



Portland General Electric Company

Bar D. Withers Vice President

July 20, 1982

Trojan Nuclear Plant
Docket 50-344
License NPF-1

Director of Nuclear Reactor Regulation
ATTN: Mr. Robert A. Clark, Chief
Operating Reactors Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Sir:

TROJAN NUCLEAR PLANT
Updated Final Safety Analysis Report

In accordance with 10 CFR 50.71(e), one original and 12 conformed copies of this letter and its attachments are submitted in support of the Trojan Nuclear Plant Updated Final Safety Analysis Report (FSAR), 13 sets of which have been transmitted under separate cover. The Updated FSAR has been totally reprinted and is a complete document in itself; no pages from the original FSAR require insertion.

This Updated FSAR has been revised to include the effects of (a) all changes made in the facility or procedures as described in the original FSAR, (b) all safety evaluations performed by PGE either in support of requested license amendments or in support of conclusions that changes did not involve an unreviewed safety question, and (c) all analyses of new safety issues performed by or on behalf of PGE at NRC request. Administrative and editorial changes have been included as well as technical corrections and clarifications. In addition, the Updated FSAR has been organized to be consistent with the format of the Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, NUREG-0800 (July 1981).

As part of the transmittal of this Updated FSAR, it is requested that the Trojan Nuclear Plant Operating License NPF-1, Section 2.A, be amended to state the following:

"This license applies to the Trojan Nuclear Plant, a pressurized water nuclear reactor and associated equipment (the facility), owned by the licensees. The facility is located on Portland General Electric Company's site on the west shore of the Columbia River in Columbia County, Oregon, and is described in the Updated Final Safety Analysis Report,

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Portland General Electric Company

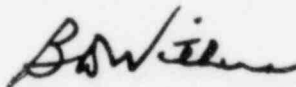
Mr. Robert A. Clark
July 20, 1982
Page Two

as amended and supplemented in accordance with 10 CFR 50.71(e),
and the Environmental Report as supplemented and amended
(Supplements 1 through 3)."

The Trojan Operating License, Section 2.A, currently references the Final Safety Analysis Report, as supplemented and amended (Amendments 1 through 26). This reference is out of date since the original FSAR was amended through Amendment 34 and also due to this transmittal of the Updated FSAR. Correcting this portion of the Trojan Operating License is viewed as an administrative revision that will prevent possible confusion in the future. Since the Updated FSAR is submitted in accordance with federal regulations, a license amendment fee should not be required. A revised Page 2 of the Trojan Operating License that reflects this suggested change is attached.

Since this is the first submittal of the Updated FSAR and has no change bars or revision numbers, a second attachment lists the sources of changes that have been incorporated. This attachment identifies the changes due to analyses submitted to the Commission or prepared pursuant to Commission requirement and the changes made under the provisions of 10 CFR 50.59. The attachment provides clarification regarding the source and extent of changes. Subsequent revisions will include change bars, revision numbers and a list that identifies the current pages of the FSAR pursuant to 10 CFR 50.71(e).

Sincerely,



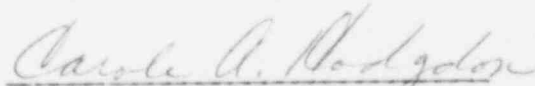
Bart D. Withers
Vice President
Nuclear

Attachments

c: Mr. Lynn Frank, Director
State of Oregon
Department of Energy

Mr. R. H. Engelken, Director
U. S. Nuclear Regulatory Commission
Region V

Subscribed and sworn to before me this 20th day of July 1982.


Notary Public of Oregon

My Commission Expires: August 9, 1983



SAMPLE OPERATING LICENSE PAGE

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- F. The licensees have satisfied the applicable provisions of 10 CFR Part 140, "Financial Protection Requirements and Indemnity Agreements," of the Commission's regulations;
 - G. The issuance of this operating license will not be inimical to the common defense and security or to the health and safety of the public;
 - H. After weighing the environmental, economic, technical, and other benefits of the facility against environmental and other costs and considering available alternatives, the issuance of Facility Operating License No. NPF-1 set forth herein is in accordance with Appendix D to 10 CFR Part 50, of the Commission's regulations and all applicable requirements have been satisfied; and
 - I. The receipt, possession, and use of source, byproduct and special nuclear material as authorized by this license will be in accordance with the Commission's regulations in 10 CFR Part 30, 40, and 70, including 10 CFR Sections 30.33, 40.32, and 70.23 and 70.31.
2. Facility Operating License No. NPF-1 is hereby issued to the Portland General Electric Company, The City of Eugene, Oregon and Pacific Power & Light Company to read as follows:
- A. This license applies to the Trojan Nuclear Plant, a pressurized water nuclear reactor and associated equipment (the facility), owned by the licensees. The facility is located on Portland General Electric Company's site on the west shore of the Columbia River in Columbia County, Oregon, and is described in the Updated Final Safety Analysis Report, as supplemented and amended in accordance with 10 CFR 50.71(e), and the Environmental Report as supplemented and amended (Supplements 1 through 3).
 - B. Subject to the conditions and requirements incorporated herein, the Commission hereby licenses:
 - (1) Pursuant to Section 103 of the Act and 10 CFR Part 50, "Licensing of Production and Utilization Facilities," to possess, use, and operate the facility at the designated location in Columbia County, Oregon in accordance with the procedures and limitations set forth in this license;

UPDATED FINAL SAFETY ANALYSIS REPORT
IDENTIFICATION OF CHANGES

The Updated Final Safety Analysis Report (FSAR) is a completely reprinted document. In order to identify changes for the Updated FSAR, the following principal sources of information were considered:

1. Plant Design Changes - Federal regulations (10 CFR 50.59) and the Trojan Facility Operating License NPF-1 allow changes to be made to the facility as described in the safety analysis report, and tests or experiments to be conducted which are not described in the safety analysis report, without prior Nuclear Regulatory Commission (NRC) approval, unless the proposed change, test or experiment involves a change in the Technical Specifications incorporated in the license or an unreviewed safety question. The Plant Design Changes described in this attachment were evaluated, and it was determined that they did not:
(a) increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety, as previously evaluated in the FSAR; (b) create the possibility of an accident or malfunction of a different type than previously evaluated in the FSAR; or (c) reduce the margin of safety as defined in the basis for any Trojan Technical Specifications.
2. Licensing Document Change Requests (LDCRs) - Licensing documents consist of various PGE Topical Reports and the Trojan FSAR. Under 10 CFR 50.59, changes are permitted to these documents if a change to the Operating License or Technical Specifications does not result and an unreviewed safety question is not created. The LDCRs described in this attachment were evaluated and it was determined that their changes do not involve a change to the Operating License, Technical Specifications or an unreviewed safety or environmental question.
3. License Amendments - License amendments to the Trojan Operating License and Technical Specifications are approved by the NRC and, in many cases, these amendments do affect the FSAR.
4. PGE to NRC Correspondence - This correspondence includes analyses and information submitted to the NRC or prepared pursuant to an NRC requirement. In many cases, this correspondence affects the FSAR text and commitments as described in this attachment.

In addition to these sources, the Updated FSAR has been organized to be consistent with the format of the Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, NUREG-0800 (July 1981).

Other administrative or editorial changes have also been included. As each section of the Updated FSAR was drafted, it was formally reviewed and approved via an LDCR as described above. The entire FSAR Update project was assigned the LDCR designation LDCR TNP 81-07, and since this LDCR number is common to all sections, it is not listed elsewhere in this attachment for brevity.

In order to provide further assurance that the Updated FSAR is up to date and accurate, certain sections were also provided to Westinghouse and Bechtel for review and comment. Due to this extensive internal and external review, it is believed that the Updated FSAR accurately reflects the as-built and operating status of the Trojan Nuclear Plant as of January 22, 1982. The changes from the original FSAR, as amended through Amendment 34, are listed below by chapter:

CHAPTER 1.0
INTRODUCTION AND GENERAL PLANT DESCRIPTION

Section 1.5, Requirements for Further Technical Information

This section has been completely rewritten by Westinghouse to provide the latest information available regarding pressurized water reactor research and development programs. The sources for this information are listed in Section 1.8, References.

CHAPTER 2.0
SITE CHARACTERISTICS

Section 2.1, Geography and Demography

LDCR TNP 80-02 - The changes to this section due to this LDCR are editorial or administrative.

Section 2.2, Nearby Industrial, Transportation and Military Facilities

PGE to NRC letter dated January 2, 1981 - This letter submitted information in response to NUREG-0737, Post TMI Action Items, relating to control room habitability requirements. The information in this letter affects Section 2.2.2.2, Description of Products and Materials, and Section 2.2.3.2, Toxic Chemicals.

PGE to NRC letter dated March 2, 1981 - This letter supplements the above January 2, 1981 correspondence and provides information relating to railroad transportation of ammonia within 5 miles of the Trojan Nuclear Plant. Section 2.2.3.2, Toxic Chemicals, is affected by this letter.

Section 2.3, Meteorology

LDCR TNP 80-02 - The changes to this section due to this LDCR are editorial or administrative.

Section 2.4, Hydrologic Engineering

PGE to NRC letter dated September 15, 1980 - This letter provides the results of a Northwest River Forecast Center of the National Weather Service analysis of flooding due to Mt. St. Helens volcanic activity. This information affects Section 2.4.4.2, Volcanically Induced Dam Failure.

Section 2.5, Geology, Seismology and Geotechnical Engineering

PGE to NRC letters dated September 15, 1980, October 16, 1980, and November 21, 1980 - These letters affect Section 2.5.6, Volcanology, and provide information regarding the effects of Mt. St. Helens volcanic activity on the Trojan Nuclear Plant.

CHAPTER 3.0 DESIGN OF STRUCTURES, COMPONENTS, EQUIPMENT AND SYSTEMS

Section 3.1, Conformance With NRC General Design Criteria

LDCR TNP 80-02 - The changes to this section due to this LDCR are editorial or administrative.

Section 3.2, Classification of Structures, Components and Systems

LCR TNP 81-21 - The changes due to this LCR affected many portions of this section by reclassifying certain Seismic Category I piping and equipment. It was determined that this reclassification is consistent with Regulatory Guides 1.26 (Rev. 3), 1.29 (Rev. 3) and 1.143 (Rev. 1) and does not have significant safety implications.

PGE to NRC letter dated May 21, 1981 - This letter discussed a variance from the original FSAR involving the location of Seismic Category I components in a Seismic Category II area. The information provided in this letter is included in Section 3.2.1, Seismic Classification.

Section 3.3, Wind and Tornado Loadings

PGE to NRC letter dated October 23, 1980 - This letter provides information regarding the ability of structures at the Trojan Nuclear Plant to withstand 200 or 300 mph tornados. The results are tabulated in Table 3.3-2.

Section 3.7, Seismic Design

PGE to NRC letters dated July 13, 1979, November 21, 1979 and December 8, 1979 - These letters responded to NRC IE Bulletin 79-02 pertaining to piping supports for safety-related equipment. Section 3.7.3.9.5, Evaluation of Piping Support Base Plates, includes information from these letters.

PGE to NRC letters dated August 1, 1979, October 30, 1979, February 27, 1980, January 19, 1981 and September 17, 1981 - These letters responded to NRC IE Bulletin 79-14 which requested licensees verify that seismic analyses of safety-related piping systems were applicable to the Plant as built. The results of the investigation in response to this IE Bulletin are included in piping Section 3.7.3.3.3.5, Verification of As-Built Safety-Related Systems.

PGE-1020, "Report on Design Modifications for the Trojan Control Building", Revision 4, February 12, 1980 and LER 79-15 and Supplements - Information from these letters and PGE topical report is provided in Sections 3.7.1 and 3.7.2 to more clearly specify the design criteria for the Control-Auxiliary-Fuel Building complex.

Section 3.8, Design of Seismic Category I Structures

Plant Design Change 77-047 - This modification installed a railway with tracks extending into the Containment equipment hatch to assist in equipment movement. Section 3.8.1.4.7.4, Equipment Hatch and Personnel Locks, includes a short description of this change.

Plant Design Change 78-040 - Two fish-rearing facility pumps were installed in the foredeck area of the Intake Structure at Elevation 23 ft by Plant Design Change 78-040. This is briefly described in Section 3.8.4.1.4, Intake Structure.

PGE to NRC letters dated April 25, 1979 and January 21, 1981 - These letters described the tendon surveillance program and the inspection and testing of sheathing filler grease. This information has been included in Section 3.8.1.7.2, Inservice Tendon Surveillance Program.

PGE to NRC letter dated December 2, 1977 - This letter responded to NRC IE Bulletin 77-06 which discussed moisture accumulation in penetration assemblies. The method by which moisture is minimized is included in Section 3.8.1.4.7, Penetrations.

PGE to NRC letter dated December 4, 1979 - This letter was Supplement 6 to Attachment 2 to LER 79-15. Information from this letter has been added to Section 3.8.4.3.2, Seismic Category I Structure During Normal Operation, to justify the use of certain terms in the equipment support loading equation.

Section 3.9, Mechanical Systems and Components

Plant Design Change 76-001 - Plant Design Change 76-001 initiated the installation of pressure and load sensors as part of the Pipe Stress Verification Program.

PGE to NRC letter dated January 12, 1978 - This letter provided the positive displacement charging pump suction line failure analysis. The results of this analysis have been added to Section 3.9.2, Dynamic Testing and Analysis.

Section 3.10, Seismic and Dynamic Qualification of Mechanical and Electrical Equipment

Plant Design Change 76-269 - Plant Design Change 76-269 initiated the replacement of nonqualified relays in the solid-state reactor protection system with seismically qualified relays. This information is included in Section 3.10.2.1.1, Solid-State Protection System.

PGE to NRC letter dated May 21, 1976 - This letter provided information regarding the relay replacement in the solid-state reactor protection system and is included in Section 3.10.2.1.1, Solid-State Protection System.

PGE affidavit to ASLB dated June 27, 1980 - This was in response to NRC IE Information Notice 80-21 and affirmed that specifications for safety-related electrical equipment procured for the Plant included qualification tests and analyses of the anchorages and supports representative of those which would be used to install the equipment. This information is included in Section 3.10.3, Methods and Procedures for Qualifying Supports.

CHAPTER 4.0
REACTOR

Section 4.1, Summary Description

Amendment 70 - This amendment to the Trojan Operating License authorized the removal of part-length control rods. References to part-length control rods have been removed from Section 4.1.

Section 4.2, Fuel System

Amendments 45 and 60 - These amendments to the Trojan operating license approved a design modification to replace certain fuel rods with stainless steel dummy rods. These changes are reflected in Section 4.2.3.2, Fuel Assembly Structure.

Amendment 70 - This amendment to the Trojan operating license authorized the removal of part-length control rods. References to part-length control rods have been removed from Section 4.2.

Section 4.3, Nuclear Design

Amendments 45 and 60 - These amendments to the Trojan operating license approved a design modification to replace certain fuel rods with stainless steel dummy rods. These changes are reflected in Section 4.3.4.2, Stainless Steel Rods.

Amendments 44 and 48 - These amendments to the Trojan operating license revised the power distribution and control rod insertion limits for the reactor and authorized the use of the Westinghouse Improved Thermal Design Procedure and the WRB-1 Critical Heat Flux Correlation. These changes are included throughout Section 4.3.

Amendment 70 - This amendment to the Trojan operating license authorized the removal of part-length control rods. References to part-length control rods have been removed from Section 4.3.

Section 4.4, Thermal and Hydraulic Design

Amendments 30, 44 and 48 - These amendments to the Trojan operating license revised the hot channel factors, power distribution and control rod insertion limits for the reactor core and authorized the use of the Westinghouse Improved Thermal Design Procedure and the WRB-1 Critical Heat Flux Correlation. These changes are included throughout Section 4.4.

Section 4.6, Functional Design of Reactivity Control Systems

Amendment 70 - This amendment to the Trojan operating license authorized the removal of part-length control rods. The description of part-length control rods has been appropriately revised in Section 4.6.1, Information for Control Rod Drive Mechanisms.

CHAPTER 5.0 REACTOR COOLANT SYSTEM AND CONNECTED SYSTEMS

Section 5.2, Integrity of Reactor Coolant Pressure Boundary

PGE to NRC letters dated April 8, 1977 and May 1, 1979 - The April 8, 1977 letter provided the Overpressure Mitigating System design details, and the May 1, 1979 letter submitted License Change Application 52. The information in these letters is included in Section 5.2.2, Overpressurization Protection.

LDCR TNP 79-22 - This LDCR revised the FSAR reactor coolant water chemistry specifications as shown in Table 5.2-5.

Section 5.4, Component and Subsystem Design

PGE to NRC letters dated April 8, 1977 and May 1, 1979 - The April 8, 1977 letter provided the Overpressure Mitigating System design details, and the May 1, 1979 letter submitted License Change Application 52. The information in these letters is included in Section 5.4.11, Safety and Relief Valves.

PGE to NRC letter dated July 12, 1976 - This letter reported the results of the J-tube modification to the steam generators. J-tubes were added to the ring to reduce the likelihood of a feed line bubble-collapse water hammer occurring. This information is in Section 5.4.2, Steam Generator.

PGE to NRC letters dated January 30, 1981, April 2, 1981 and April 30, 1981 - These letters described the extent of steam generator tube plugging at Trojan and have been added to Section 5.4.2, Steam Generator.

CHAPTER 6.0
ENGINEERED SAFETY FEATURES

Section 6.2, Containment Systems

Amendments 13 and 68 - These amendments to the Trojan operating license revised the allowed limit for the initial positive Containment pressure. This is discussed in Section 6.2.1.3.4, Limiting Condition for Initial Positive Containment Pressure.

Amendment 9 - This amendment to the Trojan operating license revised the allowed pressure drop across the hydrogen vent system, combined HEPA filters and charcoal adsorber banks. This change is reflected in Table 6.2-28, Hydrogen Vent System Fan and Filter Characteristics.

Plant Design Change 79-101 - Plant Design Change 79-101 initiated the installation of a control room post-accident monitoring panel for indication of Containment pressure, water level, high-range area radiation, hydrogen concentration and subcooling margin. This has been included in Section 6.2.1.7, Containment Instrumentation Requirements.

Plant Design Change 81-053 - This Plant Design Change installed solenoid-operated Containment isolation valves in the Containment post-accident hydrogen analysis system. This information is reflected in Table 6.2-1, Containment Isolation Barriers.

Section 6.3, Emergency Core Cooling System

LDCR TNP 77-02 - LDCR TNP 77-02 revised Table 6.3-6 by changing the boron injection recirculation pump design flow rate from 20 gpm to 11 gpm since the actual system design employed piping and valves with a higher flow resistance than originally expected.

LDCR TNP 79-16 and Plant Design Change 79-042 - This Plant Design Change and associated LDCR removed the pressurizer low-level coincidence from the pressurizer low-pressure logic for safety injection. This is reflected in Section 6.3.3, Performance Evaluation.

Plant Design Change 80-055 - Plant Design Change 80-055 changed the operation of the centrifugal charging pumps minimum flow bypass line valves so that the two installed valves do not automatically close upon receiving a safety injection signal. This has been included in Section 6.3.2.2.5.2, Centrifugal Charging Pumps.

Section 6.4, Habitability Systems

PGE to NRC letters dated January 2, 1981 and March 2, 1981 - These letters submitted information in response to NUREG-0737, Post-TMI Action Items, relating to control room habitability requirements. The information in these letters is used throughout Section 6.4.

Section 6.5, Fission Product Removal and Control Systems

Plant Design Change 76-480 and LDCR TNP 79-06 - This Plant Design Change raised the Containment recirculation sump alarm sensors to avoid spurious alarms due to normal leakage from valve cycling. LDCR 79-06 was initiated to update the FSAR, and these changes are included in Section 6.5.2.2.2.5, Containment Recirculation Sump, Section 6.5.2.5, Instrumentation Requirements, Table 6.5-3 and Figure 6.5-4.

Section 6.6, Inservice Inspection of Class 2 and 3 Components

PGE to NRC letter dated February 5, 1981 - This letter transmitted the "Trojan Nuclear Plant Inservice Inspection Program for the Second Forty Months of the First Ten-Year Interval, Revision 1, January 30, 1981". Also included in this letter is a relief request for Class 3 components. These subjects are discussed in Section 6.6.

Amendment 61 - Amendment 61 to the Trojan operating license approved the Inservice Inspection Program at Trojan and is described in Section 6.6.

CHAPTER 7.0 INSTRUMENTATION AND CONTROLS

Section 7.2, Reactor Trip System

Plant Design Change 75-331 and LDCR TNP 77-02 - This Plant Design Change installed operator-initiated blocks, operable only during a shutdown condition, to the turbine trips from the generator lockout relays to allow a Plant restart. The change to the circuitry that allows this is shown in Table 7.2-6.

Plant Design Change 76-137 and Plant Design Change 78-102 - These Plant Design Changes modified the reactor coolant pump breaker trips so that an anticipatory trip will occur due to loss of two or more reactor coolant pumps or will trip on a "no voltage" signal. This is described in Section 7.2.1.1.4, Reactor Coolant System Low Flow Trips.

Plant Design Change 77-059 - Plant Design Change 77-059 modified the circuit as shown in Figure 7.2-1, Sheet 11 of 16, to include the over-pressure protection automatic input to the power-operated relief valves.

Plant Design Change 79-042 and LDCR TNP 79-16 - This Plant Design Change and associated LDCR removed the pressurizer low-level coincidence from the pressurizer low-pressure logic for safety injection. This has been shown in Figure 7.2-1, Sheet 8 of 16.

Amendment 46 - Amendment 46 to the Trojan operating license authorized the modification to require two out of four coolant pump breaker open indications prior to initiating a reactor trip. This is reflected in Tables 7.2-1 and 7.2-2.

PGE to NRC letter dated September 14, 1979 - This letter responded to IE Bulletin 79-21 and committed to raising the low-low steam generator level trip setpoint from 5 percent to 15 percent to allow for level indication error due to possible reference leg heatup. This has been included in Section 7.2.1.1.5, Steam Generator Trips.

Section 7.3, Engineered Safety Features Actuation System

Amendment 68 - This amendment to the Trojan operating license revised the allowed limit for the initial positive Containment pressure. This has been included in Table 7.3-5.

LDCR TNP 77-08 - This LDCR initiated a change to the FSAR to revise the frequency of performance of Engineered Safety Features Actuation System tests. This is reflected in Section 7.3.2.1.5, Capability for Sensor Checks and Equipment Test and Calibration.

LDCR TNP 79-16 - LDCR TNP 79-16 initiated FSAR changes to remove the pressurizer low-level coincidence from the pressurizer low-pressure logic for safety injection. This has been included throughout Section 7.3.

Section 7.6, All Other Instrumentation Systems Required for Safety

Plant Design Change 77-059 and PGE to NRC letters dated April 8, 1977 and May 1, 1979 - This Plant Design Change initiated the installation of the Overpressure Mitigating System, and these letters provided the system design details. This system has been described in Section 7.6.1.5 and analyzed in Section 7.6.2.5.

Plant Design Change 79-094 - This Plant Design Change initiated the installation of the acoustic flow monitoring system which is used to determine pressurizer safety valve position. The system is described in Section 7.6.1.6 and analyzed in Section 7.6.2.6.

Plant Design Change 79-098 - This Plant Design Change initiated the installation of the subcooling margin monitors to provide the operators with an on-line indication of the saturation condition of the core and reactor coolant loops. The system is described in Section 7.6.1.4 and analyzed in Section 7.6.2.4.

Section 7.7, Control Systems Not Required for Safety

Amendment 70 - This amendment to the Trojan operating license authorized the removal of part-length control rods. Table 7.7-2 has deleted references to the part-length control rods since they have been removed.

LDCR TNP 79-16 - LDCR TNP 79-16 initiated FSAR changes to remove the pressurizer low-level coincidence from the pressurizer low-pressure logic for safety injection. This is reflected in Section 7.7.15, Pressurizer Pressure Control.

CHAPTER 8.0
ELECTRICAL POWER

Section 8.2, Offsite Power System

LDCR TNP 78-09 and PGE to NRC letter dated February 25, 1980 - This LDCR initiated an FSAR change regarding the settling of the Trojan switchyard. The associated letter notified the NRC of this occurrence. Section 8.2.1.1, Switchyard, discusses the changed switchyard elevation.

Section 8.3, Onsite Power Systems

Plant Design Change 75-331 - This Plant Design Change incorporated main generator underfrequency as part of the generator electrical protection lockout relay operation and is an input signal for the turbine trip-generator trip. This is included in Section 8.3.1.2.1, Generator System.

Plant Design Change 76-181 - This Plant Design Change provided alternate feeds to each of the 125-V DC distribution Panels D01, D02, D03, and D04 and also provided the provision to connect Battery D11 to either Bus D10 or D30 and Battery D12 to either Bus D20 or D40. This change affected Section 8.3.2.1.2, 125-V DC System.

Plant Design Change 78-044 and PGE to NRC letter dated May 31, 1978 - Plant Design Change 78-044 installed new diesel generator control annunciator alarms. These are discussed in Section 8.3.1.2.6, Standby Power Supply System.

Plant Design Change 80-005, Amendment 57 to the Trojan operating license and PGE to NRC letter dated January 11, 1980 - These sources affected the degraded grid voltage modifications and supplied undervoltage protection analyses. This information is provided in Section 8.3.1.2.6, Standby Power Supply System.

Plant Design Change 82-001 - This Plant Design Change installed fast-acting fuses in the 120-V instrument ac system to protect the constant voltage instrument transformer. Section 8.3.1.1.5.1, 120-V Instrument AC System, has included this information.

PGE to NRC letter dated February 29, 1980 - This letter responded to NRC IE Bulletin 79-27 and provided the results of a failure effects analysis for each electrical bus supplying 120-V AC power to instrumentation and control systems. The results have been included in Section 8.3.1.2.5, 120-V AC System.

CHAPTER 9.0
AUXILIARY SYSTEMS

Section 9.1, Fuel Storage and Handling Systems

Plant Design Change 77-100 and Amendment 25 - This Plant Design Change and associated amendment to the Trojan operating license installed siphon protection for the spent fuel pool to ensure that a minimum elevation is maintained. Applicable information is included in Section 9.1.3.3, Safety Evaluation.

Plant Design Change 78-007 - This Plant Design Change installed a new spent fuel pool purification pump, and the design data has been appropriately revised in Table 9.1-4.

Plant Design Change 78-015 - This Plant Design Change added seismic supports to a section of the spent fuel pool cooling and demineralizer system piping. Section 9.1.3.1, Design Bases, includes a description of this modification.

Plant Design Change 78-016 - This Plant Design Change installed a wall bracket jib crane on the southwest corner of the processed solid rad-waste storage area. This is described in Section 9.1.4.2.2.12, Wall Bracket Jib Crane.

Plant Design Change 78-103 - Plant Design Change 78-103 modified the spent fuel pool skimmer subsystem, and a detailed description of this system has been added to Section 9.1.3, Spent Fuel Cooling and Demineralizer System.

Section 9.2, Water Systems

Plant Design Change 76-058 - This Plant Design Change installed improved packing seals on the component cooling water pumps and installed surge tank level switches for automatic makeup pump operation. This information is included in Section 9.2.2, Component Cooling Water System.

Plant Design Change 76-170 - This Plant Design Change connected a chemical mixing tank to the component cooling water chemical additive tank. Section 9.2.2.2.3.6, Water Chemistry Monitoring and Control, describes this equipment.

Plant Design Change 76-249 - This Plant Design Change installed dual-element RTDs to measure effluent temperature in the Discharge Structure. Section 9.2.9, Plant Discharge and Dilution Structure, describes these RTDs.

Plant Design Change 76-385 - This Plant Design Change installed a line to route service water from the steam generator blowdown heat exchanger and vent condenser to the cooling tower basin so that the Plant's thermal discharge to the Columbia River would be reduced. Section 9.2.1.2, System Description, discusses this modification.

Plant Design Change 76-501 - This Plant Design Change installed an internal floating roof in the primary water storage tank to minimize oxygen absorption in the water. This internal floating roof has been described in Section 9.2.7.2, System Description.

Plant Design Change 76-524 - This Plant Design Change installed a solids settling basin which discharges to the Discharge and Dilution Structure effluent chamber. Section 9.2.9, Discharge and Dilution Structure, includes a description of this.

Plant Design Change 76-584 - This Plant Design Change modified the dechlorination monitor and control system such that the sodium bisulfate injection pump will start, when set up for automatic operation, whenever a chlorination cycle is initiated. This modification affects the text in Section 9.2.9, Discharge and Dilution Structure.

Plant Design Change 77-106 - This Plant Design Change installed an internal floating roof in the condensate storage tank to minimize oxygen absorption in the water. This modification is described in Section 9.2.6, Condensate Storage and Transfer System.

LDCR TNP 76-18 - This LDCR revised the FSAR to delete the local fire department pumping connection for the Intake Structure to eliminate the possible reliance to an alternative water source whose availability is not guaranteed. This change affected Section 9.2.1, Service Water System.

LDCR TNP 79-04 - This LDCR reanalyzed the maximum temperature which could be achieved by the Circulating Water System in the cooling tower basin. The results of this analysis are given in Section 9.2.1.3, Safety Evaluation.

Section 9.3, Process Auxiliaries

Plant Design Change 76-092 - This Plant Design Change modified the primary sampling system to allow more effective, reliable hydrogen sampling. Section 9.3.2.2.1, Primary Sampling System, was affected by this modification.

Plant Design Change 76-291 - This Plant Design Change installed a fourth air compressor in the instrument and service air system that is designed for use during normal operation. Section 9.3.1, Compressed Air System, provides details of this compressor.

Plant Design Change 76-446 - This Plant Design Change installed monitoring equipment in the secondary sampling system for automatic analyses for sodium. This has been added to Section 9.3.2, Process Sampling System.

Plant Design Changes 76-546 and 76-594 - These Plant Design Changes installed a greater capacity sewage treatment plant at Trojan. Section 9.3.3, Equipment and Floor Drainage Systems, describes this larger plant.

Plant Design Change 77-073 - This Plant Design Change installed equipment to allow pumping waste from the Auxiliary Building passageway sump to the dirty waste drain tank. This modification has been included in Section 9.3.3, Equipment and Floor Drainage Systems.

Plant Design Change 77-111 - This Plant Design Change installed a suction stabilizer and discharge pulsation dampener on the reciprocating charging pump to reduce pressure pulsations in the adjoining piping. Section 9.3.4.2.5.1, Charging Pumps, includes this modification.

Plant Design Change 78-043 - This Plant Design Change installed a low-pressure line from upstream of the volume control tank to the residual heat removal pumps for purification flow. This change is reflected in Section 9.3.4.2.2.3, Reactor Coolant Purification.

Plant Design Change 79-101 - This Plant Design Change installed monitoring capability in the control room for Containment hydrogen analysis. Section 9.3.2.2.6, Containment Hydrogen Analysis System, includes this modification.

LDCR TNP 81-21 - The changes due to this LCR affect Section 9.3.2, Process Sampling System, by reclassifying certain Seismic Category I piping and equipment. It was determined that this reclassification is consistent with Regulatory Guides 1.26 (Rev. 3), 1.29 (Rev. 3) and 1.143 (Rev. 1) and does not have significant safety implications.

PGE to NRC letters dated June 5, 1980 and August 14, 1980 - These letters responded to NRC IE Bulletin 80-05 and provided information regarding vacuum protection for certain tanks. This information is included in Section 9.3.3, Equipment and Floor Drainage Systems.

Section 9.4, Air Conditioning, Heating, Cooling and Ventilation Systems

Plant Design Changes 75-047 and 76-561 - These Plant Design Changes modified the Fuel and Auxiliary Building ventilation system to change the flow rate so that the required negative pressure could be maintained. Section 9.4.2.2.2, Fuel and Auxiliary Building Heating and Ventilation System, provides information relating to these modifications.

Plant Design Change 76-560 - This Plant Design Change installed smoke exhaust systems in the Control and Turbine Buildings. References to these systems are included throughout Section 9.4.

Section 9.5, Other Auxiliary Systems

Plant Design Changes 76-040 and 77-032 - These Plant Design Changes established the existing Containment evacuation alarm system which consists of modulated lighting intensity and audible horns. This is discussed in Section 9.5.2.2.1, In-Plant Communications.

Plant Design Change 76-510 - This Plant Design Change installed a second VHF base radio station for in-Plant and off-premise communications at Trojan. This is discussed in detail in Section 9.5.2.2, In-Plant Communications.

Plant Design Change 79-076 - This Plant Design Change removed the local indicators from the diesel fuel oil underground tanks. References to these indicators have been deleted from Section 9.5.

PGE to NRC letter dated August 14, 1980 - This letter responded to NRC IE Bulletin 80-15 and provided information regarding the operability of the Emergency Notification System. This information is included in Section 9.5.2.2.1, In-Plant Communications.

CHAPTER 10.0 STEAM AND POWER CONVERSION SYSTEM

Section 10.2, Turbine Generator

Plant Design Change 76-390 - This Plant Design Change installed pre-separator drains for the moisture separators located prior to the low-pressure turbine to improve their efficiency. This information is added to Section 10.2.2, System Description.

Section 10.4, Other Features of Steam and Power Conversion System

Plant Design Change 76-193 - This Plant Design Change allowed the use of a temporary packaged "D" type boiler to supply steam during Plant startup. Sections 10.4.3, Turbine Gland Sealing System, and 10.4.10, Process Steam System, describe this arrangement.

Plant Design Change 76-227 - This Plant Design Change modified the auxiliary feedwater pump diesel driver jacket cooling system by installing two 4,000-watt heaters to maintain the jacket water temperature at the desired level. This is described in Section 10.4.9.2.2.3, Diesel Engine Driver.

Plant Design Change 76-278 - This Plant Design Change installed an oil priming pump to maintain engine oil circulating during engine shutdown periods. Section 10.4.9.2.2.3, Diesel Engine Driver, provides this information.

Plant Design Change 76-482 - This Plant Design Change installed local meter indication for blowdown flow rate through the cooling tower blowdown line. Section 10.4.6.5, Instrumentation Application, provides this information.

Plant Design Change 76-608 - This Plant Design Change installed flow indication to monitor total blowdown flow from the steam generator blowdown heat exchanger. Section 10.4.8, Steam Generator Blowdown System, provides this information.

Plant Design Change 77-139 - This Plant Design Change installed a non-safety-related motor-driven auxiliary feedwater pump to eliminate the need to operate the turbine- and diesel-driven auxiliary feedwater pumps for routine Plant startup and shutdown. Section 10.4.9, Auxiliary Feedwater System, describes this pump.

Plant Design Change 78-004 - This Plant Design Change relocated a temperature indicator for the steam generator blowdown pumps from the outlet of the blowdown heat exchanger to the inlet side. This is reflected in Section 10.4.8, Steam Generator Blowdown System.

Plant Design Change 78-020 - This Plant Design Change installed piping, valves and instrumentation to allow circulation of cooling water from the turbine-driven auxiliary feedwater pump crossover through the lube oil and bearing coolers and back to the pump suction if cooling from the service water system is lost. Section 10.4.9, Auxiliary Feedwater System, reflects this modification.

Plant Design Change 79-063 - This Plant Design Change provided each auxiliary feedwater pump with an automatic shutoff trip to protect the pumps against a low suction pressure. This is described in Section 10.4.9, Auxiliary Feedwater System.

Plant Design Change 80-003 - This Plant Design Change modified the turbine-driven auxiliary feedwater pump so that it is independent of ac power. This is described in Section 10.4.9, Auxiliary Feedwater System.

Plant Design Change 80-054 - This Plant Design Change installed a guard pipe around the turbine-driven auxiliary feedwater pump discharge piping to protect the diesel-driven auxiliary feedwater pump from a possible pipe rupture. This is described in Section 10.4.9, Auxiliary Feedwater System.

Plant Design Change 80-061 - This Plant Design Change allowed the motor-driven auxiliary feedwater pump to discharge to either the diesel-driven or turbine-driven discharge line. Section 10.4.9, Auxiliary Feedwater System, describes this modification.

LDCR TNP 79-21 - This LDCR was initiated to update Table 10.4-10, AVT Steam Generator Steam Side and Feedwater Chemistry Specifications, to reflect the current chemistry procedures.

PGE to NRC letter dated July 19, 1979 - This letter responded to NRC IE Bulletin 79-13 and provided nondestructive testing results of the Trojan feedwater piping. Pertinent information from this letter is included in Section 10.4.7, Condensate and Feedwater System.

CHAPTER 11.0 RADIOACTIVE WASTE MANAGEMENT

Section 11.2, Liquid Waste Management Systems

Plant Design Change 76-316 - This Plant Design Change modified the Auxiliary Building drain tank nitrogen purge blanket pressure and relief valve setpoint. Section 11.2.2.1.1, Clean Radioactive Waste Treatment System, describes this tank.

Plant Design Change 77-073 - This Plant Design Change modified the Auxiliary Building passageway sump so that it can discharge to the dirty waste drain tank, clean waste receiver tank and to the two treated waste monitor tanks. Section 11.2.2.1.2, Dirty Radioactive Waste Treatment System, provides this description.

Plant Design Change 79-055 - This Plant Design Change added interlocks to prevent the automatic opening of Containment isolation valves for the Containment sump pumps on the resetting of a Containment isolation signal. Section 11.2.2.1.2, Dirty Radioactive Waste Treatment System, provides this information.

Plant Design Change 80-076 - This Plant Design Change modified the Oily Water Separator to be able to receive potentially radioactive water from the Turbine Building and Condensate Demineralizer Building sumps in the event of primary-to-secondary leakage. This is described in Section 11.2.3.1.5, Steam Generator Blowdown Treatment System Releases.

PGE to NRC letter dated July 1, 1980 - This letter responded to NRC IE Bulletin 80-10 and provided an evaluation of which systems, classified as nonradioactive, have the potential to become radioactively contaminated. This information is provided in Section 11.2.3.2, Nonradioactive Systems Contamination.

Section 11.3, Gaseous Waste Management Systems

Plant Design Change 77-103 - This Plant Design Change installed a pressure indicator in the control room to monitor the waste gas surge tank pressure. Section 11.3.2.1, Gas Collection System, reflects this modification.

LCR TNP 81-21 - The changes due to this LCR affect Section 11.3.2.1, Gas Collection System, by clarifying the seismic classification of certain equipment. It was determined that this classification is consistent with Regulatory Guides 1.26 (Rev. 3), 1.29 (Rev. 3) and 1.143 (Rev. 1) and does not have significant safety implications.

Section 11.4, Solid Waste Management System

Plant Design Changes 76-011 and 76-012 - These Plant Design Changes modified the spent resin storage tank with mixing nozzles to ensure that spent resin remains in a fluidized form prior to solidification. This is reflected throughout Section 11.4.

Plant Design Change 76-425 - This Plant Design Change located the drum baler control switch so as to ensure its safety should a radioactive drum rupture. This information has been added to Section 11.4.2.2.1.5, Solid Waste Hydraulic Baler.

Plant Design Change 76-549 - This Plant Design Change installed a high pressure blower with high velocity laminar flow ducts behind the

solid waste hydraulic baler to evacuate potentially contaminated air. Section 11.4.2.2.1.5, Solid Waste Hydraulic Baler, includes this information.

Plant Design Change 78-039 - This Plant Design Change modified the spent resin processing system to allow low level resins to bypass the spent resin tank and thus reserve this tank capacity for high level waste. This information is included throughout Section 11.4.

Plant Design Change 80-117 - This Plant Design Change installed a resin sampler downstream of the spent resin recirculation pump. Section 11.4.2.2.1.1, Spent Resin Process Components, describes this sampler.

LDCR 80-11 - This LDCR was initiated to revise the FSAR to more properly describe the onsite solid waste storage facilities. This LDCR revises Section 11.4.2.5, Storage Facilities.

Section 11.5, Process and Effluent Radiological Monitoring Systems

Plant Design Changes 79-055 and 79-057 - These Plant Design Changes affect Table 11.5-1, Process and Effluent System Characteristics, by modifying the characteristics for two radiation monitors, PRM-14 and PRM-15.

LDCR 76-17 - This LDCR was initiated to update the FSAR regarding the radioactivity measurement analytical procedures. Section 11.5.2, Analytical Procedures, has been revised due to this LDCR.

LDCR 77-15 - This LDCR was initiated to update the FSAR regarding the installation of automatic sampling capability of liquid and gaseous effluents. Section 11.5.2.1.6, Liquid Sample Collection System, reflects this change.

LDCR 79-22 - This LDCR was initiated to update Tables 11.5-2, Radiological Analysis Summary of Liquid Process Samples, and 11.5-3, Radiological Analysis Summary of Gas Process Samples, to show the current procedures in practice.

LDCR 81-04 - This LDCR was initiated to update the FSAR regarding the description of the gross failed fuel monitor. Section 11.5.1.4, Gross Failed Fuel Monitor, reflects these changes.

CHAPTER 12.0 RADIATION PROTECTION

Section 12.2, Radiation Sources

PGE to NRC letter dated January 2, 1980 - This letter provided information concerning post-accident source terms used for shielding analyses in response to TMI Short-Term Lessons Learned, Item 2.1.6.6. This information is included in Section 12.2.1.3, Sources for Design Basis Events.

Section 12.3, Radiation Protection Design Features

Plant Design Change 75-047 - This Plant Design Change modified the Fuel and Auxiliary Building ventilation systems to ensure that the air flow rate met minimum requirements. Section 12.3.3.2.2, Fuel and Auxiliary Buildings Ventilation System, includes this change.

Plant Design Change 78-042 - This Plant Design Change installed a lead shield around the fuel transfer tube seismic gap to prevent radiation streaming. Section 12.3.2.2, Containment Interior Shielding Design Description, describes this shield.

Plant Design Changes 79-051 and 79-057 - These Plant Design Changes installed additional radiation monitoring capability in the Containment and certain Containment penetration lines. This information has been included throughout Section 12.3.

Plant Design Changes 80-008 and 80-009 - These Plant Design Changes installed supplementary post-accident shielding on the Waste Gas Surge Tank and Holdup Tank "A". The details of this shielding are shown in Figures 12.3-30 through 12.3-32.

LDCR TNP 79-03 - This LDCR revised several FSAR radiation zoning drawings to correctly reflect the existing door alarms and personnel alert barriers installed at Trojan.

LDCR TNP 79-12 - This LDCR revised FSAR Section 12.3.4.2, Area Radiation Monitoring System, to change the calibration requirements for area radiation monitors.

Amendment 29 - Amendment 29 to the Trojan operating license approved the use of water-filled rubber bags for use as neutron streaming shields in the reactor vessel inspection openings and borated polyethylene blocks in the reactor vessel cavity. Section 12.3.2.2, Containment Interior Shielding Design Description, describes this shielding.

PGE to NRC letters dated January 2, 1980 and April 15, 1980 - These letters provided the results of an evaluation regarding post-accident dose rates from various systems. This information is in Section 12.3.

Section 12.4, Dose Assessment

LDCR TNP 78-11 - This LDCR was initiated to clarify the actual radiation levels at the outside surfaces of all Plant buildings. Section 12.4.1, Estimates of Exposure, reflects these changes.

Section 12.5, Health Physics Program

LDCR TNP 76-06 - This LDCR revises FSAR Section 12.5.3.2, Personnel Dosimetry, by updating the information regarding the use of TLDs rather than film badges for dosimetry.

LDCRs TNP 78-11 and 80-11 - These LDCRs revise this portion of Section 12.5 by providing a more detailed description of the portal monitors used for personnel contamination checks. Section 12.5.2.1, Health Physics Facilities, reflects this change.

LDCR TNP 81-01 - This LDCR revises FSAR Section 12.5.2.2.5, Emergency Instrumentation, by deleting the existing text and referencing, instead, the Trojan Radiological Emergency Plan and Procedures Manual (PGE-1008).

CHAPTER 13.0 CONDUCT OF OPERATIONS

Section 13.1, Organizational Structure of PGE

Amendment 66 - This amendment to the Trojan operating license approved the PGE organizational changes which occurred in 1981. Figures 13.1-1 and 13.1-2 show the current Company organizational and Plant staff structures.

PGE to NRC letter dated October 17, 1979 - This letter responded to TMI Lessons Learned items and included commitments concerning Shift Technical Advisor qualifications and training. This information is included in Section 13.1.3.1, Minimum Requirements.

Section 13.3, Emergency Planning

LDCR TNP 80-06 - This LDCR revised the FSAR by deleting the text in this section and then providing a reference to the Trojan Radiological Emergency Plan and Procedures Manual (PGE-1008).

Section 13.4, Review and Audit

Amendments 42, 52 and 66 - These amendments to the Trojan operating license approved organizational changes and certain changes to the Plant Review Board and Nuclear Operations Board. Section 13.4 reflects these changes.

CHAPTER 15.0 ACCIDENT ANALYSES

Section 15.1, Increase in Heat Removal by the Secondary System

LDCR TNP 79-16 - This LDCR revises the FSAR due to a modification to the Safety Injection System actuation logic to require two out of three low-pressurizer pressure signals. This is included in Section 15.1.4, Inadvertent Opening of a Steam Generator Relief or Safety Valve.

PGE to NRC letter dated October 5, 1979 - This letter responded to NRC IE Information Notice 79-22 and discussed potential interaction scenarios where the effect of adverse environments could lead to consequences

more limiting than previous results. Section 15.1.5.2, Rupture of the Main Steam Line with Subsequent Control Rod Failure, provides this information.

PGE to NRC letter dated September 24, 1980 - This letter responded to NRC IE Bulletin 80-18 and addressed the maintenance of adequate minimum flow through coolant charging pumps following a secondary side high energy line rupture. The results of this response have been included in Section 15.1.4, Inadvertent Opening of a Steam Generator Relief or Safety Valve, and Section 15.1.5, Spectrum of Steam System Piping Failures Inside and Outside Containment.

Westinghouse Reload Safety Evaluation, Trojan Nuclear Plant, Cycle 2, November 1977 - This report submitted the Westinghouse Improved Thermal Design Procedure for Trojan and affects several portions of Section 15.1.

Section 15.2, Decrease in Heat Removal by the Secondary System

PGE to NRC letter dated October 5, 1979 - This letter evaluated limiting consequential malfunction scenarios for Trojan. Section 15.2.8.3.1, Control System Effects Due to Adverse Environmental Conditions Resulting from High Energy Line Breaks, provides this information.

PGE to NRC letter dated September 24, 1980 - This letter responded to NRC IE Bulletin 80-18 and provided an evaluation of secondary high energy line ruptures to determine the impact of reduced safety injection flow due to normally open miniflow isolation valves. Section 15.2.8.3.2, Effect on SAR Analysis Due to Normally Open CCP Miniflow Isolation Valves, provides this information.

Section 15.3, Decrease in Reactor Coolant System Flow Rate

Westinghouse Reload Safety Evaluation, Trojan Nuclear Plant, Cycle 2, November 1977 - This report submitted the Westinghouse Improved Thermal Design Procedure for Trojan and affects several portions of Section 15.3.

Section 15.4, Reactivity and Power Distribution Anomalies

PGE to NRC letter dated November 26, 1980 - This letter provided an evaluation of the potential of a boron dilution accident at Trojan. Section 15.4.6, Chemical and Volume Control System Malfunction That Results in a Decrease in the Boron Concentration in the Reactor Coolant, includes this evaluation.

Westinghouse Reload Safety Evaluation, Trojan Nuclear Plant, Cycle 2, November 1977 - This report submitted the Westinghouse Improved Thermal Design Procedure for Trojan and affects several portions of Section 15.4.

Section 15.5, Increase in Reactor Coolant Inventory

LDCR TNP 79-16 and Plant Design Change 79-042 - These sources revise the FSAR due to a modification to the Safety Injection System that removed

the pressurizer low-level coincidence from the pressurizer low-pressure logic for safety injection. Section 15.5.1, Inadvertent Operation of ECCS During Power Operation, includes this modification.

Section 15.6, Decrease in Reactor Coolant Inventory

LDCR TNP 79-16 and Plant Design Change 79-042 - These sources revise the FSAR due to a modification to the Safety Injection System that removed the pressurizer low-level coincidence from the pressurizer low-pressure logic for safety injection. Section 15.6.3, Steam Generator Tube Rupture, is revised by this LDCR.

PGE to NRC letter dated May 7, 1980 - This letter submitted a revised emergency core cooling system performance evaluation for Trojan using the NRC-approved Westinghouse Evaluation Model. Section 15.6.5, Loss of Reactor Coolant Accidents Resulting from a Spectrum of Postulated Piping Breaks Within the Reactor Coolant Pressure Boundary, provides information regarding this evaluation.

PGE to NRC letter dated January 2, 1981 - This letter responded to NUREG-0737, TMI Lessons Learned items, and provided information regarding control room dose calculations. Section 15.6.5.6, Environmental Consequences, includes this information.

Westinghouse Reload Safety Evaluation, Trojan Nuclear Plant, Cycle 2, November 1977 - This report submitted the Westinghouse Improved Thermal Design Procedure for Trojan and affects several portions of Section 15.6.

Section 15.7, Radioactive Release from a Subsystem or Component

PGE to NRC letters dated October 19, 1977 and June 17, 1980 and Amendment 54 - These letters and amendment to the Trojan operating license provided analyses of fuel handling accidents inside Containment. The information from these sources affects several portions of Section 15.7.

PGE to NRC letter of August 13, 1979 - This letter provided an evaluation of the radiological consequences of a CVCS Holdup Tank rupture. This analysis is provided in Section 15.7.3, Postulated Radioactive Releases Due to Liquid Tank Failures.