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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket Nos. 50-522
PUGET SOUND POWER & LIGHT COMPANY, et al.,	)	50-523
	)	
(Skagit Nuclear Power Project, Units 1 and 2)	)	September 14, 1979
	)	

APPLICANTS' PROPOSED
FINDINGS OF FACT AND CONCLUSIONS OF LAW
IN THE FORM OF A
PARTIAL INITIAL DECISION
AUTHORIZING LIMITED WORK AUTHORIZATION

1. On October 24, 1975, and April 13, 1977, Applicants filed in this proceeding proposed findings of fact and conclusions of law on matters which had been heard as of those dates.

2. Subsequently, additional hearings have been held on matters which had been the subject of the earlier sessions, as well as on topics which had not been considered previously.

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3. Last month the Board prescribed the following schedule for the submission of revised proposed findings:

Environmental and Suit Suitability Issues Upon Which Hearings Have Been Completed —— Not Including Floodplain Management and Financial Qualifications.

Applicants	September 14, 1979
Other Parties (including NRC Staff)	October 5, 1979
NRC Staff & Applicants' Replies	October 19, 1979

(Tr. 14,615-616, 14,621-622, 15,026.)

Floodplain Management and Financial Qualifications.

Applicants	October 8, 1979
Other Parties (except NRC Staff)	October 25, 1979
NRC Staff Findings and Replies and Applicants' Replies	November 5, 1979

Remaining Issues.

Not yet scheduled

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4. Applicants herewith submit their proposed findings on all environmental and site suitability issues upon which hearings have been completed —— but not including Floodplain Management or Financial Qualifications —— and request that they be substituted for all of those previously submitted by Applicants.

5. Proposed findings on the other issues will be submitted in accordance with the schedule recited above.

Respectfully submitted,

PERKINS, COIE, STONE, OLSEN & WILLIAMS

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
PUGET SOUND POWER & LIGHT	)	Docket Nos. 50-522
COMPANY, et al.	)	50-523
	)	
(Skagit Nuclear Power Project,	)	September 14, 1979
Units 1 and 2)	)	

APPLICANTS' PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW IN THE FORM OF A PARTIAL INITIAL DECISION AUTHORIZING LIMITED WORK AUTHORIZATION

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UNITED STATES OF AMERICA
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BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
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APPLICANTS' PROPOSED
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PARTIAL INITIAL DECISION
AUTHORIZING LIMITED WORK AUTHORIZATION

I. BACKGROUND

1. This proceeding involves an application filed with the Nuclear Regulatory Commission ("NRC" or "Commission") by Puget Sound Power & Light Company ("Puget") for construction permits to build two boiling water reactors, the Skagit Nuclear Power Project, Units 1 and 2 ("the facility" or "the Project"), at a proposed site ("the site") in Skagit County, Washington,

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approximately 64 miles north of Seattle.* The application has been filed by Puget on its own behalf and on behalf of the other participants in the Project: Portland General Electric Company ("PGE"), Pacific Power & Light Company ("Pacific"), and The Washington Water Power Company ("WWP;" collectively, along with Puget, referred to as the "Applicants"). Each of the Skagit units will have a nuclear steam supply system with a licensed core thermal output power level of 3800 MWt. Exh. 175, pp. 1-2.

2. The application includes a request for issuance of a Limited Work Authorization ("LWA") pursuant to 10 CFR § 50.10(e)(1). The activities that Applicants seek to conduct pursuant to the requested LWA are described in Exhibit H to the application and are all within the scope of those contemplated by the above-cited regulation. Applicants have acknowledged that, as provided by 10 CFR § 50.10(e)(4), any activities undertaken pursuant to an LWA will be entirely at their own

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*The application was filed September 27, 1974 and docketed September 30, 1974. Exh. 1. It has since been amended four times, most recently through an amendment dated June 1979. Exh. 175. The application is supported by the twenty-five volume Preliminary Safety Analysis Report ("PSAR") and five-volume Environmental Report ("ER") filed in accordance with NRC regulations. Exh. 176; Exh. 4. The application, PSAR and ER have all been received in evidence. Tr. 12,358-363, 12,365, 709, 712.

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risk. If those activities are undertaken but the construction permits are denied, it would be possible to restore the site at a cost of approximately $1.5 million. Intervenor Skagitonians Concerned About Nuclear Plants ("SCANP") has stipulated that Applicants have the required financial resources for restoration and the Board so finds. Myers, fol. Tr. 708, pp. 4-5; Tr. 42-43.

3. On December 20, 1974, the Commission published in the Federal Register (39 F.R. 44,065) a Notice of Hearing on Application for Construction Permits with respect to the application. The Notice set forth the requirements that must be met under the Atomic Energy Act of 1954, as amended, and the National Environmental Policy Act of 1969 ("NEPA") before construction permits for the facility can be issued. The Notice provided that any person whose interest might be affected by the proceeding could file a petition for leave to intervene in accordance with the requirements of 10 CFR § 2.714. The Notice also announced that the Commission had designated an Atomic Safety and Licensing Board ("Licensing Board" or "Board") to conduct the proceeding.

4. Subsequently, on March 1, 1976, an Amended Notice of Hearing on Application for Construction Permits was published in the Federal Register (41 F.R. 8835). The Amended Notice provided, inter alia, a separate opportunity for any person

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whose interest might be affected by the addition of PGE and the deletion of the Washington Public Power Supply System as joint applicants to file a petition for leave to intervene in accordance with 10 CFR § 2.714.

5. This Partial Initial Decision deals with the environmental and site suitability issues specified in 10 CFR § 50.10(e)(2), as well as certain radiological health and safety matters. A decision on the remaining radiological health and safety issues, and the Board's ultimate decision on issuance of construction permits for the facility, will be issued after concluding public hearings on the remaining radiological health and safety aspects of the application.

6. Two petitioners for intervention were ultimately admitted as parties in the proceeding. They are SCANP and Forelaws On Board/Coalition For Safe Power ("FOB/CFSP"). In addition, the State of Washington Energy Facility Site Evaluation Council ("EFSEC"), the State of Oregon, and Skagit County sought and were granted participation as non-parties pursuant to 10 CFR § 2.715(c).

7. SCANP's contentions are set forth in two documents: (1) an agreed statement of SCANP's environmental and site suitability contentions ("SCANP Contentions," fol. Tr. 67), and (2) a document entitled "SCANP Contentions Regarding PSAR" ("SCANP PSAR Contentions"), dated April 15, 1975 and filed pursuant to

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the Board's order of March 17, 1975. The contentions of FOB/CFSP ("FOB/CFSP Contentions") are set forth in the Board's order of May 26, 1976.

8. Limited appearances were made by a large number of pe... . In addition, during the course of this proceeding, the Board has requested the presentation of additional evidence on a number of subjects. The relevant questions have been addressed by the Applicants and NRC Staff, and the Board concludes that the answers are fully responsive.

9. This decision is based on the complete record compiled to date.* In making the following findings and conclusions, we reviewed and considered the entire record in this case and all of the parties' proposed findings of fact and conclusions of law. Those proposed findings of fact and conclusions of law submitted by the parties which are not incorporated directly or inferentially in this Partial Initial Decision are rejected as being unsupported in law or fact or as being unnecessary to the rendering of this decision.

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*A list of the exhibits offered in evidence is attached as Appendix A.

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II. ENVIRONMENTAL MATTERS

A. Environmental Impact Statements

10. On August 6, 1974, in accordance with the requirements of 10 CFR Part 51, Applicants submitted their Environmental Report. As amended, the ER has been received into evidence as Exh. 4; Tr. 709, 712. The ER contains detailed information on, and evaluations of, the environmental impacts associated with construction and operation of the facility.

11. Based upon the information submitted by Applicants, its own review and analysis, and other sources, the NRC Staff prepared a Draft Environmental Statement ("DES"). Notice of the availability of the DES was published on January 22, 1975, and public comment was invited. 40 F.R. 4195. Copies of the DES were also circulated for comment to appropriate federal, state and local agencies. In May 1975 the Staff published its Final Environmental Statement ("FES"), fol. Tr. 2913. All comments received on the DES are set forth in Appendix A of the FES. The Staff's consideration of those comments is reflected in revisions in the text of the FES and by discussion in section 11 thereof. The FES was received in evidence in this proceeding. Tr. 2913.

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12. The Staff also prepared a Final Supplement to the FES ("FES Final Supp."), fol. Tr. 7767. The purpose of the supplement was to identify and evaluate the potential effects of the proposed Project on the Skagit River, which at the time was a "study" river under the Wild and Scenic Rivers Act, 16 U.S.C. § 1271, et seq. It also provided, as part of the NRC's environmental impact statement for the Project, information upon which the Secretary of Agriculture could rely in making his determination pursuant to Section 7 of the Wild and Scenic Rivers Act, 16 U.S.C. § 1278. See Exh. 203. Prior to issuance of the FES Final Supp., a draft was circulated. Notice of its availability was also published, and comments were invited. 41 F.R. 28,599. As with the FES, comments were bound into Appendix A of the FES Final Supp., and reflected in both textual revisions and discussion in section 11. The FES Final Supp. has also been received into evidence. Tr. 7766.

13. In Contention J.1, intervenor SCANP alleges that

> The DEIS* does not represent the independent work of the NRC.

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*We note that many of SCANP's contentions referred to the Draft Environmental Statement which was, of course, later superseded by the Final Environmental Statement. Although invited to do so, SCANP did not seek to revise those contentions following issuance of the final statement. Without objection, Applicants and Regulatory Staff therefore treated the contentions as though they referred to the final statement; we shall do likewise. Tr. 2153, 2163-165.

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a. It is hardly more than a summary of the applicants' ER, and as such necessarily represents the applicants' point of view. It incorporates many judgments made by the applicants and the applicants' consultants concerning environmental impacts; it relies entirely on the data base accumulated by the applicants and reflects any deficiencies in that data base or methodologies or judgments involved in accumulating it.

b. The preparers of the DEIS failed to make their own independent evaluation and in- vestigation with regard to: alternative sites, seismology, and the need for the project.

c. The DEIS was not prepared by the "respon- sible official" as NEPA mandates.

In Contention J.16, SCANP states further that

> For the foregoing reasons, [stated in Contentions J.1 to J.15] the DEIS does not comply with NEPA, the CEQ guidelines, or 10 CFR Part 51.

14. Details of the consideration given specific matters raised by contentions, both in the environmental impact statement and otherwise, are addressed elsewhere in this decision. In general, however, the FES was prepared by the NRC Staff with the aid of its contractor, the Argonne National Laboratory, and under the direction of the NRC's Director of Nuclear Reactor Regulation. Argonne is a Government-owned national laboratory operated by the University of Chicago under a cost-type contract. In their work, Staff and Argonne personnel relied upon information supplied by Applicants in the ER and PSAR. Those documents, which must meet the requirements, inter alia, of 10

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CFR Part 51 and Regulatory Guides 4.2 and 4.7, necessarily contain virtually all of the information required to assess the environmental impact of the proposed Project. However, Staff and Argonne personnel also made visits to the proposed and alternative sites, requested additional information from Applicants; and consulted outside experts and other independent sources of information. In addition, they relied upon their own expertise in various disciplines pertinent to assessment of the environmental impact of the Project. See, e.g., Leech, et al., fol. Tr. 2919, pp. 1-2; Leech, et al., fol. Tr. 12,542, pp. 13-15; Tr. 2914-918, 3018-029, 3189-199, 3295-310.

15. The FES Final Supp. was prepared by the NRC Staff with the assistance of the Forest Service, U. S. Department of Agriculture. Information presented therein derives largely from an environmental analysis report on the Project written by the Forest Service and submitted to the NRC for its use in preparing the supplement under the "lead agency" concept. Work on the FES Final Supp. by the Staff and Forest Service involved on-site investigations, the collection of information from numerous sources, and the application of Staff and Forest Service expertise. FES Final Supp., fol. Tr. 7767, pp. xi, 1-1 to 2; Exh. 119; Tr. 7823-832; 7845-852; 7886-890; 7904-907; 7964-974.

16. In addition, the FES and FES Final Supp. have been updated and amplified in some respects by Staff testimony at

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the hearings. See, e.g., Milsted, fol. Tr. 2913; Leech, et al., fol. Tr. 2919; Leech, et al., fol. Tr. 7767; Leech, et al., fol. 12,542; Taylor, fol. Tr. NFP 650.

17. The FES, together with the FES Final Supp., contain a detailed analysis of the environmental impact of the facility. They fully describe and analyze the site, the ecology of the site region, the major systems of the facility, the environmental effects of construction, operation and postulated accidents, Applicants' environmental monitoring programs, the need for the facility, alternative sites, alternative energy sources, and alternative plant designs. They also present an evaluation of the proposed action, including a cost-benefit analysis.

18. To some extent, SCANP appears to contend that the NRC is precluded from placing any reliance upon factual data assembled by an applicant. In the normal course, however, the ER serves as the basis for NRC Staff review of the proposal, during which it must assure itself that adequate consideration has been given to environmental concerns, but not duplicate the applicants' efforts. See generally, Public Service Company of New Hamphsire (Seabrook Station, Units 1 and 2), CLI-77-8 5 NRC 503, 524 (Mar. 31, 1977). This process takes place through an exchange with the applicant, which often leads -- as it has in this case -- to the filing of supplements to the ER, and

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through the collection of information which may be in the hands of others, such as other governmental bodies. Id. SCANP also tends to equate "independent" with "conflicting" in arguing that the NRC Staff's in-depth review was not independent because it did not reveal more disagreements with Applicants' data or conclusions -- a position for which it cites no authority in law or logic. We find no merit in either SCANP Contention J.1 or J.16.

19. The Staff concluded -- after weighing the environmental, economic, technical and other benefits of the proposed facility against environmental and other costs, and after considering available alternatives -- that the appropriate action under NEPA and 10 CFR Part 51 is the issuance of an LWA and construction permits for the facility, subject to certain limitations for protection of the environment.

20. The FES and FES Final Supp. reflect an independent and comprehensive review and analysis by the Staff of the environmental impacts resulting from construction and operation of the facility. The Board finds that these documents -- as updated and amplified by testimony during the hearing, and as modified by these findings and conclusions -- comply with the requirements of NEPA as implemented by 10 CFR Part 51. Except to the extent set forth herein, the Board accepts the facts set forth in the FES and FES Final Supp., as amended, and concurs in the

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Staff's conclusions. 10 CFR § 51.52(b)(3); Niagara Mohawk Power Corp. (Nine Mile Point Nuclear Station, Unit 2), ALAB-264 1 NRC 347, 371-72 (Apr. 8, 1975).

B. Impacts of Construction

21. Site Preparation and Offsite Construction. The main impact of the Project on the land will result from the disturbance of about 260 acres of the 1,500 acre site. Approximately 2,000,000 cubic yards of material will be excavated from the hill northwest of Bacus Hill. Rock blasting will be required after removal of the overburden. Calculations indicate that the excavation and fill volumes will be approximately balanced. No significant historical or archaeological sites have been found within the Project boundaries. Nevertheless, Applicants have arranged for an archaeological consultant to assure appropriate archaeological inspections and investigations if discoveries are made during the excavation phase. Myers, fol. Tr. 2627, p. 3; FES, fol. Tr. 2913, §§ 2.3, 4.1.1; Exh. 4, §§ 2.3.1, 4.1.1.

22. 5,200 feet of Black Creek will be permanently rerouted around the industrial zone, resulting in a change in the confluence of Black Creek and Wiseman Creek and some loss of

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stream habitat. This, in turn, may occasion the displacement and loss of some cutthroat trout. The diverted portion of Black Creek, half of which does not have a permanent fish population, represents less than 0.5 percent of the creek habitat in the Skagit River drainage basin between Sedro Woolley and Concrete. The potential loss is, therefore, only a fraction of 1 percent of the estimated salmonid population in this area. Myers, fol. Tr. 2627, p. 3-4; Tr. 2839-843, 2893-896; Exh. 4, § 4.1.2 and Fig. 2.5-15; FES, fol. Tr. 2913, § 4.1.1.

23. Culverts will be installed at the access railroad and access road crossings of Wiseman Creek. The access railroad culvert will prevent cutthroat trout spawning and reduce production of some fish food organisms. The access road culvert will involve rechannelization of 310 feet of Wiseman Creek, affecting about 6 percent of the length of the creek presently used by anadromous salmonids. Measures will be adopted, such as providing gravel on the bottom of the new channel and timing construction to avoid spawning, to minimize the impact on fish and other aquatic life in the area. Myers, fol. Tr. 2627, p. 4; FES, fol. Tr. 2913, § 4.1.1; Exh. 4, § 4.1.2.

24. Installation of the Ranney Collector wells will take place on land adjacent to the Skagit River and, therefore, will not disturb the river. Material removed during installation will be suitably disposed. In accordance with terms of the Department of Agriculture's April 11, 1977 determination pursuant to the Wild and Scenic Rivers Act, discussed below, no

additional riprap will be added to the River bank at the collector site. Installation of the collectors will have a minimal impact on the biota and wildlife habitat in the area. Myers, fol. Tr. 2627, p. 4; FES, fol. Tr. 2913, § 4.2.2.1; FES Final Supp., fol. Tr. 7764, §§ 4.1.2, 4.1.4, 4.1.5, 4.1.6, 4.1.7 and 4.1.8; Tr. 10,637-654, 10,656-657.

25. The route of the access railroad was chosen in order to minimize its visibility from SR-20 and its impact on surrounding land. About 50 acres of land will be affected by the right-of-way. Most of the excavated material, approximately 450,000 cubic yards, will be used as fill in the right-of-way; the rest will be placed in the site spoils area. Myers, fol. Tr. 2627, p.5; FES, fol. Tr. 2913, §§ 4.1.2, 4.2.2.3, 4.4.1; Exh. 4, § 4.1.1.

26. The new rights-of-way for offsite transmission lines will occupy about 150 acres of land. While larger trees will have to be removed, ground cover will not be greatly disturbed and no serious erosion problems are expected. Only a small portion of the lines will be visible from SR-20; and none will be visible from the River. There appears to be no need for new permanent access roads. FES, fol. Tr. 2913, pp. 3-25 to 3-28, 4-5 to 4-8; Exh. 4, §§ 3.9, 4.2; FES Final Supp., fol. Tr. 7767, § 4.6.

27. A sewer pipeline will be constructed from the site to the existing Sedro Wooley municipal system. All of the pipeline, except at three creek crossings, will be buried. Thus, there will be virtually no visual impact. Following burial of the sewer line, the disturbed area will either be reseeded or otherwise allowed to revegetate, thus allowing any disturbed wildlife to return. As the sewer line approaches each of the bridges over Wiseman, Coal and Hansen Creeks, it will angle up from the trench to the ground surface near the bridge. The routing is such that the stream banks will not be disturbed with any heavy equipment, thereby preventing the possibility of silt entering the streams from the work. The sewer line will cross the streams on supports attached to existing bridges. Hanging of the pipe will generate only a miniscule amount of concrete dust and, therefore, poses no environmental hazard. Installation of the sewer line will not interfere with traffic except from the occasional movement of construction equipment. Myers, fol. Tr. 2627, p. 5; Goettge, fol. Tr. 6598, pp. 2-4 and App. A, pp. 2-4, 6; Finnegan, fol. Tr. 6591, pp. 2, 4; Tr. 6701, 6705, 7043-049, 7070; Exhs 104 and 113.

28. A major portion of the pipelines required for makeup and discharge water will be buried, either under existing rights-of-way or in areas that will rapidly revert to their natural state after completion of construction. The trenching

operations will produce temporary disturbance of land use along the entire length (13.6 miles) of the pipeline routes, but there will be no permanent impact after restoration. Care will be taken to minimize surface runoff, silting and blockage of drainage patterns. Myers, fol. Tr. 2627, p. 5; FES, fol. Tr. 2913, §§ 4.1.2, 4.2.2.1, 4.4.1; Exh. 4, §§ 4.1.2.5, 4.1.2.6.

29. Major improvements will be required at the intersection of SR-20 and both the new access road planned for the site, and Bacus Road. MacIsaac, fol. Tr. 2296, p. 11. The improvement work will consist of widening 3,000 feet of SR-20 in the vicinity of the plant site; realigning Bacus Road to a new intersection with SR-20; providing an intersection with SR-20 for the proposed new access road; and installing traffic channelization and signs at and in the vicinity of the two intersections. Most of the work will be within existing state and county road rights-of-way. There will be a loss of about 3.3 acres of grass, forest and forest edge habitat and of organisms associated with the habitat in this relatively small area. The habitats and organisms affected, however, are abundant and common in the area and, hence, the impact on the terrestrial environment will be small. Goettge, fol. Tr. 6598, p. 5 and App. B, pp. 8-9; Finnegan, fol. Tr. 6591, pp. 1-2; Tr. 6618, 6633, 6697, 6706-707, 6713, 6722, 6749-751, 6760, 7043-048, 7070; Exhs 107, 108. There is little danger that

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harmful siltation will occur as a result of the road improvement work. Excavation will take place only where drainage is distant from creeks. Only a minimal amount of fill work will be done in surface areas which drain toward Wiseman Creek; none will be done on the stream bank and little work will be performed near the bank. Finnegan, fol. Tr. 6591, p. 3; Tr. 6742-744, 6748, 6813-815, 6820-825, 7028-037; Exhs 106, 107 and 108. The road work will cause reduced traffic speeds through the area while work is being done on the shoulders and a few days of one-lane traffic during paving operations. Goettge, fol. Tr. 6598, App. A, p. 11; Tr. 6701. Such traffic interference would be minimal.

30. Construction of the discharge diffuser in the bed of the river near Sedro Woolley will cause some local siltation, increase turbidity for approximately three months, and may cause some loss of aquatic biota. Construction activities will be limited in scope and duration and will be timed to minimize any loss. A rapid return to the normal pattern of aquatic life in the Skagit River can be expected. Myers, fol. Tr. 2627. p. 5; FES, fol. Tr. 2913, §§ 4.1.2, 4.2.2.1, 4.4.2; FES Final Supp., fol. Tr. 7767, 4.3.1; Exh. 4, § 4.1.2.

31. A temporary barge offloading facility will be needed for delivery of the reactor pressure vessels. It will be located near the foot of Fruitdale Road, just east of Sedro

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Woolley. Construction of the facility, which will require about 1.5 acres of land adjacent to the river and will disturb approximately 250 feet of shoreline, will cause some local siltation and turbidity in the river for a short period and may cause some loss of aquatic habitat. However, construction activities will be planned and carried out in a manner which fully considers and minimizes effects on the river and important biota. Techniques will be used to minimize surface runoff, silting, erosion, and blockage of drainage patterns. Construction, which will take approximately 60-90 days, will be timed to minimize any loss of important aquatic life. Construction of the offloading facility will not have a significant impact on the environment. Upon completion of delivery, the disturbed shoreline area will be restored, or the facility may possibly be left for public use. Myers, fol. Tr. 2627, p. 6; FES, fol. Tr. 2913, §§ 4.1.2, 4.4.2; FES Final Supp., fol. Tr. 7767, § 4.4.1; Exh. 4, § 4.1.1, Supp. 1, pp. 221a and 221b, Fig. 49A-1.

32. The site and offsite construction areas contain no unique terrestrial biota habitats, and no known rare or endangered species will be affected by construction. There will be the loss of some habitat and of some less mobile fauna due to the clearing of vegetation. However, the terrestrial habitats on the site are a minute fraction of such habitats in Skagit

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County. Animals in the affected areas will either emigrate to similar surrounding habitats or succumb due to exposure, predation, starvation, etc. The displacement of wildlife may indirectly affect adjacent habitats. Since forty-five percent (45%) of the cleared area will undergo revegetation following construction, much of the habitat loss will be temporary, and many species of fauna will return to and inhabit the site. Myers, fol. Tr. 2627, p. 2; FES, fol. Tr. 2913, §§ 4.4.1, 5.1; FES Final Supp., fol. Tr. 7767, §§ 5.4, 5.5, 5.6; Exh. 4, §§ 4.1.1.1, 4.3.

33 For a number of years, significant numbers of northern bald eagles have wintered along the Skagit River, particularly the reaches upstream from Rockport. Exh. 4, § 2.7.4.1.4. SCANP witness Ellingson testified that construction would interfere with the behavior of the eagles. He identified a slide into the river as one possible example of interference with the food supply for the eagles; however, there is no evidence that construction could possibly cause such an event. Exh. 42, pp. 12-15, 33-34. Further, most of the eagle activity in the area is at some distance from the site; eagles have demonstrated (Exh. 42, pp. 13, 14, 35-37, 50, 51, 56, 57 and 68), a high degree of tolerance for the presence of humans; and the NRC Staff believes that construction activities will have no

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impact on the eagles food supply. Exh. 42, pp. 13-14, 35-37, 56-58; Exh. 4, § 2.7.4.1.4; FES Final Supp., fol. Tr. 7767, § 11.6.1. These factors, plus the topography of the area and observed behavior of eagles along the Skagit River (e.g., Exh. 42, pp. 35-37), lead us to conclude that construction activities will neither adversely affect the bald eagles, nor interfere with the Skagit River Bald Eagle Natural Area upstream from the site.

34. Construction activities may affect stream and river ecology by altering drainage systems and stream flows, increasing the rate of siltation and reducing aquatic habitat. Intervenor SCANP offered testimony suggesting that construction activities will be detrimental to the environment, especially to the salmonid population. E.g., Brubaker, fol. Tr. 2925, pp. 14, 21-22; Brubaker, fol. Tr. 8211, pp. 2-3. The principal witness for SCANP, who was not an expert in fish biology, had, in effect, done a literature search (devoted largely to the effects of thermal and chemical discharges, subjects addressed below). He had conducted no studies in the vicinity of the site, or sampled fish populations, and indicated that his opinions were generated on the basis of what he had read. Tr. 2950, 2959, 6945-946, 8280-281, 8300-301. He had no

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studies to rely on when he predicted a reduction in salmon population as a result of the Project and could not quantify his prediction. Tr. 2973-974.

35. Applicants and the NRC Staff presented extensive evidence showing that the construction activities will not have a significant effect on the aquatic environment. E.g., Exh. 4, § 4.1.2.1; Dvorak, et al., fol. Tr. 3732; Tr. 7037-041, 7070. The Staff's evaluation confirms that effects on the aquatic environment will be slight; we agree. FES, fol. Tr. 2913, § 4.4.2; FES Final Supp., fol. Tr. 7767, §§ 4.1.4, 4.2.4, 4.3.4, 4.4.3, 4.4.4, 4.7.3, 4.7.4; Milsted, et al., Tr. of 31 July 1975 (Vol. II).

36. The impact on aquatic biota from siltation attributable to construction will be minimal. Construction will be temporary and will involve limited drainage areas. Applicants have planned an erosion control program, including the rerouting of Black Creek, four sediment retention ponds, diversion of surface runoff, and vegetative stabilization of graded and spoils areas. The program, which will be checked during construction by monitoring, should largely eliminate silt introduction during critical low-flow periods and reduce silt input during high-runoff conditions. Myers, fol. Tr. 2627, pp. 3, 4; FES, fol. Tr. 2913, §§ 4.1.1, 4.4.2.1; Exh. 4, § 4.1.2.1.2, Supp. 1, pp. 52-54, 218-220.

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37. Largely in response to a Board question, particular attention has been given to the matter of sedimentation in the Skagit River associated with construction of the discharge diffuser, the barge offloading facility, and riprapping. The evidence established that there would be no significant impact on the salmonid fishery in the River. The bases for this conclusion are the short duration of the activities and the relatively small areas affected, the timing of work to have the least possible effect on spawning activity, the location of construction areas generally downstream of major spawning areas, similarities in the type and deposition of siltation produced by construction activity and by natural events, the large volume of sediments normally present in the river, and the construction practices proposed. Derickson, Tr. of 31 July 1975 (Vol. II), pp. 1-3; Tr. 2635-671, 3199-216, 3260-266, 3288-289; FES Final Supp., fol. Tr. 7767, §§ 4.2.4, 4.3.4, 4.4.3, 4.4.4.

38. The Board also inquired into details of Reactor Pressure Vessel (RPV) delivery to the site. In response, the NRC Staff assessed -- in detail -- the potential impacts, including those resulting from barge travel up the Skagit River and installation of the necessary culverts at stream crossings to accommodate the overland portion of the RPV delivery route. NRC Staff Assessment of Impacts Associated with the Delivery of

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the Reactor Pressure Vessel, fol. Tr. 12,216. Based on that assessment, the evaluation of impacts resulting from barge slip construction contained in Section 4.4 of the FES Final Supp., fol. Tr. 7767, and the discussion in paragraph 31, above, we conclude that the potential impacts of RPV delivery have been adequately considered and are acceptable.

39. Noise. Noise produced by construction activities will depend upon factors such as day-to-day schedules, variations in equipment operation, and weather conditions. Site preparation is expected to be the noisiest phase of construction, due to rock blasting and the greater use of heavy equipment. The low frequency explosive blasting and other noise may cause some intermittent annoyance, but the estimated maximum construction noise levels at the site boundary fall within the range deemed to be normally acceptable to humans. Myers, fol. Tr. 2627, pp. 6-7; FES, fol. Tr. 2913, § 4.5.3; FES Final Supp., fol. Tr. 7767, §§ 4.1.11, 4.2.10, 4.3.10, 4.4.10, 4.5.10, 4.7.10, 5.9; Exh. 4, § 4.1.1.4.

40. Dust and Other Emissions to the Air. During construction there will be emissions resulting from operation of heavy equipment (engine exhaust and road dust), the concrete batch plant (particulates) and from permitted open burning (combustion products). Control will be exercised to reduce these emissions to the lowest levels practicable. For example,

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internal combustion engines will be kept in good mechanical condition; areas traversed regularly by heavy equipment will be dampened and in some cases, covered with gravel; all applicable burning regulations will be complied with and precautions taken to prevent accidental fires; and control techniques reflecting the best engineering practices will be used to limit dust from the concrete batch plant. FES, fol. Tr. 2913, § 4.5.3; Exh. 4, § 4.1.1.5; Myers, fol. Tr. 2627, p. 7.

41. Socioeconomic Impacts. Construction of the Project is not expected to cause a housing shortage in the county or other, significant "boomtown" effects. In spite of some testimony suggesting otherwise, the Board believes that the impact on the area will be minor.

42. Although the Sedro Woolley Police Department may require additional time, equipment, and manpower to control traffic and, to a lesser extent, for peace-keeping activities, the construction impact payments to be made by Applicants to law enforcement agencies in the county pursuant to the Rezone Contract should serve to mitigate these impacts. The impact on schools is expected to be minimal. A large proportion of those expected to work on the Project already reside in the general vicinity, from Sedro Woolley to as far away as Seattle and Bellingham, and will commute to the site. The number of new residents in the area should be relatively small and no school

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district will bear the entire burden of new students. The construction impact payments to be made by Applicants to the school districts in the county pursuant to the Rezone Contract should effectively mitigate whatever impacts may occur. Construction is not expected to have a significant adverse impact on local community services such as area hospitals, water and wastewater systems, or fire districts. Myers, fol. Tr. 2627, pp. 7-8; FES, fol. Tr. 2913, §§ 4.5.1, 4.5.4; FES Final Supp., fol. Tr. 7767, § 11.3.10; Exh. 4, § 8.2.2 and App. K, Part 4, Articles 5.2, 5.3; Winters, fol. Tr. 13,361, pp. 3-14; Tr. 8151-154, 13,822-827. The socioeconomic impact monitoring and claim payment procedures under the Site Certification Agreement between Applicants and the State of Washington should also be helpful in avoiding or minimizing socioeconomic impacts, and in mitigating any impacts which do occur. Exh. 83, Art. VI. C, pp. 32-34.

43. Traffic. The construction workforce, which will range as high as 3,100 workers, will commute to and from the site each work day. Deliveries of materials to the site will involve an estimated 200 truck trips per day in both directions combined. The impact of this Project-related traffic on the existing road system with its anticipated non-Project-related load has been assessed. FES, fol. Tr. 2913, § 4.5.2; FES Final

Supp., fol. Tr. 7767, § 11.8.16; MacIsaac, fol. Tr. 2296; Exh. 4, § 8.2.2.1.2; Tr. 2360-364 and 2425-426.

44. Prior to the July 1975 hearings which were held in this proceeding, Applicants' traffic engineering consultant performed a detailed analysis. In brief, he utilized data obtained from the Washington State Highway Department and from Skagit County for the baseline traffic condition and best estimate of traffic growth rates. From this information he derived an upper level estimate of the non-Project traffic volumes anticipated to occur at the time the construction workforce was expected to peak. MacIsaac, fol. Tr. 2296, pp. 2-4, Figs. 1, 2, 3, 4; Tr. 2306-311, 2335-336, 2416.

45. In assessing Project construction traffic, Applicants' expert examined both the 3,100-man peak work force and the "80 percentile" level of 2,000 workers; the workforce level that is not exceeded in eight of the ten years of Project construction. He applied certain assumptions regarding car pooling, work shifts and distribution of worker residences to arrive at estimates of the number of trips generated by the commuting work force and the routes they would take. Truck traffic attributable to materials deliveries to the site was included as part of the Project-related traffic. MacIsaac, fol. Tr. 2296, pp. 4-7, Figs. 5, 6; Tr. 2307-308, 2311-312, 2343-355, 2365-366, 2414-416.

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46. The estimated Project and non-Project traffic volumes were combined for both the 80 percentile and peak workforce cases. The resulting total traffic estimates were compared to the theoretical capacities of the highways in question. The analysis revealed the necessity for certain improvements such as left-turn channelization at a number of points along SR-20. Major improvements will be required at the intersections of both Bacus Road and the Project access road with SR-20; these improvements have been designed, and we have already approved portions of the work. Further measures to reduce congestion on SR-20 could range up to an expansion of the roadway to four lanes between State and Township Streets in Sedro Woolley. However, Project construction traffic will result in a notable impact, causing potential overloads on portions of the road system serving the Project site. MacIsaac, fol. Tr. 2296, pp. 7-12, Figs. 7, 8; Tr. 2312-319, 2321-334, 2364-365, 2416-418; Puget Sound Power & Light Company (Skagit Nuclear Power Project, Units 1 and 2), ALAB-446 6 NRC 870 (Dec. 9, 1977); LBP-77-72 6 NRC 1308 (Dec. 23, 1977).

47. More recently, the NRC Staff analyzed traffic impacts as part of its cost-benefit analysis. While not precisely comparable to Applicants' traffic analysis, the Staff concluded -- as did Applicants' consultant -- that construction could, at

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times, result in traffic volumes in excess of highway capacity. Winters, fol. Tr. 13,361, pp. 14-18; Tr. 13,632-634.

48. The record indicates that traffic attributable to the construction of the Skagit Project will contribute to the crowded traffic conditions which can be expected to develop in any event by virtue of anticipated growth in traffic volume. The impact will be temporary and limited almost exclusively to rush hours on work days. However, it may result in decisions by local residents to travel at other hours of the day and/or on alternative routes. This impact may be termed adverse, but can be further mitigated by such simple means as increased carpooling and the staggering of work hours. In any event, it cannot be said to threaten a substantial change in the life style of local residents. We have included it in our cost-benefit analysis. MacIsaac, fol. Tr. 2296, pp. 10-12; Winters, fol. Tr. 13,361 pp. 17-18.

C. Impacts of Operation

1. Cooling Tower Operation

49. The two natural draft cooling towers will release large quantities of heat and water vapor to the environment. As the warm, moist air condenses, cloud-like plumes will form.

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Due to bouyancy and momentum, the plumes will usually rise far above the towers. The cooling towers will also release a small amount of water in the form of droplets or drift, which will either evaporate or precipitate on the ground. FES, fol. Tr. 2913, § 5.3.1; Exh. 4, § 5.1.3.

50. The length of the visible plumes will vary depending upon the meteorological conditions and the plant heat load. The maximum predicted length, which would occur very infrequently in the wintertime, would be 12,500 feet. The average summer and winter lengths are expected to be 980 and 4,300 feet, respectively. Due to the errors in windspeed measurement (discussed below in Part III under "Meteorology"), these maximum plume lengths have been over predicted. FES, fol. Tr. 2913, § 5.3.1; Exh. 4, § 5.1.3.2; Tr. 2631.

51. The longest plumes will tend to form during conditions most conducive to cloud formation. Therefore, the visual impact of the plumes will be obscured by the naturally cloudy conditions. Reduction in sunshine due to the plumes will be negligible. While it is expected that the plumes will contribute to low-level clouds and their persistence, there is no evidence that natural draft cooling towers result in weather modification. The buoyancy of the plumes, the elevation of the plant site and the height of the towers will preclude ground

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level fogging from the plumes in the valley below the plant. Myers, fol. Tr. 2627, p. 10; FES, fol. Tr. 2913, §§ 5.3.1, 11.2.1; Exh. 4, § 5.1.3; Tr. 3250-260.

52. The major portion of the drift will be deposited within the plant site boundaries. The errors in windspeed measurement referred to above will have a very small effect in the drift distribution set forth in Figure 5.1.1 of the ER. Exh. 4, § 5.1.3; Tr. 2631. Under some conditions, the wind could carry the drift to SR-20, which could then result in a small amount of icing when temperatures are below freezing. The combination of wind and sub-freezing temperatures necessary for the possibility of icing occurs 117 hours during the year. Furthermore, it is very possible that the rate of precipitation from the drift will be too low to visibly wet the road surface and cause an icing problem. Myers, fol. Tr. 2627, p. 11; FES, fol. Tr. 2913, §§ 5.3.1.2, 11.18.9; Exh. 4, § 5.1.3, App. H.2; Tr. 3252.

53. The drift contains dissolved salts, which are present in the cooling water. These salts will be deposited on the surrounding terrain, mostly within the plant site boundaries. Calculations by the NRC Staff, which would only be very slightly affected by the windspeed measurement errors, indicate that salt deposition from the drift is less than the normal deposition from rainfall. FES, fol. Tr. 2913, §§ 5.3.1.2, 11.18.9;

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Exh. 4, §§ 3.6 [illegible] 5.1.3.3; Tr. 2631. Nevertheless, concern was expressed during the hearings, particularly by SCANP, over the possible economic consequences of damage to vegetation resulting from cooling tower operation; especially drift. SCANP Contention J.4.

54. The chief components of the drift are sulfates, which are also common constituents of fertilizers. Therefore, no adverse effect on the soil is expected. Furthermore, the high rainfall in the area will tend to prevent accumulation of salts in surface soil or in plant tissues. There will be no adverse impact on animals. FES, fol. Tr. 2913, §§ 5.3.12, 5.5.1; Exh. 4, §§ 5.1.3.3, 5.4.4; Tr. 2865, 2875.

55. The concentration of salts in the drift will be greater than that in rain and, if sufficiently high, could cause "salt burn" on salt-sensitive foliage if not washed off by rain. The NRC Staff concluded that spotting of foilage in the area of maximum drift may be observed, but that such damage will not endanger whole trees and that any damage to commercial agriculture will be so small as to be undetectable. FES, fol. Tr. 2913, §§ 5.3.1.2, 11.18.9; Milsted, et al., Tr. of 31 July 1975 (Vol. II), p. 2; Exh. 4, § 5.4.4; Tr. 2863, 2867.

56. This conclusion is also generally supported by experiments concerning the salt tolerance of strawberries, which are the most sensitive agricultural species within the vicinity of

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the site. While the experiments are not precisely comparable to the postulated drift deposition, they show that strawberries appear to be unaffected by concentrations of chloride considerably higher than the maximum to be found in the drift. Other studies, including those of operating cooling towers, confirm the conclusion that damage, if any, results from much higher salt concentrations. Tr. 2867-872, 2889, 3231-239, 3245-246, 3269-283.

57. SCANP contention J.6 alleges that there has been a failure in the FES to evaluate the impact of the plant on birds using the Pacific flyway. Considerable evidence concerning this topic was presented during the proceeding. E.g., Milsted, et al., Tr. of 31 July 1975 (Vol. II); FES, fol. Tr. 2913, § 2.7.1.2; Exh. 4, Supp. 1, pp. 197-199; Exh. 42. Specifically, with respect to the migratory path of waterfowl in the site area, baseline data collected by Applicants shows that the predominant migratory path is at a lower elevation along the Skagit River and the flood plain. Furthermore, data collected at the site of the Davis-Besse nuclear power plant, which was located directly in a migration path, shows that the impact of large, tall structures on migrating birds is not severe. Milsted, et al., Tr. of 31 July 1975 (Vol. II). The Board

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therefore concludes that the facility, during either construction or operation, will not have a significant impact on birds using the Pacific flyway.*

58. SCANP witness Ellingson has suggested that the size of the completed Project and the cooling tower plumes could disrupt the migratory pattern of bald eagles and drive them away permanently. Exh. 42, pp. 15-18, 60. However, eagles presently tolerate a good deal of human activity on both land and the river. Exh. 42, pp. 13-14, 35-37, 50-51, 56-58. Also, eagles are believed to migrate at high altitudes. Exh. 42, pp. 43-44, 65-66. We conclude that the presence of the Project will not disrupt their migration.

59. Witness Ellingson also expressed concern that the bald eagle population would be endangered by exposure to radioactive Iodine-131, an effluent of the facility. He suggested that Iodine-131 would be concentrated in the eagles' thyroids by virtue of their eating spawned-out salmon, which he presumed would contain a significant amount of Iodine-131. Exh. 42, pp. 16-17, 30-32, 63-64, 69-72, 77-89. Since there are no

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*We note that the NRC Staff, in reviewing Applicants' ER, specifically inquired concerning the effect of plant structures on bird life. Exh. 4, Supp. 1, pp. 197-199. This, alone, demonstrates that, in preparing the environmental statement, the Staff performed the very evaulation suggested by Contention J.6.

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liquid radiological releases from the plant, however, any exposure -- at all -- to salmon would necessarily occur only through the entrainment of gaseous releases by the cooling towers. Such releases, however, are small; and any resulting exposure would likely be insignificant. Tosetti, fol. Tr. 2629; FES, fol. Tr. 2913, § 5.4. See also the discussion below under "Radiological Releases." More importantly, considering that spawning salmon do not normally feed as they travel upstream, and that the half-life of Iodine-131 is approximately eight days (not "hundreds of years" as Ellingson opined, Exh. 42, p. 45), any Iodine-131 ingested by juvenile salmon while in the Skagit River will have long since decayed when they return to spawn and are consumed by eagles. Tr. 3397, 3399-401.

60. In sum, the Board finds that adequate consideration has been given to the matters raised in SCANP Contentions J.4 and J.6, and that they are without merit.

2. Visual Impacts

61. The prominent structures of the facility will be the reactor and turbine buildings and the cooling towers. There will be other buildings, but one of Applicants' design objectives is to reduce the number of minor structures. Another

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design objective is the use of simplified forms, finishes, and colors, to harmonize with the natural features of the valley. Bacus Hill and the tree-covered terrain on and around the site will provide some screening. The taller structures, including the symmetrical 520-foot cooling towers, will be visable but seen against the 4,000-foot mountains to the north. Transmission lines will largely be shielded by the natural topography from the view of observers in the valley. Myers, fol. Tr. 2627, p. 3; FES, fol. Tr. 2913, pp. 3-1, 5-1; Exh. 4, §§ 3.1, 3.9; Tr. 2779-787.

62. Some viewers will regard the facility, and particularly the cooling towers, as a visual intrusion on the landscape. See, e.g., Heilman, fol. Tr. 3098, pp. 2-6. Other viewers will regard the structures as visually pleasing. Tr. 2785. The Board has taken considerable evidence concerning the matter. See, e.g., FES, fol. Tr. 2913, §§ 3.1, 5.14; Milsted, et al., Tr. of 31 July 1975 (Volume II), pp. 1-2; FES Final Supp., fol. Tr. 7767, §§ 4.5.8, 7.1, 11.8.8; Leech, et al., fol. Tr. 7767, pp. 4-6, 8; Tr. 7886-894, 8066-069. The Board believes that the beauty or unattractiveness of the facility will be in the eye of the beholder. It will be a personal matter, and reactions will vary from individual to individual. We note, however, that the local topography, as well as design features,

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will tend to lessen the aesthetic impact considerably; and we conclude that, overall, such impact will not be substantial.

63. In contention J.8 SCANP suggests that, in violation of NEPA, the visual impact of the plant has not been considered. SCANP thus apparently ignores the description of the external appearance of the proposed facility, and the visual impact of that appearance in the final environmental statement which, in fact, includes visual impact among the "unavoidable adverse environmental effects of the proposed facility." FES, fol. Tr. 2913, §§ 3.1, 5.1.4, 10.1.1.4 and Table 10.1. Further, it is clear that the Staff, in preparing the environmental statement, considered the visual impact of the plant structures, including the cooling towers and their plumes, from several vantage points. See, Milsted, et al., Tr. of 31 July 1975 (Volume II). See also, FES Final Supp., fol. Tr. 7767, §§ 4.5.8, 11.8.8. In addition, as indicated above, we have considered the visual impact of the facility and have found that, while there will be an aesthetic impact, it will not be a significant adverse impact. For these reasons, we find that the visual impact of the plant on the recreational values of the Skagit River and surrounding terrain have been considered and that contention J.8 is without merit.

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3. Project Discharge

64. Characteristics of the Project Discharge. The Project discharge will consist of the combined flow of all plant water effluent streams except for the plant sanitary sewage' which will be routed separately to the Sedro Woolley municipal sewerage system. These streams will include the main cooling tower blowdown, the low volume waste after treatment, the fish rearing facility effluent, and the dilution water. Berthrong, fol. Tr. 3382, p.1; FES, fol. Tr. 2913, Table 3.5; Exh. 4, Fig. 3.3-1.

65. The flow rates of each of the above effluent streams will vary with plant operating conditions. Applicants used the maximum flow rates that will occur in each stream during operation of the Project to determine the "worst case" potential environmental impacts from the Project discharge. Berthrong, fol. Tr. 3382, p. 2.

66. The main cooling tower blowdown will be the only significant contributor to raising the temperature of the Project discharge above the temperature of the makeup water for the Project. The maximum Project discharge temperature of 70°F was calculated assuming that the following conditions occur simultaneously: both units operating at maximum rated power level; wet bulb temperature = 69°F; relative humidity = 50%; blowdown

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from "cold leg"; no temperature change across the fish rearing facility or in any of the pipes routing the water from point to point; cycles of concentration = [illegible]; makeup water temperature = 64°F. Berthrong, fol. Tr. 3382, pp. 2-3; FES, fol. Tr. 2913, §§ 3.6.2; 5.5.3.2; Tr. 3379-380.

67. Assuming that blowdown will be made only from the cold leg of the cooling towers, the maximum differential temperature between the Project discharge and the Skagit River would be 16°F. This maximum differential temperature was calculated assuming the following conditions: both units operating at maximum rated power level; wet bulb temperature = 50°F, relative humidity = 70% (these are the most limiting conditions that occur simultaneously with minimum river temperature); Skagit River temperature = 34°F; cycles of concentration = 12. Under these conditions, the Project discharge temperature would be 50°F. Berthrong, fol. Tr. 3382, p. 3; FES, fol. Tr. 2913, § 5.3.2; FES Final Supp., fol. Tr. 7167, p. 4-15; Exh. 119, p. 15.

68. It may be desirable to use blowdown from the hot leg of one unit in order to optimize the temperatures in the fish rearing facility, if such blowdown is permitted at some future date. Assuming the simultaneous conditions used in the calculation of the maximum differential temperature for cold leg

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blowdown, the maximum differential temperature between the Project discharge and the Skagit River would be 21°F if blowdown is taken from the hot leg of one unit. Under these conditions, the Project discharge temperature would be 55°F. Berthrong, fol. Tr. 3382, p. 4.

69. Applicants' witness Berthrong corrected certain errors appearing in the ER and FES. Since the errors involved temperatures existing only within the plant and since the data bearing on environmental effects were correct, the errors do not change the analyses of environmental impact. Berthrong, fol. Tr. 3382, pp. 4, 5.

70. The Project discharge will flow by pipeline to the Skagit River and be discharged through a 65-foot multiport diffuser. A port orientation of 60° from the horizontal in the direction of the river flow was selected to avoid the jet contact with the river bottom. The diffuser will be located at the river bottom about 100 feet from the north bank. The discharge velocity will be about 6 fps and 13 fps for one- and two-unit operation, respectively. The ports will be 4 inches in diameter, spaced on 1.5 foot centers. The diffuser system is designed to achieve rapid dilution as compared to other types of discharge schemes, such as surface discharge. Of the possible submerged discharge methods, the multiport diffuser yields the greatest dilution, and is therefore the preferred

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system for use at this facility. Scott, fol. Tr. 3382, p. 9 and Fig. 1; FES, fol. Tr. 2913, § 9.3.3.2; Exh. 4, §§ 3.4.6, 5.1.2.1, Figs. 2.5-7, H.1-1; Tr. 3389-391.

71. Impact on Water Quality. Chemicals will be used in the plant for the control of water quality, scale control, regeneration of demineralizers and the control of biological fouling. Chakravorti, fol. Tr. 3382, p. 5; Exh. 4, § 3.6.1 and Table 3.6-1. The Project discharge will consist of intake water modified by the addition of chemicals and by evaporation of the circulating water in the cooling towers. Both the chemical treatments that will cause changes in the constituent concentrations and the resulting estimated maximum and nominal (average) daily discharges are described in the ER. The estimated maximum concentrations of the various constituents in the Project discharge have also been identified. Chakravorti, fol. Tr. 3382, pp. 5, 6, 8, and Table 2; Exh. 4, § 3.6.3.1 and Tables 3.6-3, 3.6-4 and 3.6-5. The Staff's independent estimates of chemical composition in the discharge agree very well with those of Applicants. FES, fol. Tr. 2913, § 5.5.3.2.

72. Three sources of information were used to describe the ambient water quality of the Skagit River. Information from the U.S. Environmental Protection Agency-STORET computer file for the period 1959-70 was used in the ER. The second source was newer STORET data for the period 1970-74. The third source

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was the water quality data collected by Applicants' consultant Dames & Moore. Because review of the three data sets showed that they are generally consistent, each may be used to adequately describe the river's water quality. However, there are three disparities concerning reported concentrations of copper, zinc and ammonia. Applicants' witness Houghton explained the bases upon which he resolved these three disparities and presented the maximum expected concentrations of these constituents in the river. Applicants' witness Chakravorti supplemented the ER with regard to the concentrations of copper, zinc and ammonia which can be expected in the cooling tower blowdown, the Project discharge and in the river under conditions of maximum effluent concentration and minimum low flow (using the 10-year, 7-day low flow value of 4740 cfs). Chakravorti, fol. Tr. 3382, p. 618; Houghton, fol. Tr. 3382, pp. 6-8 and Table 2; Tr. 3436-438.

73. One percent sodium hypochlorite solution will, when necessary, be added to the circulating water upstream of the condensers daily for a maximum period of 30 minutes. The amount will be controlled so as to achieve a free available chlorine concentration of 0.5 mg/l (maximum) and 0.2 mg/l (average) at the condenser outlet. Residual chlorine includes free available and combined chlorine. The latter basically appear as chloramines, the compounds formed by reactions

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between chlorine and nitrogen-containing organic and inorganic compounds. Chakravorti, fol. Tr. 3382, p. 8; FES, fol. Tr. 2913, § 3.6.3; FES Final Supp., fol. Tr. 7767, p. 4-15; Exh. 4, § 3.6.3.4.

74. SCANP contended, in PSAR Contention 1.d, that "the operation of the Project will result in the discharge into the Skagit River of biocides in addition to those evaluated by the ER and PSAR." SCANP PSAR Contentions, p. 1. It presented no evidence in support of this contention. SCANP's letter dated March 17, 1975, commenting on the NRC DEIS, suggested that "supplemental shock biocide dosages" will be used because "chlorine will not be sufficient after a few years." Applicants' plan to use chlorine in the form of sodium hypochlorite solution. In view of the fact that chlorine is the only biocide in general use in steam-electric generating plants, there is no reason to believe that any other biocide will have to be used at this facility. The Board finds that the only biocide that will be discharged in connection with the operation of the facility will be chlorine, the effect of which has been thoroughly evaluated in Applicants' documents, in the FES and at the evidentiary hearing. For this reason, the Board finds that SCANP's PSAR Contention 1.d is without merit. Chakravorti, fol. Tr. 3382, p. 8; FES, follows Tr. 2913, § 11.18.6 and pp. A-70 to A-76; Exh. 4, §§ 3.6, 5.4. EFSEC's

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findings regarding Applicants' NPDES permit support this conclusion. Exh. 57, p. 16.

75. The cooling tower blowdown will be diluted with fish rearing facility effluent and dilution water. Due to this dilution, the chlorine demand of the dilution water, and the residence time of the discharge water within the pipeline, only a very small amount of total residual chlorine concentration will appear at the point of Project discharge. An extremely conservative estimate of the total residual chlorine concentration at that point is 0.09 mg/l. This estimate is based on the maximum value of ammonia observed in the Skagit River (0.31 mg/l). Chakravorti, fol. Tr. 3382, pp. 8, 9; Exh. 57, pp. 16, 17. The Staff concluded that the total residual chlorine in the Project discharge will not be detectable. FES, fol. Tr. 2913, p. 3-23.

76. Effluent from the fish-rearing facility will contribute to the suspended solids, turbidity, biological oxygen demand, and a lower dissolved oxygen in the river. Apart from residual suspended solids, the only measurable changes in water quality resulting from the operation of the fish facility will be small increases in nitrate, phosphate, ammonia and biological oxygen demand, and a decrease in dissolved oxygen. These changes will be small when compared to those introduced by the chemical additives and the effect on the discharge composition

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will be negligible. Milstead, fol. Tr. 3345, p. 2; FES, fol. Tr. 2913, §§ 3.7.3, 5.5.3.2; Exh. 45. Ammonia production in the fish-rearing facility has not been taken into consideration in relation to biocide discharges because ammonia in the expected concentrations (maximum of 1.7 mg/l) is neither toxic in itself, nor expected to contribute to chloramine formation due to the absence of free chlorine in the blowdown. The residual chloramines in the fish-rearing facility would be reduced to zero within 36 hours. Consequently, levels of chloramines, which could prove toxic to aquatic biota, are not expected to be approached. Milsted, fol. Tr. 3345, pp. 2-4; Tr. 3348, 3352, 3357.

77. Thermal Effects. Two examples of thermal impact on the Skagit River were analyzed and presented by Applicants. First, the maximum recorded river temperature of 64°F represents the critical condition for design of the diffuser because it requires the maximum dilution to meet the state water quality criteria. Second, the minimum river temperature of 34°F and the corresponding Project discharge temperature of 50°F represent the largest temperature difference between the Project discharge and the river. Scott, fol. Tr. 3382, pp. 9, 10.

78. The mean annual flow and 10-year, 7-day low flow of the Skagit River at Sedro Woolley are estimated by the USGS to

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be about 16,200 cfs and 4,740 cfs, respectively. For the 10-year, 7-day low flow and the mean flow, the flow depths at the diffuser location are estimated to be about 10 and 14 feet, respectively. The river velocities are estimated to be about 1.5 fps for the 10-year, 7-day low flow and 3 fps for the mean flow. Scott, fol. Tr. 3382, p. 10.

79. Applicants analyzed the chemical and thermal plumes associated with the Project discharge, based on models which provide the best estimate presently available of diffuser performance. 10-year, 7-day low flow conditions were assumed for the analyses. "Worst case" summer and winter thermal plumes were presented, together with the "worst case" dilution plume. Scott, fol. Tr. 3382, pp. 10, 11, and Figs. 2 through 5; Tr. 3391-397. Extreme conditions were assumed, leading to overestimates of the changes in water quality parameters. FES, fol. Tr. 2913, p. 5-19.

80. SCANP's witness Dr. Brubaker testified that fish might suffer adverse effects by virtue of the thermal discharge to the Skagit River. Brubaker, fol. Tr. 2925, p. 18; Brubaker, fol. Tr. 8211, p. 4; Tr. 2926-928. His literature search had revealed reports that an increase in predation rates for fish resulted from "thermal doses of about 10 to 20 percent less than those required to incur visual disequilibrim." Tr. 2829. However, he was unable to relate the "10 to 20 percent less" to

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any specific figure and it is therefore impossible to evaluate the allegation in the Skagit case. Tr. 2829-832.

81. From an environmental point of view, the worst case condition associated with the thermal discharge from the Project would be that where the largest possible temperature difference (delta T) between the Project discharge and the Skagit River coincides with low flow in the Skagit River. The largest delta T can be expected to occur in the winter; when the minimum Skagit River temperature is 34°F, the Project discharge temperature could be as high as 50°F, giving rise to a delta T of 16°F. Assuming the river to be flowing at the 10-year, 7-day low flow of 4740 cfs, dilution within approximately four feet downstream of the diffuser would reduce the delta T to 46°F. An organism carried at the low flow river velocity of 1.5 fps would travel through this four-foot distance in approximately three seconds. Within 100 feet of the diffuser, the elapsed time would be 67 seconds and the delta T would be reduced to 0.8°F, under low flow conditions. Juvenile salmonids migrating downstream are not always carried passively downstream. Rather they tend to swim weakly into the current to maintain their orientation while being carried downstream. The maximum sustainable cruising speed for these fish is on the order of 1 fps. If it is assumed that they are swimming upstream at this velocity under the 10-year, 7-day low flow, the

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effective downstream velocity of the fish is reduced to 0.5 fps and exposure times are tripled. A fish subjected to this worst case thermal transient as described should not experience any lasting stress. Houghton, fol. Tr. 3382, pp. 11, 12; Exh. 4, at § 5.1.2.3; FES, fol. Tr. 2913, p. 5-19; Tr. 3429, 8246, 13,207.

82. The worst case summertime condition corresponds to a Skagit River temperature of 64°F and a discharge temperature of 70°F, yielding a delta T of 6°F. Since a fish acclimated to 64°F water can be placed in 70°F water with very little stress over a period of several hours, the relatively brief exposure to the maximum summertime thermal transient certainly should cause no lasting stress. Houghton, fol. Tr. 3382, p. 13; Exh. 4, § 5.1.2.3.

83. SCANP's witness Brubaker suggested that fish would be attracted into the discharge plume and would remain there sufficiently long to become adversely affected either by various constituents of the Project discharge or by "cold shock" resulting from a ceasing of thermal effluent when the plant shuts down. He suggested that both the temperature and chlorine components of the Project were capable of attracting fish. Dr. Brubaker presented no evidence relating to thermal attraction which could be used to assess the possibility that such attraction would occur at this facility. Dr. Brubaker

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made a general reference to a study by Sprague and Drury in support of his contention that fish would be attracted to the chlorine content of the project discharge. Brubaker, fol. Tr. 2925, p. 19; Tr. 2928-929, 2932-933, 2936, 2956, 2959, 2975.

84. Applicants' witness Houghton testified that the physical configuration and location of the discharge plume negates the possibility of attraction of fish to the thermal component of the plume. For example, under the worst case winter condition, the delta T would be 4°F at a point 4 feet downstream from the diffuser. This region would be elevated from the river bottom and in an area of relatively high current. Because the maximum sustained cruising speed of juvenile salmonids is less than the velocity in the river at the 10-year, 7-day low flow, it is extremely unlikely that a juvenile salmonid would be able to remain within the plume for any substantial length of time. Further, the jet velocity of the discharge, which is 6 or 13 feet per second at the diffuser during one or two-unit operation, respectively, would cause the water in the vicinity of the diffuser to move even faster than the average river flow, thus making it even more unlikely that a juvenile salmoid would remain the discharge plume. The water velocity is also too great to allow planktonic food sources to concentrate in the plume. While adult fish are capable of a higher maximum cruising speed than juveniles, adults have a

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known tendency to remain near the bottom. Therefore, it is unlikely that they would leave the bottom and prefer to remain in the elevated discharge plume. Milsted, et al., Tr. of 31 July, 1975 (Vol. II), p. 2; Houghton, fol. Tr. 3382, pp. 18, 19; FES, fol. Tr. 2913, p. 5-19; Tr. 3402-404. Returning to Dr. Brubaker's suggestion that salmonids would be attracted to the thermal plume, we note that he did not know the cruising speed of juvenile salmonids. He further had no idea of whether they could maintain themselves in the plume at all, let alone for the time required before the fish would become acclimated. Tr. 2949-950, 2952-957. For the above reasons, we cannot agree with Dr. Brubaker. As a footnote, we observe that EFSEC also did not accept Dr. Brubaker's opinion in this regard. Exh. 57, p. 22.

85. According to Dr. Houghton, the Sprague and Drury study mentioned by Dr. Brubaker, which relates to attraction to chlorine, showed that fish were attracted to a chlorine level of 0.1 mg/l, and showed an avoidance for all other chlorine levels tested, both higher and lower. Because the maximum expected chlorine concentration at the Project diffuser (0.09 mg/l is just below the level at which attraction was shown to exist, and because that maximum level will be very rapidly diluted by mixing with the river, the fish would have to traverse a large region of the lower chlorine concentrations they

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have been shown to avoid before they could reach the relatively small region near the diffuser where attractive concentations could exist. Further, any fish that did reach the area of attractive concentrations would be quickly displaced from that region by the river current and by the jet velocity of the diffuser discharge. Tr. 3405-407.

86. Dr. Brubaker suggested the possibility that the discharge plume might constitute a block to upstream salmon migration. Brubaker, fol. Tr. 2925, p. 10. During the 10-year, 7-day low flow, the diffuser and dilution zone would occupy only about 15 percent of the total river width. Because adult salmonids swimming actively upstream are able to detect and avoid any potentially harmful conditions, they are capable of avoiding the discharge plume; such avoidance has been observed. Studies reporting interference with migration on the Columbia River indicate such interference occurred when the river temperature reached about 70°F, a condition which will not exist in the vicinity of the Skagit discharge. The Project discharge will not result in a blockage of upstream migration. Houghton, fol. Tr. 3382, p. 18, 19; FES, fol. Tr. 2913, p. 5-19; FES Final Supp., fol. Tr. 7767, p. 4-18; Exh. 4, § 5.1.2.3; Exh. 57, p. 22; Exh. 119, p. 33; Tr. 2970-973, 3409.

87. In response to a postulation by SCANP, the Staff evaluated the possible effects of the Project discharge should

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fewer than 12 cycles of concentration be used. The Staff analyzed operation of the cooling system at 6 cycles of concentration under extreme conditions (i.e., maximum blowdown temperature and low flow conditions). The result of this worst case analysis is that 25 feet from the diffuser, the fully mixed temperature increase would be only about 0.55°F (as compared to 0.34°F. in the case of 12 cycles of concentration). This very slight change in delta T is most likely not detectable and is an order of magnitude less than diurnal variations in river temperature. With respect to chemicals, the differences in concentrations in the fully mixed region in either 6 or 12 cycle operating modes are indistinguishable. Schreiber, et al., fol. Tr. 12,226, pp. 14-18. Therefore, we find that operation of the cooling system at fewer than 12 cycles of concentration (and as low as 6 cycles of concentration) would not affect our findings on the potential thermal and chemical effects of the Project discharge.

88. Chemical Effects. Dr. Brubaker also expressed the opinion that various constituents of the Project discharge would be capable of adversely affecting aquatic organisms, even to the point of death. He cited concentrations of chlorine, copper, zinc and other metals that had been shown to produce deleterious effects, either singly or in combination. In contrast to the testimony of Dr. Houghton, which included consideration of the time of exposure of an organism to a

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chemical, Dr. Brubaker rarely made any reference to an exposure period. Brubaker, fol. Tr. 2925, pp. 17-22; Brubaker, fol. Tr. 8211, p. 3; Tr. 2934-936. While Dr. Brubaker's testimony did serve to call attention to the potentially toxic nature of the Project discharge, the Board is satisfied that Dr. Houghton's analysis has fully explored these possibilities.

89. Chlorine is among the most toxic agents potentially present in the Project discharge. The conservatively estimated maximum level of total residual chlorine at the point of discharge is 0.09 mg/l, for up to 30 minutes per day with one unit operating. Within four feet of the diffuser, the concentration will be diluted to 0.03 mg/l; this corresponds to an elapsed time of three seconds for a passively transported organism. A level of 0.04 mg/l is a level appearing in the literature as affording protection to most species of fish for exposure periods of up to two hours per day. The Blue Book (Water Quality Criteria 1972, A Report of the Committee on Water Quality Criteria, Environmental Studies Board, National Academy of Sciences, National Academy of Engineering, Washington, D.C., (1972)) states that a limit of 0.05 mg/l should protect most species of fish for exposure periods of up to 30 minutes per day. Within 100 feet of the diffuser, corresponding to an elapsed time of 67 seconds, the concentration will be less than

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0.005 mg/l. Since this concentration of chlorine can only appear intermittently and since it approaches the level (0.003 mg/l) cited in the literature as adequate to protect most species for continuous exposure, no adverse impact is expected. Houghton, fol. Tr. 3382, pp. 13, 14, Figs. 2 and 5; FES, fol. Tr. 2913, p. 5-19; Exh. 4, § 5.4.3.

90. Of the other components of the Project discharge potentially toxic to fish, only ammonia is increased substantially by chemical additions during operation of the facility. The others, including several heavy metals, are simply concentrated in the cooling towers and released to the river. The maximum level of ammonia to be expected at the point of discharge is 1.23 mg/l, based on a maximum Skagit River concentration of 0.31 mg/l. That concentration at the point of discharge is below the level reported in the literature as allowing survival of steelhead for a period of several hours. Since this concentration will be very rapidly diluted, no biological stress is expected to occur. Houghton, fol. Tr. 3382, p. 14; FES Final Supp., fo' Tr. 7767, p. 4-18; Exh. 119, p. 32; Tr. 3436-437.

91. Other Project discharge consitutents including copper and zinc are naturally present in the Skagit River. The operation of the cooling towers will concentrate these natural constituents by twelve times, as a maximum, in the cooling tower

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blowdowns. However, following dilution of the cooling tower blowdown with the other components of the Project discharge, the ratio of (1) the concentration in the Project discharge to (2) the concentration in the Skagit River of a naturally present constituent will be approximately four, at the maximum. Chakravorti, fol. Tr. 3382, pp. 5, 6 and Table 2; Exh. 4, Table 3.6-5, § 5.4.1.1.

92. Aquatic organisms will be exposed to these elevated concentrations for a relatively brief length of time. For example, within 67 seconds, an organism carried at the low flow river velocity will have passed through the portion of the plume where the volume of the Project discharge relative to the volume of ambient river water is greater than five percent. After complete mixing of the Project discharge with the Skagit River at the 10-year 7-day low flow, the concentration of a naturally occurring constituent will be increased by 1.6 percent over natural conditions. Because of the brief periods of exposure to the relatively concentrated levels of these chemicals, and the very slight increase of concentrations existing during longer term exposure, no acute biological shock to aquatic organisms is predicted, nor is any measurable adverse effect on the aquatic environment expected to occur. Houghton, fol. Tr. 3382, pp. 14-16; Scott, fol. Tr. 3382, Figs. 2 and 5; FES, fol. Tr. 2913, p. 5-19; FES Final Supp.,

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fol. Tr. 7767, p. 4-18; Exh. 4, § 5.4.2; Exh. 119, pp. 32-33; Tr. 3407-408.

93. In addition to the effects of the constituents of the Project discharge taken separately, additive and synergistic interactions must also be considered. There is considerable documentation of synergism between relatively concentrated mixtures of copper and zinc in solution. At lower levels, such as those which were shown to be the maximum that may exist 100 feet downstream from the diffuser, no synergism is expected and the effects are additive. At the point of discharge, the concentrations of cooper and zinc under the worst case conditions are at levels where possible synergistic interactions might occur under longterm exposure, i.e., on the order of several hours. However, the rapid dilution of these concentrations and the short exposure time of any biota, which will be on the order of seconds, combined with the low probability of coincident high concentrations, lead to the conclusion that there will be no measurable impact resulting from the combined effects of copper and zinc. Houghton, fol. Tr. 3382, pp. 16-17.

94. It is also documented in the literature that increased temperature can increase the toxicity of various pollutants, including chlorine and heavy metals. While there are no laboratory studies researching the effect of all the various constituents in the Project discharge, it is clear that the

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increased toxicity of the various constituents due to increased temperature will not be such as to cause acute biological shock, due to the extremely brief exposure time. Houghton, fol. Tr. 3382, p. 17.

95. Dr. Brubaker cited research into the combined and synergistic effects of heat and chlorine showing that effects may be synergistic at a temperature of 20°C. However, he did not know the period of exposure required to produce the effect. Earlier published work by the same researcher (Thatcher) showed that a delta T of 10°C (18°F), which is higher than the maximum calculated for the facility, was necessary before synergy between heat and chlorine was noted. Brubaker, fol. Tr. 2925, p. 19; Tr. 2929, 2933-936, 2947-949, 2950-952, 2962-965, 3404-405.

96. Juvenile salmonid out-migration coincides with periods of high river flow in the Skagit River. Most of these juveniles travel in near-shore areas and near the surface. Since the discharge diffuser has been located so as to avoid plume contact with these areas, it is expected that very few juveniles will enter the plume at all. Of those that do enter the plume, few, if any, will pass through the limited area within four feet of the diffuser where the highest temperatures and concentrations will exist. If we assume the extreme case where

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all of the worst conditions coincide that is the highest concentration of heavy metals and ammonia in the river, the highest delta T condition, the lowest river flow, all coincident with plant chlorination -- it is possible that a juvenile swimming upstream against the current while passing through the full strength of the plume would suffer some stress. The likelihood of this is extremely low and it would not cause a measurable reduction in the total population of any fish species. Houghton, fol. Tr. 3382, pp. 17-18.

97. The Board finds that there will be no substantial adverse effect on the aquatic biota as a result of the Project discharge, and that any damage to the Skagit River fishery will be so slight as to be undetectable. Milsted, et al., Tr. of 31 July 1975 (Vol. II), p. 2; FES, fol. Tr. 2913, p. 5-19; FES Final Supp., fol. Tr. 7767, p. 4-19; Exh. 119, p. 33.

98. SCANP Contentions. In view of the fact that the thermal component of the facility's proposed discharge, acting either separately or together with other constituents of the discharge, is not expected to result in any substantial adverse effects, the Board finds that SCANP's contention that "thermal discharges into the Skagit River will be excessively high levels" is unfounded. SCANP PSAR Contention, 1.b.

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99. We have previously addressed SCANP PSAR Contention 1.d, alleging the discharge of supplemental biocides, and found it to be without merit. SCANP's final contention regarding aquatic impacts is Contention J.3:

> 3. The DEIS completely ignores the economic significance of the fishery based in the Skagit River. There is no dollar value placed on the fishery, and no attempt is made to reflect the potential economic and social harm of any damage to the fishery which may be caused by normal or abnormal plant operations.

100. The Staff, in both the FES and the FES Final Supplement, thoroughly evaluated the aquatic ecology in the site vicinity and the effects of both construction and operation of the Project on the aquatic ecology, including the fishery based in the Skagit River. FES, fol. Tr. 2913, §§ 2.7.2, 4.3.1, 4.4.2, 5.3.2, 5.5.3, 10.1.2.2; FES Final Supp., fol. Tr. 7767, Ch. 4 and §§ 5.3, 11.5.3, 11.8.9. We previously found that the damage to the fishery from construction and operation will be so slight as to be undetectable. Furthermore, the record contains no evidence of abnormal operations which could have an adverse impact on the aquatic ecology of the river. Therefore, the Board finds that Staff was correct in not including any cost figure for the fishery in its cost-benefit analysis. Milsted, et al., Tr. of 31 July 1975 (Vol. II), pp. 1-2. The Staff has conservatively estimated that the possible total economic loss in the fishery of the creeks due to the Project

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would be $5,350, which we consider to be an insignificant portion of the value of the Skagit River fishery. Id., pp. 3-4. We find no merit in Contention J.3.

4. Ranney Collector System

101. Four Ranney Collectors will supply the cooling water for the proposed facility. A Ranney Collector consists of a vertical caisson with slotted lateral pipes, which radiate horizontally from the caisson. The collectors will be installed near the banks of the Skagit River at River Mile 39. The collectors are designed to infiltrate water originating from the Skagit River through the sand and gravel aquifer at that location. Exh. 4, § 3.4.5, App. G; FES, fol. Tr. 2913, § 3.3.5.

102. Many aspects of the Ranney Collector system received attention during these proceedings. These aspects included (1) environmental effects of operation, (2) yield, (3) quality of water to be produced, and (4) reliability of the system. Each of these subjects is discussed below.

103. Environmental Effects of Operation. The pumps for the water supply will be located in a pumphouse on top of each caisson. The pumps and ventilating equipment will cause a quiet hum (about 40 dba) immediately outside the pumphouse. At the edge of

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the river the noise from operation of the collector system will be about the same as leaves rustling on trees. Such noise should have no adverse effects on or along the river. Tr. 10,654-656; Exh. 207, pp. 7, 8.

104. The pumphouses will extend to a height of two feet above the 100-year flood level and will be located between 130 to 150 feet from the river's edge, behind the dike. As such the pumphouses will not be visible from the river, except perhaps during high water conditions. In addition, the exterior of the pumphouses will be covered with coarsely textured wood siding to blend in with the surroundings. Vegetation will be planted to screen the pumphouses. Based on these plans, we find that the Ranney Collectors will have essentially no visual impact. Exhs 159-162, 204; Exh. 207, p. 7; FES, fol. Tr. 2913, App. D.; FES Final Supp., fol. Tr. 7767, pp. 4-[illegible]; Tr. 10,652-653.

105. When operating, the Ranney Collectors will induce the infiltration of river water through the aquifer. Witness Orrell suggested the possibility that salmon fry would be attracted by water moving into the aquifer and thus be drawn into the system. He assumed a velocity of water movement which is the swimming rate for salmon fry of at least 0.5 feet per second. Exh. 40, pp. 84-85, 93-95; see also, Tr. 8246. However, based upon the results of pumping tests, the velocities into the aquifer will be approximately 0.001 feet per second. Mikels, fol. Tr. 3041,

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p. 3; Tr. 3052-057. Orrell also assumed that the laterals would extend under the river when, in fact, they end at or before the river's normal edge. Exh. 164, 165; Tr. 3046-047. Therefore, we do not anticipate that salmon fry will be attracted by or drawn into the Ranney Collector system. FES Final Supp., fol. Tr. 7767, pp. 4-7, 4-8.

106. Operation of the Ranney Collector system will cause drawdown of the water table. At 800 and 1600 feet from the collectors the maximum drawdown will not exceed 4 feet and 2 feet respectively. Exh. 4, Supp. 1, pp. 208-209. The drawdowns will not materially affect local wells. Id.; FES, fol. Tr. 2913, p. 5-2. Concerns were also raised by SCANP witness Weber about what effect the water table drawdowns might have on two nearby streams--Muddy Creek and Red Cabin Creek. Weber, fol. Tr. 12,378, p. 4. However, the data indicate that these two creeks are perched above the groundwater table. Mikels, fol. Tr. 10,688, pp. 9, 10.; Anderson, fol Tr. 10,735, pp. 7, 8; Schreiber, et al., fol. Tr. 12,226, pp. 18-20; Schreiber, fol. Tr. 12,227, pp. 6-8, Fig. 1. Weber agreed that the creeks are perched. Tr. 12,509. Hence, drawdown of groundwater due to pumping of the Ranney Collectors will have no effect on the water levels in the nearby creeks. Tr. 10,849-850. Furthermore, even

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if the groundwater table were at or above the stream level, the influence on the creeks would be small. Schreiber, et al., fol. Tr. 12,226, pp. 19, 20.

107. Yield of the Ranney Collectors. The maximum water demand (68.4 million gallons per day or MGD) for the plant will be in summer, when the Ranney Collector system would produce in excess of 115 MGD. In the winter, when the plant demand would be about 49.2 MGD, the capacity of the Ranney system would be at its minimum of approximately 80.7 MGD. Under conditions of average water temperature and average river stage, the Ranney system could produce 104.3 MGD, while the average plant demand would be about 57.9 MGD. Therefore, the predicted yield of the Ranney Collector system will exceed plant requirements by at least 60% under summer, winter, or average conditions. Mikels, fol. Tr. 3041, pp. 2, 3; Mikels, fol. Tr. 10,691, p. 5; Schreiber, fol. Tr. 12,227, p. 4.

108. The Board inquired as to whether the results of the pumping tests conducted during the hydrogeological survey of the Ranney Collector site could be used to predict the yield of the system. Tr. 8,389-390. The flow rates during the pumping tests were 1.3 to 1.5 MGD while the maximum plant demand from the

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Ranney system will be 68.4 MGD. Mikels, fol. Tr. 10,691, p. 2. The pumping tests produced data for the computation of the permeability of the aquifer area that includes the area to be influenced by the proposed Ranney Collectors. Id., pp. 4, 5, and Att. A; Tr. 10,695-700, 12,321-322, 12,335. Yield was calculated using the permeabilities of the aquifer.

109. The methodology, which was used by Applicants' consultant Mikels for predicting the yield and was based on Darcy's law, is widely accepted by groundwater hydrologists. An independent check of this methodology by the NRC Staff's hydrologist produced estimated yields quite similar to those of Mikels. Mikels, fol. Tr. 10,691, pp. 3,4; Schreiber, fol. Tr. 12,227, p. 3; Tr. 10,737, 12,466. A comparison of predicted yields (based on relatively small rate pumping tests) with actual yields for all Ranney Collectors constructed in the western United States over the last 10 years indicated that the actual yield is equal to or exceeds the predicted yields. Mikels, fol. Tr. 10,691, p. 6; Att. C; Tr. 10,701-704. This demonstrates that the methodology used by Applicants here is conservative and reliable.

110. SCANP's witness Weber expressed several doubts about the estimated yields from the Ranney Collectors. He said there might be a 50% variation in yields based on his engineering judgment.

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Tr. 12,388, 12,450, 12,505. However, he neither had performed any calculations to support his claim, nor had any prior experience with Ranney Collectors. Tr. 12,435, 12,450, 12,466.

111. Weber stated that there was limited uncertainty about the application of Darcy's law, which was used for the yield calculation at this site. He reasoned that turbulent flow might develop in what he described as coarse gravels and cobbles in the aquifer at the Ranney Collectors site. Tr. 12,381-382. His opinion was based solely upon a textbook reference by Cedergren, not upon any case examples. He was not able to identify when Darcy's law begins to break down in the manner he described. Tr. 12,432, 12,453-454, 12,468. The Cedergren reference pertained to the design of filter drains with manmade materials (crushed gravels) from which all fine material such as sand had been removed. The material at the collector site is a naturally deposited sandy gravel aquifer, which is not at all comparable to the artificial material described by Cedergren. Tr. 14,263-266. The permeability for the smallest manmade materials described by Cedergren was 30 to 100 times larger than the permeabilities measured at the collector site. Id.

112. Undisputed among the witnesses was the fact that the aquifer at the collector site is highly permeable. Mikels, fol. Tr. 3041, p. 3; Exh. 4, App. G; Anderson, fol. Tr. 10,735, p. 3;

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Tr. 12,258, 12,433-434. As compared with permeabilities encountered at several other Ranney Collector and vertical well sites, the permeabilities involved here are not unusual. Deviation from laminar flow has not been observed elsewhere. Tr. 10,841, 12,258, 14,260-262, 14,315. Based upon the maximum groundwater velocities for the proposed design, the Ranney Collectors will be operated well within the laminar flow range for which Darcy's law is valid. Additional conservatism regarding the yield calculations arises from the fact that the pumping tests, which provided the data to compute the yields, were run at even higher groundwater velocities, though still within the laminar flow regime. Mikels, fol. Tr. 10,691, pp. 2, 3, Att. B; Tr. 12,519-522, 14,266, 14,314-315. Therefore, we find Weber's concerns about turbulent flow conditions occurring at the Skagit collector site to be without foundation.

113. Weber further criticized Applicants' yield predictions because a line of observation wells perpendicular to the river was not used during the pumping tests. Tr. 12,382. Mikels explained that when he started performing hydrogeological investigations for potential Ranney Collector sites, in the 1950's, a perpendicular line was used to determine whether water infiltrated from a river. In the early 1960's this procedure was dropped due to the availability of less costly means of determining recharge. His considerable experience since then demonstrates

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that a perpendicular line of wells is not needed to predict the yield from a proposed collector system. Mikels, fol. Tr. 10,691, Att. C; Tr. 14,259, 14,293-294, 14,306-312. Witness Schreiber agreed that perpendicular observation wells were not needed. Tr. 12,233. We agree.

114. Weber further criticized the yield predictions as being affected by the relocation of the caissons 50 feet further inland. Tr. 12,392-393. Applicants relocated the caissons for the collectors to reduce the visibility of the collectors from the river. Tr. 10,641-643. Weber concluded that this relocation had the effect of shifting the drawdown cone for each collector 50 feet inland. Tr. 12,392-393, 12,459-462; Exh. 178. Weber, however, did not understand the cone of drawdown for a Ranney Collector. Instead, when asked, he drew a cone of drawdown centering on the caisson as though it were a vertical well, even though caisson location has no bearing on the cone of drawdown. He ignored the horizontal laterals from which the water is obtained, and which therefore control the shape of the cone of drawdown. Id.; Exhs 209, 210; Tr. 14,266-273. The same area of the aquifer will be developed under both the original and revised design. Therefore, we find that Applicants' revision of the Ranney Collector design will not change the predicted yields, the quality

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of water to be produced or the effects on the groundwater table. Schreiber, fol. Tr. 12,227, pp. 5, 6; Tr. 10,671-683, 10,736; Exhs 164-167.

115. Weber's final criticism of the yield computations involved Applicants' use of permeability from the site of collector number one to compute the yield at collector number two. Tr. 12,382-385. The sole basis for his criticism was his interpretation from an aerial photograph of an ancient riverbed with finer grained sediments located between collectors one and two. Id.; Tr. 12,434-435; 12,442-449, 12,481-485; Exh. 177. However, Weber had never inspected the Ranney Collector site. Tr. 12,441. While no detailed pumping test was conducted at the location of collector two, similar materials were found during drilling at sites one and two. Small rate pumping tests at both sites also produced similar drawdowns, especially when compared to drawdowns at the other two collector sites which had less permeable aquifers. Exh. 4, App. G, p. 15, Fig. SW-67-5; Tr. 10,705, 14,274-276. The Staff's hydrologist concurred in Applicants' approach. Tr. 12,264-272. The comparability of permeability at the two sites was later confirmed during a higher rate pumping test at site two which demonstrated a relatively lower drawdown than encountered during the detailed pumping test

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at site one. Tr. 14,276-277. This suggests a higher permeability at site two than at site one. For all of the above reasons, we consider Applicants' predicted yield at collector site two to be reasonable.

116. Water Quality. Applicants determined that the composition of water to be produced from the Ranney Collectors will be approximately 90% river water and 10% groundwater. Hence, the water quality should approximate that of the river. Mikels, fol. Tr. 3041, p. 3; Mikels, fol. Tr. 10,688, pp. 2, 12-13; Exh. 4, App. G, pp. 18-19. All witnesses agreed that the aquifer is hydraulically well connected with the river. Id.; Weber, fol. Tr. 12,378, p. 2; Anderson, fol. Tr. 10,735, pp. 12, 13; Schreiber, et al., fol. Tr. 12,226, p. 14; Tr. 12,470-472.

117. Several methods were used to estimate the composition (ratio of river water to groundwater) of the water that the Ranney Collectors will supply. Using the Theis equation, Applicants computed that the percentage of pumped water being diverted from the river will be 92% after only 30 days of pumping. Mikels, fol. 10,688, p. 2, Exh. B. The Theis equation has been used widely and successfully by groundwater hydrologists for many years. Id., p. 12; Anderson, fol. Tr. 10,735, p. 12; Schreiber, et al., follows Tr. 12,226, pp. 12, 13. Applicants further demonstrated the validity of their prediction of a 9:1 ratio of river to groundwater based upon water quality (total hardness) data from several operating Ranney Collector installations.

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Mikels, fol. Tr. 10,688, pp. 4, 5; Exh. 168. Finally, the Staff's hydrologist, employing the current U.S. Geological Survey method, estimated that the Ranney Collectors should supply water containing 86% to 95% river water. Schreiber, et al., fol. Tr. 12,226, p. 13. SCANP's witness agreed that the proportion of infiltrated river water to stored groundwater will be high. Weber, fol. Tr. 12,378, p. 2. Therefore, we conclude that the water to be supplied by the Ranney Collectors should be quite close in quality to that of Skagit River water, which is excellent. Mikels, fol. Tr. 3041, pp. 5,6; Anderson, fol. Tr. 10,735, p. 5; FES, fol. Tr. 2913, pp. 2-15, 2-16.

118. System Reliability. The Ranney Collector system is not a safety system. A 30-day supply of water for reactor shutdown will be stored in the ultimate heatsink at the site proper. Exh. 4, p. 3.4-3; FES, fol. Tr. 2913, p. 3-7. For reasons of economics and not of health, safety or environmental impacts, however, the reliability of the Ranney Collector system has been explored. Tr. 12,512-517.

119. SCANP contended that "the provision made for intake of cooling water is inadequate and temporary." SCANP PSAR Contention 4. As we previously found, the predicted yield, which is reasonable, of the Ranney Collector system will greatly exceed (by about 60%) the plant requirements. Hence, the system will be adequate from the standpoint of yield. Ranney Collectors have

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been used for over 40 years with minimal problems. Mikels, fol. Tr. 3041, pp. 3, 4; Tr. 3061. In this regard, we take official notice of the EPA's Development Document for Best Technology Available for the Location, Design, Construction and Capacity of Cooling Water Intake Structures for Minimizing Adverse Environmental Impact, (April 1976). In that document (p. 139), the EPA noted that radial well intake systems are the "most environmentally sound intake system" and "have been in service for over 35 years and have been reliable.*

120. SCANP's witness Weber contended that there was a sufficient iron content in both river and groundwater near the collector site to permit the formation of enough iron bacteria to clog some of the laterals. Weber, fol. Tr. 12,378, pp. 2, 3. His contention was based only upon a German reference in a report by Jeffrey Haley. Weber had not read the German reference. Tr. 12,370-376, 12,429. In addition, Haley was a law student, not an expert. Tr. 10,760-761. His report was not placed in evidence. Weber's comments on iron content were also based in

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*See, Applicants' Memorandum in Reply to Intervenor SCANP's Memorandum Re the Application of Section 7(b) of the Wild and Scenic Rivers Act to the Proposed Skagit Nuclear Power Project, dated August 8, 1977, p. 13.

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part on his claim that "a well 200' from the collector site contained objectionably high iron (p. 10,825 review board)." Weber, follows Tr. 12,378, p. 3. However, Weber misread the transcript. The well "200' from the collector site" was in fact a well 200' from the Ranney Collector at Marysville, which is far distant from the Skagit site. Tr. 10,825, 12,429-430. Therefore, Weber had no sound basis for his suggestions that iron bacteria could develop at the proposed collector site.

121. Iron bacteria problems have been encountered at two Ranney Collectors (Skagit County PUD and Anacortes) in the western United States. Mikels, fol. Tr. 10,688, p. 7. The hydrogeologic conditions at these sites (flat riverbed gradient plus sandy and silty aquifer within tidal reach) differ greatly from the conditions at the proposed site more than 22 miles upstream. Moreover, the iron content (greater than 2.0 ppm) in groundwater at these two downstream sites substantially exceeded the low dissolved iron content (less than 0.1 ppm) in the water near the proposed site. Id., pp. 3, 5-7, Exh. D; Anderson, fol. Tr. 10,735, pp. 6-7; Schreiber, et al., fol. Tr. 12,226, pp. 2-6. None of the Ranney Collectors in the western United States with iron contents in the range found at the proposed site has experienced the growth of iron bacteria.

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Mikels, fol. Tr. 10,688, p. 7, Exh. D. Therefore, we find that the growth of iron bacteria at the proposed collector site is very unlikely.

122. Should a growth of iron bacteria ever occur, a proven method of treatment is available. A measured volume of chlorine solution would be allowed to percolate by gravity into the laterals and surrounding gravel packs. After standing in the laterals for 16 to 24 hours to destroy the bacteria, the solution would be pumped to waste. Mikels, fol. Tr. 10,688, p. 7; Schreiber, et al., fol. Tr. 12,226, pp. 8, 9. Weber expressed a worry that chlorine solution, if ever used, might reach the river. Tr. 12,403-406. However, the solution would be unlikely to move very far via molecular diffusion and would be largely consumed by iron bacteria and organic matter. There will be a time lag in the potential spread of the solution. When one collector is shut down for treatment, the hydraulic gradient will be away from the river and toward other operating collectors. Mikels, fol. Tr. 10,688, pp. 5-7; Schreiber, et al., fol. Tr. 12,226, p. 8; Tr. 12,229-231, 12,488, 12,501. For these reasons, we agree with Applicants and Staff that the chlorine solution, if ever needed, would not seep into the river. We also note that Weber indicated that any chlorine solution would, if it reached the river, be rapidly mixed and diluted with river water.

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123. The only other problem which has been experienced with Ranney Collectors is encrustation due to highly mineralized water, i.e., 1,000 ppm total dissolved solids or 600 ppm hardness. This problem is not anticipated at the proposed site because both surface and groundwater contain less than 100 ppm total dissolved solids and 50 ppm hardness and have a low dissolved mineral content. Mikels, fol. Tr. 3,041, pp. 5, 6; Mikels, fol. Tr. 10,688, pp. 8, 9; Schreiber, et al., fol. Tr. 12,226, pp. 1, 2; Tr. 3,062-064.

124. SCANP witness Weber foresaw two additional threats to the Ranney Collector system: (1) removal of part of the system by bank scour during a flood, and (2) development of a new channel which would take the river south of the proposed site. Weber, fol. Tr. 12,378, p. 5; Tr. 12,394-398. While Weber viewed these possibilities as not having been discussed, he failed to review the portion of the transcript where Applicants expressly addressed these matters. Weber, fol. Tr. 12,378, p. 6 (His reference No. 15 indicates reading Tr. 10,762 et seq., whereas Applicants' presentation was at Tr. 10,660-668.)

125. During a large flood (e.g., a 100-year flood), some of the riprap along the collector site could possibly erode. Tr. 10,663-664. In the area behind the dike, 7 to 9 feet of ground could be removed. Tr. 10,667, 10,777-779. This amount

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of scour would not threaten the laterals which are located at depths of at least 36 feet below ground surface. Exh. 4, App. G, Fig. SW-67-24; Tr. 10,666, 10,790-791. Neither would it be likely to harm the water discharge lines from the collectors since they will be buried at least 8 feet deep, sited no closer than 150 feet to the river bank and routed away from the river. Tr. 10,656, 10,667, 10,951-952; Exh. 158. Finally, flooding should pose no threat to the caissons since they are designed to extend about two feet above the 100-year flood level. Tr. 10,656. Ranney Collectors, which number over 400 and are usually sited next to a river without riprap protection, have never been lost during a flood. Tr. 14,319-322.

126. The possibility of riverbed movement is also quite remote. The collector site has been protected by riprap for the last 20 years. During this time the river has stayed in its present position. Exh. 4, App. L, pp. L-6, L-7. Applicants' plan to maintain, inspect and retain the existing riprap in good condition. Exh. 204; Tr. 10,656. While some of the riprap could be breached during a flood, repair of any damage is quite feasible. Tr. 7799, 10,664-666, 12,437. Finally, the possibility of the river cutting a new channel through the bend south of the collector site has been con- sidered and found to be very remote. Exh. 4, App. L, p. L-7; Tr. 10,948-949, 10,963.

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127. For the above reasons, we find that the proposed Ranney Collector system will reliably supply an adequate amount of water for the plant. We accordingly reject SCANP's contention.

5. Radiological Releases

128. During routine operation the facility will emit small amounts of radioactive material. These releases must be controlled in accordance with 10 CFR Part 20. In addition, an applicant for a construction permit must identify "the design objectives, and the means to be employed, for keeping levels of radioactive material in effluents to unrestricted areas as low as is reasonably achievable." 10 CFR § 50.34a. Appendix I to 10 CFR Part 50 provides numerical guides for design objectives and limiting conditions for operation to meet the "as low as is reasonably achievable" criterion for light-water-cooled nuclear power reactor effluents.

129. In conformance with the requirements of Appendix I, Puget filed the necessary information with the Commission to permit an evaluation of the Project. With respect to Section II.D of Appendix I, Puget has chosen to demonstrate conformance by the method prescribed in the Commission's September 4, 1975 amendment to the regulations (40 F.R. 40,816), rather than

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using the cost-benefit approach. The NRC Staff has performed a detailed analysis of the Applicants' submittals and has concluded that the radwaste treatment systems to be installed at the Project will be capable of reducing releases of radioactive materials in liquid and gaseous effluents to "as low as is reasonable achievable" levels. Since this is in accordance with the requirements of 10 CFR § 50.34a, the radwaste treatment systems are acceptable. Safety Evaluation Report Supplement No. 1 ("SER Supp. 1"), fol. Tr. 14,441, pp. 11-1, 11-7.

130. Radwaste treatment and effluent control systems, plus estimated population doses, were described at a relatively early stage in this proceeding. See, e.g., FES, fol. Tr. 2913, §§ 3.5, 5.4; Leech, fol. Tr. 2722; Hewitt, fol. Tr. 2722; Essig, fol. Tr. 2722; Safety Evaluation Report ("SER"), fol. Tr. 14,441, § 11.0. Based on more recent data at other operating nuclear power reactors, applicable to the Project, and on changes in the Staff's calculation models, new liquid and gaseous source terms were generated to determine conformance with the requirements of Appendix I. In making its determinations, the Staff considered waste flow rates, concentrations of radioactive materials in the primary system, and equipment decontamination factors consistent with those expected over the

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30-year operating life of the plant for normal operation, including anticipated operational occurrences. SER Supp. 1, fol. Tr. 14,441, p. 11-2.

131. A summary of the calculated doses resulting from the Staff's evaluation is presented in the tables below, which replace Tables 5.5 and 5.6 of the FES.

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COMPARISON OF CALCULATED DOSES TO A MAXIMUM INDIVIDUAL FROM SKAGIT NUCLEAR POWER PROJECT OPERATION WITH SECTIONS II.A, II.B, AND II.C OF APPENDIX I TO PART 50

Criterion	Appendix I Dose Design Objective	Calculated Dose
Liquid Effluents		
Dose to total body from all pathways	3 mrem per year per reactor	0 mrem per year per reactor[1]
Dose to any organ from all pathways (adult-bone)	10 mrem per year per reactor	0 mrem per year per reactor[1]
Noble Gas Effluents (at site boundary)		
Gamma dose in air	10 mrad per year per reactor	4.6 mrad per year per reactor
Beta dose in air	20 mrad per year per reactor	5.6 mrad per year per reactor
Dose to total body of an individual	5 mrem per year per reactor	1.1 mrem per year per reactor
Dose to skin of an individual	15 mrem per year per reactor	3.1 mrem per year per reactor
Radioiodine and Particulates[2] (at maximum individual)		
Dose to any organ from all pathways	15 mrem per year per reactor	7.6 mrem per year per reactor

NOTES:

1 No liquid radioactive releases

2 Includes Carbon-14 and Tritium

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COMPARISON OF CALCULATED DOSES TO A MAXIMUM INDIVIDUAL FROM SKAGIT NUCLEAR POWER PROJECT, UNITS NOS. 1 AND 2 OPERATION WITH GUIDES FOR DESIGN OBJECTIVES PROPOSED BY THE STAFF

Criterion	RM-50-2 Dose Design Objective[1]	Calculated Dose
Liquid Effluents		
Dose to total body or any organ from all pathways (adult-bone)	5 mrem per year per site	0 mrem per year per site[2]
Noble Gas Effluents (at site boundary)		
Gamma dose in air	10 mrad per year per site	9.2 mrad per year per site
Beta dose in air	20 mrad per year per site	11 mrad per year per site
Dose to total body of an individual	5 mrem per year per site	2.2 mrem per year per site
Dose to skin of an individual	15 mrem per year per site	6.3 mrem per year per site
Radioiodine and Particulates[3] (at maximum individual)		
Doses to any organ from all pathways	15 mrem per year per site	15 mrem per year per site

NOTES:

1 Applied as a design objective pursuant to Section II.D of Appendix I

2 No liquid radioactive releases

3 Includes Carbon-14 and Tritium

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As the comparison presented in the tables indicates, the Staff's calculations indicate conformance with the requirements of Sections II.A, II.B, II.C and II.D of Appendix I. SER Supp. 1, fol. Tr. 14,441, pp. 11-7 to 9.

132. SCANP has contended, in PSAR Contention 1.c, that "the present plant design will cause radiological contamination of cooling tower blowdown." SCANP PSAR Contentions, p. 1. While it is possible, under certain meterological conditions, for a portion of the gaseous radioactive wastes released to be entrained in the cooling tower blowdown and subsequently discharged to the Skagit River, the record indicates that resulting doses will be extremely small and that exposure through this pathway is insignificant. Tosetti, fol. Tr. 2629; FES, fol. Tr. 2913, § 11.18.5.

133. SCANP has also alleged, in Contention J.9, that

> There is no discussion of the statistical probability of genetic, or somatic or other forms of injury to life forms which will result from normal, and accidental, chemical and radiological releases, and of the nature of such injury.

The Staff has, however, included an estimate of genetic and somatic risks in the FES and offered additional testimony on the subject at the hearing. Milsted, et al., fol. Tr. 2983; FES, fol. Tr. 2913, § 11.17; Tr. 2979-981.

134. The Staff concluded, based on an upper bound estimate, that the range of calculated genetic effects to the U.S. population under normal operating conditions is about 0.93 to 22

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effects based on a 30-year period of operation. The Staff calculated the range of somatic effects for non-occupational exposure to plant effluents under normal operating conditions to be 0.17 to 0.86 deaths. These results, for both genetic and somatic effects, are only a tiny fraction of one percent of the effects of doses caused by natural background. Milsted, et al., fol. Tr. 2983, p. 2; Tr. 2979-980, 2995-998, 3007-014.

135. With respect to genetic and somatic effects from accidental radiological releases, the Staff estimated effects for the highest population dose listed in FES Table 7.2, "Summary of Radiological Consequences of Postulated Accidents," and concluded that there would be 0.0001 to 0.0019 genetic effects on the first generation following such a release, and 0.0015 to 0.0075 deaths from somatic effects. The estimated effects for other accidents listed in Table 7.2 would be proportional, based on the dose delivered. Milsted, et al., fol. Tr. 2983, p. 3; Tr. 2980.

136. With regard to the genetic and somatic effects from normal and accidental chemical releases from the facility, the Staff has fully analyzed such effects in the FES and testimony presented at the hearing. Their conclusion, with which we concur (see the discussion of Cooling Tower Operation and Project Discharge, above), was that the effects of chemical discharges on terrestrial and aquatic biota will be very slight. Milsted, et al., fol. Tr. 2982, p. 4; Tr. 2981-982.

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137. To summarize, the Board finds that the as low as is reasonably achievable requirements of the Commission's regulations have been met, and that the matters raised in SCANP Contention J.9 and PSAR Contention 1.c have been adequately considered and are acceptable.

D. Effects of Postulated Accidents

138. During the proceeding, intervenor SCANP questioned the adequacy of consideration given by the Staff to the environmental consequences of possible accidents. In particular, SCANP alleges in Contention J.7 that the environmental statement for the Project "entirely ignores the likelihood and consequences of accidents of any kind," and that

> It is unreasonable . . . to ignore the consequences of accidents for purposes of environmental and economic impact evaluation since the consequences of accidents are evaluated with respect to other aspects of the licensing process, including the safety analysis.

SCANP Contentions, fol. Tr. 67, p. 9.

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139. This contention, however, is without foundation in fact. Chapter 7 of the FES evaluates the environmental impact of postulated plant and transportation accidents involving radioactive materials. The Staff has concluded that the environmental risk due to postulated radiological accidents is small. Grimes, fol. Tr. 2895, p. 3; FES, fol. Tr. 2913, §§ 7.1 and 7.2. The Board agrees.

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140. During the hearings, it became clear that SCANP desired that Class 9 accidents* also be considered. In a motion dated December 3, 1975, SCANP sought to expand contention J.7 to encompass Class 9 accidents. After responses by Applicants and the Staff and oral argument, the motion was denied. Tr. 4729-745, 4854-855. Later, on April 27, 1979, SCANP served a "Motion for Order Directing Review of Staff Position Regarding Relevance of Class 9 Accidents and Renewing Motion to Consider Class 9 Accidents." By order dated July 11, 1979, the Board again declined to require consideration of Class 9 accidents and denied the motion. We now reaffirm our earlier decisions and find that, absent a showing -- not made here -- that special circumstances render a Class 9 accident credible

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*The phrase "Class 9 accident" is a term of art stemming from a 1971 Commission proposal to adopt standard assumptions concerning nuclear power plant accidents for use in preparing environmental impact statements. Proposed Annex to Appendix D to 10 CFR Part 50, 36 F.R. 22,851 (December 1, 1971); 1 Nuclear Regulation Reporter (CCH) ¶ 7469. See also, 39 F.R. 26,279 (July 18, 1974). The accidents grouped in Class 9 are of the most severe kind, involving occurrences such as "breach of containment" and "core-melt" accidents. Although the consequences of a Class 9 accident might be extremely severe, the likelihood of one occurring is deemed to be so improbable that a nuclear power plant need not be designed with protective systems or safety features to guard against it. Offshore Power Systems (Floating Nuclear Plants), ALAB-489, 8 NRC 194, 209 (1978), cert. accepted by the Comm'n, Order, December 8, 1978.

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or more likely at the reactors in question than at power reactors generally, the consideration of such accidents is not required and has been properly excluded.*

141. In sum, the Board concludes that a sufficient analysis of the environmental consequences of radiological accidents has been performed, and that the environmental risks associated with such accidents are acceptably low.

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*In this same general connection, on January 19, 1979 the Commission issued a statement of policy concerning the Reactor Safety Study (WASH-1400). The statement provided, inter alia, that the absolute values of the risks presented in the Reactor Safety Study shall not be used uncritically in the regulatory process, and that any such use in the past will be corrected as appropriate. The NRC Staff has stated that, in evaluating the environmental risks associated with accidents related to the Project, there has been no reliance on WASH-1400. See Letter from Richard L. Black to the Board, and enclosures, April 4, 1979; Tr. 2071. Accordingly, no corrective action is required.

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E. Alternative Sites

142. The subject of alternative sites was explored intensively in this proceeding. Particular attention has been directed to Applicants' site selection process, to the independence of the Staff's review of alternative sites, and to detailed comparisons by Applicants and Staff of a number of candidate sites.

143. Part of the extensive record on this subject was developed in response to the following contentions by SCANP:

> C. The studies conducted by Applicant in evaluating alternative sites for the proposed power plant were insufficient. More suitable sites, sites such as Hanford, exist within the State of Washington and these were not fully studied by Applicant. The comparative analysis of the alternative sites that were studied is biased and insufficient.
>
> J.1. The DEIS does not represent the independent work of the NRC.
>
> . . .
>
> b. The preparers of the DEIS failed to make their own independent evaluation and investigation with regard to: alternative sites, . . .
>
> J.12. The discussion of alternatives in the DEIS is completely inadequate.

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a. The preparers of the DEIS did no independent evaluation of alternative sites and they included insufficient information about alternative sites. All information that is included about alternative sites was supplied by the Applicant.

b. There is absolutely no discussion of Hanford, which is an obvious and readily available alternative site.

c. The tabular comparison of three sites is grossly inadequate and pre-ordains the outcome. The comparison of sites does not give any weight to the unique scenic and recreational values, which have been nationally recognized, of the Skagit River and its setting. Furthermore, the seismicity values assigned to the Skagit site are clearly erroneous. Even using the tabular comparison presented in the DEIS, if proper values were utilized, the Skagit site would turn out to be the least desirable.

144. Applicants' Site Selection Process. The lead Applicant is Puget Sound Power & Light Company (Puget), which will own 40% of the electrical output of the Project. As the originator and sponsor of the project, Puget is responsible for its design, construction and operation. Jacobsen, et al., fol. Tr. 6012, p. 3; Exh. 175, pp. 2, 12; FES, fol. Tr. 2913, p. 1-1.

145. Puget selected the Skagit site based upon a number of thermal power plant siting studies. The earliest studies, in 1966, covered Puget's service territory, which is almost entirely within Western Washington. These studies, which concentrated on once-through cooling sites, found the Cherry Point site to be the best. Cherry Point is located on the shoreline

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of the Strait of Georgia, about 40 miles northwest of the Skagit site. Jacobsen, fol. Tr. 3687, pp. 1, 2; Leech, et al., fol. Tr. 12,542, pp. 6, 7; Tr. 5881.

146. Despite the viability of Cherry Point site, Puget anticipated problems in developing it. These problems included difficulties in property acquisition, doubts about the licensability of a once-through cooling plant, and potential safety hazards inherent in the operation of adjacent petroleum industry facilities. For these reasons, Puget continued to look elsewhere for a site. Jacobsen, fol. Tr. 4940; Tr. 3713.

147. In 1970, Puget and three other western Washington utilities commissioned a comprehensive study of thermal power plant sites in western Washington and the Hanford area of central Washington. The study identified 117 potential site areas. Based on this study, Puget concluded that the Skagit, Nooksack and Cowlitz River regions in western Washington were among the most promising regions and warranted further study. Jacobsen, fol. Tr. 3687, pp. 2, 3; Exh. 4, § 9.2, App. O; Exh. 46.

148. A further study was conducted in 1972. Of the eight sites identified within the three watersheds, the Skagit site was found to be the most promising. The most significant factors underlying this conclusion were the rock foundation, the location of the site well above the floodplain, the natural

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screening provided by the terrain, the availability of an ample supply of cooling water, the favorable location within the northwest power grid, and the proximity to existing transmission lines, rail lines and highways. A detailed geotechnical evaluation was then made of the Skagit site. This confirmed the suitability of the Skagit site and, as a result, Puget publicly announced the Project in January 1973. Jacobsen, fol. Tr. 3687, pp. 3, 4; Leech, et al., fol. Tr. 12,542, p. 12; Exh. 47.

149. A subsequent siting study was performed in 1973 for Puget Power as a result of delay in obtaining zoning approval from Skagit County. This study identified the most promising sites in the Cowlitz and Nooksack River areas, which were, respectively, the Ryderwood and Goshen sites. A detailed evaluation was then made of Skagit in comparison with Goshen and Ryderwood. Jacobsen, fol. Tr. 3687, p. 4; Leech, et al., fol. Tr. 12,542, pp. 12, 13; Exh. 4, § 9.2.

150. Staff Review of Alternative Sites. The Staff carefully evaluated Applicants' site selection process. Its objective was to determine first, whether the final list of candidate sites were among the best that could reasonably be found in the region and second, whether any sites obviously superior to the Skagit site are likely to be found within the region of interest. Leech, et al., fol. Tr. 4124; Leech, et al., fol.

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Tr. 12,542, pp. 1-16; FES, fol. Tr. 2913, § 9.2; Tr. 13,027, 13,123.

151. In performing its review, the Staff often went beyond the studies performed for Applicants. Staff witness Stull redid the comparative analysis of 117 sites, which had been identified in the 1970 siting study for Puget. Her purpose was to determine whether any of these sites were preferable to Skagit. Stull visited all of the resource areas in which the 117 sites were located, physically setting foot on about 40 sites. She also gathered and relied upon information not included in the 1970 report. Tr. 13,173-180. Further evidence of the Staff's independent review of Applicants' site selection is its evaluation of the geotechnical aspects of 33 sites that had been identified in Puget's siting studies. These sites were compared to the Skagit site based on reconnaisance level data. Exh. 181; Tr. 12,834-887. The Staff also evaluated hydrologic engineering factors (e.g., adequacy of water supply) for most of these same sites. Exh. 192.

152. The second phase of the Staff's review involved the detailed comparison by the Staff of Skagit with five alternative sites. Several environmental and economic factors were utilized. The five alternative sites were Goshen, Ryderwood, Cherry Point, Pebble Springs and Hanford. Dvorak, et al., fol.

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Tr. 7336; Leech, et al., fol. Tr. 12,542, pp. 17 et seq. The Staff's comparisons are addressed below.

153. In performing its review, the Staff drew from several sources of information. Staff witnesses, including those from Argonne National Laboratory, inspected the six candidate sites that were compared in detail as well as many other resource areas and sites. Dvorak, et al., fol. Tr. 7336, p. 1; Leech, et al, fol. Tr. 12,542, pp. 13, 61; Tr. 7,347-350, 12,666-667, 13,175. They reviewed pertinent literature and obtained information from state and local agencies. Leech, et al., fol. Tr. 4124, p. 3; Leech, et al., fol. Tr. 12,542, pp. 36-40 and references at end; Tr. 7351-354, 7,367, 12,668-671, 13,179. They looked at siting studies done for other utilities and the State of Oregon. Tr. 13,125. They utilized the expertise the Bonneville Power Administration on the transmission system and transmission costs. Gens, fol. Tr. 5222; Leech, et al., fol. Tr. 12,542, App. B; Tr. 7468-471. Information from ERs, PSARS, NRC environmental impact statements, and NPDES permits for other dockets was used. Leech, et al., fol. Tr. 12,542, pp. 17, 38, 39, 44, 53, 61; Tr. 7395. The Staff also evaluated data supplied by Applicants, and requested further data from Applicants. Dvorak, et al., fol. Tr. 7336, p. 1; Leech, et al., fol. Tr. 12,542, p. 61; Exh. 116; Tr. 7,347, 12,668, 13,028, 13,122. Many man-months of effort were invested by the

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Staff in its review of the information on alternative sites. Tr. 7624, 7629. In the Staff's view, the consideration of alternative sites in this proceeding was unique and more detailed than on other proposed nuclear projects. Tr. 7347, 7626.

154. The Staff's evaluation of alternative sites has, without a doubt, been thorough and detailed. They have gathered and evaluated information from a wide range of sources. Their assessment of alternative sites, both in the FES and subsequent studies, has been independent. Therefore, we find no basis for the SCANP's contentions J.1.b and J.12.a.

155. Region of Interest. The Staff concluded that western Washington was the reasonable region of interest for consideration of alternative sites for the Skagit Project. Tr. 12,650, 13,120. Several factors support this conclusion. First, western Washington is deficient in generating resources. Approximately 75% of the regional load is west of the Cascades; however, most of the generation is located east of the Cascades. In western Washington, the load is more than twice as large as the generation. This serious imbalance is likely to continue until thermal power plants are located west of the Cascades. Knight, fol. Tr. 6018, pp. 2, 3; Gens, fol. Tr. 5222, pp. 2, 5, 6; Leech, et al., fol. Tr. 12,542, pp. 4, 5 and App. B, pp. 2, 3.

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156. Second, the western Washington area depends upon a few cross-mountain transmission lines for its supply of electricity. These long lines are vulnerable to various disasters such as lightning, avalanches, and ice storms. Knight, fol. Tr. 3687, pp. 5, 6; Knight, fol. Tr. 6018, pp. 1-4; Tr. 12,580-585. On several occasions, western Washington has been close to a blackout due to failures in cross-mountain transmission capability. Knight, supra. Therefore, reliability of the regional transmission system would be enhanced by locating new generating plants near load centers, such as in western Washington, thus avoiding long transmission lines. Gens, fol. Tr. 5222, p. 3; Tr. 12,584, 12,746-747.

157. Third, locating new generation close to the western Washington load center minimizes the transmission line losses. Such losses would be quite significant for an alternative site east of the Cascades. For example, the loss would be about 100 megawatts during the heavy load period in the winter. The average incremental cost of transmission losses for sites located east versus west of the Cascades would be $9,000,000 to $23,000,000 per year, using 1979 oil prices. Gens, fol. Tr. 5222, p. 13; Knight, fol. Tr. 6018, p. 6; Leech, et al., fol. Tr. 12,542, App. B, pp. 18, 20. The cost penalty over the

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life of a project could run between $234 million and $593 million in present value dollars. Leech, et al., fol. Tr. 12,542, p. 97 (corrected).

158. Finally, siting of the plant west of the Cascades postpones the need for constructing new transmission capacity across the Cascades. If the two Skagit units were relocated east of the mountains, the capacity of the cross-mountain transmission system that is presently existing or under construction would be partially filled. This would accelerate the need for new cross-mountain capacity. Leech, et al., fol. Tr. 12,542, pp. 5, 6; Tr. 12,587-589. Cross-mountain lines are extremely expensive to build, presently costing about $600,000 per mile. Tr. 5289. A new line could cost between $92 and $115 million. Knight, fol. Tr. 6018, pp. 5, 6; Tr. 6,014, 6,183.

159. As previously described, Puget Power's siting studies concentrated primarily on western Washington. Within this area are a great variety of land and water resource areas which are of sufficient size to contain a large number of alternative candidate sites. From the standpoint of the regional electric power system, western Washington is the appropriate region of interest. Leech, et al., fol. Tr. 12,542, pp. 5, 6, 10. In this regard, we note that the state of Washington siting council (EFSEC), in its consideration of alternative sites for

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the Skagit Project, concluded that "All factors considered, it is desirable and in the public interest to locate additional generation west of the Cascade Mountains." Exh. 84, p. 66. Their conclusion, which is entitled to substantial weight, was based on the factors of system reliability and transmission losses. Id. Hence, we accept the Staff's designation of western Washington as the region of interest for reasonable alternative sites to Skagit.

160. Within western Washington, Applicants identified three candidate sites: Skagit, Goshen (on the Nooksack River, about 6 miles northeast of Bellingham in northwest Washington), and Ryderwood (on the Cowlitz River in southwest Washington). FES, fol. Tr. 2913, p. 9-6; Exh. 4, § 9.2, App. O. At the request of the Board, the Cherry Point site (on the coastline about 12 miles northwest of Bellingham) was evaluated by Applicants and the Staff as an alternative site for the Skagit units. Jacobsen, fol. Tr. 4940 and fol. Tr. 5869; Dvorak, et al., fol. Tr. 7336. These four sites adequately represent the range of available environmental alternatives (three different watersheds plus one marine site) and are among the best sites that can be found west of the Cascades. Leech, et al., fol. Tr. 12,542, pp. 13-15.

161. Applicants and Staff also evaluated sites east of the Cascades at Hanford (on the Columbia River in south central

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Washington) and Pebble Springs (on the Columbia River in north central Oregon). Pebble Springs was considered at the Board's request. Applicants studied Hanford in their 1970 siting study. Exh. 46. The Staff assessed the Hanford site early in this proceeding in response to SCANP's contentions. Leech, et al., fol. Tr. 4124, pp. 4, 5. Furthermore, specifically in response to the Appeal Board's decision in the Pilgrim proceeding (ALAB-479), the Staff reexamined not only Applicants' site selection process but also the Hanford and Pebble Springs sites. Leech, et al., fol. Tr. 12,542. Therefore, the Skagit site plus five alternative sites, some of which are outside the region of interest, have been compared in extensive detail.

162. Comparison of Alternative Candidate Sites. The five sites to be compared with the Skagit site are Cherry Point, Goshen, Ryderwood, Pebble Springs and Hanford. The comparisons of each site with Skagit are reviewed below.

163. a. Skagit versus Cherry Point. Because Cherry Point is adjacent to salt water, the Staff analyzed it in terms of both fresh water (Nooksack River) and salt water cooling systems. Skagit is environmentally preferable to Cherry Point on several factors: (1) water supply (if fresh water were to be used at Cherry Point); (2) land use; (3) length of new transmission lines; (4) aquatic impacts (if once-through salt water cooling or fresh water cooling towers were used at Cherry

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Point); and (5) terrestrial impacts (if cooling towers were used at Cherry Point). Cherry Point's only environmental advantage, according to the Staff, would be an aesthetic one, but only if once-through cooling were used. Dvorak, et al., fol. Tr. 7336, pp. 9-17, Table 1; Jacobsen, fol. Tr. 5869. Cherry Point also ranks lower than Skagit on several non-environmental siting factors, such as geology and foundations, population density, seismicity, nearby industrial facilities, and hydrology. Id.; Leech, et al., fol. Tr. 12,542, pp. 25-27, 34, 35. Hence, we agree with the Staff's conclusion that Cherry Point with any type of cooling ranks lower than Skagit by a considerable margin.

164. b. Skagit versus Goshen. With respect to environmental factors, Goshen is less desirable than Skagit with respect to (1) water supply (the Nooksack is a much smaller river than the Skagit), (2) site access, (3) land use, (4) aquatic impacts, and (5) terrestrial impacts. The Staff ranked Goshen more favorably on traffic congestion and community impacts during construction. On aesthetics, the Staff ranked Goshen higher while Applicants rated Skagit higher. Dvorak, et al., fol. Tr. 7336, pp. 9-17, Table 1; Jacobsen, fol. Tr. 5869, Table 1; Exh. 4, App. O. In sum, the Goshen site does not offer environmental preference over the Skagit site. We further note that with respect to other siting factors, Goshen

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ranks below Skagit, particularly as to demography, geology, seismicity, and labor supply. Id.; Leech, et al., fol. Tr. 12,542, pp. 20-23, 32. EFSEC found that the Skagit site was preferable to the Goshen site. Exh. 84, p. 67. We agree.

165. c. Skagit versus Ryderwood. Of the alternative sites in western Washington, Ryderwood received the highest rating next to Skagit. Dvorak, et al., fol. Tr. 7336, p. 16. Ryderwood was less desirable than Skagit on several environmental factors: (1) water supply; (2) site access; (3) labor supply; and (4) socioeconomic impacts. The Staff rated Ryderwood more highly than Skagit on aesthetics, while Applicants rated them evenly. Id., pp. 9-17, Table 1; Jacobsen, fol. Tr. 5869, Table 1; Exh. 4, App. O. Hence, we find the Skagit site to be environmentally preferable to the Ryderwood site. As to other siting factors, Skagit received higher ratings on geology and foundations, meteorology, and hydrology and a lower rating on the factor of nearby industrial, transportation and military facilities. Id., Leech, et al., fol. Tr. 12,542, pp. 23-25, 32. Our conclusion on the preferability of Skagit over Ryderwood agrees with EFSEC's finding on this subject. Exh. 84, p. 67.

166. The Goshen and Ryderwood sites are suitable sites for a nuclear power plant. Cherry Point, although less desirable, is also a suitable site, provided once-through cooling is not

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utilized. No sites obviously superior to these as to Skagit are likely to be available within the region of interest, western Washington. Dvorak, et al., fol. Tr. 7336, pp. 16, 17; Leech, et al., fol. Tr. 12,542, p. 15. The Skagit site, however, is a superior site to the Goshen, Ryderwood, and Cherry Point sites from the standpoint of both environmental and non-environmental factors. SCANP alleged, in contention J.12.c. and partially in Contention C, that the comparison between the Skagit, Goshen and Ryderwood sites was inadequate. Admittedly, sites cannot be precisely compared because selecting the siting factors and the weight for each factor, and rating such factors at each site are somewhat subjective processes. See, e.g., Jacobsen, et al., fol. Tr. 6012, p. 4; FES, fol. Tr. 2913, p. 9-5. Despite this element of uncertainty, the detailed comparisons of the three sites by both Applicants and the Staff have been more than sufficient to support their independent conclusions that Skagit is the best choice of the three sites. We have previously agreed with this conclusion. Hence, we reject SCANP's position in Contentions C and J.12.c that Applicants' site selection studies and methodology were insufficient or biased, or produced an erroneous result.

167. SCANP also alleged that no attention had been given to scenic and recreational values of the Skagit River and that the

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seismicity value for Skagit was clearly erroneous. SCANP Contention J.12.c. The Staff has clearly evaluated the impact of the Skagit Project on scenic and recreational values of the Skagit River and weighed that consideration into its comparison of sites. Dvorak, et al., fol. Tr. 7336, p. 11; FES Final Supp., fol. Tr. 7767. The seismicity of not only the Skagit site but also the alternative candidate sites has also been evaluated in reasonable depth by the Staff. Leech, et al., fol. Tr. 12,542, pp. 17-40. The Staff found that the Pebble Springs and Hanford sites had an advantage over the Skagit site in terms of design ground motion, quantified the resulting cost impact, and weighed the cost disadvantage at Skagit into its economic com- parison of those sites. Id., pp. 33,102. While the Board has not determined an appropriate seismicity value for the Skagit site, we do find that the Staff's evaluation of seismicity at Skagit relative to that at other sites has been reasonable. For the above reasons, we reject SCANP Contention J.12.c.

168. d. Skagit versus either Pebble Springs or Hanford. The Pebble Springs and Hanford sites, east of the Cascades, have many similarities; hence, there is no need to compare each separately with Skagit. Both were compared with Skagit based upon potential aquatic, terrestrial and socioeconomic effects at each site. The evaluation covered numerous aspects of the

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aquatic ecology and resources and terrestrial ecology. On these important environmental subjects, Pebble Springs and Hanford are comparable to Skagit. Leech, et al., fol. Tr. 12,542, pp. 61-92.

169. Pebble Springs and Hanford, however, offer some advantages on some socioeconomic matters. Both have extremely low population densities and hence rank among the best sites in the nation in terms of remote siting. Id., p. 77. While Skagit has a relatively higher population density, it still enjoys a low population density based on the Reg. Guide 4.7 guideline of 500 people per square mile. Myers, et al., fol. Tr. 728, pp. 4-5; SSR, fol. Tr. 1888, p. 2; Exh. 183; Tr. 13,862-63.

170. A second socioeconomic factor on which the Staff thought that Hanford and Pebble Springs might be preferable is compatibility with land use. The Staff's reasoning appears to be that there is some controversy on the future development of the Skagit Valley yet no controversy at the other sites. Leech, et al., fol. Tr. 12,542, pp. 79-82. Such reasoning seems speculative. We also note that the Staff has found that construction and operation of the Skagit Project will have insignificant impact on land use. FES, fol. Tr. 2913, pp. i, 4-5, 5-1. Similar conclusions have been reached by Skagit County and the Department of Agriculture. Leech, et al., fol. Tr. 12,542, pp. 80-81. Although Hanford and Pebble Springs

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appear optimum in terms of compatibility with surrounding land use, Skagit suffers no infirmity on this factor.

171. The Staff also ranked Skagit lower than Hanford or Pebble Springs because there is a wider interest in cultural resources in the Skagit Valley and the aesthetic impact of cooling towers at Skagit would be greater. Leech, et al., fol. Tr. 12,542, pp. 86-89. Both of these effects are by their nature subjective and, hence, conjectural. Moreover, construction activities will have no adverse effects on historical or archaeological resources in the Skagit Valley. Exh. 4, § 2.3; FES, fol. Tr. 2913, p. 2-11.

172. The Board believes that the foregoing socioeconomic advantages of Hanford and Pebble Springs over Skagit should be given little weight, particularly relative to comparisons of potential biological impacts at these sites. These socioeconomic impacts pose no potential threat of measurable damage to the environment. Furthermore, such effects are by their nature speculative. While socioeconomic considerations point to small differences between Skagit and the other two sites, they do not disclose any environmental infirmities about the Skagit Project. We conclude that, based solely on environmental factors, the Skagit, Pebble Springs and Hanford sites are all comparable, with none being superior to any other one.

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173. At the Board's request, the Staff evaluated the cost impacts of moving the Skagit units to either Pebble Springs or Hanford. Leech, et al., fol. Tr. 12,542, pp. 93-110. Both sites were found to be measurably more expensive than Skagit. Id., p. 110. The cost impacts include capital, transmission and replacement power costs.

174. The Staff concluded that moving the Skagit units would increase capital costs, except in two respects. Id., p. 100. First, they calculated that $63 million would be saved by changing the seismic design level (0.35g at Skagit) to 0.25g at either Pebble Springs or Hanford. Id., p. 102. They assumed that such costs were recoverable should the Project be moved to these sites. The $63 million estimate, however, was based in part on factors other than additional materials and equipment. Ferguson, fol. Tr. 5917, Table 1. Hence, some costs may not be fully recoverable, as the Staff assumed.

175. The other factor, on which the Staff thought capital costs might decrease, is escalation. Leech, et al., fol. Tr. 12,542; p. 103. With the 3-year delay to be expected if Skagit were moved, the construction costs would escalate by over $900 million. The Staff excluded this cost and instead measured the cost of delay by the cost of replacement power. The Staff then proceeded, however, to subtract a factor said to

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represent the decrease in the present worth of the capital investment for a project delayed three years. Its estimated "savings" of $265 million appear entirely theoretical in that neither the Applicants nor their ratepayers would actually have the capital which they could invest (at a 10% rate of return) elsewhere during a 3-year delay in construction. Tr. 12,600-604. The Staff's estimated "savings" is based on its assumptions of a 7% rate of inflation and a 10% rate for the opportunity cost of money in 1987 to 1990. Both rates are obviously speculative. Were the rates reversed (i.e., 10% inflation and 7% opportunity cost), the "savings" would swing to a $265 million cost under the Staff's analysis. Since we have substantial doubts as to the soundness of the methodology and the input assumptions, we place little weight on the Staff's estimated $265 million savings.

176. The transmission costs that would be impacted by moving the Skagit units involve new transmission lines, wheeling costs and transmission losses. The transmission losses would range between 57 MW and 144 MW and would add an estimated $234 million to $593 million (both are present value) to the costs over the life of the plants. Leech, et al., fol. Tr. 12,542, pp. 96, 97 (corrected). The wheeling costs at Hanford or Pebble Springs would exceed those at Skagit by about $140 million (present value). Only a small part of this differential

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would be offset by the differential for the capital cost of transmission interferes with the BPA system. Id., p. 95.

177. The final cost increase attributable to moving the Skagit units is the cost of replacement power during an anticipated three-year delay in operation dates for the Skagit units. The energy to be replaced would amount to 5,796 megawatt-years, assuming critical water conditions or 3,320 megawatt-years, assuming average water conditions. Knight, fol. Tr. 14,329, pp. 1-3; Leech, et al., fol. Tr. 12,542, p. 107; Tr. 12,606-610. Replacement of this energy would come from additional oil-fired generation located either in the northwest or southwest. A minimum of 84 million barrels of oil would be consumed, at a tremendous cost to society. The cost of replacement power to Applicants' ratepayers would run from $2,819 million to $3,300 million. Knight, fol. Tr. 14,329, pp. 4-6.

178. The hypothetical movement of the Skagit units to either the Pebble Springs or Hanford sites would have a drastic cost impact totaling several billion dollars on both society and Applicants' ratepayers. From either an economic standpoint or a combined environmental and economic standpoint, the Skagit site is obviously superior to sites east of the Cascades, including the Pebble Springs and Hanford sites.

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179. In its Contentions C and J.12.b, SCANP claimed that Hanford was a more suitable site and had not been discussed in the DEIS. We find the former claim to be erroneous. Skagit is preferable to Hanford for the reasons discussed previously. Second, while the FES may not have explicitly addressed the Hanford site, subsequently, the Staff thoroughly studied it as an alternative. Hence, we find these contentions by SCANP to be without merit.

F. Alternative Energy Sources

180. [This paragraph is reserved. Findings will be filed after completion of hearings on this subject.]

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G. Need for Power

181. [This paragraph is reserved. Extensive findings have previously been filed on this subject. Following resolution of the pending motion to reopen, findings will be filed on this subject.]

H. Cost-Benefit Analysis

182. [This paragraph is reserved. Findings will be filed after completion of hearings on this subject.]

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I. Federal Water Polution Control Act

183. In accordance with Section 402 of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA), Pub. L. No. 92-500, 86 Stat. 816, and the Second Memorandum of Understanding between the NRC and EPA, 40 F.R. 60,115, Applicants have received a final NPDES permit for the Skagit Project. In addition, Applicants have obtained the State of Washington certification required by Section 401 of the FWPCA. Both the permit and certification have been admitted into evidence and form part of the record now before the Board. Exhs 57, 83, 84, 85; Tr. 4907-910; NFP 1755-766. Accordingly, we find that the provisions of the FWPCA applicable to this proceeding have been satisfied. See generally, Public Service Company of Oklahoma (Black Fox Station, Units 1 and 2), LBP-78-26 8 NRC 102, 121-26 (Jul. 24, 1978); Tennessee Valley Authority (Yellow Creek Nuclear Plant, Units 1 and 2), LBP-78-7 7 NRC 215, 229-36 (Feb. 3, 1978), aff'd, ALAB-515 8 NRC 702 (Dec. 27, 1978).

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J. Wild and Scenic Rivers Act

184. Certain aspects of the Project lie along or downstream of that portion of the Skagit River which forms a part of the National Wild and Scenic Rivers System. FES Final Supp., fol. Tr. 7767; National Parks and Recreation Act of 1978 § 703, Pub. L. 95-625, Pub. L. 95-625, 16 U.S.C. § 1274(a)(18). This matter has been reviewed extensively, both by this Board -- which considered the various impacts of the Project on the Skagit River in detail -- and by the Secretary of Agriculture. See, e.g., FES Final Supp., fol. Tr. 7767; Tr. 7762-922, 7925-958, 7961-8099, 8121-129, 8135-193, 8206-324, 10,635-717, 10,729-964; Exh. 203.

185. On April 11, 1978 the Department of Agriculture issued its determination, pursuant to Section 7 of the Wild and Scenic Rivers Act, as to the possible effects of the Project on the Skagit River. Exh. 203. The determination, which included consideration of environmental impacts as examined in this proceeding, concluded that the Commission could not license the Project so long as the Skagit River remained a "study" river under the Wild and Scenic Rivers Act. Id., p. 10. However, it was also determined that "[i]f the Congress adopts the President's recommendation to designate the river above the Sedro Woolley pipeline crossing as a component of the Wild and Scenic Rivers System,"

Board is bound to accept it. As for the question of fact, the environmental impact statement -- particularly the FES Final Supp. -- fully considered the status of the River and provided information used by the Department of Agriculture in making its determination. The Board finds that the consideration of environmental matters, as revealed by the record of the proceeding, is sufficient under NEPA. Accordingly, we reject Contention I as being without merit.

K. Floodplain Management

188. [This paragraph is reserved. Under the present schedule, Applicants will file its findings on this subject on October 8, 1979.]

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III. SITE SUITABILITY

A. Geography and Demography

189. [This paragraph is reserved. Findings will be filed after completion of hearings on the subject of evacuation planning, since a portion of that will deal with population estimates.]

B. Nearby Industrial, Military and Transportation Facilities

190. The facility can be designed to adequately protect the health and safety of the public from hazards associated with nearby industrial, military and transportation facilities. Military facilities and airports present no safety hazard due to their distance from the site. No hazardous materials are transported by rail or water within five miles of the reactors. The major transportation hazards are associated with transport of high explosives of petroleum products past the site on SR-20. These hazards have been evaluated. We conclude that the facility can be designed to withstand the consequences of accidents along SR-20. Myers, fol. Tr. 728, pp. 6-7; Report

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of the NRC Staff on Site Suitability ("SSR"), fol. Tr. 1888, pp. 4-5; PSAR, § 2.2; SER fol. Tr. 14,441, § 2.2.

191. The nearest pipelines are two natural gas pipelines about five miles west of the site. The impact of accidental releases of gas from the simultaneous rupture of both pipelines has been analyzed. The analysis shows that such rupture poses no hazard to the facility and need not be considered in design of the Project. Myers, fol. Tr. 728, p. 7; SSR, fol. Tr. 1888, pp. 4-6; PSAR, pp. 2.2-3, 2.2-7 to 8, 2.2-10a to 10c; SER, fol. Tr. 14,441, § 2.2.

192. The nearest industrial plants and petroleum storage facilities are about five miles west-southwest of the site. The hazard from explosion or fire at these facilities is clearly less than similar potential hazards at the site or along SR-20 adjacent to the site. Myers, fol. Tr. 728, p. 7; SSR, fol. Tr. 1888, p. 5; PSAR, pp. 2.2-1 to 2a, 2.2-3 to 5; SER, fol. Tr. 14,441, § 2.2.

193. The potential fire hazard has also been evaluated. With respect to a forest fire, the cleared area around the plant structures will form a natural firebreak. A second potential fire hazard is an accident to a tank truck during delivery of diesel fuel to the storage area on the site. The fuel storage area poses no hazard since it is underground. In both cases there would be no direct effect on the plant from

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heat or smoke. Further, the control room will be provided with ventilation system features to protect habitability from the effects of particulates. Myers, fol. Tr. 728, pp. 7-8; SSR, fol. Tr. 1888, p. 6; Tr. 1898; PSAR, pp. 2.2-10c to 12, § 9.4.1; SER, fol. Tr. 14,441, §§ 2.2, 6.5.3, 9.4.1; SER Supp. 1, fol. Tr. 14,441, § 6.4.

194. In a motion dated December 3, 1975, intervenor SCANP asserted, in part, that a statement in the PSAR to the effect that no military air routes existed within 20 miles of the site was incorrect. Applicants, in their response of December 15, 1975, agreed that the statement was in error and undertook to provide corrected, current information. This Board's response was to call for an evidentiary presentation concerning the matter. Tr. 4749-751.

195. Applicants and the Staff both presented testimony on the subject of military aviation. Commander Cobb, USN, appeared on behalf of Applicants and explained that a number of military air routes exist within the vicinity of the site. The closest of these are low level training routes TR-400 and TR-415. Department of Defense policy prescribes that such routes be aligned so that they are clear of nuclear power plants. Consistent with this policy, the centerline of routes TR-400 and TR-415 (sometimes referred to as TR-400/415, as they are the same route in the area of interest) is located 6 NM

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from the site. The nearest perimeter of these routes, which are 8 NM wide, is 2 NM away. Tr. 5141-150; Exhs 61, 62.

196. The Staff's witness, Dr. Jacques B. J. Read, performed on analysis of military aircraft hazards to the site. Dr. Read calculated an impact probability of 1×10^{-10} per flight. Under the NRC's Standard Review Plan (NUREG-75/087), if the probability of a plane crash is shown to be less than 1×10^{-7} (i.e., less than one chance in 10 million per year), such events are deemed by the Staff to be of sufficiently low likelihood that their effects may be ignored. Accordingly, up to 1,000 flights per year in the training routes near the site would still render the Project an acceptable risk. Read, fol. Tr. 5539, pp. 2-5; Read, fol. Tr. 8325, pp. 2-11.

197. In order to account for uncertainties, Dr. Read incorporated a number of conservatisms into his analysis, tending to overestimate crash risk. For example, it is clearly impossible to specify what type or types of military aircraft will be in service during the lifetime of the plant, which may extend well into the 21st century.* To be guaranteed of conservatism, Dr. Read assumed a mean time to total crash loss of any aircraft of 10,000 flight-hours in peacetime training missions;

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*Assuming commercial operation dates of 1987 and 1989, for Units 1 and 2 respectively, (see, Application for Construction Permits and Operating Licenses for Skagit Nuclear Power Project, Units 1 and 2, Exh. 175, p. 14), and a 30-year operating lifetime, the facility will be producing power from 1987 until 2019.

even though recent history indicates that such a loss rate would not be tolerated, and actual experience is about ten times more favorable. In addition, most military aircraft accidents occur during take-offs, landings and exercises. Risk to the A6 aircraft in the Pacific Fleet, for example, is dominated by the small fraction of their time spent in carrier operations and practice bombing. Nevertheless, Dr. Read conservatively assumed that accidents were uniformly distributed over the entire flight time. Read, fol. Tr. 8325, pp. 8-10.

198. We conclude that the risk of an aircraft crash is acceptably low insofar as the Skagit site is concerned. Use of TR-400/415 amounts to less than 300 flights per year. Read, fol. Tr. 5539, Att., p. 2; Tr. 5564. As a result, the probability of an aircraft crash which might affect the facility is considerably less than 1×10^{-7}. Accordingly, the site is acceptable and the facility need not be specially designed and hardened to withstand such crashes.

199. We conclude that there are no nearby industrial, military, or transportation activities which preclude either site acceptability or a finding that the site is suitable for reactors of the general type and size proposed.

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C. Meteorology

200. The Skagit Valley climate is moderate with cool summers, mild winters, and rain in all seasons. The area is dominated by the influence of the Pacific Ocean and Puget Sound to the west. Extreme weather conditions are possible -- e.g., heavy snowfalls, ice storms, thunderstorms, tornadoes, extreme winds. However, none of these possibilities could endanger safe operation of the proposed facility. Myers, fol. Tr. 728, p. 8; PSAR, § 2.3.1.

201. The climate of the region near the site is highly varied from one location to another. Much of this variation is caused by the sharply defined topography. However, the position and intensity of the high and low semipermanent pressure centers over the north Pacific, and the distance and direction from the ocean, are also important influences. The local meteorology of the site, therefore, is best described by essentially one source, the onsite meteorological measuring station. Myers, fol. Tr. 728, pp. 8-9; PSAR, § 2.3.1.

202. The onsite meteorological measuring program began operation in May 1973, with instrumentation installed at 10-, 35- and 60-meter levels on a 60-meter tower located in an open field at approximately the same ground elevation as, and 4,800 feet east

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of, the reactors. Myers, fol. Tr. 728, p. 9; PSAR, § 2.3.3. This onsite program conforms to the recommendations of Regulatory Guide 1.23, "Onsite Meteorological Program." SER, fol. Tr. 14,441, § 2.3.3.

203. Witness Badgley criticized the meteorological data collection program and suggested the desirability of obtaining additional information. For example, data might be collected regarding winds above the 60-meter level through use of balloon- or aircraft-borne instruments. The data collection period might be longer than one year.* Studies might be done to evaluate in greater detail the influence of local topography on atmospheric factors. Badgley, fol. Tr. 3120, pp. 2-4; Tr. 3167-172.

204. We note, however, that the Staff views one year of onsite meteorological data as sufficient at the PSAR stage of review. Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants, LWR Edition, Regulatory Guide 1.70, § 2.3.3. Further, Dr. Badgley acknowledged that the data obtained from the onsite meteorological tower is appropriate for determination of dispersion characteristics at the site, and that it has been properly used with conventional methods to predict the dispersion of the cooling tower plume and radioactive

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*In fact, the PSAR has been amended to include data for a two-year period. PSAR, § 2.3.

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releases. Tr. 3126, 3135, 3149, 3178. He termed himself "satisfied" with the data which had been collected at the 10- and 60-meter elevations to define Pasquill stability classes. Tr. 3160. His doubts about the suitability of the Pasquill procedure for a valley site related only to dispersion at a considerable distance from the site, and he admitted that any restrictions imposed by the valley would come into play only at a distance of some miles. Tr. 3163-167. The data which might be collected with additional instrumentation would be "marginal," and "nice background information but probably not immediately applicable" to dispersion of releases within 2-3 miles. Tr. 3175-176. Data obtained at higher elevations could be useful for predicting transport and dispersion at elevations above 60 meters and up to about 3,000 feet and 20 or more miles distant from the site. Tr. 3127-128, 3135-136, 3169-170, 3175-177 and 3180.

205. Shortly before the site suitability hearing, it was discovered that the anemometer, the instrument which measures wind speed, was defective. An investigation showed that, as a result, wind speed had been improperly recorded. The nature and magnitude of the error in recordation were identified, as well as an acceptable method by which the erroneous wind speed data could be corrected. The corrected data, which now appears in the PSAR, was used by the Staff in its evaluation of radiological doses.

Tr. 737-757, 3076-091; Exhs 13, 14, 15; PSAR, § 2.3; SER, fol. Tr. 14,441, § 2.3.3; SER Supp. 1, fol. Tr. 14,441, § 2.3.5. The meteorological program will be continued, with an equipment modification to eliminate the windspeed error, during operation of the facility to provide real-time meteorological information. Myers, fol. Tr. 728, p. 9; SER, fol. Tr. 14,441, § 2.3.3.

206. We find that the meteorological information has been properly compiled. It indicates that the site experiences no unusual meteorological phenomena which would prevent safe operation of the facility. Similarly, the diffusion capabilities of the atmosphere in the site area are good. Thus, the proposed site is suitable with respect to meteorology for reactors of the general size and type proposed. FES, fol. Tr. 2913, § 2.6; SSR, fol. Tr. 1888, pp. 7-8; PSAR, § 2.3; Exh. 4, § 2.6; Tr. 1899; SER, fol. Tr. 14,441, § 2.3; SER Supp. 1, fol. Tr. 14,441, § 2.3.5.

D. Hydrology

207. The site is approximately 300 feet above Skagit River flood plain. It encompasses parts of the drainage areas of

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Wiseman, Black, and Tank Creeks, all of which empty, eventually, into the Skagit River. The river will furnish approximately 90% of the facility's water requirements and receive its effluents. In the site vicinity the Skagit River, draining an area of about 2,960 square miles, meanders over a three-mile wide flood plain. The low-water channel is heavily braided and has numerous sloughs and side channels. Myers, fol. Tr. 728, p. 10; SSR, fol. Tr. 1888, p. 8; PSAR, pp. 2.4-1 to 2; SER, fol. Tr. 14,441, § 2.4.1.

208. Make-up water for the Project will be obtained through Ranney Collectors, located near the bank of the Skagit River approximately five miles southeast (upstream) of the site. Their pumps will be on platforms surrounded by sealed concrete walls extending above the 100-year flood elevation. The collectors are designed to induce flow from the river, using the alluvial deposits as a natural filter. Myers, fol. Tr. 728, p. 10; SSR, fol. Tr. 1888, pp. 9-10; PSAR, p. 2.4-16; SER, fol. Tr. 14,441, § 2.4.1; Tr. 10,654, 10,656; Exh. 204, p. 2.

209. Probable maximum floods on the Skagit River cannot reach the site. The floods postulated include those occasioned by failure of all existing upstream dams. Black Creek will be rerouted into a channel designed for a 100-year flood flow estimated in accordance with United States Geological Survey procedures. The maximum runup elevation was determined to be

6 feet below the grade of safety-related structures. Surge and seiche phenomena cannot occur at this site. The effect of tsunamis may travel up the Skagit River but the site elevation above the flood plain precludes damage from this source. Ice formation can cause flooding on the river but cannot damage the safety-related facilities because of their location above the flood plain. It is concluded that the site safety-related buildings and structures will not be subject to flooding from any source. Myers, fol. Tr. 728, pp. 10-11; SSR, fol. Tr. 1888, pp. 9-10; PSAR, pp. 2.4-3 to 10; SER, fol. Tr. 14,441, § 2.4.2.

210. Channel diversions have been examined. The river bend at the Ranney Collector location has been fairly stable since riprap bank protection was placed there in 1958. Riprap will be maintained to provide for continual stability. Complete blockage of the river could result from rock or landslides upstream. Such blockage would be temporary because the river flow would fill the natural reservoir so created and downstream flow would resume in a few days. In such an event, the reactors would be shut down until flow resumed. Myers, fol. Tr. 728, p. 11; Exh. 204, p. 1; Tr. 10,660-666.

211. Historical low-water occurrences have been determined. Emergency and normal shutdown flow requirements for each unit are approximately 15,000 gpm. The required water is

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stored onsite in the Standby Service Water cooling tower basins, which are designed to seismic Category I. Thus, make-up water for the facility is not required for emergency shut-down, and analysis of the effects of low-water conditions in the Skagit River is not required. We conclude that an adequate safety-related water supply will be available at the proposed site. Myers fol. Tr. 728, p. 12; SSR, fol. Tr. 1888, pp. 9-10; PSAR, pp. 2.4-11 to 13; SER, fol. Tr. 14,441, § 2.4.3.

212. Accidental spillage of radioactive liquids on the ground during operation is unlikely. If it should occur, some radioactive material may infiltrate to the water table and migrate with ground water flow. Analysis shows that probable flow paths could result in discharge to Wiseman Creek after ten years' travel time, or into a spring in about four years. Both discharge points are within the exclusion area, and a monitoring program would define the migration of radioactivity in the event of an accident. Myers, fol. Tr. 728, p. 12; PSAR, pp. 2.4-21 to 23.

213. The NRC Staff has conservatively estimated the time required for ground water to move along the most critical, 3100 foot flow path to the nearest downgradient water user to be about six years. In developing its estimate, the Staff conservatively neglected radionuclide holdup effects and concentration reductions resulting from ion exchange with the

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solid particles of the aquifer medium, except for Strontium-90 and Cesium-137. The travel times from the plant to the well for these two radionuclides were estimated to be about 210 years and 2100 years, respectively. All other radionuclides were assumed to move to the well in six years (groundwater travel time). Utilizing a dilution factor at the well resulting from dispersion and dilution of postulated containments conserva- tively estimated to be about 2600, the resultant postulated contamination of the well water would be significantly lower than the limits prescribed in 10 CFR Part 20 for releases to unrestricted areas. SER, fol. Tr. 14,441, §§ 2.4.4, 15.3.5.

214. We conclude that the proposed site is suitable, from the standpoint of hydrological conditions, for reactors of the general size and type proposed.

E. Geology and Seismology

215. [This paragraph is reserved. Findings will be filed after completion of hearings on this subject.]

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F. Suitability for Development of Evacuation Plan

216. [This paragraph is reserved. Findings will be filed after completion of hearings on this subject.]

IV. RADIOLOGICAL HEALTH AND SAFETY

A. The Application and its Review

217. [This paragraph is reserved. Findings will be filed upon completion of the construction permit hearings.]

1247 131

B. Site Criteria

218. [This paragraph is reserved. Findings will be filed upon completion of the construction permit hearings.]

C. Facility Design

219. [This paragraph is reserved. Findings will be filed upon completion of the construction permit hearings.]

D. Research & Development

220. [This paragraph is reserved. Findings will be filed upon completion of the construction permit hearings.]

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E. Technical Qualifications

221. [This paragraph is reserved. Findings will be filed upon completion of the construction permit hearings.]

F. Quality Assurance

222. [This paragraph is reserved. Findings will be filed after completion of hearings on this subject.]

1247 133

G. Conduct of Operations

223. [This paragraph is reserved. Findings will be filed upon completion of the construction permit hearings.]

H. Common Defense and Security

224. [This paragraph is reserved. Findings will be filed upon completion of the construction permit hearings.]

1247 134

I. Financial Qualifications

225. [This paragraph is reserved. Under the present schedule, Applicants will file its findings on this subject on October 8, 1979.]

J. Emergency Evacuation Plan

226. [This paragraph is reserved. Findings will be filed after completion of hearings on this subject.]

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V. CONCLUSIONS OF LAW

227. [This paragraph is reserved. Conclusions of law will be filed, as appropriate, upon completion of hearings on LWA subjects and construction permit issues.]

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VI. ORDER

228. [This paragraph is reserved. A proposed order will be filed, as appropriate, upon completion of hearings on LWA subjects and construction permit issues.]

Respectfully submitted,

PERKINS, COIE, STONE,
OLSEN & WILLIAMS

By _____
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By _____
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By _____
Michael A. Bauser

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APPENDIX A

September 14, 1979

EXHIBITS

No.	Description	Identified	Received
	JULY - AUGUST 1975 HEARING		
1	Application (General Information volume)	710	712
2	Chapter 2 of the Preliminary Safety Analysis Report	710	712
3	Section 13.3 of the Preliminary Safety Analysis Report	710	712
4	Environmental Report	710	712
5	Slides (photographs) 4.1 through 4.9	645	647
6	General Site Plan	649	653
7	Letter from U.S. Forest Service to Leed, 6/18/75	444	444
8	Skagit DES, U.S. Forest Service, 6/16/75, with letter 6/26/75 and notice 6/30/75	446	446
9	Pamphlet "The Skagit, A Proposal 1975", U.S. Forest Service	446	446
10	Report "The Skagit Wild and Scenic River Study Report", U.S. Forest Service	446	446
11	Decree Adjudicating Public Use and Necessity, 7/9/75, with drawing, "Skagit Nuclear Power Project", 7/15/75	730	731
12	Photograph No. 72-3111, 1/9/73, depicting site	733	734

No.	Description	Identified	Received
13	Sheet containing three equations of witness Lou	740	743
14	Figure 1, Error vs. Wind Speed, and Figure 2, Error vs. Wind Speed	745	754
15	Figures 2.3-12 and 2/3-13	748	754
16	Two relief maps (Concrete and Victoria)	861	862
17	Topographic map of Mount Baker	865	865
18	Seven slides of Mount Baker (photographs A through G)	868	869
19	USGS press release and attachment	879	882
20	USGS document, "Origin and Age of Postglacial Deposits and Assessment of Potential Hazards from Future Eruptions of Mount Baker, Washington", Open-file report 75-286, 1975	883	886
21	Memo from USGS (Meier) to Milhous, et al., 5/30/75	889	1473
22	Letter from U.S. Forest Service to Puget, 1/22/73	1147	1148
23	Letter from Puget to U.S. Forest Service, 2/12/73	1147	1148
24	Brochure "The Skagit River", U.S. Forest Service	1147	1148
25	Report "Skagit River Study", U.S. Forest Service	1147	1148
26	Document "Review of ERTS Imagery of Northwestern Washington and Southern British Columbia"	1169	3890

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No.	Description	Identified	Received
27	Bouguer Gravity Anomaly Map, Major Earthquake Epicenters	1172	3888
28	USGS Topographic Maps (Victoria and Seattle)	1213	____
29	Report "Summary of Geologic and Seismologic Investigations of the Skagit Nuclear Power Project Site", 3/29/75	1249	3890
30	Report "Evaluation of the December 15, 1974, Earthquake in Skagit Valley", 3/29/75	1249	3890
31	ERTS Imagery, Band 5, Western Washington	1334	1335
32	ERTS Imagery, Band 6, Western Washington	1334	1335
33	ERTS Imagery, Band 7, Western Washington	1334	1335
34	ERTS Imagery, Color Composite, Western Washington	1334	1335
35	Dr. Cheney's Resume	1344	1345
36	Rasmussen slides which accompanied his testimony before TPPSEC	1538	1873
37	Rasmussen report presented to TPPSEC	1540-A	____
38	Map of Skagit County, Washington	2304	2305
39	"Compilation of Earthquake Hypocenters in Western Washington", 1974, by Crosson	2437	2438
40	Stipulated TPPSEC testimony of Orrell	2898	2899
41	Stipulated TPPSEC testimony of Norton	2898	2899

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No.	Description	Identified	Received
42	Stipulated TPPSEC testimony of Ellingson	2898	2899
43	References to testimony of Brubaker	2923	2976
44	President's Budget, FY '76	3294	3294
45	Fish Facility Contributions to Project Discharge	3387	3388
46	Document "Thermal Power Plant Siting Study", September 1970	3688	3691
47	Letter from Bechtel to Puget (Bush), 1/20/72	3688	3691
48	Geer report, "Proposed Use of Skagit County Coal for Large-scale Electric Power Generation" and letter 6/13/75	3742	3743
49	Letter, 4/4/75, Ehrhorn to Hall, with Report on Black Diamond-Franklin Coal Deposits	3768	3769
50	Map, Complete Bouguer Gravity Anomaly Map of Washington, Bonini, Hughes and Danes, 1974	3884	3889
51	Map, Thickness of Unconsolidated Sediments, Puget Lowland, Washington, Hall and Othberg	3891	3894
52	Topographic Map, USGS, Victoria and Concrete	3896	3896
53	Map, World Astronautical Chart, ICAO, July 1973	3917	———
54	Plant site profile	3951	3954
55	Stipulated TPPSEC Testimony of Milne	3955	3955
56	Article re Solar Power, Christian Science Monitor, 4/23/75	4709	4710

No.	Description	Identified	Received
	JUNE 1976 HEARING		
57	Certificate dated May 7, 1976, signed by Roger Polzin. (401 Certification, Council Order No. 7, and NPDES Permit.)	4908	4910
58	Application (General Information volume) as amended through Amendment 2, Feb. 9, 1976	4935	4936
59	Chapter 2 of the Preliminary Safety Analysis Report, incorporating all revisions through Amendment 12, April 21, 1976	4935	4936
60	Section 13.3 of the Preliminary Safety Analysis Report, incorporating all revisions through Amendment 12, April 21, 1976	4935	4936
61	Aviation sectional map, Seattle Sector	5145	5219
62	DOD Flight Information Publication, Area Planning, Military Training Routes, North and South America, effective 20 May 1976	5150	5219
63	Aviation sectional map, Seattle Sector with circle	5145	5219
	JULY 1976 HEARING		
64	Map of U.S. coastline "Reference--Silver 1971"	5779	5780
65	Portion of state highway map showing Puget Sound area	5959	5979

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No.	Description	Identified	Received
66	Aerial photo of Cherry Point, September 11, 1973	5979	5981
67	Map entitled "Electric Power Plants"	6019	6021
68	Western Systems Coordinating Council	6019	6021
69	Variation in Cost of Power with Capacity Factor	6303	6305
70	Washington State Parks' Visitors, June 1974 to May 1976	6544	6545

AUGUST 1976 JOINT NFP HEARING

Exhibit No.			NFP Transcript	
Skagit	Pebble Springs	Description	Identified	Received
71	0-4	Energy Reserve Planning Model Input Data - West Group Annual Average Streamflow Capability	300	300
72	0-5	1976 West Group Forecast, March 1, 1976	321	619
73	A-9	Pages 1, 25, 26, 27 and 30 of Sixth Supplemental Order of WUTC in Cause No. U-73-57	636	1263
74		Portions of Pebble Springs transcript containing testimony of Charles L. Heinrich, Charles R. McClellan and Fred Weber (pp. 306-328; 945-970; 1000-1001; 1128-1132; 1147-1156; 1170-1178; 1183-1223; 1278-1287; 1292-1319; 1324-1343; 1345-1358)	752	754
	S-8	Portions of Skagit transcript containing testimony of Richard H. Swartzell (pp. 4241-4277; 4281-4289; 4312-4315; 4320-4332; 4338-4343; 4404-4407; 4434-4442)	752	754

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Exhibit No. Skagit	Exhibit No. Pebble Springs	Description	NFP Transcript Identified	NFP Transcript Received
75	P-2	Bonneville Power Administration Electric Energy Conservation Study, July 1976, Skidmore, Owings & Merrill (SOM Report)	1397	1402
76	A-10	Bonneville Power Administration letter of August 18, 1976	1403	1404
77	M-16	Testimony of Stephen Lambert, Energy Conservation Organization	1673	1673 (Rejected)
78	M-17	Appendix B entitled "Project Description" to testimony of Stephen Lambert	1677	1673
79	M-18	Testimony of William Boly	1713	1714
80	M-19	Energy Costs of Using Columbia River Water for Irrigation (13 pp.)	1717	1724
81	M-20	Can NW Afford More Irrigation, Oregon Journal, March 29, 1976	1717	1726 (Rejected)
82	M-21	New Power Required to Develop Irrigation, Oregonian, April 17, 1976	1717	1726 (Rejected)
		MARCH 1977 JOINT NFP HEARING		
83	22	Site Certification Agreement for Skagit Units, January 5, 1977	1757	1766
84	23	Council Order No. 512, September 13, 1976	1757	1766
85	24	Order Approving Application for Certification signed by Governor Evans, December 6, 1976	1757	1766

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Exhibit No. Skagit	Exhibit No. Pebble Springs	Description	NFP Transcript Identified	NFP Transcript Received
86	25	Chapter 80.50 Revised Code of Washington	1758	1766
87	26	1977 West Group Forecast, February 15, 1977	1758	1760
88	27	Choosing an Electrical Energy Future for the Pacific Northwest: An Alternative Scenario, January 31, 1977 (NRDC Scenario)	2175	2191
89	28	Portion of "An Economic Analysis of Solar Water & Space Heating", selected by Bruce C. Netschert (MITRE Report)	2543	2544
90	29	An Electricity Sales Forecasting Model for the States of Washington, Oregon, Montana and Idaho, prepared for Pacific Northwest Utilities Conference Committee by Kent P. Anderson, January 30,1976, amended July 1976 (NERA PNUCC Model)	2757	2757
91	30	Residential Customers Energy Use Survey, Puget Sound Power & Light Company, January 11-12, 1977	3013	3015
92	31	The Economic Effect of Electricity Conservation by the Residential Customers of Pacific Power & Light Company	3126	3129
93	32	Bonneville Power Administration, Power Situation Statement, Monthly Summary, January 1977	3350	3367
94	33	January Power Situation Report, January 1977	3350	3367

Exhibit No. Skagit	Exhibit No. Pebble Springs	Description	NFP Transcript Identified	NFP Transcript Received
95	34	Summary Table, West Group Area Imports and Exports	3351	3367
96	35	Imports, computer printout (4 pp.)	3351	3367
97	36	Pacific Northwest Coordination Agreement	3407	3408
98	37	Attachment I to Dr. Miller's testimony with handwritten figures added by Applicant	3455	3457
99	38	Comparison of Energy Load Growth Rates - Historical and Forecast	3532	3545
100	39	Table D to Testimony of David H. Knight, February 15, 1977 with hand-written additions (2 pp.)	3533	3545
101	40	Population Growth by County	3551	3559
102	41	Population Comparisons, 1970-1976	3551	3559
103	42	Home Insulation Questionnaire, September-November, 1976 Puget Sound Power & Light Company, Market and Rates Department	3713	3713

No.	Description	Identified	Received
	MAY 1977 PRE-LWA WORK HEARING		
104	Sanitary Sewer Line, Photographs of Stream Crossings and Sewer Line Routing, April 18, 1977	6602	6606

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No.	Description	Identified	Received
105	Highway Intersection Improvements, Photographs of Various Portions of Road Work	6602	6606
106	Drawing "Vicinity Map", Proposed Road Work, Sheet 1 of 14	6607	6612
107	Drawing "Plan", Proposed Road Work, "Plan", Sheet 5 of 14	6608	6612
108	Drawing "Plan", Proposed Road Work, Sheet 6 of 14	6608	6612
109	Drawing "Profile, Station 356 Plus 00 to Station 586 Plus 50", Proposed Road Work, Sheet 7 of 14	6609	6612
110	Drawings of Proposed Road Work, 14 sheets--full set	6684	6685
111	Map labeled Township 35, north, range 5, east-west meridian, 7 photographs and a road mapping	6795	6817
112	10 photographs	6795	6817
113	Construction layout drawings for the sewer line, 15 sheets	6841	6869
114	Data on stream flows, and total suspended solids for Wiseman Creek	7038	7134
	JULY 1977 HEARING		
115	Chapter 2 of PSAR as amended through Amendment 18	7174	7179
116	Puget letter, June 27, 1977 to NRC	7632	7634
117	Skagit FES (Forest Service)	7771	7772

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No.	Description	Identified	Received
118	Wild and Scenic River Study Report (Forest Service)	7771	7772
119	Skagit Nuclear Power Project Environmental Analysis Report by Mount Baker-Snoqualmie National Forest, May 1976	7828	7829
120	Potential Impact of Skagit Nuclear Power Project, Units 1 and 2, on Skagit River Fisheries, by Fred H. Everest, Research Fisheries Biologist, July 12, 1977	7848	____
121	Photograph, from Skagit River looking toward Bacus Hill from Rivermile 32.5	8090	8116
122	Photograph, Bacus Hill from Skagit River looking northwesterly, Rivermile 32, June 19, 1977	8091	8117
123	Photograph, Bacus Hill from Skagit River looking westerly, Rivermile 32	8092	8118
124	Photograph, Mouth of Hansen Creek from Skagit River, Rivermile 24, June 19, 1977	8096	8208
125	Pages 3574 through 3721 of the Pebble Springs transcript for January 19, 1977 and pages 3728 through 3861 of the Pebble Springs transcript for January 20, 1977	8203	____
126	Sheet 5, attached to Goettge affidavit	8344	8345
127	Sheet 6, attached to Goettge affidavit	8344	8345
128	Sheet 6, full size	8344	8345
129	Sheet 6, overlay	8344	8345

No.	Description	Identified	Received
	MARCH 1978 HEARING		
130	Amendment 19 to Skagit PSAR (filed December 9, 1977)	8705	8706
131	The Pictorial Land Form Map of the State of Washington, Including Adjacent Parts of Oregon, Idaho, and British Columbia	8711	8713
132	Composite geologic map of plant site area showing mapping done by Bechtel	8715	8731
133	Dr. Gerald Miller's geologic map (proprietary)	8910	
134	Whetten's geologic map of San Juan Islands	9068	
135	LANDSAT imagery of northwest Washington and southwest British Columbia	9068	
136	Side-looking airborne radar image entitled "Mt. Vernon Area"	9094	
137	Geologic map showing Devil's Mountain Fault (Whetten)	9094	
138	Seven-page USGS aeromagnetic survey	9104	
139	Preliminary Whetten map	9116	
140	Reduction of Exhibit 138	9134	
141	Reduction of Exhibit 132	9154	
142	Whetten geologic map (1:250,000) of Devil's Mountain Fault	9166	

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No.	Description	Identified	Received
143	BB&N High Resolution Seismic Profile Locations - 3/25/76. Map of San Juans from Whidbey Island north	9285	
144	Western Geophysical data, Line A	9293	
145	Western Geophysical data, Line B	9293	
146	Western Geophysical data, Line C	9293	
147	Western Geophysical data, Line E	9293	
148	Western Geophysical data, Line G	9293	
149	BB&N data, Line 1	9311	
150	BB&N data, Line 2	9312	
151	USGS data, Line D-1	9313	
152	Edcon index map with major geologic features	9330	
153	Map: USGS quads for Hamilton, Oso, Wickersham, Clear Lake	9994	
154	Memo to Record by William Hays of USGS, May 9, 1977	10064	
155	Enlarged portion of Rogers' map	10106	
156	Five photographs by Bolt of Rumanian earthquake	10301	

JUNE 1978 HEARING

157	Fig. 1, 6/12/78 old and new caisson locations	10644	10659
158	Fig. 1, 5/22/78 Ranney collector site, new location	10645	10659
159	Cross-section No. 3, 5/22/78	10646	10659

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No.	Description	Identified	Received
160	Cross-section No. 2, 6/16/78	10646	10659
161	Cross-section at switch gear	10647	10659
162	Colored rendition of Ranney collector pumphouse	10648	10659
163	Ranney collector design drawing	10672	10684
164	Collectors 1 and 2 lateral layout, original design and proposed design	10674	10684
165	Collectors 3 and 4 lateral layout, original design and proposed design	10674	10684
166	Mikels letter to Bechtel, 5/10/78	10683	10684
167	Mikels letter to Bechtel, 6/14/78	10683	10684
168	Table 2, "Estimated Percentage of pumped water diverted from a River Based upon Water Quality Data"	10744	10754
169	Enc. to FTT ltr. to Leed, 6/19/78, 2 pgs. test runs by Carrier Corp. & Johnston Pump Co.	10833	10834
170	Updating of Exh. 132, 5/23/78 (Comp. Geo map, 5/23 version)	11026	11046
171	Blunden review of bore hole logging	11042	11046
172	Beck: "Gravity Faulting as a Mechanism of Topographic Adjustment"	11182	11183
173	Core Drilling & Logging Procedures & Core Storage for Skagit, by Bechtel, Inc., March 1978	11247	11249
174	Staff letter 6/16/78 to Puget transmitting questions	11260	11261

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No.	Description	Identified	Received
	JULY 1979 HEARING		
175	Application (General Information volume) as amended through Amendment 4, June 1979	12359	12365
176	Preliminary Safety Analysis Report as amended through Amendment 20, January 31, 1978, including a facsimile of the General Electric Standard Safety Analysis Report for the 251 inch reactor vessel BWR/6 as amended through Supplement 18, March 4, 1977	12359	12365
177	Photo, Walker and Associates, Negative No. SW1-69-18-10, 1969	12446	12449
178	Sketch of cone of depression by P. R. Weber	12461	12465
179	Four Company Composite, Table E	12,606	12623
180	Replacement Power	12606	____
181	Staff memo for Regan from Jackson, 6/29/79, Staff Ref. 3	13005	13005
182	Preliminary Environmental Standard Review Plan, Section 9.2, February 1979	13011	13013
183	Staff memo for Leech from Kantor, March 22, 1979, Staff Ref. 52	13104	13105
184	Funding Requirements, Nuclear Projects Nos. 1 through 5, 3/79	13247	____
185	1979 West Group Forecast	13260	13261

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No.	Description	Identified	Received
186	Western System Coordinating Council (WSCC) Table 2	13276	13952
187	WSCC, Figure 6	13278	13952
188	WSCC, Table 13	13282	13952
189	WSCC, 4 pp., Tables 17, 21, 25 and 29	13284	13952
190	Page 26, First Mortgage Bond Issue, Pacific P & L, 3/28/79	13300	13949
191	Page B-5, Western Economic Indicators, March - April '79, Fed. Res. Bank, San Francisco	13320	13950
192	Staff memo for Regan from Hulman, 3/8/79	13231A	13233A
193	Staff memo re floodplain management	13264A	13951
194	Pages from Application for Site Certification to EFSEC by Northern Tier Pipeline Company	13612	13952
195	Cook - Alternative sites	13663	____
196	Cook - RFV	13663	____
197	Weber - RFV, 7/24/79	13664	____
198	Cheney - Additional Supplemental Alternative Sites, 7/25/79	13686	____
199	Darland - four pages of data	13805	13956
200	Puget Estimated Loads and Resources Table A, 1/19/79	14047	14176
201	WSCC - Ten-Year Coordinated Plan Summary 1979-1988, May 1979	14151	14151
202	WSCC - Summary of Estimated Loads and Resources	14151	14151

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No.	Description	Identified	Received
203	Letter from Cutler to Gossic (undated) and enclosed determination (April 11, 1978) pursuant to Section 7(b) of the Wild & Scenic Rivers Act	14153	14155
204	Letter from Mecca to Regan, May 22, 1978 and attached page 32 of Site Certification Agreement	14153	14155
205	Letter from Moore to Cutler, June 5, 1978	14154	14155
206	Letter from Bergland to Deale, March 8, 1979	14154	14155
207	Letter from Bergland to Moore, May 2, 1979 and enclosed Environmental Assessment	14154	14155
208	Darland - Alternative Site Selection Criteria, 7/26/79	14181	———
209	Four sketches of Ranney Collector	14267	14324
210	Two cross-sections of Ranney Collector	14272	14324
211	WSCC Figure 6	14330	14387
212	WSCC Resources Planned	14330	14387
213	Skagit Safety Evaluation Report (SER), NUREG - 0309, September 1977	14441	
214	SER, Suppl. No. 1, October 1978	14441	
215	SER Errata Sheet	14441	
216	Flood Hazard Boundary Map	14534	14546
217	Letter from Shelver to FIA, July 30, 1979	14540	14546
218	Document (3 pages; rejected) and attached Hanauer Memo of 9/20/72 (4 pages; received)	14573	14583

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No.	Description	Identified	Received
219	UCS Document dated December 1978 and attachments	14573	14586 (Rejected)
220	WUTC, Second Supp. Order, U-78-21, Puget's last rate case	14756	14875
221	Excerpt, WPPSS study, April 1979, p. 10, graph 6	14726	14735
222	Graph, CPIS, Source: Rand, R-2304-DOE, p. 32	14731	14735
223	Solomon Bros. July Report	14842	14872
224	Puget 1978 10-K report	14879	14881
225	PGE 1978 10-K report	14879	14881
226	Pacific 1978 10-K report	14879	14881
227	Water Power 1978 10-K report	14880	14881

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
PUGET SOUND POWER & LIGHT COMPANY, et al.	)	DOCKET NOS.
	)	50-522
(Skagit Nuclear Power Project, Units 1 and 2)	)	50-523
	)	

CERTIFICATE OF SERVICE

I hereby certify that the following:

APPLICANTS' PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW IN THE FORM OF A PARTIAL INITIAL DECISION AUTHORIZING LIMITED WORK AUTHORIZATION, dated September 14, 1979

in the above-captioned proceeding have been served upon the persons shown on the attached list by depositing copies thereof in the United States mail on September 14, 1979 with proper postage affixed for first class mail.

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