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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

Sheldon J. Wolfe, Esq., Chairman
Dr. Frederick P. Cowan, Member
Frederick J. Shon, Member



In the Matter of)	
)	Docket No. 50-344
PORTLAND GENERAL ELECTRIC)	
COMPANY, <u>ET AL.</u>)	(Proposed Amendment for Fuel
)	Storage Pool Modification)
(Trojan Nuclear Plant))	

INITIAL DECISION

(Amendment to Operating License)

Appearances

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Portland General Electric Company, the Eugene
Water and Electric Board, and Pacific Power
and Light Company

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Department of Energy

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David B. McCoy, appearing pro se.

Susan M. Garrett, appearing pro se and for the
Coalition for Safe Power.

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TABLE OF CONTENTS

- I. PRELIMINARY STATEMENT
 - II. FINDINGS OF FACT RE: MATTERS IN CONTROVERSY
 - A. Quality Assurance
 - B. Corrosion
 - C. Structural Matters
 - D. Repairs and Maintenance
 - E. Accidents
 - F. Criticality
 - G. Cooling Systems
 - H. Thermal Impacts
 - I. Radiological
 - J. Environmental Impact Appraisal
 - 1. Adequacy
 - 2. Proper Issuance
 - K. Alternatives To And Need For The Proposed Modification
 - L. Board Questions On Volcanism, Landslides And The Release Of Plutonium
 - III. CONCLUSIONS OF LAW
 - IV. ORDER
- APPENDIX A - LIST OF EXHIBITS ADMITTED IN EVIDENCE

I. PRELIMINARY STATEMENT

This initial decision involves the application filed under date of January 6, 1977 with the Nuclear Regulatory Commission (NRC), by the Portland General Electric Company acting on behalf of itself, the Eugene Water and Electric Board, and Pacific Power and Light Company (hereinafter referred to as the Licensees or PGE). Therein, the Licensees requested an amendment of Operating License NPF-1 for the Trojan Nuclear Plant (the facility or plant) to allow more spent fuel to be stored in the facility's spent fuel pool (SFP) by a modification of the SFP which would substitute new spent fuel storage racks with spaces for 651 fuel assemblies in lieu of the existing approved racks which can hold 280 fuel assemblies (PGE Ex. 2, known as PGE-1013, which was supplemented and amended by PGE Exs. 4-11).

On February 14, 1977, the NRC issued a "Notice of Proposed Issuance of Amendment to Facility Operating License" which, in part, provided that those whose interest might be affected by the Licensees' request could file a petition to intervene and request a hearing (42 Fed. Reg. 9068). Petitions to intervene were filed and ultimately the Board admitted the following as intervening parties pursuant to 10 C.F.R. § 2.714: David B. McCoy; the State of Oregon, acting by and through its Department of Energy and its Energy Facility Siting Council; Susan M. Garrett, acting on her own behalf and as the representative of the Coalition for Safe Power; and Sharon S. McKeel.

After the Board had admitted various contentions of the intervening parties as issues in controversy and after discovery had been concluded, the hearing commenced in Portland, Oregon on January 4, 1978. Numerous limited appearance statements by members of the public were received through January 6, 1978. The evidentiary phase of the hearing began on January 9^{1/} and continued through January 20, 1978. Thereafter the evidentiary hearing was held between January 30th and February 10th,^{2/} and between April 17th and April 26, 1978. On the latter date the evidentiary record was closed. There were 6493 pages of transcript.

^{1/} On January 9, 1978, at the beginning of the evidentiary portion of the hearing, the State of Oregon withdrew Contentions A3(b) and (c), A5(b), (c) and (d), A8(b), B3(a)(2), (3) and (4), B3(b) and (c), B4(a)(2), and B7(b)(4), because, as a result of the discovery process, it concluded that these contentions were not well-founded (Tr. 932-36). Further, on February 10th, the State withdrew Contention B6 because the Licensees had agreed to and had conducted additional dye penetrant testing of the SFP liner plate. (Tr. 3868, Tr. 4884-4892).

Further, on January 9, 1978, Mr. McCoy filed a Motion For Admission of a New Contention which, in substance, asserted that there existed an enhanced probability that an earthquake would occur which could damage the SFP. (Tr. 981) The Board denied the Motion in that it was untimely and in that it challenged the Safe Shutdown Earthquake for the entire facility, a matter which was beyond our jurisdiction to determine. (Tr. 2488-91; see our Order of February 15, 1978). We rejected a similar Motion by Ms. Garrett (Tr. 2491-93) with regard to Mr. McCoy's seismic contention because the National Environmental Policy Act does not confer on the Board jurisdiction that it would not otherwise possess - i.e., the Commission had delegated to us only the authority to decide whether to permit the modification to the operating license which would change the capacity of the SFP racks (Tr. 3008-14).

^{2/} On February 6, 1978, the Board visited the Trojan plant to view the SFP.

All parties, except Ms. McKeel and Mr. McCoy, called witnesses. (Appendix A hereto lists the exhibits admitted into evidence).

Parenthetically we note that, prior to the hearing, on August 30, 1977 PGE forwarded to us Revision 2 to PGE-1013 (PGE Ex. 2) which stated that, although no spent fuel had been stored in the SFP, the SFP had been used to temporarily store liquid radwaste in July 1976. Further, we note that in a letter dated September 20, 1977, PGE advised that certain preparatory work was being performed to facilitate the installation of the new SFP storage racks after the license amendment was received. Consequently, in our Order of October 31, 1977, we directed Staff and the Licensees to present evidence regarding the exact nature of the preparatory work being performed and the exact contamination level in the pool at the time the preliminary work commenced as well as the present time. We do not make specific findings herein on these two matters since the Board's posing of questions does not create an inviolate duty to make findings specifically addressing the subject matter of the questions. Southern California Edison Company, et al., (San Onofre Nuclear Generating Station, Units 2 and 3), ALAB-248, 8 AEC 957, 975 (1974). Based upon the evidence adduced by the Staff and Licensees and subjected to cross-examination, we conclude (1) that the preparatory work did not reduce the structural integrity of the existing racks (Aldersabaes, Tr. 1216-17; Morrill, Tr. 1870-72) or liner (Aldersabaes/Bushnell, Tr. 1230, 1341; Pate, Tr. 1707-08), and (2) that the total exposure experienced by the Licensees'

personnel working in the contaminated SFP was insignificant. (Withers written testimony, pp. 1-2, fol. Tr. 1881; Fish written testimony, pp. 1-4, fol. Tr. 1935; Fish, Tr. 1969-70).

II. FINDINGS OF FACT RE: MATTERS IN CONTROVERSY^{3/}

A. Quality Assurance

Garrett Contention A5:

The Licensee has not demonstrated the existence of a detailed quality assurance program which would effectively detect and prevent defective work by contractors and manufacturers of the Licensee's proposed spent fuel storage system.

1. The Quality Assurance Program for the new storage racks is governed by 10 C.F.R. Part 50, Appendix B, which is captioned "Quality Assurance Criteria For Nuclear Power Plants and Fuel Reprocessing Plants". To satisfy these requirements, PGE required that its contractor-vendor, Programmed and Remote Systems, Inc. (PaR)^{4/}, as well as subvendors, adopt

^{3/} At the time of its filing of proposed findings of fact and conclusion of law, the State of Oregon withdrew several of its Contentions - A(1)(a), B(2), A(3)(a), B(3)(a)(1), B(4)(a)(1), B(4)(b)(1) and (2), A(5)(a), A(5)(e)(1) and (2), B(5)(a), (b) and (c), A(7)(a) and (b), B(7)(a)(1) and (2), and B(7)(b)(3). After reviewing the record and the proposed findings submitted by Staff and Licensees, we conclude that Oregon's withdrawal of these contentions was well-taken in that said contentions are not supported by the evidence and we do not discuss them further.

Mr. McCoy did not file proposed findings of fact and conclusions of law. Ms. McKeel submitted remarks in the form of a prayer. Ms. Garrett limited her proposed findings and conclusions of law to two of her contentions (A-1 and A-2), which we discuss under heading II. K, *infra*. Since these intervening parties have not formally withdrawn their contentions, we proceed with our adjudication thereof.

^{4/} PaR is responsible for the new rack design, fabrication and installation (Frewing written testimony, p. 12, fol. Tr. 2249).

ANSI N45.2-1971 which implements Appendix B (Frewing written testimony, pp. 9-10, fol. Tr. 2249; Pate, Tr. 2609; Sturm, Tr. 3985; PGE Ex. 2 p. 7-1). The ANSI Standard N45.2-1971 includes the following quality assurance program elements: (1) program; (2) organization (3) design control; (4) procurement document control; (5) instructions, procedures, and drawings; (6) document control; (7) control of purchased material, equipment and services; (8) identification of materials, parts, and components; (9) control of special processes; (10) inspection; (11) test control; (12) control of measuring and testing equipment; (13) handling, storage, and shipping; (14) inspection, test, and operating status; (15) non-conforming items; (16) corrective actions; (17) quality assurance records, and (18) audits (Frewing written testimony, p. 10, fol. Tr. 2249). The Staff reviewed the Licensees' quality assurance program for the design, fabrication and installation of the new spent fuel racks and found that it conformed to the requirements of Appendix B (George written testimony, p. 7, fol. Tr. 2516; Staff Ex. 1A, p. 14).

2. PGE performed two audits to verify that PaR's quality assurance program satisfied Appendix B requirements and made subsequent visits to the vendor's plant to verify that action had been taken to correct certain deficiencies (Attach. to Frewing written testimony, fol. Tr. 2249; Greenwood, Tr. 2280). Further, with regard to the actual fabrication, inspectors of the Bechtel Corporation, as agent for the Licensees, made twelve inspections at PaR's plant (Greenwood, Tr. 2279,

2484-85). In addition, PaR conducted quality assurance audits of work being performed by its sub-contractors (Sturm, Tr. 3745-46). Finally, an inspector in the NRC Office of Inspection and Enforcement (OIE) examined welds on one of the new SFP racks and found them to meet the ASME visual inspection requirements (Pate testimony, p. 4, fol. Tr. 1644). This inspector, after requesting additional liquid penetration testing, did find that there were some liquid penetrant indications in welds on a module locating frame. However, at the time of the hearing, all but two of these indications had been corrected by surface grinding, and, we understand that, with respect to these two indications, PGE will take corrective action which will be verified by the OIE. (Pate, Tr. 2503-04).

3. From our review of the record, we are satisfied that the Licensees' quality assurance program meets the requirements of Appendix B to Part 50. There is no evidence that the QA program has not effectively detected and prevented defective work. Indeed, there is no evidence that there has been faulty workmanship - the liquid penetrant indications result from pits or scratches incurred in normal welding, and do not indicate faulty workmanship (George, Tr. 2583).

B. Corrosion

Oregon Contention A(2):

Long-term Storage: The Licensee has failed to demonstrate that utilization of the spent fuel pool, associated systems and storage racks, as proposed pursuant to the requested amendment, is

adequate to accommodate storage of spent fuel elements safely either for the length of time contemplated by its analysis or for what is reasonably likely to be a substantially longer period of time. This failure precludes a conclusion that issuance of the proposed amendment is not inimical to the public health and safety. Specifically, the Licensee did not assess:

- (a) the potential effects of increased corrosion on pool liners, storage racks, or spent fuel;
- (b) the increased need for water chemistry or detrimental materials controls;
- (c) the need for, and adequacy of, in-service inspections and surveillance of the pool liner, storage racks, spent fuel and the support systems associated with the spent fuel pool.

4. Although Oregon, in its Proposed Findings, asserts that it still advances this contention, it is evident to the Board that the State's present position is very different from that suggested by the contention as worded above. In particular, the State now levels a criticism at the Licensees' plan which is much narrower in scope than that set forth above (Oregon's Proposed Findings, Nos. 17-24, pp. 2-4). Far from holding that the Licensees have "not assessed" the effect of increased corrosion, the need for chemistry and material controls, and the need for surveillance of equipment, Oregon now limits itself to implying that we should require as conditions for the proposed amendment (a) a Technical Specification fixing water chemistry in the pool (rather than a less formal commitment on the Licensees' part), and (b)

the instituting of a corrosion coupon program. (Oregon Proposed Findings 17-24).

5. We turn first to the notions advanced in Oregon's Proposed Findings. We shall deal with the contention itself in those findings wherein we address similar corrosion contentions advanced by other intervenors.

6. We note that the Staff witnesses did not believe that imposing SFP water chemistry Technical Specifications would be necessary (Herring, Tr. 4593; Trammell, Tr. 4598; that an effective means of policing the Licensees' adherence to appropriate water chemistry limits exists without a Technical Specification (Trammell, Tr. 4597); and that the halide concentrations to which the Licensees were being held were, if anything, more restrictive than necessary (Weeks, Tr. 4590; Trammell, Tr. 4598). The Staff witnesses also mentioned that there is an ongoing generic study of water chemistry requirements for SFP's and they expressed reluctance to set Technical Specifications before the results of that study were known (Trammell, Tr. 4600).

7. This testimony was uncontroverted, and Oregon's witness, Mr. Godard, did not give any reasons why Technical Specifications should be imposed (Oregon Ex. 1). Indeed, Oregon's witness alleged that he himself would also be independently checking records of the SFP water chemistry to give further assurance that it would be kept within the limits to which the Licensees have committed (Godard, Tr. 3463).

8. We see no particular advantage in imposing Technical Specifications on SFP water chemistry. The combination of regulatory control operating through 10 C.F.R. 50.59 mentioned by the Staff's witness (Trammell, Tr. 4597) and State surveillance of records (Godard, Tr. 3463) seems adequate.

9. The evidence does not indicate the necessity for requiring a corrosion coupon program, which would entail the examination of samples of pool materials exposed to the environment. Staff witness Dr. John Weeks, testified that, in his opinion, such a program was not necessary, although he felt it might be "possibly" desirable (Tr. 4580, 4583) as a long range study. Licensees' witness, Dr. A. B. Johnson, testified that there might be merit to a coordinated program, but that "great confusion" could come from a program where individual reactors were required to conduct such tests (Tr. 2851-52). Licensees' witness, John Frewing, asserted that no useful information could be gained by such a program because the very low corrosion rate in the SFP would make measurements difficult (Frewing written testimony, p. 21, fol. Tr. 3047; Tr. 3218).

10. The State's witness, Mr. Donald Godard, felt that a corrosion coupon program would be of value as a check to assure that violations of water chemistry conditions had not occurred. (Oregon Ex. 1, pp. 10-11). But even he agreed the coupons would have little "predictive value" (Tr. 3442). He also conceded that his own experience, where

a coupon program had proved useful, involved much more corrosive environments, wherein corrosion rates would be higher, and that at the low rates expected in the SFP, corrosion coupons would not be so effective (Tr. 3477). Moreover, Mr. Godard did not feel that the corrosion coupons would affect a "go no-go decision" on fuel pool expansion (Tr. 3448). We see no reason to require such a program.

Garrett Contention A4:

The Licensee has not adequately analyzed corrosion and radiation damage to the fuel assembly racks, the assemblies, the steel pool liner, and the concrete walls and flooring of the spent fuel pool due to:

- (a) increased radioactivity in the pool;
- (b) increased and uninterrupted spent fuel assembly residence time including possible residence beyond 1988, and
- (c) increased temperatures resulting from the proposed modification.

An adequate analysis of potential corrosion and radiation damage is especially important in view of the fact that the opportunities for pool and rack maintenance will be reduced due to the constant, uninterrupted spent fuel residence in the pool under the proposed modification.

McKeel Contention A1(b):

The Licensee has failed to adequately demonstrate that the storage of greater amounts of irradiated fuel for longer periods of time than originally anticipated and the attendant increased fission product inventory, heat load and displacement of SFP cooling water will not:

- (b) result in unacceptable radioactivity and heat induced acceleration of corrosion of the SFP racks, the seismic restraint system, the stainless steel SFP liner, and the zircaloy cladding on the stored fuel elements.

McCoy Contention A5(a):

The Licensee has failed to adequately demonstrate that the proposed expansion of spent fuel storage will not increase to unacceptable levels the corrosion of the fuel storage racks, the spent fuel elements therein and the fuel pool itself as a result of the increased amount of spent fuel and the increased number of racks under the proposed modification, and the potential increased length of time for storage of spent fuel that would be made possible for the proposed amendment.

McCoy Contention B5(b):

The proposed seismic design for the modified SFP is inadequate to withstand the proposed safe shut down earthquake in that: . . . (b) the weakening of SFP structures because of increased radiation fields and temperatures has not been addressed in the analysis. The structures involved include racks, liner, fastenings, and cooling system components.

11. These contentions, and Oregon Contention A2(a) above, allege that corrosion will be increased and pool components or fuel assemblies will be weakened because the proposed change will affect parameters such as temperature, radiation level, and the length of time fuel is stored. The materials present in the modified SFP will be Type 304 stainless steel in the racks, the pool liner and the discharge header

and piping; 17-4 pH stainless steel in the racks; and Zircaloy 4 and Inconel-318 in the spent fuel assemblies. (PGE Ex. 2, Ch. 3). The SFP water is to be maintained during normal operation at a quality comparable to that of the reactor coolant (Frewing, Tr. 3075) and at temperatures less than or equal to 140°F (PGE EX. 2, p. 3-17). The racks and the liner will likely remain in the SFP until the expiration of the facility operating license in the year 2011 and there is presently nothing in the operating license that would prohibit the storage of a particular fuel assembly in the Trojan SFP until that date. Thus, the period of exposure of materials in the SFP would be on the order of 33 years from a corrosion standpoint.

12. Extensive testimony by Staff witness Dr. A. Johnson indicates that similar fuel has been stored up to a maximum of 18 years, and many assemblies have been stored up to 14 years without significant degradation (Johnson written testimony, pp. 2, 4, Table 3, fol. Tr. 2692; Tr. 2752, 2763).

13. Testimony by Licensees' witness, Mr. R. Frey, and by Staff's witness, Dr. John Weeks, confirms the notion that fuel elements of the type used at Trojan suffer very little corrosion in water near the temperature produced by the proposed modification (Frey written testimony, p. 1, fol. Tr. 3049; Weeks written testimony, p. 1, response to McCoy Contention A5(a), fol. Tr. 4567).

14. We find that general corrosion of the fuel is not expected to be a problem. Local corrosion conditions of Zircaloy-clad fuel, including stress corrosion cracking, galvanic corrosion and helium embrittlement, were also examined in detail by Dr. Johnson (Tr. 2727-29). The evidence establishes that Zircaloy is generally immune to stress corrosion cracking in aqueous media (Johnson written testimony, p. 68, fol. Tr. 2692; Tr. 2784) and that Inconel is similarly resistant to this phenomenon (Frey written testimony, p. 4, fol. Tr. 3049; Tr. 3386). Similarly, Zircaloy and Inconel are highly resistant to crevice corrosion (Johnson written testimony, p. 69; Tr. 2858), and there is no galvanic corrosion between Zircaloy and Inconel (Staff Ex. 2, p. 7; Johnson, Tr. 2790-92). While the type of fuel used at Trojan is internally pressurized with helium, the form of helium used is such as to preclude substantial migration into clad and helium embrittlement (Johnson, Tr. 2856-57). Thus, we find that local corrosion phenomena will not significantly affect spent fuel integrity under the storage conditions and time period contemplated by the proposed amendment. General corrosion rates for materials other than fuel will also be low under the conditions proposed for the expanded facility (Johnson, Tr. 2878; Staff Ex. 2, pp. 2, 5, 10).

15. Local corrosion rates of components other than fuel were also addressed. It appears that stress corrosion cracking of stainless steel could be of concern because of the possible existence of sensitized areas generated by welding. (Bushnell, Tr. 1231; Carter, Tr. 1305-07, 3196, 3260-61; Frey, Tr. 3091). However, this phenomenon occurs only at

levels of halide concentration considerably above those at which the SFP water purity will be controlled (Johnson, Tr. 2787; Johnson written testimony, p. 67, fol. Tr. 2692; PGE Ex. 2, Table 3.6; Frey written testimony, p. 3, fol. Tr. 3049). The evidence indicates that gamma radiation will have no effect on corrosion rates of materials in the SFP other than possibly to increase oxygen levels in the SFP which would tend to inhibit corrosion. (Weeks written testimony, response to Garrett Contention A4, pp. 1-2, response to McKeel Contention A1(b), p. 2, fol. Tr. 4567). Neutron radiation levels are orders of magnitude below those known to cause damage to the materials present in the SFP and will not affect corrosion rates significantly. (Weeks written testimony, response to Garrett Contention A4, pp. 1-2, fol. Tr. 4567, response to McKeel Contention A1(b), p. 2, fol. Tr. 4825; Frey written testimony, p. 2, fol. Tr. 3049). There is no evidence that the radiation generated by the fuel once it is removed from the reactor (Johnson, Tr. 2845) or the amount of fuel stored (Weeks written testimony, response to McCoy Contention A5(a), p. 1, fol. Tr. 4567) has any effect on corrosion rates of materials in the SFP. Similarly, radioactive material present in the pool due to fuel defects will have no effect on corrosion (Johnson, Tr. 2756, 2962).

16. We see no reason to believe that the components of the modified SFP or the fuel assemblies stored therein will be subject to corrosion of a sort which would threaten their integrity or interfere

with their intended functions.

McKeel Contention A2(a):

In view of the longer period of storage of spent fuel contemplated under the proposed amendment and the increased amount of fission products and heat the stainless steel SFP liner will be exposed to, the maintenance of adequate safety margins requires the installation of a thicker pool liner which will be more resistant to minor imperfections in the plate and the liner's welded joints in order to reduce the likelihood of leaks to acceptable levels .

17. Stainless steel has been stored under water for periods up to 20 years without degradation (Carter, Tr. 3257). It is deemed satisfactory for storage up to 40 years (Staff Ex. 2, pp. 5, 10). The anticipated level of radiation will not affect the corrosion rate (Frey written testimony, p. 2, fol. Tr. 3049). As with the other stainless steel components of the SFP, the liner, having been welded, could be subject to stress corrosion cracking in weld heat affected zones, but this can be precluded by proper water chemistry control (see the discussion of other corrosion contentions, supra).

18. Dr. Weeks testified that fuel pools having liners the same thickness as the Trojan fuel pool liner, one-quarter inch, have not experienced leakage, and that he saw no need for an increased lining thickness. (Weeks written testimony responding to McKeel Contention A2(a), p. 1, fol. Tr. 4567). Both Dr. Weeks and Mr. Kenneth Herring (Herring written testimony responding to Oregon Contention B7, p. 2, fol. Tr. 4473), testified that leaks, should any develop, can be repaired.

19. We see no need to increase pool liner thickness in connection with the proposed increase in storage capacity.

C. Structural Matters

20. As noted above, at the time it filed its Proposed Findings of Fact and Conclusions of Law, Oregon withdrew its Contentions B4(a)(1) and B4(b)(1) and (2). Oregon also withdrew the last sentence of its Contention A4, leaving that Contention to read:

Oregon Contention A4:

The Licensee has not demonstrated that the design of the new spent fuel storage racks provide a structural integrity sufficient to store spent fuel onsite safely in the manner and for the period contemplated by its application. This failure precludes the conclusion that issuance of the proposed amendment is not inimical to the public health and safety. Specifically, the drop test described at Page 3-7 of PGE-1013 does not accurately reflect the reasonably likely impacts upon the storage racks in that, while the tests simulated the dropping of a 2000-lb. object onto a test rack section from a height of 18 in., the current Trojan Technical Specifications would permit loads of up to 2500 lb. to be transported over the spent fuel pool at heights greater than 18 in.

21. We note that the test mentioned in the contention was not intended as a proof test for rack integrity under very severe circumstances (Herring, Tr. 4034 - 4035). It was used only to determine local damage under conditions simulating the dropping of a fuel element (PGE Ex. 2, p. 3-7) and to determine rack response in order to permit other

calculations to be made (Herring, Tr. 4035).

22. The test did not represent an accident severe enough to cause the racks to yield (Bushnell, Tr. 3544). The test subjected the racks to only 20,000 in.-lbs. of impact energy (PGE Ex. 2, p. 3-8) but allowable stresses in the most critical structural member of the racks would be reached only for impact energies around 240,000 in.-lbs. (Bushnell, Tr. 3545).

23. Technical Specifications prohibit the carrying of loads greater than 2500 pounds over stored spent fuel, but there is no limit on the height at which lighter loads may be carried (Bushnell, Tr. 3573). There is a Technical Specification requiring demonstration that crane stops be in place to prevent the high capacity fuel building crane from traversing the fuel assemblies (Tr. 3951). We note that there are many objects that can be carried over spent fuel: an 800 pound burnable poison handling tool, a 356 pound handling tool, and a 292 pound thimble plug handling tool are some examples (Trammell, Tr. 4023). Analysis indicates that the worst-case drop (an 800 pound tool from a height of 12 feet) yields an impact energy of 118,400 in.-lbs. (Bushnell, Tr. 3614, 3755-56). This is far less than the 240,000 in.-lbs. of energy required to overstress the racks.

24. We find that data from the drop test have been appropriately used, and that the design of the racks is adequate to resist the type of dropped objects which will be routinely handled over the pool.

Oregon, however, in its Proposed Findings, raises a new issue distantly related to this contention, an issue which we believe merits further attention - i.e., Oregon believes that we should require a Technical Specification which would limit loads and the heights at which they are carried over spent fuel so as to preclude impact energies in excess of 240,000 in-lbs. (Oregon's Proposed Findings, p. 7, paragraph 31). Oregon points out that, although it is not a routine matter, a situation could be visualized in which a weight of 700 pounds could pass over fuel at a height of 48 feet (Oregon Proposed Findings, p. 7, paragraph 29; Trammell, Tr. 4021) and that damage to the racks could cause damage to the stored fuel elements. (Oregon's Proposed Findings, p. 7, paragraph 30).

25. We believe that this condition would be a sensible one to impose. It would impose no burden on routine operations, and testimony indicates that even non-routine operations could be carried out in accord with it (Trammell, Tr. 4021). We therefore impose in our Order, infra, the condition Oregon requests.

Garrett Contention A3:

The Licensee's description of possible accidents has provided no analysis of possible loss of seismic restraint capability of the spent fuel pool which might result from accidental dropping, or repeated droppings over a period of time of fuel assemblies or other similar large objects into or upon the expanded storage area.

26. The ability of the SFP itself to withstand seismic events is not changed by the proposed modification and is not an issue in this proceeding. The seismic restraints for the racks result from rack-to-rack connections to prevent overturning (Bushnell, Sturm, Tr. 3624-26). Shear forces present no problem. (Bushnell, Tr. 3626). The only portion of the racks that could be damaged by dropped objects is the set of funnels at the tops of the racks. The overall rack integrity would not be impaired and such damage would not affect the ability of the racks to withstand a seismic event. Cumulative effects of repeated dropping of objects need not be considered since the Licensees intend to examine the structural elements and take corrective action whenever a drop incident occurs. (Herring written testimony on Garrett A3, pp. 1-2, fol. Tr. 4001).

27. We conclude that the seismic restraint capability of the SFP racks will not be significantly degraded by accidental dropping or repeated droppings of fuel assemblies or similar large objects. Garrett Contention A3 is without merit.

McCoy Contention B5(a):

The proposed seismic design for the modified SFP is inadequate to withstand the proposed Safe Shutdown Earthquake in that: (a) the increased stresses on pool structure, pool liner, and other building structural components, due to the greater weight of fuel and racks, have not been evaluated.

28. Licensees' witness established that seismic loads have been considered in the design of the racks (Bushnell, Tr. 3636), and that the structural systems affected by the modification have been evaluated in accord with all regulatory acceptance criteria (Bushnell written testimony, p. 5, fol. Tr. 3538). Maximum weights and masses were used in the design (Bushnell, Tr. 3645, 3649).

29. The Staff witness, Dr. Herring, also assures us that design of the modified installation conforms to all regulatory requirements, including seismic ones (written testimony on McCoy B5(a), p. 1, fol. Tr. 4001).

30. We see no reason to believe that the seismic design has failed to account for any change in rack weight or fuel weight. McCoy Contention B5(a) is without merit.

McKeel Contention A2(b):

In view of the longer period of storage of spent fuel than that contemplated in the original operating license and the increased fission product inventory to be stored under the proposed amendment, the associated increase in the likelihood and consequences of a leak from the SFP requires that the reinforced concrete structure be designed to be leak tight in addition to providing structural support for the SFP.

31. It is not the concrete structure, but the pool liner which is designed to assure leak tightness (Frewing, Tr. 3831). The liner has been analyzed for load combinations including dead, live, thermal and seismic loads and thus its structural integrity will be maintained (Herring written testimony on McKeel A2(b) p. 1, fol. Tr. 4001). No

degradation of the liner due to corrosion is expected (see discussion of Corrosion, supra). The concrete will not be degraded by radiation or thermal effects (Frewing testimony, pp. 23-24, fol. Tr. 3533; Frewing testimony, p. 36, fol. Tr. 4181). Any leakage through the liner will be readily detectable through the leak-chase channel system and the concrete itself acts as a secondary barrier (Frewing testimony, p. 36, fol. Tr. 4181).

32. We find that the modification engenders no need for the reinforced concrete pool structure to be made more leaktight than it already is, and McKeel Contention A2(b) is without merit.

D. Repairs and Maintenance^{5/}

Oregon Contention B7(b)(1) and (2):

The Licensee's analysis of potential accidents after the proposed modifications have been made is deficient, and therefore cannot be used to support a conclusion that issuance of the proposed amendment would not be inimical to the public health and safety. Specifically: . . . (b) the Licensee did not discuss what provisions have been made to recover from accidents described in Paragraph (a) above or from the longer term effects of spent fuel storage such as degradation of the pool liner, the fuel cooling systems, or storage racks. Specifically, the Licensee has failed to demonstrate that: (1) pool liner leakage can be repaired, and (2) sufficient numbers of casks are available for or can be obtained to allow removal of fuel from the pool if such removal is necessary for the performance of repairs.

^{5/} Oregon did not submit proposed findings on Contention B7(b)(1) and (2). However, the Board finds no indication in the record of withdrawal of this contention and therefore will make findings on it as part of this initial decision.

33. If under abnormal circumstances a fuel assembly is dropped and its corner directly strikes the pool liner over a leak detection channel, there is a possibility of liner rupture (Bushnell, Tr. 3544). In such a situation, the concrete walls and floor of the SFP will provide an essentially leak tight barrier (Frewing written testimony, pp. 36-37, fol. Tr. 4181), the location of the liner leak could be determined visually or by means of the monitoring system built into the pool (Bushnell, Tr. 4189-93; Bushnell written testimony, p. 2, fol. Tr. 3538; Lantz, Tr. 4494-5), and repairs could be accomplished by divers using welding or other techniques that have been used elsewhere (Herring written testimony on Oregon Contention B7(b)(1), p. 1, fol. Tr. 4001; Frewing written testimony, p. 37, fol. Tr. 4181; Bushnell, Tr. 4324-5).

34. The only situation in which liner leakage from a dropped object might result is where the object directly impacts the liner and this would only occur in the spaces at the edge of the pool between the racks and the SFP where no racks or fuel are located. Nevertheless, even assuming that a leak could occur under storage racks, the necessity to move fuel to effect repairs is not appreciably altered by the proposed modification (Frewing, Tr. 4334-35). Because of the design of the locating frames for the modified SFP, a leak beneath particular locating frames could require the removal of, at worst, four racks to get to the leak.

This could be done without removing fuel from the SFP after as many as seven prior refuelings or until about 1985 assuming that the proposed amendment is authorized in 1978 (Frewing written testimony, p. 38, fol. Tr. 4181; Bushnell, Tr. 4199-4200). Such fuel shifting would provide ample space and radiation protection to allow divers to repair the liner and does not differ markedly from the situation as it would exist in the event of a leak in the unmodified SFP (Lantz written testimony, p. 2, fol. Tr. 4473). In fact, from the standpoint of the availability of on-site storage space for the shuffling of fuel to allow liner repairs, the proposed modification will provide substantially more space than the existing pool since full-core storage capability will not be lost until after the eighth refueling as compared with loss after the second refueling for the unmodified SFP.

35. The proposed modification itself does not affect the availability of casks to ship fuel off the Trojan site so that repairs may be made to the SFP. (Lantz written testimony, p. 3, fol. Tr. 4473). The need for shipping casks in the liner repair context could arise in 1982 or earlier with the existing SFP. For the modified SFP, we have previously found that the need to ship fuel off-site so that liner repairs can be performed would not arise until 1985 at the earliest. Casks are available for rental from vendors within time periods of one year, which is the time it would take the Licensees to purchase a cask of their own (Lentsch, Tr. 4225; Owens, Tr. 4226) and there is no evidence that would

indicate that this situation with regard to cask availability will be different in 1985 with a modified SFP than it is now with the existing SFP.

36. Since the record establishes that modification of the spent fuel pool results in no appreciable change in repairability of the pool liner, that there is no change in the availability of fuel casks as a result of the pool modification, and that there is a reasonable likelihood of casks being available when possibly needed after 1985, Oregon Contention 87(b)(1) and (2) is without merit.

E. Accidents

Oregon Contention A8(a)(1) and (2):

The Licensee's analysis of potential accidents after the proposed modification have been made is deficient, and therefore cannot be used to support a conclusion that issuance of the proposed amendment would not be inimical to the public health and safety. Specifically: (a) the Licensee did not accurately address either the increased risks of or consequences from releases of radioactivity from or criticality occurring in the modified spent fuel pool due to an accident resulting from: (1) the transport of spent fuel casks and other heavy objects alongside, over, and near the spent fuel pool; (2) projectiles generated by natural events, such as earthquakes or tornados, or by mechanical failure, such as turbine failure.

37. The likelihood of a cask drop or tip accident in the vicinity of the SFP is not changed by the proposed modification. It is extremely low because it would require not only the violation of the Licensees' administrative procedures for heavy load handling but also the simultaneous failure of the mechanical stops on the fuel building

crane, a mechanical device, such as the crane hook, on the crane itself and the safety sling. (PGE Ex. 2, p. 4-3; Frewing, Tr. 4946-47). If a cask drop did occur in the cask loading pit, there would be no water loss from the SFP and no effects on safety related equipment (Staff Ex. 1A, p. 7).

38. The Staff currently has underway a generic load handling study in which cask drop and tip accidents in the vicinity of spent fuel pools are being assessed to determine what further actions may be necessary (Staff Ex. 1A, pp. 7-8). This study is scheduled for completion in January of 1979 (Oregon Ex. 2, pp. 6-7; Trammell, Tr. 4030). The Staff has evaluated the likelihood of a cask drop or tip accident in the vicinity of the Trojan SFP prior to the completion of the generic study and has determined that such probability is essentially zero since no casks will be present at Trojan until 1984 (Trammell, Tr. 4023). Because of this, the Staff has taken the position that no restrictions on cask handling are required until completion of the generic study and the Board agrees. (Staff Ex. 1A, pp. 7-8; Donohew written testimony, pp. 1-2. fol. Tr. 5030). However, the present technical specification limiting loads carried over stored fuel to 2500 lbs. doesn't preclude carrying loads of lesser weight at substantially greater heights. Therefore in Finding 25, supra, we have specified the imposition of a condition limiting the impact energy of any potentially dropped object to 240,000 in-lbs.

39. The evidence demonstrates that objects that could normally be carried over spent fuel under the existing Technical Specifications would, if dropped, initially impact only one spent fuel assembly. Although such a dropped object could bounce after the initial impact, it would not hit other stored fuel assemblies because stored fuel is nine inches below the top of the modified racks. As a result, it is physically impossible for a dropped fuel assembly or tool to damage more than one stored fuel assembly (Donohew written testimony, pp. 2-3, fol. Tr. 5030; Donohew, Tr. 5056-57). Such damage would, at worst, result in the rupture of all fuel rods in a single fuel assembly.^{6/} That particular accident was previously analyzed as the design basis accident for the Trojan SFP and the consequences found to be acceptable. The accident and its analysis are still applicable to the modified SFP (Frewing written testimony, p. 43, fol. Tr. 4936; Lentsch, Tr. 4944-46; Frewing, Tr. 4948).

40. In the event that an object impacts and ruptures fuel in the SFP, radioactivity will be released from the fuel. The consequences of such an accident will depend on the amount and age of the fuel which is damaged. The Staff calculated, as a function of decay time, the number of fuel assemblies which could suffer the rupture of all fuel

^{6/} This is an extremely conservative assumption since, in 8 of the 10 fuel assembly drop accidents experienced to date, there was no measurable release of radioactivity (Donohew, Tr. 5071), which indicates that few, if any, fuel rods were ruptured. In fact, the evidence indicates that only a dropped cask could cause the rupture of all fuel rods in a single assembly (Frewing, Tr. 4947).

rods with the consequences within the guidelines of 10 C.F.R. Part 100. Those calculations demonstrate that at 96 hours after reactor shutdown (minimum decay time before fuel may be moved from the reactor to the SFP) at least 10 fuel assemblies could be damaged without exceeding the guidelines of Part 100. In about three and a half weeks after reactor shutdown, an entire third of a core can be damaged without unacceptable consequences^{7/} (Donohew written testimony, table 1 and p. 4, fol. Tr. 5030).

41. In the event that the proposed amendment is authorized and reracking of the SFP occurs while some spent fuel is stored in the pool, the potential exists for dropping an empty fuel rack on stored fuel while the empty rack is being removed from or installed in the pool. The Licensees have stated that if the SFP modification is made with fuel stored in the pool, the reracking procedure would be to lift an empty rack a few inches off the pool floor, move it at that height to the end of the pool opposite where the spent fuel is located and then lift the empty rack from the pool. The installation of new racks would involve the same procedure in reverse (Bushnell, Tr. 4953-57). Such a procedure would clearly minimize the chances of damaging stored fuel from dropping an empty rack. In addition, the Staff proposed, and the Board agrees (see

^{7/} The Staff's calculations in this regard are extremely conservative in that a peaking factor of 1.65 was assumed for every fuel element. An analysis of the more realistic, expected consequences shows that all fuel elements in one-third of a core could be ruptured before 96 hours after shutdown without exceeding Part 100 guidelines (Donohew written testimony, p. 6, fol. Tr. 5030).

findings 53 and 81, infra), that conditions on boron concentration in the SFP and minimum decay times for stored fuel be imposed if the pool reracking is performed while fuel is stored in the SFP. Such conditions will preclude criticality and the occurrence of unacceptable radiological consequences from a dropped storage rack accident.

42. The probability of generating a turbine missile that would hit the SFP is so low as to be considered inevitable and the probability of damage to freshly discharged fuel is even lower (Lentsch, Tr. 4985-86; Donohew written testimony, p. 4, fol. Tr. 5030; Tr. 4050; Tr. 4056).

43. The probability of a tornado occurring in the vicinity of the plant is about 7×10^{-5} per year. This probability, combined with the fraction of a year during which refueling takes place and the critical period for fuel damage occurs, results in a probability that a tornado would occur in the site vicinity during the critical period of about 6×10^{-6} per year (Donohew written testimony, p. 4, fol. Tr. 5030). The evidence shows that the siding on the Fuel Building is designed to wrap around structural girders in the event of a tornado; consequently such siding could not become missiles that could damage stored fuel (Bushnell, Tr. 4938). The concrete walls of the SFP will resist any postulated, low trajectory tornado missiles so that such missiles will not damage stored fuel (Frewing, Tr. 4939; Bushnell, Tr. 4941-42). In view of this, the probability that a tornado would generate a missile that could damage more than 10 freshly discharged

fuel assemblies during the critical period for fuel damage is clearly lower than 6×10^{-6} and is so low as to be incredible. This is confirmed by the Licensees' analysis for the modified SFP which shows that tornado missiles will not cause damage beyond the design basis fuel handling accident (Bushnell, Tr. 4950).

44. The evidence also shows that the likelihood of the occurrence of a seismic event which generates a missile large enough to damage more than 10 fuel assemblies during the critical period is similarly low (Donohew written testimony, p. 5, fol. Tr. 5030). The only missiles that might be generated by a seismic event are those carried by the cranes in the Fuel Building (Godard, Tr. 4149-50). The Technical Specifications preclude the large Fuel Building crane from carrying objects greater than 2500 pounds near the SFP, we have previously found that smaller objects which may normally be carried over the SFP would not damage more than one fuel assembly, and we have imposed a limit of 240,000 in-lbs. on potential impact energy to preclude remotely conceivable situations involving objects weighing less than 2500 pounds. Thus, a seismic event will not generate missiles that will result in consequences from fuel damage in the modified SFP exceeding the guidelines of Part 100 or consequences that exceed the previously analyzed and acceptable design basis fuel handling accident.

45. Based on the foregoing, we find that radiological consequences from fuel damaged by projectiles generated by natural events or mechanical failures will be within the guidelines of 10 C.F.R. Part 100. In addition,

there is no evidence that those consequences will be significantly different for the modified SFP than what they would be for the existing pool (Godard, Tr. 5088) and, in fact, if freshly discharged fuel is stored on 26.6 inch centers as the Licensees have committed, the consequences could be lower for the modified pool since such a storage arrangement is not used in the existing pool (Lentsch, Tr. 4986-91).

46. The likelihood that a projectile will cause criticality in the modified SFP will not change substantially from the likelihood of its causing criticality in the existing SFP. The spacing between assemblies is the primary difference between the existing and the modified SFP from a criticality standpoint. This spacing prior to projectile impact will do little to prevent criticality where the projectile is very large (Lantz written testimony, pp. 1-2, fol. Tr. 5026). The probability that a smaller projectile will push assemblies into a critical configuration increases as the spacing between assemblies prior to impact decreases (Lantz, Tr. 5047-48). At the same time, the probability that a small missile will be generated that will cause criticality by wedging between assemblies and pushing them into close contact with other assemblies decreases as initial spacing decreases because there are fewer missiles of the proper size and shape (Lantz written testimony, p. 2, fol. Tr. 5026). In view of this, we find that the likelihood of criticality due to impacts of projectiles does not

change substantially for the modified SFP. Under actual conditions of spent fuel storage, circumstances are such that a substantial portion of the refueling concentration of boron will remain in the SFP. In addition, in the expected circumstances, all stored fuel will have been irradiated in the reactor for at least one year and probably more. In these circumstances, the evidence shows that criticality in the spent fuel pool is very unlikely and that it is precluded for Trojan low-load fuel, regardless of the nature of the accident involving missile impact (Lantz, Tr. 5054, Tr. 5072-73; Perry, Tr. 5168-70; Lantz, Tr. 5174-75).^{8/}

47. Based on the foregoing, we find that the potential consequences of heavy load drops and of projectiles damaging spent fuel in the modified SFP have been adequately analyzed and shown to be within the requirements of the regulations and acceptable from the standpoint of public health and safety. We, therefore, find Oregon Contention A8(a)(1) and (2) to be unfounded.^{9/}

^{8/} In its proposed findings, Oregon urged us to impose a Technical Specification requiring spacing of freshly discharged fuel no closer than every other cell in the new racks. Although the Board recommends that this procedure be carried out as planned, the record does not justify the imposition of such a rigid additional requirement. The Board reaches the same conclusion in regard to a demand by Oregon in its proposed findings that a Technical Specification be imposed requiring drastic action, including reactor shutdown, should pool temperature exceed 140°. The record doesn't reveal any serious consequences should 140° be exceeded during an accident situation, nor does it address the possible adverse consequences of such rigidity imposed on PGE's management of an accident.

^{9/} In its direct testimony (Godard, Tr. 5087) the State of Oregon asserted that a pool cover is part of the design for the Pebble Springs facility and that installation of a pool cover should be considered for the Trojan SFP.

F. Criticality

Oregon Contention A6:

The Licensee's analysis of the effect of the revised spent fuel configuration upon criticality, although it conservatively assumed zero boron for purposes of analysis, is deficient in that it fails to identify the need to maintain 2000 ppm of boron in the spent fuel pool water at all times. This deficiency precludes a conclusion that issuance of the proposed amendment is not inimical to the public health and safety.

48. The criticality analysis for the modified SFP assumed that no boron was present in the water. (Frewing, Tr. 5160). Analyses were made for normal storage conditions and for a wide range of off-normal conditions including boiling of the water (Fisher, Tr. 5139-40), Safe Shutdown Earthquake (SSE), a fuel assembly dropped upon the racks, an assembly dropped between loaded racks, and an assembly dropped between rack and wall. For each of these conditions k_{eff} was less than 0.94.

49. Thus the NRC acceptance criterion, k_{eff} 0.95 would be met for all cases with no boron present (Lantz written testimony on McCoy A7, pp. 1-2, fol. Tr. 5173), and it is clear that boron is not needed to preclude criticality for any of the possible off-normal conditions noted above (Frewing written testimony, p. 52, fol. Tr. 5123; Tr. 5128-29).

50. However, the boron concentration is generally kept at 2000 ppm in the pool, not to guard against criticality in the pool, but to

Footnote continued:

The evidence presented by Oregon does not establish a rationale for installation of a pool cover at Trojan and the expert witness testifying on behalf of the State indicated that, in his view, the proposed SFP modification, of itself, does not increase the consequences of SFP accidents or bring about the need for a pool cover (Godard, Tr. 5087-89). The evidence shows that use of a pool cover at Trojan would require substantial design changes to the Fuel Building (Oregon Ex. 1, p. 29) and that there is no reasonable or practical way for a pool cover to be installed or used (Frewing, Tr. 4964-66). In view of this and of our findings with regard to the consequences of accidents without a pool cover, there is no need for a pool cover at the Trojan facility due to the proposed amendment.

facilitate meeting a Technical Specification which requires such a concentration in the reactor cooling system and refueling cavity during refueling, since pool water mixes with the water in those systems at that time (Frewing written testimony, p. 52, fol. Tr. 5123, as amended; Tr. 5118).

51. Oregon, in its Proposed Findings (Findings 37-39, pp. 10-11) urges that we require a Technical Specification which would require maintenance of 2000 ppm at all times, saying that "certain scenarios" set forth at pp. 5168-70 of the transcript indicate "rearrangements of spent fuel" would result in criticality, absent this concentration of boron. We have reviewed the portion of the transcript cited in context, and we note that any rearrangement that has that characteristic would be one in which all spacing between the fuel assemblies had completely collapsed, but the assemblies themselves had not. We deem the spontaneous occurrence of this condition, even as a result of some external missile, to be extremely improbable. Oregon has not pointed out any mechanism by which it could occur. We conclude that such a requirement for continuous maintenance of 2000 ppm is unnecessary.

52. The Staff also urges a condition with regard to boron concentration. The Staff's proposal, however, is quite a different matter from that of Oregon. Staff urges that we require 2000 ppm "in the event the proposed amendment is authorized and the modified racks are installed while fuel is stored in the SFP," said requirement to be effective

during the installation of the racks. The Staff urges this to preclude criticality due to overturned racks and consequent spilled fuel elements, or due to the dropping of racks one on the other (Staff Proposed Findings, finding 110, p. 67).

53. We note that the mechanisms hypothesized by the Staff, in particular the one in which an overturned rack spills its burden of fuel, could result in just the sort of configuration which the Licensees' witnesses suggested might require boron (Frewing, Tr. 5167-70). Further, since the concentration is normally near 2000 ppm, it seems no great burden to require that it be at least that high during reracking, should reracking occur while fuel is being stored (as it is now evident it will). We shall therefore impose that condition.

54. We also agree with Staff's proposal that an upper limit of 44.3 grams per axial centimeter of ²³⁵U should be placed on the fuel stored in the modified racks (Staff's Proposed Findings, Finding III, p. 68) since the criticality analyses assumed this value (Lantz written testimony on McCoy Contention A7, p. 2, fol. Tr. 5173; Staff Ex. 1A, pp. 2, 4). We therefore impose this condition.

McCoy Contention A7:

The Licensee has failed to demonstrate that the increased amount of spent fuel proposed to be stored will not become critical some time during the period of storage permitted under the proposed amendment.

55. As we noted above with regard to Oregon Contention A6, it has been clearly demonstrated that criticality will not occur for any normal condition in the fuel pool, nor for a wide range of credible but unlikely off-normal conditions. It cannot be flatly stated that criticality can be absolutely ruled out; however, no party suggested a reasonably probable mechanism leading to criticality, other than the mechanisms mentioned by the Staff (and noted above), mechanisms which could occur only briefly under certain conditions of reracking. We have already determined that certain additional precautions are warranted for that period.

56. Intervenor McCoy did not submit proposed findings and has propounded no credible mechanism which would require additional demonstration of subcriticality.

57. Oregon did not propose findings on this contention. It did, however, submit proposed findings on its Contention A8(a) 1 and 2 which mentions criticality as a result of accidents. Significantly, those proposed findings (Oregon Proposed Findings, Findings 32-36, pp. 8, 9) did not suggest any accident which could result in criticality but dealt only with the potential for damage to fuel and boiling of the pool.

58. After careful consideration of the record we conclude that it has been demonstrated that the fuel stored in the pool after the proposed modification will remain subcritical in all circumstances likely to be encountered, and McCoy Contention A7 is without merit.

G. Cooling Systems^{10/}

McKeel Contention A1(a):

The Licensee has failed to adequately demonstrate that the storage of greater amounts of irradiated fuel for longer periods of time than originally anticipated and the attendant increased fission product inventory, heat load and displacement of SFP cooling water will not: (a) impose an excessive burden on the two SFP cooling pumps, the two heat exchangers and other interrelated components of the Spent Fuel Pool Cooling and Demineralizer System (SFPCDS).

59. The Licensees' evaluations demonstrate that no equipment modifications are required for the Spent Fuel Pool Cooling and Demineralizer System. The Residual Heat Removal (RHR) System and the Spent Fuel Pool Cooling and Demineralizer System components are not adversely affected by increasing the Spent Fuel Pool temperature design limit from 125°F to 140°F. The proposed change in Spent Fuel Pool temperature design limit will make that limit compatible with that of the refueling cavity and Reactor Coolant System during refueling (PGE Ex. 2, pp. 3-17). Changes in support systems were not required because of the rack replacement, since the increase in heat load because of the longer term storage is small and existing systems have sufficient capacity (Rabe written testimony, p. 2, fol. Tr. 5220). The displacement of 5% of the water in the existing SFP by the new racks, and the increased amount of fuel that could be stored under the proposed amendment will have no effect on this cooling capability (Frewing written testimony, p. 66a, fol. Tr. 5216).

10/ All of the Oregon contentions on cooling systems were withdrawn leaving McKeel Contentions A1(a) and A8. The Board will make findings on these two although Ms. McKeel presented no supporting testimony and did not file proposed findings.

60. The relatively small discrepancy between design and as-built capability of the SFP forced circulation flow has no significance in cooling the SFP (Rabe, Tr. 5226). With respect to long-term storage, the Licensees have evaluated the point in time when decay heat is at its maximum and that point is just after the tenth region is placed in the pool. From that time forward, heat input to the pool drops off. Thus the maximum heat condition for the duration of the license has been evaluated and found to be of no concern (Frewing, Tr. 5229).

61. The maximum incremental heat from the proposed amendment will not be added all at once but will build up in stages as the pool is filled. When the total incremental heat load is added to the modified SFP, the average pool temperature will have increased by 6°F. This small increase in temperature is not detrimental to the SFP pumps, heat exchangers, filters, demineralizer, valves or other components of the Cooling and Demineralizer System (Lantz written testimony, pp. 1-2, on McKeel A1(a), fol. Tr. 5257).

62. In view of the foregoing, we find that the operating requirements under the proposed amendemnt will not impose an excessive burden on the SFP Cooling and Demineralizer System or its components or cause significant degradation of those components beyond that which would result from operation of the existing, unmodified SFP. Consequently, we conclude that McKeel Contention A1(a) is without merit.

McKeel Contention A8:

The Licensee has failed to adequately demonstrate that systems used commonly by both the reactor and the SFP, specifically the Residual Heat Removal System, the Chemical and Volume Control System, and the Service Water System, will have adequate capacity to maintain safe operating conditions for both the reactor and the SFP in light of the increased amount of spent fuel that may be stored under the proposed license amendment.

63. The maximum incremental heat load due to the proposed modification, 2.4 million BTU's per hour, is about 3.5% of the design heat load for the Component Cooling Water System (CCWS) which transfers heat from the SFP to the Service Water System (SWS). This incremental heat load will raise the CCWS outlet temperature by less than 1^oF which will have no affect on the SWS (Lantz written testimony, p. 1 on Contention A8, fol. Tr. 5256).

64. The Chemical and Volume Control System (CVCS) is not needed for the SFP at any particular time and so can be used to service the reactor when needed. The situation is the same in this regard for the unmodified SFP. The proposed modification will have no effect on the required capacity of the CVCS (Lantz written testimony, p. 2 on Contention A8, fol. Tr. 5256).

65. The RHR System can only be used to cool the SFP during or after a full core transfer to the SFP or after refueling but prior to

the time the reactor is restarted. Use of the RHR during these times when the reactor is shut down will not lessen its ability to perform its safety function. The RHR System will be used to cool the SFP only after the reactor has been shut down for 125 hours or more. By that time, the combined decay heat from the reactor and the fuel in the SFP will be less than 45 million BTU's per hour. Since the RHR capacity is 75 million BTU's per hour, it has adequate capacity to maintain safe conditions for the shut down reactor and the modified SFP together (Lantz written testimony, p. 2 on McKeel Contention A8, fol. Tr. 5256).

66. In view of the foregoing, we find that the SWS, CVCS and RHR systems have adequate capacity to maintain safe conditions for both the reactor and the modified SFP and that no changes to these systems are required because of the proposed amendment. Accordingly, we find McKeel Contention A8 to be without merit.

H. Thermal Impacts^{11/}

McCoy Contention A1(1), (2), (3):

The Licensee's analysis of cumulative environmental impacts of the proposed licensing action is inadequate in that it fails to account for the effect of increased heat to be discharged to the river due to the proposed modification, (1) on aquatic biota, (2) on water availability as a result of increased consumptive use, and

^{11/} The Board notes that neither Mr. McCoy nor Ms. McKeel presented any evidence in support of their contentions on thermal impacts nor did they file any proposed findings with regard thereto.

(3) on increased fogging caused by the discharge of greater amounts of heated water.

McKeel Contention A5:

Section 2.1.3 of the Trojan Environmental Technical Specifications limits heat discharged into the Columbia River during power operations to less than 79×10^6 btu/hr. The proposed amendment would permit the storage of more SFA's for longer periods of time which will, in turn, generate more heat to be discharged into the Columbia River than is permitted by the current Environmental Technical Specification limits. This additional amount of excessive heat will impose an unacceptable thermal impact on the biota of the river and result in a deleterious imbalance of the ecosystems contained within the Columbia River.

67. PGE presented the written testimony of Messrs. Katanski and Frewing (fol. Tr. 5280 and 5301). The Staff presented the testimony of Messrs. Lantz, Dorohew and Cain (fol. Tr. 5322, 5323 and 5345). On the basis of this testimony, which was confirmed, reiterated and extended during cross-examination, the Board finds that:

- (a) The incremental increase in heat load due to the proposed SFP modification is only 0.03% of the total heat load from the plant, an increase that is less than can be measured;
- (b) At most, heat discharges to the Columbia River by the whole plant will increase by about 4% due to modification of the SFP, an increase that will not cause any significant rise in river temperature, even in the mixing zone.

- (c) Actual river studies have detected no impact on river biota due to Trojan operations and it is clear that the impact of the very small incremental heat added will be negligible;
- (d) The incremental heat load would at worst increase evaporation of water from the cooling towers by 4 gallons per minute, an increase of only 0.0085% in consumptive use of water by the plant due to the SFP modification. This increased evaporation will result in an indiscernable increase in the dew point and no observable increase in fogging.
- (e) The incremental discharge of heat to the river is so small that the pool modification cannot result in Trojan exceeding the current National Pollutant Discharge Elimination System permit or NRC Technical Specification limits governing discharge of heat to the river.

68. In view of the foregoing, we find that the additional heat from the proposed modification will have negligible impact on consumptive use of water and the availability of water to downstream users, no observable effect on fogging in the plant vicinity or the compliance with heat discharge specifications, and no impact of any kind on aquatic biota or the ecosystems of the Columbia River. Accordingly, we conclude that McCoy Contention A1(1, 2 and 3) and McKeel Contention A5 are without merit.

I. Radiological^{12/}

McCoy Contention A2(a), (b), (c):

^{12/} All of Oregon's radiological contentions having been withdrawn, only those advanced by Mr. McCoy and Ms. McKeel are left for adjudication. The Board notes that these two Intervenor did not present any evidence in support of their radiological contentions and did not file proposed findings thereon.

While the Trojan request identified planned environmental releases of radioactivity, no consideration is given to the environmental impacts associated with these releases. Specifically: (a) the analysis presented does not, on a cumulative basis for the maximum time of storage under consideration, evaluate the potential impacts on biota (both terrestrial and aquatic) in the vicinity of the facility which may ultimately effect the human food chain, in a cost-benefit framework, (b) no analysis is made of the overall costs (in terms of both health effects and potential associated medical costs) associated with the additional exposures of the plant personnel to increased radioactivity levels due to the increased spent fuel storage, and (c) no analysis is made of the overall costs (in terms of both health effects and potential associated medical costs) associated with the additional exposures of persons off the Trojan site to increased radioactivity levels due to the increased spent fuel storage.

69. The environmental impacts of the potential releases of radioactivity due to the proposed modification were addressed in detail in the Staff's Environmental Impact Appraisal (Staff Ex. 1B, Section 5.3). The maximum time of storage considered was the operating license lifetime for the Trojan facility (Trammell, Tr. 2165). The radiological impact on marine life, plants, foodstuffs, soil and hydrology of the additional radioactivity released under the proposed modification was evaluated as was the additional impact through all pathways considered in the NRC's Final Environmental Impact Statement related to operation of Trojan. The impacts on terrestrial and aquatic biota of increased releases due to the proposed modification are insignificant and so small

that all conclusions set forth in the Final Environmental Statement are unaffected (Donohew written testimony on A2, pp. 2-3, fol. Tr. 5400; Staff Ex. 1B, pp. 7-8, and 10-13; Frewing written testimony, p. 76, fol. Tr. 5337).

70. Based on experience at similar facilities, the Staff estimates that the occupational exposure during installation of the new racks in the SFP, which is already storing spent fuel, will be about 2 man-rem (Staff Ex. 1B, p. 13). The incremental exposure to plant workers from operation of the modified SFP is estimated to be about 2.4 man-rem per year or substantially less than 1% of the expected annual exposure for the facility (Donohew written testimony on McCoy A2, pp. 3-5, fol. Tr. 5400; Staff Ex. 1B, p. 13). It is clear that these exposures are extremely low, that the proposed modification will result in an insignificant increase in doses received by occupational workers, and that it will have an insignificant effect on health costs to workers (Donohew written testimony on McCoy A2, pp. 4-6, fol. Tr. 5400; Staff Ex. 1B, p. 13; Donohew written testimony on Oregon B3, p. 2, fol. Tr. 5401; Frewing written testimony, p. 73, fol. Tr. 5337).

71. Additional releases from the facility as a result of the proposed modification have been evaluated in detail. These include the release of an additional 54 Curies per year of krypton 85. The additional krypton results in a dose of less than 0.001 mrem per year at the

site boundary as compared to 0.31 mrem per year for total plant releases of noble gases or to 100 mrem per year which an individual receives from natural background radiation. (Donohew written testimony on McKeel A3(a), pp. 1-2, and on McCoy A2, p. 6, fol. Tr. 5400). The additional total body dose to the population within a 50-mile radius due to the total additional releases from the modified SFP is less than 0.005 man-rem per year. This is less than the normal fluctuations in the dose this population would receive from natural background and is less than 0.5% of the level of exposure to the population from the plant as a whole (Donohew written testimony on McCoy Contention A2, pp. 6-7, fol. Tr. 5400). The potential dollar cost to the population within a 50-mile radius from this incremental exposure would be \$5 per year based on the \$1000 per man-rem figure set forth in section 2. D of Appendix I to 10 C.F.R. 50. These doses to the public will not result in any observable health effects (Donohew written testimony on McCoy Contention A2, p. 8, fol. Tr. 5400) and can only be considered as insignificant.

72. The effect of the generation of solid waste to be shipped off-site was also evaluated conservatively assuming that one additional resin bed a year would be replaced because of the proposed modification. This would increase the total volume of radwaste shipped from the plant by less than 1% per year. Disposal of the existing fuel storage racks as radwaste would also increase the total volume of radwaste shipped

from the plant by less than 1%, averaged over the plant lifetime. These quantities are small fractions of solid radwaste previously evaluated for plant operation and the overall environmental impact of these slight increases in the amount of solid radwaste due to the proposed modification is insignificant (Staff Ex. 1B, pp. 11-12).

73. Based on the foregoing, we find that the additional releases of radioactivity from normal operation of the modified SFP have been adequately evaluated and that the environmental impacts of such releases on biota, plant workers and persons off the Trojan site are insignificant. We also find that health costs to plant workers and to the public will not be measurably increased due to additional radioactivity from the proposed modification. Consequently, we find McCoy Contention A2 to be without merit.

McCoy Contention A3:

There is no adequate analysis of the environmental impacts, such as described in Contention 2(a)-(c), which would result from abnormal and/or accidental releases of the increased radioactivity from the modified spent fuel storage pool.

74. Staff does address environmental impacts of abnormal events which are high probability events resulting in releases greater than normal but less than the limits imposed by the Technical Specifications. These specifications will not be changed, will be applicable to the modified SFP, and will prevent release of radioactive materials due to abnormal events in excess of Part 20 limits. The environmental impacts

of postulated accidents are given in Section VI of the FES for Trojan. These postulated accidents will not change because of the proposed modification of the SFP and the analysis of environmental impacts made in the FES is still valid. (Donohew written testimony on McCoy A3, pp. 1-2, fol. Tr. 5400).

75. On the basis of this testimony, the Board finds that an adequate analysis of environmental impacts due to abnormal and/or accidental releases of increased radioactivity from the modified SFP has been made and that McCoy Contention A3 is without merit.

McKee1 Contention A3(a), (b):

The potential increase in gaseous emissions resulting from the proposed SFP modifications, when considered in combination with gaseous releases from reactor operations as proposed by the Licensee, will increase total gaseous emissions to the environment to the extent that such emissions are likely to exceed the emissions of Appendix I to 10 C.F.R. Part 50, and (b) the Licensee's inability to accurately predict the type of radionuclides released, and therefore, its inability to accurately predict the quantity of such releases increase the likelihood that the limits of Appendix I to 10 C.F.R. 50 will be exceeded if the SFP capacity is increased.

76. The Staff has not completed its review of overall Trojan compliance with Appendix I to 10 C.F.R. 50 limits as applied to gaseous emissions. However, these emissions were conservatively estimated in the Staff's Environmental Impact Appraisal as an additional 54 curies per year of Kr-85 due to modification of the SFP, compared with a total

noble gas release of 3244 curies per year, i.e., an increase of 2.6%. This additional release would result in a dose rate of less than 0.001 mrem per year at the site boundary. Since the design objective for gas releases in Appendix I is 5 mrem per year to the whole body at the site boundary, the 0.001 mrem/year is not expected to cause the plant to exceed Appendix I requirements. (Donohew written testimony on McKeel A3(a), pp. 1-2, fol. Tr. 5400; Staff Ex. 1B, p. 10).

77. In both the Final Safety Analysis Report for the Trojan facility and PGE Ex. 2, the Licensees list radionuclides expected to be released to the atmosphere from refueling and fuel storage operations. Those radionuclides listed were those of greatest dosimetric significance and those calculated to have release rates above certain minimum values. The evidence shows that the Licensees' analytical methods and models for predicting radionuclide releases are consistent with those recommended for use by NRC Regulatory Guides and that the accuracy of the estimates produced by the models has been confirmed by studies and actual measurements at operating reactors. Thus there is no evidence that the Licensees' predictions of radionuclide releases are inaccurate or that calculational errors will result in releases exceeding the limits of Appendix I to 10 CFR Part 50. (Walt written testimony, pp. 1-2, fol. Tr. 5338; Donohew written testimony on McKeel A3(b), pp. 1-2, fol. Tr. 5401). Accordingly we find McKeel Contention A3(a) and (b) to be unfounded.

McKeel Contention A4:

The Licensee has failed to adequately assess the environmental impacts of increased liquid and gaseous radioactive emissions and leaks likely to result from assemblies which are not subject to removal from the SFP under current contractual arrangements.

78. The environmental impacts from the release of radioactive effluents as a result of the proposed modification have been addressed in our findings regarding McCoy Contentions A2 and A3. The incremental total body dose that might be received by an individual or the estimated population within a 50-mile radius due to the proposed modification is less than 0.001 mrem per year and 0.005 man-rem per year respectively. These doses are less than the normal fluctuations that would be received from natural background radiation and are clearly insignificant releases of radioactivity in liquid form would not change because of the modification since pool water will be processed in the radwaste system prior to release (Donohew written testimony on McKeel A4, pp. 1-2, fol. Tr. 5400). In summary, there is substantial evidence demonstrating that the environmental impacts of additional releases of liquid and gaseous radioactive effluents due to the proposed modification have been adequately considered and are insignificant (Staff Ex. 18, pp. 7-13). Thus, McKeel Contention A4 is without merit.

McKeel Contention A6:

The Licensee's calculation of personnel exposure rates and doses (Section 5.2.1.4 of PGE-1013), based on infrequent change (once per year) of the SFP CDS filter and demineralizer changeouts, is inaccurate in that the proposed expansion of SFP capacity and increased fission product inventory will require more frequent changes of such filters to maintain efficient operation, thereby increasing the radiation doses to plant personnel beyond those calculated.

79. The amount of additional solid radioactive waste generated by the proposed modification will be very small. The evidence indicates that the frequency of filter and demineralizer resin bed changeouts will not be significantly affected by the proposed amendment since the amount of solid material in the SFP water will not change significantly (Frewing written testimony, p. 41, fol. Tr. 4181; Staff Ex. 1B, p. 11; Donohew written testimony on McKeel A6, pp. 1-3, fol. Tr. 4501). Nevertheless, for purposes of its assessment of environmental impacts, the Staff conservatively assumed that the amount of solid radwaste may be increased by an additional resin bed a year due to the proposed modification.^{13/}

^{13/} Although the Staff did not assume that the frequency of filter replacement would increase due to the proposed modification, this is of no moment from the standpoint of occupational exposures. Since filter changes are performed remotely, with no direct personnel involvement (Lentsch, Tr. 4262-63), occupational exposures from such changes should be extremely low.

This would increase the total waste volume shipped from the plant by less than 1% per year (Staff Ex. 1B, p. 12). The annual occupational exposure due to the additional resin bed replacement is a very small fraction of the annual occupational exposure due to operating the SFP and will not affect the Licensees' ability to maintain individual occupational exposures to the levels required by the regulations. (Donohew written testimony and McKeel A6, pp. 3-4, fol. Tr. 5401).

80. Accordingly, we find that the evaluation of occupational exposures due to the proposed modification has adequately accounted for more frequent changes of the Cooling and Demineralizer System filters and resin beds and that McKeel Contention A6 is without merit.

Staff's Proposal for Conditions on Installation of Modified Racks While Fuel is Stored in SFP

81. The Staff has recommended an additional condition requiring that new fuel racks be installed in the SFP only after spent fuel stored therein has decayed more than 60 days. Since this will assure that the off-site consequences of a seismic event damaging spent fuel during the installation operation will be well within the guidelines of 10 C.F.R. Part 100 (Donohew written testimony, fol. Tr. 5400, "Unresolved Item in the Staff's Safety Evaluation Dated November 11, 1977", pp. 1-4), we find that this condition, in addition to that regarding minimum boron

concentration specified, supra, is appropriate, and it is imposed in our Order, infra.

J. Environmental Impact Appraisal

1. Adequacy

McCoy Contention B2:

The environmental impact statement (or impact appraisal) required for this licensing action must fully consider all environmental impacts attributable to expansion of the Trojan spent fuel storage pool capacity as well as similar impacts at other facilities and such statement (or appraisal) must consider those impacts as persisting for the period of the operating license.

82. The Staff issued the Environmental Impact Appraisal (EIA) on November 11, 1977. (Staff Ex. 1B). The EIA describes the proposed modification of the Trojan SFP, identifies and discusses the environmental impacts involved, and, under the heading captioned "Basis and Conclusion for not Preparing an Environmental Impact Statement", states that:

"We have reviewed this proposed facility modification relative to the requirements set forth in 10 C.F.R. Part 51 and the Council on Environmental Quality's Guidelines, 40 C.F.R. 1500.6 and have applied, weighed, and balanced the five factors specified by the Nuclear Regulatory Commission in 40 Fed. Reg. 42801. We have determined that the proposed license amendment will not significantly affect the quality of the human environment. Therefore, the Staff has found that an environmental impact statement need not be prepared, and that pursuant to 10 C.F.R. 51.5(c), the issuance of a negative declaration to this effect is appropriate."
(Staff Ex. 1B, p. 26).

The impacts were evaluated for the period of the operating license (Donohew, Tr. 5578-79).

83. The EIA's conclusions were as follows: (1) The proposed modification will not require any additional commitment of land. (Staff Ex. 1B, p. 5). (This conclusion was uncontroverted); (2) There will be no significant change in plant water usage (p. 6). (See Findings 67 and 68, supra, wherein we conclude that the increase in water use due to the proposed modification will be negligible and will have no environmental impact, that the thermal impacts on biota from incremental increase in heat released because of the proposed modification will be negligible, and that the small amount of additional heat will have no observable effect on fogging); (3) There will be no significant liquid or gaseous radioactive releases to the environment as a result of the proposed modification (pp. 10-13). (See Findings 73 and 78, supra, wherein we conclude that incremental liquid and gaseous releases will have an insignificant environmental impact); (4) The amount of additional solid radioactive waste resulting from the proposed modification will be less than one percent of the amount shipped annually from the plant (pp. 11-12). (See Finding 79, supra); (5) The proposed modification will add less than one percent to the total annual occupational radiation exposure at the facility and will not result in any significant increase in doses received by workers (p. 13). (See Finding 79, supra, wherein we find that the increase in occupational exposure due to the proposed modification

is not significant); (6) There will be no change in the chemical or biocidal effluents from the plant as a result of the proposed modification (p. 14). (This conclusion was uncontroverted). (7) No significant environmental impact on the community is expected to result from the fuel rack conversion or from subsequent operation with the increased storage of spent fuel in the SFP (p. 14). (With respect to conclusion number (7), while the Staff did not address and calculate in the EIA any cumulative environmental impacts either of other spent fuel modifications in other parts of the country upon Trojan or of the Trojan modified SFP upon other modified SFP's in other parts of the country, it did not overlook these impacts. The Staff considered the environmental impacts resulting from the SFP modifications at Trojan and at other plants in the country to be localized and inconsequential, and concluded that there would be no cumulative environmental impacts. (Donohew written testimony, pp. 1-2, fol. Tr. 5558; Donohew, Tr. 5559-61; 5565-66). The testimony of the Staff's witness withstood cross-examination and the Intervenors did not present direct testimony challenging this conclusion).

84. Accordingly, we find that, for the lifetime of the operating license, the EIA fully considered all environmental impacts attributable to the expansion of the Trojan spent fuel storage pool capacity as well as similar impacts at other facilities. The contention is without merit.

85. We note that the State of Oregon asserts that Staff and Licensees have failed to meet their burden of proving that certain factors have been applied, weighed and balanced in Section 8.4 of the EIA ^{14/} as required by the Commission's notice of "Intent to Prepare Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel", 40 Fed. Reg. 42801 (September 16, 1975). ^{15/} (Oregon's Proposed Findings 58-64 and Memorandum of Law, pp. 2-9).

86. Since Oregon agrees that the evidence supports a finding that the first factor has been adequately evaluated, no further discussion is needed. With regard to the second factor, Oregon asserts that it has been adequately evaluated in part because the amount of materials and money expended would not significantly tend to foreclose consideration of alternatives, but that, in part, it has not been evaluated because a Staff witness testified that, assuming the modification is approved and in place, there will be a strong disincentive to do anything other

^{14/} In passing, we reject Oregon's criticism that the Staff's discussions in the EIA are brief and are in summary form since such treatment is in accord with a Council on Environmental Quality Guideline, 40 C.F.R. 1500.6 (e), and NRC regulation, 10 C.F.R. § 51.7.

^{15/} In this notice the Commission concluded that there should be no general deferral of licensing actions intended to ameliorate a possible shortage of spent fuel storage during the period required for the completion of the generic environmental impact statement. The Commission listed the following five factors to be applied, weighed and balanced within the context of an environmental impact statement or impact appraisal:

(1) It is likely that each individual licensing action of this type would have a utility that is independent of the utility of other licensing actions of this type.

than use the modified racks until they are full. However, our review of the witness's entire testimony shows that he did not necessarily concur that, once the modified racks were in place, there would be a strong disincentive to do anything other than use them until they were full (Clark, Tr. 5748). Accordingly, the evidence supports a finding that the second factor has been adequately evaluated. As concluded above in Finding 83, the Staff did not overlook any cumulative environmental impacts and thus the third factor has been sufficiently evaluated. With regard to the fourth factor, while we agree with Oregon that there is a technical problem concerning the transportation of heavy objects which could impact upon stored spent fuel, we disagree that this problem cannot be resolved by the Board - see Finding 25, supra, where we have imposed a condition to the license amendment.^{16/} Finally, regarding the

Footnote continued:

(2) It is not likely that the taking of any particular licensing action of this type during the time frame under consideration would constitute a commitment of resources that would tend to significantly foreclose the alternatives available with respect to any other individual licensing action of this type;

(3) It is likely that any environmental impacts associated with any individual licensing action of this type would be such that they could adequately be addressed within the context of the individual license application without overlooking any cumulative environmental impacts;

(4) It is likely that any technical issues that may arise in the course of a review of an individual license application can be resolved within that context; and

(5) A deferral or severe restriction on licensing actions of this type would result in substantial harm to the public interest.

^{16/} We note that, on the one hand, Oregon asserts in substance that not all concerns regarding the transportation of heavy objects which could impact upon stored spent fuel have been resolved satisfactorily in this proceeding, that the Staff is conducting a generic review upon the subject, and thus that the license amendment should not be granted at this time. (Proposed Finding 62). On the other hand, however, Oregon asserts that, if the license

fifth factor, we are aware that 1/3 of the core was off-loaded and stored in the Trojan SFP in March 1978. At this annual rate of off-loading and refueling, by the Spring of 1979, the existing SFP will lose full-core storage capacity. Because full-core discharge would not be possible thereafter, the Licensees might be unable to perform ad hoc necessary inspections and maintenance, and the plant might have to be shut down (Frewing, Tr. 5643; Clark written testimony, p. 6, fol. Tr. 5692; Clark, Tr. 5694; Trammell, Tr. 5695, 5825-26). We are advised that there is a greater than 0.50 chance that Trojan will have to discharge a full-core in the period between 1979 (when full-core storage capacity will be lost) and 1982 (when the existing SFP will be filled) (Frewing, Tr. 5621; Owens, Tr. 5644, 5649-51, 6159, 6161-63). Since Trojan might be forced to shut down after the Spring of 1979 because the SFP could not accommodate a full-core if necessary or, at the latest by 1982, when the pool will be filled, we concur with the Staff's conclusion in the EIA that deferral or severe restriction of the action here proposed would result in substantial harm to the public interest (Staff Ex. 1B, p. 26).

Footnote continued:

amendment is granted, it would be reasonable to impose a Technical Specification prohibiting PGE from carrying loads over the SFP at heights such that the impact energy of any dropped object upon the storage racks cannot exceed 240,000 in.-lbs. (Proposed Finding 31).

Further, we note that, except for this technical problem, Oregon states that it "believes there is a minimal danger to public health and safety posed by the modification". (Memorandum Of Law In Support Of Proposed Findings Of Fact And Conclusions Of Law, p. 1).

87. We conclude that the Staff has shown that it adequately applied, weighed and balanced the five factors set forth in the notice of Intent to Prepare Generic Environmental Statement on Handling and Storage of Spent Light Water Power Reactor Fuel.

2. Proper Issuance

McCoy and Garrett Contention B1:

The proposed license amendment constitutes a major federal action which significantly affects the quality of the human environment and, therefore, requires the preparation, circulation for comment, and issuance in final form of a formal environmental Impact Statement, in accordance with the requirements of the National Environmental Policy Act and the guidelines of the Council on Environmental Quality, prior to any Commission action on the proposed license amendment.

87. Despite the fact that the State of Oregon concedes, "based upon the record in this case, that the site-specific environmental impacts of the Trojan modification are insignificant", and despite the fact that it does not oppose installation of the new SFP storage racks, it opposes the use of such racks for the storage of more than 1 1/3 cores of spent fuel. Apparently Oregon argues that, insofar as permitting the use of the new racks is concerned, the requested license amendment cannot be granted, without violating the National Environmental Policy Act (42 U.S.C. 4321, et seq.), absent completion of an adequate generic environmental impact statement on the subject of handling and storage of light water reactor spent fuel. It requests that we defer ruling upon the requested amendment

until after said generic statement (GEIS) has been issued and evaluated in the instant proceeding (Oregon's Memorandum of Law In Support Of Proposed Findings And Conclusions, pp. 1-2, 16).

89. The National Environmental Policy Act of 1969, § 102(2)(c), 42 U.S.C. § 4332(2)(c) (NEPA)^{17/} provides in pertinent part that:

. . . all agencies of the Federal Government shall - . . .

(C) include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on -

(i) the environmental impact of the proposed action

90. We conclude that the contention, as well as Oregon's argument, are without merit. NEPA does not require the issuance of either a Final Environmental Impact Statement or of a GEIS on the handling and storage of light water reactor spent fuel before this Board can proceed to determine whether or not to grant the requested modification. Our unpublished Memorandum and Order, dated December 14, 1977, recognized this in affirming previous rulings with regard to the McCoy-Garrett Contention B1, wherein we had held that we would defer determining whether or not a Final Environmental Impact Statement was required until after we had heard the evidence

^{17/} The language of the Council on Environmental Quality's Guidelines, 40 C.F.R. 1500.2, tracks that of NEPA.

and reviewed the Staff's EIA.^{18/} Even were we to assume that this action could be considered a "major" one, the evidence of record establishes and our findings reflect that the proposed modification will not significantly affect the quality of human environment. Accordingly, we affirm the Staff's determination to make a negative declaration to that effect pursuant to the Commission's regulations, 10 C.F.R. §§ 51.5(c)(1) and 51.7, and pursuant to the Council on Environmental Quality Guidelines, 40 C.F.R. 1500.6(e).^{19/}

^{18/} At the time of these rulings, Oregon had not advanced its legal argument concerning the generic environmental impact statement on the handling and storage of spent fuel.

^{19/} 10 C.F.R. 51.5(c)(1) provides in pertinent part:

" . . . if it is determined that an environmental impact statement need not be prepared . . . , a negative declaration and environmental impact appraisal will, . . . , be prepared"

10 C.F.R. 51.7 provides in pertinent part:

"(a) Negative declarations. The negative declaration required by § 51.5(c) will be prepared prior to the taking of the associated action and will state that the Commission has decided not to prepare an environmental impact statement for the particular action and that an environmental impact appraisal setting forth the basis for that determination is available for public inspection. Negative declarations will be published and made publicly available in accordance with §§ 51.50(d) and 51.55. Lists of negative declarations will be maintained and made publicly available in accordance with § 51.54(b).

(b) Environmental impact appraisals. An environmental impact appraisal will be prepared in support of all negative declarations. The appraisal will include:

(1) A description of the proposed action;

(2) A summary description of the probable impacts of the proposed action on the environment; and

K. Alternatives To And Need For The Proposed Modification

Oregon Contention A1:

The Licensee's justification for the proposed amendment, in terms of the economic and environmental costs and benefits thereof and of alternatives thereto, is inadequate to support issuance of the proposed amendment. Specifically:

- (b) the Licensee's brief, conclusionary discussion in Section 6 of PGE-1013 does not constitute adequate consideration of the economic and environmental consequences of other alternatives deserving of present consideration including Trojan shutdown, shipment of spent fuel to another reactor, or shipment of spent fuel to an off-site repository.
- (c) the Licensee did not establish that the taking of the requested licensing action would not constitute a commitment of resources that would tend to significantly foreclose other alternatives such as development of an off-site interim repository, development of a regional spent fuel storage facility or shipment of spent fuel to another reactor or off-site facility.

Oregon Contention B1:

The Licensee's justification for the proposed amendment, in terms of the economic and environmental costs and benefits thereof and of alternatives thereto, is inadequate to support issuance of the proposed amendment. Specifically:

- (a) the Licensee has not provided an adequate justification, i.e., need for the amount of expanded storage capacity it has selected.

Footnote continued:

(3) The basis for the conclusion that no environmental impact statement need be prepared.

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40 C.F.R. 1500.6(e) provides in pertinent part:

". . . If an agency decides that an environmental statement is not necessary for a proposed action. . . (iv) for which the agency has made a negative determination . . . , the agency shall prepare a publicly available record briefly setting forth the agency's decision and the reasons for that determination"

Garrett Contention A1:

The Licensee has not provided an adequate analysis of alternatives to the proposed spent fuel pool modifications. Specifically:

- (a) The Licensee has not adequately considered the comparative costs and benefits of such alternatives as the following: storage at a commercial facility; storage at the Allied General Nuclear Services' reprocessing plant; storage at a federal military facility; storage at another nuclear plant; storage of four regions of spent fuel in the existing unmodified Trojan spent fuel pool without retaining a three-region reserve capacity;
- (b) The Licensee has not adequately considered alternatives which premature expansion of spent fuel pool storage capacity would tend to significantly preclude or foreclose such as the above and the following: storage at federal retrievable surface storage sites; the use and promotion of measures such as conservation and development of non-nuclear power sources, which would allow reactor shutdown or reduced power output from Trojan and a consequent reduction in the rate of generation of spent fuel.

Such failure to adequately consider alternatives violates the National Environmental Policy Act. In addition, foreclosure of development or exploration of such alternatives would tend to significantly affect other licensing actions designed to ameliorate a possible shortage of spent fuel storage capacity.

Garrett Contention A2:

The explicit basis for the Licensee's application for expanded spent fuel storage is that off-site storage will not be available when needed. This "need for expanded storage capacity" assumption is speculative. Since (1) the Licensee can store

spent fuel in existing unmodified facilities (without retaining reserve capacity) until 1982, and (2) off-site storage could be available by 1982, the Licensee has not adequately demonstrated a present or future need for expanded storage capacity which would justify the economic and environmental risks and costs which will be incurred as a result of premature modification of the existing spent fuel pool. Moreover, for these same reasons, the Licensee has not demonstrated that "substantial harm to the public interest" would result if approval of the proposed modification were to be delayed until after the issuance of the generic Environmental Impact Statement now being prepared by the Commission.

McCoy Contention A4:

The Licensee's analysis of alternatives to the proposed modification is inadequate in that it fails to properly consider both the comparative economic and environmental costs of those alternatives identified in Section 6.0 of the Application for License Amendment. In addition, the Licensee has failed to provide an adequate basis for limiting its consideration to those alternatives which it has discussed.

McKeel Contention A7:

The Licensee's analysis of the alternative of suspending power operations at the Trojan plant, in lieu of installing the modified spent fuel storage racks, is inadequate in that comparative cost estimates for replacement power for Trojan are predicated upon the Licensee's erroneous calculations of the future availability of power sources and the present and future demand for power generated.

91. The Staff and the Licensees submitted proposed findings on all these contentions. Oregon and Ms. Garrett submitted proposed

findings on their respective contentions. For the reasons set forth below, we will not make findings on each contention, but will treat these as a group.

92. Both Oregon's and Ms. Garrett's witnesses testified regarding these contentions (Timm written testimony, fol. Tr. 5957; Oregon Ex. 1, pp. 3-8; Garrett Ex. 8). We heard extensive direct testimony of the Staff's and Licensees' witnesses (Clark written testimony, fol. Tr. 5692; Frewing written testimony, fol. Tr. 5638) and rebuttal testimony of the Licensees' witnesses (Hunt written testimony, fol. Tr. 6495; Schultz written testimony, fol. Tr. 6398; Moke written testimony, fol. Tr. 6404).

93. The gist of the Intervenors' witnesses' testimonies was that Trojan could be shut down for certain periods without causing either serious shortages of electric power or incurring excessive costs. Indeed, one witness, Dr. Timm, predicted that shut down would save money under certain circumstances, principally because of the effect on his calculations of a concept he favored: the notion that Trojan's expected lifetime could be extended by some fraction of any period for which the plant might be shut down (Timm written testimony, p. 23 and Schedule 10 fol. Tr. 5957). The Licensees' witness disputed this idea (Moke written testimony, pp. 8-10, fol. Tr. 6404). Further, in order to generate figures showing a cost advantage for shut down, Dr. Timm assumed availability of hydro power at average, rather than "critical water" flows.

The average flow he assumed was, in fact, 20% above the critical flow (Timm written testimony, pp. 17-18, fol. Tr. 5957). We note that hydro-electric power is very low-cost power (Anderson, Tr. 6157; Schultz, Tr. 6471).

94. Mr. Lionel Topaz, whose testimony comprises Garrett Exhibit 8, made no economic analysis of the Trojan plant, but attempted to demonstrate that the need for power in this region could be met without operating Trojan. He used demand growth curves considerably below those of the Licensees (Garrett, Ex. 8, attachment 4) and urged changes in Bonneville Power Administration water policy which would make more hydro power available (rather than conserving large amounts of water) (Garrett Ex. 8, p. 13), but he did not take credit for such changes. He assumed 100 MW of secondary hydro power at 78% availability and surplus 1000 MW at 56% availability (Garrett, Ex. 8, p. 15). Both Dr. Timm and Mr. Topaz assumed the availability of plants not yet built (Timm, Tr. 6049-51; Topaz, Tr. 6318).

95. The Staff's position is that no significant change has occurred in the need for power since the plant was licensed to operate, nor has any interim change occurred in the availability of alternatives (Clark written testimony, pp. 8-9, fol. Tr. 5692).

96. Licensees' position is that the matter of need for power was established in the operating license proceeding (Applicants' Proposed Findings at pp. 56-7) and that other alternatives have been adequately considered (Applicants' Proposed Findings, pp. 47-57, passim).

97. The Board recognizes the difficulties which inhere in comparing the costs of various alternatives and in extrapolating electrical power requirements. Indeed, in an area where hydroelectric power is an important resource, both the availability and the comparative cost of power depend strongly on the availability of such hydroelectric power, and that in turn depends upon that paradigm of unpredictability, the weather itself.

98. It is not necessary, however, to choose among alternatives or to predict needs on the basis of the present evidence. In our findings, supra, we have determined that the adverse environmental impacts of this license amendment will be negligibly small. Clearly, if the adverse impacts of the proposed action are negligible, the impacts of any alternative must be equal or greater, and it has been held that "An alternative which would result in similar or greater harm need not be discussed" (Sierra Club v. Morton, 510 F.2d 813, 825 (5th Cir. 1975)). As to the question of need for power, as we view it, that question could only be considered against the background of a cost-benefit balance, and, absent any substantial environmental costs, any benefit whatever would tip the scale. We therefore believe that we need not

consider alternatives or the need for the modification in any detail. Indeed, in the opinion of this Board, not only is such consideration unnecessary, it is very inadvisable, since it infringes upon those very prerogatives and duties of corporate management which we should eschew usurping. To be sure, were there substantial adverse environmental impacts, our duties under NEPA would require us to balance them against benefits and examine less damaging alternatives. But where, as here, the proposed action has no such impacts, we can leave considerations such as economic advantage, capacity requirements, and the vigor with which off-site storage should be pursued to those within the company to whom such decisions are normally entrusted.

L. Board Questions On Volcanism, Landslides And The Release of Plutonium

99. During the taking of limited appearance statements, several members of the public expressed concerns with regard to a possible increase in volcanic activity in the Pacific Northwest region (Tr. 434), the potential for landslides in the vicinity of the Trojan facility (Tr. 474; Tr. 833-48) and the release of plutonium from the Trojan facility (Tr. 564). After review of these limited appearance statements, the Board determined that additional consideration should be given to the concerns expressed therein and directed that evidence should be presented with regard to volcanism and landslides as they might affect SFP integrity and with regard to the effects of the proposed modification on the release of

plutonium from the Trojan facility (Tr. 884-85). These matters are addressed below.

Board Question 1:

"We note that one of the limited appearors mentioned a recent increase in volcanism in this area, an increase in the activity of volcanoes. We have not seen anything that discussed this in your direct testimony or the safety portion of the Staff's testimony, and we would like the Staff, the Applicant, or, for that matter, any of the other parties to be prepared to present evidence as to whether any increases in volcanism could present a hazard to the integrity of the fuel pool.

The same is true of the phenomenon of landslides. We recognize that landslides are often associated with earthquakes, but they are in this area also present when there are no earthquakes, and we want to know whether the threat which landslides might present to the integrity of the spent fuel pool has been thoroughly investigated. We will welcome testimony from any of the parties."
(Tr. 884).

100. Two new studies on Cascade volcanism have been performed since the issuance of the Trojan Safety Evaluation Report in 1974. Neither study shows anything that would affect the SFP at Trojan (Christensen written testimony, p. 2, fol. Tr. 5581). Mt. St. Helens, 65 km from the Trojan site, has the highest potential to affect Trojan, but this potential is very small. Although there has been some recent increase in activity at Mt. Baker in the State of Washington, an eruption at Mt. Baker would not affect the Trojan site because of the distance

from the site (Christensen written testimony, p. 1, Tr. 5601). An eruption at Mt. St. Helens would have little or no effect on Trojan from the standpoint of ashfall because the prevailing winds are in the opposite direction (Christensen written testimony, p. 2, Tr. 5602). The winds blow from Mt. St. Helens toward the 12^o sector including Trojan less than 1% of the time. The probability of persistent winds from Mt. St. Helens toward Trojan for a 12-hour period is less than .001 per year and for a 24-hour period is less than .00001 per year (Christensen written testimony, p. 2). In addition, ashfall decreases rapidly with downwind distance from the volcano. At a distance of 25 to 30 km., the problem from ashfall is reduced to one of cleanup (Christensen written testimony, p. 2). Mud or lava flows present no hazard because of the distance of Cascade volcanos from the site (Tr. 5605). In view of all of this, we conclude that potential hazards to the Trojan site and the SFP from Cascade volcanoes have been adequately addressed and that these hazards are essentially non-existent. No evidence to the contrary was presented by any party.

101. Landslides were evaluated in the Trojan Safety Evaluation Report issued in 1974. More recently, a study on landslides in the Columbia River Gorge was performed for the Licensees in 1978 (Christensen written testimony, p. 1). That study considered landslide phenomena and potential mechanisms for an area from the Bonneville Dam to the Dalles.

Nothing above the Bonneville Dam could result in a landslide that would dam the river and landslides below the study area would be of such a nature that the plant site would not be endangered, although some blockage of the river could occur (Christensen, Tr. 5593-94). The study performed for the Licensees shows that only one slide, the Collins Point Landslide, has even a remote potential to block the Columbia River. The resulting flood would crest at 25 feet above MSL and would not affect the Trojan facility which is designed against floods up to 45 feet above MSL (Christensen written testimony, p. 1; Tr. 5599-5600). As to the slide-block phenomenon, the available geological and geophysical information shows that the Trojan site is underlain by bedrock and that deep mass movement below the site is not a factor (Christensen written testimony, pp. 1-2). No evidence suggesting that landslides present a hazard was presented by any party. In view of the foregoing, we conclude that the potential hazards to the Trojan site and to the integrity of the SFP from landslides have been adequately addressed and that those hazards are essentially non-existent.

Board Question 2:

"Several limited appearors suggested that there might be a substantial increase in the leakage of plutonium because of the additional storage in the fuel pool. This seems to the Board intuitively unlikely, but we would like to have this addressed, some comparison between the total leakage from the plant of plutonium before and after the expansion of the fuel pool" (Tr. 884-885).

102. Pursuant to the Board's direction, an analysis was performed to determine the total plutonium inventories in fuel assemblies as a function of burnup. Leakage of plutonium into SFP water was calculated assuming .12% of the stored spent fuel had defects (Lentsch written testimony, pp. 1-2, fol. Tr. 5438). From this analysis, which includes a factor of conservatism on releases of at least 10 (Lentsch, Tr. 5494), the total incremental gaseous releases of plutonium as a result of the proposed modification were shown to be less than 4.3×10^{-8} curies per year (Lentsch written testimony, Table 3). The maximum incremental off-site doses from plutonium releases in gaseous form due to the proposed modification, considering all possible exposure pathways, were shown to be on the order of 10^{-5} mrem per year for bone and 10^{-6} mrem per year for all other organs and the whole-body (Lentsch written testimony, p. 2). These doses are less than 0.01% of doses from total plant emissions, less than 0.001% of 10 C.F.R. Part 50, Appendix I design objective values and less than 0.0001% of natural background doses (Lentsch written testimony, p. 3).

103. Although, in the Licensees' view, no plutonium would be released in liquids from the SFP (Lentsch written testimony, p. 2), the Staff assumed, for purposes of analysis, that the primary mechanism

for plutonium release would be through liquid releases. Based on its evaluation, the Staff predicted that the maximum amount of plutonium released from the plant as a whole will be less than 10^{-5} curies per year, resulting in off-site exposures of less than 10^{-7} mrem per year, which is insignificant compared to doses from natural background or other plant releases (Donohew written testimony, p. 1, Tr. 5504). The amount of plutonium in SFP water will not be significantly affected by the proposed modification and any increased amounts that do result from the modification should be removed by the SFP purification systems (Donohew written testimony, pp. 1-4).

104. The evidence shows that plutonium releases from the plant should be undetectable (Donohew, Tr. 5509-10) and that the increase in releases due to the proposed modification will be negligible and infinitesimally small (Lentsch written testimony, p. 3; Lentsch, Tr. 5447, Tr. 5459; Donohew written testimony, p. 4). The evaluation of the environmental effects of plutonium release took account of environmental accumulation (Lentsch, Tr. 5491-92; Donohew, Tr. 5531). The evidence shows that the total amount of plutonium released from the modified SFP over 40 years is considerably less than the equivalent amount of americium in a home smoke detector (Lentsch, Tr. 5447). Resultant doses are insignificant (Donohew, Tr. 5510, Tr. 5531). No evidence to the contrary was offered. We conclude that concerns with regard to plutonium releases have been adequately addressed, that the

amount of plutonium released due to the proposed modification will be infinitesimal, that the resultant doses will be negligible and that the environmental impacts, if any, will be insignificant.

III. CONCLUSIONS OF LAW

The Licensing Board has thoroughly reviewed and evaluated the evidence submitted by all parties with respect to the contentions raised by the Intervenors herein which have not been withdrawn and remain as issues in this proceeding. The Licensing Board has also considered all of the proposed findings of fact and conclusions of law submitted by the parties. Those proposed findings not adopted by the Board are herewith rejected. Based upon its evaluation of the Staff's Safety Evaluation and Environmental Impact Appraisal, the Licensees' safety evaluation, the written testimony of all of the witnesses, as well as the answers elicited from these witnesses in response to questions of the Board and the parties, the Board makes the following conclusions of law:

- (1) That there is reasonable assurance that the activities authorized by the operating license amendment can be conducted without endangering the health and safety of the public provided that the conditions set forth in the Order, below, are incorporated into the license;

- (2) That the activities authorized by the operating license amendment will be conducted in compliance with the Commission's regulations;
- (3) That the issuance of the operating license amendment will not be inimical to the common defense and security or to the health and safety of the public provided that the conditions set forth in the Order, below, are incorporated into the license; and
- (4) That the issuance of the license amendment is not a major Commission action significantly affecting the quality of the human environment and that it does not require the preparation of an environmental impact statement under the National Environmental Policy Act of 1969, as amended, 42 U.S.C. § 4321, et seq., and Part 51 of the Commission's Regulations, 10 C.F.R. Part 51.

IV. ORDER

Wherefore, it is ORDERED, in accordance with the Atomic Energy Act, as amended, and the regulations of the Nuclear Regulatory Commission, and based on the findings and conclusions set forth herein, that the Director of Nuclear Reactor Regulation is authorized to make appropriate findings in accordance with the Commission's regulations and to issue the appropriate license amendment authorizing the requested expansion of the spent fuel storage pool capacity at the Trojan Nuclear Plant.

The aforementioned license amendment shall contain the following conditions:

- (1) Fuel stored in the spent fuel pool shall have a U^{235} loading less than or equal to 44.3 grams per axial centimeter;
- (2) Since spent fuel is now being stored in the spent fuel pool, upon commencement of work on either the existing racks or the new racks in the spent fuel pool in conjunction with replacement of the existing racks with new racks:
 - (a) the water in the spent fuel pool shall contain at least 2000 ppm boron and shall be maintained at this boron concentration until completion of the rack replacement; and

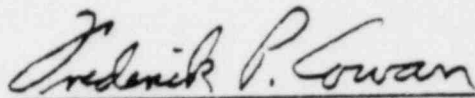
- (b) spent fuel stored in the spent fuel pool must have decayed at least 60 days from the time it was last removed from the reactor.
- (3) The sizes of loads carried over the SFP and the heights at which they may be carried over racks containing spent fuel shall be limited in such a way as to preclude impact energies over 240,000 in.-lbs., if the loads are dropped.

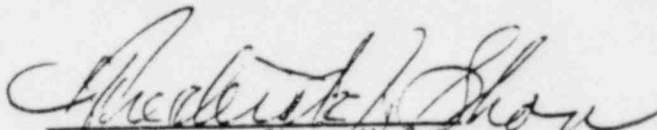
It is further ORDERED, in accordance with 10 C.F.R. §§ 2.760, 2.762, 2.764, 2.785, and 2.786, that this Initial Decision shall be effective immediately and shall constitute the final action of the Commission forty-five (45) days after the issuance thereof, subject to any review pursuant to the above-cited 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 of the Appellant (forty (40) days in the case of the NRC

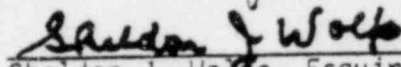
Staff), any other party may file a brief in support of, or in opposition to, the exceptions.

IT IS SO ORDERED.

THE ATOMIC SAFETY AND
LICENSING BOARD


Dr. Frederick P. Cowan, Member


Frederick J. Shon, Member


Sheldon J. Wolfe, Esquire
Chairman

Dated at Bethesda, Maryland
this 5th day of October, 1978.

APPENDIX A

LIST OF EXHIBITS ADMITTED IN EVIDENCE



Licensees' (PGE) Exhibits

<u>No.</u>		<u>Id.</u>	<u>Evid.</u>
1		1324-26	1328
A	Letter, July 22, 1977 from J. L. Frewing to B. D. Withers		
B	Minutes, Plant Review Board, August 2, 1977		
C	Minutes, Nuclear Operations Board Meeting, August 8, 1977		
D	Letter, September 29, 1977, from J. L. Frewing to C. Goodwin		
E	NOB Minutes, October 3, 1977		
F	Request for Design Change, January 21, 1976		
G	Letter, October 11, 1977, from J. L. Frewing to S. R. Christensen		
H	Minutes, Nuclear Operations Board Meeting, October 26, 1977		
I	Letter, November 29, 1977, from J. L. Frewing to S. R. Christensen		
J	Letter, December 5, 1977, from J. L. Frewing to S. R. Christensen		
2	PGE-1013	2006	2048
3	Letter, November 22, 1977, signed by Fred Greenwood to Programmed and Remote Systems Corp.	3022	3022
4	Letter, September 27, 1977, C. Goodwin to A. Schwencer	3511	3521
5	Letter, October 4, 1977,	" "	" "
6	Letter October 10, 1977,	" "	" "
7	Letter, November 8, 1977,	" "	" "
8	Letter, November 10, 1977,	" "	" "
9	Letter, December 15, 1977,	" "	" "

Licensees' (PGE) Exhibits

<u>No.</u>		<u>Id.</u>	<u>Evid.</u>
10	Letter, December 21, 1977, C. Goodwin to A. Schwencer	3513	3521
11	Letter, January 18, 1978, D. J. Broehl to A. Schwencer	3513	"
12	FSAR References (4 pp.); FSAR References, PGE Testimony (3 pp.)	4920	4922
13	Dr. Richard Timm's work papers	5975	5977

Staff Exhibits

<u>No.</u>			
1A	Safety Evaluation Report	2125	2134
1B	Environmental Impact Appraisal	2128	2134
2	Corrosion of Materials In Spent Fuel Storage Pools, by J. R. Weeks, July 1977	4569	4580
3	Affidavit of Dr. John Weeks	4926	6252 (one sentence deleted, 6148)

Oregon Exhibits

<u>No.</u>			
1	Testimony of Donald Godard	2627	2636
2	Category A Technical Activity No. A-36, Revision O, October 5, 1977	4025	4027
3	Agreement between PGE and Allied-Gulf Nuclear Services for Nuclear Fuel Recovery Services, June 30, 1970	5660	5662

Garrett Exhibits

<u>No.</u>			
1	Telephone Memorandum by G. G. Bair re: conversation with Al Johnson, July 27, 1977	1136	1140
2	Letter, October 10, 1977 from C. Goodwin to A. Schwencer	1148	1183

Garrett Exhibits

<u>No.</u>		<u>Id.</u>	<u>Evid.</u>
3	Telephone Memorandum by J. L. Frewing and D. Walt re: Conversation with C. Trummell and J. Gray, July 13, 1977	1155	1183
4	LWR Spent Fuel Disposition Capabilities, 1977 Ed., prepared by ERDA	2917	2924 (qualified admission)
6	Letter, January 3, 1977, from J. E. Grund to Doug Heider, subject: Nuclear Waste Disposal Schedules	6154	6158
7	Memorandum, August 4, 1977, from Edson G. Case, NRC Executive Director for Operations, to NRC Commissioner Gilinsky	6174	6180 (qualified admission)
8	Testimony of Lionel Topaz	6284	6284 (portions stricken at 6272, 6279-80)

McKeel Exhibits

<u>No.</u>			
1	Estimate of Man Hours, New Spent Fuel Pool Rack Modification, 9/27/76, from W. Zuver to T. Bushnell	1266	1285

Board Exhibits

<u>No.</u>			
1	NRC Staff's Response to Licensee's Request That Licensing Board Take Official Notice of Portions of FSAR	4921	4922