
MWe	Megawatt Electrical	SCA	Site Certification Application
MWt	Megawatt Thermal	SPI	Schedule Performance Index
NAS	Nuclear Assessment Section	VP	Vice President
NCR	Nonconformance Report	WBS	Work Breakdown Structure

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PROGRESS ENERGY COMPANY CONFIDENTIAL
EXTENDED POWER UPRATE (Including Point of Discharge)
Does Not Include AFUDC
2008 Variance Report (Actuals Through March 2008)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	March YTD	Annual
EMPLOYEE LABOR	Budget	[redacted]												[redacted]	Budget: [redacted]
	Projection:	[redacted]												[redacted]	Projection: [redacted]
	Actual:	78,174	124,148	162,578	85,097	0	0	0	0	0	0	0	0	364,901	
	Budget Variance Fav/(Unfav)	[redacted]												[redacted]	Variance: Fav/(Unfav) [redacted]
	Projection Variance Fav/(Unfav)														
PURCH MATL/FURN/EQUIP/SUPPLIES	Budget	[redacted]												[redacted]	Budget: [redacted]
	Projection:	[redacted]												[redacted]	Projection: [redacted]
	Actual:	1,367,468	1,291,012	149,409	0	0	0	0	0	0	0	0	0	2,807,888	
	Budget Variance Fav/(Unfav)	[redacted]												[redacted]	Variance: Fav/(Unfav) [redacted]
	Projection Variance Fav/(Unfav):														
OUTSIDE LABOR SVC EMPLOYED	Budget	[redacted]												[redacted]	Budget: [redacted]
	Projection:	[redacted]												[redacted]	Projection: [redacted]
	Actual:	1,407,653	1,685,379	2,033,366	0	0	0	0	0	0	0	0	0	5,126,398	
	Budget Variance Fav/(Unfav)	[redacted]												[redacted]	Variance: Fav/(Unfav) [redacted]
	Projection Variance Fav/(Unfav):														
OTHER COSTS	Budget	[redacted]												[redacted]	Budget: [redacted]
	Projection:	[redacted]												[redacted]	Projection: [redacted]
	Actual:	242,468	241,986	198,568	29,446	0	0	0	0	0	0	0	0	683,022	
	Budget Variance Fav/(Unfav)	[redacted]												[redacted]	Variance: Fav/(Unfav) [redacted]
	Projection Variance Fav/(Unfav)														
Total	Budget:	[redacted]													Budget: [redacted]
	Projection:	[redacted]													Projection: [redacted]
	Actual:	3,095,762	3,342,526	2,543,921	114,543	0	0	0	0	0	0	0	0	8,982,209	
	Budget Variance Fav/(Unfav):	[redacted]													Variance: Fav/(Unfav) [redacted]
	Projection Variance Fav/(Unfav):														

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PROGRESS ENERGY COMPANY CONFIDENTIAL
EXTENDED POWER UPRATE (Including Point of Discharge)
<u>Does Not Include AFUDC</u>
2007 Variance Report

REDACTED

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Dec YTD	Annual	
EMPLOYEE LABOR	Budget:	[redacted]												[redacted]	Budget:	[redacted]
	Projection:	[redacted]												[redacted]	Projection:	[redacted]
	Actual:	19,405	56,141	63,040	62,439	76,658	141,022	98,114	92,400	104,927	108,108	143,799	120,762	1,086,814		
	Budget Variance Fav/(Unfav):	[redacted]												[redacted]	Variance: Fav/(Unfav)	[redacted]
	Projection Variance Fav/(Unfav):	[redacted]												[redacted]		
PURCH MATL/FURN/EQUIP/SUPPLIES	Budget:	[redacted]												[redacted]	Budget:	[redacted]
	Projection:	[redacted]												[redacted]	Projection:	[redacted]
	Actual:	1,950	0.00	1,209	2,429	21,901	163,513	2,305,646	(2,195,345)	3,633,258	1,471,884	5,471,882	9,320,938	20,199,265		
	Budget Variance Fav/(Unfav):	[redacted]												[redacted]	Variance: Fav/(Unfav)	[redacted]
	Projection Variance Fav/(Unfav):															
OUTSIDE LABOR SVC EMPLOYED	Budget:	[redacted]												[redacted]	Budget:	[redacted]
	Projection:	[redacted]												[redacted]	Projection:	[redacted]
	Actual:	304,113	(293,896)	1,152,740	436,736	337,299	(213,092)	1,839,492	4,229,205	236,525	8,272,277	3,554,674	(3,836,255)	16,019,817		
	Budget Variance Fav/(Unfav):	[redacted]												[redacted]	Variance: Fav/(Unfav)	[redacted]
	Projection Variance Fav/(Unfav):															
OTHER COSTS	Budget:	[redacted]												[redacted]	Budget:	[redacted]
	Projection:	[redacted]												[redacted]	Projection:	[redacted]
	Actual:	47,780	(14,145)	(38,587)	68,689	260,747	87,600	163,750	8,782	132,241	204,417	(45,525)	339,270	1,215,019		
	Budget Variance Fav/(Unfav):	[redacted]												[redacted]	Variance: Fav/(Unfav)	[redacted]
	Projection Variance Fav/(Unfav):															
Total	Budget:	[redacted]												[redacted]	Budget:	[redacted]
	Projection:	[redacted]												[redacted]	Projection:	[redacted]
	Actual:	373,248	(251,901)	1,178,401	570,294	696,605	179,043	4,406,901	2,135,042	4,106,950	10,056,686	9,124,930	5,944,715	38,520,916		
	Budget Variance Fav/(Unfav):	[redacted]												[redacted]	Variance: Fav/(Unfav)	[redacted]
	Projection Variance Fav/(Unfav):															

PROGRESS ENERGY COMPANY CONFIDENTIAL
EXTENDED POWER UPRATE (Including Point of Discharge)
Does Not Include AFUDC
2006 Variance Report

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Dec YTD	Annual	
EMPLOYEE LABOR	Budget	0	0	0	0	0	0	0	0	0	0	0	0	0	Budget:	0
	Projection:	0	0	0	0	0	0	0	0	0	0	0	0	0	Projection:	0
	Actual:	0	0	0	0	0	0	0	0	0	0	3,575	33,736	37,311		
	Budget Variance Fav/(Unfav)	0	0	0	0	0	0	0	0	0	0	(3,575)	(33,736)	(37,311)	Variance: Fav/(Unfav)	0
	Projection Variance Fav/(Unfav)	0	0	0	0	0	0	0	0	0	0	(3,575)	(33,736)	(37,311)		
PURCH MATL/FURN/EQUIP/SUPPLIES	Budget	0	0	0	0	0	0	0	0	0	0	0	0	0	Budget:	0
	Projection:	0	0	0	0	0	0	0	0	0	0	0	0	0	Projection:	0
	Actual:	0	0	0	0	0	0	0	0	0	0	0	28,148	28,148		
	Budget Variance Fav/(Unfav)	0	0	0	0	0	0	0	0	0	0	0	(28,148)	(28,148)	Variance: Fav/(Unfav)	0
	Projection Variance Fav/(Unfav)	0	0	0	0	0	0	0	0	0	0	0	(28,148)	(28,148)		
OUTSIDE LABOR SVC EMPLOYED	Budget	0	0	0	0	0	0	0	0	0	0	0	0	0	Budget:	0
	Projection:	0	0	0	0	0	0	0	0	0	0	0	0	0	Projection:	0
	Actual:	0	0	0	0	0	0	0	0	0	0	638,351	1,500,517	2,138,868		
	Budget Variance Fav/(Unfav)	0	0	0	0	0	0	0	0	0	0	(638,351)	(1,500,517)	(2,138,868)	Variance: Fav/(Unfav)	0
	Projection Variance Fav/(Unfav)	0	0	0	0	0	0	0	0	0	0	(638,351)	(1,500,517)	(2,138,868)		
OTHER COSTS	Budget	0	0	0	0	0	0	0	0	0	0	0	0	0	Budget:	0
	Projection:	0	0	0	0	0	0	0	0	0	0	0	0	0	Projection:	0
	Actual:	0	0	0	0	0	0	0	0	0	0	32,077	63,269	95,347		
	Budget Variance Fav/(Unfav)	0	0	0	0	0	0	0	0	0	0	(32,077)	(63,269)	(95,347)	Variance: Fav/(Unfav)	0
	Projection Variance Fav/(Unfav)	0	0	0	0	0	0	0	0	0	0	(32,077)	(63,269)	(95,347)		
Total	**Budget:**	0	0	0	0	0	0	0	0	0	0	0	0	0	Budget:	0
	Projection:	0	0	0	0	0	0	0	0	0	0	0	0	0	Projection:	0
	Actual:	0	0	0	0	0	0	0	0	0	0	674,003	1,625,670	2,299,673		
	Budget Variance Fav/(Unfav):	0	0	0	0	0	0	0	0	0	0	(674,003)	(1,625,670)	(2,299,673)	Variance: Fav/(Unfav)	0
	Projection Variance Fav/(Unfav):	0	0	0	0	0	0	0	0	0	0	(674,003)	(1,625,670)	(2,299,673)		

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2006 CR3 Uprate Costs

Project Level 2 Descriptn (Number)	Project Level	Resource Type	Account	Month/Year	Corporate Work	Transaction Am
60GB9D CR3 POWER UPRATE STUDY (20058901)	20058901	Labor	1071000	11/2006		34,839.95
	20058901	Miscellaneous	1071000			812.39
	20058901	Outside Services	1071000			638,350.60
				11/1/2006	**Sum:**	**674,002.94**
Project Level 2 Descriptn (Number)	**Project Level**	**Resource Type**	**Account**	**Month/Year**	**Corporate Work**	**Transaction Am**
	20058901	Labor	1071000	12/2006		94,967.10
	20058901	Materials	1071000			28,147.76
	20058901	Miscellaneous	1071000			2,037.94
	20058901	Outside Services	1071000			1,500,517.32
				12/1/2006	**Sum:**	**1,625,670.12**
60GB9D CR3 POWER UPRATE STUDY (20058901)					Sum:	2,299,673.06

					Sum:	2,299,673.06

Joint Owner vs. Progress Energy Costs
Summary of Power Uprate WO 20058849

	2007	2006	Total	
Gross Charges	39,075,373.31	2,299,673.06	41,375,046.37	
JO Exclusions (AFUDC and Other)	-951,630.44	0.00	-951,630.44	
JO gross charges	38,123,742.87	2,299,673.06	40,423,415.93	
	x 8.2194%	x 8.2194%	x 8.2194%	
JO paid	3,133,542.92	189,019.33	3,322,562.25	
Gross Charges	39,075,373.31	2,299,673.06	41,375,046.37	
JO paid	3,133,542.92	189,019.33	3,322,562.25	
Net Charges paid by PEF	35,941,830.39	2,110,653.73	**38,052,484.12**	In Power Plant as of Dec 31, 2007

R:\Nuclear Cost Recovery (NCR)\Dockets\Data Respository Docs\[JO power uprate project_recap_2.xls]Summary
03/31/08
Source: Emily Gibson, Accounting

Sum of Amount		
Charge Mo Yr	Cost Category	Total
Nov-06	Accrual	(639,129.99)
	Pa Credit	(55,399.00)
	Pow Block Eng	638,350.60
	Proj Mgmnt	35,652.34
Nov-06 Total		(20,526.05)
Dec-06	Accrual	(1,514,319.95)
	Pa Credit	(133,620.33)
	Pow Block Eng	1,528,665.08
	Proj Mgmnt	97,005.04
Dec-06 Total		(22,270.16)
Jan-07	Accrual	1,390,796.52
	AFUDC	5,132.13
	Pa Credit	(30,678.76)
	Pow Block Eng	306,062.92
	Proj Mgmnt	66,599.39
Jan-07 Total		1,737,912.20
Feb-07	Accrual	660,267.70
	AFUDC	12,819.52
	Pa Credit	20,704.74
	Pow Block Eng	(293,896.13)
	Proj Mgmnt	42,581.11
Feb-07 Total		442,476.94
Mar-07	Accrual	(1,030,729.67)
	AFUDC	11,038.76
	Pa Credit	(96,857.50)
	Pow Block Eng	1,153,948.27
	Proj Mgmnt	24,452.89
Mar-07 Total		61,852.75
Apr-07	Accrual	126,582.45
	AFUDC	9,748.14
	Pa Credit	(46,874.75)
	Pow Block Eng	439,165.72
	Proj Mgmnt	131,128.31
Apr-07 Total		659,749.87
May-07	Accrual	218,968.23
	AFUDC	15,780.93
	Pa Credit	(57,256.74)
	Pow Block Eng	359,199.66
	Proj Mgmnt	337,405.25
May-07 Total		874,097.33
Jun-07	Accrual	576,831.28
	AFUDC	21,906.80
	Pa Credit	(14,716.30)
	Pow Block Eng	(49,579.18)
	Proj Mgmnt	228,622.64
Jun-07 Total		763,065.24
Jul-07	Accrual	(3,674,475.53)
	AFUDC	24,941.02
	Pa Credit	(362,220.82)
	Pow Block Eng	4,145,037.76
	Proj Mgmnt	214,430.85
Jul-07 Total		347,713.28
Aug-07	Accrual	1,913,126.67
	AFUDC	26,787.61
	Pa Credit	108,442.06
	Pow Block Eng	(1,370,364.87)
	Proj Mgmnt	98,454.49
Aug-07 Total		776,445.96
Sep-07	Accrual	(1,940,582.20)
	AFUDC	41,869.84
	Pa Credit	(621,496.42)
	Pow Block Eng	7,274,007.94
	Proj Mgmnt	287,327.72
Sep-07 Total		5,041,126.88
Oct-07	Accrual	(4,152,983.42)
	AFUDC	83,741.90
	Pa Credit	(826,599.22)
	Pow Block Eng	9,744,160.61
	Proj Mgmnt	312,525.04
Oct-07 Total		5,160,844.91
Nov-07	Accrual	(5,536,477.35)
	AFUDC	122,904.45
	Pa Credit	(750,014.48)
	Pow Block Eng	9,026,656.24
	Proj Mgmnt	98,273.56
Nov-07 Total		2,961,342.42
Dec-07	Accrual	10,339,484.98
	AFUDC	177,786.62
	Pa Credit	(455,974.72)
	Pow Block Eng	5,484,683.19
	Proj Mgmnt	460,032.21
Dec-07 Total		16,006,012.28
Jan-08	Accrual	1,726,953.51
	AFUDC	238,074.00
	Pa Credit	(250,018.86)
	Pow Block Eng	2,775,120.16
	Proj Mgmnt	320,641.94
Jan-08 Total		4,810,770.75
Grand Total		39,600,614.60

2006 Total $ (42,796.21)

Docket No. 080119-EI
OPC's 1st Set for Production of Documents (Nos. 1-11)
Witness: Garrett
ATTACHMENT "C"

R:\Nuclear Cost Recovery (NCR)\Dockets\Schedules\Support\Power Plant_Uprate project 200588491.xls

PEF-NCR-05267