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Douglas C. Tingey
Assistant General Counsel

January 30, 2009

Via Electronic Filing and U.S. Mail

Oregon Public Utility Commission
Attention: Filing Center
550 Capitol Street NE, #215
PO Box 2148
Salem OR 97308-2148

Re: UE 196 - Boardman Deferral Amortization

Attention Filing Center:

Enclosed for filing in the captioned docket are an original and five copies of:

- **Testimony and Exhibits of Stephen Quennoz, PGE Response to ALJ Bench Requests – Quennoz/500-501a, 501bC-506C, 507-509, 510C, 511-512, 513C, 514, 515C, 516, 517C, 518, 519C.**
- **Testimony and Exhibits of Janet Kahl, PGE Response to ALJ Bench Requests – Kahl/600-602, 603C-604C, 605-607, 608 (CD only), 609C, 610.**
(Included are confidential and non-confidential versions. The confidential portion is subject to protective order 07-433 and therefore not to be posted on the OPUC website).

This document is being filed by electronic mail with the Filing Center. An extra copy of the cover letter is enclosed. Please date stamp the extra copy and return to me in the envelope provided.

These documents are being served upon the UE 196 service list.

Thank you in advance for your assistance.

Sincerely,

DOUGLAS C. TINGEY

DCT:cbm
Enclosures
cc: Service List-UE 196

CERTIFICATE OF SERVICE

I hereby certify that I have this day caused **TESTIMONY AND EXHIBITS OF STEPHEN QUENNOZ and TESTIMONY AND EXHIBITS OF JANET KAHL** to be served by electronic mail to those parties whose email addresses appear on the attached service list, and by First Class US Mail, postage prepaid and properly addressed, to those parties on the attached service list who have not waived paper service from OPUC Docket No. UE 196.

Dated at Portland, Oregon, this 30th day of January, 2009.

DOUGLAS C. TINGEY

SERVICE LIST

OPUC DOCKET # UE 196

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BEFORE THE PUBLIC UTILITY COMMISSION

OF THE STATE OF OREGON

UE 196

Boardman Deferral Amortization

PORTLAND GENERAL ELECTRIC COMPANY

PGE

Portland General Electric

January 30, 2009

UE 196 / PGE / 500
QUENNOZ

BEFORE THE PUBLIC UTILITY COMMISSION

OF THE STATE OF OREGON

PGE Responses to Bench Request Nos. 1-8

PORTLAND GENERAL ELECTRIC COMPANY

Stephen Quennoz

January 30, 2009

Table of Contents

I. Introduction

Q. Please state your name and position with Portland General Electric (PGE).

A. My name is Stephen Quennoz. My position is Vice President, Power Supply. My qualifications previously appeared in PGE Exhibit 100, Section VI.

Q. Do your qualifications include thermal plant operational experience?

A. Yes. Prior to working for PGE, I held positions as Plant Superintendent at the Davis-Besse Nuclear Station for Toledo Edison and General Manager at the Arkansas Nuclear One Station for Arkansas Power and Light. I also coordinated the restart of the Turkey Point Nuclear Station for Florida Power and Light. I joined PGE in 1991 and served as Trojan Plant General Manager and Site Executive.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to respond to Question Nos. 1-8 in the December 8, 2008 Bench Request issued in this docket. Janet Kahl (Gulley) provides responses to Bench Request Nos. 5, 5(a), and 5(b) in PGE Exhibit 600.

II. Bench Request No. 1

Q. PGE states that it relied exclusively on Siemens, the original equipment manufacturer, for the installation and maintenance of the upgraded LP1 turbine. ***See, e.g.,*** **PGE/300, Quennoz/13.**

A. We believe that this question overstates PGE's reliance on Siemens. PGE hired Siemens to manufacture and install the upgraded Boardman turbines. However, PGE did not rely "exclusively" on Siemens for installation and maintenance of the low pressure (LP1 and LP2) turbines. PGE took an active role. Specifically, PGE designated an individual to act as PGE's Quality Control Representative (PQCR) to oversee the manufacturing and installation of the turbines. Details of PGE's monitoring and oversight efforts are set out in my testimony and the testimony of Janet Kahl, PGE Exhibit 600. As Ms. Kahl's testimony makes clear, qualified PGE employees were on site day and night, closely observing and recording the installation process. By the same token, PGE employees monitored and accepted Siemens' maintenance activities after installation of the upgraded turbines.

III. Bench Request No. 1(a)

Q. What is standard industry practice for turbine installation and maintenance?

A. Based on my experience and knowledge, hiring the original equipment manufacturer (OEM) to install and maintain turbines, particularly large turbines like those at the Boardman plant, is standard industry practice. This was confirmed by information PGE has received from Siemens and from other utilities in response to PGE's requests for information, as described below in my response to Bench Requests 1(b) and 1(c).

Long-term relationships with OEMs like Siemens ensure that the plant has ready access to specialized knowledge (*e.g.*, tolerances, drawings, and fleet operating history) and tooling needed to efficiently perform repairs. Such relationships allow access to engineering talent and experience not otherwise available to a utility that only operates a single large steam plant turbine generator.

IV. Bench Request No. 1(b)

Q. Provide examples of other utilities that have relied on an original equipment manufacturer to provide such services.

A. In response to this Bench Request, PGE conducted a survey of other fossil fueled generating plants. PGE conducted this survey through Fossil Operations and Maintenance Information Service (FOMIS), a utility information service based in Dunedin, Florida. The FOMIS service is sponsored by 77 utility companies, representing 156 plant sites and over 400 generating units. The survey was sent to sponsor plant sites and responses were received from those who could reply on a short turn-around basis.

FOMIS broadcast PGE's survey questions to its members, and responding utilities e-mailed their answers directly to PGE. The nine survey questions, together with a summary of all responses, are attached as PGE Exhibits 501(a) and 501(bC). PGE Exhibit 501(bC) is confidential and subject to the protective order in this docket (Order No. 07-513).

Thirteen utilities responded to PGE's survey questions. They are:

- Nova Scotia Power Inc.
- Colorado Springs Utilities
- TransAlta
- Grand River Dam Authority
- Platte River Power Authority
- City Utilities of Springfield (Missouri)
- Dairyland Power Cooperative
- Omaha Public Power District (OPPD)
- SaskPower

- Dayton Power and Light Company
- Public Service Company of New Mexico
- Lansing Board of Power and Light
- Orlando Utilities Commission.

The survey respondents represent over 90 steam turbines across the U.S. and Canada. Of the thirteen responding utilities, twelve reported that they used the OEM for steam turbine installation. The respondent from one utility reported that it did not know. All thirteen utilities reported that they use the OEM for some or all of their steam turbine maintenance.

These responses demonstrate that it is a common and accepted practice for utilities to hire their OEMs for installation and maintenance services, subject to the utilities' monitoring and oversight. This is also consistent with my experience prior to joining PGE.

V. Bench Request No. 1(c)

Q. Provide examples of other instances in which Siemens has provided such services to PGE and other utilities.

A. PGE Exhibit 502C is a list of instances in which Siemens provided installation or maintenance services. The first page of the exhibit lists 34 cases in which Siemens performed LP or HP/IP turbine upgrades. It is our understanding that this included installation. The remaining pages list 407 cases in which Siemens provided either maintenance or inspection services. The OEM is listed in each case. In the large majority of cases, Siemens is the OEM per se, or effectively the OEM via Siemens' relationship with Westinghouse. (Siemens purchased Westinghouse. The combined entity was first called Siemens-Westinghouse, later simply Siemens.)

VI. Bench Request No. 2

Q. Provide copies of the Siemens reports provided in response to the Industrial Customers of Northwest Utilities (ICNU) Data Request Nos. 009, 010, 016, and 018. *See* ICNU/105, Martin/1.

A. Copies of those Siemens reports are attached as PGE Exhibits 503C-506C, as described in Table 1 below.

Table 1

Data Request No.	PGE Exhibit No.	Description
009	503C	2002 report on warranty work, including bearing replacement.
010	504C	2004 report related to the HP/IP turbine upgrade.
016	505C	Report concerning the period from November 3, 2005 through May 22, 2006, entitled "Forced Outage: Investigate Rotor Vibration."
018	506C	2000 report related to the LP turbine upgrade.

VII. Bench Request No. 3

Q. Other than Siemens, what entities provide turbine installation or maintenance?

A. Many entities provide some level of turbine installation and maintenance services. Entities that perform turbine installation or maintenance work include the following:[1]

- Mechanical Dynamics and Analysis LTD
- Power Generation Service, Inc.
- Alstom Power Services
- Wood Group
- Interpro Technical Services LTD
- TurboCare
- Preferred Machine and Tool Products Corp
- ReGENco
- Mitsubishi
- General Electric

It is important to note that using a vendor other than the OEM for installation and maintenance of a large turbine is unusual. PGE typically has used non-OEM providers where a secondary market is well developed, such as in services for PGE's Beaver plant, which went into service in 1976. The Boardman LP and HP/IP turbines were upgraded in 2000 and 2004 with new rotors that Siemens designed using sophisticated finite element analysis and computational fluid dynamics to increase efficiency. We would have been reluctant to contract out either the installation or maintenance of this advanced technology to

1 Web page print-outs are provided in PGE Exhibit 507.

vendors who did not have the design or field experience of an OEM with a worldwide fleet of similar turbines.

VIII. Bench Request No. 4

Q. Is it standard industry practice for a utility to rely exclusively on an outside entity's (including an original equipment manufacturer) quality assurance/quality control (QA/QC) program for the installation and maintenance of a turbine rotor instead of having its own QA/QC program? *See, e.g.*, ICNU/105, Martin/1.

A. Yes. It is typical for a purchaser/user of a steam turbine, like PGE, to rely on the manufacturer's quality programs, in combination with adequate oversight and monitoring. William P. Sanders, a noted turbine maintenance and repair expert, states that "A quality assurance (QA) program is prepared and implemented by an equipment supplier to achieve certain requirements or characteristics in the components produced within his or her facilities." (See William P. Sanders, *Turbine Steam Path Maintenance and Repair*, Vol. II at 677, PenWell 2002).[2] "The purchaser/user has an implied responsibility to monitor," but this monitoring "can normally be achieved by the monitoring of the supplier's quality program, and also by directing inspection or surveillance attention to those critical characteristics that must be achieved if the unit is to perform as anticipated." *Id.* at 654. (Copies of the relevant pages of Sanders' book are included in PGE Exhibit 508). PGE fulfilled this responsibility by reviewing and accepting Siemens' QA/QC program and by monitoring Siemens' performance and compliance with its programs.

PGE did not use a separate comprehensive QA/QC program to oversee Siemens' manufacturing, installation, or maintenance activities. However, PGE did not rely exclusively on Siemens' QA/QC programs.

2 Mr. Sanders has worked since 1982 for Turbo-Technic Services, Inc. He presents seminars for people who maintain and repair turbines.

As the operator of the Boardman Plant, PGE recognized its responsibility to monitor the manufacture and assembly of the upgraded LP and HP/IP turbine components. PGE personnel reviewed the Siemens QA program, examined material test reports, and made inspection visits to the manufacturing facilities during the manufacture of both LP turbine rotors and the HP/IP turbine rotor. During installation at the Boardman Plant, experienced PGE personnel were assigned day and night to monitor Siemens' activities, including installation, interface problems, QA program compliance and any material or program nonconformance.

PGE does not implement separate QA/QC programs to govern the operations of equipment suppliers and service providers like Siemens. Instead, PGE ensures that (1) the outside entity has its own QA/QC program that meets industry standards; and (2) the outside entity follows its program. Also, PGE augmented inspections performed by Siemens with inspections conducted by its own personnel. Those PGE personnel were qualified to perform Non-destructive Examinations in accordance with standards set by the American Society for Nondestructive Testing (ASNT).

Before purchasing the upgraded LP turbines from Siemens, PGE required Siemens to have a QA program that clearly established the authority and responsibilities of those responsible for the program. PGE also required that program details and description be made available for PGE review. The relevant excerpts of PGE's bid specifications are included in PGE Exhibit 509. In its contract with Siemens for manufacture and installation of the LP turbines, PGE required that Siemens' QA program be ISO 9001 certified.[3] PGE Exhibit 510C is a copy of this contract, which was also provided as an attachment to PGE's

3 ISO 9001 certification is the industry standard for QA/QC programs. PGE Exhibit 511 contains a description of ISO 9001 certification.

Response to ICNU Data Request No. 012. PGE Exhibit 510C is confidential and subject to the protective order in this docket (Order No. 07-433). The ISO 9001 certification requirement is on page 83 of the contract. PGE Exhibit 511 is a description of the elements required for ISO 9001 certification. PGE Exhibit 512 is a copy of Siemens ISO 9001 certification.

During the manufacture of the LP and HP/IP turbines, PGE employees conducted site visits to Siemens' facilities in North Carolina, Ohio, Mexico and Germany, where the turbine components were being manufactured. As Ms. Kahl discusses in PGE Exhibit 600, during those site visits, PGE employees reviewed and accepted Siemens' QA/QC documentation. (See PGE Exhibit 600 at 2 and PGE Exhibits 603C and 604C). PGE employees also monitored Siemens' testing and manufacturing to ensure that Siemens was following its QA/QC program.

The same was true during installation and maintenance of the LP and HP/IP turbines. PGE employees actively oversaw and monitored Siemens' employees at Boardman, as discussed below in my response to Bench Request No. 5.

Reliance on the vendor's certified QA/QC program, together with appropriate monitoring, is accepted industry practice. (*See* Sanders at 654, 677, at PGE Exhibit 508.) Further, the responses to PGE's FOMIS survey confirm this industry practice. Almost all of the responding utilities reported that they relied on the QA/QC program of the OEM, with appropriate oversight. (See the discussion on Page 5 above and PGE Exhibit 501bC.)

IX. Bench Request No. 4(a)

Q. Describe the key elements of Siemens' QA/QC program.

A. In connection with the manufacturing and installation of the LP and HP/IP turbines, PGE reviewed and accepted Siemens' QA/QC program. As I stated above in my response to Bench Request No. 4, PGE's contract for the LP rotor upgrades required Siemens to follow a QA program that met international (ISO 9001) standards, which are described in PGE Exhibit 511. The ISO 9001 requirement is stated on page 83 of the contract, a copy of which is PGE Exhibit 510C.

A manufacturer's quality assurance program should include procedures or processes for controlling all aspects of a component's quality. Key elements include:

- procedures for controlling the purchase of materials,
- inspection and test methods and plans,
- personnel responsibilities and authorities,
- control and calibration of measuring and test equipment,
- control of special processes,
- methods for reporting, evaluating, and dispositioning non-conforming items,
- instructions for storage, packaging and shipping, and
- plans for controlling documents and records.

See Sanders at 678 (PGE Exhibit 508).

PGE examined Siemens' QA/QC program and found that it addressed the key program elements and had received ISO 9001 certification. The following documents describing Siemens' QA program, and PGE's review of that program, are attached as PGE Exhibit 513C:

- Siemens Project Management Organization document
- Work scope for normal maintenance
- Site Project Management document
- Installation Division of Responsibilities
- Project Readiness Review Meeting document
- QST Quality Assurance Specification Turbine Plants Submittal
- Siemens Quality Management Manual

These documents are more recent than the LP rotor upgrades. However, they are also representative of Siemens' QA program for the LP rotor upgrades, particularly given the LP upgrade contractual requirement for a QA program meeting ISO 9001 standards. PGE Exhibit 513C is confidential and subject to the protective order in this docket (Order No. 07-433).

The documents in PGE Exhibit 513C set out in detail many aspects of Siemens QA/QC program applicable to the Boardman turbine upgrades. These documents are consistent with the QA/QC manuals and documents that PGE employees reviewed in 1999 and 2000 in connection with the LP upgrade. PGE did not retain earlier documents describing Siemens' QA/QC program, but the key program elements listed above have remained consistent through both the LP and HP/IP upgrades. Page 1 of PGE Exhibit 512 shows that the original approval date for Siemens' ISO 9001 certification was November 20, 1992, well before the LP upgrade in 2000.

The Boardman Plant Unit 1 Turbine Update Project – Contract – Feb. 8, 1999 with Siemens also describes Siemens' QA/QC program. PGE Exhibit 510C is a copy of this contract. Pages 10, 11, 12, 69, 73, 75-77, 83, 84, 85 and 93 are particularly relevant to

QA/QC requirements required of Siemens during manufacture, shipping, installation, and testing of the LP turbines.

X. Bench Request No. 4(b)

Q. Provide examples of other instances where PGE and other utilities have relied exclusively on an outside entity's QA/QC program for installation and maintenance services.

A. As I discussed above in my response to Bench Request No. 4, PGE did not use a separate QA/QC program to direct Siemens' operations. PGE verified that Siemens had ISO 9001 certified QA/QC programs and then closely monitored Siemens' work in the manufacturing, installation and maintenance of the upgraded turbines. Reliance on a vendor's certified QA/QC program, together with appropriate monitoring, is accepted industry practice. *See* Sanders at 654, 690 (PGE Exhibit 508). PGE successfully used the same approach in the construction of Coyote Springs, Port Westward, and Biglow Canyon Phase 1, and in other large projects. PGE is also using the same approach in the current construction of Biglow Canyon Phase 2.

The responses to PGE's FOMIS survey confirm this industry practice. Nearly every responding utility reported that it relied on the QA/QC program of its OEM for steam turbine work, with appropriate oversight. None of the responding utilities reported that they have their own QA/QC programs governing the OEM for steam turbine work. (See the discussion on Page 5 above and PGE Exhibit 501bC.)

PGE also contracts with the OEM, with PGE oversight, for maintenance at some of its other thermal plants. The Coyote Springs plant is a combined cycle unit with General Electric gas and steam turbines. PGE has a long term service agreement with General Electric to provide planned maintenance services on both the gas and steam turbines. The Port Westward plant is a combined cycle unit with Mitsubishi gas and steam turbines. PGE has a long term service agreement with Mitsubishi to provide planned maintenance services on the gas turbine. PGE's practices with Coyote Springs and Port Westward are consistent with PGE's practices at Boardman, and with the practices of other utilities that responded to the FOMIS survey.

XI. Bench Request No. 5

Q. Describe in detail the actions PGE personnel took to oversee the installation and maintenance work performed by Siemens on the LP1 turbine. ***See, e.g.,*** **PGE/400, Quennoz/10.**

A. PGE monitored Siemens' manufacturing, installation and maintenance activities, as we do with work performed by any vendor. Details of PGE's oversight and monitoring activities are also provided in my responses to Bench Requests 1 and 4, above, and in Janet Kahl's testimony (PGE Exhibit 600). Ms. Kahl was one of the key PGE employees overseeing and monitoring Siemens' manufacturing and installation of the LP turbines.

It is important to note that the scope of main steam turbine maintenance work at Boardman varied from year to year. Work scope depended on whether any major turbine modifications were made or a major inspection interval had been reached, or only minor maintenance was required (e.g., repairing valves and fixing steam leaks). As a result, Siemens did not perform main steam turbine maintenance every year at Boardman. Between 2000 and 2005, Siemens performed the following at Boardman:

- During the 2000 Boardman plant outage, Siemens performed the Low Pressure Turbine installation/upgrade. They installed the new low pressure rotors and performed modifications and maintenance necessary to accommodate the new rotors. The work was performed in accordance with Siemens' procedures and QA/QC program. PGE maintained careful oversight of the work.
- During the 2001 annual Boardman plant outage, PGE craftsmen performed maintenance on the turbine governor and intercept valves (e.g., fixing hydraulic control fluid leaks).

- During the 2002 annual Boardman plant outage, Siemens replaced the sleeve bearings on the low pressure turbines with new tilt-pad bearings. Similar to the 2000 installation work, PGE maintained careful oversight of this work. Apart from the Siemens work, PGE craftsmen and qualified inspectors inspected, cleaned, and repaired steam valves (governor, throttle, reheat stop, and intercept valves) on the turbine. Qualified PGE personnel performed Non-Destructive Examinations (NDE) as part of this work.
- During the 2003 outage, PGE craftsmen repaired steam and air leaks, checked piping, repaired valves, and changed the turbine rupture disks.
- During the 2004 outage, the HP/IP turbine upgrade work was performed by Siemens, similar to what was performed in 2000 for the low pressure turbine upgrade. PGE maintained careful oversight of the work. PGE craftsmen also inspected and repaired the governor, throttle, reheat stop valves, fixed air leaks and a broken support weld, fabricated supports for a new main steam pressure tap added during the HP/IP turbine upgrade, and fixed leaks.
- During the 2005 annual outage (Spring 2005), PGE craftsmen repaired oil leaks and worked on the turbine throttle valves.

Thus, although Siemens performed some turbine maintenance tasks for PGE between 2000 and 2005, qualified PGE personnel always monitored and accepted Siemens' maintenance work, in accordance with PGE's regular practice for maintenance outages.

When PGE scheduled a maintenance outage at Boardman, we listed tasks to be performed on an outage schedule. A copy of an outage schedule is attached as PGE Exhibit 514.

During a maintenance outage, one or more PGE employees are assigned to oversee service providers hired to perform maintenance tasks. The assigned PGE employees verify completion of the maintenance tasks, and report the tasks as complete to plant management. This is the protocol that PGE followed for turbine maintenance performed by Siemens. At least one PGE employee was assigned to monitor every scheduled turbine maintenance task. Those employees observed Siemens' maintenance activities, consulted or asked questions where necessary, and reported on progress at regular progress meetings with the Boardman Plant Manager and staff. When Siemens completed a task, the assigned employee was responsible for verifying that the task was completed satisfactorily and reporting to plant management. Additional details related to installation are provided by Ms. Kahl in PGE Exhibit 600.

XII. Bench Request No. 6

Q. Did PGE hire any outside consultants to oversee, monitor, or examine Siemens' installation and maintenance? If so, provide any reports or other similar materials prepared by these outside consultants.

A. Yes. In addition to regular PGE oversight, PGE sometimes hired outside consultants to perform services related to the LP1 and LP2 turbine installation and maintenance. This served as an additional check on Siemens' installation and maintenance work. PGE hired Stone and Webster to review performance test procedures and results for the LP upgrade. PGE also regularly employed RK, Ltd. to monitor turbine vibrations during startups following extended maintenance outages. Turbine Master, Inc., Wesdyne International, and Advanced Thermal Solutions, Inc. provided NDE, inspection, and heat treatment services to Siemens and PGE during installation of the LP turbines.

Copies of the following relevant reports and documents are attached as PGE Exhibits 515 and 516:

- Summary of Steam Path Audit and Preliminary Acceptance Test Results.
- Alstom Engineering Study Draft Report, April 2003.
- Turbine Master Inc's Report of Fluorescent Magnetic Particle Inspection, Penetrant Inspection, and Ultrasonic Inspection, May 2004.
- Memo from Performance Engineering, LLC re: Fluidic Techniques Site Visit, Inspection of the PGE Boardman ASME Condensate Flow Section.

PGE Exhibit 515C is confidential and subject to the protective order in this docket (Order No. 07-433).

XIII. Bench Request No. 7

Q. Provide any reports or other similar materials prepared by the contractor hired in 2006 to perform the "frame foot loading test" referenced in ICNU/312C at 4.

A. PGE Exhibit 517C is the October 27, 2006 Sensoplan report titled "Vibration Measurements on PGE's Boardman Plant LP Turbines." With respect to the "frame foot loading test," Sensoplan reported no indication of an insufficiently stiff foundation joint. PGE Exhibit 517C is confidential and subject to the protective order in this docket (Order No. 07-433).

XIV. Bench Request No. 8

Q. Provide any reports or other similar materials prepared by the consultant(s) hired to conduct alignment checks and measure turbine component movement. *See* PGE/300, Quennoz/3, lines 14-15.

A. Copies of the following responsive reports and materials are PGE Exhibits 518 and 519C:

- Alignment Vibration Analysis Report for PGE Boardman Power Plant dated July 23, 2006. Steam Turbine/Generator Unit.
- Alignment Vibration Analysis Report for PGE Boardman Power Plant dated July 10, 2007. Boardman Generating Facility Turbine / Generator Profiles.
- PGE Boardman Generating Plant Steam Turbine Generator Drive System Off Line to Running Machinery Movement Survey, Jan, Feb, April, May 2008.

PGE Exhibit 518 contains copies of the first two documents. A copy of the third document is PGE Exhibit 519C, which is confidential and subject to the protective order in this docket (Order No. 07-433).

Q. Does this conclude your testimony?

A. Yes.

List of Exhibits

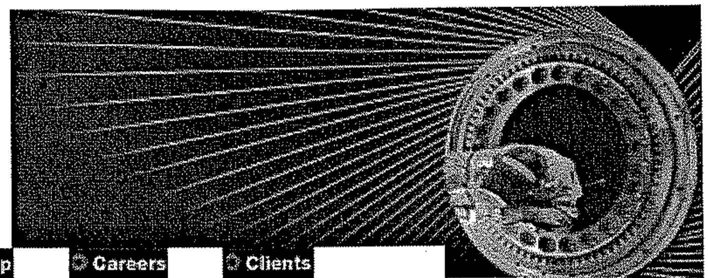
PGE Exhibit	**Description**
501a	PGE Survey Questions
501bC	**PGE Survey Result Summary**
502C	**Examples of Siemens' Provision of Installation and Maintenance Services**
503C	**Attachment to PGE's Response to ICNU Data Request No. 009**
504C	**Attachment to PGE's Response to ICNU Data Request No. 010**
505C	**Attachment to PGE's Response to ICNU Data Request No. 016**
506C	**Attachment to PGE's Response to ICNU Data Request No. 018**
507	Web Page Print-Outs for Providers of Installation and Maintenance Services
508	Copies of Relevant Pages from Sanders, *Turbine Steam Path Maintenance and Repair*, Vol. II
509	PGE Bid Specifications
510C	**Contract for LP Turbine Upgrade**
511	Description of ISO 9001 Certification Standards
512	Siemens' ISO 9001 Certification
513C	**Siemens' QA/QC Program Documentation**
514	PGE Outage Schedule
515C	**Outside Consultants' Reports**
516	Outside Consultants' Reports
517C	**"Frame Foot Loading" Test Report**
518	Alignment Reports
519C	**Alignment Report**

PGE's Questions for the Fossil Operation and Maintenance Information Service (FOMIS) Survey

PGE conducted a survey through FOMIS, an on-line utility information service based in Dunedin, Florida. FOMIS broadcast survey questions provided by PGE to its members, and responding utilities e-mailed their answers directly to PGE. The FOMIS service is sponsored by 77 utility companies that represent 156 plant sites and over 400 generating units. The survey was sent to all of the sponsor plant sites and responses are received from those who could reply on a short turn-around basis. PGE's survey nine questions are provided below.

PGE Questions	
1	Did you have the original equipment manufacturer (OEM) install or verify proper installation of the steam turbines during original installation?
2	Do you rely on the turbine OEM, an outside service provider, or utility staff personnel for maintenance of the steam turbine, including: (a) major turbine inspection and overhaul, (b) periodic major turbine maintenance, (c) Rotor Alignment
3	If the work is performed in-house, how many "turbine experts" do you have on your Plant and on your Corporate engineering staff, each location?
4	If a turbine services contractor is used, what is their name?
5	If you use a service contractor or the OEM, please describe the level of utility oversight, monitoring, and examination/checking of the work.
6	Do you use independent contractors to assist in the oversight of the contractor? If so, for which tasks?
7	Does your utility have its own formal Quality Assurance/Quality Control program that applies to steam turbine work or do you rely on the contractor's QA/QC program?
8	If you have your own utility QA/QC program, please describe how it applies to steam turbine work.
9	Number of Siemens or Westinghouse Main Turbines.

MECHANICAL DYNAMICS and ANALYSIS, LTD



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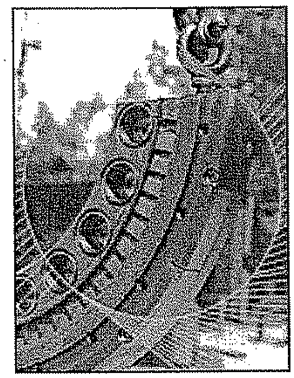

Mechanical Dynamics & Analysis is a leading non-OEM supplier of steampath engineering services for power generators and steam turbine owners, worldwide. Our Steampath Engineering Division provides experienced, on-site engineering personnel, most of whom are factory-trained and completed years of OEM field experience prior to joining our team. The Steampath Engineering Services Division is fully supported by MD&A's Field Engineering Division, tools and programs that are needed to ensure technical excellence on every project.

An abbreviated list of our steampath engineering services includes:

- Structural steampath analysis of stationary and rotating components
- Thermodynamic analysis of steampath components
- Engineered repairs of diaphragms and blade rings
- Supervision of L-0 and L-1 blade installations
- Capacity increase modifications
- Supervision of dished diaphragm repairs
- Supervision of nozzle block reconstructions
- Owner's representative for turbine repair recommendations
- Failure analysis
- Reverse engineering of turbine components
- Turbine cycle performance testing
- Shell weld repairs
- Controls upgrades

If you have questions about MD&A's turbine engineering services or other steampath services, please call our Steampath Engineering Service division at (518) 399-3616.

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Mechanical Dynamics & Analysis, Ltd.
29 British American Blvd, Latham, NY 12110
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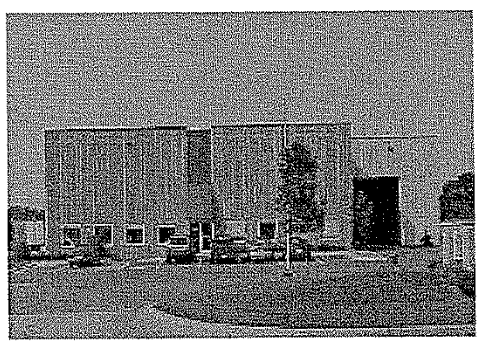
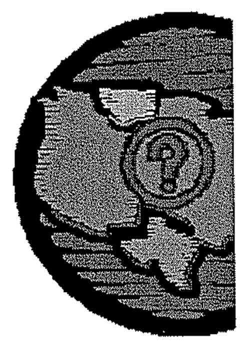
Power Generation Service, Inc.

COMPLETE TURBINE GENERATOR SERVICE





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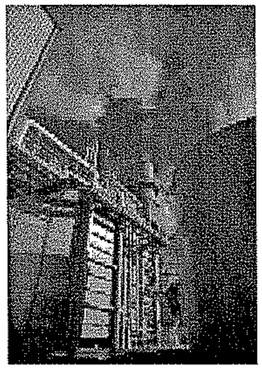

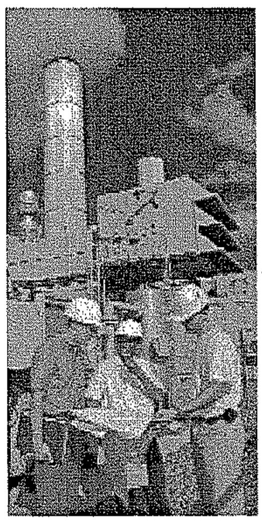

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A leading company in the power generation sector, ALSTOM Service is committed to providing high quality parts and world unparalleled customer service. We design and implement sta steam power plant solutions tailored to meet your needs.

ALSTOM's catalogue caters for a wide range of steam turbin applications, whether back-pressure or condensing. Our serv available for both simple cycle and waste heat steam generat applications.

Maintenance and components replacement belong to our cor competencies. If you require a new turbine blade or adjustme steam generator, ALSTOM will help you.

If you are looking for further modernisation of your plant, ALS Service can help you increase the efficiency of your steam su condenser, or optimise your steam transformer: we can recor technologies and provide system upgrades, to help you achie competitiveness.

ALSTOM Power Service has developed specific turbine retrol programs. The scope of our retrofitting solutions may vary, fr replacement of entire turbine modules to specific steam path (rotors, diaphragms), depending on our customers' needs.

And to offer you even more control over your maintenance pr you choose the role we play in it. Our clients can decide on th scope of their Long-Term Service Agreements, from simple p to full outage management.

For ALSTOM Power Service, the result of such good servicin leading position on the market: our customers around the wo services and rely on us to provide them with innovative and c solutions.

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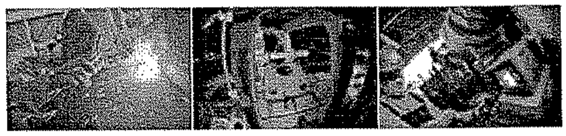

Steam Turbines

Wood Group Gas Turbine Services is highly experienced in providing maintenance support for both small (line shaft to 60MW) and large (200MW to 1000MW) steam turbines from our dedicated facilities in the US, Thomason Mechanical Corporation (TMC) and Lovegreen Turbine Services, and in the UK, Wood Group Heavy Industrial Turbines Steam Turbines.

We retain an extensive pool of skilled field service personnel to support all of your steam turbine service requirements including major overhaul, inspection, outage and maintenance support, and relocation and installation services. In the UK we offer a full complement of steam turbine component repair and coating capabilities for blades and nozzles to diaphragms and shrouds.

Turbines serviced include those from General Electric, Westinghouse, Alis Chalmers, Elliot, Turbodyne, Worthington, Delaval, ABB and Siemens.

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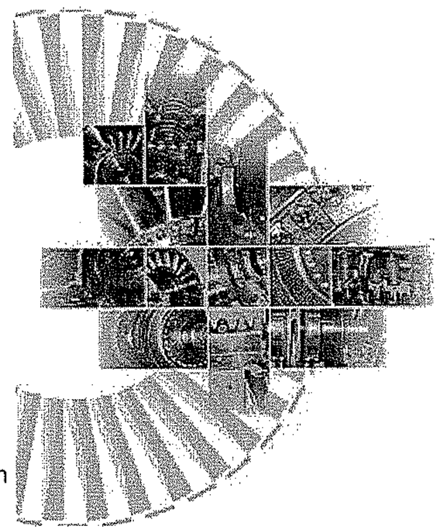


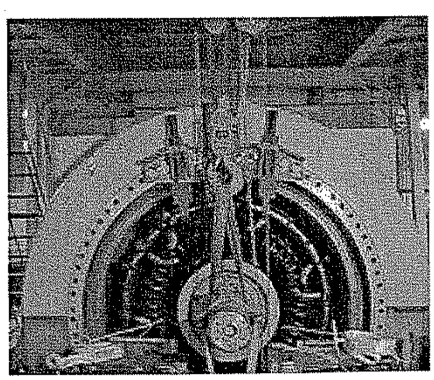
Project planning and management

Interpro's project planning and management expertise guides you through all facets of projects: budgeting, project scope development and turbine outage planning. Interpro helps choose and install the best solution, acting as prime contractor to major suppliers and coordinating all aspects of a job. From primary power systems to the recapture of energy from process steam, Interpro ensures the most cost effective and timely installation.

Documentation and drawing updates

Frequently, aging steam turbine generator units lack the documentation necessary upon which to build improvements to meet economic and environmental challenges. Interpro's technicians and engineers aid in all aspects of documentation updates, including conversion of original drawings to CAD, updating of all manner of documents that relate to turbine operation, maintenance and training.

Turbine and generator inspections



Properly operated and maintained, the life cycle of any turbine generator unit has the potential to extend over many decades of reliable, dependable service. Interpro's focus emphasizes helping our customers to take all possible advantages of the opportunities that exist in this regard.

Vibration analysis, in-place multiplane balancing

Turbine control system upgrades

Interpro's skills include some unique techniques relating to turbine-generator vibration and balance issues. Challenging problems such as remedial balancing of thermally sensitive generator rotors are routinely taken in stride.

Generator protection, excitation and control system inspection, testing and maintenance

Interpro has the resources at hand to deal with all aspects of high voltage distribution systems, and generator protective devices and systems.

Training

Seminars are offered in all aspects of turbine power and generation systems. Our training seminars do not present generic information. These are unit-specific presentations designed specifically to meet the exact needs of each client.

Interpro's experienced staff and management have prepared and given many seminars and training classes on all aspects of turbine power and generation systems. From safety and operations to inspection and reliability, seminars on all aspects of the care and operation of systems from small to large are available.

> A total of 76 people participated from our operating and maintenance crews - all said it was the most interesting and useful course they had ever attended.
> G. St. Cyr, T. Wilson, B. Mulholland

Let us design a series of seminars or courses for your employees and management.

REPLACEMENT PARTS, HARDWARE UPGRADES, INSPECTIONS, REPAIRS AND INSTALLATIONS

New installations, moves, updates, upgrades

Interpro is far more than its industry-leading maintenance reputation. While typical projects involve the inspection, repair or upgrade of existing units, our range of skills and resources also allows us to take on projects for our customers relating to the installation of new or resurrected units.

Replacement parts

Interpro has become a key source of parts for our customers. We routinely provide all manner of turbine generator parts to our customers, at competitive cost and lightning quick delivery. Parts provided by Inter-pro to date have ranged from babbitt bearings, steam valves and valve stems, interstage and gland steam seals and high temperature studs, bolts and nuts to an entire new steam path for a 50+ MW industrial steam turbine.

Steam path repair services

We have the resources to provide expert steam path component repair services of quality and productivity that is unsurpassed in the turbine steam path repair business. Our experienced technicians carry out re-pairs ranging from minor touchups to complete reconstruction of diaphragm nozzle partitions, on site when required, and typically within the planned duration of a maintenance outage.

Steam turbine controls

Among Interpro's areas of expertise is mechanical and electronic steam turbine control design. Our representatives include two former control system design engineers, both of whom worked in excess of twenty years designing both mechanical and electronic turbine controls for large utility and medium sized industrial steam turbine generators.

Turbine control system upgrades

Updates to older mechanical and even early OEM electronic turbine controls can return significant benefits through in-creased dependability - reduced maintenance and downtime, and enhanced controllability. State of the art controls available through Interpro can be interfaced with plant DCS systems to automatically and continually manipulate turbine operation to optimize the efficient use of available energy, and maximize the return on the plant's investment in steam generation, while potentially enabling conformance with future possible emissions standards.

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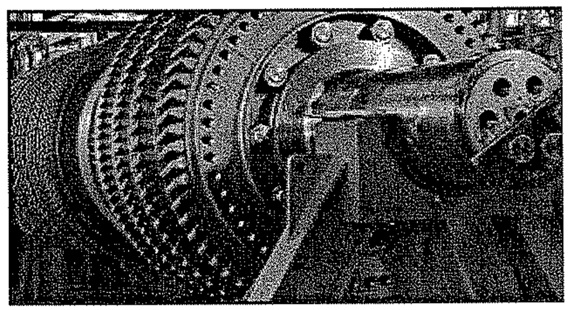

TurboCare Group Welcome Message

The TurboCare Group of Businesses is the world's largest network of independent service providers, operating in almost all locations in the world. TurboCare offers engineered solutions, maintenance support and service to owners and operators of rotating equipment manufactured by major OEMs. TurboCare provides customers with an unsurpassed combination of responsiveness, dependability and quality in the industrial and power generation markets in more than 100 countries worldwide.

Read the entire TurboCare Group Welcome Message here

What's Ne

Nov. 26, 2008: Turl S.p.A. announces TG 300.000 hrs celebrat release)

Oct. 15, 2008: "Rep low-pressure rotors v cracked blade attachments" (Full a

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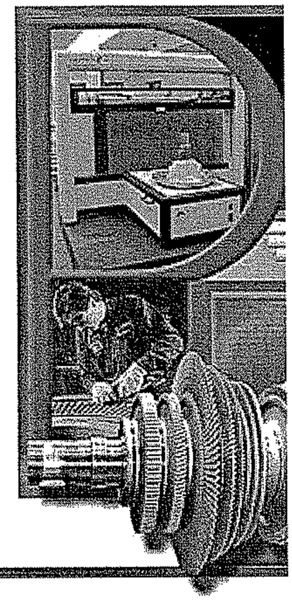
We specialize in the reverse engineering and short-cycle manufacturing of precision parts for turbines from a variety of OEMs. We also provide expert repair of turbine components and a wide range of on-site services.



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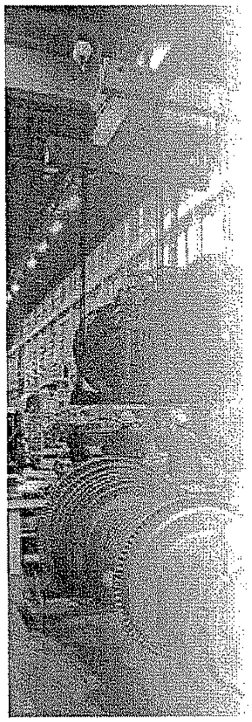
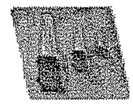


Integrated Turbine and Generator Repair



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Field Service and Support

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Facsimile: 1-724-778-5149

E-mail: powersys@meppi.com

In addition, each MEPPI project is assigned to a Project Manager and Management Team (Project Manageme the Project. 24/7 cellular phone and other contact information of the appropriate Project Team members is pro Award.

Equipment is the best-built and best-backed product available today, assuring utilities and their customers of u delivery. Our service engineers are intimately familiar with the products, through hands on training and certific

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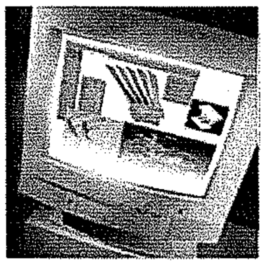

Full Range of Services

GE's Industrial Steam Turbine Application Center (ISTAC) wa established specifically to serve industrial steam turbine custo engineers from every technical turbomachinery discipline, GE qualified to serve all of your turbine needs. This experienced t further strengthened through access to original OEM drawings and history data and analytical tools to provide you with the hi quality solutions.

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- Integrated Design System
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IDS Turbine Design Analysis Program

ISTAC engineers are supported by GE's proprietary Integrated Design System (IDS) to provide tl effective turbine design. IDS is an automated design tool developed by GE which enables our en use selection criteria and algorithms that can "assemble" components into a complete turbine. ID stage-by-stage thermal and mechanical analysis and is calibrated to 44 ASME field tests and 18 tested sections for accuracy. IDS also runs "real" operating points and establishes maximum stag conditions. In addition, IDS performs mechanical analysis of the total steam and generates perfoi curves and stress summaries. Combined with the use of the OEM drawings and design records, proposed turbine designs are thoroughly analyzed, so the resulting modifications fit the turbine cc first time.

Our engineering expertise, state-of-the-art design tools, computer-aided design, and solid modeli enable us to evaluate solutions across your total turbine system. Reliability, capacity, plant chang maintainability, and plant life cycle cost can be optimized to meet your operating goals. The ISTA engineers work with you to provide the solutions that best fit your plant needs.

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TURBINE STEAM PATH MAINTENANCE AND REPAIR

Volume Two

William P. Sanders, P. Eng.

PennWell

Library of Congress Cataloging-in-Publication Data

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they are applied and assembled. Many of these technical requirements are not obvious from casual observation, and to ensure the design specifications are achieved in the delivered product, it is necessary to investigate these during the process of awarding a contract, and then to monitor their application during manufacture, and also to have access to any instances of nonconformance.

This availability of access to (and even involvement in) the disposition of nonconforming situations provides considerably greater confidence in the quality of the final product. Such participation also allows the purchaser to be able to anticipate, and identify manufacture as the cause of any specific mechanical problems subsequent to going into service.

The purchaser/user has an implied responsibility to monitor the manufacture and assembly of these components. This monitoring does not require the physical measurement of the components themselves, but can normally be achieved by the monitoring of the supplier's quality program, and also by directing inspection or surveillance attention to those critical characteristics that must be achieved if the unit is to perform as anticipated.

To undertake a "quality review and monitor" it is necessary to compare the manufactured components against the standards defined by the design engineering function. These engineering standards establish component requirements, and the quality of the products is dependent upon the ability of the manufacturing department to achieve an acceptable level of compliance.

This synopsis is not complete, as the requirements from one manufacturer to another may be defined by different methods. This is not unreasonable, and these differences reflect the differences in both the manufacturers' method of manufacture and their experience. It is only by seeing that the manufacturer has (and follows) their own documented standards, that an acceptable component can, from a manufacturing/refurbishment perspective, be achieved.

In some instances, component testing is used to help ensure the less tangible characteristics, such as vibration frequencies and levels of deflection are within acceptable levels. In those instances where the original design criteria are not known, a direct comparison with the original sample is used to ensure compliance. To allow this, a test rig is manufactured, which will allow the reverse engineered components and the original samples to be tested under identical conditions, simulating the operational conditions as much as is practicable.

Component installation

At completion of manufacture, the reverse engineered component must be capable of being installed into the turbine steam path, while allowing the unit to be returned to service to operate with an efficiency and reliability at least consistent with that of the original components. The installation of the reversed components is often as critical to the performance level of the turbine unit as the actual manufacture of the components. For this reason the owner should take care to ensure that qualified people install the components correctly, and there are records produced of any critical characteristics having the potential to affect the quality of the unit and its short and long-term operation.

THE QUALITY ASSURANCE PROGRAM

A quality assurance (QA) program is prepared and implemented by an equipment supplier to achieve certain requirements or characteristics in the components produced within his or her facilities. The QA program is normally not limited to measuring and gauging products; this inspection activity represents only a portion of the total QA program.

A quality assurance program should include various items controlling total quality. These would typically include:

- for an alternative supplier, procedures for reverse engineering. This will ensure the reverse engineered components comply (are equivalent to or better than the original product) and that tolerances are to industry standards. It also includes production planning to ensure delivery dates are met
- procedures for controlling the purchase of materials and other items that will affect the quality of the finished components
- details of inspection and test methods, their implementation, and a definition of those responsible for this work and their authority. This inspection includes incoming, in-process, and final inspection
- methods for controlling the calibration and use of measuring instruments
- methods for calibrating and controlling special processes, including the qualification of operators responsible for their application
- methods for reporting and evaluating nonconforming conditions as they arise in the manufacturing facility as well as the isolation of nonconforming items from those that comply, and are suited for shipment
- methods of packing and preserving the components ready for shipment
- details of record storage, retention, and retrieval

Such a program should have a person within the supplier's organization responsible for its implementation. This person must have enough authority to halt production until corrective action is taken (if it is determined the manufacturing process used to manudefined as one that conforms in all respects to the requirements of design. Any effort made by a manufacturer to achieve a product with compliance, in terms of dimensional conformance, surface finish, mechanical properties, or other characteristic beyond design engineering specification, cannot be considered necessary to improve the defined quality level. Certainly, such narrower control may improve the value of the product. But the assumption in accepting the design-specified value of these various component characteristics is that the value defined by design is acceptable from technical considerations. Such a finish may have certain ascetic value, or can even be used as part of a marketing strategy, but if it is beyond the design requirements, no quality value can be attached to it.

To obtain assurance that delivered components meet or comply with the design definition, and can be considered a quality product, there are certain steps the purchaser can take. These include an "engineering review" of the design and manufacturing specification, then the undertaking of surveillance of the components during the total procurement process, from material procurement to shipment, to ensure they comply. Alternatively, it can include only that part of the total process considered most likely to influence quality. Product surveillance will help establish that elements are produced in accordance with the design specification, and that all steps, processes, and checks included in the manufacturing processes are undertaken correctly.

PRODUCT SURVEILLANCE

During the total procurement cycle, there are a number of actions that influence the quality of the product. It is normal for many purchasers to monitor details of production to help ensure components are produced to specification, and will perform ade-

MEMORANDUM

To: Rob Hatteberg Jm-052-95

From: Jaisen Mody (signed: JMody)

Date: November 8, 1995

Subject: Boardman Plant
RDC BN 95-003, Transmittal Of Bid Specification
Turbine Capacity Increase Retrofit

This memorandum transmits the bid specification (BN95-003SP01) for the Boardman turbine upgrade, with an option for a combined boiler turbine package. This is a performance-based, turnkey specification asking bidders to improve the overall heat rate of the plant and produce additional megawatts. We are also allowing the turbine vendors to form an alliance with one of the boiler bidders and submit a combined package for both the turbine and the boiler upgrade. The boiler bidders are currently bidding on contract 56 for the boiler upgrade.

Two sets of this specification should be sent to the following bidders: Siemens Power Corporation, Attention: Mark Wenkus; ABB Inc, Attention: Bob Grasso; and Westinghouse Electric Corporation, Attention: Julie A. Giancarlo.

A bid evaluation sheet will be transmitted to you at a later date. The bids are due **December 11, 1995**. A pre- bid meeting is scheduled for November 28th 1995. The Project Engineer for the turbine modifications is Brian Fritz; Project Engineer for the Boiler Modifications is Janet Gulley. The Project manager for the overall project is Jaisen Mody.

Attachment

c: Tom Kingston, attachment
Dan Turley
Tom Meyers
Brian Fritz
Janet Gulley
RDC File

Rev.	Date	Initial
0	11/8/95	BEF

TECHNICAL SPECIFICATION

BN95-003SP01

TECHNICAL REQUIREMENTS AND SPECIFICATIONS FOR TURBINE CAPACITY INCREASE RETROFIT

BOARDMAN COAL PLANT

RDC BN 95-003

PORTLAND GENERAL ELECTRIC COMPANY
PORTLAND, OREGON

DATE 11/8/95
PREPARED BY [signature]
APPROVED BY [signature]

TECHNICAL SPECIFICATION FOR TURBINE CAPACITY INCREASE RETROFIT

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TECHNICAL SPECIFICATION FOR TURBINE CAPACITY INCREASE RETROFIT

1.0 SCOPE

1.1 The Contractor shall replace the , HP/IP and L.P. Turbine Steam Paths, Inlet Nozzle Blocks and other components that are required for the uprate of a tandem compound four-flow Westinghouse BB71 LP and BB44 HP/IP unit. The uprate shall give a maximum generator output of 626 MVA at .95 power factor (95 MW) with a maximum possible heat rate gain over the original guarantee of 7908 BTU/KWhr at 514527 KW. The replacement material is to incorporate whatever design features are necessary to provide the maximum in thermal performance consistent with the highest possible unit availability and reliability. The Contractor shall receive the unit on turning gear and it shall remain under its control until it is again on turning gear ready to return to commercial operation.

1.2 Replacement rotors to be of mono block (boreless) construction and design.

1.3 The replacement material is to be compatible and interface with the remaining Turbine Generator components.

1.4 The Contractor shall provide supervision and labor required for installation in the field in a manner which will meet the unit's planned outage schedule.

1.5 The Contractor shall supervise installation; unit start-up and vibration testing. Performance testing, per ASME PTC-6 standards, will be performed. However, materials for the test and its supervision will be covered under a separate contract.

1.6 The Contractor shall supply any special installation and handling tools required for the replacement material. While the special tools and fixtures will be made available to the Contractor during the installation they are to be returned to the PGE in usable condition after the installation.

1.7 The Contractor shall supply and install a complete set of hydraulic coupling bolts for the three main shaft couplings, SKF Supergrip or equal.

2.0 TURBINE/GENERATOR DESCRIPTION

2.1 Turbine
The existing turbine is of Westinghouse design, the HP/IP is a building block (BB) model 44 coupled to two Westinghouse BB71 model LP's with 25 inch last stage blades. This unit has a guaranteed nameplate rating of 514527 KW at .95 power factor, 2400 PSIg throttle pressure, 1000° F/1000° F steam inlet conditions, 2.0 inches Hg abs. exhaust pressure per original heat balance diagram.

2.2 Generator

The generator is a Westinghouse hydrogen intercooled unit, with a name plate rating of 590 MVA at a 0.95 power factor, hydrogen pressure at 60 PSIg.

3.0 TECHNICAL REQUIREMENTS

3.1 General Requirements

3.1.1 The equipment shall be designed to interface with existing equipment not replaced for all mechanical fits, instrumentation and mechanical connections. The rotors shall be supplied fully bladed and balanced. The cylinders are to be complete with all stationary blading properly sized both thermodynamically and mechanically to match the rotors supplied with each assembly. The blading is to be assembled in removable blade rings and these blade rings are to be complete with all bolts, studs, nuts, washers, locking devices, and hardware required to install, locate and fasten the halves together and in the outer shell. All of the internal steam seals are to be installed and machined to the proper clearances.

The new components will not impose any restrictions to the normal operation of the unit and shall be guaranteed to operate safely, reliably, continuously and without undue maintenance over the entire operating load range, 20% to VWO-5% OP. The design shall allow unit start-ups within the current operating time periods without any restraints. The new and modified parts shall not impose any restraints to current operating ramp rates. The design will consider steady-state operation, normal plant transients, including plant/unit trips , and peak output with the top two feedwater heaters out of service. The new equipment shall impose no restrictions on the number of unit startups or shutdowns, and the installed equipment shall have a life of at least 30 years.

3.1.2 The contractor shall provide resumes and current experience records of project engineer(s), project technicians, and other personal assigned to the project for PGE approval.

3.1.3 The contractor shall perform a system design analysis required to fully integrate the new equipment into the existing turbine/generator system. These design analysis shall include, but not be limited to, items such as:

a. The coupled critical speeds of the complete turbine/generator train.
b. Coupling alignments for new to new, and new to existing interfaces.
c. Rotor sag lines of the new equipment.
d. Complete modal analysis.
e. Compliance with the extraction pressure/temperature ratings for all extraction points to existing feedwater heaters, boiler feed pump and gland steam system.
f. Evaluation of the LP exhaust areas for adequate area to pass required steam flows.

equipment.

h. Thermal analysis of rotor, rotating and stationary blades, and installed unit.

3.1.4 The location of all extraction annuluses shall be of the same size and in the same physical position as the location of the exiting extraction points.

3.1.5 All new turbines couplings that will connect to existing couplings are to be bored to mate all mechanical interfaces of the existing couplings. Existing coupling spacers, and coupling components shall be used or new components shall be provided by the contractor. All new bearings shall be made to match all mechanical interfaces of the existing bearing pedestals and covers or new/modified bearing pedestals and covers shall be supplied. All new bearings will be supplied with a bearing lift system, all material required for bearing pedestals, covers and lift system will be supplied by the contractor. The location of all balance planes are to be maintained.

3.1.6 The finished rotor shall have a 1 minute overspeed test at ten percent (10%) above normal operating speed of 3600 RPM.

3.1.7 All design, materials, fabrication procedures and equipment will be in accordance with the latest requirements of the following codes, as applicable; ASME, ANSI, NFPA, NEC, NEMA, ASTM, AWS, the laws of the state of Oregon, all local ordinances, and the applicable requirements of the Federal and State "Occupational Safety and Health Standards". When required the proper stamps will be affixed to denote conformance to the appropriate codes. Codes and standards will be based on current issue at the time of the contract date to perform this project.

The current ASME steam tables, Thermodynamic and Transport Properties of Steam, and Mollier Chart shall be used in the design and test calculations. Where computer programs are used they will be in accordance with the "International Formulation Committee Formulations for Industrial Use" which is included in the ASME Steam Tables Appendix.

3.1.8 The new LP turbine equipment shall be designed and manufactured to match/interface with existing crossover components or new components shall be supplied.

3.1.9 Contractor will supply a LP turbine exhaust hood that is removable without requiring personnel entrance into the LP turbine to facilitate turbine shell, or exhaust hood removal.

3.2 <u>Manufacturing and Installation Schedule</u>

A manufacturing and installation schedule shall be developed which supports a six weeks outage in the spring of 1997. The schedule shall indicate the critical path and the installation portion should be on the basis of two ten hour shifts, six days a week with the seventh day as a fall back.

3.2.1 Status Reports

A brief monthly status report shall be provided during the manufacturing cycle consisting of a statused schedule and explanation of any delays and corrective actions to be taken.

A weekly status report should be provided during the installation phase which includes completion status, critical path analysis, problems encountered and their solution, potential problems and projected solutions.

3.3 Materials

The material to be used are as follows:

3.3.1 Rotor - ASTM A 470 class 6 or equal
3.3.2 Rotating Blades - ASTM A276 type 410H or equal
3.3.3 Stationary Blades - ASTM A276 type 410H or equal
3.3.4 Shaft seals - A151-1045 or equal
3.3.5 Journal bearing (if required) - Manufacturer's Standard

3.4 Rotor

3.4.1 The rotors shall be of a mono block (boreless) construction/design.

3.4.2 The contractor shall supply PGE with certified mill test reports for rotor material from the material manufacturer showing all physical and chemical results of material testing.

3.4.3 Contractor shall supply PGE with copies of all forging heat treatment records and procedures.

3.4.4 Contractor shall supply PGE with all NDE procedures, rejection criteria, and all final NDE reports associated with the rotor.

3.4.5 Contractor shall not initiate any modification, repairs, or machining changes to the rotor or rotor forging that may alter the design, or function of the rotor without PGE approval.

3.4.6 Contractor shall supply PGE with calculation results showing maximum stresses on wheel dovetail geometry. Contractor shall supply PGE with a report showing calculation method used to determine stresses, and describe, if applicable, finite element code used, mesh size and boundary conditions.

3.4.7 Contractor shall supply PGE with forging ladle analysis and tensile tests.

3.4.8 Contractor shall specify if shot peening or coatings are to be used in manufacture of the rotors, and if they are will supply PGE with shot peening and coating procedures and material specifications on coatings.

3.5 Rotating Blades

3.5.1 The contractor shall supply PGE with certified mill test reports from the material manufacturer showing all physical and chemical results of material testing. Mill test reports required for blade, shroud, tie wire, and cross pin materials should be cross referenced to an ASTM or AISI specification.

3.5.2 Contractor shall supply PGE with all NDE procedures, rejection criteria, and all final NDE reports associated with the rotating blades.

3.5.3 Contractor shall supply PGE with all shot peening procedures and certificates, coating procedures and coating material specifications, and vane and dovetail surface finish acceptance criteria.

3.5.4 Contractor shall provide blade assembly chart, blade moment-weight chart, and all QA/QC checks performed during assembly and their reports.

3.5.5 Contractor shall provide Campbell or interference diagrams for each row, and supply single, group, or assembled wheel stationary frequency test data. Contractor shall supply reports specifying margins from running speed harmonics for each tuned row.

3.5.6 Contractor shall supply reports specifying maximum steady state stress in tenon, root, airfoil, and lug/tie wire for each row or blade, and identify the calculation method used.

3.5.7 Contractor shall specify percent of spare blades to be supplied by row, and provide information on row/blade interchangeability with similar rotors in use within the electric utility industry.

3.5.8 The blades will have a minimum 32 RMS surface finish, the exhaust edge will be straight within 10 mils/inch with maximum 30 mils in 12 inches and 60 mils total, individual blade radial height and radial height variation between blades will be 5 mils/inch with 60 mil max deviation, blending radius to the sidewall at 1/32 inch +/- 1/64 inch. The total area to be +/-2% of vendor specified design, and individual area to be +/-2% of vendor specified design. All bores to be round within 5 mils.

3.5.9 The contractor shall supply the design and measured values of blade pitch, radial height, and throat at X, Y, & Z.

3.6 <u>Rotor Dynamic Requirements</u>

3.6.1 Contractor shall specify maximum acceptable vibration, at unit guarantee load point, in the vertical and horizontal directions at the shaft, bearings, couplings and collector rings, if operating balance is not met then the contractor shall balance the unit.

3.6.2 Contractor shall perform a spin pit balance with an absolute minimum vibration corrected for slow roll runout of 1 mil peak to peak at speed, 2 mils peak to peak during criticals during rollup/rolldown, and 2 mils peak to peak at overspeed. The test will have a 30 minute hold with no change in amplitude or phase at speed, the rollup/rolldown rates shall be the same with no more than 1 mil and +/- 10 degree change between them.

3.6.3 The turbines shall be designed and manufactured such that torsional frequencies are at least 2 hz from 120 hz forcing frequency, and so that no modes are at or near multiples of power frequency when connected to the existing transmission system. Contractor shall supply a torsional analysis confirming that there will be no torsional modes of concern. Contractor shall perform torsional tests after installation and will detune any modes found to be of concern.

3.6.4 The contractor shall correct all problems at speed, multiples of speed or subharmonic of speed.

3.7 <u>Stationary Blading</u>

3.7.1 The stationary blades will have a minimum 32 RMS surface finish, the exhaust edge will be straight within 10 mils/inch with maximum 30 mils in 12 inches and 60 mils total, individual blade radial height and radial height variation between blades will be 5 mils/inch with 60 mil max deviation, blending radius to the sidewall at 1/32 inch +/- 1/64 inch. The total area to be +/-2% of vendor specified design, and individual area to be +/-2% of vendor specified design. All bores to be round within 5 mils.

3.7.2 The contractor shall supply the design and measured values of blade pitch, radial height, and throat at X, Y, & Z.

3.8 <u>Calculations</u>

3.8.1 Calculations shall be provided to reflect a lateral and torsional stability analysis to verify that no vibrations above contractors limits exist.

3.8.2 Alignment criteria and procedures shall be provided for review and approval.

3.8.3 Campbell Diagrams, for rotating blades shall be provided for review and verification that no potential vibration problems exist.

3.8.4 Steady state stress calculations of the rotating and stationary blades, the code used, and mesh size if finite element used will be provided. Calculations to include effects of centrifugal and steam forces.

3.8.5 Dynamic stress calculations for rotating and stationary blades, and the codes used will be provided, and will include harmonic and random steam excitation loads.

3.8.6 Calculations to determine new cross over temperatures and pressures, with stress and thermodynamic analysis to determine that existing crossover components can withstand the new stresses, pressure and temperature conditions.

3.8.7 The contractor shall provide complete cycle heat balances and thermal performance data,including diagrams and tabulation form, for the following conditions:

1. Maximum Guaranteed Point
2. 100% Valves Wide Open (VWO), or Maximum Calculated
3. 100% VWO at 5% Over Pressure (OP)
4. 25% Maximum guaranteed Point
5. 4TH, 5TH, & 6TH Valve Point
6. Expansion Lines for Guarantee, VWO, 5% OP, and Valve Points
7. Pressure Flow Curves for First Stage, and all Extraction Points
8. Leakage and Enthalpy Curves for Steam Chest, HP/IP Shaft, HP Exhaust Bushing, IP Inlet Bushing, LP Shaft, Regulator Supply, & Gland Steam
9. Expansion Line Data Curves for First Stage Enthalpy, HP/IP/LP Turbine Expansion Line End Points.
10. Loss Curves for Generator and Exhaust
11. Correction Curves to Heat Rate and Load for Throttle Pressure, Throttle Temperature, Reheater Pressure Drop, Reheater Temperature, Superheater Attemperator Spray, Reheater Attemperator Spray, LP Turbine Exhaust.
12. Performance curves for HP Turbine Efficiency, and Heat Rate

Each heat balance shall indicate the generator loads, power factor, hydrogen pressure; and pressures, temperatures, enthalpies, and flow quantities of main steam, reheat steam, extraction steam, exhaust steam, sealing steam and leakoff steam. The temperatures, enthalpies, and flow quantities of feedwater and heater drains shall be indicated. Generator and mechanical or fixed losses shall be indicated. Boiler feed pump power shall be indicated. Bowl pressures for the HP, IP, and LP turbines and turbine stage pressures at extraction points shall be indicated.

*Note that existing feedwater heater design data sheets are in attachment 1 to this specification.

3.8.8 The contractor shall supply complete cycle heat balances and thermal performance data, including diagrams and tabulation form, for the following "Non-Standard Operating Conditions":

1. H.P. Heater No. 7 out of service
2. I.P. Heater No. 6 out of service and H.P. Heater No. 7 draining to condenser
3. I.P. Heater No. 5 out of service and I.P. Heater No. 6 draining to condenser
4. I.P. Heater No's 5 & 6 out of service and H.P. Heater No. 7 draining the condenser
5. L.P. Heater No. 3 out of service
6. L.P. Heater No. 2 out of service and L.P. Heater No. 3 draining to condenser
7. L.P. Heater No's 2 and 3 out of service
8. L.P. Heater No's 1A, 1B, 2, and 3 out of service
9. L.P. Heater No's 1A & 1B out of service and L.P. Heater 2 draining to condenser
10. L.P. Heater No's 1A, 1B, & 2 out of service and L.P. Heater No 3 draining to condenser
11. One Bank of L.P. Heater No 1 out of service, 75% of condensate flow through the remaining bank of Heater No. 1, 25% of condensate flow bypassed to L.P. Heater No. 2, 100% of condensate enters L.P. Heater No. 2 (Note that in regards to turbine load restrictions that each bank of L.P Heater No. 1 extracts from its own L.P. turbine extraction, line are not manifolded)

Each heat balance shall indicate the generator loads, power factor, hydrogen pressure; and pressures, temperatures, enthalpies, and flow quantities of main steam, reheat steam, extraction steam, exhaust steam, sealing steam and leakoff steam. The temperatures, enthalpies, and flow quantities of feedwater and heater drains shall be indicated. Generator and mechanical or fixed losses shall be indicated. Boiler feed pump power shall be indicated. Bowl pressures for the HP, IP, and LP turbines and turbine stage pressures at extraction points shall be indicated.

*Note that existing feedwater heater design data sheets are in attachment 1 to this specification.

3.9 <u>Drawings/Data</u>

All drawings and instructions are to be in English with U.S. units followed by metric units in parentheses. All drawings shall be submitted in electronic format utilizing Auto Cad or Integraph formats, if electronic format is not provided then format shall be of a reproducible media. Instructions manuals shall be bound in a ringed binder with section clearly marked and outlined, 7 copies of all instruction manuals are required.

The following drawings/data shall be provided to the PGE prior to equipment shipment:

(A) LP, HP/IP rotor assembly drawing.

(B) LP, HP/IP casing alteration drawings.

(C) LP, HP/IP outer casing alteration drawings.

(D) Assembly drawing showing installation/fit-up requirements.

(E) Rotor clearance drawing showing required seal clearance and stationary/rotating blade alignment.

(F) Rotor alignment chart showing rotor to rotor alignment requirements.

(G) Inlet Nozzle Block assembly drawing

(H) Component assembly drawings to reflect the as installed condition for future maintenance and inspection.

(I) Recommended spare parts lists including price information.

(J) Drawing showing rotating blade rim loads.

(K) Detail drawings of all wheel dovetails for blades in the creep region and downstream of the Wilson line.

(L) Detail drawings of bearings.

(M) Instruction books covering installation, maintenance and operations.

(O) Cycle heat balance and thermal performance data in diagram and tabular form for conditions in sections 3.8.8 & 3.8.9

3.10 Vibration

Vibration of the assembled unit shall be measured at the Vibration detector locations on the each shaft, at each coupling, and at each pedestal connection point. The contractor shall test the assembled unit with a limiting vibration of 3.0 mils peak to peak in the horizontal, vertical and axial directions, with the unit in a loaded condition at steady state.

3.11 Performance

The revised steam path configuration is provided to enhance performance of both heat rate and unit output. The Contractor shall provide, based on the new design, a heat rate improvement which will be guaranteed. A performance test of the refurbished unit will be performed with steam conditions, condenser pressure, and electrical conditions as close as practical to the stated guaranteed conditions from the contractors heat rate diagram guarantee point to verify that the guarantee point has been achieved. All corrections for calculations the performance will be in accordance with the ASME PTC-6 procedures.

3.12 Design Data

The following parameters are those which define the basis for the revised design:

3.12.1 HP/IP Rotor Shaft

• Type of construction	Mono Block
• Material of construction, ASTM	________
• Yield strength minimum, psi	________

3.12.2 Low Pressure Rotor Shaft

• Type of construction	Mono Block
• Material of construction, ASTM	________
• Yield strength minimum, psi	________

Note: Rotor bore holes are not acceptable. Welding of blades to wheel disc or rotor drum will not be acceptable at any stage. Metal spray of journal surfaces is not acceptable.

3.12.3 HP/IP Rotor Assembly

• 1st critical speed, RPM	________
• Coupled critical speed, RPM	________
• Maximum expected shaft Vibration, mils D. amplitude	________
• Rotor weight, estimated lbs.	________

3.12.4 Low Pressure Rotor Assembly

• 1st critical speed, RPM	________
• Coupled critical speed, RPM	________
• Maximum expected shaft Vibration, mils D. amplitude	________
• Rotor weight, estimated lbs.	________

Note:
1. Bidder is to provide a description of balance weight/groove accessibility.
2. Torsional resonant frequencies corresponding to twice line frequency (120 HZ) are to be avoided.

3.12.5 HP Rotating Blading

- Number of rows, per end ______
- Material, ASTM ______
- Yield strength, psi ______
- Tensile strength, psi ______

  FATT deg F ______

3.12.6 IP Rotating Blading

- Number of rows, per end ______
- Material, ASTM ______
- Yield strength, psi ______
- Tensile strength, psi ______

  FATT deg F ______

3.12.7 LP Rotating Blading

- Number of rows, per end ______
- Material, ASTM ______
- Yield strength, psi ______
- Tensile strength, psi ______

  FATT deg F ______

Last Stage Blade

- Tip speed, ft/sec ______
- Effective blade length, in. ______
- Blade tip diameter, in. ______
- Pitch diameter, in. ______
- Blade root stress, psi ______
- Erosion protection, feature ______

  ______

- Actual steam loading, lb/hr/sq ft. ______

  ______

  (VWO, 2.0" HgA, 0% Mu) ______
  (105%, 2.0" HgA, 0% Mu) ______

3.12.8 HP Stationary Blading

- Material of blade, ASTM ______
- Material of blade carrier, ASTM ______

3.12.9 IP Stationary Blading

- Material of blade, ASTM ______

- Material of blade carrier, ASTM ______________

3.12.10 LP Stationary Blading

- Material of blade, ASTM ______________
- Material of blade carrier, ASTM ______________

3.12.11 HP/IP Shaft Sealing

- Material of shaft packing, ASTM ______________
- Type of shaft packing ______________
- Spring backed arrangement ______________
- New packing clearance, mils ______________
- Worn packing clearance, mils ______________

3.12.12 LP Shaft Sealing

- Material of shaft packing, ASTM ______________
- Type of shaft packing ______________
- Spring backed arrangement ______________
- New packing clearance, mils ______________
- Worn packing clearance, mils ______________

3.12.13 HP/IP Radial Seals

- Number of stages with seals ______________
- Material of seals, ASTM ______________
- Seal arrangement ______________
- Spring backed arrangement ______________
- New seal clearance, mils ______________
- Worn seal clearance, mils ______________

3.12.14 LP Radial Seals

- Number of stages with seals ______________
- Material of seals, ASTM ______________
- Seal arrangement ______________
- Spring backed arrangement ______________
- New seal clearance, mils ______________
- Worn seal clearance, mils ______________

3.12.15 Journal Bearings

- New or existing bearings ______________

- Bearing loadings ______________
- Bearing damping and spring coefficients ______________

3.12.16 Thrust Bearings

- New or existing bearings ______________
- Bearing loadings ______________
- Bearing damping and spring coefficients ______________

3.12.17 Backpressure

	High	Low
• Allowable for continuous operation, HgA		
• Maximum load point	______________	
• Guaranteed load point	______________	
• Control Point	______________	
• No load	______________	
• Maximum for abnormal operation, HgA		
• Maximum load point	______________	
• Guaranteed load point	______________	
• No load	______________	
• Recommended settings, HgA		
• Alarm	______________	
• Trip	______________	
• Recommended settings, deg F		
• Alarm	______________	
• Trip	______________	

3.12.18 Special Tools

Are special tools required for assembly and disassembly? ______________

If yes, what is provided? ______________

* To be provided later by selected Contractor

3.12.19 Coatings

Components to be coated ______________
____
____
____

Types of coatings ______________
____
____
____

3.13 Preparation for Shipment

3.13.1 Cleaning

The equipment shall be cleaned in accordance with the Contractor's standard practice consistent with the specified intended service.

The interior of all equipment shall be free from all foreign material such as welding rod, waste, loose mil scale, oil, grease, or other deleterious material. All openings shall be closed immediately after cleaning. Any entrapped water shall be removed.

Machined surfaces shall be coated with a short term light oil preservative, such as Gulf Oil coat Vt, and the Contractor is to provide removal/cleaning procedures.

3.13.2 Packaging

All equipment and materials shall be suitably crated, boxed, or otherwise prepared for shipment to prevent contamination, mechanical damage or deterioration during handling and shipping. Each box or crate shall contain a detailed packing list. All openings shall be properly protected to prevent the entrance of dirt or debris. All parts which, of necessity due to physical size or arrangement, may be exposed to the weather shall be adequately protected by suitable weatherproofing. It shall be the responsibility of the Contractor to take any other precautions required to reasonably ensure job site arrival of the equipment in an undamaged and ready for installation condition.

The Boardman plant is located in north central Oregon near Boardman Oregon, approximately 150 east of Portland off of I-84 exit 159 on Tower Road and 15 miles south of the I-84 exit.
From Portland take I-84 east to exit 159 and south on Tower road to plant, from Pasco Washington take 395 south to I-84, I-84 West to exit 159 Tower road and south to the plant.

Truck deliveries shall be via tower road through the plant main gate. Rail deliveries will be via the plant spur off Union Pacific railroad main, this spur is currently used for coal deliveries and any use by the contractor must be coordinated with Union Pacific and the plant, with the plant receiving notification seven (7) days prior to delivery. Contractor is responsible to obtain all State, Local and Federal permits required for transportation on roads, highways and railroads.

3.13.3 Identification

All containers shall be identified with PGE's purchase order number.

The address for delivery of material at the Boardman plant is:

"Contractor Name"
Attention Turbine/Boiler Uprate Project
Boardman Plant
Carty Reservoir Power Site
Boardman OR 97818

The billing address for the Boardman plant is:

Portland General Electric
121 SW Salmon St.
Portland OR 97204

When several components are shipped in one container, a list itemizing the contents shall be attached to the outside of the container.

Weights of all pieces over 5 tons should be marked on the piece so that weights are plainly visible to ensure use of proper site hoisting equipment.

The Contractor shall establish a coding system for marking each crate or package to indicate the type of on site storage protection required.

Where special shipments are to be made, e.g., items that exceed weight limitation for railroads or highways or require special handling, a detailed procedure shall be sent to PGE for approval.

The weight, lifting points, or center of gravity indicated on the crate, skid, or package shall be utilized for all handling procedures.

Written instructions covering the location and stacking limits of the crates or boxes on the transport vehicle shall be specified. These should be marked on the container.

3.13.4 Provision for Storage

It is expected that the equipment covered by this specification could be stored at the job site for several months in an unheated building.

Any special storage requirements shall be forwarded to the job site with each shipment to which they are applicable.

3.14 Deviations and Nonconformances

No deviation or nonconformance from this specification or drawings, applicable federal, state, and local codes and standards invoked by this specification, or Contractor drawings and documents approved by PGE shall be accepted until approved by PGE. Deviations are departures from any requirements of these documents. Uncorrectable nonconformances are conditions which cannot be corrected within the requirements of these documents by rework or replacement.

The Contractor shall promptly document and notify PGE of all deviations and nonconformances. Further engineering and fabrication after detection of any deviation or nonconformance prior to PGE's approval shall be at the Contractor's risk. No deviation or nonconformance from the specification has been issued by PGE. No deviation or nonconformance from PGE's drawings and Contractor's drawings and documents approved by PGE shall be binding on any party until reviewed and approved in writing by PGE.

3.15 Other Work by PGE

Other plant work by PGE that does not relate the this contract, but will be underway during the same time period:

1. Conversion of one (1) coal mill.
2. Replacement of existing analog controls with DCS system.
3. Boiler uprate project.

4.0 QUALITY ASSURANCE REQUIREMENTS

4.1 Quality Assurance Program Requirements

The Contractor shall have in effect at all times a QA Program which clearly establishes the authority and responsibility of those responsible for the QA Program. Details and description of the Contractor's QA Program will be made available for review by PGE, if requested. No submittal of this QA program is required.

4.2 Contractor's Responsibilities for Subsuppliers

The Contractor shall identify, in purchase documents to this subsuppliers, all applicable quality and QA requirements imposed by the specification on the Contractor and shall ensure compliance thereto.

4.3 Witness Points

PGE shall have the right to establish witness points for which the Contractor shall give prior notification of at least five working days in advanced of the scheduled time of performance with confirmation within 24 hours of the date. The activity may proceed as scheduled if PGE's Quality Control Representative (PQCR) is not present at the appointed time. PGE may require that activities performed without proper notification be repeated for the observation of the PQCR at the Contractor's expense.

4.4 PGE's/Contractor's Quality Assurance Interface

The Contractor is subject to witnessing of tests and inspections by the PQCR to ensure compliance with the requirements of the specification, codes, and drawings. The PQCR's exercise of, or failure to exercise, their right to inspect or witness, and any subsequent approval by the PQCR, shall not relieve the Contractor of their obligation to comply with the ms/conditions of the purchase order. Any request for approval of deviations or nonconformances to the purchase order/contract documents shall be processed in accordance with Section 3.14 of this specification.

4.5 Submittal of Manufacturing and Inspection Plan

After award of purchase order/contract, the Contractor shall submit copies of its manufacturing and inspection plan to PGE for their information and use in developing witness points.

4.6 Examinations and Tests

4.6.1 Shop Tests

The Contractor's test listed below shall be witnessed by the PQCR.

4.6.2 Turbine Rotor

Rotor Final Balance and Overspeed Test

4.6.3 Field Tests

The Contractor shall be completely responsible for organizing and conducting all required tests of its equipment, except that PGE will furnish personnel for observing and recording data and PGE will operate the equipment.

The tests to be performed in the field are as follows:

4.6.3.1 Performance test at 100 percent output with 2" Hga backpressure to verify improved heat rate as well as unit increased generating capacity.

4.6.3.2 Vibration testing to assure that the total assembled unit does not exceed 3.0 mils peak to peak, loaded condition , steady state.

5.0 FACILITIES

PGE shall provide for the Contractor's use:

5.1 All tools, equipment and devices previously provided by the existing turbine OEM necessary to perform the dismantle of the existing turbine train. In addition, the Contractor is to be provided sufficient space for component laydown and component cleaning.

5.2 As required, operating personnel, compressed air at 100 PSIg, steam, electric power (3 phase 480 volt), oil, supplies, tools, and materials for starting, operating, and testing the equipment. It will be the contractors responsibility to distribute the supply sources to assure adequate requirements at the equipment.

5.3 Limited washroom and toilet facilities.

5.4 Gate access and egress, and parking space.

5.5 Certified station crane, suitable for 75 ton lift, without a qualified operator.

5.6 Existing personnel elevator.

The contractor shall supply for their own use:

5.7 A suitable site office facility with adequate room to use and store all drawings, installation instructions, and other documentation required to perform this work.

5.8 A suitable storage facility for all tools and small parts required to complete this job.

5.9 All specialty tools and instrumentation required to install and disassemble the new equipment, and rotor stands, these items to remain with PGE upon completion of the job.

5.10 Additional washroom and toilet facilities.

5.11 Phones and phone billings.

6.0 PGE RESPONSIBILITIES

6.1 Single Point Contact

PGE shall designate a project manager to be the interface contact during the installation period. This contact will have full access to the work activities, design data, and the decision making process.

6.2 Spare Parts

PGE shall be responsible for maintaining an inventory of spare parts for the equipment that is outside the replacement scope of supply, i.e., end seals, oil deflectors, journal bearings, etc.

7.0 INSTALLATION

7.1 Scope

This section describes the project management, installation, and support services required of the contractor to install equipment per this specification.

The contractor shall provide a management package for the following activities:

a. Preoutage planning.
b. Existing equipment disassembly.
c. New equipment installation.
d. As required modification of existing equipment not to be replaced.
e. Testing of completed unit.
f. Balancing.

7.2 Deliverables

The contractor shall provide PGE with the following by the specified date, if no date is specified then delivery shall be prior to the start of installation work. All scheduling and spare parts information shall become property of PGE.

7.2.1 A recommended spare parts list for the equipment supplied under this specification. The minimum following information is required on the spare parts list:

a. Vendor part number.
b. Part description.
c. Quantity required.
d. Price.
e. Delivery lead time.
f. Original Mfg and MF part number (if applicable).

Date this information is required: Within three months after bid award.

7.2.2 A design, engineering, material procurement, equipment manufacture, and equipment delivery schedules. These schedules should be computer based, updated throughout the project and should include the following items:

a. A critical path project schedule (Ganntt).
b. Work breakdown structure
c. Detailed manpower requirements.
d. Specialty resource requirements.
e. Contractor requirements.
f. Test schedule.

Date this information is required: Within three weeks after bid award.

7.2.3 An installation schedule that supports a six weeks outage starting on 4/27/97. The schedule shall indicate the critical path and the installation portion should be on the basis of two ten hour shifts, six days a week with the seventh day as a fall back. This schedule should be computer based and updated throughout the project, and should include the following items:

a. A critical path project schedule (Ganntt).

b. Work breakdown structure
c. Detailed manpower requirements.
d. Specialty resource requirements.
e. Contractor requirements.
f. Unit specific work packages, not to include outage management packages.
Date this information is required: Within two months after bid award.

7.2.4 A list of all machining and/or modifications to existing equipment required to install the new equipment. A list of all materials and tooling required and supplied by the contractor to perform the work per this specification.

7.2.5 A brief monthly status report shall be provided during the manufacturing cycle consisting of a statused schedule and explanation of any delays and corrective actions to be taken.

A weekly status report should be provided during the installation phase which includes completion status, critical path analysis, problems encountered and their solution, potential problems and projected solutions.

7.3 Work Scope

The Contractor shall be solely responsible for the installation into the existing unit of the replacement material. Contractor shall be responsible for providing the supervision and labor required to effect the installation at the Boardman Unit for Portland General Electric Company. Contractor shall be responsible for moving tools, equipment, etc, from storage to the work area. If at any time during the performance of work, a condition is found on a portion of the existing unit that may require either rework or replacement, then immediate notification must be made to PGE's representative and resolution agreed to before proceeding to a point whereby the replacement or repair could not be achieved. The contractor is responsible for performing all required pre-outage training of vendor personnel, contract/sub-contract personnel and PGE personnel to complete the project. The turbine-generator is to be turned over to Portland General Electric in a condition that can be released for continuous operation with no load reduction requirements or other operating constraints. The following provides a minimum scope of work needed to complete this project:

7.3.1 Pre-outage planning with PGE involvement shall be completed and include the following as a minimum;
a. Schedule.
b. Manpower requirements.
c. Develop QA/QC program.
d. Project work packages with tooling lists, reading sheets, task summary, and checklists ensuring completion of tasks.
e. Preoutage planning readiness reviews with PGE.
f. An outage organization chart.
g. Tooling lists and work packages for specialty items.
h. Parts/Materials lists.

i. Contingency plans.
j. Pre-outage training requirements.

7.3.2 Disassembly of the HP/IP and LP rotors as required to complete the project, to include but not limited to the following:
a. Removal of dog house and outer casings.
b.. Separation of steam leads, and extraction piping.
c. Removal of valves, and crossover piping.
d. Removal of top half internal covers, rotors, and bottom half internal covers.
e. Removal of bearings and pedestals.
f. Removal of instrumentation.

7.3.4 Inspection of components to be reused and modification of such components as required.

7.3.5 Reassembly of the turbine/generator train as required to complete the project, to include but not be limited to the following:
a. Install bearings and pedestals.
b. Reconnect extraction piping, steam leads, valves, and cross overs.
c. Install lower and upper half internals and align.
d. Install and align rotors, couple and align to existing couplings/rotors.
e. Align steam seal glands.
f. Install and align outer cylinder covers and dog house.
g. Install instrumentation.
h. Replace removed insulation and lagging.
i. The contractor shall be responsible for any touchup painting of the unit.

7.3.6 The contractor is responsible for completion and supply of the required equipment to perform a flush of the turbine/generator lube oil system. The system will be deemed acceptable when accepted by the contractor and/or when each sample point meets the acceptable flush criteria. PGE will supply craft labor to work under contractors technical direction to complete the flushing operation. The flushing skid and piping for connection to the lube oil reservoir exist on-site and are available for use.

7.3.7 The contractor will provide a vibration/balancing engineer/technician as required to perform the operating load balance and vibration data collection tasks. Following the completion of balancing a completion report will be submitted detailing the data collected, amounts and location of weights installed, and the effect data of all balance moves.

7.4 Work Practices

The Contractor shall impose on the work force whatever procedures PGE requires for on-site work such as safety, fire prevention, waste disposal etc. The contractor is responsible for the handling and disposal of all hazardous waste they generate and will ensure that its work force is trained to procedures required for the removal and disposal of such waste.

The contractor will keep the areas occupied by them to complete this project in a clean and safe condition. Upon completion of work the contractor will remove all of its equipment, temporary structures, and materials. Before final payment is made to the contractor, at its expense, dispose of all temporary structures, materials, rubbish, and other items belonging to the contractor or used by them in the completion of this project. The contractor will leave the premises in a clean and safe condition and at a minimum in the same condition found before the start of work.

7.5 Consumables

The Contractor is responsible for providing any consumables required during the unit rebuild.

7.6 Technical Director

The Contractor's technical director for the installation shall be familiar with the Westinghouse Electric Corp. Assembly and Startup procedures for the BB44 & BB71 unit. If these qualifications are not available, then the Contractor is to secure the services of a Westinghouse representative to provide advice and comment on the Westinhouse procedures. The concern is to assure that the transition to a replacement turbine rotating element is as smooth as possible with a minimal impact on the presently utilized startup procedures.

The Contractor is to provide a final installation report for PGE review/approval. This report is to include, but is not limited to: documented design clearances/tolerances/fitups along with "As-Built" dimensions etc. Recommendations for future repairs based on observations of the untouched portion of the machine, recommendations for spare parts. Photographs of critical lifting/handling arrangements. Photographs of damaged areas and their repairs.

The Contractor shall make available to PGE, a representative to report at outage planning meetings if required.

7.7 Support and Labor Resources

The contractor will be responsible for all management, supervision, planning and scheduling, implementation of the work, specialty technicians/engineers, craft labor, and the management/supervision of all technical,support and craft personnel. Contractor shall employ people that are represented by labor collective bargaining organizations which have a maintenance or project labor agreement that is effective during the entire duration of this project. The labor agreement must specifically apply to this project and all represented labor organizations, the contractor, and its subcontractors must be signatory to this agreement. The agreement must provide PGE with protection by disallowing strikes, walkouts, work stoppages, slowdowns, jurisdictional, or other actions that would impede progress of the project.

7.8 Overhead Crane

The existing over head crane is rated to seventy five (75) ton lifting capacity, PGE will complete an inspection of the crane to insure its operability and safety prior to the start of any work related to this project. If the contractor has any equipment that may weigh more than the rated capacity of the existing crane, then it is the sole responsibility of the contractor to make modifications as required to uprate the cranes capacity. PGE reserves the right to accept/reject any modifications proposed by the contractor.

7.9 Division of Responsibilities

All items not specifically identified will be mutually agreed upon between PGE and contractor. See note 1 for limitations of items that are PGEs responsibility.

7.9.1 PGE

Equipment lay down space
Existing Specialty Tools
Water, Compressed air
Necessary oxygen, acetylene, hydrogen, carbon dioxide, argon, and lubricants
Lay Down Space
Renewal Parts
Cables, Slings, and Lifting Devices, for removal of existing equipment
Bolt Heaters and Wrenches, for removal of existing rotors
Electrical power, electrical connection/disconnections & labor
Overhead Crane, pre inspection of overhead crane
Toilet facilities (SEE NOTE 4)
Scaffolding
Cribbing, rotor stands, pallets, etc.. for disassembled existing turbine parts.
Cribbing, pallets for new equipment
Turbine deck fire protection equipment
Non-special slings, cables, or lifting devices
On site first aid and ambulance service (SEE NOTE 3)

7.9.2 Contractor

Project management
Preplanning and Scheduling
Technical, Supervision, Administration Labor, and Craft Labor
Develop Project Work Packages
Safety and House Keeping
Office and Storage Space
Office Equipment
Field Reports
Machine shop (SEE NOTE 2)
New Specialty Tools
General Tools
Crane operator
Contractor office & storage fire protection equipment

Rotor stands for new equipment
Balancing and shaft alignment equipment
All Non Destructive Examinations, and associated material
Computer equipment
Tool set transportation
Expendable materials
Telephone service and expenses
Tool set refurbishment for contractor supplied tools
Special slings, cables, or other lifting devices required to install new equipment.
Toilet facilities

Notes:

1) PGE will supply items as listed under their responsibility to the extent that these items are readily available on-site and at existing volumes/quantities. It is the contractors responsibility to review PGE resources and purchase or otherwise supply additional items as needed to supplement PGE resources.
2) PGE has a maintenance machine shop available with limited capabilities. With prior arrangement this shop may be used for machining operations defined in the workscopes that are within the capabilities of PGE shop.
3) PGE has emergency medical technicians and ambulance on-site. In the event additional treatment is required the contractor will be required to use off site medical personnel/facilities.
4) There are limited toilet facilities on-site, it will be the contractors responsibility to supply additional facilities as required to support the work crews.

8.0 BID FORM

8.1 Bid Explanations

A. Base Bid:
The Base bid will be for the replacement of the existing High Pressure/Intermediate Pressure (HP/IP) Turbine and the two (2) Low Pressure (LP) turbine Steam path as required to achieve the maximum Heat Rate and turbine efficiency possible at a maximum of 626 MVA at a 0.95 power factor (595 MW) out of the existing generator.

B. Alternate Bid:
If the bidders so choose they may form a strategic alliance with one or more boiler manufacturer to perform the Turbine and Boiler uprate. The boiler manufacturers acceptable to PGE and available to form this alliance are, Foster Wheeler (FW), Asea Brown Boveri (ABB) Combustion Engineering (CE) Services Group, Babcock and Wilcox (B & W), and DB Riley. The Turbine manufacturer will have sole responsibility for all warranty, guarantee, and liquidated damages associated with this project for the turbine in a "Wrap

Around Warranty" for all work performed. The boiler work shall be performed per the conditions in the existing boiler specification titled "Boiler Performance Improvement Project" numbered Contract 56, the above listed boiler manufactures currently have of this specification. The liquidated damages as listed in this specification take precedence over those stated in the boiler specification for, schedules, heat rate and power output. The liquidated damages for the performance guarantees as listed in the boiler bid document Contract #56 Part V shall remain in place. The turbine manufacturer is responsible for overall project management and schedule, it will be the responsibility of the turbine manufacturer to work with the boiler manufacturer to optimize boiler/turbine heat rate and cycle efficiency.

8.2 Base Bid:

The undersigned hereby proposes and agrees to perform the Work specified as the Base Bid in these Contract Documents for a firm price of

________________________________ dollars ($________).

8.3 Alternate Bid Prices

The Performance Requirements of these Bid Documents require specific performance improvements in the turbine, and boiler efficiency. The alternate Bid is proposed to allow the Bidder to for an alliance with a Boiler manufacturer to maximize the efficiency gains of the total project Turbine and Boiler.

The undersigned hereby proposes and agrees to perform the Work specified as the Alternate Bid in these Contract Documents for a firm price of

________________________________ dollars ($________).

8.4 Base Bid Price Breakdown Schedule

Bids will be considered on the following Bid Price Breakdown Schedule, and no Bid will be considered for only a part of the schedule. Payment will be made on the basis of contractors estimate.

The contractor shall indicate the amount included in the Base Bid for each of the following items.

	Base Bid
A. Bonds and insurance	________
B. Mobilization	________
C. Construction facilities	________
D. Engineering	________
1. Unit assessment	________
2. Conceptual design	________

3. Special reports	______
4. Procurement documents	______
5. Manufacturing/Installation Drawings	______
6. Commodity specifications	______
7. Control logic (if required)	______
8. Equipment instruction books	______
9. Spare parts information	______
10. Submittal finalization	______
11. As-Built information	______
12. Close-Out information	______
E. Project Management	______
F. Material Receiving	
1. Material receipt	______
2. Material storage	______
G. Turbine Disassembly	
1. LP Turbine	______
2. LP Turbine	______
3. HP/IP Turbine	______
H. Installation of New Equipment	
1. LP Turbine	______
2. LP Turbine	______
3. HP/IP Turbine	______
4. Other-specify	______
I. Modification of Existing Equipment	______
J. Instrumentation	______
K. Access modifications	______
N. Testing	______
O. Demobilization	______
P. Cleanup	______
Q. Performance Testing	______
R. Manufacturers Service Representative	______
Total Bid	$______

Detail to be provided by Bidder. This cost breakdown shall provide the outline for development of the Estimate - Construction Contract which will be the cost breakdown for payment purposes.

8.5 Alternate Bid Price Breakdown

Bids will be considered on the following Bid Price Breakdown Schedule, and no Bid will be considered for only a part of the schedule. Payment will be made on the basis of contractors estimate. The contractor shall indicate the amount included in the Alternate Bid for each of the following items.

			Alternate Bid
A.	Bonds and insurance		_______
B.	Mobilization		_______
C.	Construction facilities		_______
D.	Engineering		_______
	1.	Unit assessment	_______
	2.	Conceptual design	_______
	3.	Special reports	_______
	4.	Procurement documents	_______
	5.	Construction drawings	_______
	6.	Commodity specifications	_______
	7.	Electrical design documents	_______
	8.	Control logic (if required)	_______
	9.	Equipment instruction books	_______
	10.	Spare parts information	_______
	11.	Submittal finalization	_______
	12.	As-Built information	_______
	13.	Close-Out information	_______
E.	Project Management		_______
F.	Boiler Scaffolding		_______
G.	Material Receiving		_______
	1.	Material receipt	_______
	2.	Material storage	_______
H.	Cleanup		_______
I.	Demolition		_______
J.	Disassembly		
	1. HP/IP Turbine		_______
	2. LP Turbine		_______
	3. LP Turbine		_______
K.	Structural and miscellaneous steel		_______
L.	Boiler insulation and lagging		_______
M.	Installation		
	1. HP/IP Turbine		_______
	2. LP Turbine		_______
	3. LP Turbine		_______
	4. Other-specify		_______

N.	Modification of Existing Equipment	_______
O.	Boiler modifications (Detail to be provided by Bidder. This cost breakdown shall provide the outline for development of the Estimate-Construction Contract which will be the cost breakdown for payment purposes.)	_______
	1. _________________	_______
	2. _________________	_______
	3. _________________	_______
	4. _________________	_______
	5. _________________	_______
	6. _________________	_______
	7. _________________	_______
	8. _________________	_______
	9. _________________	_______
	10. _________________	_______
P.	Electrical equipment installation	_______
Q.	Wiring, grounding, lighting	_______
R.	Instrumentation	_______
S.	Access modifications	_______
T.	Control modifications	_______
U.	Miscellaneous piping	_______
V.	Testing	_______
W.	Demobilization	_______
X.	Performance Testing	_______
Y.	Manufacturers Service Rep.	_______

8.6 <u>Schedule of Work</u>

A. Does Bidder agree to perform the Work on the Base Bid in accordance with the schedule set forth in this specification?
(Answer Yes or No) [__________]

B. If answer is "No" on Paragraph 8.6 A., on what page of the proposal has Bidder presented an alternate schedule of work? [__________]

8.7 Completeness of Pricing

A. Is the proposal complete with regard to all costs considered part of the Work covered by the Bid Documents?
(Answer Yes or No) [________]

B. If answer is "No", please detail costs and explain:
____
____
____

C. Does Bidder foresee any work or services not covered by Bid Documents but applicable to theintended work or services?
(Answer Yes or No) [________]

D. If answer is "Yes", please explain:
____
____
____

E. The Bidder should identify the additional monitoring and control requirements that it is proposing which will impact the existing control and/or monitoring equipment. The additional requirements are located on pages ______ of SECTION _____ of this proposal.

8.8 Addenda

Bidder represents that this proposal includes provision for the following Addenda (Bidder shall insert Addenda number and dates. If none included, so state).

8.9 Conformity with Bid Documents

A. Bidder shall be advised that the number and scope of exceptions attached to the bid will be considered in the evaluation. Any exception to the Bid Documents may be reason to exclude the proposal from consideration at the discretion of the Owner.

B. Bidder may submit an explanation of its acceptance of, or exception to, the Bid Documents.

C. Bidder must submit a proposal in total compliance with the Bid Documents. Bidder may offer any alternate bids or options to the base bid.

D. Does Bidder accept the Contract Documents as is with no exceptions?
(Answer Yes or No) [________]

E. If No, Bidder hereby certifies that Bidder agrees to specifically and clearly list all exceptions in the proposal and identify them as Exceptions. Any exceptions which Bidder has taken are listed on the Clarification List on Proposal Page.
[__]

F. Bidder shall be advised that the specifications contained in these Bid Documents are minimum acceptable specifications and that the Bidder is responsible to design, engineer, furnish and erect the equipment and systems as required to meet the Performance Requirements of the Contract using these specifications as a minimum. If a higher level of quality is required by the Bidder's design, the Bidder shall furnish that higher level of quality. In addition, items which are not covered by these specifications shall be designed and engineered using "good utility engineering practice," and the results of the engineering and design work shall be presented to the Owner for their review. Has the Bidder prepared its proposal based on these requirements?
(Answer Yes or No) [________]

8.10 Base Bid Performance Test Guarantees

1. Turbine Heat Rate (BTU/KWhr) at Guarantee Point: ___________

2. Turbine/Generator Power output (Megawatt) at Guarantee Point: ___________

8.11 Alternate Bid Performance Test Guarantees

1. Turbine Heat rate (BTU/KWhr) at Guarantee Point: ___________

2. Turbine/Generator Power output (Megawatt) at Guarantee Point: ___________

3. Total Plant heat rate (BTU/KWhr) at Guarantee Point: ___________
(Total plant heat rate is a predicted value)

Contractor shall list additional Performance test guarantees and predicted performance for the Boiler shall be listed in Boiler bid specification Contract 56, Part II - BID FORM performance information sheets in section 2.09 & 2.10 titled "Base Bid Performance".

8.12 Turbine Project Schedule
(For boiler project schedule see Contract 56)

The Bidder must propose to perform the work in accordance with a Project Schedule which the Bidder has prepared. Notification to proceed is expected to occur by January 30, 1996. As a minimum, the Bidder's Project Schedule must address all items shown on the Bidder's proposed Work Plan and the contract price breakdown schedule. In addition, the below activities and dates shall be listed and adhered to:

Activity/Milestone	Latest Date
Pre-bid Meeting (optional)	11/28/95
Bid Due	12/11/95
Contract Award	Issue Notice to Proceed
Submittal of standard binder (to be used for manufacturer's information provided by Contractor)	15 days after notice of award
Submittal of detailed schedule	15 days after notice of award
Certificate of insurance and performance bond submitted	20 days after notice of award
Submittal of Quality Control Program	30 days after notice of award
Preliminary Submittal	30 days after Notice to Proceed
Submittal of Safety, Health and Accident Prevention Program	30 days after Notice to Proceed
Initial Design and Engineering	40 days after Notice to Proceed
Condition Assessment Report	60 days after Notice to Proceed
Design and engineering presentation	90 days after Notice to Proceed
Permit Submittal	90 days after Notice to Proceed
I/O List for Owner's Controls	120 days after Notice to Proceed
Site Mobilization	2/24/97
Material Delivery Commences	3/17/97
Plant Outage Begins	4/21/97

Turbine On Turning Gear	4/25/97
Turbine Installation Complete	5/30/97
Cleanup and Demobilization Complete	6/16/97
Performance Test	Per specification requirements.

NOTE: The information requested in sections 8.13 through 8.16 are for the base bid and the turbine portion of the Alternate Bid only, the requirements for the Boiler are listed in Articles 4 through 7 of Part II - Bid Form in Contract 56, the requirements of Contract 56 shall apply for the Boiler portion of this project.

8.13 List of Proposed Subcontractors and Suppliers

If awarded the Contract, the Bidder proposes to employ the following Subcontractors who will perform work or labor or render service to the Bidder as well as the Suppliers who will furnish major components, materials, equipment, testing laboratories for hazardous waste, the Solid Waste Disposal sites (RCRA Subtitle D), and the Hazardous Waste Disposal Facilities (RCRA Subtitle C). The Bidder shall state below the name(s) and address(es) of all proposed Subcontractor(s) and Supplier(s). If no subcontract work or purchases are proposed, the Bidder shall so state.

Description of Work Items To Be Subcontracted and Major Item Purchases:

8.14 Equipment Requirements

8.14.1 Plant equipment

The Bidder proposes to utilize the following plant and on-site equipment (including equipment of Subcontractors).

TYPE	QUANTITY

8.14.2 Permanent Equipment Furnished

The Bidder proposes to furnish the following major equipment items as part of its work

TYPE	QUANTITY

8.15 Required Bid Information

8.15.1 General

A. Bidder shall submit with its bid all information requested in these Contract Documents. Any Bidder who omits any of the requested information does so at its own risk, as any omissions may cause the bid to be considered nonresponsive to the specifications.

B. The information requested in this section will be used to evaluate bids and to award the contract. Any additional information the Bidder desires to be evaluated shall be attached to this Section.

C. The Bidder shall also list any exceptions to this specification. Failure to take exception will be considered acceptance.

8.15.2 Work Plan

As part of this bid proposal, the Bidder shall submit an overall Work Plan. Subsequently, within five days after award, the Contractor shall formally submit for the Owner review and concurrence the Work Plan with any modifications or details developed after the proposal submittal. The elements of the Work Plan shall be identifiable in the construction schedule.

The overall design, engineering, procurement and construction Work Plan must, as a minimum, delineate sequencing steps, planned procurement , proposed methods of construction , proposed work week, methods of environmental protection, and methods to be utilized for:

A. Condition Assessment - Verify Existing Conditions.

B. Conceptual Design Finalization.

C. Detailed Construction Drawings.

D. Procurement Specifications.

E. Fabrication of Equipment.

F. Mobilization - Unloading and Receipt of Material.

G. Disassembly.

H. Installation.

I. Installation of raceway and cable system.

J. Installation of electrical equipment and instrumentation.

K. Pre-operational testing and checkouts.

Sketches may be used to supplement or clarify the Work Plan narrative.

8.15.3 Bidder Project Team

A. Bidder shall submit detailed resumes for proposed Project Manager, Engineering Manager, Procurement Manager, Construction Superintendent, Assistant Superintendents, and Technicians.

B. Bidder shall provide an organizational chart showing names and phone numbers of personnel in home office and in field office who will be supporting this project. Indicate the percent of time per month that each individual will devote to this project.

C. Bidder shall submit with its bid a manpower loading chart showing engineering and procurement hours during the design and procurement and construction labor hours by trade (including subcontractors) for each week during construction.

8.15.4 Construction Equipment Facilities

A. Bidder shall submit a detailed list of construction equipment that it intends to use on this project.

B. Bidder shall indicate the number and size of construction trailers (including subcontractors) that will be required for this project.

C. Bidder shall indicate the type and size of storage building that it will utilize during construction of this project.

8.15.5 Engineering Rates

Bidder shall attach to the proposal a schedule of rates that shall apply to changes in the scope of engineering Work done on a Time and Material basis. The rates shall include all costs for payroll, payroll taxes, insurance computer services, supplies, taxes, overhead and profit.

8.15.6 Time and Material Rates

Bidder shall attach to the proposal a schedule of rates that shall apply to changes to the scope of construction Work done on a Time and Material basis. The rates shall include all costs for payroll, payroll taxes, insurance, small tools, equipment originally costing less than $1,000, supplies, taxes, overhead and profit. Rates shall be included for all crafts and each level of supervision expected to be involved in this work.

8.15.7 Equipment Rental Rates

Bidder shall attach to the proposal a schedule of equipment rental rates for equipment originally costing more than $1,000. These rates shall apply to changes to the construction scope of Work. The rates shall include insurance, gasoline, oil, taxes and all other expenses except operating personnel. Rental payment shall be based on the lowest applicable rate determined by the length of time the equipment is on the jobsite.

8.15.8 Proposal Data

Bid must include two prints of all the manufacturers' data called for in the Specifications section 8 in addition to any other data submitted at the Bidder's option. Data so submitted shall illustrate the physical characteristics of the Equipment and Materials to be furnished. Any deviations from the requirements of the Bid Documents shall be called to the attention of the Owner.

8.15.9 Additional data

Turbine heat balance diagram with full tabulation of the heat balance information for the guarantee point, 100% valves wide open and at 105% pressure conditions.

8.16 PRICE FOR PERFORMANCE BOND:

Bidder shall list below firm prices for furnishing a Performance Bond Part I, ARTICLE 6, if required by Owner after award of the Contract.

FIRM PRICE FOR PERFORMANCE BOND $________________________

NAME OF SURETY ________________________

FIRM PRICE FOR PERFORMANCE BOND $________________________

NAME OF SURETY ________________________

* * * * *

Attachment 1 to the Boardman Turbine Uprate Specification

Attachement 1 includes original specification and data sheets for all feedwater heaters and the condenser in the Boardman plant steam cycle. Note that heater number for in the train is the Dearator.

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NOTE: STRESS-RELIEVED PARTS MARK - "SR"
RADIOGRAPHED PARTS MARK - "XR"

SERVICE Feedwater Heater No. 1A/1B CONSISTS OF: Two (2) SHELLS PER UNIT
TYPE: Straight Tube SIZE: 46-573 ARRG'T Horizontal
EFFECTIVE SURFACE PER SHELL: 7964 GROSS SURFACE PER SHELL: 8037

PERFORMANCE OF ONE SHELL

ZONE	RATE	MTD	DUTY	SURFACE
DESUPERHEATING	---	---	---	---
SUB COOLING	327	27.73	11412149	1260
CONDENSING	613	21.98	90375463	6704
TOTAL	-	-	101787612	7964

		SHELL SIDE		TUBE SIDE
FLUID CIRCULATED		STEAM	DRAINS	FEEDWATER
FLOW RATE - IN	LB/HR	93117	109829	1664089
TEMPERATURE - IN	°F	170.6	173.4	102.1
- OUT	°F	112.1	112.1	163.4
ENTHALPY - IN	BTU/LB	1101.5	141.38	70.22
- OUT	BTU/LB	80.05	80.05	131.39
PRESSURE AT INLET	PSIA	5.77 (168.4 °F SAT. TEMP.)		----
PRESSURE DROP	PSI	DESUP. ---	DRAIN COOLER 1.5	15.2
VELOCITY	FT/SEC.	-		7.52 AT 60 °F
NUMBER OF PASSES		DRAIN COOLER One		Two

CONSTRUCTION

		SHELL SIDE	TUBE SIDE
PRESSURE	PSIG	DESIGN 50 TEST 75	DESIGN 520 TEST 780
DESIGN TEMPERATURE	°F	300 SKIRT)	300
CORROSION ALLOWANCE	IN.	---	---

CODES AND STANDARDS APPLIED - ASME Section VIII, Division I and HEI
TUBE LENGTH - TOTAL 48.2' EFFECTIVE 47.75

PART	NO.	SIZE	THICK.	MATERIAL ASTM NO.	DETAILS
TUBES	850	3/4 "O.D.	18 BWG	90/10 CuNi B-111	PITCH 15/16 " Tria. ~~XXXXXX~~ ROLLED
SHELL	46	"I.D. ~~O.D.~~	1/2 IN.	Stl. (A-285-C)	
SHELL COVER	---		IN.		WELDED ON FLANGED
SKIRT	46		1/2 IN.	Stl. A-285-C	
CHANNEL	32" I.D.		1/2 IN.	Stl. A-516-70	
CHANNEL COVER	41" O.D.		3 3/8 IN.	Stl. A-516-70	
FIXED TUBESHEET	47" O.D.		2 5/8 IN.	Stl. A-516-70	~~INTEGRAL~~ WELDED IN ~~XXXXXXX~~
FLOAT. TUBESHEET	---		IN.	---	---
FLOAT. HD. COVER	---		IN.	---	---
SHROUDS			3/8 IN.	Stl. A-36	DESUP. DR. COOLER 181" Lg.
BAFFLES	(10) (35%)		1/4 IN.	Stl. A-36	PITCH-(DESUP.) --- " (DR. COOLER) 16 1/
SUPPORT PLATES	21		3/4 IN.	Stl. A-36	PITCH 26"
IMPACT PLATES	3		3/8 IN.	SS A-240-304	

GASKETS Metal J'k'd. Asb. BOLTING A-193-B7

CONNECTIONS (NO., SIZE & RATING)							
STEAM IN	2	30"	BW	DRAINS OUT	1	8", 10"	BW
F.W. IN & OUT	1	12"	BW	SHELL RELIEF	---	---	---
DRAINS IN	1	8"	BW				

OVERALL LENGTH 52'-3" PULLING DISTANCE FROM F.W. NOZZLE ----
WEIGHT - DRY 48,700 FLOODED 82,500 OPERATING 57,850 BUNDLE ONLY ---
MANUFACTURER MODEL PURCHASE ORDER
NOTES: Terminal Temperature Difference - 5 °F
Drain Subcooler Approach - 10 °F

REV.	DESCRIPTION	DR	CHK	SUPV	MATL	APPROVALS	DATE
0	ISSUED FOR BIDS						

FEEDWATER HEATER NO. 1A/1B
DATA SHEET
SPECIFICATION NO. 11230-M010
BOARDMAN PLANT UNIT NO. 1
PORTLAND GENERAL ELECTRIC COMPANY

BECHTEL POWER AND INDUSTRIAL

JOB No 11230
11230-M010-DS-1
REV.

-15-63

PE 425

STRUTHERS WELLS

FEEDWATER HEATER SPECIFICATION SHEET

Revised 9/29/77

		JOB	
CUSTOMER	Portland G. E. Co.	REF.	3-77-06-33004
ADDRESS	Bechtel Power Corp. Cons'g. Eng'rs.	PROPOSAL	8995-S6
PLANT LOCATION	Portland, Oregon	DATE	

No.						
1	SERVICE OF UNIT	Low Pressure Feedwater Heater No. 1A & B			ITEM NO.	1.0
2	SIZE	46-573	TYPE ST-Tube	Two Zone	POSITION	Horizontal
3	SURFACE PER UNIT	7,964 SQ. FT EFF	8,037 SQ. FT. TOTAL		2 = NO. OF UNITS	

PERFORMANCE OF ONE UNIT

No.		SHELL SIDE		TUBE SIDE
4	FLUID CIRCULATED	STEAM	DRAINS	FEED WATER
5	TOTAL FLUID ENTERING #/HR.	93,117	109,829	1,664,089
6	INLET ENTHALPY BTU/#	1101.50	141.38	70.22
7	OUTLET ENTHALPY BTU/#		80.05	131.39
8	INLET TEMPERATURE °F	170.6 (168.4 SAT.)		102.10
9	OUTLET TEMPERATURE °F		112.10	163.40
10	OPERATING PRESSURE P. S. I. A.		5.77	--
11	NUMBER OF PASSES PER SHELL	Two Zones (one shrouded)		Two
12	VELOCITY F. P. S.			7.52 AT SP. GR. = 1.0
13	PRESSURE DROP P. S. I.	(A)	(C) 1.5	15.2

No.		HEAT EXCHANGED BTU/HR.	SURFACE SQ. FT.	M T D °F	TRANSFER RATE BTU/HR./SQ. FT./°
14	(A) DESUPERHEATING SECTION	---	---	---	---
15	(B) CONDENSING SECTION	90,375,463	6,704	21.98	613
16	(C) DRAIN COOLING SECTION	11,412,149	1,260	27.73	327

CONSTRUCTION OF ONE SHELL

No.		SHELL SIDE	TUBE SIDE
17	DESIGN PRESSURE PSI	50 & Vac.	520
18	TEST PRESSURE PSI	76	780
19	DESIGN TEMPERATURE °F	300	300

No.			
20	TUBES 90/10CuNi An'd	NO. 850 O. D. 3/4 B. W. G. .049Av	S. E. T. L.* 47'-9" PITCH 15/16
21	SHELL Steel	I.D. 46	THICKNESS 1/2 (A-285-C)
22	SHELL COVER Stl.	WELDED TO SHELL	SHELL SKIRT Steel 1/2 thk (A-285
23	CHANNEL (SR) Steel	I.D. 32	CHANNEL COVER Steel
24	TUBE SHEETS Steel		IMPINGEMENT BAFFLE - STNLS STEEL (3) 3/8
25	SUPPORT PLATES - STEEL	AIR BAFFLE - STEEL (3)	SEGMENTAL BAFFLE Steel
26	SHROUDS (A) None		(C) Steel
27	TYPE JOINTS - SHELL SIDE Welded		TUBESIDE Bolted and flanged
28	GASKETS - SHELL None		CHANNEL Metal Jacketed Asbestos
29	CONNECTIONS: STEAM-INLET (2) 30	DRAINS-INLET 8	SERIES Weld Ends
30	DRAINS-OUTLET 8,10		SERIES Weld Ends
31	FEED WATER-INLET 12	OUTLET 12	SERIES Weld Ends
32	CODE REQUIREMENTS ASME CODE SECTION VIII, DIV. I, & HEAT EXCHANGE INSTITUTE		
33	WEIGHTS - SHELL AND BUNDLE	BUNDLE ONLY	FULL OF WATER
34	ACCESSORIES: SHELL SAFETY VALVE By others.		TUBE SIDE RELIEF VALVE Included
35	SHELL DRAINER By others.		SHELL GAGE GLASS Included
36	REMARKS: (SR) INDICATES STRESS RELIEVING	(XR) INDICATES RADIOGRAPHING	
37	"U" TUBES WILL BE DUAL GAGE WHERE REQUIRED TO COMPENSATE FOR BEND THINNING		
38	* S. E. T. L. - STRAIGHT EFFECTIVE TUBE LENGTH.		

1. Bends stress relieved after bending. 2. Tubes are roller expanded into double-grooved tubesheet. 3. Pass partition cover required. 4. Cond. neck mtg. plate (w/welded shell collar) provided for both ends. 5. Mtg. plates and shell cradl shipped loose for field installation by others. 6. Insulation clips provided o

SWC 3-77-06-33005 Revised 9/29/77

NOTE: STRESS-RELIEVED PARTS MARK - "SR"
RADIOGRAPHED PARTS MARK - "XR"

CONSISTS OF: One (1) SHELLS PER UNIT

1 SERVICE Feedwater Heater No. 2 ARRG'T Horizontal
2 TYPE: Straight Tube SIZE: 51-428 GROSS SURFACE PER SHELL: 10392
3 EFFECTIVE SURFACE PER SHELL: 10232

PERFORMANCE OF ONE SHELL

ZONE	RATE	MTD	DUTY	SURFACE
DESUPERHEATING	---	---	---	---
SUB COOLING	412	21.13	6709159	770
CONDENSING	719	16.4	111645027	9462
TOTAL	-	-	118354186	10232

		SHELL SIDE: STEAM	SHELL SIDE: DRAINS	TUBE SIDE: FEEDWATER
11 FLUID CIRCULATED				
12 FLOW RATE - IN	LB/HR	114159	105500	3328178
13 TEMPERATURE - IN	°F	208.2	208.9	163.4
14 - OUT	°F	173.4	173.4	198.9
15 ENTHALPY - IN	BTU/LB	1149.2	177.04	131.39
16 - OUT	BTU/LB	141.3	141.3	166.95
17 PRESSURE AT INLET	PSIA	12.5 (203.9 °F SAT. TEMP.)		---
18 PRESSURE DROP	PSI	DESUP. ---	DRAIN COOLER 1.1	14.4
19 VELOCITY	FT/SEC.	-		8.75 AT 60
20 NUMBER OF PASSES		DRAIN COOLER One		Two

CONSTRUCTION

		SHELL SIDE	TUBE SIDE
22 PRESSURE	PSIG	DESIGN 50 TEST 75	DESIGN 520 TEST 78(
23 DESIGN TEMPERATURE	°F	300	(SKIRT) 300
24 CORROSION ALLOWANCE	IN.	---	---

25 CODES AND STANDARDS APPLIED - ASME VIII, Div. I and HEI
26 TUBE LENGTH - TOTAL 36.2' EFFECTIVE 35.67'

PART	NO.	SIZE	THICK.		MATERIAL ASTM NO.	DETAILS
28 TUBES	1464	3/4" O.D.	18 BWG		90/10 CuNi B-111	PITCH 15/16" Tria. ROLLED
29 SHELL	51	" I.D.	1/2	IN.	Stl. A-285-C	WELDED ON FLANGED
30 SHELL COVER	---			IN.	---	
31 SKIRT	51 I.D.		1/2	IN.	Stl. A-285-C	
32 CHANNEL	41 I.D.		5/8	IN.	Stl. A-516-70	
33 CHANNEL COVER	50 O.D.		4 1/8	IN.	Stl. A-516-70	WELDED IN SEPAR
34 FIXED TUBESHEET	52		3 3/8	IN.	Stl. A-516-70	
35 FLOAT. TUBESHEET	---			IN.	---	
36 FLOAT. HD. COVER	---			IN.	---	DESUP. --- DR. COOLER 64" Lg.
37 SHROUDS			3/8	IN.	Stl. A-36	PITCH-(DESUP.) --- " [DR. COOLER] 1
38 BAFFLES	(4) [20%]		3/8	IN.	Stl. A-36	PITCH 23 7/8"
39 SUPPORT PLATES	17		3/4	IN.	Stl. A-36	
40 IMPACT PLATES	3			IN.	SS A-240-304	BOLTING A-193-B7

41 GASKETS Metal J'k'd. Asbestos

42 CONNECTIONS (NO., SIZE & RATING)	NO.	SIZE	RATING		NO.	SIZE	RATING
STEAM IN	2	22"	BW	DRAINS OUT	1	8" 14"	BW
F.W. IN & OUT	1	16"	BW	SHELL RELIEF	---	---	
DRAINS IN	1	8"	BW				

44 PULLING DISTANCE FROM F.W. NOZZLE -----
45 OVERALL LENGTH 41'-7" OPERATING 62,000 BUNDLE ONLY --
46 WEIGHT - DRY 51,000 FLOODED 83,000 PURCHASE ORDER
47 MANUFACTURER MODEL
48 NOTES: Terminal Temperature Difference - 5 °F
49 Drain Subcooler Approach - 10 °F

REV.	DESCRIPTION	DATE	APPROVALS	MATL	SUPV	CHK	DR	ENG
0	ISSUED FOR BIDS	6/16/77				NDH		RT

BECHTEL POWER AND

FEEDWATER HEATER NO. 2
DATA SHEET
SPECIFICATION NO. 11230-M010
BOARDMAN PLANT UNIT NO. 1
PORTLAND GENERAL ELECTRIC COMPANY

JOB No 11230
11230-M010-DS-1
2 6

PE 425

STRUTHERS WELLS

FEEDWATER HEATER SPECIFICATION SHEET

Revised 9/29/77

CUSTOMER	Portland G. E. Co.	JOB REF.	3-77-06-33005
ADDRESS	Bechtel Power Corp. Cons'g. Eng'rs.	PROPOSAL	8995-S6
PLANT LOCATION	Portland, Oregon	DATE	

No.				
1	SERVICE OF UNIT	Low Pressure Feedwater Htr. No. 2	ITEM NO.	2.0
2	SIZE 51-428	TYPE ST-Tube Two Zone	POSITION	Horizontal
3	SURFACE PER UNIT 10,232	SQ. FT EFF 10,392	SQ. FT. TOTAL	1 = NO. OF UNITS

PERFORMANCE OF ONE UNIT

No.			SHELL SIDE		TUBE SIDE
4	FLUID CIRCULATED		STEAM	DRAINS	FEED WATER
5	TOTAL FLUID ENTERING	#/HR.	114,159	105,500	3,328,178
6	INLET ENTHALPY	BTU/#	1149.20	177.04	131.39
7	OUTLET ENTHALPY	BTU/#		141.30	166.95
8	INLET TEMPERATURE	°F	208.2 (203.9 SAT.)		163.40
9	OUTLET TEMPERATURE	°F		173.40	198.90
10	OPERATING PRESSURE	P. S. I. A.		12.5	-------
11	NUMBER OF PASSES	PER SHELL	Two Zones (One Shrouded)		Two
12	VELOCITY	F. P. S.			8.74 AT SP. GR. = 1
13	PRESSURE DROP	P. S. I.	(A)	(C) 1.1	14.4

No.		HEAT EXCHANGED BTU/HR.	SURFACE SQ. FT.	M T D °F	TRANSFER RATE BTU/HR./SQ. FT./°F
14	(A) DESUPERHEATING SECTION	---	---	---	---
15	(B) CONDENSING SECTION	111,645,027	9,462	16.40	719
16	(C) DRAIN COOLING SECTION	6,709,159	770	21.13	412

CONSTRUCTION OF ONE SHELL

No.			SHELL SIDE	TUBE SIDE
17	DESIGN PRESSURE	PSI	50 & Vac.	520
18	TEST PRESSURE	PSI	76	780
19	DESIGN TEMPERATURE	°F	300	300

20 TUBES 90/10CuNi. An'd. NO. 1,464 O. D. 3/4 B. W. G. 18 Av. S. E. T. L.* 35'-8" PITCH 15/16

21 SHELL Steel I.D. 51 THICKNESS 1/2 (A-285-

22 SHELL COVER Steel WELDED TO SHELL SHELL SKIRT Steel 1/6th k. (A-285-C)

23 CHANNEL (SR) Steel I.D. 41 CHANNEL COVER Steel

24 TUBE SHEETS Steel IMPINGEMENT BAFFLE - STNLS STEEL (3) 3/8

25 SUPPORT PLATES - STEEL AIR BAFFLE - STEEL (3) SEGMENTAL BAFFLE Steel

26 SHROUDS (A) None (C) Steel

27 TYPE JOINTS - SHELL SIDE Welded TUBESIDE Bolted and flanged.

28 GASKETS - SHELL None CHANNEL Metal Jacketed Asbestos

29 CONNECTIONS: STEAM-INLET (2) 22 DRAINS-INLET 8 SERIES Weld Ends

30 DRAINS-OUTLET 8, 14 SERIES Weld Ends

31 FEED WATER-INLET 16 OUTLET 16 SERIES Weld Ends

32 CODE REQUIREMENTS ASME CODE SECTION VIII, DIV. I, AND HEAT EXCHANGE INSTITUTE

33 WEIGHTS - SHELL AND BUNDLE BUNDLE ONLY FULL OF WATER

34 ACCESSORIES: SHELL SAFETY VALVE By others. TUBE SIDE RELIEF VALVE Included

35 SHELL DRAINER By others SHELL GAGE GLASS Included

36 REMARKS: (SR) INDICATES STRESS RELIEVING (XR) INDICATES RADIOGRAPHING

37 "U" TUBES WILL BE DUAL GAGE WHERE REQUIRED TO COMPENSATE FOR BEND THINNING

38 * S. E. T. L. - STRAIGHT EFFECTIVE TUBE LENGTH.

1. Bends stress relieved after bending. 2. Tubes are roller expanded into double-grooved tube sheet. 3. Pass partition cover required. 4. Cond. neck mtg. plates (welded shell collar) provided for both ends. 5. Mtg. plates and shell cradles ship loose for field install. by others. 6. Insulation clips provided on approx. 18" ce 7. S.S. lagging provided internal of cond. neck. 8. Lagging is shop fitted but

SWC 3-77-06-33006 Revised 9/29/77

NOTE: STRESS-RELIEVED PARTS MARK - "SR"
RADIOGRAPHED PARTS MARK - "XR"

1 SERVICE Feedwater Heater No. 3 CONSISTS OF: One (1) SHELLS PER UN
2 TYPE: U-Tube SIZE: 53-434 ARRG'T Horizontal
3 EFFECTIVE SURFACE PER SHELL: 8933 GROSS SURFACE PER SHELL: 9019

4 PERFORMANCE OF ONE SHELL

ZONE	RATE	MTD	DUTY	SURFACE
DESUPERHEATING	---	---	---	---
SUB COOLING	381	20.34	2874696	371
CONDENSING	774	15.74	104349090	8562
TOTAL	-	-	107223786	8933

No.			SHELL SIDE		TUBE SIDE
11	FLUID CIRCULATED		STEAM	DRAINS	FEEDWATER
12	FLOW RATE - IN	LB/HR	105500	---	3328178
13	TEMPERATURE - IN	°F	305.2	---	198.9
14	- OUT	°F	208.9	---	230.9
15	ENTHALPY - IN	BTU/LB	1193.16	---	166.95
16	- OUT	BTU/LB	176.94		199.17
17	PRESSURE AT INLET	PSIA	23.2 (235.9 °F SAT. TEMP.)		---
18	PRESSURE DROP	PSI	DESUP. ---	DRAIN COOLER 1.7	12.2
19	VELOCITY	FT/SEC.	-		8.61 AT 6(
20	NUMBER OF PASSES		DRAIN COOLER One		Two

21 CONSTRUCTION

No.			SHELL SIDE	TUBE SIDE
22	PRESSURE	PSIG	DESIGN 50 TEST 75	DESIGN 520 TEST 78
23	DESIGN TEMPERATURE	°F	520 SKIRT)	300
24	CORROSION ALLOWANCE	IN.	---	---

25 CODES AND STANDARDS APPLIED - ASME VIII, Division I and HEI
26 TUBE LENGTH - TOTAL 37.7' EFFECTIVE 37.28'

No.	PART	NO.	SIZE	THICK.	MATERIAL ASTM NO.	DETAILS
28	TUBES	523 U's	7/8 "O.D.	18 BWG	90/10 CuNi (B-395)	PITCH 1 1/8 " Tria. ~~XXXX~~ ROLLE
29	SHELL	53	"I.D. ~~XXX~~	1/2 IN.	Stl. A-285-C	
30	SHELL COVER	53"		1/2 IN.	Stl. A-285-C	WELDED ON ~~FLANGED~~
31	SKIRT	53"		1/2 IN.	Stl. A-285-C	
32	CHANNEL	42		7/16 IN.	Stl. A-516-70	
33	CHANNEL COVER	---		IN.	Stl. A-515-70	
34	FIXED TUBESHEET	54 O.D.		4 3/8 IN.	Stl. A-516-70	~~INTEGRAL~~ WELDED IN ~~SERX~~
35	FLOAT. TUBESHEET	---		IN.	---	
36	FLOAT. HD. COVER	---		IN.	---	
37	SHROUDS			3/8 IN.	Stl. A-36	DESUP. --- DR. COOLER 37" Lg
38	BAFFLES	(8) [20%]		3/8 IN.	Stl. A-36	PITCH-(DESUP.) " [DR. COOLER] 3
39	SUPPORT PLATES	17		3/4 IN.	Stl. A-36	PITCH 25 1/2"
40	IMPACT PLATES	1		3/8 IN.	S.S. A-240-304	

41 GASKETS Metal J'k'd. Asbestos BOLTING A-193-B7

42-44 CONNECTIONS (NO., SIZE & RATING)							
STEAM IN	1	24"	BW	DRAINS OUT	1	10"	BW
F.W. IN & OUT	1	16"	BW	SHELL RELIEF	1	4"	150# Flg
DRAINS IN	---	---	---				

45 OVERALL LENGTH 41'-0" PULLING DISTANCE FROM F.W. NOZZLE 36'
46 WEIGHT - DRY 45,000 FLOODED 80,000 OPERATING --- BUNDLE ONLY 30,0
47 MANUFACTURER MODEL PURCHASE ORDER
48 NOTES: Terminal Temperature Difference - 5 °F
49 Drain Subcooler Approach - 10 °F

REV.	DESCRIPTION	ENG	DR	CHK	SUPV	MATL	APPROVALS	DATE
0	ISSUED FOR BIDS	RT		[illegible]				6/16/76

BECHTEL POWER AND INDUSTRIAL

FEEDWATER HEATER NO. 3
DATA SHEET
SPECIFICATION NO. 11230-M010
BOARDMAN PLANT UNIT NO. 1
PORTLAND GENERAL ELECTRIC COMPANY

JOB No 11230
11230-M010-DS-1
RE

PE 425

STRUTHERS WELLS

FEEDWATER HEATER SPECIFICATION SHEET

Revised 9/29/77

CUSTOMER	Portland G. E. Co.	JOB	
		REF.	3-77-06-33006
ADDRESS	Bechtel Power Corp. Cons'g. Eng'rs.	PROPOSAL	8995-S6
PLANT LOCATION	Portland, Oregon	DATE	

1	SERVICE OF UNIT	Low Pressure Feedwater Htr. No. 3		ITEM NO.	3.0
2	SIZE 53 - 434	TYPE	U-Tube Two Zone	POSITION	Horizontal
3	SURFACE PER UNIT 8,933	SQ. FT EFF	9,019	SQ. FT. TOTAL	1 = NO. OF UNITS

PERFORMANCE OF ONE UNIT

		Shell Side		Tube Side
4	FLUID CIRCULATED	STEAM	DRAINS	FEED WATER
5	TOTAL FLUID ENTERING #/HR.	105,500	------	3,328,178
6	INLET ENTHALPY BTU/#	1193.16	------	166.95
7	OUTLET ENTHALPY BTU/#		176.94	199.17
8	INLET TEMPERATURE °F	305.2 (235.9 SAT.)		198.90
9	OUTLET TEMPERATURE °F		208.90	230.90
10	OPERATING PRESSURE P. S. I. A.		23.2	------
11	NUMBER OF PASSES PER SHELL	Two Zones (One Shrouded)		Two
12	VELOCITY F. P. S.			8.61 AT SP. GR. = 1.
13	PRESSURE DROP P. S. I.	(A)	(C) 1.7	12.2

		HEAT EXCHANGED BTU/HR.	SURFACE SQ. FT.	M T D °F	TRANSFER RATE BTU/HR./SQ. FT./°F
14	(A) DESUPERHEATING SECTION	---	---	---	---
15	(B) CONDENSING SECTION	104,349,090	8,562	15.74	774
16	(C) DRAIN COOLING SECTION	2,874,696	371	20.34	381

CONSTRUCTION OF ONE SHELL

		SHELL SIDE	TUBE SIDE
17	DESIGN PRESSURE PSI	50 & Vac.	520
18	TEST PRESSURE PSI	75	780
19	DESIGN TEMPERATURE °F	520	300

20	TUBES 90/10Cu.Ni. An'd. NO. 523 U's O. D. 7/8 B. W. G. .049A		S. E. T. L.* 36'-2	PITCH 1 1/8 Δ
21	SHELL Steel,		I.D. 53	THICKNESS 1/2 (A-285-C)
22	SHELL COVER Steel	WELDED TO SHELL	SHELL SKIRT	Steel 1/2 thk (A-285-C)
23	CHANNEL (SR) Steel	I.D. 42	CHANNEL COVER	Steel
24	TUBE SHEETS Steel		IMPINGEMENT BAFFLE - STNLS STEEL	(1) 3/8 t
25	SUPPORT PLATES - STEEL	AIR BAFFLE - STEEL (2)	SEGMENTAL BAFFLE	Steel
26	SHROUDS (A) None		(C)	Steel
27	TYPE JOINTS - SHELL SIDE Welded **		TUBESIDE	Hemispherical 14"x18" openi
28	GASKETS - SHELL None		CHANNEL	Metal Jacketed Asbestos
29	CONNECTIONS: STEAM-INLET (1) 24	DRAINS-INLET	SERIES	Weld Ends
30		DRAINS-OUTLET 10"	SERIES	Weld Ends
31		FEED WATER-INLET 16 OUTLET 16	SERIES	Weld Ends
32	CODE REQUIREMENTS ASME CODE SECTION VIII, DIV. I & HEAT EXCHANGE INST.			
33	WEIGHTS - SHELL AND BUNDLE	BUNDLE ONLY	FULL OF WATER	
34	ACCESSORIES: SHELL SAFETY VALVE Included		TUBE SIDE RELIEF VALVE	Included
35	SHELL DRAINER By others.		SHELL GAGE GLASS	Included

36 REMARKS: (SR) INDICATES STRESS RELIEVING (XR) INDICATES RADIOGRAPHING

37 "U" TUBES WILL BE DUAL GAGE WHERE REQUIRED TO COMPENSATE FOR BEND THINNING

38 * S. E. T. L. - STRAIGHT EFFECTIVE TUBE LENGTH.

** Stainless steel flame protecting band provided at cut point.

1. Bends stress relieved after bending. 2. Tubes are roller expanded into double-grooved tubesheet. 3. Shell support rollers provided for shell removal. 4. Pass partition covers are sectioned and bolted to webbing. 5. Insulation clips provided on approx. 18 inch centers. 6. [illegible]

SWC 1-77-06-33007

Revised 9/29/77

NOTE: STRESS-RELIEVED PARTS MARK - "SR"
RADIOGRAPHED PARTS MARK - "XR"

SERVICE Feedwater Heater No. 5 CONSISTS OF: One (1) SHELLS PER UNI[T]

TYPE: U-Tube SIZE: 73-367 ARRG'T Horizontal

EFFECTIVE SURFACE PER SHELL: 16,434 GROSS SURFACE PER SHELL: 16,771

PERFORMANCE OF ONE SHELL

ZONE	RATE	MTD	DUTY	SURFACE
DESUPERHEATING	91	166.72	30,918,704	2,047
SUB COOLING	551	26.81	227,694,060	3,177
CONDENSING	916	22.18	46,914,556	11,210
TOTAL	-	-	305,527,320	16,434

		SHELL SIDE		TUBE SIDE
FLUID CIRCULATED		STEAM	DRAINS	FEEDWATER
FLOW RATE - IN	LB/HR	246,015	541,175	4,331,336
TEMPERATURE - IN	°F	675.7	376.5	298.7
- OUT	°F	308.7	308.7	366.5
ENTHALPY - IN	BTU/LB	1363.7	349.83	269.21
- OUT	BTU/LB	278.56	278.56	339.75
PRESSURE AT INLET	PSIA	166	(366.5 °F SAT. TEMP.)	---
PRESSURE DROP	PSI	DESUP. 1.8	DRAIN COOLER 4.3	13
VELOCITY	FT/SEC.		-	8.11 AT 60
NUMBER OF PASSES		DRAIN COOLER One		

CONSTRUCTION

		SHELL SIDE		TUBE SIDE
PRESSURE	PSIG	DESIGN 185 & Vac.	TEST 278	DESIGN 84 TEST 12[6]
DESIGN TEMPERATURE	°F	385	(730 SKIRT)	385 Bends/420 Str
CORROSION ALLOWANCE	IN.	---		---

CODES AND STANDARDS APPLIED - ASME VIII, DIV. 1, AND HEI

TUBE LENGTH - TOTAL 32.7' EFFECTIVE 31.97'

PART	NO.	SIZE	THICK.	MATERIAL ASTM NO.	DETAILS
TUBES	1571 U's	5/8 "O.D.	18 BWG	90/10 Cu Ni B-345	PITCH 7/8 " Tria. ~~XXXX~~ ROLLE[D]
SHELL	73	"I.D. ~~XXX~~	5/8 IN.	Stl. A-285-C	WELDED ON FLANGED
SHELL COVER	73		5/8 IN.	Stl. A-285-C	
SKIRT	73		1/2 IN.	Stl. A-204-B	
CHANNEL	57		IN.	Stl. A-516-70	
CHANNEL COVER	---		IN.	Stl. A-515-70	
FIXED TUBESHEET	74 1/8"		8 IN.	Stl. A-516-70	INTEGRAL WELDED IN SEPA[RATE]
FLOAT. TUBESHEET	---		IN.	---	
FLOAT. HD. COVER	---		IN.	---	
SHROUDS			3/8 IN.	Stl. A-36	DESUP. 96 DR. COOLER 148
BAFFLES	(6)[60%] 5/8"&10@20%3/8"			Stl. A-36	PITCH-(DESUP.) * "(DR.COOLER) *
SUPPORT PLATES	13		3/4 IN.	Stl. A-36	PITCH 20-7/8"
IMPACT PLATES	2		3/8 IN.	S.S. A-240-304	* 15-7/16" **12-3/4"

GASKETS Metal Jacketed Asbestos BOLTING SA-193-B7

CONNECTIONS (NO., SIZE & RATING)	NO.	SIZE	RATING		NO.	SIZE	RATING
STEAM IN	1	18"	BW	DRAINS OUT	1	14"	BW
F.W. IN & OUT	1	16"	BW	SHELL RELIEF	1	4"	150# Flg.
DRAINS IN	1	10"	BW				

OVERALL LENGTH 36'-7" PULLING DISTANCE FROM F.W. NOZZLE 35'-2"

WEIGHT - DRY 82,000 FLOODED 142,000 OPERATING --- BUNDLE ONLY 62,0[00]

MANUFACTURER MODEL PURCHASE ORDER

NOTES: Terminal Temperature Difference - 0 °F
Drain Subcooler Approach - 10 °F

REV.	DESCRIPTION	DATE	ENG	DR	CHK	SUPV	MATL	APPROVALS
0	ISSUED FOR BIDS	6/16/76						

FEEDWATER HEATER NO. 5
DATA SHEET
SPECIFICATION NO. 11230-M010
BOARDMAN PLANT UNIT NO. 1
PORTLAND GENERAL ELECTRIC COMPANY

BECHTEL POWER AND INDUSTRIAL DIVISION

JOB No 11230

11230-M010-DS-1

SHEET 4 OF 6

PE 425

STRUTHERS WELLS

FEEDWATER HEATER SPECIFICATION SHEET

CUSTOMER	Portland G.E. Company	JOB REF.	1-77-06-33007
ADDRESS	Bechtel Power Corp., Cons'g. Engrs.	PROPOSAL	8995-S6
PLANT LOCATION	Portland, Oregon	DATE	9/29/77

1 SERVICE OF UNIT I.P. Feedwater Heater No. 5 ITEM NO. 5.0
2 SIZE 73-367 TYPE U-Tube Three Zone POSITION Horizontal
3 SURFACE PER UNIT 16,434 SQ. FT EFF 16,771 SQ. FT. TOTAL 1 = NO. OF UNITS

PERFORMANCE OF ONE UNIT

			SHELL SIDE		TUBE SIDE
4	FLUID CIRCULATED		STEAM	DRAINS	FEED WATER
5	TOTAL FLUID ENTERING	#/HR.	246,015	541,175	4,331,336
6	INLET ENTHALPY	BTU/#	1363.70	349.83	269.21
7	OUTLET ENTHALPY	BTU/#		278.56	339.75
8	INLET TEMPERATURE	°F	675.7 (366.5	SAT.)	298.70
9	OUTLET TEMPERATURE	°F		308.70	366.50
10	OPERATING PRESSURE	P. S. I. A.		166.02	---
11	NUMBER OF PASSES	PER SHELL	Three Zones (Two Shrouded)		Two
12	VELOCITY	F. P. S.			8.11 AT SP. GR. = 1.0
13	PRESSURE DROP	P. S. I.	(A) 1.8	(C) 4.3	13

		HEAT EXCHANGED BTU/HR.	SURFACE SQ. FT.	M T D °F	TRANSFER RATE BTU/HR./SQ. FT./°F.
14	(A) DESUPERHEATING SECTION	30,918,704	2,047	166.72	91
15	(B) CONDENSING SECTION	227,694,060	11,210	22.18	916
16	(C) DRAIN COOLING SECTION	46,914,556	3,177	26.81	551

CONSTRUCTION OF ONE SHELL

			SHELL SIDE	TUBE SIDE
17	DESIGN PRESSURE	PSI	185 & Vac.	840
18	TEST PRESSURE	PSI	278	1260
19	DESIGN TEMPERATURE	°F	Skirt 730/Shell 385	Strs 420/Bends 385

20 TUBES 90/10 Cu Ni An'd. NO. 1571U's O. D. 5/8 B. W. G. .049A S. E. T. L.* 30'7" PITCH 14/16 Δ
21 SHELL Steel I.D. 73 THICKNESS 5/8(A-285-C)
22 SHELL COVER Steel WELDED TO SHELL SHELL SKIRT C-½ Mo ½ THK.(A-204-B)
23 CHANNEL (SR) Steel I.D. 57 CHANNEL COVER Steel
24 TUBE SHEETS Steel or Forged Steel IMPINGEMENT BAFFLE - STNLS STEEL (2)3/8
25 SUPPORT PLATES - STEEL AIR BAFFLE - STEEL (2) SEGMENTAL BAFFLE Steel
26 SHROUDS (A) Steel (C) Steel
27 TYPE JOINTS - SHELL SIDE Welded ** TUBESIDE Hemispherical 14"x18" Ope
28 GASKETS - SHELL None CHANNEL Metal Jktd.Asb.
29 CONNECTIONS: STEAM-INLET (1) 18 DRAINS-INLET 10 0 SERIES Weld Ends
30 DRAINS-OUTLET 14 SERIES Weld End
31 FEED WATER-INLET 16 OUTLET 16 SERIES Weld Ends
32 CODE REQUIREMENTS ASME CODE SECTION VIII, DIV. 1, & HEAT EXCHANGE INSTITUTE
33 WEIGHTS - SHELL AND BUNDLE BUNDLE ONLY FULL OF WATER
34 ACCESSORIES: SHELL SAFETY VALVE Included TUBE SIDE RELIEF VALVE Included
35 SHELL DRAINER By Others SHELL GAGE GLASS Included
36 REMARKS: (SR) INDICATES STRESS RELIEVING (XR) INDICATES RADIOGRAPHING
37 "U" TUBES WILL BE DUAL GAGE WHERE REQUIRED TO COMPENSATE FOR BEND THINNING
38 * S. E. T. L. - STRAIGHT EFFECTIVE TUBE LENGTH. ** S.S. flame protecting band provided at cu
point. 1) Bends stress reliefed after bending. 2) Tubes are roller expanded into double-grooved tubesheet. 3) Shell support rollers provided for shell removal. 4) Pass partition covers are sectioned and bolted to webbing. 5) Insulation clips provided on approx. 18 inch centers. 6) Tube and shell sides are nitrogen blanketed.

SWC 1-77-06-33008 Revised 9/29/77

NOTE: STRESS-RELIEVED PARTS MARK = SR; RADIOGRAPHED PARTS MARK = XR

CONSISTS OF: One (1) SHELLS PER UNIT

SERVICE: Feedwater Heater No. 6
TYPE: U-Tube SIZE: 66-371 ARR'G: Horizontal
EFFECTIVE SURFACE PER SHELL: 15407 GROSS SURFACE PER SHELL: 15691

PERFORMANCE OF ONE SHELL

ZONE	RATE	MTD	DUTY	SURFACE
DESUPERHEATING	127	189.44	50078292	2086
SUB COOLING	490	25.95	29220144	2297
CONDENSING	808	23.81	212109460	11024
TOTAL			291407896	15407

		SHELL SIDE		TUBE SIDE
FLUID CIRCULATED		STEAM	DRAINS	FEEDWATER
FLOW RATE - IN	LB/HR	244248	295927	4331336
TEMPERATURE - IN	°F	851.4	446.4	366.5
- OUT	°F	376.5	376.5	429.1
ENTHALPY - IN	BTU/LB	1446.91	426.16	339.75
- OUT	BTU/LB	349.77	349.77	407.02
PRESSURE AT INLET	PSIA	333. (427.1 °F SAT. TEMP.)		----
PRESSURE DROP	PSI	DESUP. 2.9	DRAIN COOLER 2.8	8.9
VELOCITY	FT/SEC.			6.87 AT 60
NUMBER OF PASSES		DRAIN COOLER One		Two

CONSTRUCTION

		SHELL SIDE	TUBE SIDE
PRESSURE	PSIG	DESIGN 385 TEST 578	DESIGN 840 TEST 126[illegible]
DESIGN TEMPERATURE	°F	445 / 910 SKIRT	Bends 445/Str. 48[illegible]
CORROSION ALLOWANCE	IN.	---	---

CODES AND STANDARDS APPLIED - ASME Section VIII, Division I and HEI
TUBE LENGTH - TOTAL 33.0 EFFECTIVE 32.38

PART	NO.	SIZE	THICK.	MATERIAL ASTM NO.	DETAILS
TUBES	1212 U's	3/4 O.D.	18 BWG	Monel B-163	PITCH 15/16 Tria. ROLLED
SHELL	66 I.D.		7/8 IN.	Stl. A-515-70	WELDED ON
SHELL COVER	66"		7/8 IN.	Stl. A-515-70	
SKIRT	66"		1 IN.	Stl. A-387-B	
CHANNEL	52"		3/4 IN.	Stl. A-516-70	
CHANNEL COVER	---		IN.		INTEGRAL WELDED IN
FIXED TUBESHEET	68" O.D.		7 1/4 IN.	Stl. A-516-70	
FLOAT. TUBESHEET	---		IN.	---	
FLOAT. HD. COVER	---		IN.	---	
SHROUDS			3/8 IN.	Stl. A-36	DESUP. 105" Lg. DR. COOLER 116"
BAFFLES	(6)	[60%&25%	5/8&3/8 IN.	Stl. A-36	PITCH (DESUP.) 17 1/16" DR. COOLER 16
SUPPORT PLATES	11		3/4 IN.	Stl. A-36	PITCH 24 1/4"
IMPACT PLATES	2		3/8 IN.	SS A-240-304	

BOLTING A-193-B7
GASKETS Metal J'k'd. Asb.

CONNECTIONS (NO., SIZE & RATING)	NO.	SIZE	RATING		NO.	SIZE	RATING
STEAM IN	1	16"	BW	DRAINS OUT	1	14"	BW
F.W. IN & OUT	1	16"	BW	SHELL RELIEF	1	4"	300# Flg
DRAINS IN	1	10"	BW				

OVERALL LENGTH 37'-0" PULLING DISTANCE FROM F.W. NOZZLE 31'
WEIGHT - DRY 77,000 FLOODED 123,000 OPERATING ---- BUNDLE ONLY 54,1[illegible]
MANUFACTURER MODEL PURCHASE ORDER
NOTES: Terminal Temperature Difference = -2 °F
Drain Subcooler Approach = 10 °F

REV'S | DESCRIPTION | ISSUED FOR BIDS | ENG | DR | CHK | SUPV | MATL | APPROVALS | DATE

FEEDWATER HEATER NO. 6

DATA SHEET
SPECIFICATION NO. 11230-M010
BOARDMAN PLANT UNIT NO. 1
PORTLAND GENERAL ELECTRIC COMPANY

BECHTEL POWER AND INDUSTRIAL

JOB No 11230

11230-M010-DS-1

PE 425

STRUTHERS WELLS

FEEDWATER HEATER SPECIFICATION SHEET

Revised 9/29/77

CUSTOMER Portland G. E. Co. — JOB REF. 1-77-06-33008 D1
ADDRESS Bechtel Power Corp. Cons'g. Eng'rs. — PROPOSAL 8995-S6
PLANT LOCATION Portland, Oregon — DATE

1 SERVICE OF UNIT I. P. Feedwater Heater No. 6 — ITEM NO. 6.0
2 SIZE 66 - 371 TYPE U-Tube Three Zone — POSITION Horizontal
3 SURFACE PER UNIT 15,407 SQ. FT EFF 15,691 SQ. FT. TOTAL 1 = NO. OF UNITS

PERFORMANCE OF ONE UNIT

No.			Shell Side: Steam	Shell Side: Drains	Tube Side: Feed Water
4	FLUID CIRCULATED		STEAM	DRAINS	FEED WATER
5	TOTAL FLUID ENTERING	#/HR.	242,248	295,927	4,331,336
6	INLET ENTHALPY	BTU/#	1446.91	426.16	339.75
7	OUTLET ENTHALPY	BTU/#		349.77	407.02
8	INLET TEMPERATURE	°F	851.4 (427.1 SAT.)		366.50
9	OUTLET TEMPERATURE	°F		376.50	429.10
10	OPERATING PRESSURE	P. S. I. A.		333.0	
11	NUMBER OF PASSES	PER SHELL	Three Zones (Two Shrouded)		Two
12	VELOCITY	F. P. S.			6.87 AT SP. GR. = 1
13	PRESSURE DROP	P. S. I.	(A) 2.9	(C) 2.8	8.9

No.		HEAT EXCHANGED BTU/HR.	SURFACE SQ. FT.	M T D °F	TRANSFER RATE BTU/HR./SQ. FT./°F
14	(A) DESUPERHEATING SECTION	50,078,292	2,086	189.44	127
15	(B) CONDENSING SECTION	212,109,460	11,024	23.81	808
16	(C) DRAIN COOLING SECTION	29,220,144	2,297	25.95	490

CONSTRUCTION OF ONE SHELL

No.			SHELL SIDE	TUBE SIDE
17	DESIGN PRESSURE	PSI	385 & Vac.	840
18	TEST PRESSURE	PSI	578	1,260
19	DESIGN TEMPERATURE	°F	Skirt 910/Shell 445	Strs. 480/Bends 445

20 TUBES Monel SR B163 NO. 1212U's O. D. 3/4 B. W. G. .049A S. E. T. L.* 30'-11 PITCH 15/16
21 SHELL Steel I.D. 66 THICKNESS 7/8 (A-515-70
22 SHELL COVER Steel WELDED TO SHELL SHELL SKIRT CR-1/2Mo 1 thk (A-3
23 CHANNEL (SR) steel I.D. 52 CHANNEL COVER Steel XR
24 TUBE SHEETS Stl. or Forged Steel IMPINGEMENT BAFFLE - STNLS STEEL (2) 3/8
25 SUPPORT PLATES - STEEL AIR BAFFLE - STEEL (2) SEGMENTAL BAFFLE Steel
26 SHROUDS (A) Steel (C) Steel
27 TYPE JOINTS - SHELL SIDE Welded ** TUBESIDE Hemispherical 14"x18" Oper
28 GASKETS - SHELL None CHANNEL Metal Jacketed Asbestos
29 CONNECTIONS: STEAM-INLET (1) 16 DRAINS-INLET 10 SERIES Weld Ends
30 DRAINS-OUTLET 14 SERIES Weld Ends
31 FEED WATER-INLET 16 OUTLET 16 SERIES Weld Ends
32 CODE REQUIREMENTS ASME CODE SECTION VIII, DIV. I, & HEAT EXCHANGE INSTITUTE
33 WEIGHTS - SHELL AND BUNDLE BUNDLE ONLY FULL OF WATER
34 ACCESSORIES: SHELL SAFETY VALVE Included TUBE SIDE RELIEF VALVE Included
35 SHELL DRAINER By others. SHELL GAGE GLASS Included
36 REMARKS: (SR) INDICATES STRESS RELIEVING (XR) INDICATES RADIOGRAPHING
37 "U" TUBES WILL BE DUAL GAGE WHERE REQUIRED TO COMPENSATE FOR BEND THINNING
38 * S. E. T. L. - STRAIGHT EFFECTIVE TUBE LENGTH.

** Stainless steel flame protecting band provided at cut point.
1. Bends stress relieved after bending. 2. Tubes are roller expanded into double-grooved tubesheet. 3. Shell support rollers provided for shell removal. 4. Pass partition covers are sectioned and bolted to webbing. 5. Insulation clips provided

BRC 1-77-06-33009 Revised 9/29/77

NOTE: STRESS-RELIEVED PARTS MARK - "SR"
RADIOGRAPHED PARTS MARK - "XR"

1 SERVICE Feedwater Heater No. 7		CONSISTS OF: One (1)	SHELLS PER UNIT	
2 TYPE: U-Tube	SIZE: 65-361	ARRG'T Horizontal		
3 EFFECTIVE SURFACE PER SHELL: 17320		GROSS SURFACE PER SHELL: 17890		

PERFORMANCE OF ONE SHELL

ZONE	RATE	MTD	DUTY	SURFACE
DESUPERHEATING	144	82.17	25545100	2152
SUB COOLING	478	25.41	15350100	1264
CONDENSING	804	19.98	223258730	13904
TOTAL	-	-	264153930	17320

		SHELL SIDE		TUBE SIDE
FLUID CIRCULATED		STEAM	DRAINS	FEEDWATER
FLOW RATE - IN	LB/HR	295927	---	4331336
TEMPERATURE - IN	°F	648.2	---	436.4
- OUT	°F	446.4	---	491.7
ENTHALPY - IN	BTU/LB	1316.58	---	417.09
- OUT	BTU/LB	426.03	---	478.07
PRESSURE AT INLET	PSIA	631 (491.7 °F SAT. TEMP.)		---
PRESSURE DROP	PSI	DESUP. 1.6	DRAIN COOLER 3.1	15.4
VELOCITY	FT/SEC.	-		8.14 AT 60 °
NUMBER OF PASSES		DRAIN COOLER One		Two

CONSTRUCTION

		SHELL SIDE	TUBE SIDE
PRESSURE	PSIG	DESIGN 745 TEST 1118	DESIGN 3450 TEST 517
DESIGN TEMPERATURE	°F	515 700 SKIRT)	515 Bends/555 Str
CORROSION ALLOWANCE	IN.	----	----

CODES AND STANDARDS APPLIED - ASME Section VIII, Division I and HEI

TUBE LENGTH - TOTAL 32.7 EFFECTIVE 31.55

PART	NO.	SIZE	THICK.	MATERIAL ASTM NO.	DETAILS
TUBES	1678 U's	5/8 "O.D.	18 BWG	Monel B-163	PITCH 13/16 " Tria. ROLLED
SHELL	65	"I.D.	1 7/16 IN.	Stl. A-515-70	
SHELL COVER	65		1 7/16 IN.	Stl. A-515-70	WELDED ON
SKIRT	65		1 1/2 IN.	Stl. A-515-70	
CHANNEL	56		2 7/8 IN.	Stl. A-515-70	
CHANNEL COVER	17 1/8"		4 1/16 IN.	F'g'd. Stl. A-266-2	
FIXED TUBESHEET	67 7/8		12 7/16 IN.	F'g'd. Stl. A-350-LF2	WELDED IN
FLOAT. TUBESHEET	---		IN.		
FLOAT. HD. COVER	---		IN.		
SHROUDS			3/8 IN.	Stl. A-36	DESUP. 94" Lg DR. COOLER 55" Lg.
BAFFLES	(6) 60% & 20%		5/8&3/8 IN.	Stl. A-36	PITCH-(DESUP.) 15 11/16 (DR. COOLER) 6 3
SUPPORT PLATES	13		3/4 IN.	Stl. A-36	PITCH 23 1/2"
IMPACT PLATES	1		3/8 IN.	SS A-240-304	

GASKETS Soft Steel BOLTING A-193-B7

CONNECTIONS (NO., SIZE & RATING)	NO.	SIZE	RATING		NO.	SIZE	RATING
STEAM IN	1	14"	BW	DRAINS OUT	1	8"	BW
F.W. IN & OUT	1	18"	BW	SHELL RELIEF	1	4"	600# Flg.
DRAINS IN	---	---	----				

OVERALL LENGTH 37'-9" PULLING DISTANCE FROM F.W. NOZZLE 30'

WEIGHT - DRY 100,100 FLOODED 144,000 OPERATING --- BUNDLE ONLY 65,1[illegible]

MANUFACTURER MODEL PURCHASE ORDER

NOTES: Terminal Temperature Difference - 0 °F
Drain Subcooler Approach - 10 °F

REV.	DESCRIPTION	DATE	APPROVALS
0	ISSUED FOR BIDS	6/16/76	

FEEDWATER HEATER NO. 7
DATA SHEET
SPECIFICATION NO. 11230-M010
BOARDMAN PLANT UNIT NO. 1
PORTLAND GENERAL ELECTRIC COMPANY

BECHTEL POWER AND INDUSTRIAL DIVISION

JOB No 11230
11230-M010-DS-1
SHEET 6 OF 6
REV 0

N-310-E 4-15-63

PE 425

STRUTHERS WELLS

FEEDWATER HEATER SPECIFICATION SHEET

Revised 9/29/77

CUSTOMER · Portland G. E. Co.
ADDRESS Bechtel Power Corp., Cons'g. Eng'rs.
PLANT LOCATION Portland, Oregon

JOB
REF. 1-77-06-33009
PROPOSAL 8995-S6
DATE

1 SERVICE OF UNIT High Pressure Feedwater Htr. No. 7 ITEM NO. 7.0
2 SIZE 65-361 TYPE U-Tube Three Zone POSITION Horizontal
3 SURFACE PER UNIT 17,320 SQ. FT EFF. 17,890 SQ. FT. TOTAL 1 = NO. OF UNITS

PERFORMANCE OF ONE UNIT

No.			Shell Side		Tube Side
4	FLUID CIRCULATED		STEAM	DRAINS	FEED WATER
5	TOTAL FLUID ENTERING	#/HR.	295,927		4,331,336
6	INLET ENTHALPY	BTU/#	1316.58		417.09
7	OUTLET ENTHALPY	BTU/#		426.03	478.07
8	INLET TEMPERATURE	°F	648.2 (491.7 SAT.)		436.40
9	OUTLET TEMPERATURE	°F		446.40	491.70
10	OPERATING PRESSURE	P. S. I. A.		631.0	
11	NUMBER OF PASSES	PER SHELL	Three Zones (Two Shrouded)		Two
12	VELOCITY	F. P. S.			8.14 AT SP. GR. = 1
13	PRESSURE DROP	P. S. I.	(A) 1.6	(C) 3.1	15.4

No.		HEAT EXCHANGED BTU/HR.	SURFACE SQ. FT.	M T D °F	TRANSFER RATE BTU/HR./SQ. FT./°F.
14	(A) DESUPERHEATING SECTION	25,545,100	2,152	82.17	144
15	(B) CONDENSING SECTION	223,258,730	13,904	19.98	804
16	(C) DRAIN COOLING SECTION	15,350,100	1,264	25.41	418

CONSTRUCTION OF ONE SHELL

No.			SHELL SIDE	TUBE SIDE
17	DESIGN PRESSURE	PSI	750 and Vac.	3,450
18	TEST PRESSURE	PSI	1,125	5,175
19	DESIGN TEMPERATURE	°F	Skirt 700/Shell 515	Strs. 558/Bends 515

20 TUBES Monel SR B163 NO. 1678U's O. D. 5/8 B. W. G. 18Min. S. E. T. L.* 30'-1 PITCH 13/16 Δ
21 SHELL Steel I.D. 65 THICKNESS 1 7/16 (A-515-
22 SHELL COVER Steel WELDED TO SHELL SHELL SKIRT Steel 1-1/2thk (A-515-70) XR
23 CHANNEL (SR) Steel I.D. 56 CHANNEL COVER Stl. or Forged Stl.
24 TUBE SHEETS Forged Steel IMPINGEMENT BAFFLE - STNLS STEEL (1) 3/8t
25 SUPPORT PLATES - STEEL AIR BAFFLE - STEEL (2) SEGMENTAL BAFFLE Steel
26 SHROUDS (A) Steel (C) Steel
27 TYPE JOINTS - SHELL SIDE Welded ** TUBESIDE Hemispherical (18" opening)
28 GASKETS - SHELL None CHANNEL Soft Steel
29 CONNECTIONS: STEAM-INLET (1) 14 DRAINS-INLET SERIES Weld Ends
30 DRAINS-OUTLET 12 SERIES Weld Ends
31 FEED WATER-INLET 18 I.D. OUTLET 18 I.D. SERIES Weld Ends
32 CODE REQUIREMENTS ASME CODE SECTION VIII, DIV. I, & HEAT EXCHANGE INSTITUTE
33 WEIGHTS - SHELL AND BUNDLE BUNDLE ONLY FULL OF WATER
34 ACCESSORIES: SHELL SAFETY VALVE Included TUBE SIDE RELIEF VALVE Included
35 SHELL DRAINER By others SHELL GAGE GLASS Included
36 REMARKS: (SR) INDICATES STRESS RELIEVING (XR) INDICATES RADIOGRAPHING
37 "U" TUBES WILL BE DUAL GAGE WHERE REQUIRED TO COMPENSATE FOR BEND THINNING 12
38 * S. E. T. L. - STRAIGHT EFFECTIVE TUBE LENGTH. Inner Rows 17 Min.

** Stainless steel flame protecting band provided at cut point.

1. Internal shroud provided in outlet pass of channel. 2. Bends stress relieved afte bending. 3. Shell support rollers provided for shell removal. 4. Pass partition covers are sectioned and bolted to webbing. 5. Insulation clips provided on approx. 18 inch centers. 6. Tube and shell sides are nitrogen blanketed.

SERVICE: MAIN T/G STEAM CONDENSER — EQUIPMENT NO: 1-E000A & B

TYPE: SURFACE

IB4-OB4-41.833 Twin Shell Single Press.

PERFORMANCE

EFFECTIVE SURFACE	285,000 SQ. FT.		
DUTY	2490 x 10-6 BTU/HR		
MTD °F	CONDENSATE RESIDENCE TIME 6.2 MIN.	CLEANLINESS FACTOR 85 %	
HEAT TRANSFER RATE	592.71 BTU/HR/°F/SQ. FT.		
GUARANTEED CONDENSATE & TURBINE EXHAUST TEMP. DIFF.	Per Spec. °F MAX		
GUARANTEED EXHAUST PRESSURE AT TURBINE EXHAUST FLANGE	5.12 "HG ABS		

	SHELL SIDE	TUBE SIDE
FLUID CIRCULATED	STEAM	CIRCULATING WATER
FLOW RATE	2,427,832 #/HR	180,000 GPM
TEMPERATURE IN °F	134.67	102.00
OUT °F	134.67	129.67
OPERATING PRESSURE	5.12 "HG ABS	50.0 PSIG
PRESSURE DROP FT. OF WATER	—	20.05
VELOCITY FT./SEC.	—	6.54
NO. OF PASSES	—	One Per Shell
MAX. FREE O_2 IN CONDENSATE	0.005 CC PER LITER	

CONSTRUCTION

DESIGN PRESSURE	15 PSIG & Full Vac "HG ABS	50.0 PSIG
TEST PRESSURE PSIG	Fill With Water	75.0
HOTWELL CAPACITY: CU. FT. 6283.	REQUIRED 6283.	ACTUAL 6283.

CODES AND STANDARDS APPLIED

PART	NO.	SIZE	THICK.	MATERIAL ASTM NO.	DETAILS
TUBES – COND. SECT.	24924	1" O.D.	20 BWG	See Remarks	ROLLED
TUBES – COOLER SECT.	1100	1" O.D.	20 BWG	90:10 CuNiB543-706	ROLLED
SHELL	2	24' x 23'	3/4" IN.	C.S. A285-Gr C	
WATER BOXES	8	12'-3"x8'-0"x 9'-0"	IN.	C.S. A285-Gr C	
WATER BOX COVERS	4	12'-3" x 8'-0"	1 1/4 in	C.S. A285-Gr C	
TUBESHEETS	8	12'-11"x 8'-8"	1 IN.	Muntz B171-365	
SUPPORT PLATES	14	14'-0" x 11'-6"	5/8" IN.	C.S. A285-Gr C	SPACING 36" & 30" INCH
HOTWELL – SIDES	Integral With Shell		IN.	—	
HOTWELL – BOTTOM	2	23'x41' x	3/4" IN.	C.S. A285-Gr C	
NECK PIECE					

CONNECTIONS: (SIZE & RATING) STEAM INLET 19'-0" x 16' - 0" — COND. OUTLET 30"

WATER BOX 72" 125# LWF — AIR OFFTAKE 2-10"

EXPANSION JOINT – TYPE Per Spec — MAT'L

TUBES: LENGTH – EFFECTIVE: 41'-10" OVERALL: 42'-0" WEIGHT: 449,400

CONDENSER SUPPORTS Steel And Lubrite

UNIT WEIGHT – EMPTY 1,329,000 lbs. OPERATING 2,157,200 lbs. FLOODED 4,672,000 lbs.

MANUFACTURER	Southwestern Engineering	FOREIGN PRINT NO.	
MODEL	IB1-0B4-41.833		
VENDOR		LOCATION DWG. NO:	
PURCHASE ORDER NO.	D-00019	P & I DIAGRAM NO:	

REMARKS 2656--1" O.D. 20 BWG ASTM B543-715 70:30 CuNi Impingement Tubes
22268--1" O.D. 20 BWG ASTM B543-706 90:10 CuNi Main Condensing Section

REV.	DESCRIPTION
0	ISSUED FOR BIDS
1	ISSUED FOR PURCHASE

APPROVALS: MATL, SUPV, CHK, DR, ENG

BECHTEL — TPO

SURFACE CONDENSER DATA SHEET

BOARDMAN PLANT UNIT NO. 1
PORTLAND GENERAL ELECTRIC COMPANY

JOB NO. 11230

M-4-DS-1 — REV 1

SHEET 1 OF 1

M-320-E 3-18-74

FORM 814 REV. 1

Southwestern Engineering 6111 E. Bandini Blvd., P.O. Box 54940, Terminal Annex Los Angeles, Cal. 90054, Tel: 213/685

SURFACE CONDENSER SPECIFICATION SHEET

1	CUSTOMER Portland General Electric	JOB NO. 5697-20
2	ADDRESS Portland, Oregon	FILE NO. 29664
3	PLANT LOCATION	INQUIRY NO.
4	SERVICE OF UNIT Main Condenser	DATE 7-12-78
5	NO. UNITS One	ITEM NO.
6	SIZE: 285,000 SQ. FT. TYPE IB1-OB4-41.833	SPECIFICATION NO. 11230-M-4
7	**SHELL SIDE**	**TUBE SIDE**
8	STEAM TO UNIT #/HR. 2,427,832	SOURCE WATER
9	NON CONDENSABLES #/HR.	GPM 180,000
10	LATENT HEAT BTU/#	WATER IN °F. 102.0
11	U SERVICE 592.71 BTU/HR. Sq. Ft. F	WATER OUT °F. 129.67
12	CLEANLINESS FACTOR 85.0 Percent	NUMBER PASSES Two/One Per Shell
13	TEMPERATURE IN 134.67 F	PRESSURE DROP 20.05 Ft. Water
14	TEMPERATURE OUT 134.67 F	VELOCITY FT./SEC. 6.54
15	LMTD 14.74 F	
16	OPERATING PRESSURE 5.12 In Hg. abs.	
17	PRESSURE DROP	
18	TOTAL BTU DUTY PER HR. 2490 x 10^{-6}	
19		
20	SHELL: DESIGN PRESSURE 15 PSIG & Full Vac TEST PRESSURE Fill With Water	CODE REQUIREMENTS H
21	MATERIAL A-285 Gr C HEIGHT 24' - 0" WIDTH 23' - 0"	LENGTH 41' - 0" THICKNESS 3/4"
22	NUMBER & THICKNESS TUBE SUPPORTS 14 - 5/8"	TUBE SUPPORT MATERIAL A285 Gr C
23	DIFFERENTIAL SPACING: MAX. SPACE 36"	MIN. SPACE 30"
24	STEAM INLET NOZZLE(S): NUMBER Two	DIMENSIONS 19'-0"x16'-0" FLG. FACING BW
25	NUMBER AIR OFFTAKES Two SIZE 10"	FACING BW AIR MANIFOLD Yes
26	OPENINGS: NORMAL TEST, DRAIN, GAGE, VENT AND RETURN, AND Access	
27		
28	WATER BOX & REVERSING CHAMBER: DESIGN PRESSURE 50 PSIG	TEST PRESSURE 75 PSIG
29	MATERIAL A285 Gr C HEIGHT 12'-3" WIDTH 8'-0"	DEPTH 9'-0"/7'-5" THICKNESS 15/16"
30	NUMBER INLET NOZZLES Two SIZE 72"	NUMBER OUTLET NOZZLES Two SIZE 72"
31	FACING FF Flanged NUMBER OF COVERS 4	THICKNESS 1 1/4" LIFTING EYES Yes
32	HINGED DAVITED	DRAINS 4-4" VENTS 4-4"
33	OPENINGS 2-20" 0 Manways Per Box	CORROSION ALLOWANCE 1/16"
34	WATER BOX REMOVABLE Yes	REVERSING CHAMBER REMOVABLE Yes
35	TUBES: MATERIAL 90:10 CuNi NUMBER 26024*	GAGE & DIA. 20 BWG-1" LENGTH 42'-0" OVE
36	PITCH 1.250"	TUBES IN AIR COOLER(S) 1100 BOWED Sloped
37	PRE-STRESSED	BELLED Inlet End WELDED
38	*Includes 1100 90:10 CuNi Air Cooler Tubes	
39	TUBE SHEETS: MATERIAL Muntz Metal HEIGHT 12'-11"	WIDTH 8'-8" THICKNESS 1"
40	NUMBER ON WATER BOX END 4	NUMBER ON REVERSING CHAMBER END 4
41	DIAMETER HOLES 1.011"	DOUBLE GROOVED Yes CHAMFERED Yes
42		
43	HOTWELL: MATERIAL A285 Gr C HEIGHT **	WIDTH 23'-0" LENGTH 41'-0"
44	THICKNESS 3/4" STORAGE 1493 Ft^3	AT 1'-7" NORMAL LEVEL
45	OXYGEN GUARANTEE 0.005 cc/l	NUMBER PUMP SUCTION CONNECTIONS One *** SIZE 30"
46	** Integral With Shell	*** One Shell Only
47	WEIGHTS: EMPTY 664,500 lbs. OPERATING 1,078,600 lbs.	MAX. (FLOODED SHELL) 2,336,000 lbs.
48	WEIGHTS: WATER BOX 14,700 lbs.	Transfer 15,200 lbs.
49	REMARKS Line 47-Weights are shown for one shell-Two Shells Required	
50		
51		
52		
53		
54		
55		

Specification No. 11230-M009
Rev. 1 1/6/77

APPENDIX A – RATED CONDITIONS

The deaerating feedwater heater shall be designed in conformance with the operating conditions below:

1. Condensate entering deaerator:

Quantity, lb/hr	3,328,178
Enthalpy, Btu/lb	199
Temperature, F	231

2. Extraction steam entering deaerator:

Quantity, lb/hr	216,295
Enthalpy, Btu/lb	1,276
Pressure at deaerator inlet, psia	65

3. High-pressure heater drains entering deaerator:

Quantity, lb/hr	786,863
Enthalpy, Btu/lb	279
Temperature, F	309

4. Deaerated condensate leaving deaerator:

Quantity, lb/hr	4,331,336
Enthalpy, Btu/lb	267
Temperature, F	298
Pressure at heater outlet, psia	65

DA.

TABLE OF CONTENTS

DESIGN SPECIFICATIONS

Type:	Tray Type H-H
Heater Size:	8'-0" diameter x 36'-0" straight
Storage Size:	12'-0" diameter x 73'-0" straight
Construction:	ASME = HEI
Material	285-C
Design Pressure:	65 psig FV
Storage Capacity:	53,775 gal.
Outlet Capacity:	4,331,336#/hr.
Operating Pressure:	65 psia
Makeup:	
Condensate:	
H.P. Drains:	

ISO 9000

From Wikipedia, the free encyclopedia
(Redirected from ISO 9001)

ISO 9000 is a family of standards for quality management systems. ISO 9000 is maintained by ISO, the International Organization for Standardization and is administered by accreditation and certification bodies. Some of the requirements in ISO 9001 (which is one of the standards in the ISO 9000 family) include

- a set of procedures that cover all key processes in the business;
- monitoring processes to ensure they are effective;
- keeping adequate records;
- checking output for defects, with appropriate and corrective action where necessary;
- regularly reviewing individual processes and the quality system itself for effectiveness; and
- facilitating continual improvement

A company or organization that has been independently audited and certified to be in conformance with ISO 9001 may publicly state that it is "ISO 9001 certified" or "ISO 9001 registered". Certification to an ISO 9000 standard does not guarantee any quality of end products and services; rather, it certifies that formalized business processes are being applied. Indeed, some companies enter the ISO 9001 certification as a marketing tool.

Although the standards originated in manufacturing, they are now employed across several types of organization. A "product", in ISO vocabulary, can mean a physical object, services, or software. In fact, according to ISO in 2004, *"service sectors now account by far for the highest number of ISO 9001:2000 certificates - about 31% of the total."* [1]

Contents

ISO 9000 family

ISO 9000 includes standards:

- **ISO 9000:2000, Quality management systems – Fundamentals and vocabulary.** Covers the basics of what quality management systems are and also contains the core language of the ISO 9000 series of standards. A guidance document, not used for certification purposes, but important reference document to understand terms and vocabulary related to quality management systems. In the year 2005, revised ISO 9000:2005 standard has been published, so it is now advised to refer to ISO 9000:2005.
- **ISO 9001:2000 Quality management systems – Requirements** is intended for use in any organization which designs, develops, manufactures, installs and/or services any product or provides any form of service. It provides a number of requirements which an organization needs to fulfill if it is to achieve customer satisfaction through consistent products and services which meet customer expectations. It includes a requirement for the continual (i.e. planned) improvement of the Quality Management System, for which ISO 9004:2000 provides many hints.

This is the only implementation for which third-party auditors may grant certification. It should be noted that certification is not described as any of the 'needs' of an organization as a driver for using ISO 9001 (*see* ISO 9001:2000 section 1 'Scope') but does recognize that it may be used for such a purpose (*see* ISO 9001:2000 section 0.1 'Introduction').

- **ISO 9004:2000 Quality management systems - Guidelines for performance improvements.** covers continual improvement. This gives you advice on what you could do to enhance a mature system. This standard very specifically states that it is not intended as a guide to implementation.

There are many more standards in the ISO 9001 family (see "List of ISO 9000 standards" (http://www.iso.ch/iso/en/CatalogueListPage.CatalogueList?ICS1=3&ICS2=120&ICS3=10&scopelist=) from ISO), many of them not even carrying "ISO 900x" numbers. For example, some standards in the 10,000 range are considered part of the 9000 family: **ISO 10007:1995** discusses Configuration management, which for most organizations is just one element of a complete management system. ISO notes: "The emphasis on certification tends to overshadow the fact that there is an entire family of ISO 9000 standards ... Organizations stand to obtain the greatest value when the standards in the new core series are used in an integrated manner, both with each other and with the other standards making up the ISO 9000 family as a whole".

Note that the previous members of the ISO 9000 family, 9001, 9002 and 9003, have all been integrated into 9001. In most cases, an organization claiming to be "ISO 9000 registered" is referring to ISO 9001.

Contents of ISO 9001

ISO 9001:2000 Quality management systems — Requirements is a document of approximately 30 pages which is available from the national standards organization in each country. Outline contents are as follows:

- Page iv: *Foreword*
- Pages v to vii: Section 0 *Introduction*

- Pages 1 to 14: *Requirements*
  - Section 1: *Scope*
  - Section 2: *Normative Reference*
  - Section 3: *Terms and definitions* (specific to ISO 9001, not specified in ISO 9000)
- Pages 2 to 14
  - Section 4: *Quality Management System*
  - Section 5: *Management Responsibility*
  - Section 6: *Resource Management*
  - Section 7: *Product Realization*
  - Section 8: *Measurement, analysis and improvement*

In effect, users need to address all sections 1 to 8, but only 4 to 8 need implementing within a QMS.

- Pages 15 to 22: Tables of Correspondence between ISO 9001 and other standards
- Page 23: *Bibliography*

The standard specifies six compulsory documents:

- Control of Documents (4.2.3)
- Control of Records (4.2.4)
- Internal Audits (8.2.2)
- Control of Nonconforming Product / Service (8.3)
- Corrective Action (8.5.2)
- Preventive Action (8.5.3)

In addition to these, ISO 9001:2000 requires a Quality Policy and Quality Manual (which may or may not include the above documents).

Summary of ISO 9001:2000 in informal language

- The quality policy is a formal statement from management, closely linked to the business and marketing plan and to customer needs. The quality policy is understood and followed at all levels and by all employees. Each employee needs measurable objectives to work towards.
- Decisions about the quality system are made based on recorded data and the system is regularly audited and evaluated for conformance and effectiveness.
- Records should show how and where raw materials and products were processed, to allow products and problems to be traced to the source.
- You need a documented procedure to control quality documents in your company. Everyone must have access to up-to-date documents and be aware of how to use them.
- To maintain the quality system and produce conforming product, you need to provide suitable infrastructure, resources, information, equipment, measuring and monitoring devices, and environmental conditions.
- You need to map out all key processes in your company; control them by monitoring, measurement and analysis; and ensure that product quality objectives are met. If you can't monitor a process by measurement, then make sure the process is well enough defined that you can make adjustments if the product does not meet user needs.
- For each product your company makes, you need to establish quality objectives; plan processes; and document and measure results to use as a tool for improvement. For each process, determine what kind of procedural documentation is required (note: a "product" is hardware, software, services, processed materials, or a combination of these).

- You need to determine key points where each process requires monitoring and measurement, and ensure that all monitoring and measuring devices are properly maintained and calibrated.
- You need to have clear requirements for purchased product.
- You need to determine customer requirements and create systems for communicating with customers about product information, inquiries, contracts, orders, feedback and complaints.
- When developing new products, you need to plan the stages of development, with appropriate testing at each stage. You need to test and document whether the product meets design requirements, regulatory requirements and user needs.
- You need to regularly review performance through internal audits and meetings. Determine whether the quality system is working and what improvements can be made. Deal with past problems and potential problems. Keep records of these activities and the resulting decisions, and monitor their effectiveness (note: you need a documented procedure for internal audits).
- You need documented procedures for dealing with actual and potential nonconformances (problems involving suppliers or customers, or internal problems). Make sure no one uses bad product, determine what to do with bad product, deal with the root cause of the problem and keep records to use as a tool to improve the system.

1987 version

ISO 9000:1987 had the same structure as the UK Standard BS 5750, with three 'models' for quality management systems, the selection of which was based on the scope of activities of the organization:

- ISO 9001:1987 *Model for quality assurance in design, development, production, installation, and servicing* was for companies and organizations whose activities included the creation of new products.
- ISO 9002:1987 *Model for quality assurance in production, installation, and servicing* had basically the same material as ISO 9001 but without covering the creation of new products.
- ISO 9003:1987 *Model for quality assurance in final inspection and test* covered only the final inspection of finished product, with no concern for how the product was produced.

ISO 9000:1987 was also influenced by existing U.S. and other Defense Standards ("MIL SPECS"), and so was well-suited to manufacturing. The emphasis tended to be placed on conformance with procedures rather than the overall process of management—which was likely the actual intent.

1994 version

ISO 9000:1994 emphasized quality assurance via preventive actions, instead of just checking final product, and continued to require evidence of compliance with documented procedures. As with the first edition, the down-side was that companies tended to implement its requirements by creating shelf-loads of procedure manuals, and becoming burdened with an ISO bureaucracy. In some companies, adapting and improving processes could actually be impeded by the quality system.

2000 version

ISO 9001:2000 combines the three standards 9001, 9002, and 9003 into one, called 9001. Design and development procedures are required only if a company does in fact engage in the creation of new products. The 2000 version sought to make a radical change in thinking by actually placing the concept of process management front and center ("Process management" was the monitoring and optimizing of a company's tasks and activities, instead of just inspecting the final product). The 2000 version also demands involvement by upper executives, in order to integrate quality into the business system and avoid delegation of quality functions to junior administrators. Another goal is to improve effectiveness via process performance metrics — numerical measurement of the effectiveness of tasks and activities. Expectations of continual process improvement and tracking customer satisfaction were made explicit.

The ISO 9000 standard is continually being revised by standing technical committees and advisory groups, who receive feedback from those professionals who are implementing the standard.[1] (http://iso9001-consultant.co.uk/)

2008 version

ISO 9001:2008 only introduces clarifications to the existing requirements of ISO 9001:2000 and some changes intended to improve consistency with ISO14001:2004. There are no new requirements. A quality management system being upgraded just needs to be checked to see if it is following the clarifications introduced in the amended version.[2]

Certification

ISO does not itself certify organizations. Many countries have formed accreditation bodies to authorize certification bodies, which audit organizations applying for ISO 9001 compliance certification. Although commonly referred to as ISO 9000:2000 certification, the actual standard to which an organization's quality management can be certified is ISO 9001:2000. Both the accreditation bodies and the certification bodies charge fees for their services. The various accreditation bodies have mutual agreements with each other to ensure that certificates issued by one of the Accredited Certification Bodies (CB) are accepted worldwide.

The applying organization is assessed based on an extensive sample of its sites, functions, products, services and processes; a list of problems ("action requests" or "non-compliances") is made known to the management. If there are no major problems on this list, the certification body will issue an ISO 9001 certificate for each geographical site it has visited, once it receives a satisfactory improvement plan from the management showing how any problems will be resolved.

An ISO certificate is not a once-and-for-all award, but must be renewed at regular intervals recommended by the certification body, usually around three years. In contrast to the Capability Maturity Model there are no grades of competence within ISO 9001.

Auditing

Two types of auditing are required to become registered to the standard: auditing by an external certification body (external audit) and audits by internal staff trained for this process (internal audits). The aim is a continual process of review and assessment, to verify that the system is working as it's supposed to, find out where it can improve and to correct or prevent problems identified. It is considered healthier for internal auditors to audit outside their usual management line, so as to bring a degree of independence to their judgments.

Under the 1994 standard, the auditing process could be adequately addressed by performing "compliance auditing":

- Tell me what you do *(describe the business process)*
- Show me where it says that *(reference the procedure manuals)*
- Prove that that is what happened *(exhibit evidence in documented records)*

How this led to preventive actions was not clear.

The 2000 standard uses the process approach. While auditors perform similar functions, they are expected to go beyond mere auditing for rote "compliance" by focusing on risk, status and importance. This means they are expected to make more judgments on what is effective, rather than merely adhering to what is formally prescribed. The difference from the previous standard can be explained thus:

> Under the 1994 version, the question was broadly "Are you doing what the manual says you should be doing?", whereas under the 2000 version, the question is more "Will this process help you achieve your stated objectives? Is it a good process or is there a way to do it better?".

The ISO 19011 standard for auditing applies to ISO 9001 besides other management systems like EMS (ISO 14001), FSMS (ISO 22000) etc.

Industry-specific interpretations

The ISO 9001 standard is generalized and abstract. Its parts must be carefully interpreted, to make sense within a particular organization. Developing software is not like making cheese or offering counseling services; yet the ISO 9001 guidelines, because they are business management guidelines, can be applied to each of these. Diverse organizations—police departments (US), professional soccer teams (Mexico) and city councils (UK)—have successfully implemented ISO 9001:2000 systems.

Over time, various industry sectors have wanted to standardize their interpretations of the guidelines within their own marketplace. This is partly to ensure that their versions of ISO 9000 have their specific requirements, but also to try and ensure that more appropriately trained and experienced auditors are sent to assess them.

- The **TickIT** guidelines are an interpretation of ISO 9000 produced by the UK Board of Trade to suit the processes of the information technology industry, especially software development.
- **AS9000** is the Aerospace Basic Quality System Standard, an interpretation developed by major aerospace manufacturers. Those major manufacturers include AlliedSignal, Allison Engine, Boeing, General Electric Aircraft Engines, Lockheed-Martin, McDonnell Douglas, Northrop Grumman, Pratt & Whitney, Rockwell-Collins, Sikorsky Aircraft, and Sundstrand. The current version is **AS9100**.
- **PS 9000** is an application of the standard for Pharmaceutical Packaging Materials. The Pharmaceutical Quality Group (PQG) of the Institute of Quality Assurance (IQA) has developed PS 9000:2001. It aims to provide a widely accepted baseline GMP framework of best practice within the pharmaceutical packaging supply industry. It applies ISO 9001: 2000 to pharmaceutical printed and contact packaging materials.
- **QS 9000** is an interpretation agreed upon by major automotive manufacturers (GM, Ford, Chrysler). It includes techniques such as FMEA and APQP. QS 9000 is now replaced by ISO/TS 16949.
- **ISO/TS 16949:2002** is an interpretation agreed upon by major automotive manufacturers (American and European manufacturers); the latest version is based on ISO 9001:2000. The emphasis on a process approach is stronger than in ISO 9001:2000. ISO/TS 16949:2002 contains

the full text of ISO 9001:2000 and automotive industry-specific requirements.

- **TL 9000** is the Telecom Quality Management and Measurement System Standard, an interpretation developed by the telecom consortium, QuEST Forum (http://www.questforum.org/). The current version is 4.0 and unlike ISO 9001 or the above sector standards, TL 9000 includes standardized product measurements that can be benchmarked. In 1998 QuEST Forum developed the TL 9000 Quality Management System to meet the supply chain quality requirements of the worldwide telecommunications industry.
- **ISO 13485:2003** is the medical industry's equivalent of ISO 9001:2000. Whereas the standards it replaces were interpretations of how to apply ISO 9001 and ISO 9002 to medical devices, ISO 13485:2003 is a stand-alone standard. Compliance with ISO 13485 does not necessarily mean compliance with ISO 9001:2000.

Debate on the effectiveness of ISO 9000

The debate on the effectiveness of ISO 9000 commonly centers on the following questions:

1. Are the quality principles in ISO 9001:2000 of value? (Note that the version date is important: in the 2000 version ISO attempted to address many concerns and criticisms of ISO 9000:1994).
2. Does it help to implement an ISO 9001:2000 compliant quality management system?
3. Does it help to obtain ISO 9001:2000 certification?

Advantages

It is widely acknowledged that proper quality management improves business, often having a positive effect on investment, market share, sales growth, sales margins, competitive advantage, and avoidance of litigation.[3][4] The quality principles in ISO 9000:2000 are also sound, according to Wade,[5] and Barnes, [4] who says "ISO 9000 guidelines provide a comprehensive model for quality management systems that can make any company competitive." Barnes also cites a survey by Lloyd's Register Quality Assurance which indicated that ISO 9000 increased net profit, and another by Deloitte-Touche which reported that the costs of registration were recovered in three years. According to *the Providence Business News* [6], implementing ISO often gives the following advantages:

1. Create a more efficient, effective operation
2. Increase customer satisfaction and retention
3. Reduce audits
4. Enhance marketing
5. Improve employee motivation, awareness, and morale
6. Promote international trade
7. Increases profit
8. Reduce waste and increases productivity

However, a broad statistical study of 800 Spanish companies [7] found that ISO 9000 registration in itself creates little improvement because companies interested in it have usually already made some type of commitment to quality management and were performing just as well before registration.[3]

In today's service-sector driven economy, more and more companies are using ISO 9000 as a business tool. Through the use of properly stated quality objectives, customer satisfaction surveys and a well-defined continual improvement program companies are using ISO 9000 processes to increase their efficiency and profitability.

Problems

A common criticism of ISO 9001 is the amount of money, time and paperwork required for registration.[8] According to Barnes, "Opponents claim that it is only for documentation. Proponents believe that if a company has documented its quality systems, then most of the paperwork has already been completed."[4]

According to Seddon, ISO 9001 promotes specification, control, and procedures rather than understanding and improvement. [9] [10] Wade argues that ISO 9000 is effective as a guideline, but that promoting it as a standard "helps to mislead companies into thinking that certification means better quality, ... [undermining] the need for an organization to set its own quality standards." [5] Paraphrased, Wade's argument is that reliance on the specifications of ISO 9001 does not guarantee a successful quality system.

The standard is seen as especially prone to failure when a company is interested in certification before quality.[9] Certifications are in fact often based on customer contractual requirements rather than a desire to actually improve quality.[4][11] "If you just want the certificate on the wall, chances are, you will create a paper system that doesn't have much to do with the way you actually run your business," said ISO's Roger Frost.[11] Certification by an independent auditor is often seen as the problem area, and according to Barnes, "has become a vehicle to increase consulting services." [4] In fact, ISO itself advises that ISO 9001 can be implemented without certification, simply for the quality benefits that can be achieved. [12]

Another problem reported is the competition among the numerous certifying bodies, leading to a softer approach to the defects noticed in the operation of the Quality System of a firm.

Summary

A good overview for effective use of ISO 9000 is provided by Barnes: [4]

> "Good business judgment is needed to determine its proper role for a company... Is certification itself important to the marketing plans of the company? If not, do not rush to certification... Even without certification, companies should utilize the ISO 9000 model as a benchmark to assess the adequacy of its quality programs."

See also

- ISO 10006 Quality management—Guidelines to quality management in projects
- ISO 14000—Environmental management standards
- ISO 19011—Guidelines for quality management systems auditing and environmental management systems auditing
- ISO/TS 16949—Quality management system requirements for automotive-related products suppliers
- Verification and Validation
- Quality management system

References

1. ^ the ISO Survey 2004 (http://www.iso.org/iso/en/iso9000-14000/certification/isosurvey.html)
2. ^ ISO 9001:2008 (http://www.iso.org/iso/iso_catalogue/management_standards/iso_9000_iso_14000/iso_9001_2008.htm)
3. ^ *a* *b* "Probing the Limits: ISO 9001 Proves Ineffective" (http://www.qualitymag.com/CDA/Archives/17062620c7c38010VgnVCM100000f932a8c0____) Scott Dalgleish. *Quality Magazine* April 1, 2005.
4. ^ *a* *b* *c* *d* *e* *f* "Good Business Sense Is the Key to Confronting ISO 9000" (http://www.allbusiness.com/specialty-businesses/713376-1.html) Frank Barnes in *Review of Business*, Spring 2000.
5. ^ *a* *b* "Is ISO 9000 really a standard?" (http://www.bin.co.uk/IMS_May_2002.pdf) Jim Wade, ISO Management Systems – May-June 2002
6. ^ "Reasons Why Companies Should Have ISO Certification", *Providence Business News*, August 28, 2000.
7. ^ "ISO 9000 registration's impact on sales and profitability: A longitudinal analysis of performance before and after accreditation." Iñaki Heras, Gavin P.M. Dick, and Martí Casadesús. *International Journal of Quality and Reliability Management* Vol 19, No. 6, 2002.
8. ^ "So many standards to follow, so little payoff" (http://www.inc.com/magazine/20050501/management.html). Stephanie Clifford. *Inc Magazine,* May 2005.
9. ^ *a* *b* "The 'quality' you can't feel" (http://money.guardian.co.uk/work/story/0,,613363,00.html), John Seddon, *The Observer*, Sunday November 19, 2000
10. ^ "A Brief History of ISO 9000: Where did we go wrong?" (http://www.lean-service.com/3-1-article.asp). John Seddon. Chapter one of "The Case Against ISO 9000", 2nd ed., Oak Tree Press. November 2000. ISBN 1-86076-173-9
11. ^ *a* *b* "ISO a GO-Go." (http://www.entrepreneur.com/magazine/entrepreneur/2001/december/46342.html) Mark Henricks. *Entrepreneur Magazine* Dec 2001.
12. ^ *The ISO Survey – 2005* (http://www.iso.org/iso/en/iso9000-14000/pdf/survey2005.pdf) (abridged version, PDF, 3 MB), ISO, 2005

- http://www.iso.org/iso/survey2007.pdf - An abstract of the latest ISO survey of certificates

Further reading

- Bamford, Robert; Deibler, William (2003). *ISO 9001: 2000 for Software and Systems Providers: An Engineering Approach* (1st ed.). CRC-Press. ISBN-10: 0849320631, ISBN-13: 978-0849320637

- Naveh. E., Marcus, A. (2004). "When does ISO 9000 Quality Assurance standard lead to performance improvement?", *IEEE Transactions on Engineering Management*, 51(3), 352–363.

External links

- ISO (http://www.iso.org/) (International Organization for Standardization)
  - Introduction to ISO 9000 and ISO 14000 (http://www.iso.org/iso/iso_catalogue/management_standards/iso_9000_iso_14000.htm)
  - List (http://www.iso.org/iso/en/prods-services/ISOstore/memberstores.html) of national ISO member organizations.
  - The ISO Survey – 2007 (http://www.iso.org/iso/survey2007.pdf) [PDF 620 KB]
- ISO's Technical Committee 176 (http://www.tc176.org/) on Quality Management and Quality Assurance
  - Technical Committee No. 176, Sub-committee No. 2 (http://www.iso.org/tc176/sc2), which is responsible for developing ISO 9000 standards.
  - Basic info (http://www.tc176.org/About176.asp) on ISO 9000 development

  - ISO 9000 FAQs (http://www.tc176.org/FAQ.asp)
  - ISO 9001 Interpretations (http://www.tc176.org/Interpre.asp)
- ISO 9001 Turkey (http://www.iso.com.tr/)
- ISO9000Council (http://www.iso9000council.org/) with tips on ISO 9000 implementation

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CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

Siemens Power Generation

Headquarters:

Erlangen - Bayern, Germany (Worldwide)

Orlando - FL, USA (Americas Region)

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
BS EN ISO 9001 :2000

The Quality Management System is applicable to:

Sales, Marketing, 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 Applications 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:	*July 11, 2005*
Certificate Expiry:	*August 31, 2007*

Issued by LRQA, Inc. Houston

Deutscher Akkreditierungs Rat
DAR
TGA-ZM-02-91-00

UKAS QUALITY MANAGEMENT
001

ANAB ACCREDITED

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.
The use of the UKAS Accreditation Mark indicates Accreditation in respect of those activities covered by the Accreditation Certificate Number 001
Macro Revision 13

CERTIFICATE SCHEDULE

Siemens Power Generation

Certified Locations

Orlando – FL, USA
Alpharetta – GA, USA
Atlanta – GA, USA
Charlotte – NC, USA
Fort Payne – AL, USA
Hamilton – ONT, CA
Houston – TX, USA
Pittsburgh – PA, USA
Trenton – NJ, USA

Erlangen – Bayern, DE
Aberdeen, Scotland, UK
Berlin – Berlin, DE
Brno, CZ
Budapest, HU
Duisburg – NRW, DE
Erfurt – Thüringen, DE
Essen – Nordrhein-Westfallen, DE
Finspong, SE
Görlitz – Sachsen, DE
Hengelo, ND
Karlsruhe – Baden-Württemberg, DE
Lincoln – Lincolnshire, UK
Ludvika, SE
Mülheim – Nordrhein-Westfallen, DE
Newcastle-upon-Tyne, UK
Nürnberg – Bayen, DE
Offenbach – Hessen, DE

Approval
Certificate No: UQA 0100412

Original Approval: November 20, 1992
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Macro Revision 13

CERTIFICATE SCHEDULE

Siemens Power Generation

Head Office	Activities
Siemens PG Erlangen – Bayern, Germany	*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, Germany	*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.*

Approval
Certificate No: UQA 0100412

Original Approval: *November 20, 1992*
Current Certificate: *July 11, 2005*
Certificate Expiry: *August 31, 2007*

Deutscher Akkreditierungs Rat
DAR
TGA-ZM-02-91-00

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CERTIFICATE SCHEDULE

Siemens Power Generation

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.*
Penn Hall/Pittsburgh – PA, USA *(Turbine Generator Services)*	*Installation, Field Service and Operation of Steam and Combustion Turbines and Electric Generators.*
Atlanta – GA, USA	*Central Tool & Instrument Facility.*
New Kensington – PA, USA	*New Kensington Storage 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.*

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CERTIFICATE SCHEDULE

Siemens Power Generation

Service Division

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.*

Sales & Marketing

Americas Region *Orlando – FL, USA*	*Sales and Marketing of Power Generation Equipment.*

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Siemens Power Generation

Sales & Marketing

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
Budapest, Hungary
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.

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CERTIFICATE SCHEDULE

Siemens Power Generation

Instrumentation & Control

Alpharetta – GA, USA *Erlangen - Bayern, Germany* *Karlsruhe – Baden-Württemberg, Germany* *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.*

Stationary Fuel Cells

Pittsburgh – PA, USA	*Research & Development, Design, Prototype Manufacture, Installation and Service of Stationary Fuel Cell Power Generation Systems.*

Industrial Applications

Aberdeen, Scotland, UK	*Design, Development, Manufacture, Installation Servicing, Overhaul/Remanufacture, Retrofit, 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. Manufacture and Supply of Gas Turbine Engine Components as Spares. Design, Development, Manufacture, Servicing and Associated Testing of Electronic and Microprocessor Based Control Systems for Such Control Systems.*
Brno, Czech Republic	*Design, Project Management, Manufacture, Commissioning and Servicing of Components and Units for Power Industry including Machinery Rooms, Steam Turbines, Turbines and Related Accessories.*

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Siemens Power Generation

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.*
Essen, Nordrhein-Westfallen, Germany	*Service, Modernization and Maintenance of Steam Turbines and Electrical Machines*
Finspong, Sweden	*Development, Sales, Design, Procurement, Manufacturing, Assembly, Erection, Installation and Commissioning, Service, Maintenance and Operation of Components, Systems and Complete Plants for Heat and Power Generation for Industrial Applications.*

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Siemens Power Generation

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.*
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.*
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.*
Ludvika, Sweden	*Development, Sales, Design, Procurement, Manufacturing, Assembly, Erection, Installation and Commissioning, Service, Maintenance and Operation of Components, Systems and Complete Plants for Heat and Power Generation for Industrial Applications.*

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Siemens Power Generation

Industrial Applications

Lincoln, Lincolnshire, UK	*Design, Development, Manufacture, Installation Servicing, Overhaul/Remanufacture, Retrofit, 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. Manufacture and Supply of Gas Turbine Engine Components as Spares. Design, Development, Manufacture, Servicing and Associated Testing of Electronic and Microprocessor Based Control Systems for Such Control Systems*
Nürnberg, Bayern, Germany	*Design and Manufacture of Steam Turbines for Generators and Mechanical Drives. Service, Modernization and Maintenance of Steam Turbines and Industrial Power Plants.*
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.*

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TURBINE MASTER inc.
2220 North Grand Avenue
Tahlequah, OK 74464

SIEMENS WESTINGHOUSE POWER CORPORATION
PORTLAND GENERAL ELECTRIC BOARDMAN STATION
BOARDMAN, OREGON
WESTINGHOUSE UNIT #1 SERIAL #13A5681-1
MAY 2004

REPORT OF FLUORESCENT MAGNETIC PARTICLE INSPECTION
REPORT OF PENETRANT INSPECTION
REPORT OF ULTRASONIC INSPECTION

2.2. LP1 and LP2 Turbines

2.2.1. Rotating Blading

2.2.1.A. Work scope

Ashok Patel with Siemens Westinghouse Power Corporation took mold impressions of the L-0R blades.

2.2.1.B. "As Found" Discrepancies and Repairs

Refer to Ashok's report.

2.2.1.C. Recommendations

No recommendations for this component.

2.2.2. Bearings and Pedestals

2.2.2.A. Work scope

The No. 3, 4, 5, and 6 bearings were removed for inspection.

2.2.2.B. "As Found" Discrepancies and Repairs

The customer sent the no. 3 and 6 bearings to Pioneer Motor Bearing for rebabbitting due to electrolysis damage on the pads.

The no. 4 and 5 bearings were cleaned, inspected, and reassembled.

The bearing top pad clearances were checked at reassembly:

Bearing	LS	RS
3	.028"	.030"
4	.031"	.031"
5	.029"	.029"
6	.034"	.030"

The bearings were squared to the shaft within .003" and the bearing keepers locked down. The pedestal covers were installed and the top pad pinch and clearance checked and adjusted to get the .000-.003" pinch on the top three pads and .004" to .008" clearance on the two side pads.

At reassembly the lift was checked:

Bearing	LS-45°	RS-45°	Pressure (PSI)
3	.003"	.002"	1400
4	.004"	.003"	1250
5	.003"	.004"	1200
6	.004"	.003"	1100

The no. 4 and 5 outboard pedestal oil seals were re-stripped and machined to 16.500" diameter. The rotor shaft lands were severely scoured.

The LP1 to LP2 coupling pedestal was removed and cleaned. The drain line was found to be clogged with burnt oil. The coupling oil

REPORT OF FLUORESCENT MAGNETIC PARTICLE INSPECTION

OF: Westinghouse **UNIT** #1 **SERIAL** # 13A5681-1

FOR: Siemens Westinghouse Power Corporation
Portland General Electric / Boardman Station
Boardman, Oregon

DATE: May 20, 2004

PURPOSE: *To test steel castings and wrought material for discontinuities.*

EQUIPMENT:

Instrument - 1560-W
Machine with capability of head shot and coil shot.
Prods
Wet Fluorescent particles, or Dry black particles (visible).
Black Light (for Fluorescent particle)
Dark Room (or curtain to make portable dark room for Fluorescent).

SYSTEM CHECK

Test bath for correct particle concentration.
Assure magnetic source (instrument) is properly functioning.
White light - background - no greater than 2 candle power.
Visible particle - white light intensity 200 candle power, minimum.
Assure black light is functioning properly.

INSPECTION

Apply magnetic source into part.
Use either PIE gage or GAUSS meter for proper magnetism.
Apply particles onto part.
For wet particle method apply magnetic source into part while particles are draining from the part.
Inspect the part within 5 minutes after the magnetic source has been applied.

RESULTS OF INSPECTION

Procedures Used:
84350KC Rev. J MT

<u>THROTTLE VALVES</u>

Right Side

Stem

- No indication of discontinuity was observed.

Cap / Strainer

- No indication of discontinuity was observed.

Throttle Valves Continued:
Left Side
Stem
- No indication of discontinuity was observed.

Cap / Strainer
- No indication of discontinuity was observed.

HP GLANDS
Inner Governor End
Upper Half
- No indication of discontinuity was observed.

Lower Half
- No indication of discontinuity was observed.

Outer Governor End
Upper Half
- No indication of discontinuity was observed.

Lower Half
- No indication of discontinuity was observed.

Outer Generator End
Upper Half
- No indication of discontinuity was observed.

Lower Half
- No indication of discontinuity was observed.

*****Each item was visually examined concurrently with mag particle inspection***

REPORT OF PENETRANT INSPECTION

OF: Westinghouse **UNIT** #1 **SERIAL #** 13A5681-1

FOR: Siemens Westinghouse Power Corporation
Portland General Electric / Boardman Station
Boardman, Oregon

DATE: May 20, 2004

PURPOSE: *To detect cracks in metallic parts using Visible Dye or Fluorescent Penetrant.*

METHOD AND EQUIPMENT:

PREPARATION
1. Parts shall be cleaned prior to the test.
2. Surface shall be blast cleaned or steps necessary to obtain a clean area.

EQUIPMENT
1. Penetrant - Process (Water-Washable, Fluorescent, Visible Dye)
2. Cleaner
3. Black Light
4. Developer (as necessary)
5. Cotton Swabs

INSPECTION
1. Assure part cleanliness
2. Apply penetrant by brushing, swabbing, or dipping.
3. Allow dwell per required time. (20-30 minutes for Fluorescent or 5-10 minutes for Visible)
4. Remove excess by washing with water using a course spray.

4.1. Wash under the black light to prevent overwashing.

4.2. Water temperature shall be 60 deg. F to 125 deg. F.

5. Dry the part until surface is dry. (225 deg. max.)
6. Apply Developer if required. (Inspect after 5 minutes and before I hour)

EVALUATION
1. Inspect the parts using the black light and mark any area having indications.
2. Evaluate parts using applicable limitations.

RESULTS OF PENETRANT INSPECTION

Procedures Used:
84350KD Rev. Q PT

THROTTLE VALVES

Right Side

Body
- Contained indication of discontinuity from 12 to 6 o'clock in inner radius of trepan.

Seat
- Contained indication of discontinuity 1 1/8" long upstream from seating area at 1 o'clock.
- Contained indication of discontinuity 4" long with separation of stellite from base metal between 7 and 8 o'clock.

Seal Weld
- No indication of discontinuity was observed.

Anti-swirl Dam
- Contained 4 indications of discontinuity 1/8"—1" long in welds.

Disc
- No indication of discontinuity was observed.

Left Side

Body
- No indication of discontinuity was observed.

Seat
- No indication of discontinuity was observed.

Seal Weld
- No indication of discontinuity was observed.

Anti-swirl Dam
- Contained 8 indications of discontinuity 1/8"—1" long in welds.

Disc
- No indication of discontinuity was observed.

Each item was visually examined concurrently with penetrant inspection.

REPORT OF ULTRASONIC INSPECTION

OF: Westinghouse **UNIT** #1 **SERIAL #** 13A5681-1

FOR: Siemens Westinghouse Power Corporation
Portland General Electric / Boardman Station
Boardman, Oregon

DATE: May 20, 2004

PURPOSE: *Inspection for cracks, erosion, thickness, or other flaws.*

PROCEDURES: *Equipment*

A. Instrument Sonic 136
B. Transducer
1. Straight
C. Reference Standard II W Type 2
CALIBRATION
A. Set frequency 5 MHZ
B. Set range to 1 back reflection for repeatable indications
C. Set gain at 80%
D. Reject off
INSPECTION
A. Calibrate per paragraph III
B. Scan area of inspection for repeatable indications
EVALUATION
A. Indication of discontinuity forwarded to engineering for evaluation.

RESULTS OF INSPECTION

Procedures Used:
84357KY Rev. 4 UT

THROTTLE VALVES
Right Side
Studs

- No indication of discontinuity was observed.

Left Side
Studs

- No indication of discontinuity was observed.

BOLTING
HP—IP Through Shell Studs

- No indication of discontinuity was observed.

Bolting Continued:

Main Steam Line Studs
A
- No indication of discontinuity was observed.

B
- No indication of discontinuity was observed.

C
- No indication of discontinuity was observed.

D
- No indication of discontinuity was observed.

E
- No indication of discontinuity was observed.

F
- No indication of discontinuity was observed.

#2 Bearing Pucks & Liners
- No indication of discontinuity was observed.

#3 Bearing Pucks & Liners
- No indication of discontinuity was observed.

*****Each item was visually examined concurrently with ultrasonic inspection.***

PERFORMANCE ENGINEERING LLC

1547 EAST ROYCE COURT
CAMARILLO, CA 93010

File
21343

December 10, 2003

Janet Gulley
Portland General Electric
121 SW Salmon Street
Portland, Oregon 97204

Subject: **Fluidic Techniques Site Visit**
Inspection of the PGE Boardman ASME Condensate Flow Section

Janet,

Please find a report of the subject visit to Fluidic Technique Inc. (FTI) in Mansfield, Texas on Thursday and Friday December 4 and 5, 2003. This report describes the condition of the Boardman ASME flow section and the work required to restore the flow section to meet ASME PTC-96 Code requirements. I have also attached photographs of the flow section, and FTI's own inspection evaluation sheet.

When I arrived at FTI, the flow section was still in crates and had not been removed for inspection. Darrel Barnes (FTI Vice President) and Tom Blanton (FTI Sales Manager) were with me during most of the inspection. The flow nozzle was inspected first. The nozzle was removed from the shipping crate with a nylon strap to not damage the throat surface of the nozzle. The first impression of the nozzle was good.

We noted damage in the nozzle throat, but initially thought it was minor and could be machined out. The nozzle had a light ferrite deposit on the flow surface. The surface finish of the nozzle was excellent, approximately 10 micro inches. The nozzle was then put into a lathe to fully clean the flow surface for visual inspection and measurement of the throat.

When the nozzle was cleaned, it became evident that the damage was worse than originally thought. There were several deep gouges in the throat of the nozzle. Darrel Barnes (FTI VP) said the damage looked familiar. Darrel has seen several nozzles that were picked up by inserting a forklift arm into the nozzle throat. The damage to the nozzle seemed to fit that scenario.

There were other damaged areas at the nozzle discharge indicating that the nozzle may have also been picked up with a chain. The depth of the deepest gouge was estimated at 160 mils. Based on the depth of the damage and the amount of material that would have to be machined out of the nozzle, the nozzle was considered damaged beyond repair. Please see the attached pictures of the damage to the nozzle and FTI's evaluation report.

PERFORMANCE ENGINEERING LLC

The ASME low beta ratio nozzle with throat taps is a precision machined nozzle with an exact geometry that has many critical dimensions. The amount of material that would have to be removed to clear the damage in the nozzle throat would change the geometry of the nozzle.

The tube-type flow straightener was inspected and found to have minor damage to the outlet of some of the tubes on the outer periphery of the tube bundle. Please see the attached pictures. The damage can be easily repaired and the flow straightener returned to service.

The inlet and outlet pipe sections had a heavy deposit on the flow surface of the pipe. There was damage and evidence that the pipe has also been picked up with a forklift arm. Once we cleaned the deposit off the flow surface of the pipe, it was still in good condition. The pipe sections can be cleaned up and re-honed and returned to service.

Based on a complete inspection of the ASME flow section, FTI provided a cost to manufacture a new nozzle and repair the remaining components. The cost to refurbish the meter is shown below:

<u>Refurbish Meter</u>

1. Manufacture new nozzle.
2. Repair tube bundle.
3. Remove pipe insulation.
4. Clean, inspect, and hone pipe sections as required.
5. Sandblast and paint external pipe/flange surfaces.
6. Replace gaskets and hardware as needed.
7. Assembly

Total Refurbishment Cost - $27,596.00

FTI also provided a cost for the flow calibration at Alden Labs. The cost for the calibration is shown below.

<u>Laboratory Flow Calibration at Alden</u>

1. Four tap sets at 25 points of calibration per tap set - $8729.00
2. Freight to the lab via dedicated truck - $3200.00
3. Witness of calibration - $275.00

Total Calibration Cost - $ 12,204.00

FTI will also provide a turn-key repair and calibration of the nozzle as follows:

Fluidic Techniques recommends the turn-key handling of the above work by their company for a total price of $38, 900.00, F.O. B. Alden Lab. This approach will ensure the meter meets the strict requirements of PTC-6-1996 with sole source responsibility and minimum expenditure by Portland GE.

Delivery - 16 weeks

PERFORMANCE ENGINEERING LLC

FTI will provide a report based on the ASME PTC-6-1996 Code that evaluates the laboratory calibration data for the following required parameters:

1. The average values of the coefficients of discharge, C, using the Reynolds numbers and measured values of C from the laboratory test versus the ASME reference nozzle coefficients.

2. Reynolds number independence.

3. Scatter of calibration data..

If the laboratory calibration data meets the above code requirements, the flow meter will be an ASME PTC-6-1996 code flow meter.

It is my understanding that FTI will assume all responsibility to meet the ASME PTC 6-1996 Code requirements for the flow meter, even if the nozzle has to be shipped back to FTI and then retested again at Alden.

I am currently soliciting bids from two vendors for a replacement flow nozzle. I hope to have the bids by Friday December 12, 2003. My initial discussions on the phone with the two vendors seem to indicate that FTI is in the ballpark for refurbishment of the flow meter. I will send you another letter when I receive the information from the vendors.

It is my recommendation that the nozzle is replaced and the remaining flow meter components be refurbished. I believe both Siemens Westinghouse and General Electric use FTI as a vendor for ASME PTC flow meters. It would also seem cost effective to have a turnkey project by FTI that included the calibration and evaluation of the calibration data. This would limit PGE's exposure and meet the requirements of all parties involved.

Thank you for the opportunity to be of service. If you have any questions or need any further information please give me a call or email.

Sincerely,

/S/

S. F. Gibson

Performance Engineering LLC

Alex Berman	949.289.7009	aberman@pe-llc.com
O Jay Cassellius	805.432.7145	ojcassellius@pe-llc.com
Sam Gibson	310.345.6821	sfgibson@pe-llc.com
Kevin Weeks	562.254.9425	kmweeks@pe-llc.com

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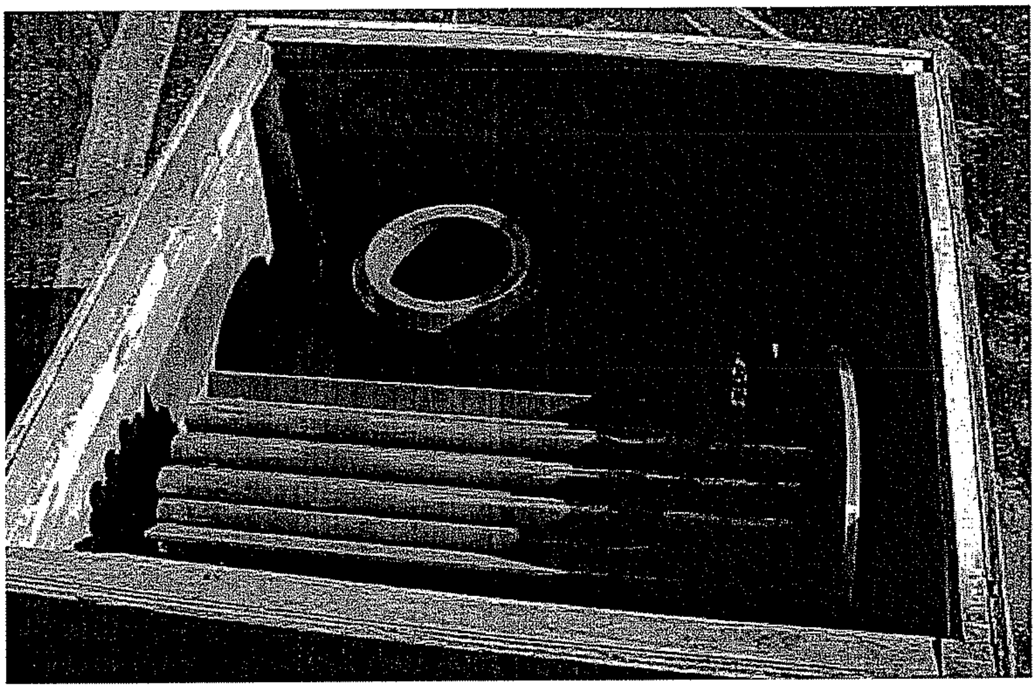
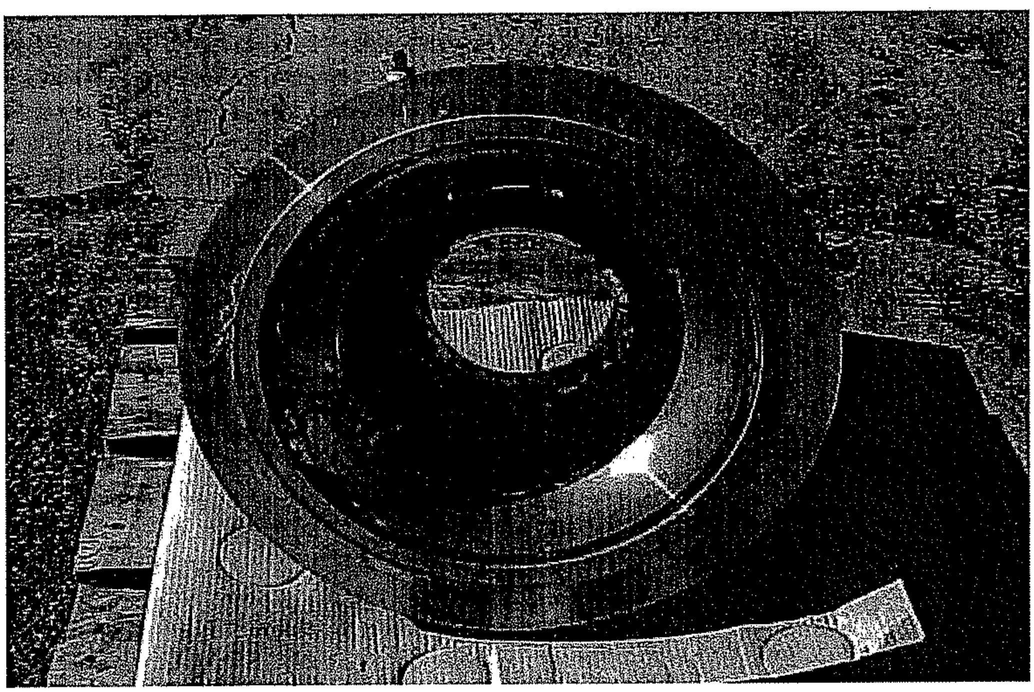
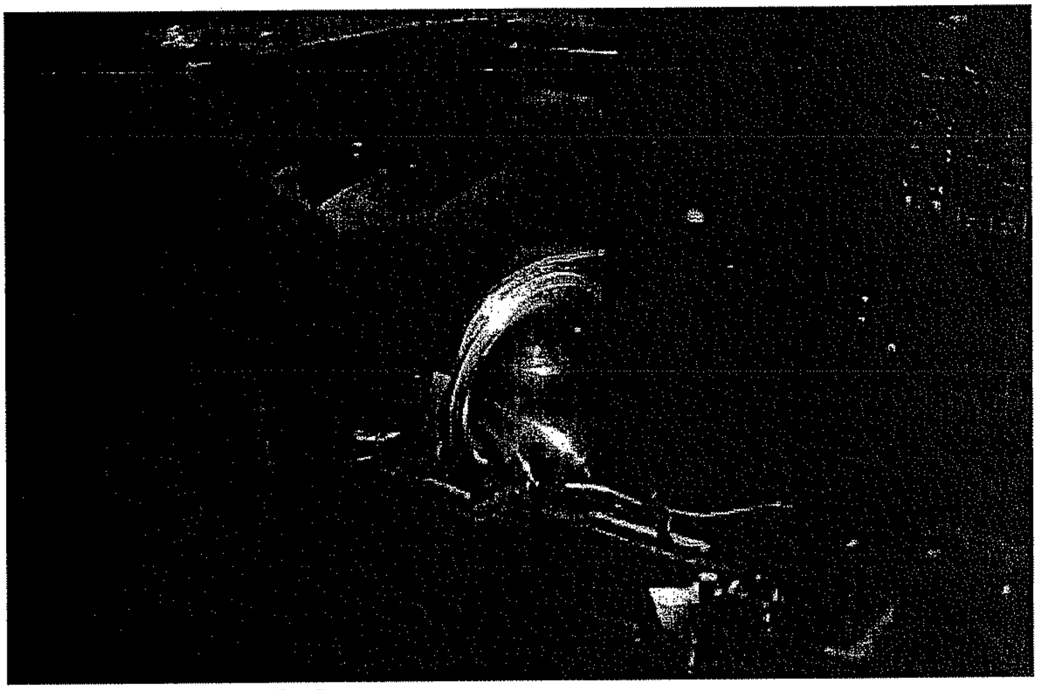


Nozzle and Tube Type Flow Straightener
Note: Still in shipping crate.



Nozzle as Received
Note: Light deposit on flow nozzle, excellent surface finish.

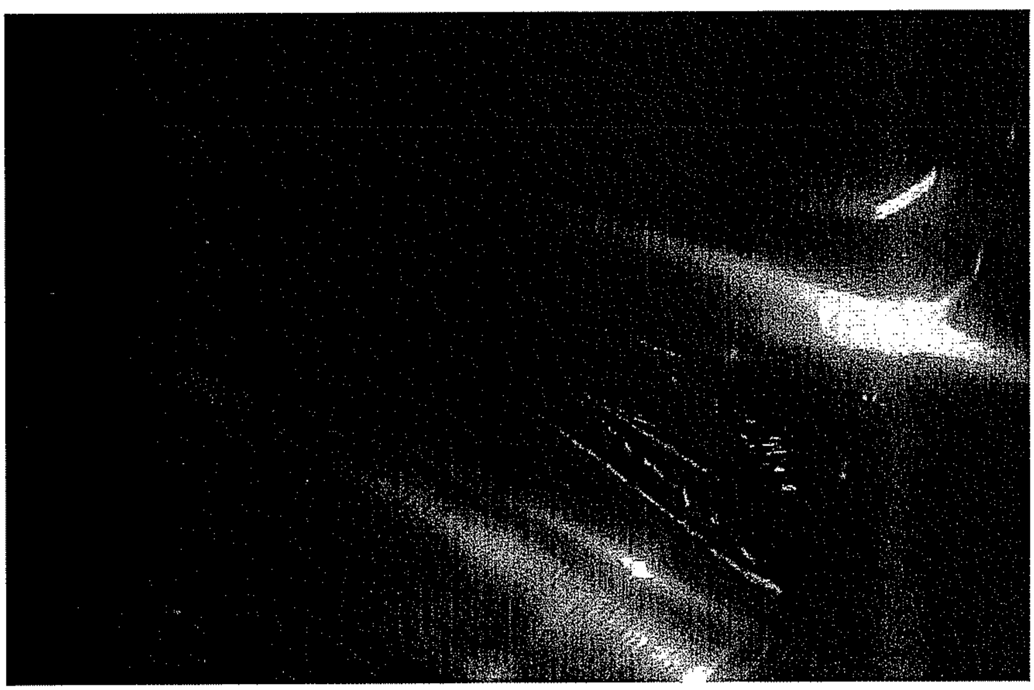
PERFORMANCE ENGINEERING LLC



Cleaning of Nozzle in Lathe
Note: Nozzle was cleaned with a scotch brite and solvent.

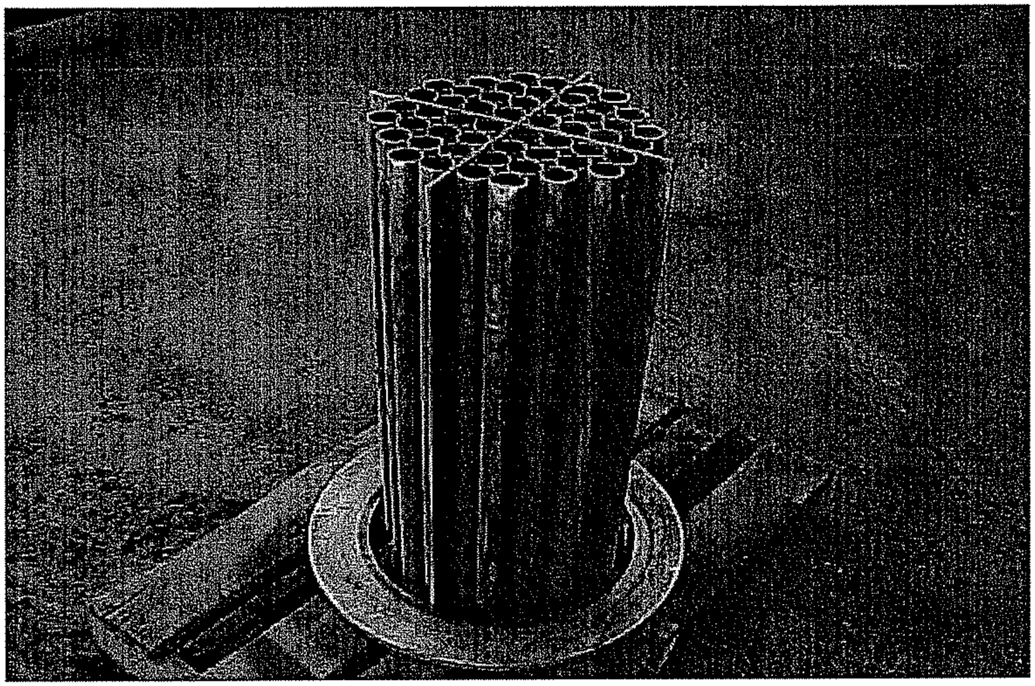
Cleaning of Nozzle in Lathe
Note: Nozzle was cleaned with a scotch brite and solvent.

Damaged Areas in Nozzle
Note: The nozzle may have been damaged from being picked up with a forklift arm.

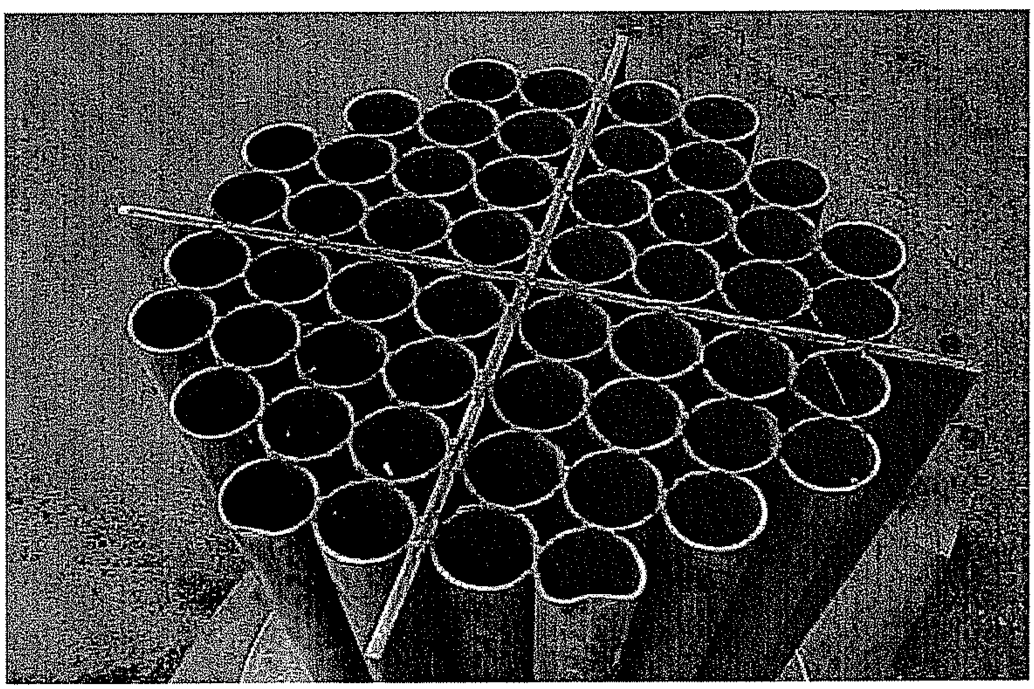


Damaged Areas in Nozzle
Note: The nozzle may have been damaged from being picked up with a forklift arm.

PERFORMANCE ENGINEERING LLC

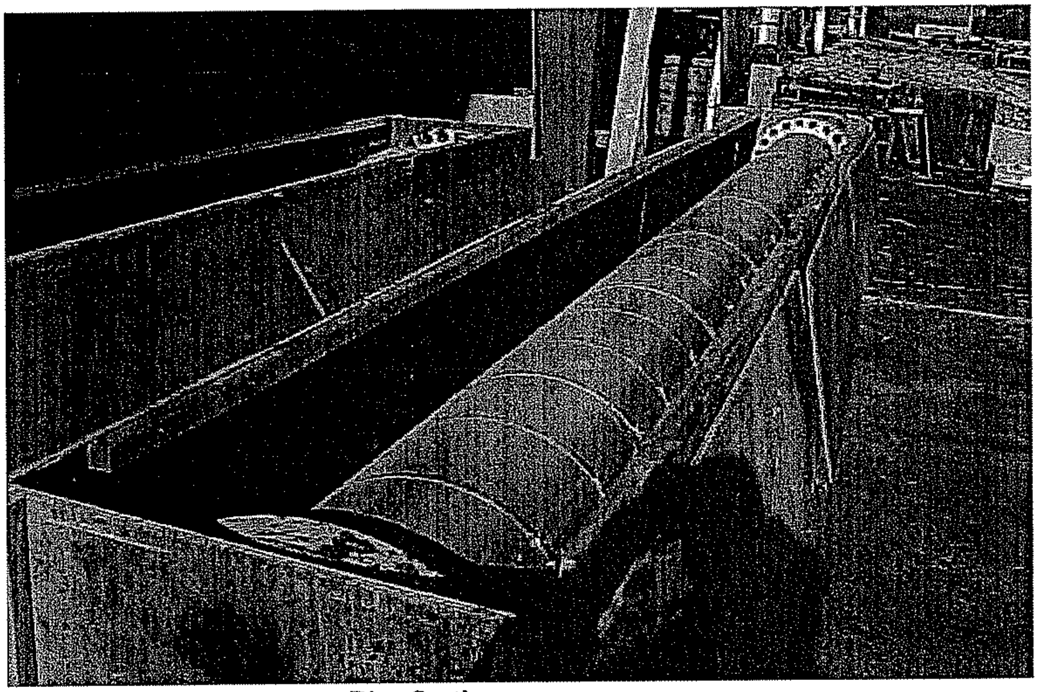


Flow Straightener
Note: Light deposit on flow straightener and light damage to end of tubes.

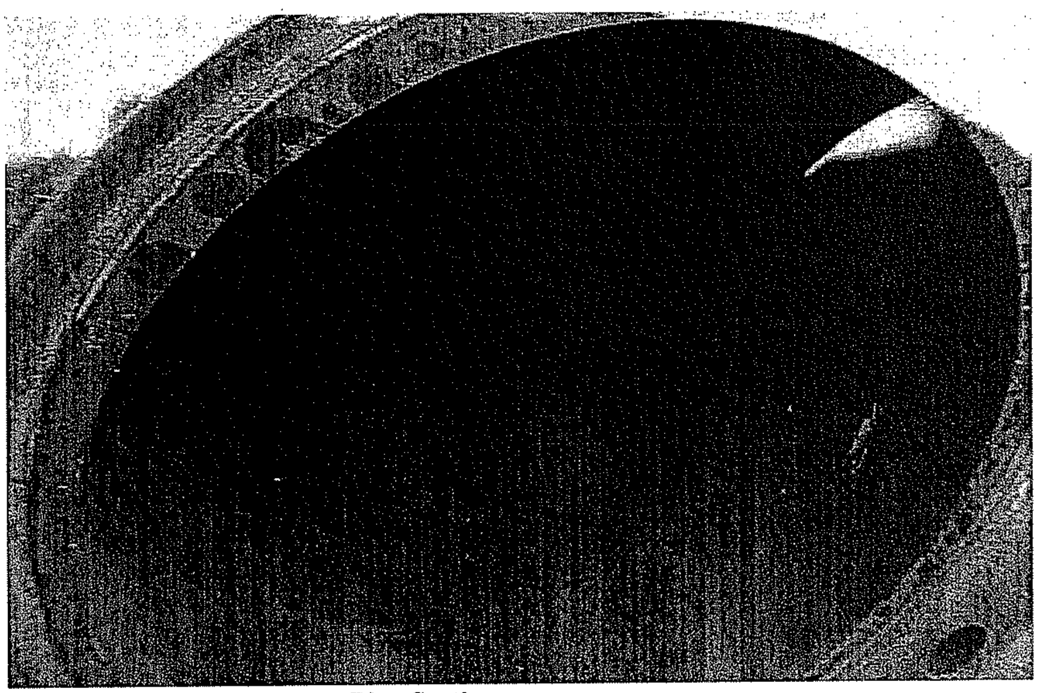


Flow Straightener
Note: Light damage to end of tubes.

PERFORMANCE ENGINEERING LLC

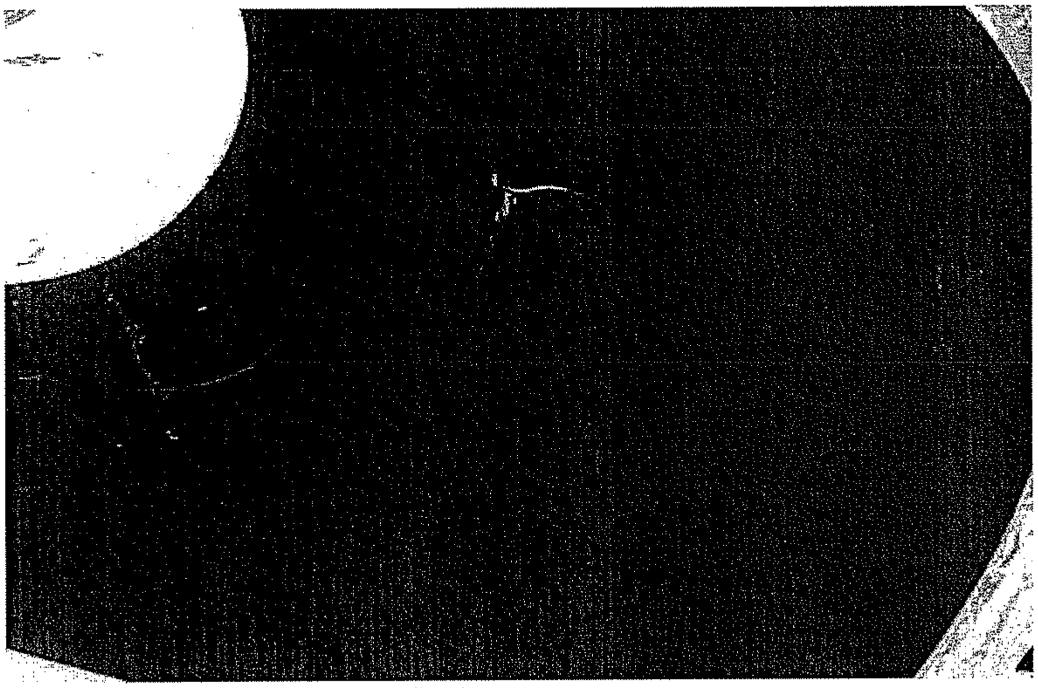


Upstream and Downstream Pipe Sections
Note: Heavy deposit in the upstream and downstream pipe sections.

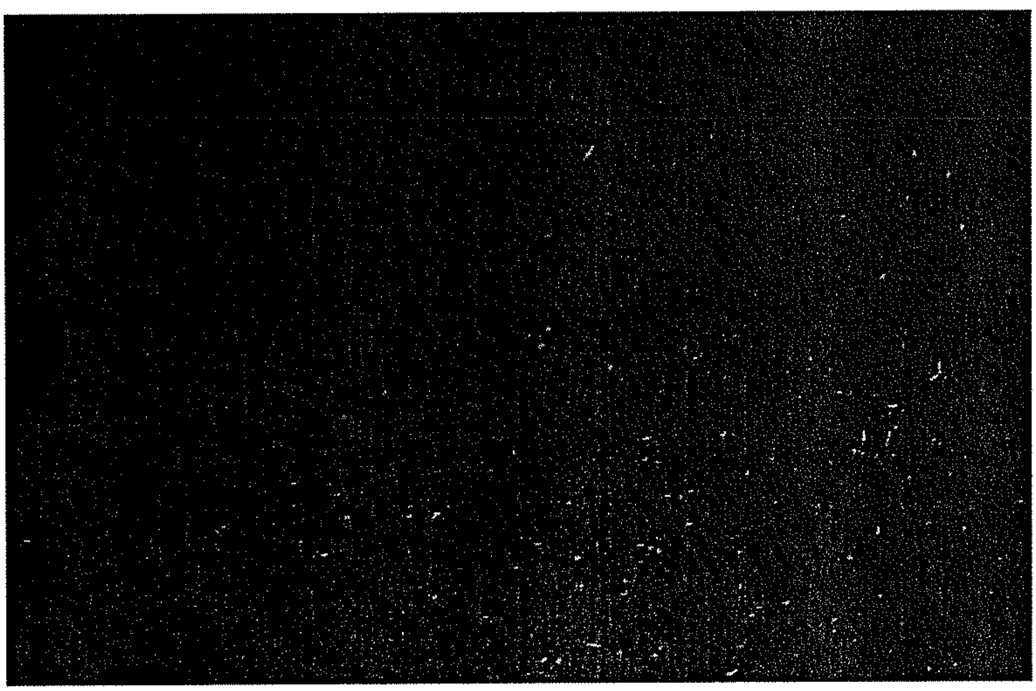


Upstream and Downstream Pipe Sections
Note: Heavy deposit in the upstream and downstream pipe sections.

PERFORMANCE ENGINEERING LLC

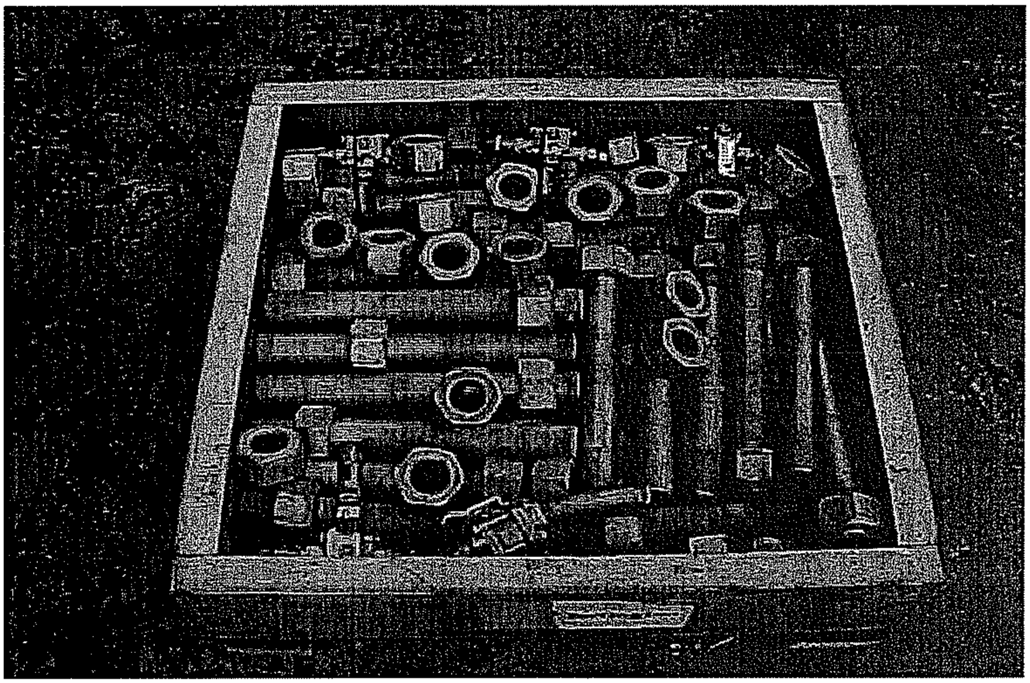


Upstream and Downstream Pipe Sections
Note: Heavy deposit in the upstream and downstream pipe sections.



Upstream and Downstream Pipe Sections
Note: Heavy deposit in the upstream and downstream pipe sections.

PERFORMANCE ENGINEERING LLC



Flange Bolting and Pressure Tap Valves
Note: Valve attachment pipe was broken off in one of the pressure taps in the pipe.

alignment vibration analysis, ltd. AVA™

Alignment Vibration Analysis Report #207A-449-3

for:

PORTLAND GENERAL ELECTRIC COMPANY

BOARDMAN, OREGON

Boardman Generating Facility Turbine / Generator Profiles

Vertical & Radial Shaft Centerline
Alignment Profiles

Purchase Order # BDMN031283

July 10th, 2007

Attention: David Rodgers

Submitted by: ______________
Gilbert L. Koerger

Copies: **Loren Mayer (PGE)**
Scott Ross (PGE)
Rodger Lewis (PGE)

File: AVA207A-449

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Introduction

During the May 2007 outage of the Boardman Power Plant a review was performed of the shaft ℄ (centerline) profile for the Turbine/Generator unit. The vertical (elevation view) profile was established and compared to the previous vertical profile, dated July 7th, 2006. In addition, Mr. David Rodgers requested a radial (side-to-side) profile to see if any issues should be considered for future adjustments.

The baseline for the radial offset line was established as a equidistant offset (319.290") from bearing #1 and bearing #8 centerlines. This offset line was then used for all intermediate node points in the determination of distance from Shaft center to theoretical center.

Survey Results

The vertical profile (taken at compromised data points on 05/14/07) was interpolated to actual node points and compared to the 2006 vertical profile. This interpolated profile followed the profile shown on attached drawing BMN-CL-TRBSFT, Rev. 4, dated 05/07/06. Attenuated deviations are within ±3 mils at all locations. This is a good indication that the profile is holding and that the data continues to be repeatable.

The radial profile, taken for the first time on May 14th, 2007 has a fairly consistent curve other than the 3 mil reversal at bearing #2. Changes to this radial profile are not recommended at this time unless other changes are going to be made at bearings #2, #3, #4 and/or bearing #5. If any modifications are to take place at those locations then slight radial shifts might be incorporated.

The vertical profile is still questionable in the area of the "C" coupling and the tail end of the generator. The differential alignment of the "C" coupling between bearing #6 and #7 should be addressed. Bearing #8 is ≈3/8" higher than the Siemens recommended profile. A vertical pre-offset of -14 mils and +7 mils (open at bottom of coupling "C") must be confirmed and corroborated. Data for static sag of the generator rotor and the "free" end of LP-2 must also be confirmed in order to accurately determine and confirm the recommended pre-set condition at coupling "C".

Recommendations

Final pre-sets and guidelines for re-alignment of the turbine/generator shaft during the 2008 outage should be established and fully reviewed by January 2008. Only then can a detailed program for setting the shafts and aligning the couplings be prepared.

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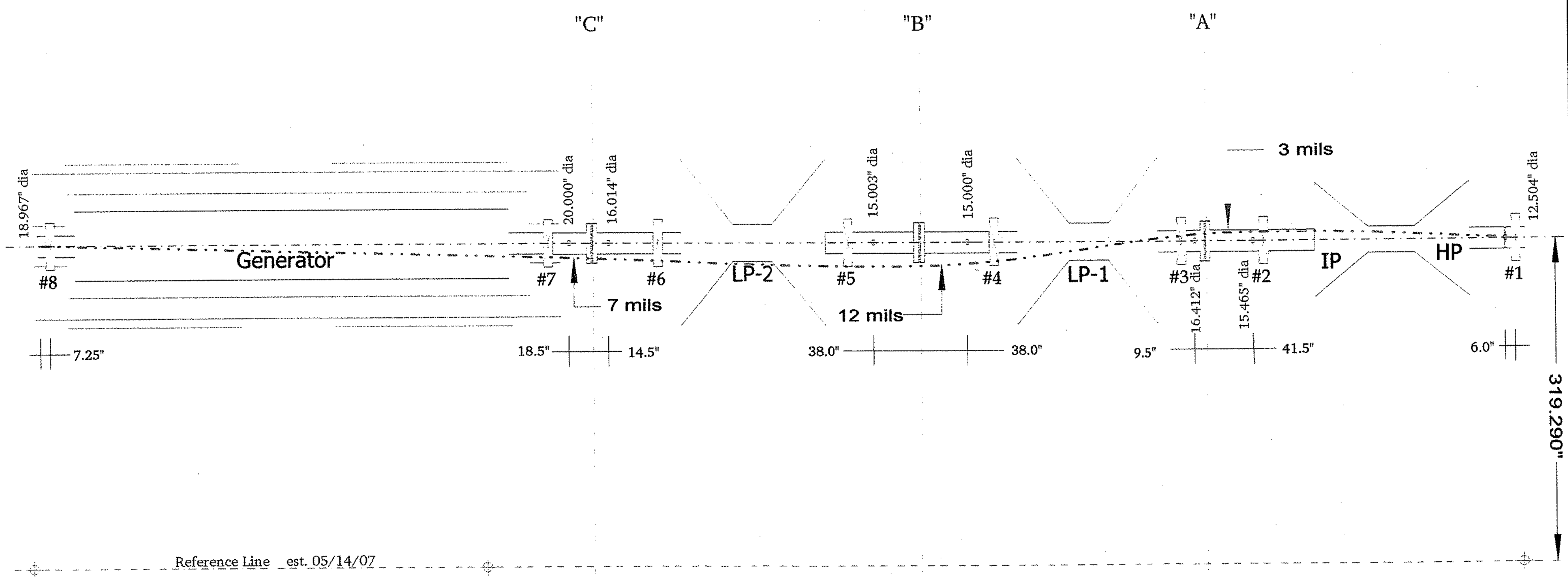


Note 1: This radial profile was taken with all couplings coupled, bearing caps on and strongbacks in place.

1.79=f / axial

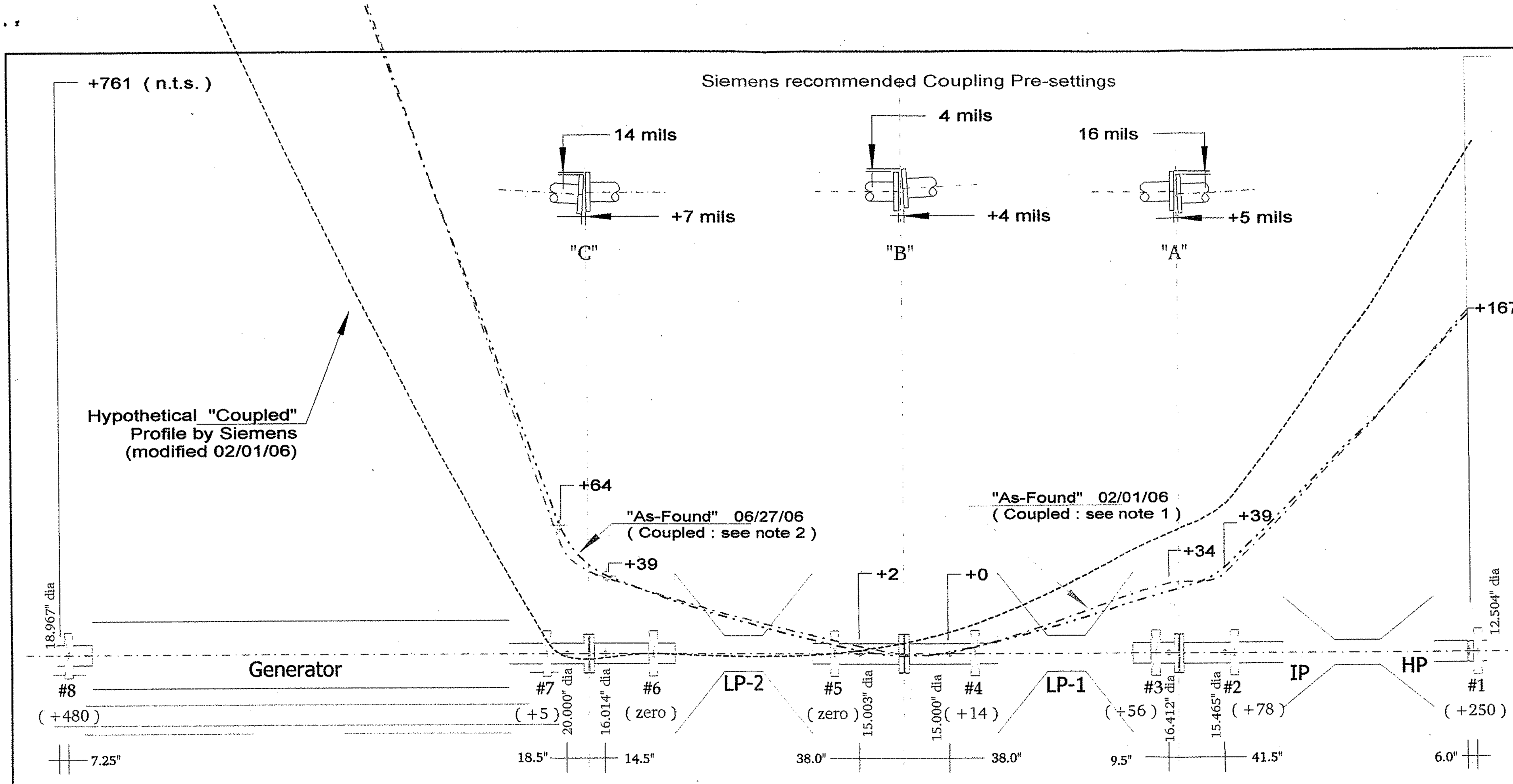
PGE - Boardman Generating Plant

Boardman, Oregon USA

Turbine /Generator - Radial Shaft Profile

AVA, LTD. Alignment Vibration Analysis, Ltd.
Portland, Oregon 800-730-0220

Drawn by: G. Koerger	Drawing Number	Revision
Project No: 207A-449	BMN-CL-RADPRO	1
Rev. Date: 05/15/2007		



Note 1: Profile taken with all couplings coupled. Not all bearing caps are on and none of the strongbacks are in place.
Note 2: All couplings coupled; bearing caps & strongbacks in place.

1.79=f / axial

PGE - Boardman Generating Plant

Boardman, Oregon USA

Steam Turbine - Generator Shaft Profile

AVA, LTD.

Alignment Vibration Analysis, Ltd.
Portland, Oregon 800-730-0220

Drawn by: G. Koerger	Drawing Number	Revision
Project No: 206A-409	BMN-CL-TRBSFT	4
Rev. Date: 07/07/2006		

alignment vibration analysis, ltd. AVA™

Alignment Analysis Report #206A-409-1

for:

PGE - BOARDMAN POWER PLANT

BOARDMAN, OREGON

Steam Turbine / Generator Unit

Shaft Centerline Profile
incl. Bearing Pedestals and Turbine Casings

Purchase Order #BDMN031283

July 23rd, 2006

Attention: David Rodgers (PGE)

Submitted by:
Gilbert L. Koerger

Copies: **Loren Mayer (PGE)**
Janet Gulley (PGE)
Elizabeth Van Wormer (KVW)

File: AVA206A-409

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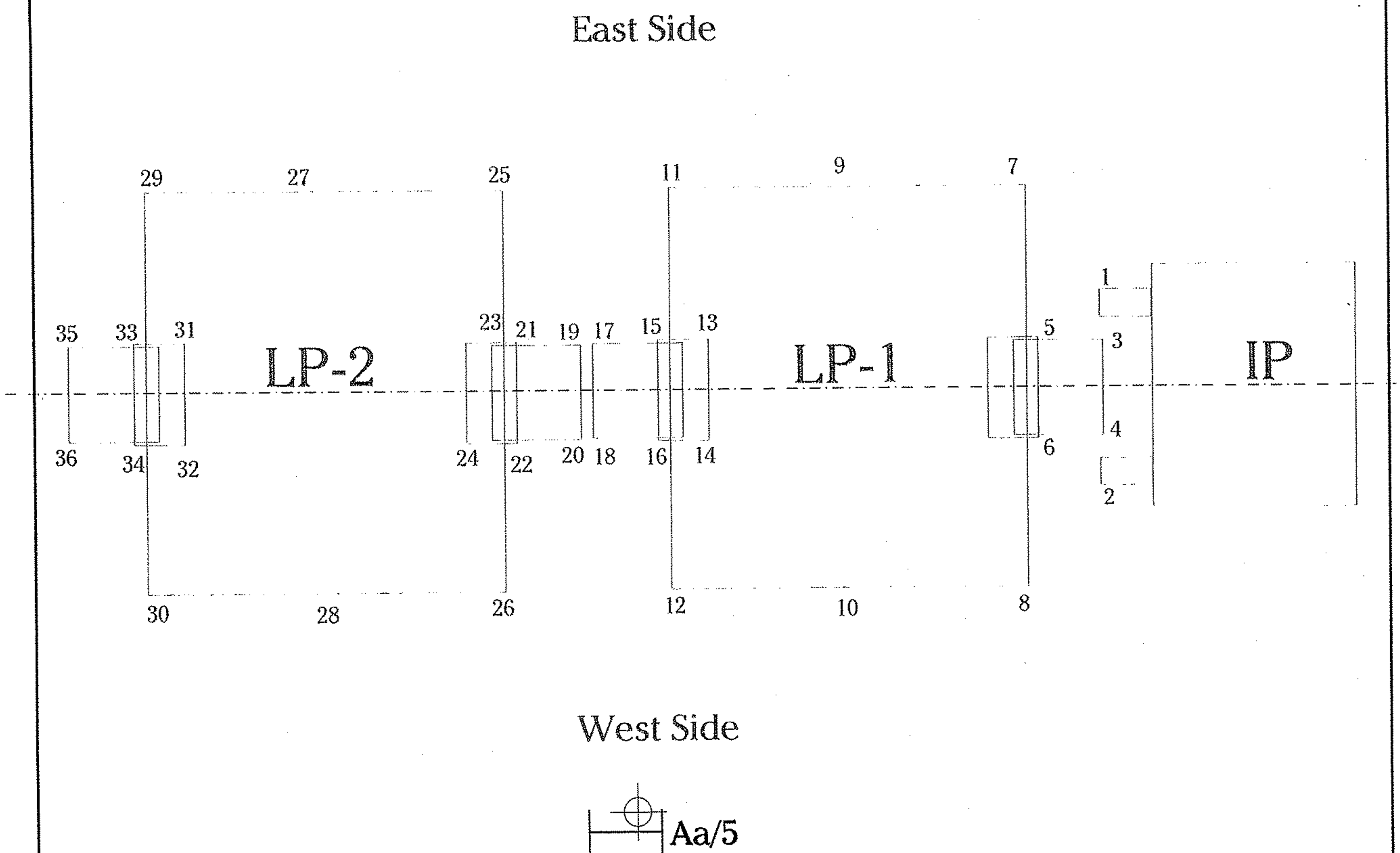
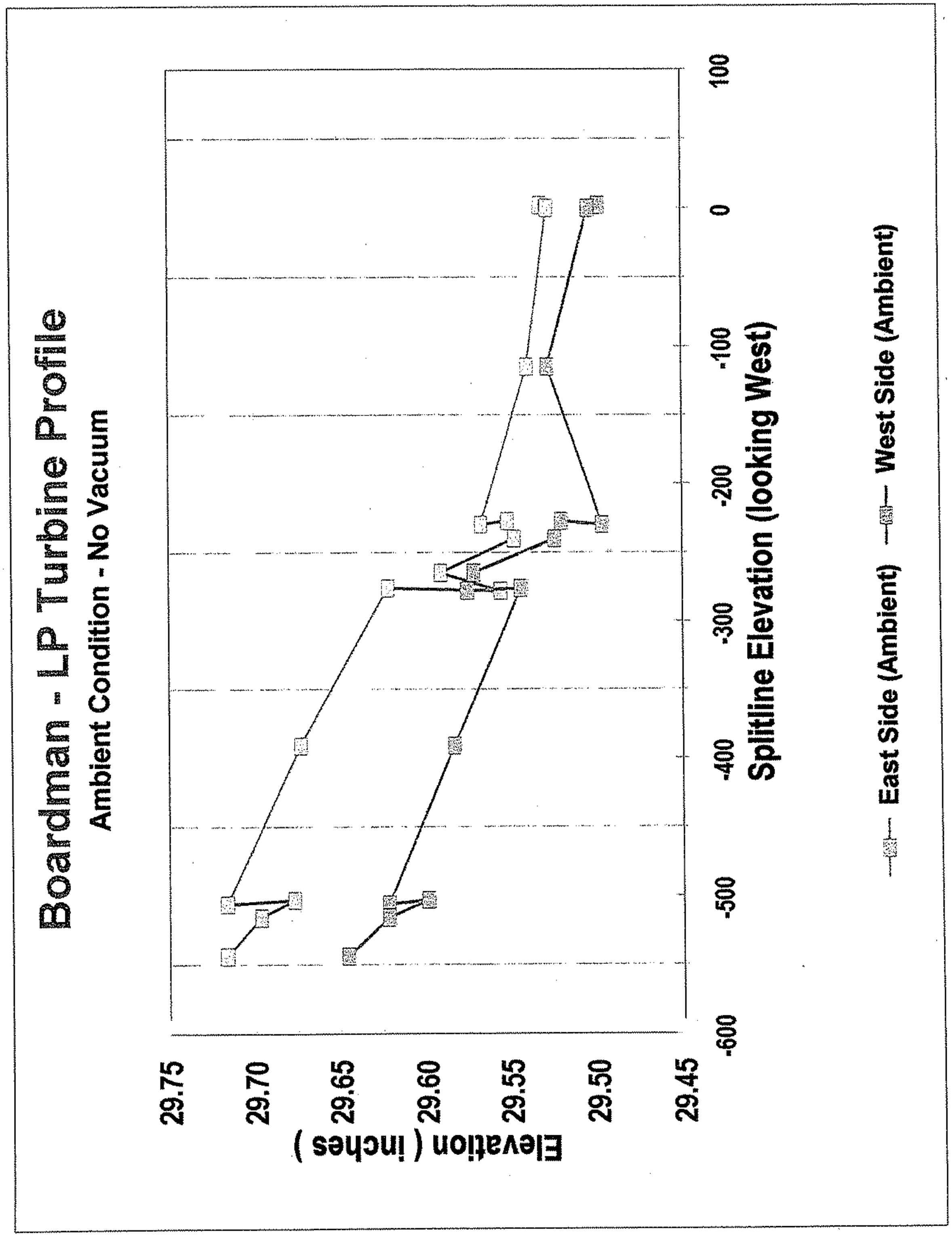
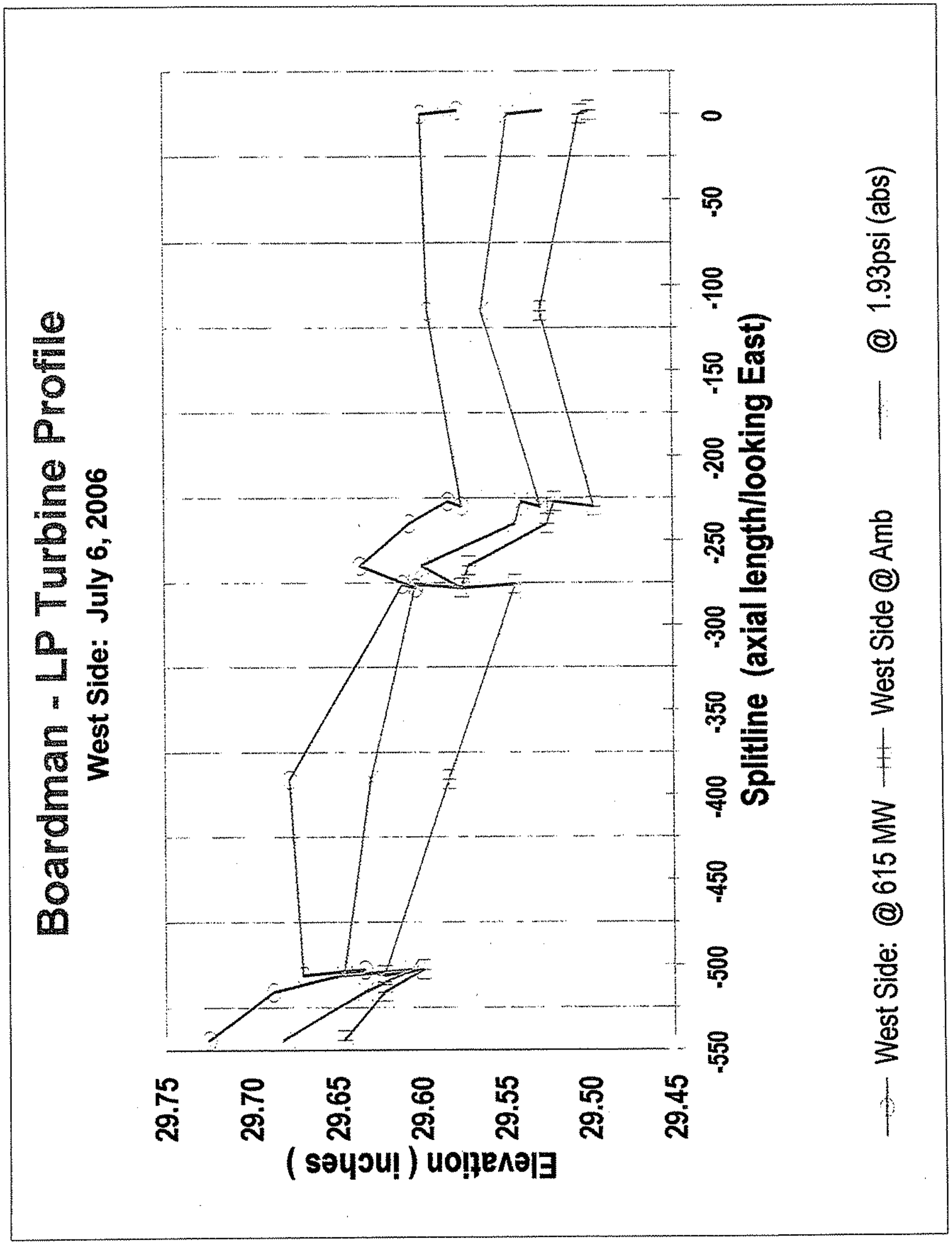
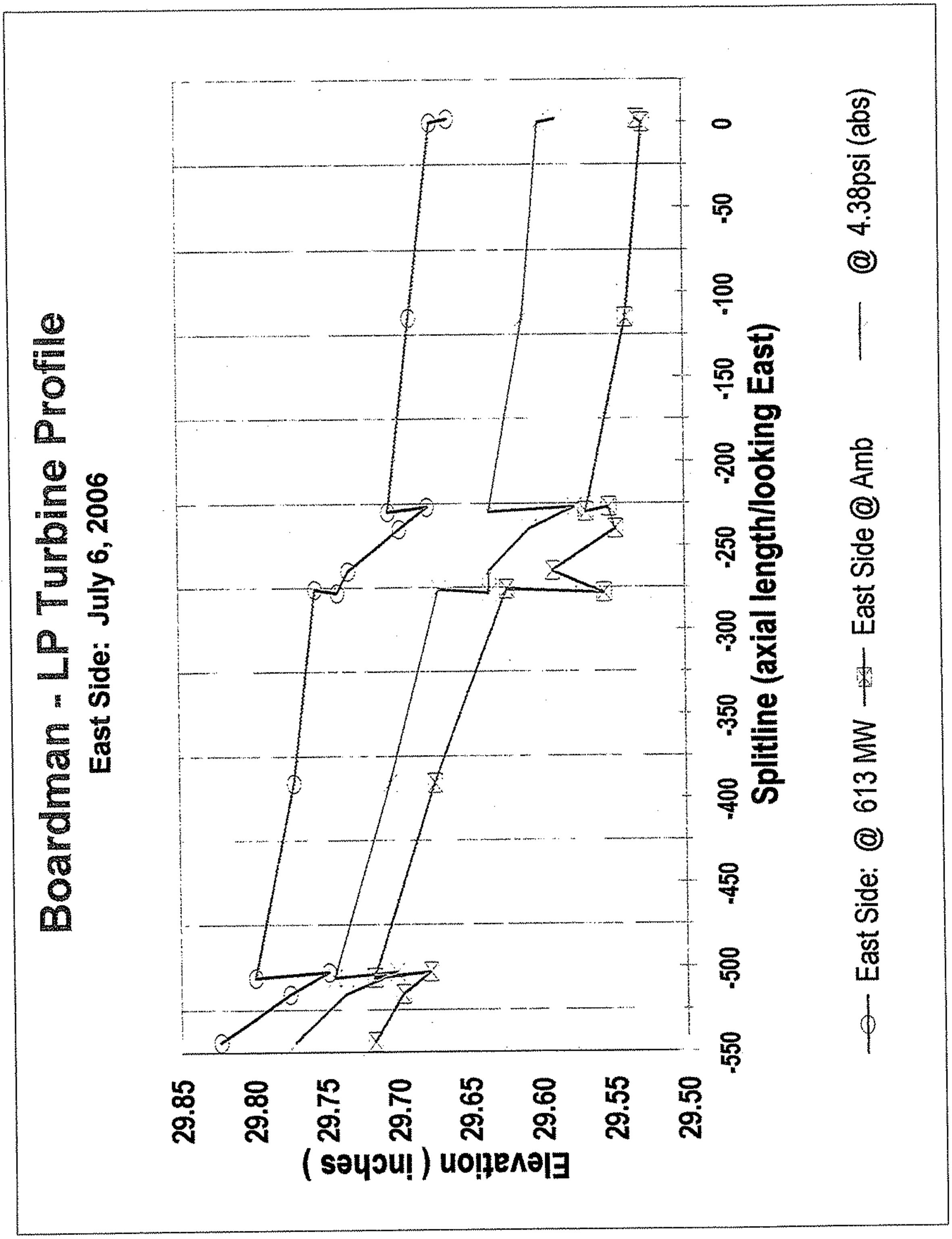


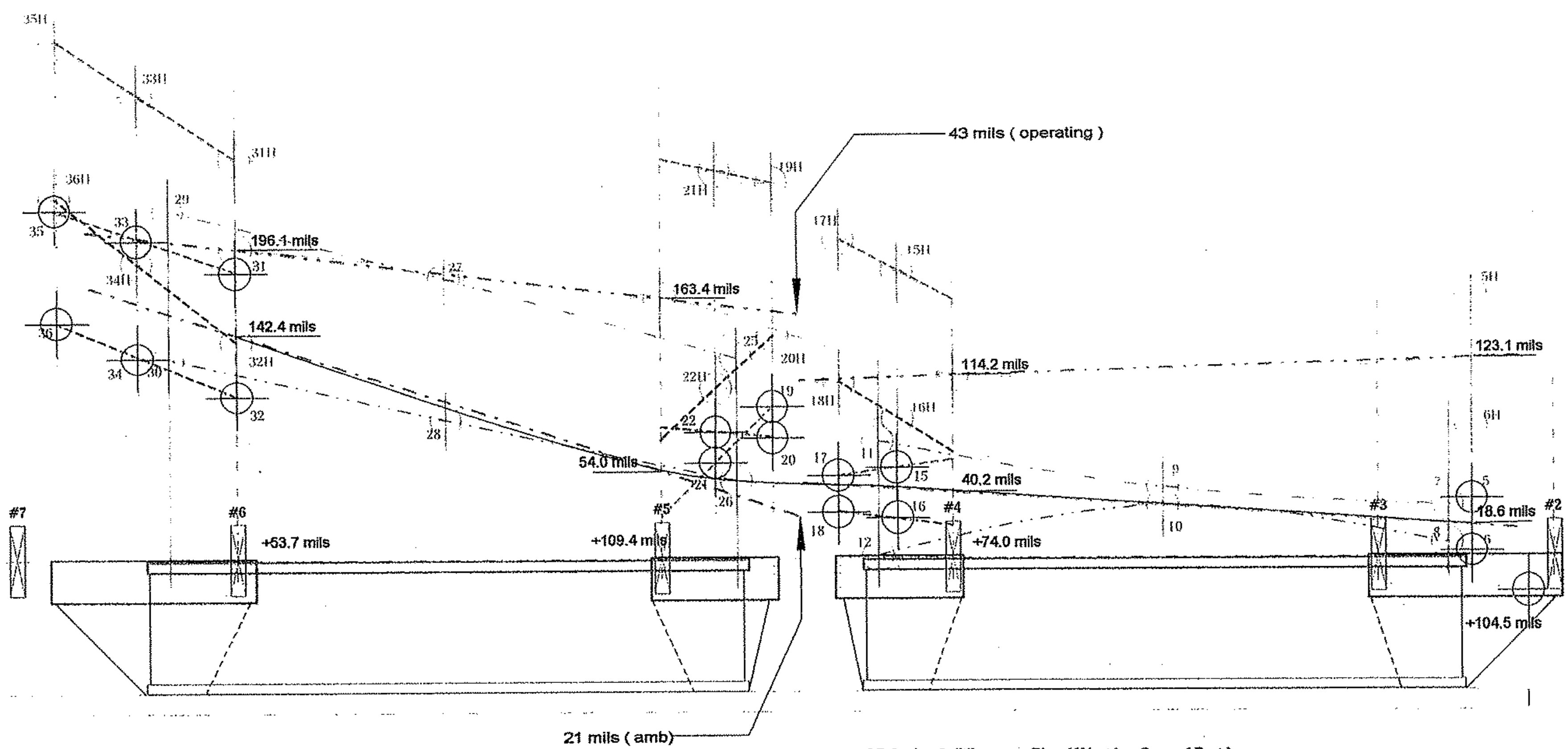
PGE - Boardman Generating Facility Boardman, Oregon USA LP-1 & LP-2 Turbines - Node Point Layout	AVA Alignment Vibration Analysis, Ltd. Portland, Oregon 1-800-730-0220

Drawn by: GJK	Drawing No.	Revision
Job No. 206A-409	BMN-LPTB-PRF	1
Rev.Date: 05/12/2006		


Boardman - LP Turbine Profile
Ambient Condition - No Vacuum
Elevation (inches)
29.75
29.70
29.65
29.60
29.55
29.50
29.45
-600
-500
-400
-300
-200
-100
0
100
Splitline Elevation (looking West)
East Side (Ambient)
West Side (Ambient)


Boardman - LP Turbine Profile
West Side: July 6, 2006
29.75
29.70
29.65
29.60
29.55
29.50
29.45
Elevation (inches)
-550
-500
-450
-400
-350
-300
-250
-200
-150
-100
-50
0
Splitline (axial length/looking East)
West Side: @ 615 MW
West Side @ Amb
@ 1.93psi (abs)


Boardman - LP Turbine Profile
East Side: July 6, 2006
Elevation (inches)
29.85
29.80
29.75
29.70
29.65
29.60
29.55
29.50
-550
-500
-450
-400
-350
-300
-250
-200
-150
-100
-50
0
Splitline (axial length/looking East)
East Side: @ 613 MW
East Side @ Amb
@ 4.38psi (abs)



Note 1: Readings on LP-1 and LP-2 after re-torquing the soleplate anchor bolts. Reference Q-Pro file BDM-K26A-409, Rev. 5

Note 2: Node point numbers followed by "H" indicate the operating condition.

PGE - Boardman Generating Facility

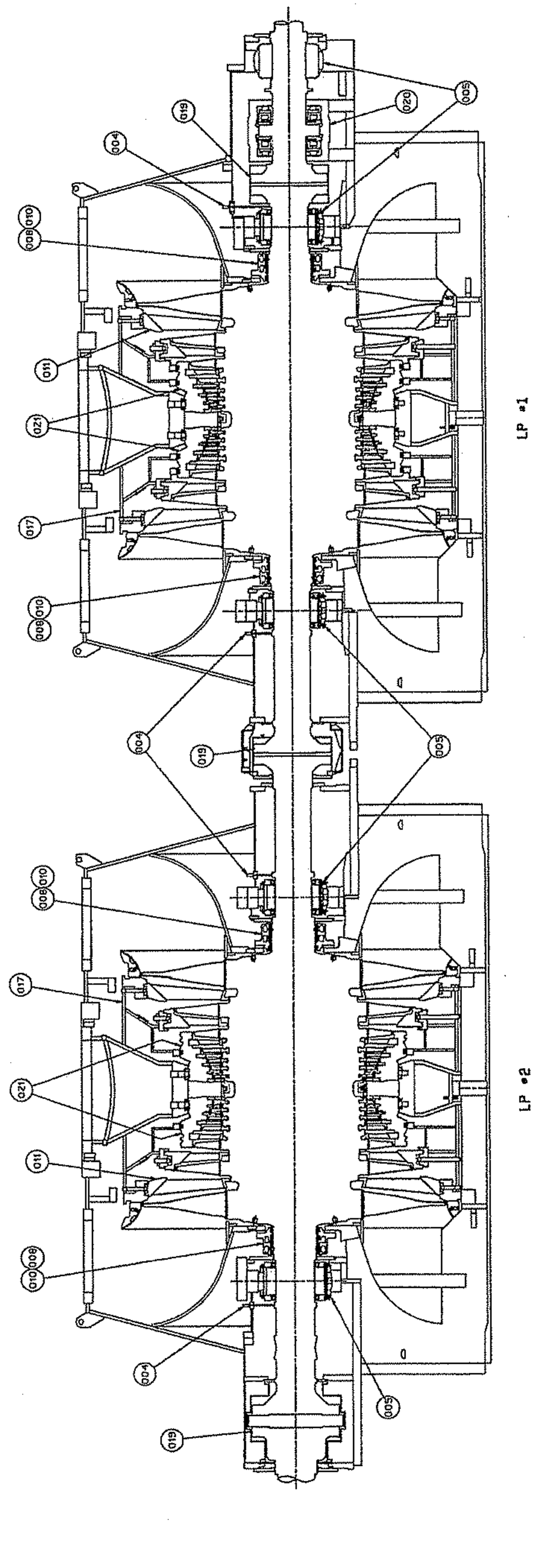
Boardman, Oregon USA

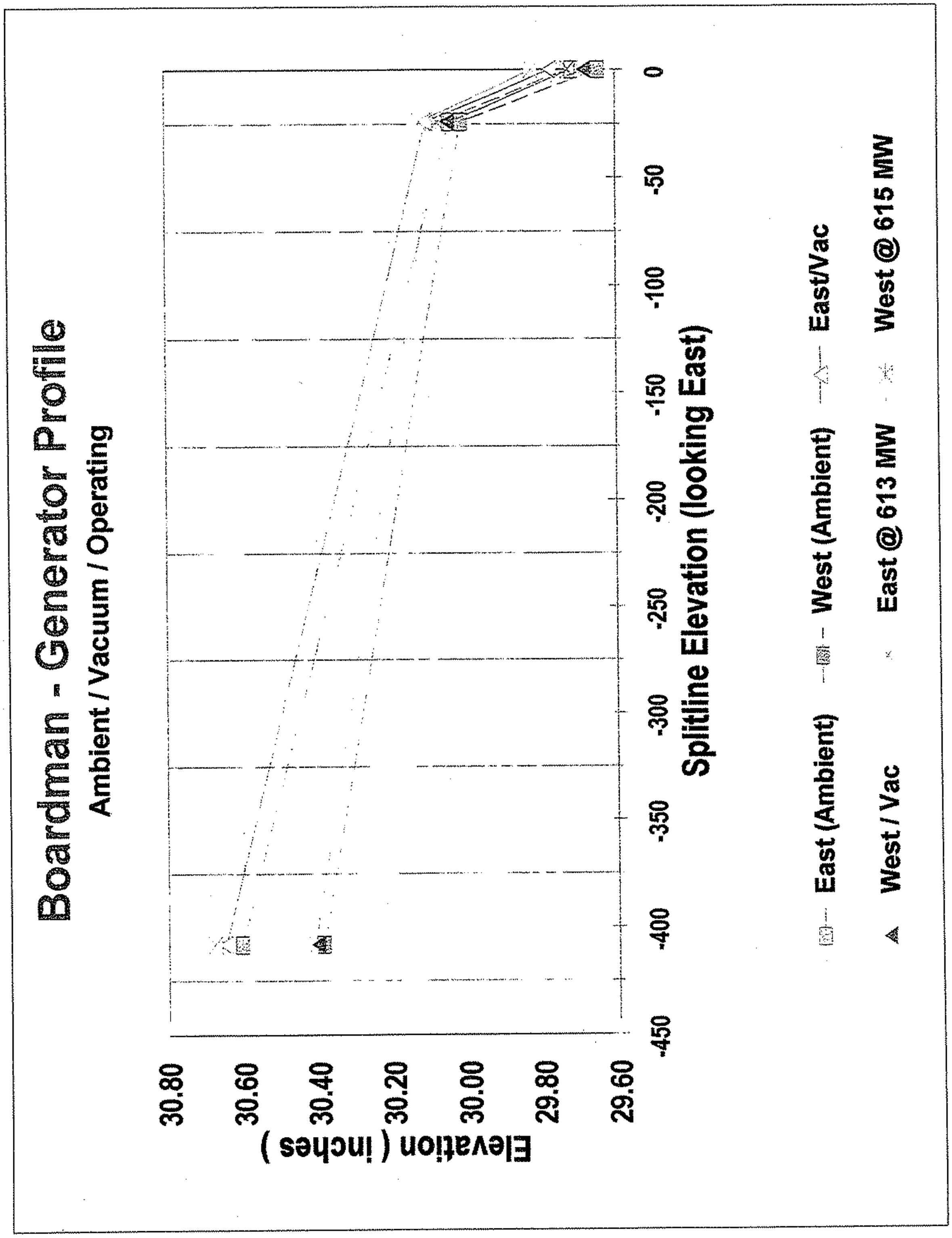
Low Pressure Turbines & Bearings - Elevation Profile

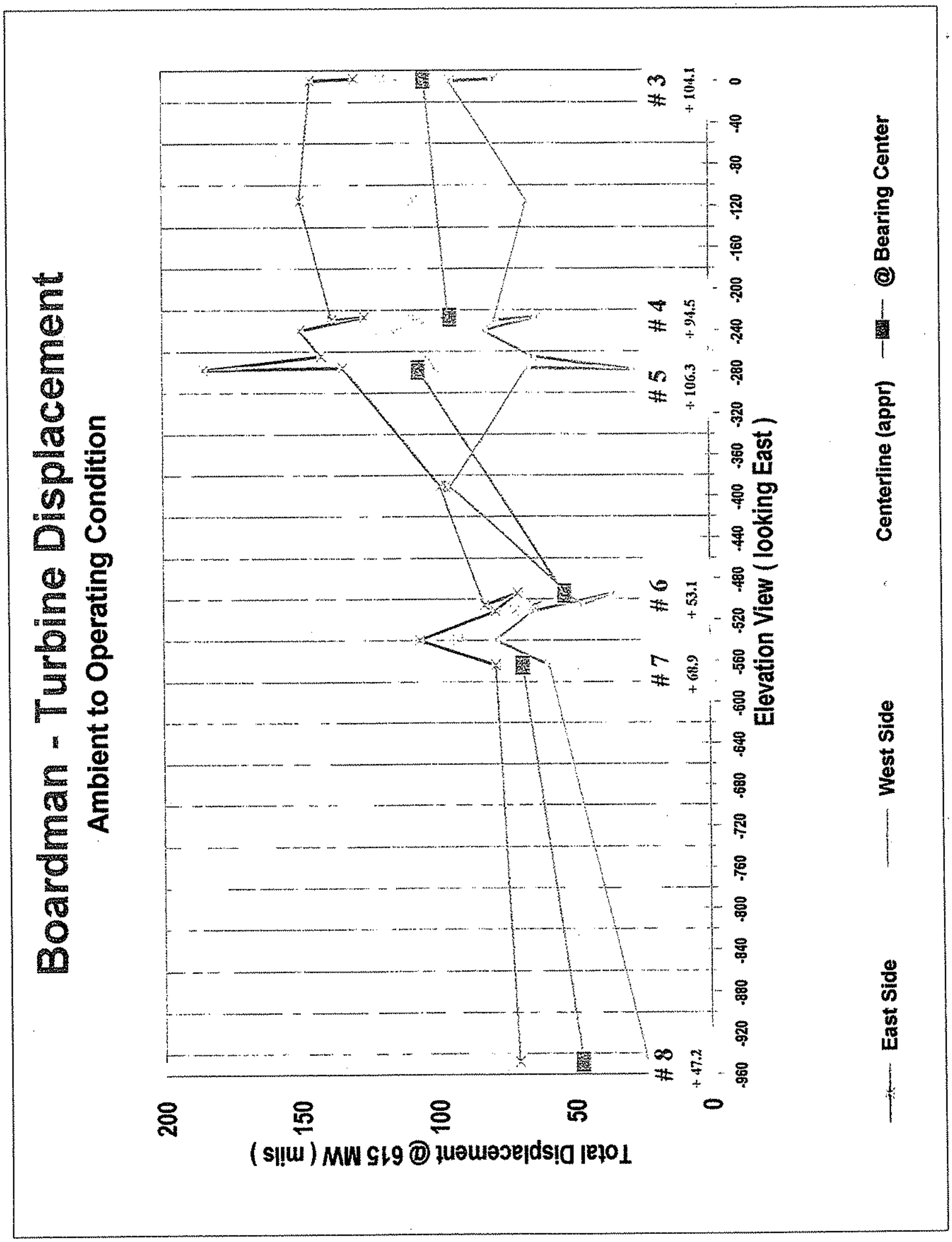
KVW

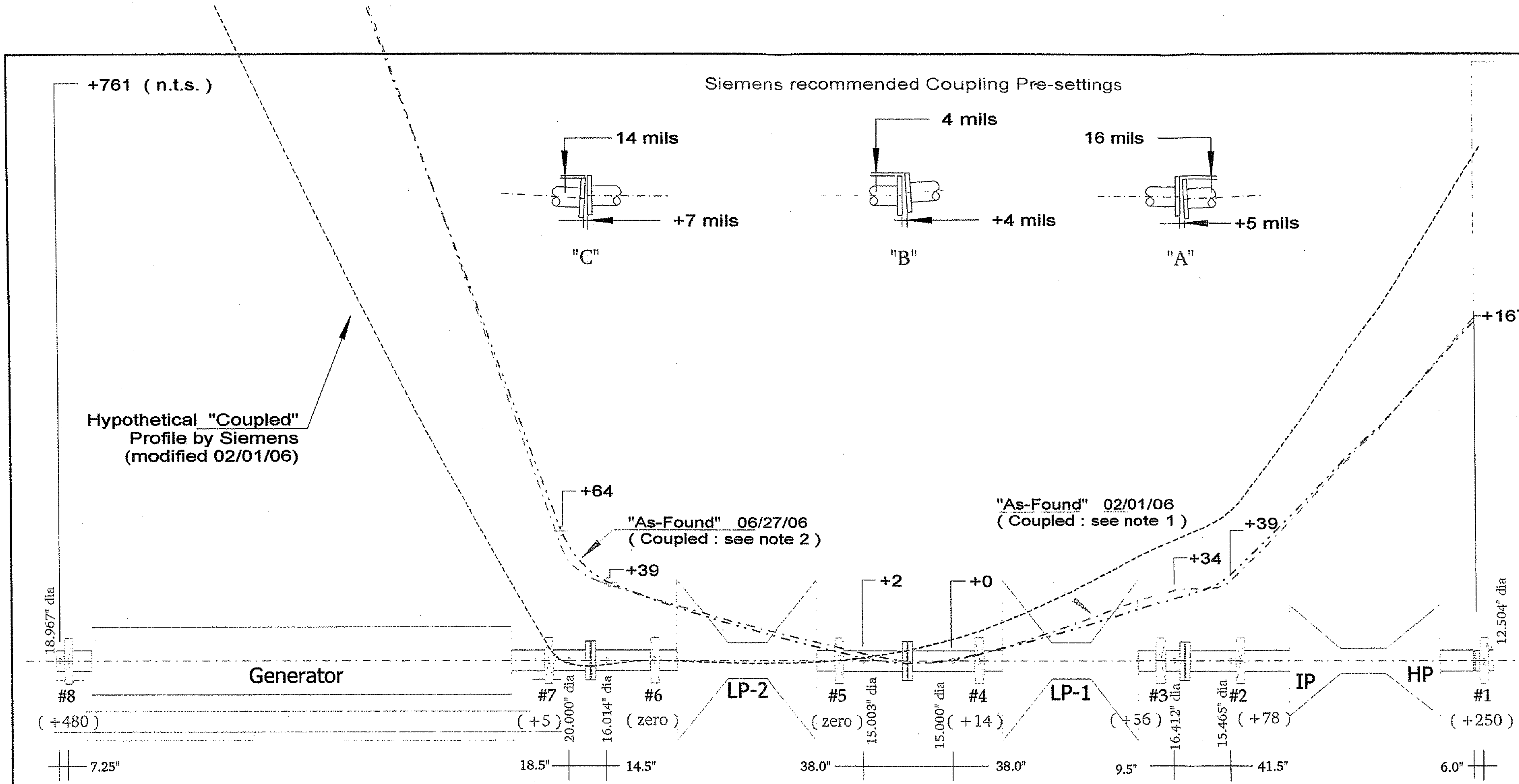
KVW, Incorporated
Portland, Oregon 1-800-730-0220

Drawn by: G. J. Koerger	Drawing No.	Revision
Job No. 206K-409	BMN-LPT-EPRF	3
Rev.Date: 07/10/2006		


LP #1
LP #2
004
005
008
010
011
017
019
020
021


Boardman - Generator Profile
Ambient / Vacuum / Operating
Elevation (inches)
30.80
30.60
30.40
30.20
30.00
29.80
29.60
-450
-400
-350
-300
-250
-200
-150
-100
-50
0
Splitline Elevation (looking East)
East (Ambient)
West (Ambient)
East/Vac
West / Vac
East @ 613 MW
West @ 615 MW


Boardman - Turbine Displacement
Ambient to Operating Condition
Total Displacement @ 615 MW (mils)
200
150
100
50
0
8
+ 47.2
# 7
+ 68.9
# 6
+ 53.1
# 5
+ 106.3
# 4
+ 94.5
# 3
+ 104.1
-960 -920 -880 -840 -800 -760 -720 -680 -640 -600 -560 -520 -480 -440 -400 -360 -320 -280 -240 -200 -160 -120 -80 -40 0
Elevation View (looking East)
East Side
West Side
Centerline (appr)
@ Bearing Center



Note 1: Profile taken with all couplings coupled. Not all bearing caps are on and none of the strongbacks are in place.
Note 2: All couplings coupled; bearing caps & strongbacks in place.

1.79=f / axial

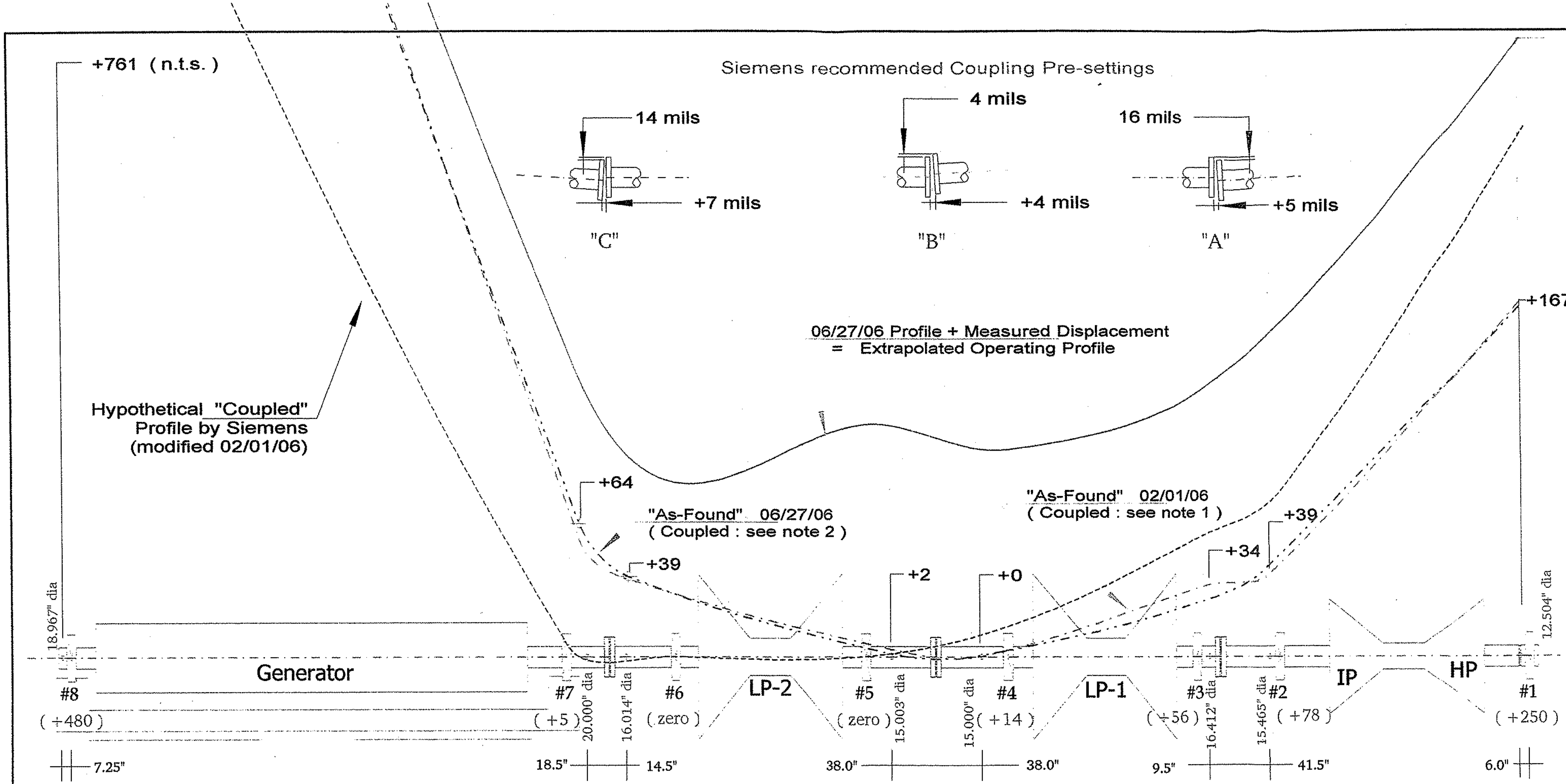
PGE - Boardman Generating Plant

Boardman, Oregon USA

Steam Turbine - Generator Shaft Profile

AVA, LTD. Alignment Vibration Analysis, Ltd.
Portland, Oregon 800-730-0220

Drawn by: G. Koerger	Drawing Number	Revision
Project No: 206A-409	BMN-CL-TRBSFT	4
Rev. Date: 07/07/2006		



Note 1: Profile taken with all couplings coupled. Not all bearing caps are on and none of the strongbacks are in place.
Note 2: All couplings coupled; bearing caps & strongbacks in place.

1.79=F axial

PGE - Boardman Generating Plant

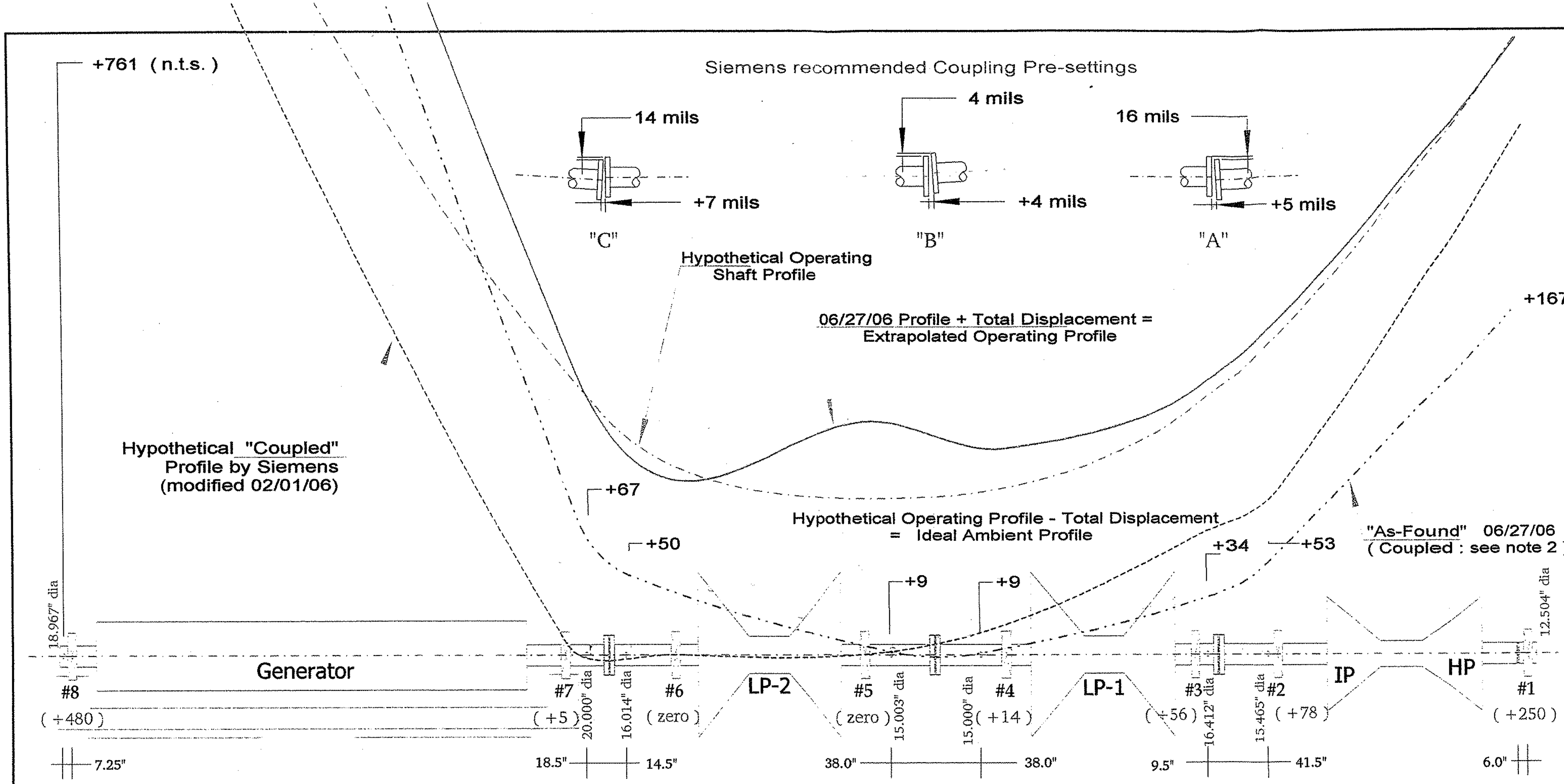
Boardman, Oregon USA

Steam Turbine - Generator Shaft Profile

AVA, LTD.

Alignment Vibration Analysis, Ltd.
Portland, Oregon 800-730-0220

Drawn by: G. Koerger	Drawing Number	Revision
Project No: 206A-409	BMN-CL-TRBSFT-A	1
Rev. Date: 07/07/2006		



Note 1: Profile taken with all couplings coupled. Not all bearing caps are on and none of the strongbacks are in place.
Note 2: All couplings coupled; bearing caps & strongbacks in place.

1.79=f axial

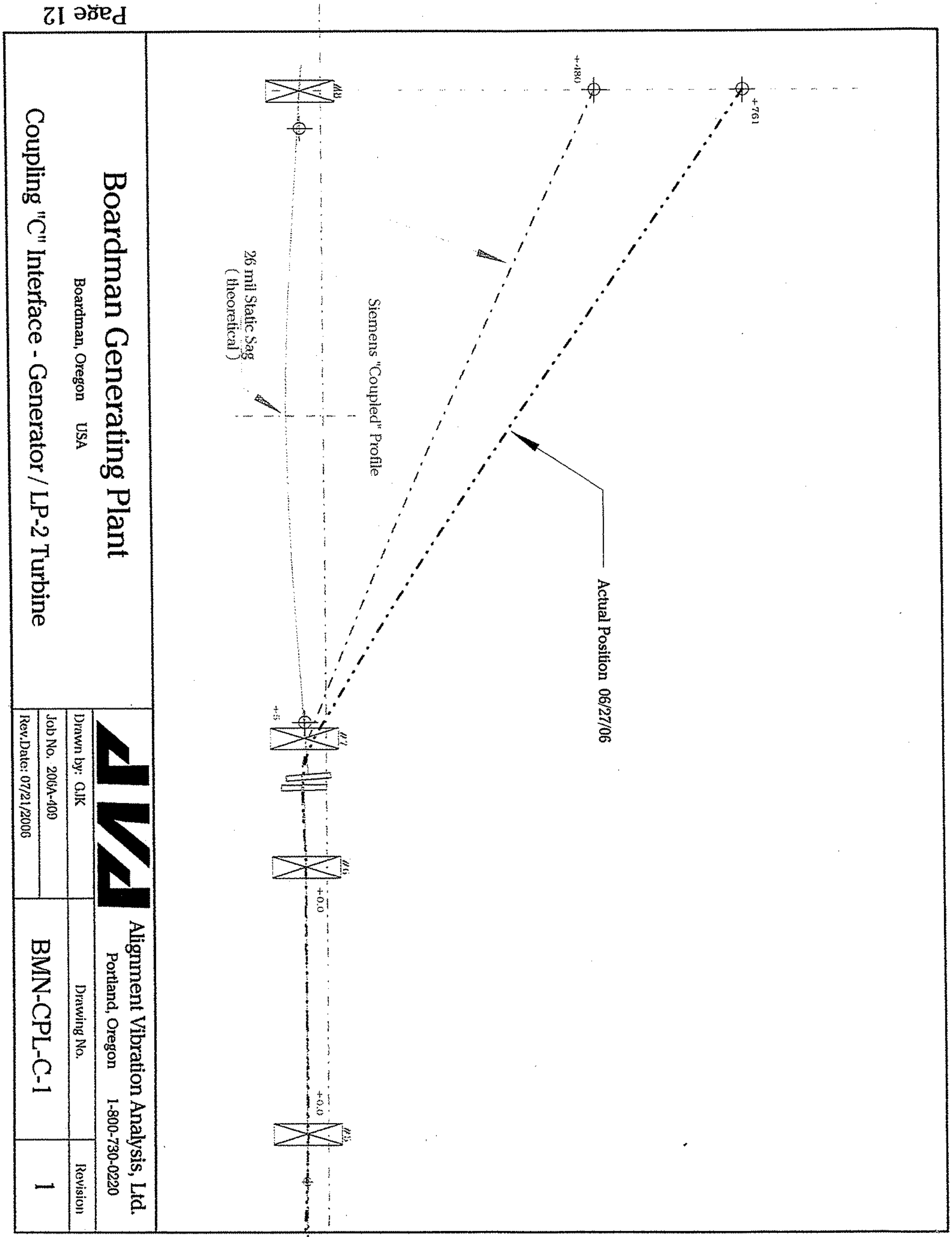
PGE - Boardman Generating Plant

Boardman, Oregon USA

Steam Turbine - Generator Shaft Profile

AVA, LTD. Alignment Vibration Analysis, Ltd.
Portland, Oregon 800-730-0220

Drawn by: G. Koerger	Drawing Number	Revision
Project No: 206A-409	BMN-CL-TRBSFT-H	1
Rev. Date: 07/07/2006		


Page 12
+.480
+.761
Siemens "Coupled" Profile
26 mil Static Sag
(theoretical)
Actual Position 06/27/06
+.5
+0.0
+0.0
Boardman Generating Plant
Boardman, Oregon USA
Coupling "C" Interface - Generator / LP-2 Turbine
Alignment Vibration Analysis, Ltd.
Portland, Oregon 1-800-730-0220
Drawn by: GJK
Job No. 206A-409
Rev.Date: 07/21/2006
Drawing No.
BMN-CPL-C-1
Revision
1

UE 196 / PGE / 600
KAHL

BEFORE THE PUBLIC UTILITY COMMISSION

OF THE STATE OF OREGON

PGE Response to Bench Request No. 5

PORTLAND GENERAL ELECTRIC COMPANY

Janet Kahl

January 30, 2009

Table of Contents

I. Introduction

Q. Please state your name and position with Portland General Electric (PGE).

A. My name is Janet Kahl (Janet Gulley, in some of the attached exhibits). My position at PGE is Manager, Mechanical Engineering in Power Supply Engineering Services. I have been employed at PGE since 1987. My qualifications appear in the last section of this testimony.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to respond to Question No. 5 in the December 8, 2008 Bench Request issued in this docket. This question concerns PGE's monitoring of the Boardman LP 1 turbine installation and maintenance work performed by Siemens.

II. Bench Request No. 5

Q. Describe in detail the actions PGE personnel took to oversee the installation and maintenance work performed by Siemens on the LP1 turbine. See, e.g., PGE/400, Quennoz/10.

A. PGE actively monitored Siemens' manufacture, installation, and maintenance of the upgraded turbines. My involvement in the Boardman turbine upgrade began in 1998, when I participated in contract negotiations with Siemens on the turbine upgrade purchase. PGE's right to monitor Siemens' QA/QC programs and performance was explicitly addressed during those negotiations. PGE negotiated the right to establish "witness points" during the manufacture of the turbine. (See PGE Exhibit 510C, Contract, at 73 and 83.) These "witness points" were specific events during manufacturing that PGE's Quality Control Representative (PQCR) oversaw to ensure compliance with the requirements of the specifications, codes and drawings. I personally served as PQCR during the monitoring of Siemens' high-speed balance of the LP turbines. Another "witness point" was the review and acceptance of the rotor forging ladle analysis.

The contract also required that Siemens maintain a QA/QC program that was certified under ISO 9001 standards. Siemens' QA/QC program met that standard. (See PGE Exhibit 512, Siemens' ISO 9001 Certification.) PGE had the contractual right "to witnessing of tests and inspections by the PQCR to ensure compliance with the specifications, codes, and drawings" of the QA/QC program and turbine design. (See PGE Exhibit 510C, Contract, at 83.)

As part of this oversight, I, along with other PGE employees, visited Siemens' facilities to review their QA/QC programs and to witness specific events related to the manufacture of the turbines. I personally made multiple visits to Siemens' design and manufacturing facilities, in Florida, North Carolina, Ohio, and Mexico. Since the visits took place approximately 10 years ago, I no longer have complete travel documents. However, I was able to locate some documentation regarding PGE visits to review and monitor Siemens' work. PGE Exhibit 601 is a copy of an e-mail I sent from my visit to Mexico, where I verified Siemens' work on the inner turbine cylinders and reviewed Siemens' QA program for the Mexico facility. PGE Exhibit 602 contains copies of my travel vouchers related to monitoring the LP turbine upgrade, along with similar travel vouchers of other PGE personnel performing similar duties.

PGE's contract with Siemens included rights to review the results of tests that Siemens performed on the LP turbines. (See PGE Exhibit 510C, Contract, at 10-14.) For example, PGE reviewed the Forging Ladle Analysis, which tests the rotor's metallurgical composition, to ensure that the composition met contract specifications. PGE Exhibit 603C is a copy of the Forging Ladle Analysis. PGE also reviewed Siemens' Tensile Test data related to the turbines. PGE Exhibit 604C contains copies of these test results. PGE Exhibits 603C and 604C are confidential and subject to the protective order in this docket (Order No. 07-433).

PGE's "witness points" and QA/QC reviews allowed us to monitor production of the turbines. These events were milestones under PGE's contract with Siemens, which meant that PGE's periodic payments to Siemens were tied to successful completion of these steps during the production process. The contract also required that PGE be informed of deviations or non-conformances and approve disposition of those items. When Siemens deviated from any design aspect during production, Siemens was required to inform PGE and to obtain PGE's agreement that the deviation did not affect the form, fit, or function of the turbine. Siemens informed PGE through its Material Disposition Reporting system, as shown in PGE Exhibit 605.

After completion of the manufacturing process, Siemens shipped the LP1 and LP2 turbine rotors to Boardman for installation. When the turbine rotors arrived at Boardman, an American Society for Nondestructive Testing (ASNT) Level II qualified PGE employee conducted visual receipt inspections of the rotors to check for damage. PGE Exhibit 606 contains reports from these inspections, with photographs.

After PGE's receipt, inspection and acceptance, Siemens installed the upgraded turbines. I monitored the turbine installation together with other PGE employees. As part of my monitoring, I kept a daily log of Job Notes, which is contained in PGE Exhibit 607. I also took approximately 1,000 photographs of the installation, which are provided on a CD as PGE Exhibit 608. Representative photographs of activities during the installation are appended to my Job Notes in PGE Exhibit 607. This exhibit also includes photographs of PGE's activities related to installation of the HP/IP turbine in 2004 and manufacture of both the LP and HP/IP turbines. To summarize, other PGE employees and I were present day and night during the installation; photographed and recorded installation progress; consulted with Siemens personnel about the installation; physically inspected turbine components during installation; and ultimately approved the progress and completeness of the installation.

PGE also employed a third-party consultant, Stone & Webster, to review and validate Siemens' performance test procedures and results for the upgraded turbines. Because performance guarantees were exceeded, no written report was required or prepared.

After the upgraded LP turbines were operating, PGE continuously monitored their condition. As described by Mr. Quennoz (see PGE Exhibit 100 at 3, 6, 7, and 9), PGE continuously monitored vibration and temperature readings at the turbine bearings to detect changes that might indicate problems with the turbines. PGE's monitoring of temperatures uncovered issues that led Siemens to replace Bearing Nos. 3-6 on the turbines in 2002. PGE's monitoring also detected increased vibrations that led to discovery of the LP1 rotor crack in 2005, and PGE removed the turbine from service before a catastrophic failure occurred. PGE Exhibit 609C contains copies of PGE vibration data that were included in the Alstom root cause analysis (provided in PGE Exhibit 105C-B). PGE Exhibit 609C is confidential and subject to the protective order in this docket (Order No. 07-433). PGE also monitored Siemens' maintenance of the upgraded LP turbines. I was not directly involved in that monitoring, which is described in Mr. Quennoz's testimony (PGE Exhibit 500).

To summarize, I and other PGE employees oversaw and monitored Siemens' manufacturing, installation, and maintenance of the upgraded LP turbines. Siemens was required to obtain PGE's approval before manufacturing, installation, and maintenance tasks were considered complete. Although PGE contracted with Siemens to perform these tasks, they were performed under our monitoring and subject to our acceptance.

III. Bench Request No. 5(a)

Q. Identify the PGE personnel responsible for overseeing Siemens' installation and maintenance of the LP1 turbine and describe their experience, training, education, and specialized knowledge.

A. PGE Exhibit 610 provides the experience, training, education and specialized knowledge of 17 primary PGE personnel listed below who oversaw Siemens' installation and maintenance of the turbine. The following personnel are highly trained, have worked for PGE for many years, have substantial experience, and have received numerous hours of training.

Name	Position
Loren Mayer	Current Plant Manager
Larry Smythe	Maintenance Manager
Randy Curtis	NDE Inspections
Janet Kahl (formerly Gulley)	Project Manager
Rick Neimann	Level III NDE
Jim Chartrey	Night Shift and NDE
Dave Rodgers	Manager of Boardman Plant Engineering
Roger Lewis	Plant Engineer for HP/IP
Cheryl Bryant	Performance Testing
Wayne Oren	Electrical Support and Controls Engineer
Rick Tetzloff	Staff Engineer
Bob Ball	Work Scheduler and Outage Planner
Tom Meyers	Operations Manager
Scott Ross	Mechanical Maintenance Foreman
Bryan Timms (Retired)	Plant Turbine and Maintenance
Tom Kingston (Retired)	Plant Manager for LP
Jeff Carter (Retired)	Engineering Staff, Metallurgist

IV. Bench Request No. 5(b)

Q. How could PGE provide effective oversight if much of the information about the installation of the new rotors in the LP1 turbine was considered proprietary and not shared with PGE? ***See, e.g.,*** **PGE/105C-A, Quennoz/4-5.**

A. The fact that some of Siemens' design information was proprietary did not prevent PGE from monitoring the work during manufacturing and installation (to ensure that the components met design criteria), ensuring compliance with Siemens' QA/QC program, or reviewing inspection and test results. PGE's contract with Siemens included rights to review Siemens' reports, calculations, and analyses. (See Pages 10 and 11 of PGE Exhibit 510C, which is a copy of the contract.) Prior to on-site installation, I reviewed proprietary design information with Siemens engineers and went to Siemens manufacturing facilities. (See Page 8 of PGE Exhibit 510C, Technical Specifications, for additional information that Siemens was required to provide.) During installation, I monitored daily site work activities and reviewed material, inspection, and test reports. I also reviewed rotor alignment criteria and tolerances on Siemens drawings and ensured that the actual field measurements were reviewed and accepted by Siemens design engineering in Florida. I ensured that the turbine lube oil was cleaned prior to startup, and that the bearing vibrations were acceptable during startup as the turbine speed increased through critical regions. I ensured that the overall turbine performance was acceptable (which also verified the efficacy of the design), and that contractual requirements were met before final payment was made.

The installation itself was not proprietary; other PGE staff and I monitored and photographed the installation. Furthermore, during turbine startup, after the LP rotors were installed, PGE continuously monitored vibration and temperature to ensure that they remained within acceptable limits for turbine operation. These parameters provided another level of assurance that the turbine had been manufactured and assembled correctly. PGE also hired an independent consultant to review turbine startup vibration readings, to provide further assurance that the turbine was operating acceptably. That consultant, RK, Ltd., monitored vibrations during restarts after extended outages between the LP installation in 2000 and the 2005 outage. Trained and experienced Siemens and PGE personnel also conducted separate vibration analyses during restarts.

The pages of the exhibit cited in this Bench Request (PGE Exhibit 105C-A, pages 4 and 5) state only that Siemens did not provide PGE with some calculations that Siemens used during alignment of the turbines. As discussed above, PGE was heavily involved in the installation process, and reviewed design and installation documentation with Siemens before and during installation. The proprietary information referred to on pages 4 and 5 of PGE Exhibit 105C-A are the calculations that Siemens uses to verify turbine alignment. It is Siemens' practice for these calculations to be held as proprietary and not shared. Typically, as long as the calculation results are within tolerances, which was the case for the Boardman turbines, the plant is available for restart. PGE was on-site for the alignments, and monitored the results through continuous monitoring of the vibrations and temperature at the bearings.

V. Qualifications

Q. Ms. Kahl, please describe your qualifications.

A. I hold a Bachelor of Science degree in Mechanical Engineering from Oregon State University. Since joining PGE in 1987, I have managed a number of power supply engineering projects including the HP/IP Turbine Upgrade Project in 2004, in which the high/intermediate-pressure steam turbine at Boardman was upgraded; the LP Turbine Upgrade Project in 2000 that entailed the upgrade of the low pressure steam turbine at Boardman by installing two new fully bladed rotors and inner cylinders; the Boiler Upgrade Project in 1998 when the boiler at Boardman was upgraded by adding new heat transfer surfaces to the radiant division walls, a lower economizer and a primary superheater. I have also worked on various hydroelectric projects such as Faraday Load Rejection Testing and the Fish Passage System for River Mill Dam. I was appointed to my current role as Manager Mechanical Engineering in Power Supply Engineering Services in 2006.

Q. Does this conclude your testimony?

A. Yes.

List of Exhibits

PGE Exhibit	Description
601	E-Mail from Visit to Siemens' Mexico Facility
602	Travel Vouchers for Monitoring Trips
603C	**Forging Ladle Analysis**
604C	**Tensile Test Results**
605	Material Disposition Reporting System
606	Non-Destructive Examination Reports
607	Installation Job Notes and Photographs
608	Installation Photographs Provided Electronically (CD) Only
609C	**Vibration Data**
610	PGE Personnel Involved with Installation and Maintenance

From: Janet Gulley
To: Jaisen Mody
Date: Fri, Sep 17, 1999 2:58 PM
Subject: Short Report on the Inner Cylinders 95003

Bryan Timms, Larry Beal SWPC and I visited the machine shop in Queretaro MX where the LP1 inner cylinder is being fabricated on Sept 14, 1999.

Industra Del Hierro (i/h) is owned by ICA. ICA was instrumental in building the infrastructure for Mexico in the 40's and 50's. i/h is a growing subsidiary company with sales of 66 M last year and 81M this year. They have 5 offices in Mexico, along with Houston and Belgium.

The Queretaro plant has 500 union workers. They received their ISO 9001 cert in 1995. They work to ASME, API and AAR standards. They specialize in high thickness rolling and complex forming.

Our inner cylinder has been cut from the plate, the center stays have been formed and the outer wrappers are being cut. It looks like they will just make the Nov 15 ship date. All the workers are high quality and they always produce a quality project. They are a very proud bunch of people, really nice.

The quality control department was excellent. Each material cert, weld rod, weld, etc.. was fully documented. The plate for this project came from Bethlehem Steel and the rod from Lincoln.

My only slight concern is the schedule. The shop has lots of work. GE has a guy that is there 2 weeks per month year round just to make sure that the GE work gets done. Mitsubishi HT has a person there full time. SWPC is monitoring the work so I don't anticipate any problems.

The design was modified to allow it to be cut into 3 pieces then welded back together. This allows it to be manufactured quicker. There is no compromise in quality with these extra welds.

i/h fails 2 ½ % of UT and 1 ½ % RT examinations done by their in-house QA staff. This is better than industry average. All Manufacturing Deficiency Reports (MDR's) reports are reviewed by SWPC and me. None have been written for this project yet. They have one Level III NDE guy. Pretty typical.

It was a great visit, I learned a lot and had a good time.

janet_gulley@pgn.com
Project Manager
Power Supply Engineering Services
464-8167

CC: TOM KINGSTON

BN 95-003

From: <Lawrence.Beal@swpc.siemens.com>
To: HQ2.EM6(Janet Gulley)
Date: Thu, Nov 18, 1999 11:47 AM
Subject: Boardman - MDR

Janet,

The Material Disposition Reporting (MDR) System is the nonconforming material control system.

When an MDR affects FORM, FIT OR FUNCTION, it is classified as customer sensitive and the customer is made aware of the noncomformance and its disposition.

Recently an MDR was written against the LP1 rotor during maching on the side entry machine. Here are the details for your information.

DESCRIPTION:

The row 1 gov. lockslot was machined .103 over the finish dimension on the length and width

ENGINEERING RESPONSE:

The faces of the entering slot defined by the "X" and 1.564" dimensions were machined .103" out of location making in larger entering slot. As reported the exit, concave (trailing) corner was not machined in error due to discovery of the error. The entering slot is to be machined as follows: 1) Finish machining the exit, concave (trailing) corner entering slot faces with the same .103" offset (this will result in an entering slot with the "X" dimension being 1.237" and the 1.564" being 1.770"; 2) machine the inlet and exit serrations per drawing location, 4242C05 006 (Maintain the 1.564" serration center to center dimension. The resulting entering slot condition will not require any special parts or blades. The originally specified 1R blades is to be assembled in the row. The increase in blade stresses, lock piece stresses, and rotor stresses have been evaluated and determined to be acceptable. The resulting visibility of the .103" gaps around the entering slot also was determined to be acceptable.

Here is a pictorial of the area discussed:

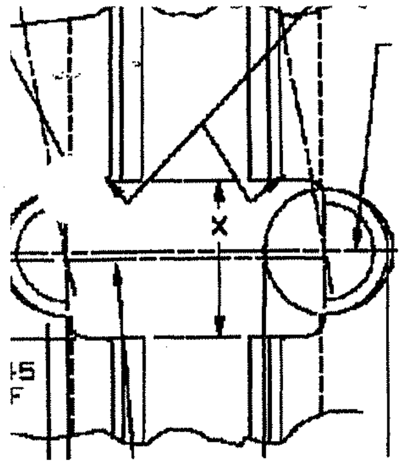
(Embedded image moved to file: pic15259.pcx)

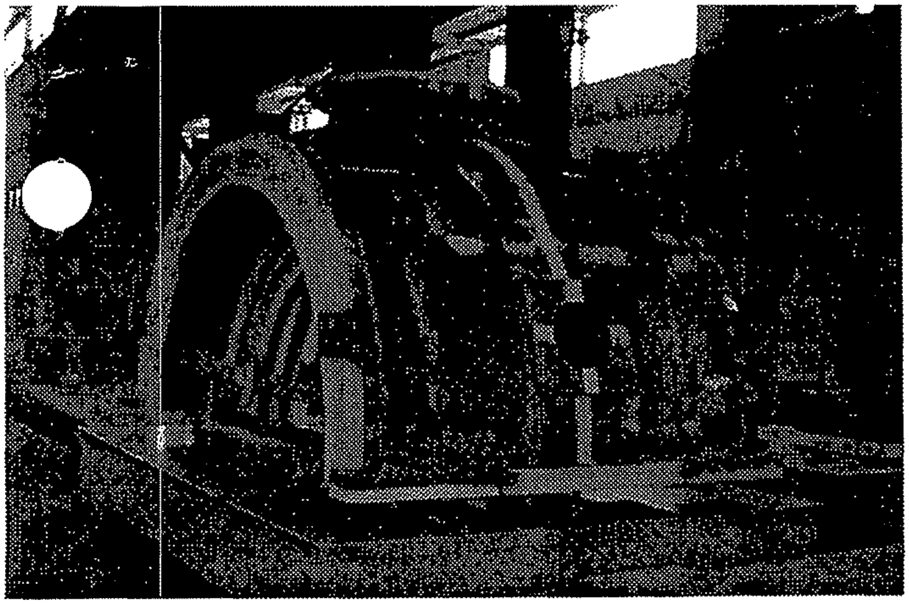
The final disposition was to use per engineering directions.

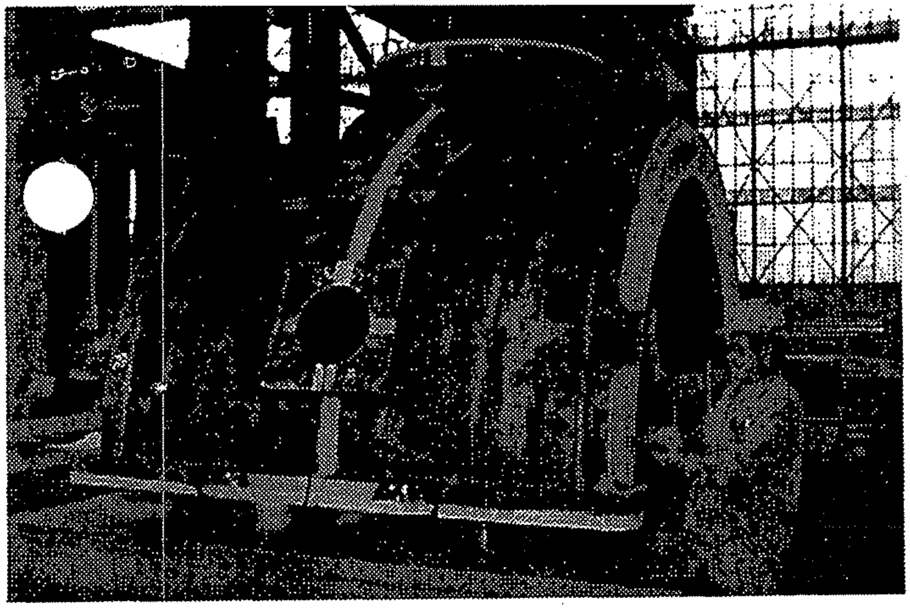
No action is required on your part, but please review and if you have any questions or concerns, let me know.

Larry

CC: WIZ.IXGate("David.Reighn@swpc.siemens.com","Julie....


X





PGE NONDESTRUCTIVE EXAMINATION REPORT

Report No.	
Date	5/30/2000
Plant - Facility - Dept	BOARDMAN
MR-RDC-DCP-Job No.	
Component Description (Equip No. Inst. No. stage of manuf.)	LP ROTOR
Material Specification(s) (ASTM, AWS, etc)	varies
Location (Bldg, Floor, Elev, etc)	TURBINE DECK
Drawing No. (P&ID, ISO, Spool, etc)	—
Examination Procedure(s) Rev.	VISUAL Receipt INSPECTION
Examination Code(s)	VT
Acceptance Standard(s)	N/A
NDE Equipment (Make, Model, Configuration, Set Up, etc)	N/A

Examination Method(s)

			Accept	Reject
Visual	VT		✓	
Magnetic Particle	MT			
Liquid Penetrant	PT			
Ultrasonic Thickness	UT-TM			
Ultrasonic Flaw Detection	UT			
Eddy Current	ET			

Report (Remarks, Comments, Sketch, etc)

[Vi]sual receipt inspection for shipping damage [f]or cleanliness problem. Results summarized in JWC-12-2000 ATTACHED

Exa[miner](s) [signature]
Signature

Certification Level II
(I, II, III, etc)

H11841

June 6, 2000
JWC-0012-2000

To: Janet Gulley

From: Jeff Carter

Subject: Receipt Inspection of LP Rotor

I conducted a receipt inspection of the above rotor to check for shipping damage or cleanliness problems. The rotor was found to be acceptable. Three items of note were found. These are:

1. There is a small ding on a non-mating surface on the generator end of the rotor.

2. At least two of the recessed head hexagonal locking cap screws on the fourth row opposite the generator have had the hexagonal socket stripped out. This will not affect current function, but will make subsequent removal more difficult.

3. The light preservative oil used on the rotor is still present and has collected small quantities of dust and dirt. I talked to Larry Quinn about the effect of the oil and entrained material on the steam circuit. He stated that the full flow condensate polishers would remove any of this material as it is steamed off the rotor. Based on this, I do not believe that there is any concern in this respect.

The rotor is shown in Figure 1. The generator end is on the left, and what will be termed the other end is on the right. The side closest to the camera in Figure 1 will be termed the near side, and the other side will be termed the far side.

Figure 2 is a closer view of the generator end near side, while Figure 3 shows the blading on the generator end far side. A series of progressively closer views of the generator end of the rotor are seen in Figures 4 - 6. Note the peened over metal at about the 9:30 o'clock position.

The condition of the other end on the far side is seen in Figures 7 & 8. Similar views of the near side are found in

Figures 9 & 10. Note the blade locking recessed hexagonal head cap screws in the latter figure. Closer examination of the cap screws in the fourth wheel (Figures 11 & 12) show them to have been stripped out. For comparison, see Figure 13 where this has not been done.

cc: Jaisen Mody
Rick Neimann

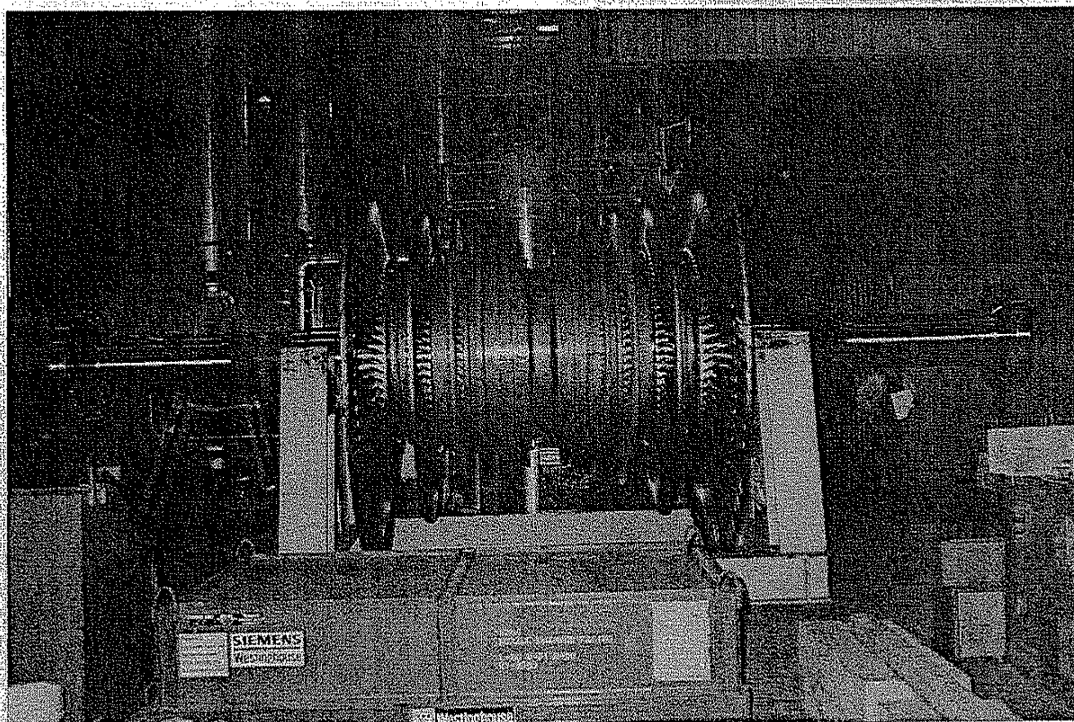


Figure 1

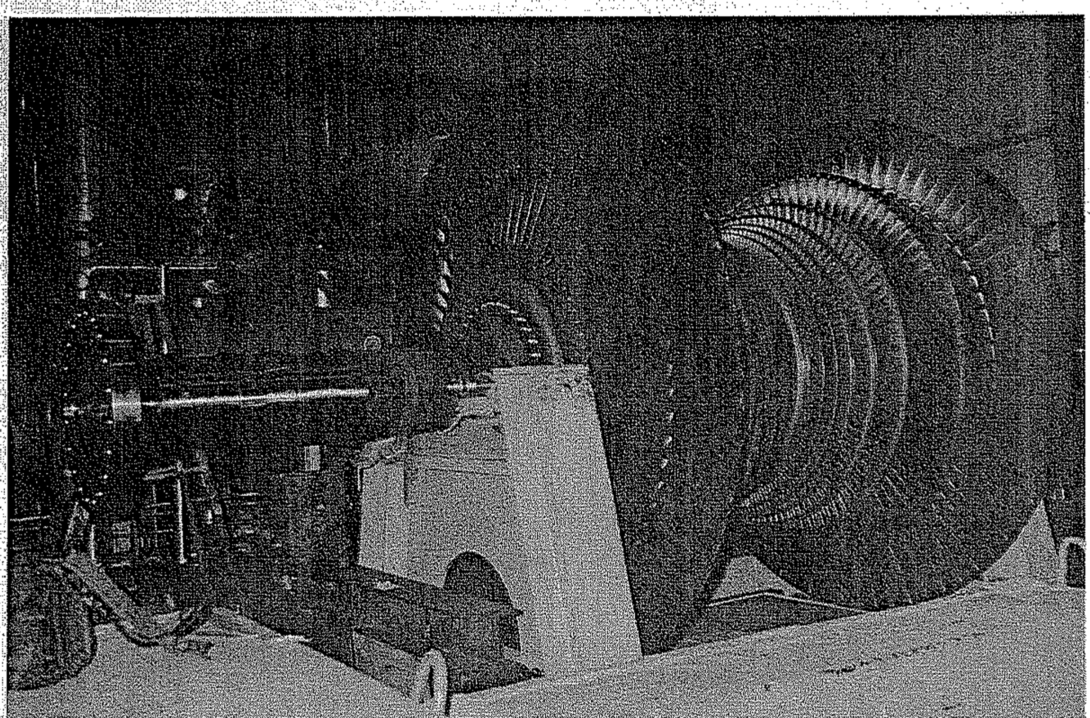


Figure 2

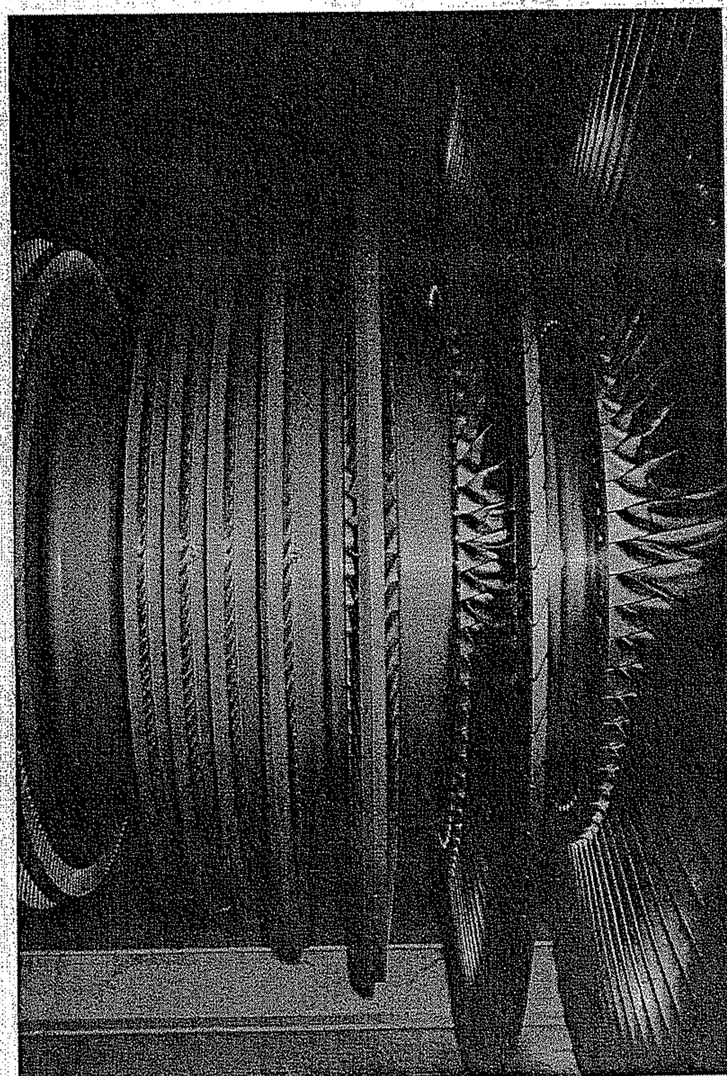


Figure 3

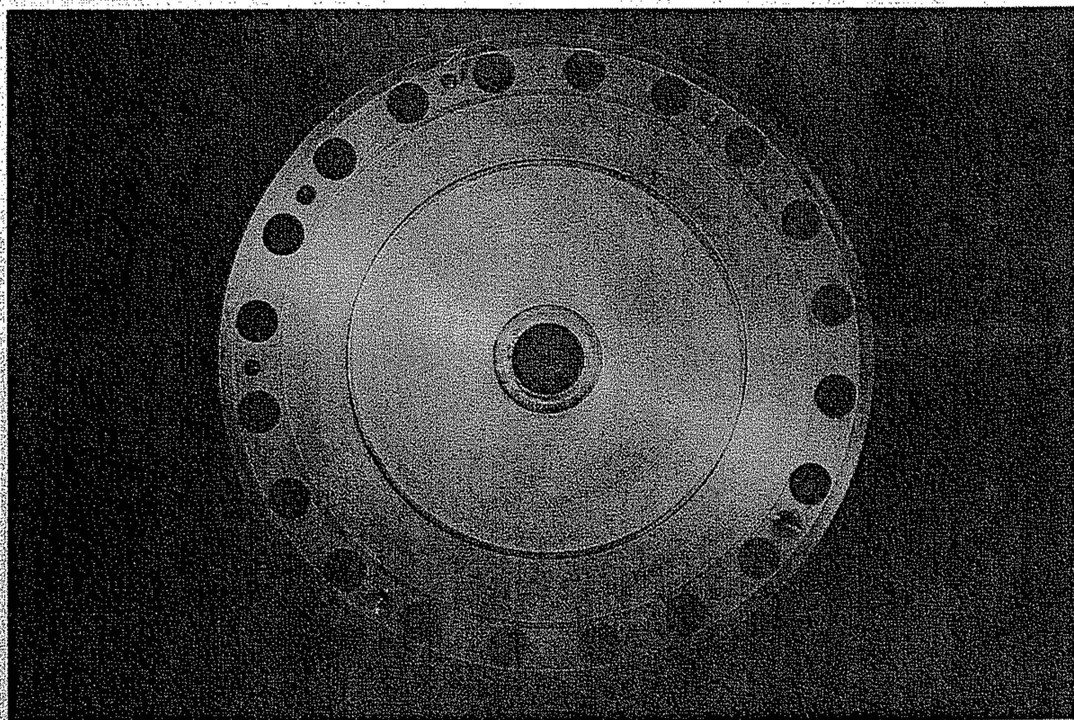


Figure 4

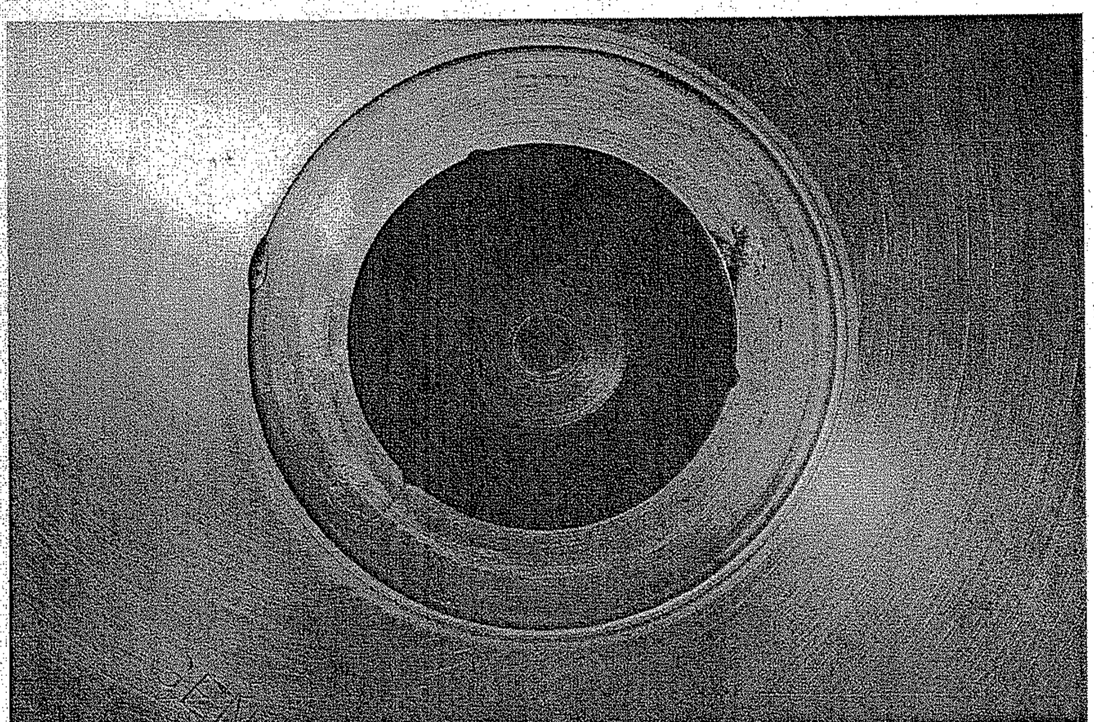


Figure 5

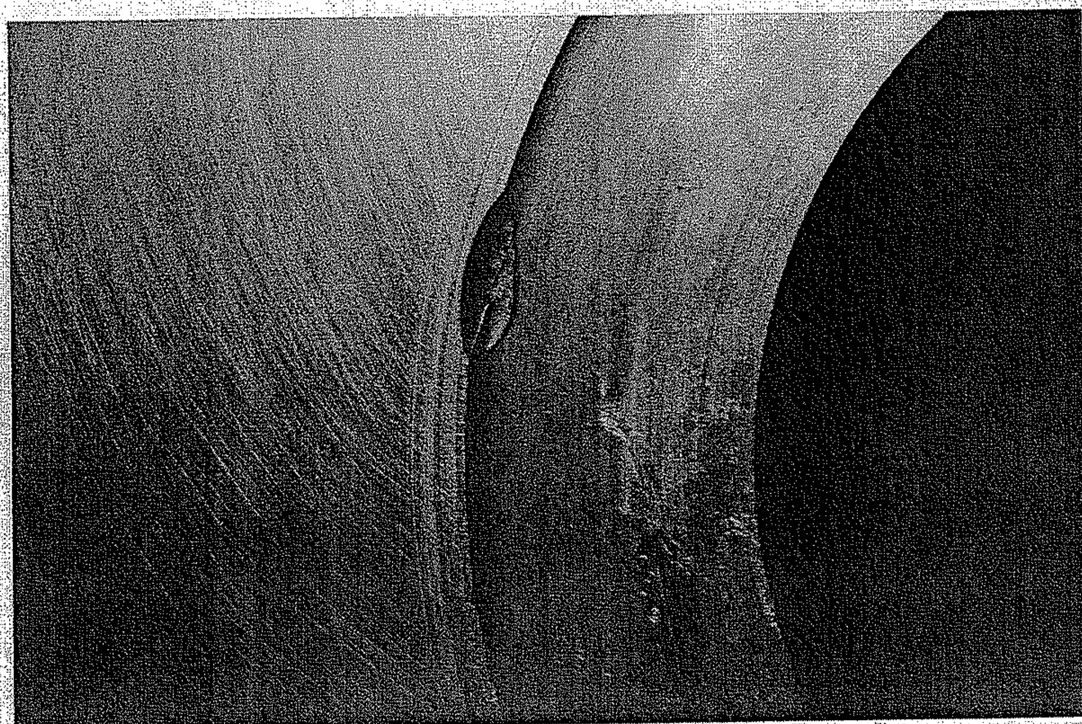


Figure 6

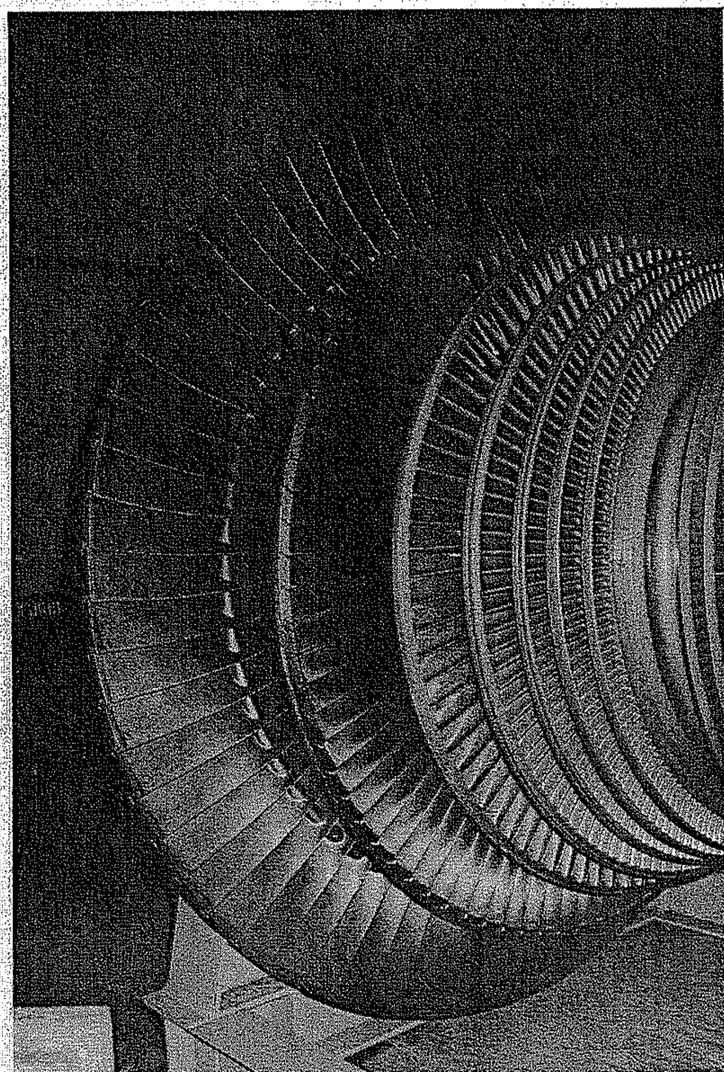


Figure 7

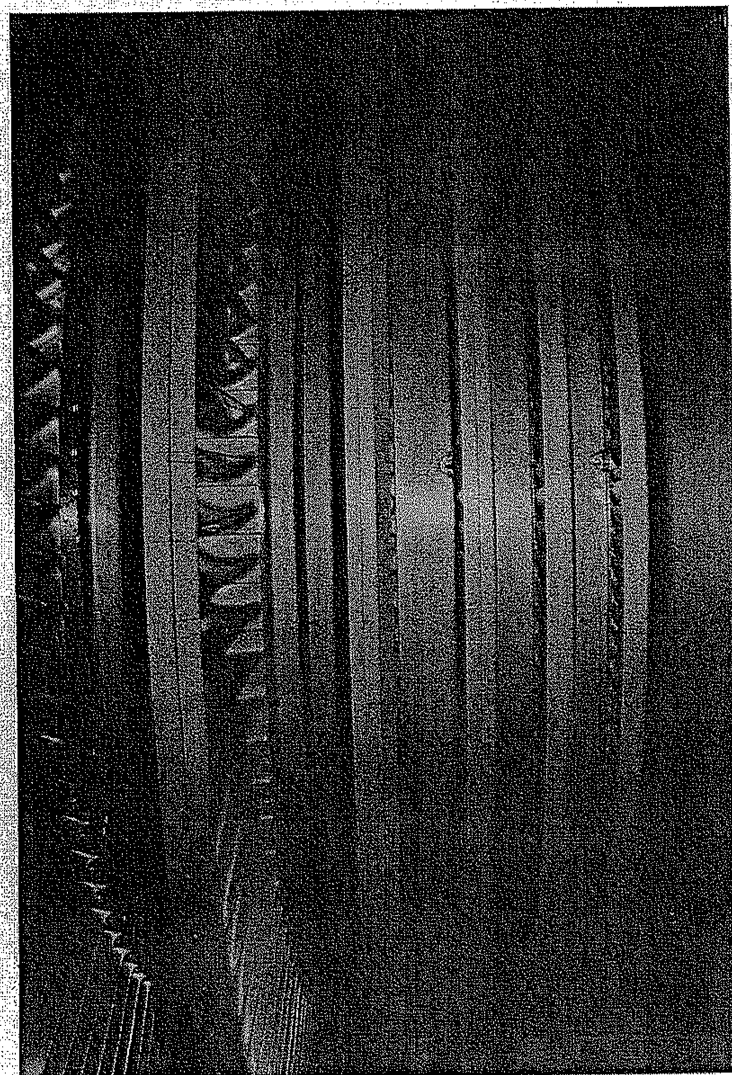


Figure 8

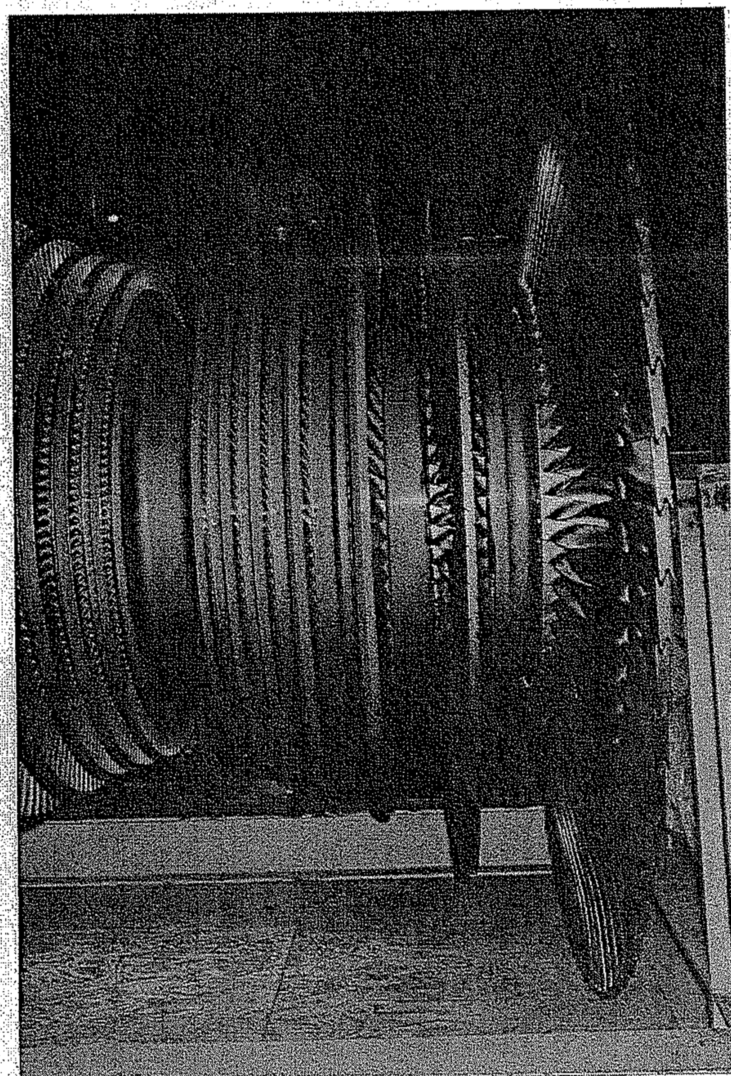


Figure 9

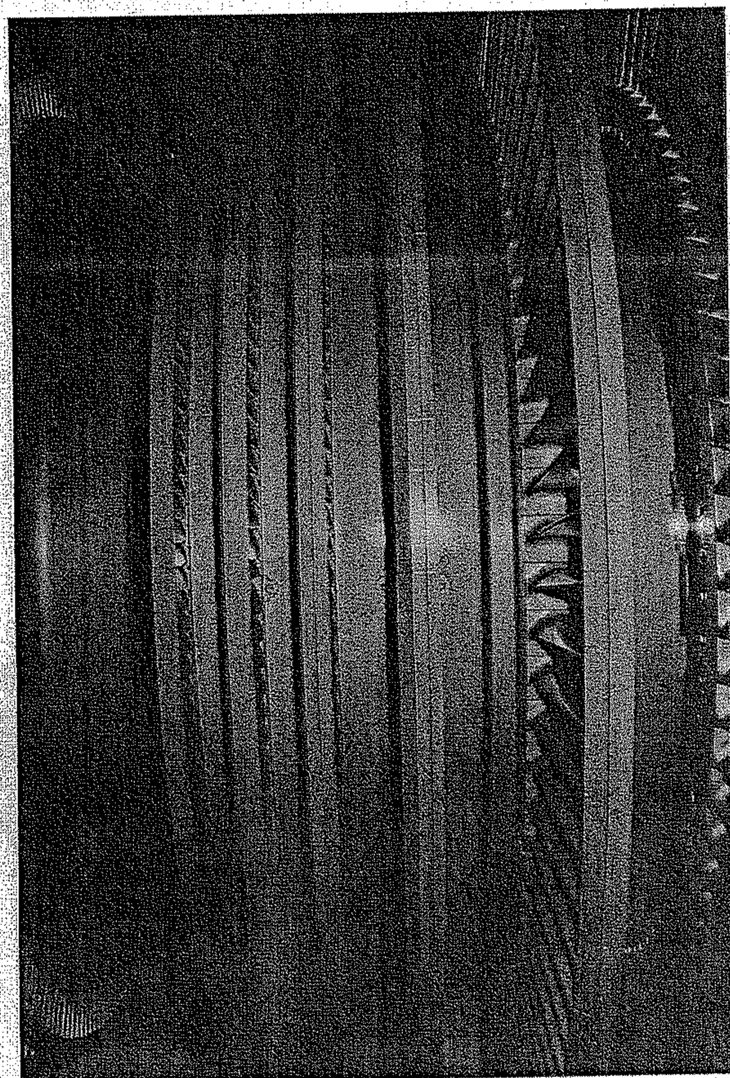


Figure 10

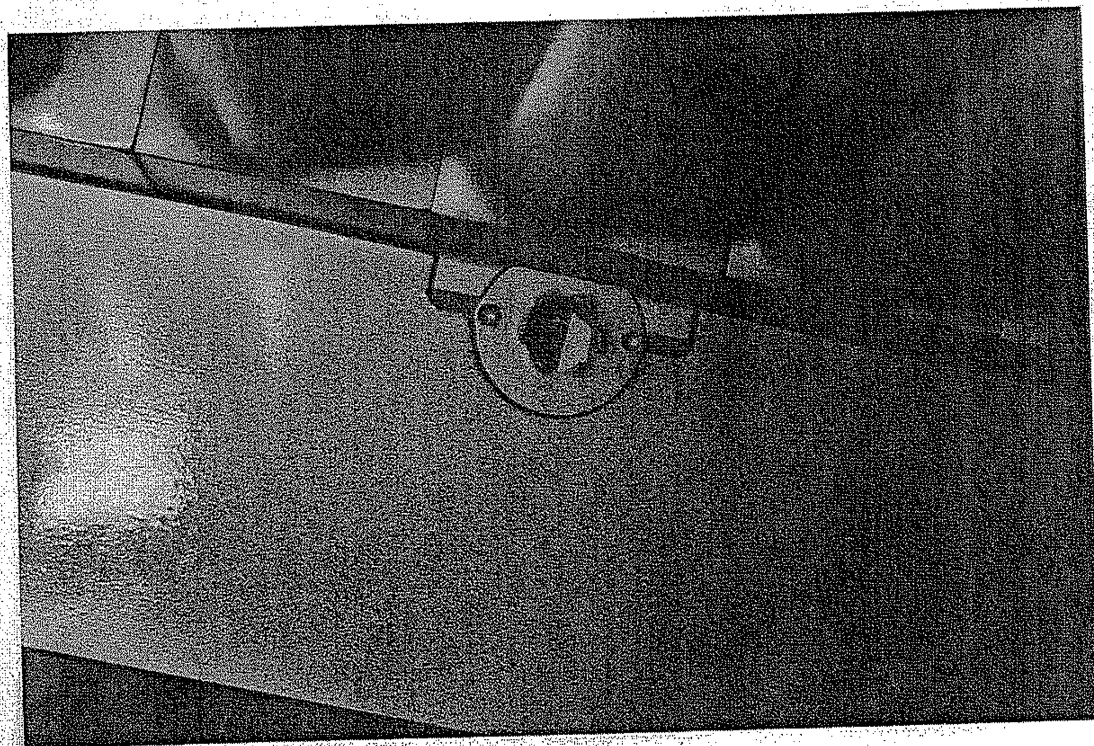


Figure 11

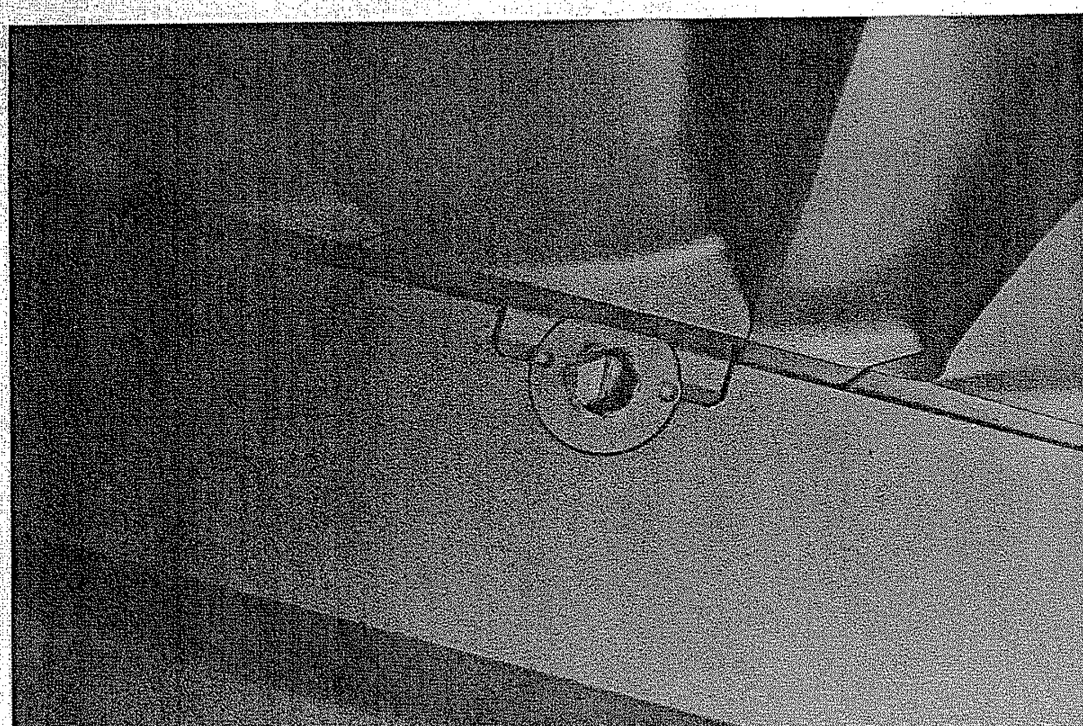


Figure 12

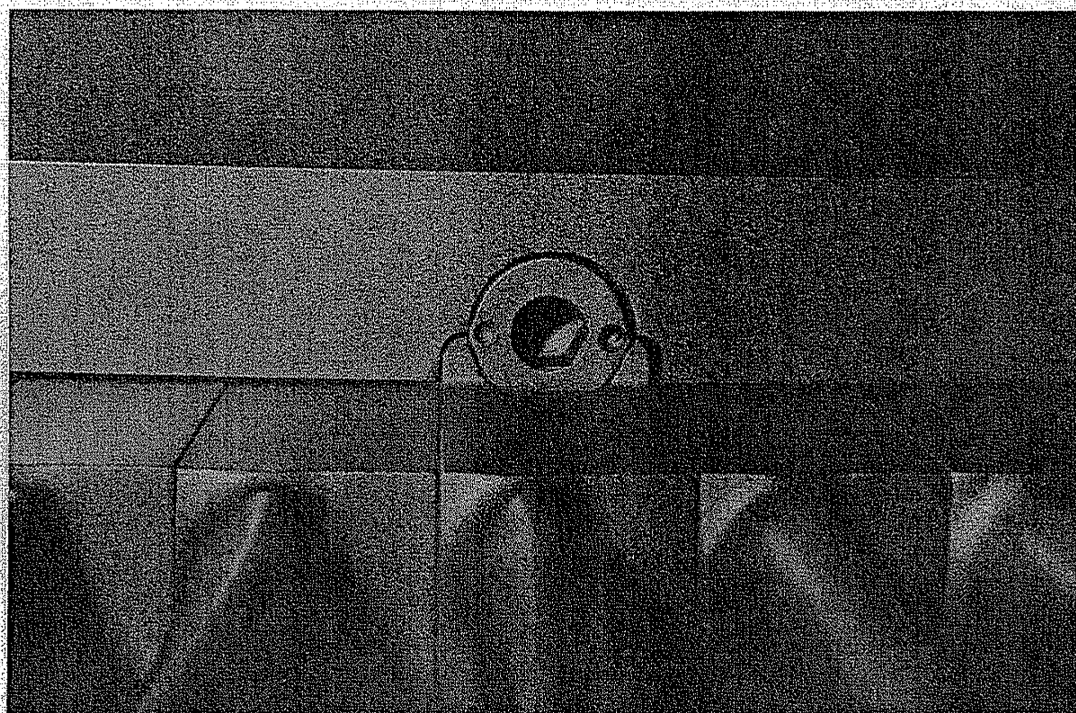


Figure 13

PGE	NONDESTRUCTIVE EXAMINATION REPORT	Report No.
		Date 6/7/2000

Plant - Facility - Dept	MR-RDC-DCP-Job No.
BOARDMAN	
Component Description (Equip No. Inst. No. stage of manuf.)	Material Specification(s) (ASTM, AWS, etc)
LP ROTOR	N/A
Location (Bldg, Floor, Elev, etc)	Drawing No. (P&ID, ISO, Spool, etc)
TURbine DECK	—

Examination Procedure(s) Rev.	Examination Code(s)	Acceptance Standard(s)
VISUAL	VT	N/A General APPEARANCE

NDE Equipment (Make, Model, Configuration, Set Up, etc)

N/A

Examination Method(s)

Method	Code		Accept	Reject
Visual	VT	✓	✓	
Magnetic Particle	MT			
Liquid Penetrant	PT			
Ultrasonic Thickness	UT-TM			
Ultrasonic Flaw Detection	UT			
Eddy Current	ET			

Report (Remarks, Comments, Sketch, etc)

shipping receipt inspection for damage & cleanliness.

Examiner(s) JW Carles
Signature

Certification Level II
(I, II, III, etc)

6-11841

June 12, 2000
JWC-0013-2000

To: Janet Gulley

From: Jeff Carter

Subject: Receipt Inspection of Second LP Rotor

I conducted a receipt inspection of the above rotor to check for shipping damage or cleanliness problems. The rotor was found to be acceptable. Two items of note were found. These are:

1. As on the previous rotor, some of the recessed head hexagonal locking cap screws on the fourth row opposite the generator have had the hexagonal socket stripped out. This will not affect current function, but will make subsequent removal more difficult.

2. The light preservative oil used on the rotor is still present and has collected small quantities of dust and dirt. As discussed in JWC-0012-2000, Larry Quinn feels that the full flow condensate polishers would remove any of this material as it is steamed off the rotor. Based on this, I do not believe that there is any concern in this respect.

The rotor is shown in Figure 1. The generator end is on the left, and what will be termed the other end is on the right. The side closest to the camera in Figure 1 will be termed the near side, and the other side will be termed the far side.

Figure 2 is a closer view of the generator end near side. Figures 3 & 4 show progressively closer views of the generator end of the rotor. The condition of the blading on the generator end near and far sides is seen in Figures 5 & 6.

Similar views for the other end near and far sides are found in Figures 7 & 8. One of the partially stripped out blade locking recessed hexagonal head cap screws is shown in Figures 9 & 10.

cc: Jaisen Mody
Rick Neimann

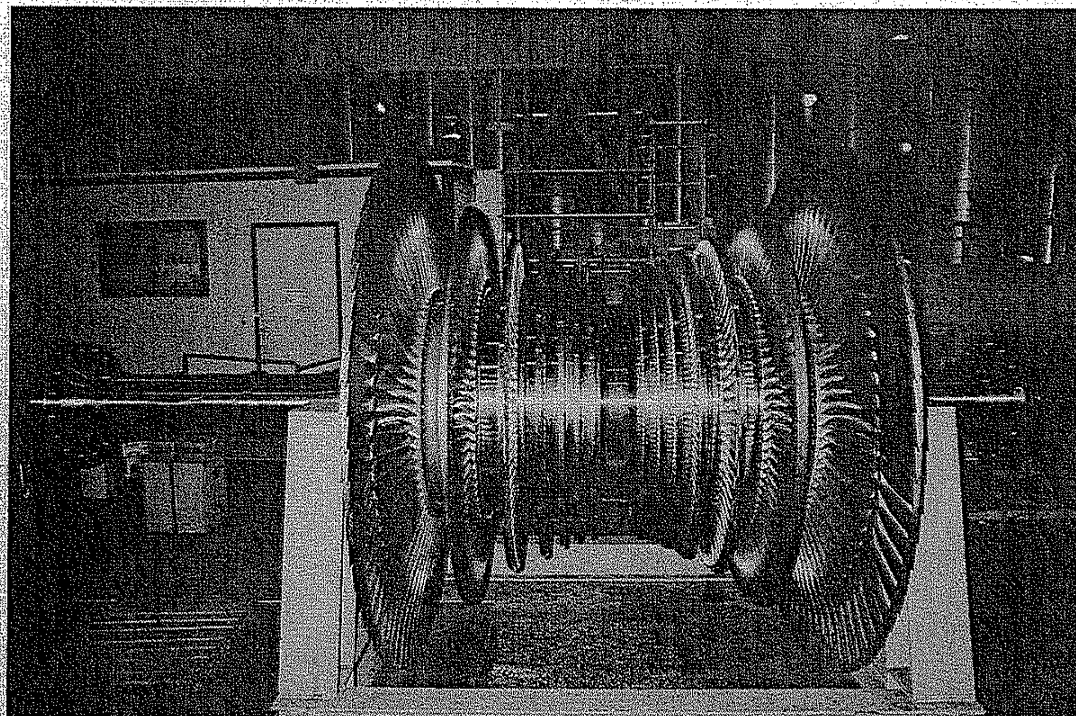


Figure 1

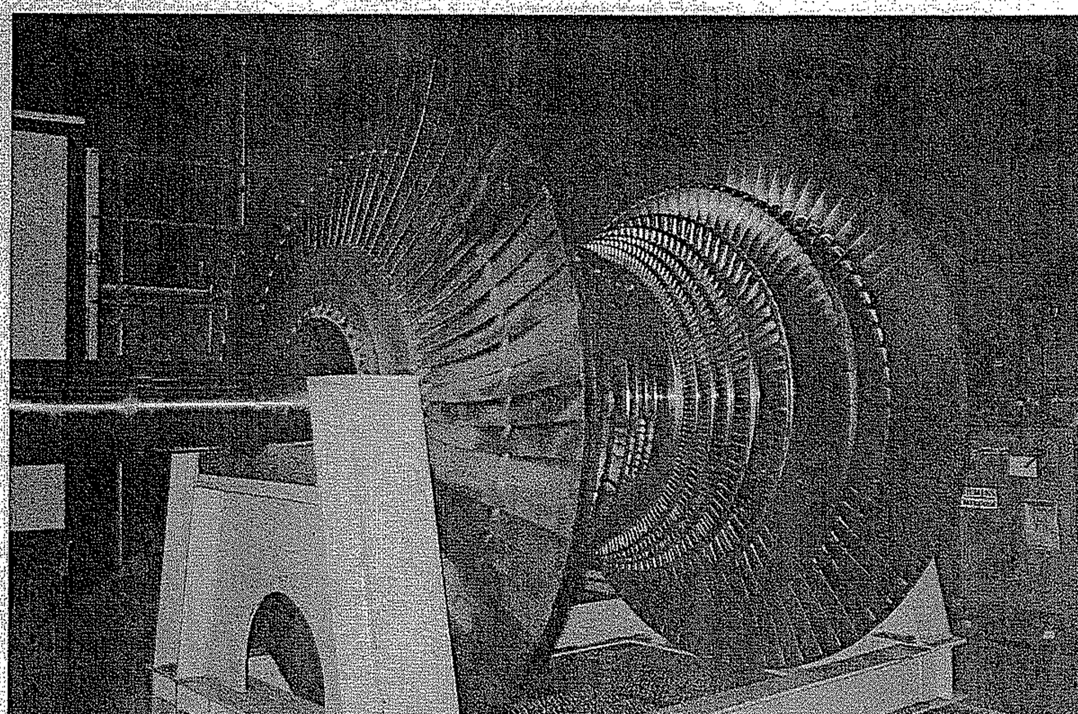


Figure 2

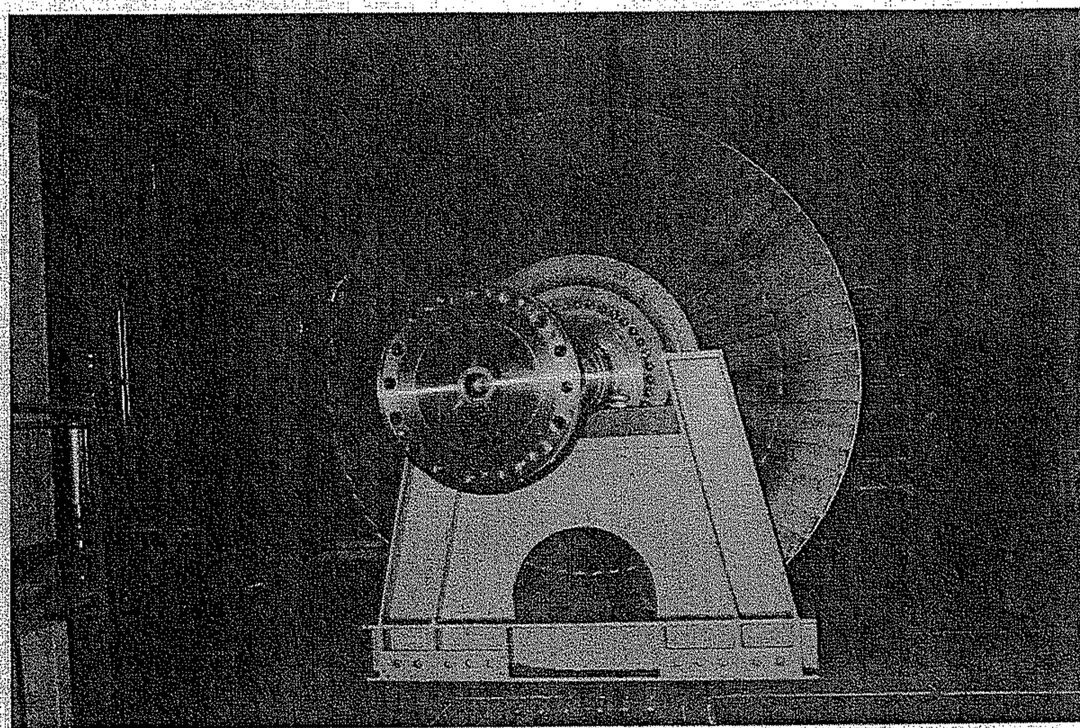


Figure 3

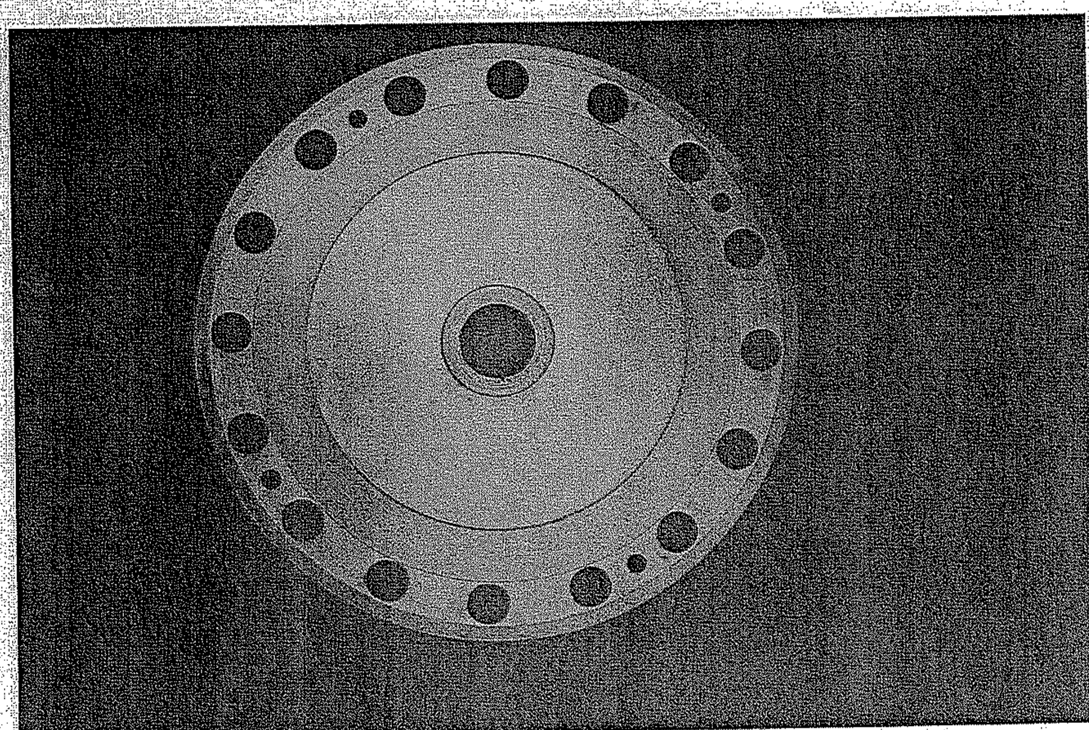


Figure 4

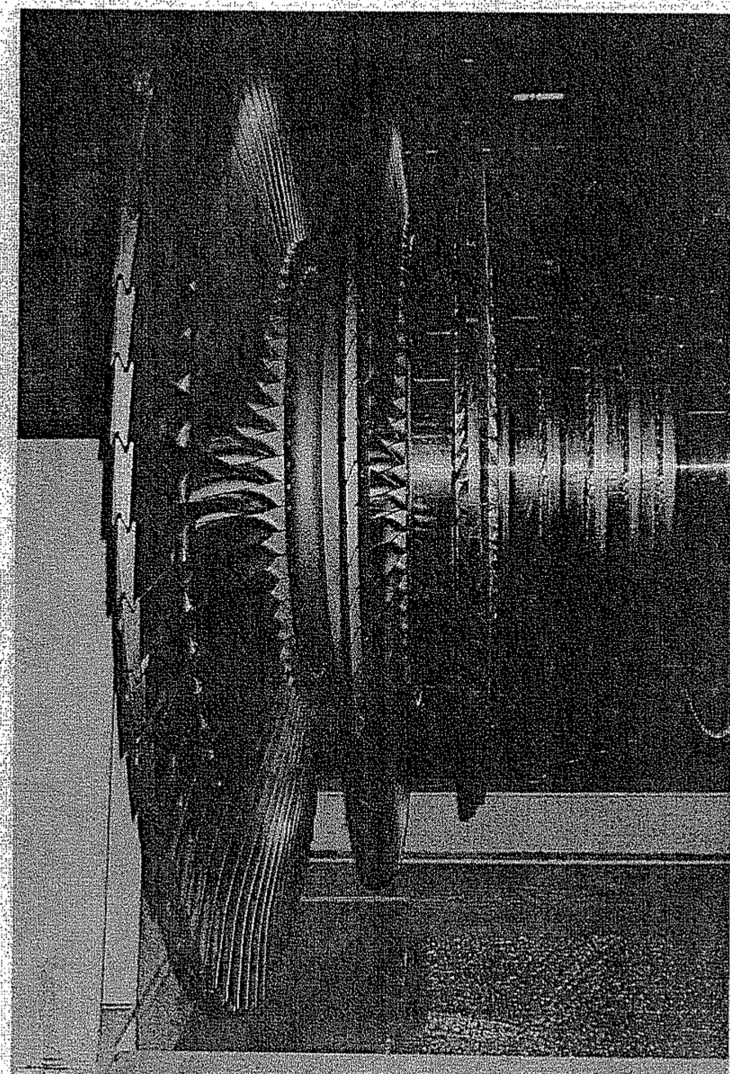


Figure 5

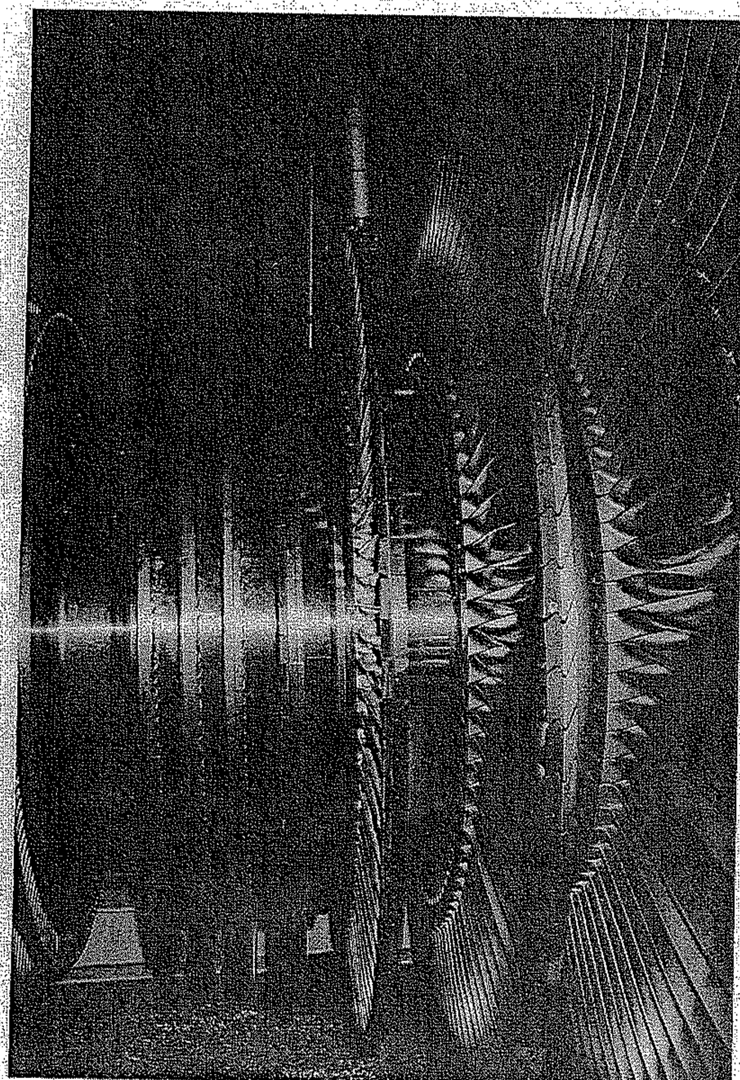


Figure 6

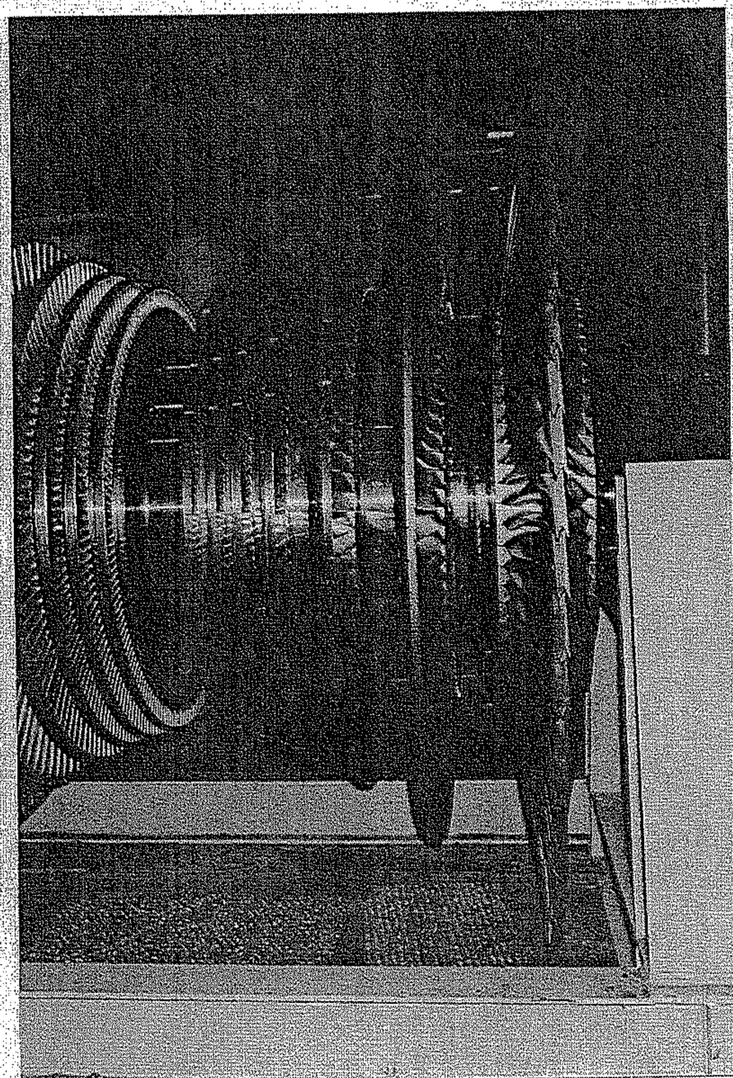


Figure 7

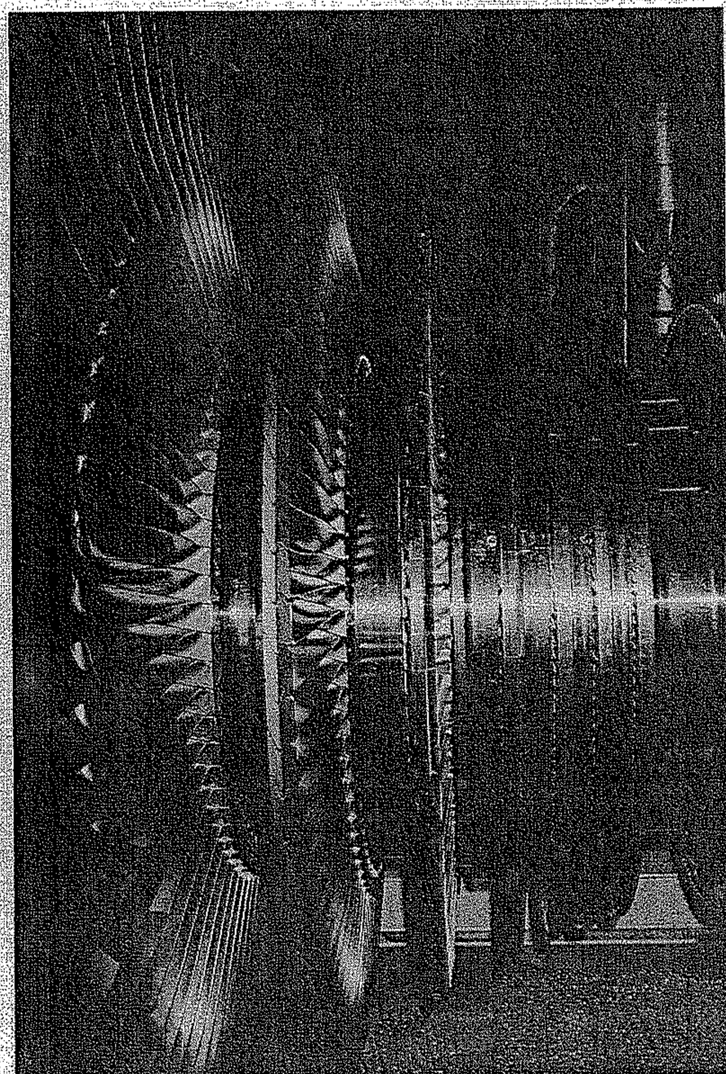


Figure 8

Figure 9

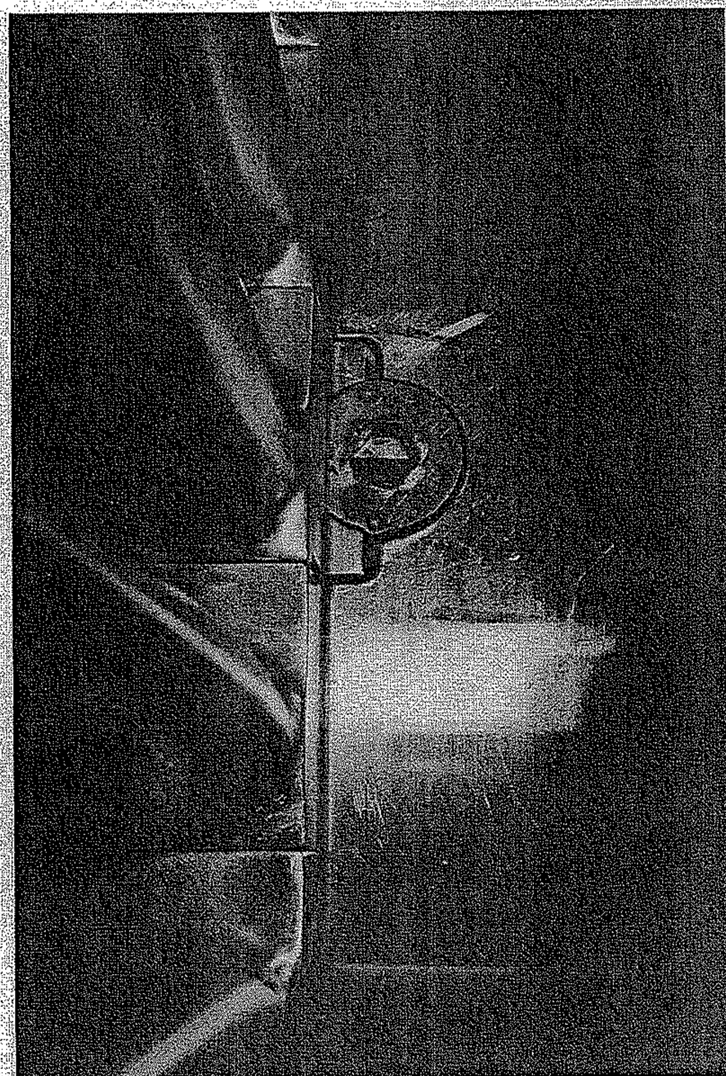


Figure 10

Primary PGE personnel:

PGE Name	Experience	Training	Education	Specialized Knowledge
Loren Mayer	U.S. Navy from 1968 to 1973. Division of Naval Reactors, Washington D.C. Graduate of the Bettis Nuclear Reactor Engineering School, operated by Westinghouse for the U.S. Navy with equivalent of Master's Degree in nuclear engineering. Had design review authority for steam turbines and other equipment going into nuclear powered submarines and nuclear powered surface ships. 1973 to 1977. Worked for A/E firm in Denver designing coal fired power plants. Worked on specifications for steam turbines, boilers, and other equipment. 1977 to 1994. Worked for PGE in engineering department, moving up to manage the department. Reviewed Westinghouse efforts to identify cause of blade failures in Boardman turbine in 1980. 1994 to 2000. Managed hydroelectric power generation projects for PGE. Late 2000 to present. General Manager of the Boardman Plant for PGE. Took the position after LP turbine upgrades were completed and unit was started up.	PGE TRAINING: Contract Administrator, 11/12/2002	Bachelor of Science in Mechanical Engineering from Oregon State University in 1968	PLANT MANAGER FOR HP/IP:
Larry Smythe	PGE Experience: Maintenance Manager for 14 years. Planning Supervisor for 13 year at Boardman Plant. Human Resource Safety for 2 years. Plant Operator for 2 years.	PGE TRAINING: Public Utilities Executives Course (PUEC), 1999	Bachelor of Architecture Degree 1971, University of Oregon. Master of Business Administrator, City University, 1995	MAINTENANCE MANAGER
Randy Curtis	Employed at PGE for 25 years. Participated in the oversight of the repairs on the turbine rotor. Spent about 1 1/2 weeks at the Alstom facility in Richmond VA.	Numerous additional training opportunities both in house training and professional short courses outside of the company. PGE TRAINING:	B.S. degree in Industrial Technology with a specialization in Welding Engineering from Utah State University. This	NDE INSPECTIONS Certified ASNT TC1A level II in visual inspection, Dye Penetrant Inspection, Magnetic Particle inspection and UT

Primary PGE personnel:

PGE Name	Experience	Training	Education	Specialized Knowledge
	Witnessed machining the failed portion of the shaft, the fit up of the new portion of the turbine shaft to the existing shaft and the initial portion of welding the shaft back together. Witnessed some of the Alstom inspections of the turbine. Monitored the schedule of the repairs and report back to the plant the status of the ongoing repairs.	Root Cause Analysis (Boardman), 2/27/2008. Pumping and Piping Analysis, 5/25/2006. Contract Administrator, 11/12/2002. Job Safety Analysis, 2/18/2002.	program was designed to provide technicians and engineers with an in-depth knowledge of welding, welding design, inspection techniques, metallurgy and other welding related training.	thickness inspection. Primary contact at the Boardman plant for most of the welding and mechanical inspections since 1990.
Janet Kahl (formerly Gulley)	PGE, 1987 to Present	PGE TRAINING: Pumping and Piping Analysis, 5/25/2006. Project Management Simulation, 4/7/2005. Contract Administrator, 7/16/2003. PSES Quality Management System, 3/1/2001. Root Cause Analysis for Power Plants, 3/21/1989. Corrosion Control/Metal Repair, 5/12/1988.	Bachelor of Science Degree, Mechanical Engineering, Oregon State University 1986	Steam turbine. PROJECT ENGINEER
Rick Neimann	Tennessee Valley Authority as a NDT Level III. 1989 began employment with PGE at Trojan as an NDT Level III.	PGE TRAINING: Certified ASNT Level III	Lake Oswego High School, 1978 Specialized Training: Trained in Military Went to "A" school, for hull maintenance technician. Re-enlisted. Then attend to "C" school, which was Nondestructive Testing NDT. Worked on two submarine repair ships (Tenders). For 3 years each as and NTE level II Inspector. Certified in 5 methods as a level II	LEVEL III NDE FOR PROJECT

Primary PGE personnel:

PGE Name	Experience	Training	Education	Specialized Knowledge
			for nuclear and non-nuclear applications in the Navy. Pittsburg Testing Laboratories PTL in the Portland, Oregon Office. ANST Level III, 1985-86 Over 20 years experience as a Level III, Over 30 years experience in NDT. Various certificates from EPRI. More detailed training available upon request. All the above experience in power generation.	
Jim Chartrey	Started with PGE in 1983 in Facilities Management. In 1984 moved to Drawing Control. 1989 to present have been working in Power Supply Engineering.	20 years of Mechanical Drafting and Design work. An additional 5 years working with Engineering Drawings and Documents. PGE TRAINING: Pumping and Piping Analysis, 5/25/2006. Project Management Simulation, 2/21/2006. Contract Administrator, 7/16/2003 and 10/15/2002. Drawing Control, 4/3/2001. Control Non-conforming Products and Services, 3/21/2001. Field Safety Evaluation, 1/05/2001. Ultrasonic Examination Level II, 12/8/1997 and Level I, 12/1/1997. ASME B31.1 Piping Design and Fabrication, 6/24/1996. Magnetic Particle Level I and II, 11/21/1994. Liquid Penetrant Levels I&II, 11/16/1994. Visual Examination Level I & II, 11/14/1994. Level I & II Eddy Current Testing, 2/28/1994.	A.A.S. Industrial Drafting from Portland Community College in 1993.	NIGHT SHIFT AND NDE Non-Destructive Examination Training in 1994. First Aid/CPR Training. ASME B31.1 Pipe Design and Fabrication Training Qualified ASNT Level II Inspector

Primary PGE personnel:

PGE Name	Experience	Training	Education	Specialized Knowledge
Dave Rodgers	Naval Officer, Submarines, 1980-1987. Engineer, South Texas Project, Houston Lighting and Power 1987-1988 Engineer, Trojan Nuclear Plant, PGE 1988-1992 Engineer, Diablo Canyon Nuclear Plant, PG&E, 1993-1995 Engineer, Boardman, PGE 1995-1999 Technical Services Manager, Boardman Plant, PGE 1999-2007 Operations and Technical Services, 2007 -Present	Several Westinghouse and Emerson Control courses. Courses in Steam Plant Thermodynamics PGE TRAINING: Boiler, steam and turbine controls. Plant Thermodynamics. Plant electrical systems. Registered Professional Engineer, Electrical. Root Cause Analysis (Boardman), 2/20/2008. Job Briefing, 2/18/2008. Contract Administrator Contractor, 11/12/2002. Job Safety Analysis, 3/11/2002.	BSEE, University of Kansas MSEE, University of Portland Navy Nuclear Trained Submariner	MANAGER OF ENGINEERING
Roger Lewis	1976-1985 Worked for Bechtel Power Corporation initially as a Design Engineer in the San Francisco Office. Then as a Startup and Construction Engineer at Duane Arnold Energy Center, Trojan Power Plant, WNP-1, and Diablo Canyon. 1985-1993 Worked For Portland General Electric at the Trojan Power Plant as an on-site engineer. 1993-1994 Worked as a Consulting Engineer to NMAC (an EPRI Division) and Brown Bovari performing modifications to the Bonneville Dam. 1994 to present Worked for Portland General Electric initially at the Trojan Plant and in 2005 transferred to the Boardman Coal Plant.	PGE TRAINING: Root Cause Analysis (Boardman), 2/7/2008. Contract Administrator, 9/25/2002 Rigging and Crane Initial, 3/13/2000	Bachelor of Science in Mechanical Engineering with a major in Power Plant Design, Oregon State University, 1976 Other continuing education including courses in Gas Turbine Design	PLANT ENGINEER FOR HP/IP
Cheryl Bryant	In 2000 had worked for PGE for 11.5 years in Distribution, Standards, Trojan Decommissioning and Generation Engineering starting in 1992. 8 years of experience working in Generation	PGE TRAINING: Reliability Leadership, 9/1/2008. Reliability Centered Maintenance, 8/4/2008.	B.S. Mechanical Engineerint: Cornell University 1988	PERFORMANCE TESTING Served as engineering (PSES) on-site representative during five night shifts

Primary PGE personnel:

PGE Name	Experience	Training	Education	Specialized Knowledge
	Engineering	Root Cause Analysis, 7/29/2008. Pumping and Piping Analysis, 5/25/2006. Project Management Simulation, 4/7/2005. Field Safety Evaluation, 1/1/2002.		
Wayne Oren	US Coast Guard Electronics Technician 1972-1976 Weyerhauser Electrician 1977-1981 Gormet Foods Electrician and Instrument Technician 1981-1986 PGE Electrician and Instrument Technician Control Specialist 1986- Present	Radar School Electronic Counter Measures 4 year Apprenticeship Journeyman Electrician PLC's and Plant Control processes Emerson Training; 7300 and 2500 WDPF and Ovation Controls PGE TRAINING: Grounding and Bonding, 10/8/2008. NEC Code Changes 2008- Boardman, 6/24/2008. Root Cause Analysis, (Boardman), 2/7/2008. Contract Administrator Contractor, 11/12/2002. Electronic Communication, 8/27/2002. Motors and Transformers, 8/13/2002. National Electric Code Analysis, 2002, 5/23/2002. Fault Current Calculations – Boardman, 4/21/1999. Examination of Equipment for Safety – Boardman, 4/21/1999.	Military Schools Vendor Supplied Training Courses Vendor Training in many subjects	ELECTRICAL SUPPORT AND CONTROLS ENGINEER Turbine Controls. Plant Control Systems. Plant Print Systems
Rick Tetzloff	in 2000, 8 years of mechanical engineering experience in the electric power industry (7 years with an architectural/engineering consulting firm (Black & Veatch) and 1 year with PGE in PSES department)	PGE TRAINING: Field Safety Evaluation, 9/12/2006. PSE Quality Management Program, 6/26/2006. Pumping and Piping Analysis, 5/25/2006.	B.S. Mechanical Engineering, University of Nebraska	Registered Professional Engineer(Mechanical), Kansas, License No. 14436 PROJECT MANAGEMENT

Primary PGE personnel:

PGE Name	Experience	Training	Education	Specialized Knowledge
		Control Nonconforming Products/Services, 3/21/2001.		
Bob Ball	28 yrs with PGE	PGE TRAINING: Raising Issues, 7/17/2008 Job Briefing, 3/5/2008. Root Cause Analysis (Boardman), 2/7/2008. Job Safety Analysis, 2/11/2002. Accident Investigation, 1/15/2001. Job Safety Analysis, 1/15/2001.	High School and 1 yr college	WORK SCHEDULER AND OUTAGE PLANNER
Tom Meyers	US Navy MM3 1965 – 1969 Ship-board engineering plant operation & maintenance. S California Edison 1969 – 1974 Plant Equip.Oper./Assist. Control Operator 1969 – 1974 Three different plants, gas and oil fired sub-critical and super critical units including a gas peaking simple cycle unit. Pacific Power & Light Jim Bridger Plant units 1 – 3 coal fired. Assist. Control Operator and Control Operator 1974 – 1977. Portland General Electric Boardman Plant 1977 – present. Shift Supervisor, Operations Manager and Plant Projects Manager. 1993 – 1997 represented PGE as the company's representative to the PacifiCorp Centralia Coal Plant and the Montana Power Company Colstrip Coal Plant. Company alternate representative 1998 – 2008.	US Navy: Machinist Mate A school. SCE: Apprentice Operator school and OTJ training. Basic Electricity and Electronics. Westinghouse 135 MW Simple Cycle generator unit. Control Oper. Guideline, OTJ and classroom training. Foster Wheeler Super-critical boiler training course. General Electric Tandem compound 750 MW turbine generator training class. Equipment vendor and SCE classes on balance of plant systems and equipment. Pacific Power & Light: Combustion Engineering sub-critical drum type cyclone fired forced circulation boiler training class. General Electric 515 MW Tandem Compound	High School – Tecumseh, MI. US Navy Machinist Mate A school SCE Apprentice Operator School: Basic Electricity I, Electronics I and Chemistry I PSU Engineering Short Course. Numerous plant specific utility, vendor equipment classes and courses; supervisory and management courses and classes and self improvement classes and courses.	OPERATIONS MANAGER ASNT Level II

Primary PGE personnel:

PGE Name	Experience	Training	Education	Specialized Knowledge
		Turbine- Generator classes. Vendor and PP&L classes on balance of plant equipment and systems. Portland General Electric: Pre-Operation - Developed and administered Operator Training classes and OTJ training programs. Foster Wheeler sub-critical natural circulation drum type boiler operation. Westinghouse Turbine and Generator training classes. Balance of plant training classes. Fossil fuel Control Room Simulator training classes: 3 classes as a student and four classes as a observer with 25% hands inter action and 75% observation.		
Scott Ross	PGE Hire date; 6-4-79, Beaver Maintenance 8-79, Trojan Nuclear Plant maintenance, Refueling crew, 9 yrs, Valve repair 2 yrs, Emergency Diesel Generator maintenance 10 yr, Tool repair and calibration 1yr, Reactor coolant pump seal repair 3 yr, Pump repair and overhaul, turbine overhaul and repair. 7-90, Boardman Coal Plant Maintenance, Serviceman AA, Valve Repair/Replacement foreman 9 yr, Feed pump turbine and pump repair foreman 3yr, Railcar	Attended numerous training classes for mechanical equipment and tooling. Designed and built tooling for special applications.	Graduated St. Helens Sr. High, 1978 Lower Columbia College, Blueprint reading, machine shop classes	BEAVER MAINTENANCE SUPERVISOR

Primary PGE personnel:

PGE Name	Experience	Training	Education	Specialized Knowledge
	repair shop foreman 3yr, 10-03, Boardman Engineering Group, Maintenance Specialist. Helped to develop strategies for the implementation of new Computerized Maintenance Management System. Develop procedures for turbine component Maintenance and support equipment. Oversee replacement and repair of turbine components. Oversee new component design and installation in plant sub-systems. 12-07 to present. Beaver Maintenance Supervisor. Direct the daily and annual maintenance practices of the mechanical maintenance department. Develop and implement best practices which are common to industry in the maintenance of generation equipment.			
Bryan Timms (Retired)	Began career at PGE on December 27, 1972. Retired on April 28, 2005. Journeyman machinist prior to joining PGE. Hired as a blacksmith at Hawthorne shop. Employed as a welder, machinist, and mechanic. Then loaned to Trojan around 1974 and became permanent staff in 1976. Employed at Boardman and oversaw the final phases of construction. Maintenance Supervisor till retirement.	PGE TRAINING: PLANT TURBINE MAINTENANCE Lube Master, 8/20/2002. Job Safety Analysis, 2/5/2001.	Attended Eastern Oregon College from 1957 to 1958 Attended Boise Junior College. Joined the Marine Corps in 1960. Attended Fullerton State and studied mechanical engineering.	PLANT TURBINE AND MAINTENANCE
Tom Kingston (Retired)	America Electric Power Company, 9 years (1965-1974). Portland General Electric Company, 1973 to Retirement. Assistant Resident Engineer, Trojan Nuclear Plant. Second in charge of construction.		BSME from Indiana Institute of Technology, 1965. Public Utility Executive Course, University of Idaho, 1982. Utility Executive Training, University	PLANT MANAGER FOR LP

Primary PGE personnel:

PGE Name	Experience	Training	Education	Specialized Knowledge
	Plant completed on schedule in 1976. Resident Engineer, Boardman Plant, 1976-1980. Responsible for overall construction with PGE functioning as the general contractor. Also responsible for startup in 1979 and 1980. Plant started up on time and within budget. General Manager Boardman Plant, 1980 to retirement. Responsible for all activities associated with plant operation and maintenance.		Of Michigan Graduate School of Business Administration, 1984.	
Jeff Carter (Retired)	Employed by PGE for 30 or more years.		Metallurgy, PhD	Engineering Staff – Metallurgist ASNT Level II