UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

THE ATOMIC SAFETY AND LICENSING BOARD

Marshall E. Miller, Esquire, Chairman
Dr. Kenneth A. McCollom, Member
Dr. Hugh C. Paxton, Member

In the Matter of

PORTLAND GENERAL ELECTRIC COMPANY, et al.) Docket No. 50-344SP

(Trojan Nuclear Plant)) July 11, 1980

INITIAL DECISION

(Control Building Modifications)

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1. PRELIMINARY STATEMENT

A. ULTIMATE ISSUES

This Initial Decision concerns the ultimate issue of whether the scope and timeliness of proposed modifications, required to bring the Trojan Nuclear Plant into substantial compliance with NRC Operating License No. NPF-1, are adequate from a safety standpoint. This issue was defined in Section IV of the Commission's Order for Modification of License issued May 26, 1978 (43 Fed. Reg. 23678, 23770).

This ultimate issue of the adequacy of proposed modifications from a safety standpoint, also involves the question of whether operation of the Trojan plant can be conducted safely while such modifications are being performed and prior to their completion. Interim operation of this nuclear plant was authorized in Phase I of this proceeding by our Partial Initial Decision issued

December 21, 1978 (LBP-78-40, 8 NRC 717). Pursuant to that Partial Initial Decision, an amendment was issued to the Trojan operating license authorizing interim operation of the plant "until further order of the Atomic Safety and Licensing Board issued in conjunction with the decision on the scope and timeliness of modifications from a safety standpoint..." (Id. at 747). That "further order" is one of the subjects under consideration in this Phase II of the proceeding.

The background events of this proceeding were set forth in the Partial Initial Decision (8 NRC 717), and they will not be repeated in unnecessary detail here. The May 26, 1978 Modification Order resulted from the discovery by the Licensee[1/] and its agent, the Bechtel Corporation, of several design errors with respect to the shear walls in the Control Building at the facility. This Modification Order found that these design errors reduced the structural capacity of the Control Building, that the originally intended seismic capability and safety margins should be substantially restored by appropriate modifications, and that operation of the facility in its as-built condition would violate the facility license Technical Specification 5.7.1. However, the Modification Order further found that the Control Building had adequate structural capacity to safely withstand the licensed Safe Shutdown Earthquake

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1/ Portland General Electric Company (PGE), the City of Eugene, Oregon and Pacific Power and Light Company, the licensed owners of the plant referred to collectively as the "Licensee".

(SSE)[2] for the Trojan facility (0.25g peak horizontal ground acceleration).

The Modification Order also provided that any person whose interests might be affected could file a request for hearing. A number of persons availed themselves of this opportunity for hearing and were admitted as intervening parties to the Phase I evidentiary hearings (8 NRC at 722-23). The Licensing Board also ordered the bifurcation of the proceeding into two phases (Order of August 25, 1978). Phase I involved a consideration of and decision upon the question of interim operation of the Trojan plant prior to modifications of the Control Building, and culminated after evidentiary hearings in the Partial Initial Decision of December 21, 1978 (LBP-78-40, 8 NRC 717). The instant Phase II of the proceeding involves consideration of the structural adequacy of the proposed modifications themselves and the safety aspects of their implementation.

B. PHASE II EVIDENTIARY HEARING

Written contentions were required to be filed by the intervening parties in Phase II of the proceeding, and contentions were filed by the Coalition for Safe Power (CFSP) by Eugene Rosolie and by the Consolidated Intervenors (CI, consisting of Nina Bell, David

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[2] That is, the facility design must be such as to insure that, should there be an earthquake providing the defined level of vibrating ground motion at the site, the structures, systems and components necessary to bring about a safe shutdown of the reactor will remain functional. See 10 CFR Part 100, Appendix A, Section III(c).

B. McCoy and C. Gail Parson).[3] Following oral argument at a prehearing conference on March 29, 1979, certain of the proffered contentions of both CFSP and CI were admitted as issues in controversy. The admitted contentions of CI were subsequently dismissed because of the failure of CI to comply with a Licensing Board Order compelling responses to discovery requests from the Staff.[4] At the Intervenor's request, CI was consolidated with CFSP, and CI was bound by the responses to interrogatories filed by CFSP. The contentions which remained as issues are as follows:

CFSP No. 3	Plant Staff review of proposed modification is inadequate to assure no violations of Technical Specifications will occur (Tr. 3011-20).
CFSP No. 4	NRC Staff review of proposed modification is inadequate to assure no violations of Technical Specifications will occur (Tr. 3046-51).
CFSP No. 12	Licensee has not provided information which shows that the plant can be operated during modification work without an undue risk to the public health and safety (Tr. 3055-59).
CFSP No. 13	The plant cannot operate in a safe condition while the modification work is being done (Combined with CFSP No. 12, above. Id.).
CFSP No. 15	Licensee has not identified all safety equipment or equipment needed for safe operation of the plant that would be

[3] Intervenors Columbia Environmental Council (CEC) and Stephen M. Willingham failed to file contentions in Phase II, and accordingly they were dismissed as parties by the Prehearing Conference Order (Phase II) of April 12, 1979.

[4] See Orders entered June 5 and June 15, 1979 and October 17, 1979.

affected by proposed modifications (Tr. 3062-63).

CFSP No. 16 Licensee has not made adequate plans to protect all safety equipment and equipment for safe operation during the modification work (Id.).

CFSP No. 17 Performance of modification work will hamper the ability of plant operators to respond to any emergency properly and thus poses an undue risk to the public health and safety (Tr. 3063-65).

CFSP No. 20 Inadequate assessment of the effects of drilling in the Control Building walls during modifications has been made (Tr. 3078-83).

CFSP No. 22 The effect of the steel plate on displacement in the Complex has not been completely analyzed (Tr. 3094-98, 3108-11).

The Licensee filed a motion for summary disposition of CFSP Contentions 3, 17, 20 and 22. After hearing from all parties, the Board granted the motion for summary disposition as to CFSP 3 (Tr. 3485), but denied the motion with regard to CFSP 17 and 20 (Tr. 3498, 3513). The Licensee withdrew its motion as to CFSP 22 (Tr. 3514), and CFSP voluntarily withdrew its Contention 4 (Tr. 3615). Accordingly, the contentions considered at the Phase II evidentiary hearing were Nos. 12, 13, 15, 16, 17, 20 and 22, supra.

The Intervenors also sought to raise an issue concerning the adequacy of the Licensee's existing security plan to deal with the modification work. At the Board's suggestion, all parties stipulated a procedure under which a Staff security expert would review and evaluate the security plan in light of the Intervenor's concerns over the modification wor...[5] Subsequently, CFSP requested this security review to include several incidents which had occurred at the Trojan plant after the original review.[6] The security review was performed as requested and the evaluation showed the security plan to be adequate while the modification work was being performed. Although CFSP indicated that it felt that the Staff's review was not adequate, it gave no basis for this view when requested to do so by the Board.[7] No nexus was shown between the incidents alleged and the issues over which this Board has jurisdiction. Such matters are therefore not relevant to this proceeding and cannot be considered here.[8]

All parties prefiled their written testimony according to the schedule set by the Board at the March 11, 1980 prehearing conference. On March 17, 1980, Licensee prefiled the written testimony of Donald J. Broehl, Lief W. Erickson, Richard C. Anderson, William H. White and Kenneth M. Cooke on matters other than structural adequacy of the modified Complex (Licensee Exh. 27). In addition, Licensee prefiled the written testimony of Richard C. Anderson, William H. White, Bimal Sarkar and Patrick Chang-Lo on

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[5] Tr. 3090-93.

[6] Tr. 3402-12, 3527-30, 3583-89.

[7] Tr. 3529-30, 4682-83.

[8] However, the Intervenors may request the Director of Nuclear Reactor Regulation to institute a show-cause proceeding if they have concerns about security at the Trojan facility. 10 CFR 2.202; Portland General Electric Company (Trojan Nuclear Plant), ALAB-534, 9 NRC 287, 290, n. 6 (1979).

the structural adequacy matters (Licensee Exh. 28), as well as the testimony on these matters of Licensee's independent experts, Professors Myle J. Holley, Jr. and Boris Bresler (Licensee Exh. 29A).

The Staff prefiled the direct written testimony of Charles M. Trammell, III, Fred Clemenson, James E. Knight, Kenneth S. Herring and Drew Persinko on matters other than structural adequacy of the modified Complex (Staff Exhs. 12, 14, 15 and 16). On March 21, the State of Oregon prefiled the testimony of Dr. Harold I. Laursen on the structural adequacy of the modified Complex (Oregon Exh. 2). On March 24, 1980, the Staff prefiled the testimony of Kenneth S. Herring and Drew Persinko on structural adequacy matters (Staff Exh. 17). Finally, Licensee prefiled its answers to questions previously propounded by Dr. McCollom (Tr. 3531-35), on March 30 (Licensee Exh. 30).

The Phase II evidentiary hearing was held in Portland, Oregon on March 31-April 3 and April 16-17, 1980. The only limited appearance statement from a member of the public was heard on March 31 (Tr. 3792-94). Witnesses were presented at both sessions by Licensee, the State of Oregon and the NRC Staff. CFSP attended the hearing and cross-examined witnesses, but presented no witnesses of its own. The Board conducted extensive examination on all of the direct evidence presented.

When the hearing began on March 31, the Staff's prefiled testimony indicated that resolution had not yet been reached between the Staff and the Licensee with respect to a number of the matters that had been described as unresolved in the Staff's Safety Evaluation Report (SER) filed February 14, 1980 (Staff Exhs. 13A, 13B). With respect to nonstructural matters, the Staff indicated that all matters were resolved by the close of the first hearing session (Tr. 4480-81 (Gray)). The illness of the Staff's principal structural witness (Tr. 4476-83) caused a delay in the resolution of structural matters. However, the Staff subsequently filed revised testimony which reflected that these matters were resolved to the Staff's satisfaction (Staff Exhs. 15A, 17A). Thus, there were no controversies between the Licensee and the Staff before the Board for resolution at the hearing.

The record compiled for Phase II comprises more than 1,000 pages of transcript as well as the exhibits which were admitted into evidence, as listed in the Appendix attached hereto.

II. FINDINGS OF FACT

A. DESCRIPTION OF THE BUILDING COMPLEX

The Control, Auxiliary and Fuel Buildings (Building Complex) are interconnected by their foundation systems and floor slabs. The Auxiliary Building is located between the Fuel Building at the east end of the Building Complex and the Control Building at the west end and is supported laterally by both the Fuel and Control Buildings, with the reinforced concrete floor slabs acting as diaphragms to transfer lateral loads. The connecting floor slabs and walls interact when subjected to seismic forces (8 NRC 723-24; Licensee Exh. 24, pp. 1-12). The Turbine Building, which is closely associated with the proposed modification, is adjacent and west of the Control Building.

The Control Building is a box-type structural system with its ground floor on rock foundation at elevation 45 feet, concrete floors at elevations 61 feet, 77 feet, and 93 feet and with a roof slab at elevation 117 feet. The Control Building is composed of a structural steel framing system with steel beams and columns supporting reinforced concrete floor slabs, with shear walls designed to resist lateral seismic forces of an earthquake. Most of the shear walls are of a composite-type construction (composite walls) consisting of a reinforced or unreinforced concrete core between two layers (wythes) of reinforced grouted masonry block. The two block wythes generally sandwich the structural steel frame so that the steel frame members are embedded in the concrete core (Licensee Exh. 24, pp. 3-12; Staff Exh. 13A, p. 1). A railroad bay is located at ground level in the Control Building between column lines 41 and 46 with large openings in the east and west walls for train access.

The Auxiliary Building is approximately 115 feet by 62 feet with the longer dimension running in the East-West direction. At the lower level, the north and south walls are composite walls and the other walls are of reinforced masonry block. Above elevation 61 feet, the exterior walls are reinforced masonry block and interior walls are reinforced masonry block or, for shield walls, composite walls. The walls from elevation 93 feet to 117 feet are reinforced masonry block (Licensee Exh. 24, pp. 3-13).

The Fuel Building is approximately 62 feet by 180 feet with the longer dimension running in the North-South direction. Floor slabs at elevation 61 feet, 77 feet and 93 feet provide continuity with the Auxiliary Building. From 93 feet to the roof level at elevation 138 feet, the structural system is steel framing rather than block and reinforced concrete walls. Most of the lateral resistance of the Fuel Building is provided by the enclosure structure for the holdup tanks and the spent fuel pool (Licensee Exh. 24, pp. 3-13).

B. <u>DESIGN DEFICIENCIES AND OBJECTIVES OF MODIFICATIONS</u>

The Control Building design deficiencies that led to the Order for Modification of License of May 26, 1978 are:

(1) Both the horizontal and vertical reinforcing steel embedded in the inner concrete core of the Control Building shear walls is generally discontinuous, in that it is not anchored to the steel beams and columns of the Control Building's steel frame as required by applicable codes and standards.

(2) Misapplication of the applicable code ACI 318-63 shear design formulae in combination with the applicable limiting OBE seismic

loading resulted in less than the required amounts of reinforcing steel in the shear walls.

As a result of these design deficiencies, the capacity of the Building Complex together with the contained systems and components to withstand seismic events is lower than intended (8 NRC 725-26; Staff Exh. 13A, p. 2, §10; Staff Exh. 17A, p. 3).

1. The Wall Problem

In late 1979 during a plant shutdown, the Licensee reported deficiencies in certain double-block walls (wall problem) in the Control Building Complex, which could influence structural integrity and support of piping in the event of an earthquake. Because the wall problem introduced uncertainty in issues that led to interim operation, the Board issued an order requiring further information on the matter and specifying that permission of the Board would be required for resumed operation.[9/] The Board held a hearing on December 28 and 29, 1979 for expeditious consideration of the matters in this order. Testimony of witnesses at this hearing satisfied the Board that interim operation could safely continue when permitted by the Office of Inspection and Enforcement (Tr. 3443-46, 344.-50). Although both Licensee and Staff viewed the wall problem as an independent enforcement matter, the Board did not agree and it asked to be kept informed of further developments.

[9/] Modification of Order Permitting Interim Operation of Trojan Nuclear Plant, November 30, 1979.

Subsequently a report by the Staff's masonry consultant questioned Licensee's assumed value of allowable stress in mortar bonding the double wall, "collar joint stress" (Staff Exh. 19). This led to Staff's requirements for short term _in situ_ tests regarding collar joint stresses and ill-defined long term tests. At the prehearing conference of March 11, 1980, a Staff witness testified that double-block walls enter STARDYNE analyses and explained the Staff's desire for a "confirmatory" test program (Tr. 3544, 3603-14). As a result, the Board continued to view the wall problem as a potential issue and asked Licensee and Staff to provide evidence regarding it at the evidentiary hearing.

2. Objectives of the Proposed Building Complex Modifications

Although the as-built complex was found to be capable of withstanding the 0.25g acceleration of the SSE specified for Trojan Nuclear Plant, the design deficiencies both reduced the conservatism and design margins with respect to seismic capability below that intended for the life of the plant, and reduced the operating basis earthquake (OBE)[10] capability below that required by the operating license (Staff Exh. 13A, p. 2; Licensee Exh. 28, pp. 7, 7a). The Licensee proposed modifications intended to add strength to the Control Building, to tie the Control Building

[10] That is, the facility must be designed so that, should there be an earthquake providing that defined level of vibratory ground motion at the site, the plant nonetheless could continue in normal operation without undue risk to the public health and safety (10 CFR Part 100, Appendix A, §III(c)). The 0.15g value assigned to the OBE by the seismic criteria pertaining to the Trojan facility, is not in present dispute.

together in a better way, and to minimize the impact of the modifications on operation of the Trojan Nuclear Plant (Tr. 3705-07, 3764 (Anderson); Licensee Exh. 27, p. 15).

The objective of the proposed modifications is to substantially restore the seismic margins and conservatisms intended in the original design. Such are relied upon to account for uncertainties in analysis, design and construction as well as assuring that older plants, such as Trojan, do not need to be backfitted to meet newly-generated seismic design requirements that may be more stringent than those usually required (Staff Exh. 17A, p. 3).

C. DESCRIPTION OF PROPOSED MODIFICATIONS

The proposed modifications to the Control Building include four new structural elements: three parallel walls running in the North-South direction and a steel plate added to the west wall. The railroad bay through the Control Building will be closed off by two of these walls, and the third wall is an interior wall crossing the current railroad bay (Licensee Exh. 24, §§1.2.6, 3.2.1; Licensee Exh. 28, p. 10; Staff Exh. 13A, p. 6, §20; Tr. 3703-05 (Anderson)). The four new structural elements proposed are:

(1) Adding an interior shear wall on column line N in the Control Building railroad bay structurally connected to shear walls at column lines 41 and

46 and to the underside of the floor slab at elevation 65 feet (Licensee Exh. 24, p. 3-3; Licensee Exh. 27, pp. 8, 9).

(2) Adding a shear wall on column line R in the Control Building railroad bay structurally connected by bolts and grouted reinforcement steel to the existing north and west walls of the Control Building (Licensee Exh. 24, pp. 3-2, 4-5; Licensee Exh. 27, pp. 9-10).

(3) Adding a shear wall along column line N in the Control Building railroad bay structurally connected by high-strength bolts and grouted reinforcement steel to the existing N line wall above elevation 65 feet and the walls at column lines 41 and 46 (Licensee Exh. 24, pp. 3-2, 4-8; Licensee Exh. 27, p. 11).

(4) Adding a three-inch thick steel plate onto the outside face of the R line wall to further strengthen the west wall of the Control Building extending from column line 41 to beyond column line 46 and between elevations 59 feet 3 inches and 97 feet 3 inches with structural connections to the existing R line wall by the use of high-strength steel through-bolts (Licensee Exh. 24, Fig. 3.1-2; Licensee Exh. 27, p. 10).

The addition of these four structural elements will add strength directly to the areas of the Control Building where the inherent structural weaknesses were brought about primarily by the railroad bay openings.

In addition to the four new structural elements, structural improvements will be made at several locations involving welding of beam-column connections and connecting of discontinuous reinforcing steel. The six structural improvements proposed are:

(1) Welding of existing bolted beam-column connections on the south side of column 46-N beneath elevation 77 feet.

(2) Welding of existing bolted beam-column connections on the south side of column 46-N beneath elevation 93 feet.

(3) Making the existing horizontal reinforcing steel continuous at the following locations:

(a) In the 41 line wall at column line Q between elevations 45 feet and 65 feet,

(b) In the 46 line wall at column line N between elevations 45 feet and 61 feet,

(c) In the 55 line wall at column line Q between elevations 45 feet and 61 feet, and

(d) In the 55 line wall at column line N between elevations 45 feet and 61 feet.

Making the existing horizontal reinforcing steel continuous requires removal of existing block and parts of the concrete core in walls to expose the reinforcing steel (Licensee Exh. 27, pp. 12, 13).

Certain ancillary work, not a part of the structural enhancement of the Building Complex, will be performed in addition to the major structural work described. These include: modifications to safety-related equipment, components, and piping necessary for their seismic qualifications to the new building response spectra, installation of a new louvered section in the Turbine Building wall along column line 41, relocation of the existing Turbine Building roll-up door between column lines S' and T west to column line U to provide an air supply for the emergency diesel generators after closing off the railroad bay, alteration of the railroad spur outside of the Control Building, and installation of a new floor slab at elevation 54 feet 6 inches in the closed-off portion of the railroad bay to accommodate use of that area as office space (Licensee Exh. 27, pp. 13-14).

D. STRUCTURAL ADEQUACY OF THE MODIFIED COMPLEX

Among other things, the May 26, 1978 Order for Modification of License requires that the Control Building be brought into substantial compliance with Technical Specification 5.7.1, of the Trojan Operating License and to restore the intended design margins of that Technical Specifications such that: (a) the Control Building OBE capacity of 0.15g is met using 2% damping (FSAR Table 3.7.1); (b) the Control Building OBE capacity of 0.15g and SSE capability of 0.25g are met using a yield strength for reinforcing steel of 40,000 psi (FSAR §3.8.1.3.3); and (c) the masonry portions of the Control Building walls comply with Uniform Building Code (UBC) requirements for reinforced grouted masonry (FSAR §3.8.1.4).

1. Criteria for Determining Structural Adequacy

The criteria for determining structural adequacy of both the unmodified and modified Control Building are complicated by the fact that the major shear walls of the Building Complex are generally composite walls consisting of a reinforced concrete core placed between two layers of reinforced grouted masonry. The provisions of the UBC applicable to masonry are not applicable to the combination of masonry and concrete making up the composite walls. The UBC does provide for use of testing as an alternative to the code formulas.[11/]

11/ For example, existing building codes do not deal with the type of construction present in the Complex in which a steel frame is embedded in composite walls (Tr. 4420 (Bresler)). Composite walls, as used at Trojan are not addressed by the UBC (Licensee Exh. 28, p. 28; Licensee Exh. 30; Staff Exh. 17A, pp. 41-42). Consequently, the requirement in FSAR §3.8.1.5 that "concrete block walls" be designed to UBC requirements for masonry cannot be met for the composite walls of the Complex for which there is no applicable code provisions (Licensee Exh. 29, p. 48). Instead, in the absence of specific code provisions for composite walls, a test program was utilized to provide the information and capacity criteria that building codes would have provided (Licensee Exh. 28, p. 25; Licensee Exh. 29A, pp. 5-6).

a. Determining Structural Adequacy

The appropriate criteria by which it can be determined whether the requirements of the May 26, 1978 Order for Modification of License are met include: (1) the specifications listed therein are used in the analytical model; (2) it is demonstrated that the modifications would bring substantial compliance with the seismic design requirements of the Trojan FSAR as referenced by Technical Specifications 5.7.1; and (3) where substantial literal compliance with those requirements is not possible due to the type of building construction, then conservative engineering judgments using alternative equivalent methodology are used.

The capacities of the new reinforced concrete walls and the new steel plate to be added are determined by two codes not referenced in FSAR §3.8, ACI 318-77 Code and AISC Manual of Steel Construction, 7th Edition, respectively. Their use is consistent with that section's requirements regarding these materials (Licensee Exh. 28, p. 47; Staff Exh. 13A, p. 69, §5.2.1; Tr. 4405 (White)).

b. Seismic Input for the Analytical Model

The seismic input criteria for use with the analytical model were provided for in the FSAR §3.7, and all such specifications were used accordingly except for the derivation of the floor response spectra. A new artificial time history with different frequency intervals from that specified in the FSAR was developed, which better characterizes the motion described by the ground response spectra. The new frequency intervals selected for the ground response spectra are in accordance with current practices as set forth in Regulatory Guide 1.122. A reassuring result is that the new floor response spectra enclose the one used for the original seisric design of the Building Complex.

2. Determing Structural Adequacy of the Modified Building Complex

The modified Building Complex was modeled and analyzed, with the three dimensional finite element STARDYNE computer program used for evaluation of the current unmodified Building Complex for interim operation (Partial Initial Decision, 8 NRC 717, pp. 730-33). This model generates loads, displacements and floor response spectra using the specified seismic input discussed above (Licensee Exh. 28, p. 36).

The determination of the structural strengths (capacities) of the composite walls unique to the Control Building was derived from test results, with proper application to the individual wall panels in the modified Building Complex prov' ed as an alternative in the UBC. The various potential effects on the collection of wall panels of having the steel frame embedded in the composite walls were also assessed and accounted for in the analytical model. Similarly, the added walls and steel plates were analyzed to assure that the appropriate amounts of shear wall capacities would be realized.

a. The STARDYNE Analytical Model

The analytical model was based on actual knowledge of the distribution of mass within the Building Complex, and the requirements of FSAR §3.7 with respect to lumping masses were complied with (Licensee Exh. 28, pp. 37, 40; Staff Exh. 13A, p. 12, §3.2.1.2.2). The stiffness of the structural elements in the model was based on material properties of those elements (Licensee Exh. 24, App. B, pp. B-5 to B-5-c).

The analytical model assumes linear elastic behavior and does not directly model potential nonlinear behavior. Nonlinear behavior, in turn, could result in a reduction of stiffness of the structural elements, a change in its natural frequency, and a potential for change in the seismic loads imposed on the structure as a whole (Licensee Exh. 28, p. 22; Licensee Exh. 29A, pp. 13-14). A reduction in stiffness will also result in an increase in displacement. The change in building frequency affects floor response spectra and may therefor affect seismic qualifications of equipment, components and piping (Licensee Exh. 28, pp. 29-30).

The potential nonlinear behavior was evaluated using the STARDYNE analytical model through additional iterative analyses and postprocessing of the results predicted by the linear elastic model (Licensee Exh. 28, p. 39; Tr. 4422-23(Bresler)). Thus, the effects of nonlinearities and stiffness degradation were accounted for with appropriate broadening of the floor response spectra (Licensee Exh. 28, pp. 38-39, 72; Tr. 4385-86 (White)). Included in the analysis were the effects of cyclic loading from earthquakes and resulting cyclic degradation previously verified in the wall test program (Staff Exh. 13A, pp. 15-16, §3.2.1.2.18). The resulting seismic analysis was performed in accordance with the applicable FSAR criteria on seismic system analysis (Staff Exh. 13A, pp. 10-15).

b. Sources of Nonlinearity Accounted For

The sources of nonlinear behavior considered by the Licensee included cracking that develops in the concrete of the wall panels (Licensee Exh. 28, pp. 33-34) and potential lack of connectivity between wall panels which are partially separated by embedded steel columns (Licensee Exh. 28, p. 34).

The nonlinear behavior of the cracking in the concrete wall panel was accounted for through the use of stiffness reduction factors derived from the results of the Licensee's test program (Licensee Exh. 28, pp. 35, 38, 40 and 44; Licensee Exh. 24, App. B, pp. B-5-c, B-5-d; Staff Exh. 13A, p. 62, §5.1). Because the stiffness reduction is a function of shear and normal stresses, iterative STARDYNE analyses were performed to evaluate the appropriate reduced stiffness properties (Staff Exh. 13A, p. 63, §5.1.1; Licensee Exh. 28, pp. 38, 44).

The potential lack of connectivity between wall panels resulted in further investigation of three related variables - the amount of vertical reinforcement from the beam-column connections of the steel framing system used in determining stiffness in the model, the normal stress parameter in determining stiffness, and the overall bending parallel to the component of the earthquake being considered tending to change stiffnesses at each end of the wall.

The Licensee initially used the embedded steel frame as vertical reinforcement in the analytical model (Licensee Exh. 28, pp. 40-41). To remove the concern of the effect of this potential nonlinearity, the Licensee submitted an evaluation indicating the impact of neglecting the contribution of the beam-column connections to stiffness with appropriate consideration for the result (Staff Exh. 13A, pp. 63-64, §5.1.1.1; Licensee Exh. 25U; Licensee Exh. 28, pp. 67-69; Licensee Exh. 33).

The Licensee concluded that the normal stress parameter contributing to wall stiffness consisted of the dead load of the portions of the wall above the elevation under consideration (Licensee Exh. 28, pp. 41-42). The potential effects for reducing this dead load considered were the effects of creep and shrinkage, stiffening of beams due to encasement in concrete and the effect of changes in mean wall temperatures for exterior walls. The potential effect for increasing the dead load considered was the vertical growth in the wall panels in an earthquake due to the development of flexural cracking. The vertical growth was found to more than compensate for the potential reduction factors even when panels were subjected to stress cycles (Licensee Exh. 25Q, Attch. 4; Licensee Exh. 25U; Licensee Exh. 28, pp. 43, 70; Licensee Exh. 32; Licensee Exh. 33).

Seismic loads create a nonlinear "gross bending effect" which tends to increase compressive load on one end of a wall which is parallel to the component of the earthquake and to decrease the available normal stress on the other end of that wall. This, in turn, results in an increase and decrease in wall stiffness in the local wall areas (Licensee Exh. 28, p. 43; Licensee Exh. 29A, pp. 13-15; Staff Exh. 13A, pp. 66, 68, §5.1.1.3). Although the STARDYNE analysis did not account for this gross bending behavior, evaluations by the Licensee assured that overall stiffness would not change substantially (Licensee Exh. 28, p. 43; Licensee Exh. 29A, pp. 13-15; Licensee Exh. 25Q, Attch. 1,2 and 9; Licensee Exh. 32; Staff Exh. 17A, pp. 29-30).

c. Load Determinations

The STARDYNE linear elastic analysis predicted the magnitude of the seismic loads to be resisted by the modified Building Complex and predicted the distribution of such loads among the various structural elements of the modified Building Complex (Licensee Exh. 24, pp. 3-11, §3.3.1). Postprocessing of results, iterative calculational cycles, and supplemental analyses performed, as described above, have accounted for the effects on predicted loads of the influence of stiffness reduction.

The relative load distributions among the major shear walls will not be changed by the stiffness reduction from dead load reduction and neglecting the beam-column connections (Licensee Exh. 28, pp. 31, 45). Reductions in stiffness due to gross bending effect will be offset by an associated change in shear capacity to satisfactorily account for potential shifting of load from panels on the tension side of a wall to panels on the compression side (Licensee Exh. 25Q, Attch. 1; Licensee Exh. 28, p. 70).

An overall reduction in the stiffness of the modified Building Complex due to potential nonlinear behavior would not result in a significant increase in the total inertia forces to be resisted by the structure, since the natural frequency of the modified complex approximates the frequency which corresponds to the peak of the ground response spectra (Licensee Exh. 28, pp. 30, 38-39, 45-46; Tr. 4424-25 (Holley)).

d. Capacities Determination

The composite wall capacities were determined by the Licensee by use of testing as provided in UBC §106 and §107 (Licensee Exh. 28, p. 48; Licensee Exh. 29A, pp. 5-6; Licensee Exh. 30; Staff Exh. 17A, pp. 41, 42; Tr. 4420 (Bresler)). The Licensee derived capacity criteria from the results of a test program using 23 test specimens which simulated the parameters of the existing walls of the Building Complex (Licensee Exh. 24, App. A., pp. A-1 to A-5). The materials of construction, the aspect ratio and the thickness of test specimens were similar to those of the actual walls in the Building Complex (Licensee Exh. 30; Staff Exh. 17A, p. 45).

The test program was adequate to provide valid information on the behavior of composite walls and allow the derivation and verification of capacity criteria (Licensee Exh. 28, pp. 25-26; Tr. 4468 (Laursen); Licensee Exh. 29A, p. 8; Tr. 4431, 4444 (Bresler); Tr. 4431-32 (Holley)).

The behavioral characteristics of the test specimens were used to develop a theoretical double curvature shear capacity of individual wall panels as a function of the percentage of vertical reinforcing steel and the vertical or dead load acting on the wall. Capacities derived by application of this equation ignored the bond between the steel columns and the composite walls (Licensee Exh. 28, p. 49). This reflects at least the same level of conservatism as code Equations (Tr. 4431 (Bresler)).

To arrive at capacity values, the Licensee calculated the double curvature capacities of the individual wall panels for a given wall using the theoretical flexural equation. Each individual wall panel's diagonal tension capacity was also computed based on the lower bound diagonal tension capacities derived from the test results. The lower of the panel's double curvature and diagonal tension capacities multiplied by an appropriate capacity reduction factor, was then considered to be the ultimate seismic capacity of the panel. The ultimate seismic capacity of an entire wall was then obtained by summation of the capacities of individual panels (Licensee Exh. 24, pp. 3-18-b to c, §3.9.2.2, Table 3.5-1 and 2, Figs. 3.5-6 to 11; Oregon Exh. 2, p. 7; Tr. 4445 (Holley), 4445-56 (Bresler), 4468 (Laursen)).

After later evaluations were requested by the Staff, further capacity calculations were made such that the capacity projected for a given wall be selected as the lowest capacity for any of four potential modes including single curvature flexural and sliding failure in addition to the double curvature flexural and diagonal tension failure capacities. Potential dead load reductions were also considered in the determination of the walls sliding and the single and double curvature capacities (Staff Exh. 13A, pp. 71-74, §5.2.2.1). Licensee satisfied the Staff's concerns in these areas (Licensee Exh. 25U, Attch. 1; Licensee Exh. 28, pp. 53, 55, 77, 79; Licensee Exh. 30; Licensee Exh. 32; Licensee Exh. 33; Staff Exh. 17A, p. 31).

In all determinations of capacities, the design strength of the reinforcing steel and the design strength of concrete were used even though tests have shown that actual strengths are larger than the design strengths (Licensee Exh. 24, pp. 3-18-e, 3-23, 3-27, §§3.4.2.2, 3.6.1.2, 3.6.2; Licensee Exh. 28, p. 46).

The transfer of shear forces from existing structural elements to the new ones will utilize a post tensioned bolt system to clamp the new and the old together and roughening of the adjacent surfaces to assure adequate functional resistance. The resulting combination should assure the full capacities of the new walls (Licensee Exh. 28, p. 47; Licensee Exh. 33; Staff Exh. 13A, pp. 69-70, §5.2.1; Tr. 4365 (White), 4519-21 (Broehl)).

e. Comparison of Capacities to Loads

The capacity of the modified Building Complex to resist both the SSE and the OBE must be established. Since the OBE governs the design of the Building Complex and satisfaction of the OBE design criteria would also constitute satisfaction of the SSE design criteria, the controlling load combination and acceptance criterion is that of the OBE (Licensee Exh. 24, pp. 2-1, 3-20, §§2.1, 3.5; Staff Exh. 13A, pp. 17-18, §3.2.2.1.3). This criterion requires that there exist a margin of 40% between the calculated loads and the corresponding ultimate capacities of the modified Building Complex (Licensee Exh. 28, p. 58; Tr. 4423-24 (Holley)).

Capacity to force comparisons show that all but two of the minor shear walls in the modified Building Complex had a margin of at least 40% between ultimate capacity and unfactored OBE loads (Licensee Exh. 24, pp. 3-21). Each of these two minor shear walls contributes a very small percentage of the total shear capacity of the Building Complex. Loads predicted but not carried by these two walls were readily shown to redistribute to the adjacent major shear walls (Licensee Exh. 28, p. 39; Licensee Exh. 30). Moreover, no substantial deterioration of these walls would be expected from an SSE (Oregon Exh. 2, pp. 7-8; Licensee Exh. 28, p. 25; Licensee Exh. 30; Tr. 4362-63 (White)), and no equipment would be impacted by any wall degradation that might potentially take place (Staff Exh. 13A, p. 33, §5.12).

The Staff requested further evaluations of seismic capability assuming further conservati[illegible]ns of wall capability, i.e., single curvature and sliding capacity failures, neglecting contributions of beam-column connections in determination of stiffness, the gross bending effect on stiffness and load distributions, and reduced coefficient of friction for the bolted connections for the R-line and N'-line walls. Since most of these might have their impacts on the seismic capabilities of the added shear walls on N-line, N'-line and R-line, the added conservative analysis does reassure that the intended capability [illegible] exist (Tr. 3532, 4369-70 (Chang-Lo); Licensee Exh. 28, pp. 59-60; Licensee Exh. 25U, Attch. 1, 4; Licensee Exh. 25Q, Attch. 1; Licensee Exh. 32; Licensee Exh. 33; Staff Exh. 17A, pp. 27, 38-40).

The evidence shows that the potential effects of these uncertainties in behavior and in the application of test results to predict behavior and capacities have been properly accounted for by these additional analyses and evaluations performed by the Licensee (Staff Exh. 17A, pp. 35, 39-40). The results show that capacity to force ratios for some individual wall panels for the unfactored OBE may fall below 1.4 for the worst possible combinations of dead load reduction, gross bending and single and double curvature behavior. However, redistribution of forces in the wall will occur so that the capacity to force ratio for the entire wall will not be less than 1.4. Thus the walls will maintain substantial margins in capacity even when uncertainties in structural behavior and application of test results are accounted for by analyzing the worst possible combinations of loading and structural behavior (Staff Exh. 17A, pp. 39-40).

f. Building Displacements

Consideration of building displacements is necessary to verify that (1) adequate clearance exists between adjacent structures so that any displacements induced by an earthquake (interstructure displacements) will not result in contact of, and physical damage to the adjacent structures and (2) neither relative displacements between stories of a building (interstory displacement) nor interstructure displacements will adversely affect equipment that is attached to more than one story or which runs between buildings.

The displacements for the modified Building Complex were determined as part of the output of the STARDYNE analysis used to determine structural adequacy (Licensee Exh. 28, p. 60). The STARDYNE analysis provided elastically calculated displacements which accounted for the nonlinearities due to the material characteristics of the walls. Supplemental calculations were performed to account for the additional nonlinearities considered under structural adequacy evaluations discussed previously. These additional nonlinearities would result in calculated displacements increased by a factor of 2.1 over that calculated initially for the modified Building Complex (Licensee Exh. 28, p. 80; Licensee Exh. 25U; Staff Exh. 17A, p. 32).

The structures adjacent, but not connected to, the Building Complex are the Containment and the Turbine Buildings. The difference between the available clearance and the sum of calculated displacements multiplied by 2.1 for the Building complex-Containment Building interface is quite large and do not present any potential for impacts during an SSE (Licensee Exh. 25H).

The available clearance at the interface between the Control and Turbine Buildings in the modified Building Complex will be reduced at elevations 69 feet and 93 feet by the addition of the steel plate to the west wall of the Control Building (Licensee Exh. 25E). By removal of a part of a concrete floor slab at elevation 69 feet and of part of the flange of a steel girder at elevation 93 feet in the Turbine Building, the resulting clearances between the Buildings at these levels are respectively at least 2.5 inches and 2.0 inches (Staff Exh. 17A, p. 52; Licensee Exh. 28, pp. 61-63). Even after including the added factor of 2.1, there is ample clearance since maximum reduction in gap is 0.29 inches and 1.10 inches, respectively, at the 69 feet and 93 feet levels between the Control and Turbine Buildings (Licensee Exh. 28, pp. 61-63).

g. Influence of the Wall Problem on Structural Integrity

Evidence concerning the wall problem included results of the short term test program. Collar-joint shear stresses for standard weight double-block walls were within the range assumed by Licensee, but for heavyweight block walls they were less than expected though still greater than the postulated allowable value. Licensees' witnesses explained that there are no heavyweight double-block walls in the Control Building that are relied on in the STARDYNE model and that the heavyweight block walls in the Building Complex as a whole contribute less than 2.5% to the total shear resistance of the Building Complex (Tr. 4893-94, 4729). This effect on structural integrity is therefore considered negligible, but there remains the matter of adequately supported safety-related piping, discussed post.

h. Conclusions of Structural Adequacy

The Board concludes that a thorough and extensive analysis has been made of the modified Building Complex and the effects undergone in the event of an SSE or OBE. Specifically, the Board finds:

(1) That an appropriate seismic input criterion is used in the analytical model;

(2) That the STARDYNE analytical model, augmented to include the effects of nonlinearities and repetitive earthquake events was an appropriate and acceptable model;

(3) That appropriate seismic analyses were performed resulting in a conservative assessment of the behavior of the modified complex subjected to OBE and SSE events;

(4) That the seismic loads for the modified Building Complex have been adequately determined taking into consideration the appropriate potential nonlinear behaviors;

(5) That the capacities of the walls of the modified Building Complex were properly determined through appropriately derived characteristics based on test results and through proper consideration of potential behavior unique to the wall construction;

(6) That the assessment of the capacity to force ratios for individual walls and wall panels was appropriate to meet the criteria previously stated (§II-D, supra);

(7) That the relative displacements between the Building Complex and adjacent structures have been properly assessed and that the available clearances are sufficient to preclude building contact in the event of an OBE or SSE; and

(8) That the effect of the "Wall Problem" on structural integrity of the Building Complex is negligible.

3. Seismic Qualifications of Equipment, Components and Piping

To satisfy the criteria for determining the adequacy of the modifications, the safety-related[12/] equipment, components and piping in the modified Building Complex must be seismically qualified to withstand the OBE and SSE and continue to operate satisfactorily. The method of seismic qualification to the original ground level response spectra at elevation 45 feet which was specified in FSAR §§3.7, 3.9 and 3.10 was also used to determine the seismic qualifications of equipment, components and piping for the modified Building Complex (Licensee Exh. 24, App. B, p. B-1, §1.2; Licensee Exh. 28, p. 64).

a. Floor Response Spectra

The SSE floor response spectra for these floors in the as-built Building Complex above ground level were redeveloped during Phase I of these proceedings to account for changes in the Building Complex response due to the design deficiencies. They must again be redeveloped due to the proposed modifications. Although

12/ "Safety-related" refers to equipment, components and piping to be seismically qualified as identified in 10 CFR Part 50, Appendix B and further identified in Regulatory Guide 1.26, Revision 3 and 1.29, Revision 3 (Licensee Exh. 28, p. 64; Licensee Exh. 24, p. B-1).

the OBE response spectra were not addressed in Phase I of these proceedings, they must now be developed to account for changes in Building Complex response due to both the design deficiencies and the proposed modifications.

The new OBE and SSE floor response spectra have been generated using the artificial time history and frequency intervals previously described (§II-D-1-b, supra) and the STARDYNE model (Licensee Exh. 24, App. B., pp. B-2, B-3, §§2.2.1.1, 2.2.1.2). The resulting response spectra curves were then broadened to account for variations in mass and for variations in stiffness due to variations in the modulus of elasticity and in the stiffness reduction factors due to dead load, shear stress and experimental uncertainties. The response spectra curves were also broadened on the low frequency side of the response spectra to account for potential reduction in stiffness due to the postulated occurrence of multiple earthquakes, the potential dead load reductions, exclusions of the beam-column connections from vertical reinforcement ratios, the potential influence of gross bending and potential vertical slip along the embedded columns (Licensee Exh. 24, App. B, pp. B-5-e, B-5-f, §2.2.1.4; Staff Exh. 17A, p. 34). These effects accumulatively result in a total broadening of 41% on the low side and 10% on the high side of the peaks of the response spectra associated with the structural frequencies (Licensee Exh. 25U; Licensee Exh. 28, p. 81).

b. Qualifications of Safety-Related Equipment, Components and Piping

Licensee has made a commitment to evaluate the seismic qualification of all safety-related equipment, components and piping in the Building Complex using the revised response spectra developed above. Modifications will be implemented to assure qualifications based on these evaluations (Licensee Exh. 24, pp. 4-4, 4-8, 5-1, §§4.2.1, 4.2.5, 5.2; Licensee Exh. 24, App. B, §§1, 3-6; Licensee Exh. 25G; Licensee Exh. 27, p. 13; Licensee Exh. 28, pp. 64-65a).

c. Influence of the Wall Problem on Equipment Qualification

Much of the safety-related equipment that had been supported by double-block walls, generally piping required for shutdown in the event of an earthquake, has either been through-bolted or anchored elsewhere (Tr. 4698). But the disputed value of acceptable collar-joint shear strength of the heavyweight block walls casts uncertainty on seismic qualification of equipment that is still supported there. Consequently, Licensee agreed to resolve remaining misgivings of the Staff before operation is resumed after the current shutdown for refueling, and proposed modifications to accomplish this (Tr. 4695-97, 4699, 4742-44). Staff's witnesses testified that the parties were converging on an acceptable analytic procedure, that the Licensee's proposed method of strengthening double-block walls seemed appropriate, and that long term tests related to collar-joint shear stress may be unnecessary (Tr. 4546-47, 4792-98). Licensee has agreed to confirmatory testing of support anchors in double-block walls, although loads have been reduced (Tr. 4701-02, 4743-45).

In view of the Licensee's agreement to resolve remaining double-block wall issues before resuming operation, and the negligible influence of these walls on structural adequacy, the Board is persuaded that the wall problem has been explored adequately.

d. Conclusions on Seismic Qualifications of Safety-Related Equipment

The Board finds that the implementation of modifications determined by application of the revised response spectra to all safety-related equipment, components and piping in the Building Complex will bring compliance with FSAR requirements and Technical Specifications 5.7.1.

4. Conclusions on Meeting the Criteria for Structural Adequacy of the Modified Building Complex

The evidence shows that the evaluations of the proposed modifications of the Building Complex and the safety-related equipment contained therein have been made appropriately to assure, upon completion of implementation of the resulting modification, that the criteria established previously (§II-D-1, supra) will be satisfied.

This conclusion was supported by three technical experts testifying at the hearing who did not participate in the detailed design of the proposed modifications. Professors Myle J. Holley and Boris Bresler found the analysis and criteria for the structural design and evaluation to be both reasonable and appropriate, and that the criteria had been applied properly to the walls of the Building Complex. They concluded that the modification design, in their judgment, would bring the Control Building into substantial compliance with the originally intended design (Licensee Exh. 29A, p. 17; Tr. 4422-23, 4445-46 (Bresler and Holley)). Professor Harold Laursen concluded that the proposed modifications would restore the major shear walls to necessary margins of capacity (Oregon Exh. 2, pp. 7-9; Tr. 4469-70 (Laursen)).

In addition, the Staff testified that the Licensee has properly accounted for the limitations in STARDYNE and for uncertainties in structural behavior and in applying the test program results with the results that the proposed modifications will substantially restore the seismic margins and bring the Control Building into substantial compliance with the requirements of the Trojan License (Staff Exh. 17A, pp. 39, 54-55).

Based on the uncontroverted evidence in this hearing, the Board finds that the proposed modifications satisfy the required criteria stated earlier and that they are adequate from a safety standpoint. Upon satisfying that implementation of the modifications can be accomplished in a safe manner, the proposed modifications to the Control Building should be implemented.

E. MODIFICATION WORK AND EFFECTS ON SAFETY OF PLANT OPERATION

With the exception of installation of massive plate 8, the plant is expected to be in operation during the Control Building modification work. The possible influence on safe operation was examined in detail and protective measures were devised where appropriate. Objectives were to protect safety-related equipment from mechanical damage and deleterious effects of dust and vibration, to prevent interference with operation by noise or Control Room traffic, and to maintain seismic qualification of equipment and effective emergency procedures including access for fire protection and for safe shutdown in the event of an earthquake.

Major activities, placement of new concrete walls, installation of steel plates on the west wall of the Control Building, and exposure and joining of steel columns and beams, are described below and protective measures are specified.

1. Placement of Concrete Walls

The concrete walls to close the former railroad bay of the Control Building and to provide internal structure are poured as an early stage of modification. Footings for these walls must be placed around piping and a cable duct bank that are below grade. For protection, the duct will be covered with compressible backfill and the pipe will be enclosed in sleeves (Licensee Exh. 27, pp. 18-19; Tr. 3772-76). Forms for the concrete imply the temporary presence of combustible material that will be taken into consideration for fire protection. The forms for the east wall will frame battery room ducts such that ventilation will be maintained (Licensee Exh. 27, p. 40). Otherwise, no safety-related equipment will be disturbed.

Steel plates 1 to 3, positioned as discussed below, will constitute part of the form for the west wall (Licensee Exh. 27, pp. 47-48). The new walls will be joined to the existing structure by means of bolts and grouted rebar (Licensee Exh. 27, pp. 8-13).

2. Installation of Steel Plates

Preliminaries to plate installation include the following: Concrete floor slabs and steel girder flanges of the Turbine Building will be trimmed to provide space for the plates and to maintain clearance to the Control Building with the plates in place (Tr. 3758, 4606-07). Holes for bolts to secure the plates, drilled through the west wall of the Control Building, will be positioned to avoid reinforcing steel. Finally, the hole pattern will be transferred to the plates and matching bolt holes drilled in the shop.

Eight three-inch thick steel plates are sequentially brought into place through the Turbine Building, raised to the turbine floor (El. 94 feet), jockeyed into position, and lowered into place against the west wall of the Control Building. They are secured by bolts through the wall (into the wall for plate 7) and joined by welding to form a single reinforcing plate (Licensee

Exh. 27; Tr. 3962-68). Equipment to be protected during this process consists of four groups of cable trays that pass underneath from the Control Building to the Turbine Building, and the duct bank and piping below ground level. For the first seven plates, ranging in weight from 2,700 to 24,000 pounds, margins of safety on handling equipment will be at least a factor of five, and the effect of accidental dropping along the west wall will be limited by energy-absorbing material. With an additional license requirement for installation of plate 7 (Staff Exh. 13A, p. 90), the Staff agrees that these plates may be installed while the plant is operating (Tr. 4666-67).

Seismic effects added to a drop of plate 8, however, introduce uncertainty in safe plant shutdown if required during handling of that 47,000-pound plate. For this reason, the plant will be shut down while plate 8 is being moved into position and secured to the west wall (Staff Exh. 15A, pp. 19-24). Special protection includes an A-frame support to prevent the plate from falling if the crane support should fail while the plate is being moved into position (Tr. 3976), cribbing on the floor, cribbing to prevent an accidental drop of more than two inches while the plate is lowered into position, and energy-absorbing material to mitigate the effect of a two-inch drop (Licensee Exh. 27, p. 54, Tr. 3922-23).

3. Welding Beam-Column Connections and Rebar

The six "structural improvements", welding beam-column connections in two locations and Cadwelding rebar in four locations, require exposure of the steel by removal of concrete and block. To the extent practicable, this will be done outside the Control Building or in the former railroad bay. Nevertheless, there are locations where cables in trays may be subject to damage from dislodged fragments or dropped tools unless protected (Licensee Exh. 27, pp. 24-27).

Because simultaneous exposure in all six locations could reduce seismic resistance unacceptably, the Licensee proposes two alternative work sequences in which structural capacity is restored in each of five phases before proceeding to the next phase (Tr. 3708-12). Evidence demonstrates that either sequence will maintain adequate resistance to the 0.25g SSE (Tr. 3906, 4463-65, 4620, 4658).

4. Protection of Equipment During Modification

Safety-related equipment within modification work areas consists primarily of cables in trays. During trimming of Turbine Building floors and steel flanges, drilling holes for bolts that support steel plates, installation of bolts and washers, and exposing steel for welding, nearby cables will be protected from dropped fragments, components or tools. This will be accomplished by steel covers for cable trays and by scaffolds under massive pieces such as steel washers while being positioned (Licensee Exh. 27, pp. 24-30). Temporary openings through which tornado-driven missiles might enter will be closed by shields satisfying FSAR criteria (Licensee Exh. 27, pp. 27-28; Staff Exh. 15A, pp. 31-32).

Equipment to be protected from dust generation during the above operations extends to electrical relays in the Control Room and equipment in the Switchgear Room. Methods of protection will include water sprays on drills and collectors, temporary enclosures about work areas, and, if necessary, fans and ducts (Licensee Exh. 27, pp. 31 and 38; Tr. 3786-88).

Because of seismic qualification, vibration is not expected to influence safety-related equipment.

5. Maintenance of Fire Protection During Modification

The modification work can complicate fire protection in the following ways: There will be additional combustible material such as forms for new concrete walls, temporary enclosures for dust control, and scaffolds and wooden cribbing to limit accidental dropping of steel plates and washers. Splatter from welding or slag from flame cutting could ignite combustibles. Some fire barriers will be penetrated by bolt holes or openings to expose steel. Finally, access paths for fire-fighting could be blocked by the extra workers and equipment that will be required.

Whenever wood is in the neighborhood of safety-related equipment, fire extinguishers will be nearby and the area will be inspected at least hourly by a fire patrol (Licensee Exh. 27, pp. 35-36; Staff Exh. 13A, pp. 26-27; Staff Exh. 14, pp. 22-23). Where possible, wood will be removed beforehand from any area where there is to be welding or cutting (Tr. 3932).

A special permit is required for welding or flame cutting. This permit provides for a fire watch near the work that must remain at least 30 minutes after completion. It also requires protection of equipment and cables, which will be accomplished by either fireproof blankets or protective barriers between the work and equipment (Licensee Exh. 27, pp. 31-32; Tr. 3753, 3783-84 and 3889-90; Staff Exh. 13A, pp. 24-25; Staff Exh. 14, pp. 18-21).

Where fire barriers are breached by bolt holes, as in east and west walls of the Control Building, the holes will be plugged temporarily until bolts are installed. (This will also maintain Control Room ventilation.) Where there are larger openings, as for exposure of columns for welding, there will be either a continuous fire watch, or a temporary fire barrier, fire detector, and a fire watch patrol (Licensee Exh. 27, pp. 32-33; Staff Exh. 13A, pp. 59-60).

There will not be a large number of workers who might interfere with access for fire or other emergency, sixteen for installation of plate 8 and no more than eight for other tasks (Licensee Exh. 27, p. 78). Training of workers and supervisors will provide for evacuation to the Visitors Information Center in the event of an emergency (Licensee Exh. 27, pp. 76-77). Two access routes are available to any area with equipment for emergency operation and one always will be unobstructed by modification work (Licensee Exh. 27, p. 75; Staff Exh. 13A, pp. 28-29; Staff Exh. 14, pp. 23-7).

The Staff has determined, and the Board agrees, that Licensee has appropriate administrative means to satisfy Technical Specifications, primarily fire protection and Control Room ventilation requirements, during modification (Staff Exh. 13A, p. 60).

6. Prevention of Interference With Operator Actions By Modification Work

In addition to potential interference with emergency action, as discussed above, operators could be disturbed by workers in the Control Room, or noise or dust from modification work.

There will be some drilling and bolting through Control Room walls, but at a distance from controls and instrumentation. Although drilling will be from outside the walls, workers who will collect water for dust control and debris will be on the inside (Licensee Exh. 27, pp. 31 and 38). The shift supervisor will prevent interference with operation by workers or excessive noise, and the NRC's Resident Inspector also may halt work, if necessary, until tools or methods are changed to reduce noise (Licensee Exh. 27, p. 81; Staff Exh. 13A, pp. 49-50; Staff Exh. 14, pp. 36-38).

7. Seismic Qualification During Modification

The only modification work (including bolt hole effect) that could reduce seismic resistance of the Building Complex significantly would be the removal of concrete for exposing steel to be welded (Licensee Exh. 27, pp. 60-72). With the exception of a column at the new interior wall, these modifications will be performed after the Control Building is strengthened by new walls and steel plate (Licensee Exh. 24, p. 4-6-a). Either alternative sequence proposed by the Licensee for steel exposure and replacement of concrete will maintain seismic capability of the Building Complex (Licensee Exh. 27, pp. 69-71; Staff Exh. 15A, pp. 27-29; Oregon Exh. 2, pp. 9-10; Oregon Exh. 2A; Tr. 3708-10, 3903-06, 4341, 4461-66, 4619-21).

Temporary effects of modification work on the seismic qualification of equipment are forestalled by the described measures to protect equipment and by plant shutdown during installation of plate 8 because of uncertain seismic effects (Staff Exh. 15A, pp. 19-24; Tr. 4019, 4113). At Intervenors' suggestion, both trains of equipment for maintaining cold shutdown will be operable during installation of plate 8 (Tr. 4102, 4305-07).

F. ADDITIONAL CHANGES RESULTING FROM THE MODIFICATIONS

In addition to the modifications discussed above, there will be other changes in existing features of the Building Complex: the changes brought about by closing off the railroad track through the Control Building and the reduction in size of the equipment hatch into the Electrical Auxiliaries Room of the Control Building at elevation 65 feet.

1. Relocation of Railroad Track From Control Building

Currently, the air intake path to the Emergency Diesel Generators relies on an opening to the outside through the railroad bay in the Control Building. Before the Control Building railroad bay is sealed off at column line R, an alternate air intake system will be provided in the north wall of the Turbine Building railroad bay. The design of the alternate air intake was found to be adequate (Staff Exh. 13A, pp. 40-41; Staff Exh. 14, p. 58, Licensee Exh. 24, p. 5-5; Licensee Exh. 25I, Fig. 15-1).

A new railroad spur to the Fuel Building is required as an alternate to the path being closed through the Control Building. The railroad spur was initially designed through the Control Building as a matter of convenience and efficiency to serve both the Turbine Building and the Fuel Building (Staff Exh. 16, p. 5) Since there is no need for loading or unloading railroad cars in the Control Building bay, there is no safety-related impact of removing it and providing a spur to the Fuel Building (Staff Exh. 16, p. 5).

Since the railroad track in the Turbine Building will be terminated at the face of the new shear wall at the west face of the Control Building, a bumping post will be installed that is only designed to prevent a typical train loading from impacting the west wall when the train is traveling at very low speeds (Staff Exh. 16, p. 6; Staff Exh. 13A, pp. 77-78; Staff Exh. 17A, p. 50). However, the Licensee has in place administrative procedures to control the movement of trains on site (Staff Exh. 16, p. 6). Also, the accidental approach of a train to the railroad bay from the main track is prevented by two derailers located both outside and inside the security fence and an uphill grade of the track outside the security fence (Staff Exh. 16, pp. 6-7).

The Board finds that the proposed modifications to the railroad spur and the proposed administrative controls on operation of trains by Licensee personnel when inside the security area are acceptable.

2. Reduction in Size of Existing Equipment Hatch

The existing equipment hatch into the Electrical Auxiliaries Room of the Control Building at elevation 65 feet on the east wall approximately midway between column lines 41 and 46 will be reduced in size from 8 feet high by 7 feet wide to 4 feet high by 4 feet wide. The large hatch currently allows larger equipment to be brought into and removed from this elevation without need for disassembly. After the reduction in size, disassembly of some equipment will be required in order to fit the smaller equipment hatch, or use of an alternative path such as the Control Building elevator or Auxiliary Building access ways (Staff Exh. 16, pp. 2-3). No safety significance for this additional disassembly has been identified.

The Board finds that neither the performance of the modification work on the equipment hatch nor the reduction in size of the hatch has safety significance and this modification is acceptable.

G. RESOLUTION OF INTERVENORS' CONTENTIONS

The Contentions in issue in this proceeding are CFSP Contentions 12, 13, 15, 16, 17, 20 and 22.[13] Our findings of fact

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[13] See §I-B, supra.

above have encompassed all substantive matters raised by these contentions and, based on our review of the entire record, we find that the original concerns of the Intervenors that brought the contentions into issue have now been addressed in a satisfactory manner, leaving all of the contentions upon completion of the evidentiary hearing without merit. All of the contentions are covered in our findings under §II-E, supra, entitled Modification Work and Effects on Safety of Plant Operation.

H. LENGTH OF INTERIM OPERATION AND TIME FOR COMPLETION OF MODIFICATION

Based on the evidentiary record in the Phase I hearings on interim operation, the Board found that the existing Building Complex had adequate seismic capacity to safely withstand a 0.25g SSE (8 NRC 735). In the event of one or more seismic events of 0.08g or larger, the Trojan Nuclear Plant must be brought to a cold shutdown condition and be inspected to determine the effects, if any, of the earthquake. Operation cannot resume under these circumstances without prior NRC approval (8 NRC 748). Nevertheless, since there may be some effect in the event of seismic events above 0.08g, because there may be some time dependence of the seismic capability, and since the May 26, 1978 Order instructed an expeditious implementation of modifications, it seems appropriate to impose a time restriction on completion (Staff Exh. 17A, pp. 9-11).

The evidence shows that it will take approximately 10 months to complete the modifications as currently proposed. The Staff has reviewed the modification work schedule, has concluded that it is reasonable, and has recommended that a license condition be imposed requiring completion of the proposed modification work within a period of 12 months from the date of authorization (subject to extension for circumstances beyond Licensee's control) (Licensee Exh. 27, pp. 86-87; Staff Exh. 13A, p. 88; Tr. 4018-19 (Trammell)). The Board finds that such a condition provides appropriate assurance that the modification program will be completed expeditiously (Licensee Exh. 24, Fig. 4-1; Staff Exh. 13A, p. 88) and that the design intended margins will be restored in a timely fashion.

I. ENVIRONMENTAL CONSIDERATIONS

While no issue was raised in this proceeding as to the environmental impacts of the proposed modifications and the attendant licensing action authorizing them, an environmental analysis was performed by the Staff. That analysis demonstrates that the proposed modifications will not result in significant environmental impacts and that the impacts, if any, will be negligible (Staff Exh. 13A, pp. 92-94, §8.0). Based on the analysis, the Staff concluded that the proposed modifications do not require the preparation of an Environmental Impact Statement or Environmental Impact Appraisal and Negative Declaration pursuant to 10 CFR Part 51.

The evidence presented in this regard was uncontroverted. We find that the Staff's conclusions as to the environmental impacts of the proposed modifications are adequately supported by the environmental analysis presented, and that those conclusions are justified.

J. POSTHEARING AFFIDAVITS

1. An Additional As-Built Wall Discrepancy

On May 19, 1980, after the record was closed in this Hearing, the Licensee informed Mr. R. H. Engelken, Director, U. S. Nuclear Regulatory Commission, Region V, about conditions found in the south wall of the Auxiliary Building adjacent to column line 55 between column lines F and N from Elevation 61 feet to Elevation 93 feet which was not connected to the floor slab at Elevation 93 feet as assumed. The wall was assumed to be connected and participate as a minor structural shear-resisting element in the STARDYNE finite element analyses of the Building Complex. The wall also provides partial lateral restraint for cable trays vertically supported from structural steel beneath the Elevation 93 feet floor slab.

The discovery of this condition was reported in greater detail in a "Reportable Occurrence" in Licensee Event Report 80-07 in a letter to Mr. Engelken from Donald J. Broehl of Portland General Electric dated May 30, 1980. Also, in a letter from Licensee to Mr. Robert A. Clark, Chief, Operating Reactors Branch No. 3, Division of Licensing, dated June 4, 1980, justifying change of Trojan Nuclear Plant operation from modes 6 to 5 in preparation for a return to power after refueling, further inspection had identified no additional walls that were not connected at the top, although 11 other walls were identified as not yet meeting the criteria documented in Supplement 3 to LER-79-15.

The Board was concerned about some of the implications of these reports and the conditions described therein, particularly regarding the Auxiliary Building wall which is not adequately connected at its top to interfacing structural elements. In the study of the structural adequacy of the Building Complex and in the modifications proposed to correct these conditions, the Board relied on the analyses using the STARDYNE computer program. In the model, all walls were assumed to be in a state of construction which we now find for this wall did not exist. This concern was reflected in an "Order Requesting Licensee to Supply Information by Affidavit" issued by the Board on June 2, 1980, in which the Board requested the Licensee to supply the following information:

(a) The cause of the occurrence,

(b) When all other walls with similar potential defects will have been examined to determine if there are other such problems,

(c) Report of method and timeliness of corrections to the current identified defects and any others discovered, and

(d) Contribution to structural adequacy of the Building Complex for any other walls found with this deficiency.

The Licensee responded to the order in a letter transmitted to the Board dated June 16, 1980, with affidavits containing the requested information.

In addition to the original discrepancy described above, the field examinations by Licensee identified five walls having nonconformances of potential safety significance, three in the Fuel Building and two in the Auxiliary Building. Three of the five nonconformances related to incomplete construction, two involving incomplete grouting from the top of the masonry unit to the floor slab and the third an approved Field Change Request that was not implemented. A fourth nonconformance related to an interference between reinforcing dowels from the slab above and a steel beam supporting the floor. The fifth nonconformance was at a nontypical interface on a minor shear wall where the assumed design interface conditions were not implemented.

The Licensee stated that all of the above-described corrective actions (the fifth nonconformance was determined not necessary to be corrected) were to be completed by June 18, 1980, and in any event prior to the resumption of power operations at Trojan Nuclear Plant. Following completion of corrective actions, the only reduction in capacity is claimed to be 1.1% in the North-South direction.

The Board finds this an acceptable resolution of the nonconformances discovered in connection with LER-80-07.

2. Anchorage and Support of Electrical Equipment

In another communication dated June 12, 1980, and subsequent to the closing of the evidentiary record in this proceeding, the Staff brought to the Board's attention IE Information Notice 80-21 concerning potential deficiencies in anchorage and support of safety-related electrical equipment at some older plants. Although the Staff indicated that problems addressed by this Information Notice were not directly related to the Control Building design deficiencies or proposed structural modifications, it requested that Licensee provide a written response to the Notice.

The response by the Licensee, in the form of a letter and affidavit dated June 27, 1980, described inspections showing that no significant deficiencies brought out by the Notice exist at the Trojan Plant. Nevertheless, the affidavit promised a further inspection program to confirm the conclusion that all safety-related electrical equipment is properly supported and anchored, and made a commitment to satisfy the Staff in this regard.

The Board concludes that IE Information Notice 80-21 and Licensee's response introduce no new safety consideration appropriate to this proceeding, and that the Staff and the Licensee have concluded arrangements adequate to handle such matters administratively.

III. CONCLUSIONS OF LAW

This proceeding concerns the issue of whether the scope and timeliness of proposed modifications, required to bring the plant into substantial compliance with Operation License No. NPF-1, are adequate from a safety standpoint. We have reviewed all of the evidence submitted by the parties relating to this issue. We have also considered all of the proposed findings of fact and conclusions of law submitted by the parties. Those proposed findings not adopted in this Initial Decision are hereby rejected.

Based upon our consideration and evaluation of the entire record, we conclude that:

1. The proposed modifications of the Building Complex should be permitted in accordance with the amendments to the Operating License set forth in the Order below and subject to the terms and conditions therein;

2. There is [illegible]asonable assurance that operation of the plant, including the activities authorized by the operating license, as thus amended, and including the terms and conditions set forth in the Order below, can be conducted without endangering the health and safety of the public;

3. There is reasonable assurance that operation of the plant, including the activities authorized by the operating license, as thus amended, and including

the terms and conditions set forth in the Order below, will be conducted in compliance with the Commission's regulations;

4. The issuance of this operating license amendment as set forth in the Order below will not be inimical to the common defense and security or to the health and safety of the public;

5. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied; and

6. The proposed modifications will satisfy the Order of May 26, 1978 by bringing the Control Building into substantial compliance with Technical Specification 5.7.1 of the operating license, and restoring the intended design margins of Technical Specification 5.7.1 such that (a) the Control Building has a capacity to withstand a 0.15g OBE using 2% damping as required by FSAR Table 3.7.1; (b) the Control Building OBE capability of 0.15g and SSE capability of 0.25g are met using a yield strength for reinforcing steel of 40,000 psi; and (c) the masonry portions of the Control Building walls comply with the UBC requirements for reinforced grouted masonry for inplane loading.

IV. ORDER

Wherefore, it is ORDERED, in accordance with the Atomic Energy Act of 1954, as amended, and the regulations of the Nuclear Regulatory Commission, and based on the findings and conclusions set forth above that the Director of Nuclear Reactor Regulation is authorized to make appropriate findings consistent with this Initial Decision in accordance with the Commission's regulations, and to issue the appropriate license amendment to Facility Operating License No. NPF-1 authorizing implementation of modifications to the Control Building of the Trojan Nuclear Plant. This license amendment shall contain the following provisions and conditions:

A. Upon the effective date of this Amendment to Facility Operating License No. NPF-1, said License is modified as follows:

1. The following provision shall be added to Facility Operating License NPF-1: 2.C.11 Control Building Modifications. The Licensee is authorized to and shall proceed with modifications to the Control Building in order to restore substantially the originally intended design margins. The modification program shall be accomplished in accordance with PGE-1020, "Report on Design Modifications for the Trojan Control Building", as revised through Revision No. 4, and as supplemented by PGE Exh. 27 (Licensee's Testimony ("Broehl, et al.")

on Matters Other Than Structural Adequacy of the Modified Complex, March 17, 1980). Any deviations or changes from the foregoing documents shall be accomplished in accordance with the provisions of 10 CFR part 50.59. The Control Building modification program shall further be subject to the following:

(a) The modification program shall be completed not later than 12 months from the date of this amendment, provided however that such completion date may be extended by the Director of Nuclear Reactor Regulation upon a showing that the completion of the modification program is necessarily delayed by circumstances wholly beyond the control of Licensee. When all modifications have been completed, license condition 2.C.(10), relating to interim operation pending completion of modifications, is cancelled.

(b) For the installation of steel plate No. 8, the plant shall be in the cold shutdown condition (Modes 5 or 6) from the time that the plate is lifted from the transporter at Elevation 45 feet until the plate has been secured with 48 inches of weld to the previously installed plates and attached to the wall with five bolts made snug. During the installation of plate No. 8, both trains of safety-related equipment necessary for maintenance of a cold shutdown condition shall be operable. Prior to the installation, Diesel Generator A shall be started and proper operability verified.

(c) Solid steel cable tray covers shall be installed over cable trays in work areas where cable damage is possible from accidental dropping of steel plate washers during their installation.

(d) A fire watch patrol shall be established whose sole responsibility shall be to watch for fires at the plant and which shall make at least hourly inspections at all safety-related areas where combustible materials (e.g., wood framing, planking, plastic, etc.) related to the modification work must remain in the work area (not required for areas in which a continuous fire watch is present). Such hourly inspections shall include direct visual observations of all combustible materials added to such safety-related areas.

(e) Scaffolding and timber planking shall be installed against the R line wall in the Cable Spreading Room during the installation of the steel plate washers at each locati n where a potential plate washer drop onto a cable tray could exceed three feet. The planking shall be placed and constructed to limit the maximum height of a dropped washer to three feet or less.

(f) Any construction work in the diesel generator combustion/ventilation air pathway which could potentially generate dust, dirt or debris shall be temporarily halted when any diesel generator is in operation.

(g) In the event that either the Shift Supervisor or NRC Resident Inspector determines that construction noise is resulting in noise levels in the Control Room of such magnitude as to interfere with normal communications, the construction activity shall be halted until alternate means are devised (e.g., lighter weight tools, other means of concrete/block removal, etc.) to proceed with the work with acceptably reduced Control Room noise level.

(h) In the event that the NRC Resident Inspector determines that the construction activity in the Electrical Auxiliaries Room or Control Room is generating excessive dust, dirt or debris or the use of water is being improperly controlled, construction work shall be halted until appropriate corrective measures have been taken.

(i) During periods when safety-related equipment is vulnerable to either external missiles or missiles from construction work (e.g., jackhammers), Licensee shall provide suitable barriers to protect against such exposure or place the plant in cold shutdown during such work.

(j) During hole drilling in the east and west walls of the Control Building, personnel shall be stationed on the opposite side of the wall from the driller to monitor the drill penetration. Continuous voice communications shall be maintained between the drill operator and the monitor.

(k) Fire blankets (Claremont Weld Shield 800-24 or FabriCote 1584-white) shall be used over all cables in areas where Cadwelding, welding or cutting will be performed.

(l) The Battery Room exhaust duct shall not be disabled unless an alternate, equivalent means of Battery Room ventilation is first provided.

(m) Prior to the installation of plates 1 through 6, a temporary energy absorber shall be installed to preclude exceeding the allowable compressive strength of the underlying concrete in the event of an accidental plate drop.

(n) An energy absorber shall be placed on plate 4 prior to the installation of plate 7.

(o) A one-inch-thick, precrushed, stabilized Hexcel pad and timber cribbing shall be used on top of the previously installed plates for energy absorption during the installation of plate 8.

(p) The work area at 41 R (Elevation 55 feet) shall be protected by a dust-tight flame-retardant enclosure. Similar protective measures shall be applied at any other locations in the Electrical Auxiliaries Room or Control Room where wall removal is necessary.

(q) Piping systems, equipment and components within the Control/Auxiliary/Fuel Building Complex required for safe shutdown or to maintain off-site doses from accidents to within 10 CFR Part 100 guideline values shall remain seismically qualified for earthquakes up to and including the SSE throughout all structural modification work. Any changes to piping systems, equipment and components necessary to ensure that this condition is met shall be performed before the structural modifications are made.

(r) The Licensee shall perform three grout tests for each size and orientation of reinforcing steel (rebar) to be grouted into the existing walls and hole size (considering both depth and radius) in which they are to be grouted prior to proceeding with construction (grouting of rebar), or the Licensee shall perform three grout tests using the maximum bar size in the minimum diameter hole size and embedment length for each orientation (i.e., horizontal, vertically up and down). These tests shall be designed to demonstrate that the yield strength of the rebar can be developed by the grout. If any test result is unsuccessful, the NRC shall be notified.

(s) Should a drop of plates 7 or 8 occur onto the plates below, the Licensee shall report the circumstances to NRC immediately. Plates 1 through 6 shall be removed and damage inspection made unless it can be substantiated to the satisfaction of the NRC Staff that plate removal is unnecessary.

(t) Exposure of embedded steel columns in the Control Building walls during the modification work shall be subject to the following restrictions:

(1) Between Elevation 45 feet and Elevation 65 feet, column 41 Q may not be exposed unless columns 41 R and 41 N are embedded in the original wall or encased in concrete that has attained a compressive strength of 2,000 psi; likewise columns 41 R and 41 N may

not be exposed unless column 41 Q is embedded or encased by 2,000 psi concrete.

(2) Columns 55 N' and 55 Q may not be exposed concurrently, and the second of these may not be exposed before the concrete encasing the first has attained a compressive strength of 2,000 psi.

(3) No columns may be exposed above Elevation 65 feet before concrete in the new N' wall has attained a compressive strength of 3,500 psi and the new concrete in the N and R walls below Elevation 65 feet has attained a compressive strength of 2,000 psi.

(4) Between Elevation 65 feet and Elevation 77 feet, columns 41 N and 46 N may not be exposed unless columns 41 R and 46 R are embedded in the original wall or encased in concrete that has attained a compressive strength of 2,000 psi; likewise columns 41 R and 46 R may not be exposed unless columns

41 N and 46 N are embedded in the original wall or encased in 2,000 psi concrete.

(5) Above Elevation 77 feet, column 41 R may not be exposed unless the new concrete in R line wall below that elevation has attained 2,000 psi compressive strength, and columns 41 N and 46 N are embedded in the original wall and/or encased in 2,000 psi concrete.

(u) Prior to the installation of plate 7, the concrete behind plates 1-4 shall have attained a compressive strength of 3,500 psi. Prior to the installation of plate 8, the concrete behind plates 1-7 shall have attained a compressive strength of 3,500 psi.

(v) In any plane of a wall at any given floor elevation, the wall area removed from drilling pursuant to the proposed modifications, including holes abandoned because rebar was encountered and not filled with grout that has reached design strength, shall be limited to 6%.

2. The following amendments shall be made to the Technical Specifications in Appendix A to Facility Operating License NPF-1:

   (a) Section 5.7 of Appendix A shall be amended in accordance with Attachment 21-1 of Licensee Exh. 33.

   (b) A Technical Specification and Bases for the Control Building modification connection bolts shall be added conforming to Attachment 6-1 of Licensee Exh. 33.

It is further ORDERED, in accordance with 10 CFR §§2.760, 2.762, 2.764, 2.785 and 2.786, that this Initial Decision shall be effective immediately[14] and shall constitute the final action of the Commission forty-five (45) days after the issuance thereof, subject to any review pursuant to the above-cited Rules of Practice. Exceptions to this Initial Decision may be filed within ten (10) days after service of this Initial Decision. A brief in support of the exceptions shall be filed within thirty (30) days thereafter (forty (40) days in the case of the NRC Staff).

Within thirty (30) days of the filing and service of the brief and service of the brief of the Appellant (forty (40) days in the

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[14] This proceeding is not covered by the Commission's recent suspension of the immediate effectiveness rule (10 CFR §2.764) for certain purposes. 44 Fed. Reg. 65049 (November 9, 1979).

case of the NRC Staff), any other party may file a brief in support of, or in opposition to, the exceptions.

It is so ORDERED.

THE ATOMIC SAFETY AND
LICENSING BOARD

Kenneth A. McCollom

Dr. Kenneth A. McCollom, Member

Hugh C. Paxton

Dr. Hugh C. Paxton, Member

Marshall E. Miller

Marshall E. Miller, Chairman

Dated at Bethesda, Maryland
this 11th day of July 1980.

APPENDIX

List of Exhibits Admitted in Evidence

No.	Licensee Exhibits	Identified	Admitted Into Evidence
24	"Report on Design Modifications for the Trojan Control Building" (PGE-1020), as revised through Revision 4.	3668	3676
25A	Licensee's Letter to the NRC enclosing additional information provided by Bechtel relating to the proposed modifications of the Trojan Control Building (shear wall specimen testing program and lateral stiffness and response spectra determination) (February 28, 1979).	3668	3676
25B	Licensee's letter to the NRC providing clarification to letter of February 28, 1979 (March 2, 1979).	3668	3676
25C	Licensee's letter to the NRC with responses prepared by Bechtel to the NRC Staff technical questions of March 8, 1979 (March 28, 1979).	3668	3676
25D	Licensee's letter to the NRC with responses prepared by Bechtel to 20 of the 50 questions of May 18, 1979 (June 22, 1979).	3668	3676
25E	Licensee's letter to the NRC with responses prepared by Bechtel to 14 of the 50 questions of May 18, 1979 (June 29, 1979).	3668	3676
25F	Licensee's letter to the NRC with responses prepared by Bechtel to NRC questions raised during the June 13-14, 1979 visit to the Trojan Nuclear Plant (July 5, 1979).	3668	3676
25G	Licensee's letter to the NRC with responses prepared by Bechtel concerning most of the outstanding questions of May 18, 1979 (July 6, 1979).	3668	3676

No.	Licensee Exhibits	Identified	Admitted Into Evidence
25H	Licensee's letter to the NRC with responses prepared by Bechtel concerning most of the outstanding questions of May 18, 1979 (July 6, 1979).	3668	3676
25I	Licensee's letter to the NRC with responses prepared by Bechtel to NRC questions of July 20, 1979 (August 13, 1979).	3668	3676
25J	Licensee's letter to the NRC with responses prepared by Bechtel to NRC questions of August 17, 1979 (September 5, 1979).	3668	3676
25K	Licensee's letter to the NRC confirming discussions concerning timing and content of PGE-1020 revisions (September 26, 1979).	3668	3676
25L	Licensee's letter to the NRC with responses prepared by Bechtel to several of the NRC Staff questions September 14, September 28 and October 2, 1979 (November 21, 1979).	3668	3676
25M	Licensee's letter to the NRC with responses prepared by Bechtel to several of the NRC Staff questions of September 14, September 20, September 28 and October 2, 1979 (December 17, 1979).	3668	3676
25N	Licensee's letter to the NRC with responses prepared by Bechtel to several of the NRC Staff questions of September 14, September 20, October 2, and October 18, 1979 (December 21, 1979).	3668	3676
25O	Licensee's letter to the NRC wtih responses prepared by Bechtel to the remaining NRC Staff questions of September 14, September 20, and October 2, 1979 (December 22, 1979).	3668	3676

No.	Licensee Exhibits	Identified	Admitted Into Evidence
25P	Licensee's letter to the NRC with supplemental material prepared by Bechtel relating to the proposed modifications to the Trojan Control Building in response to NRC Staff questions of May 18, October 2, September 20 and September 14, 1979, respectively (January 28, 1980).	3668	3676
25Q	Licensee's letter to the NRC with material prepared by Bechtel responding to requests from NRC Staff in telephone conversations during the week of January 28, 1980 including corrected Page 3 of Attachment 5 (February 13, 1980).	3668	3676
25R	Licensee's letter to the NRC with material referenced in Licensee's response to NRC Question 6 of September 20, 1979, University of Missouri Test Report (February 21, 1980).	3668	3676
25S	Licensee's letter to the NRC with Bechtel Drawings RSK-1, -2, -3, -4 (March 5, 1980).	3668	3676
25T	Licensee's letter to the NRC with information on compressive strength of masonry assemblies (f'm) March 6, 1980).	3668	3676
25U	Licensee's letter to the NRC with responses prepared by Bechtel to the NRC Staff's request for supplemental information at the meeting of March 7, 1980 (March 17, 1980).	3668	3676
25V	Licensee's letter to the NRC with summary tables prepared by Bechtel which describe the reinforcing steel in shear wall panels of the Control-Auxiliary-Fuel Building Complex (March 20, 1980).	3668	3676

No.	Licensee Exhibits	Identified	Admitted Into Evidence
25W	Licensee's letter to the NRC with design criteria prepared by Bechtel for the A-frame supports (March 21, 1980).	3668	3676
25X	Licensee's letter to the NRC with additional information prepared by Bechtel regarding the A-frame supports (March 27, 1980).	3668	3676
26A	Licensee's responses to Interrogatories dated August 27, 1979 from the State of Oregon (September 17, 1979).	3669	3676
26B	Licensee's supplemental responses to Interrogatories dated August 27, 1979 from the State of Oregon (February 29, 1980).	3669	3676
27	Licensee's Testimony ("Broehl, *et al.*") on Matters Other Than Structural Adequacy of the Modified Complex (March 17, 1980).	3669	3694
28	Licensee's Testimony ("Anderson, *et al.*") on the Structural Adequacy of the Modified Complex (March 17, 1980).	3669	4338
29A	Review of Proposed Design of Modifications for Trojan Control Building, by Professors Myle J. Holley, Jr., and Boris Bresler (March 1[illegible], 1980).	3669	4427
29B	Statement of Qualifications of Myle J. Holley, Jr.	3669	4427
29C	Statement of Qualifications of Boris Bresler.	3669	4427
30	Licensee's Responses to McCollom's Prehearing Conference Questions, March 11, 1980 (March 31, 1980).	3670	4338

No.	Licensee Exhibits	Identified	Admitted Into Evidence
31	Slides Used in Oral Testimony of Mr. R. C. Anderson and Dr. William H. White on March 31, 1980.	4347	4453
32	Licensee's Answers to NRC Staff Questions of March 30, 1980 (April 2, 1980).	4448	4685
33	Licensee's responses prepared by Bechtel to NRC Staff questions of April 3, 1980 (April 14, 1980).	4509	4685
34	Licensee's "Report on Tests of Shear Strength of Collar Joint Mortar In Double Wythe Masonry Walls" (April 15, 1980).	4525	4687
35	Licensee's letter with attachments to NRC providing PGE comments on "Report on Design Criteria for Masonry Walls in the Trojan Nuclear Power Plant" by Dr. James Colville (March 15, 1980).	4778	4778
36A	Licensee's responses to NRC Staff questions of December 29, 1979 (December 31, 1979).	4822	4821-22
36B	Licensee's response to NRC Staff Question 6 of December 29, 1979 (January 9, 1980).	4822	4821-22
36C	Licensee's response to NRC Staff Question 1a of December 29, 1979 (January 18, 1980).	4822	4821-22
36D	Licensee's response to NRC Staff Question 6 of December 29, 1979 (January 31, 1980)	4822	4821-22
36E	Licensee's response to NRC Staff Question 6 of December 29, 1979 (February 9, 1980).	4823	4821-22
36F	Licensee's response to NRC Staff Question 1 of December 29, 1979 (February 15, 1980).	4823	4821-22

No.	Licensee Exhibits	Identified	Admitted Into Evidence
36G	Licensee's response to NRC Staff Question 12 of December 29, 197. (March 5, 1980).	4823	4821-22
36H	Licensee's "Addendum 1, March 1980, to Report on Testing of Composite Masonry Walls" (April 1, 1980).	4823	4821-22

No.	NRC Staff Exhibits	Identified	Admitted Into Evidence
12	NRC Staff Testimony of Charles M. Trammell, III, Identifying Staff Personnel Who Prepared the Safety Evaluation Report and Responding to Licensing Board Question on Proposed License Condition (March 17, 1980).	4004	4073
13A	Safety Evaluation by the Office of Nuclear Reactor Regulation Relating to Design Modifications to the Control Building (February 14, 1980).	4005	4005
13B	Letter of A. Schwencer transmitting errata to NRC Staff Safety Evaluation Report (February 15, 1980).	4005	4018
14	NRC Staff Testimony of Fred Clemenson and James E. Knight Regarding Modification Work and Effects on Plant Operation and on Safety-Related Equipment (March 17, 1980).	4005	4074
15	NRC Staff Testimony of Kenneth S. Herring and Drew Persinko on CFSP Contentions 20, 12/13 and 16 (March 17, 1980).	4006	(withdrawn at 4505)
15A	NRC Staff Revised Testimony of Kenneth S. Herring and Drew Persinko on CFSP Contentions 20, 12/13 and 16 and on Structural Aspects of the Modification Work Itself. (Superceedes Exh. 15).	4504	4679

No.	NRC Staff Exhibits	Identified	Admitted Into Evidence
16	NRC Staff Testimony of Charles M. Trammell, III, on Questions Regarding Relocation of the Railroad Spur and Reduction in Size of an Equipment Hatch Under the Proposed Modifications (March 17, 1980).	4006	4308
17	NRC Staff Testimony of Kenneth S. Herring and Drew Persinko on the Structural Adequacy of the Proposed Modifications to the Trojan Control Building (March 24, 1980).	4006	(withdrawn at 4504)
17A	NRC Staff Revised Testimony of Kenneth S. Herring and Drew Persinko on the Structural Adequacy of the Proposed Modifications to the Trojan Control Building (Supercedes Exh. 17).	4504	4679
18	Report on Concrete Masonry Wall Design Criteria for Transverse Loadings (February 22, 1980).	4007	4007
19	"Report on Design Criteria for Masonry Walls in the Trojan Nuclear Power Plant" (attachment to February 22, 1980 Board notification letter).	4531	4541
20	"Comments on Documentation Substantiating 18 psi Allowable Collar Shear Stress" (April 8, 1980).	4532	4581
21	"Response to Comments on Appendix B of Dr. Colville's Report of 2/13/80 on Trojan Masonry Walls" (April 8, 1980).	4532	4581
22	"Comments on Review by Professor B. Bresler of Evaluation of Tensile Bond and Shear Bond of Masonry by Means of Centrifugal Force, by A. Hatzinikolas, J. Longworth and J. Warwaruk, Alberta Masonry Institute Undated (1978-1979)" by Dr. James Colville (April 8, 1980).	4532	4581

No.	NRC Staff Exhibits	Identified	Admitted Into Evidence
23	Letter of Joseph Gray transmitting Affidavit of Charles E. Gaskin re NRC Staff Evaluation of additional security review (April 11, 1980) (marked for identification only).	4682-4683	----
24	Letter of R. H. Engelken to Licensee re short term testing results of double-wythe masonry walls with mortared collar joints (April 17, 1980).	4694	4786

No.	State of Oregon's Exhibit	Identified	Admitted Into Evidence
2	Testimony of Harold I. Laursen on Behalf of the State of Oregon Regarding Structural Adequacy of the Modified Complex (March 21, 1980).	4457	4461
2A	Supplement to the Testimony of Harold I. Laursen Regarding the Adequacy of the Proposed Modification of the Trojan Nuclear Plant Control Building	4651	4664