Final

environmental statement

related to the proposed

HANFORD NUMBER TWO NUCLEAR POWER PLANT

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

DOCKET No. 50-397

DECEMBER 1972

UNITED STATES ATOMIC ENERGY COMMISSION
DIRECTORATE OF LICENSING

SUMMARY AND CONCLUSIONS

This Final Environmental Statement was prepared by the U. S. Atomic Energy Commission, Directorate of Licensing.

1. This action is administrative.

2. This statement is submitted in relation to the proposed issuance of a construction permit to the Washington Public Power Supply System for the construction of the Hanford No. 2 Nuclear Power Plant, located in the State of Washington, County of Benton, near the City of Richland. (Docket No. 50-397)

Hanford No. 2 will consist of a single-cycle, forced-circulation, boiling-water reactor as a source of steam and a coupled turbine-generator unit, which will have a final power level of 3458 MWt and a nominal net electrical output of 1100 megawatts. Heat from the turbine-condensers will be dissipated in an evaporative, forced-draft cooling tower system. Water makeup to compensate for evaporation losses and blowdown will be taken from the Columbia River. Blowdown from the cooling tower system will be discharged to the river.

3. A summary of environmental impact and effects of the proposed Hanford No. 2 Plant follows:

a) the use (for the life of the plant) of 30 acres of land not otherwise used or intended for use in an area of thousands of acres of relatively unproductive land;

b) the destruction of the habitat of small mammals occupying the site area.

c) localized temporary increase in turbidity of the river from dredging;

d) the consumptive use of 37 cfs (maximum) of Columbia River water, which is about 0.1% of licensed minimum flow;

e) a possibility of increasing fog in winter on highways a few miles from the plant for 12 to 26 hours per year in an area where natural fog occurs up to 38 days per year;

f) the discharge of gaseous and liquid effluents containing radionuclides that will result in an increased exposure to the local population of less than the normal variation of the natural radioactive background;

g) the discharge of heat and chemicals to the river in such amounts as to cause no measurable effect on the overall ecological balance in the river;

h) the use of 480 acres of desert for transmission lines;

i) a very low risk of accidental radiation exposure to the population;

4. Principal alternatives considered were:

- Abandonment of the project
- Alternative sources of power
- Alternative sites for this plant
- Alternative cooling systems
- Alternative discharge configuration
- Alternative transportation procedures

5. Comments on the Draft Environmental Statement issued in August 1972 have been received from the following entities and have been considered in this Final Statement:

Advisory Council on Historic Preservation
Department of Agriculture
Department of Army (Corps of Engineers)
Department of Commerce
Department of the Interior
Department of Transportation
Environmental Protection Agency
Federal Power Commission
Department of Health, Education, and Welfare
Department of Housing and Urban Development
State of Washington
Washington State Department of Commerce and Economic Development
State of Oregon Nuclear and Thermal Energy Council
Natural Resources Defense Council, Incorporated

6. This final statement was made available to the public, to the Council on Environmental Quality, and to the other Governmental agencies in December 1972.

7. On the basis of the analysis and evaluation set forth in this statement, after weighing the environmental, economic, technical, and other benefits of Hanford No. 2 Nuclear Power Plant against environmental costs

and considering available alternatives, it is concluded that the action called for under NEPA and Appendix D to 10 CFR 50 is the issuance of a construction permit for the facility subject to the following conditions for the protection of the environment:

a) Constructs a meteorology tower to provide data for use in assessing potentially adverse environmental effects of a radiological and nonradiological nature resulting from the construction and operation of the plant.

b) Immobilizes chemicals discharged to the soil by some means such as earth cover so that residues cannot become airborne.

c) Incorporates three additional river monitoring stations into the radiological monitoring program in order to more clearly discriminate between liquid discharges from the plant and other sources. These monitoring stations are to be located approximately one mile upstream, 500 feet downstream, and approximately one mile downstream of the plant discharge point in the river.

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FOREWORD

This final statement on environmental considerations associated with the proposed issuance of a construction permit for the Hanford No. 2 Nuclear Power Plant was prepared by the U.S. Atomic Energy Commission, Directorate of Licensing (staff) in accordance with the Commission's regulation, 10 CFR Part 50, Appendix D, implementing the requirements of the National Environmental Policy Act of 1969 (NEPA).

NEPA states, among other things, that it is the continuing responsibility of the Federal government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs and resources to the end that the nation may:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations,
- Assure for all Americans safe, healthful, productive and aesthetically and culturally pleasing surroundings,
- Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences,
- Preserve important historic, cultural and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice,
- Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities,
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Further, with respect to major Federal actions significantly affecting the quality of the human environment, Section 102(2)(C) of the NEPA calls for preparation of a detailed statement on:

(1) The environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local, short-term use of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Pursuant to Appendix D of 10 CFR Part 50, the AEC Directorate of Licensing prepares a detailed statement on the foregoing considerations with respect to each application for a construction permit or full-power operating license for a nuclear power reactor.

When application is made for a construction permit or a full-power operating license, the applicant submits an environmental report to the AEC. The staff evaluates this report and may seek further information from the applicant, as well as other sources, in making an independent assessment of the considerations specified in Section 102(2)(C) of NEPA and Appendix D of 10 CFR Part 50. This evaluation leads to the publication of a draft environmental statement, prepared by the Directorate of Licensing, which is then circulated to Federal, State and local governmental agencies for comment. Interested persons are also invited to comment on the draft statement.

After receipt and consideration of comments on the draft statement, the staff prepares a final environmental statement, which includes a discussion of objections and questions raised by the comments and the disposition thereof; a final cost-benefit analysis which considers and balances the environmental effects of the facility and the alternatives available for reducing or avoiding adverse environmental effects, with the environmental economic, technical and other benefits of the facility; and a conclusion as to whether, after weighing the environmental, economic, technical and other benefits against environmental costs and considering available alternatives, the action called for is the issuance or denial of the proposed permit or license or its appropriate conditioning to protect environmental values.

Single copies of this statement may be obtained by writing the Deputy Director for Reactor Projects, Directorate of Licensing, U. S. Atomic Energy Commission, Washington, D. C. 20545.

Mr. Ronald R. Loose is the AEC Environmental Project Manager (Area Code 301, 973-7220) for this statement.

I. INTRODUCTION

The Washington Public Power Supply System, a joint operating agency of the State of Washington, proposes to construct and operate the Hanford No. 2 Nuclear Power Plant on a site within the U. S. Atomic Energy Commission Reservation in Benton County, Washington. The 1089-acre site is presently unused barren land located approximately 12 miles north of the city of Richland and about 3 miles west of the Columbia River. Figure I-1 is a view of the site.

The Washington Public Power Supply System (also referred to herein as the Supply System) is a municipal corporation empowered under the terms of Chapter 43.52 of the Revised Code of Washington to acquire, construct, and operate plants and facilities for the generation and transmission of electric power. The Supply System consists of 18 Public Utility Districts and the cities of Richland and Seattle, all within the State of Washington. The output of the 1100-megawatt electric plant will be distributed to 95 consumer-owned utilities by the Bonneville Power Administration (BPA) within the Federal Columbia River Power System.

Application for a construction permit was filed with the U. S. Atomic Energy Commission by the Supply System in August 1971. Docket No. 50-397 was assigned and copies of the application have been forwarded to state and local agencies.

Public hearings have been held in connection with the Supply System's application to the State of Washington Thermal Power Plant Site Evaluation Council (TPPSEC). The council consists of the directors of the various departments of state government which have an interest in construction or operation of thermal power plants. By act of the 1970 Washington State Legislature, this council was established to provide a means by which a utility proposing to build a thermal power plant of capacity exceeding 250,000 kW can satisfy all requirements of state law through a single proceeding. On the basis of the Council's recommendation, the Governor entered into a Site Certification Agreement dated May 17, 1972, authorizing the Supply System to construct and operate the plant. This Agreement is in lieu of any permit required by any other agency of the state.[1]

The Supply System owns and operates the 860-MW Hanford Generating Plant, identified as Hanford No. 1, which generates electric power from by-product steam produced by the AEC's New Production Reactor (NPR). This dual purpose nuclear reactor is located about 18 miles northwest of the proposed site for Hanford No. 2.

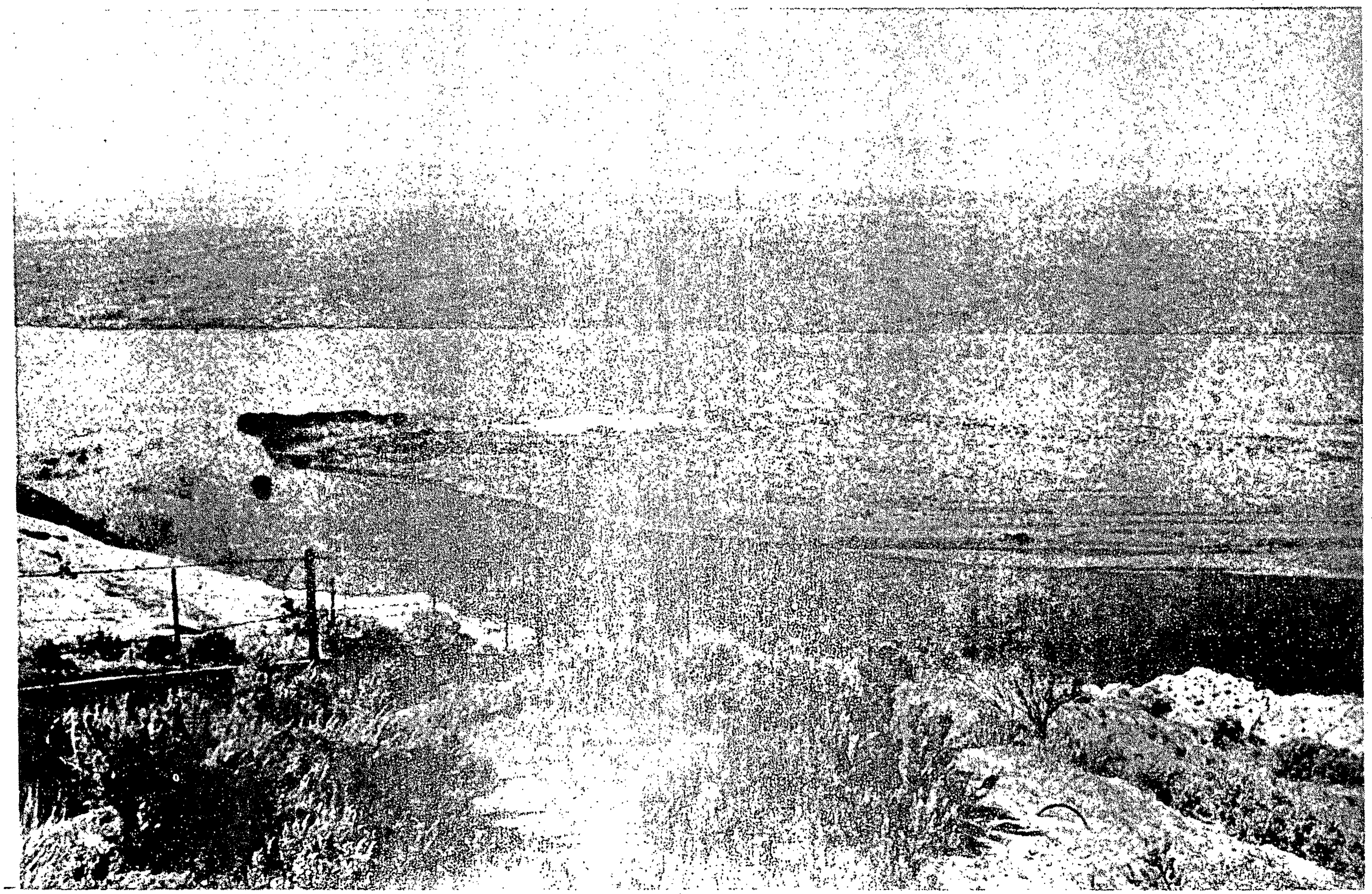


Fig. I-1. View of Hanford No. 2 Site from White Bluffs across the Columbia River with Rattlesnake Mountain in the Background. From Applicants' Environmental Report, Section 2.3.2.1.

A. SITE SELECTION

The proposed Hanford No. 2 Plant, now designated as Plant No. 4 in the Hydro-Thermal Program (see Section X), was originally scheduled for completion in 1978 as Plant No. 5. It was to be located in southwest Washington, partially because of transmission considerations. However, the operational date of the plant was advanced to 1977 when the voters of Eugene, Oregon, delayed the Eugene Water and Electric Board's Hydro-Thermal Plant No. 4.

Because of this advance in schedule, it became important for the Supply System to insure approval of a site for Plant No. 4 with a minimum of delay. Selection of the U. S. Atomic Energy Commission's Hanford Reservation as a site was motivated to a large degree by the known suitability of such a location for a large nuclear plant. Comprehensive experience and data concerning environmental and ecological factors in this vicinity are available, since the Hanford Reservation has served as a nuclear center since 1943. It could be reasonably concluded from this experience and data that the impact of a nuclear power plant on the surroundings of the site would be minimal. In addition, the Hanford Reservation is an area where public acceptance of nuclear operations has been demonstrated and where ancillary nuclear facilities and skilled nuclear personnel are available. As a result of these considerations, the Supply System recommended the Hanford Reservation as the plant site to the Public Power Council, the Joint Power Planning Council, and the Bonneville Power Administration. These agencies subsequently endorsed the choice of this location.

Another advantage to a site on the Hanford Reservation is the convenience of transmission facilities. A relatively short line would need to be constructed to connect to the existing BPA system. This new line would be entirely within the reservation.

A contract was concluded between the U. S. Atomic Energy Commission and the Supply System on December 10, 1971, providing for the lease of two contiguous parcels of land, one for 50 years and one for 30 years from January 1, 1972, with option to extend the terms of the lease.[2] The major structures will be located on the first parcel, and the intake and outfall pipes to the Columbia River will be on the second parcel.

Finally, there are no competing uses for the land. It has never been in productive use nor was any other such use planned.

B. APPLICATIONS AND APPROVALS

Table I-1 lists the applications filed by Washington Public Power Supply System with governing bodies or agencies. The date of approval is included for those which have been sanctioned as of this time (August 1972).

TABLE I-1. Chronology of Applications Filed and Permits Granted

Gov. Body or Agency	Date of Application	Action	Date Approved
STATE			
State of Washington, Thermal Power Plant Site Evaluation Council	Jan. 28, 1971	Site Certification Agreement	May 17, 1972
FEDERAL			
U. S. Atomic Energy Commission	Aug. 19, 1971	Application for construction permit	
U. S. Army Corps of Engineers	(pending)	Permit to construct river water pumphouse	
U. S. Army Corps of Engineers	(pending)	Permit to discharge cooling tower blowdown to river	
U. S. Army Corps of Engineers	(pending)	Permit to accomplish dredging.	

REFERENCES

1. Revised Code of Washington, Chapter 80.50, Thermal Power Plants - Site Location.

2. Contract No. AT (45-1)-2269 between the United States of America, Represented by United States Atomic Energy Commission, and the Washington Public Power Supply System.

II. THE SITE

A. GENERAL

The Washington Public Power Supply System proposes to build Hanford No. 2 on a site leased from the U. S. Atomic Energy Commission within the Hanford Reservation in the southeastern part of the State of Washington. The Hanford Reservation has served as a nuclear center since 1943 and has not been open to the general public since its inception.

The proposed site is located in a sparsely populated region and consists of a desert tract of land which has not been used since access was restricted by the AEC. No other productive land use has been planned for the proposed site. The siting of Hanford No. 2 in the Hanford Reservation is compatible with AEC plans for the reservation.[1]

Comprehensive experience and data concerning environmental and ecological factors in the vicinity of the site have been acquired by the AEC and its contractors, and are available to the Supply System. According to the applicant, this extensive compilation of baseline information was one of the principal criteria considered in the selection of the Hanford Reservation for the location of Hanford No. 2.

B. LOCATION

Hanford No. 2 will be located in Section 5 of Township 11 North, Range 28 East, Willamette Meridian, in Benton County, State of Washington, as shown on the boundary map of the Hanford Reservation, Figure II-1. The site is 175 miles south of the Canadian border at the Okanogan River crossing; 111 miles west of the Idaho-Washington border at Lewiston, Idaho; 38 miles north of the Oregon-Washington border at Umatilla, Oregon; and 226 miles east of the Pacific Ocean at Long Beach, Washington. Hanford No. 2 is 12 miles north of Richland, Washington, the nearest incorporated community.[2]

The Columbia River crosses the Hanford Reservation and then flows south to form the eastern boundary of the southern part of the reservation. The site for Hanford No. 2 is about three miles west of this latter stretch of the Columbia River. The closest approach of the Yakima River is at Horn Rapids Dam, eight miles southwest of the plant, outside the reservation.

The applicant has leased from the USAEC 1089 acres of which approximately 30 acres will be modified by construction activities; of these, about 10 acres will be used for plant structures and auxiliary facilities. The remaining 1059 acres will remain in the natural state.

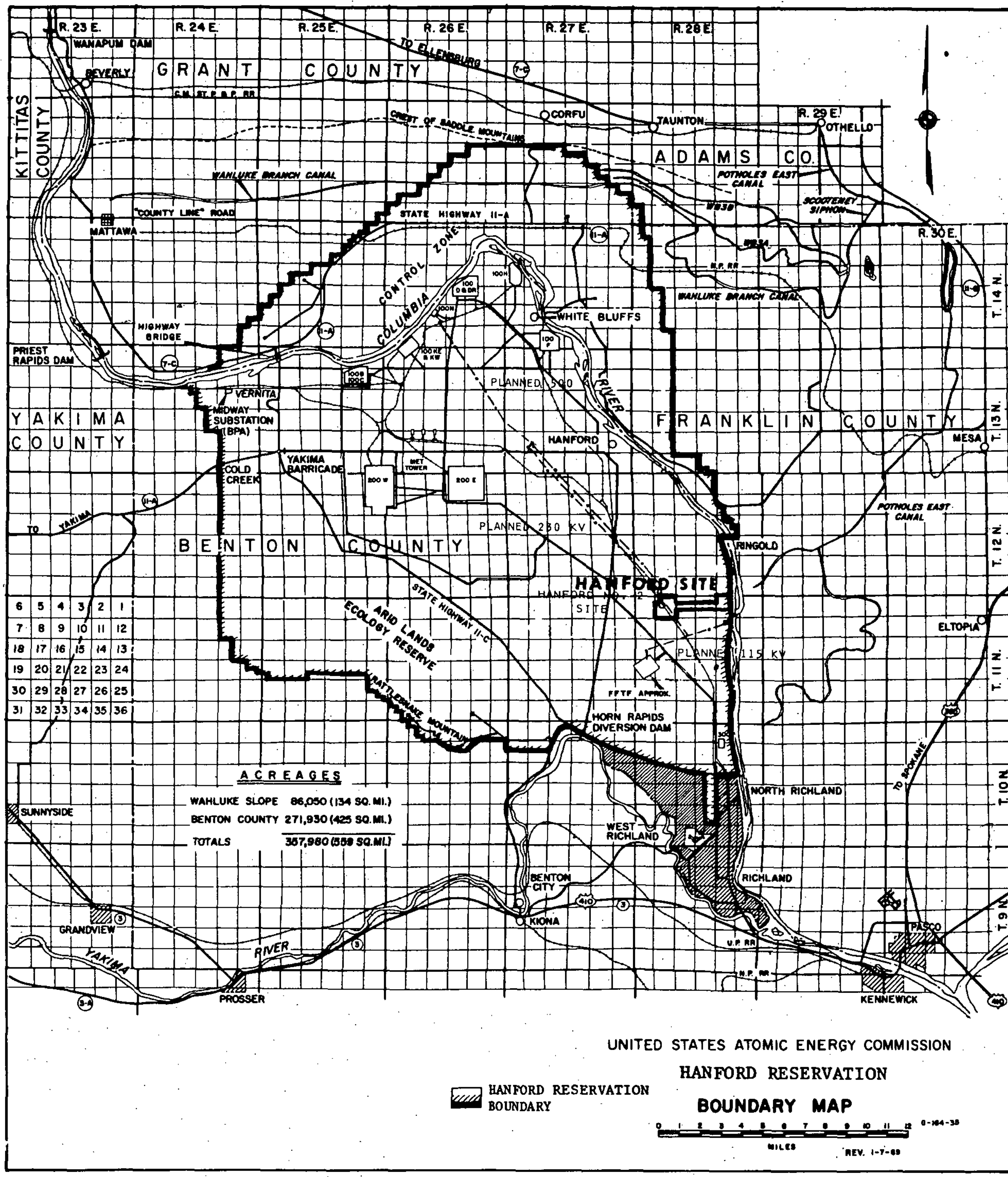


Fig. II-1. Boundary Map of the Hanford Reservation. From Applicants' Environmental Report, Amendment 1.

C. REGIONAL DEMOGRAPHY AND LAND USE

1. Population

The peak daytime working population on the reservation in June 1971 was about 3400 people. Of these, 460 were located in the production reactor zones adjacent to the Columbia River in the northern portion of the reservation; 770 people were in the irradiated fuel processing zones in the central part of the reservation; and 2200 others were in the laboratory zones in the southeast corner. The Fast Flux Test Facility, 2-3/4 miles from the Hanford No. 2 Site, will employ about 250 to 275 people when operation begins.

The nearest industrial facility outside the AEC Reservation boundary is the Jersey Nuclear Company, located approximately eight miles south of the plant site. It is expected to employ 100-200 people. The North Richland-Port of Benton industrial area, which is located eight miles south-southeast of the site, provides employment for about 1200 people. There is a two-mile wide buffer zone between the AEC Reservation boundary and the City of Richland.

The Tri-Cities of Kennewick, Pasco, and Richland, with a combined urban population of about 60,000 people, are located 10 to 20 miles southeast of the site.

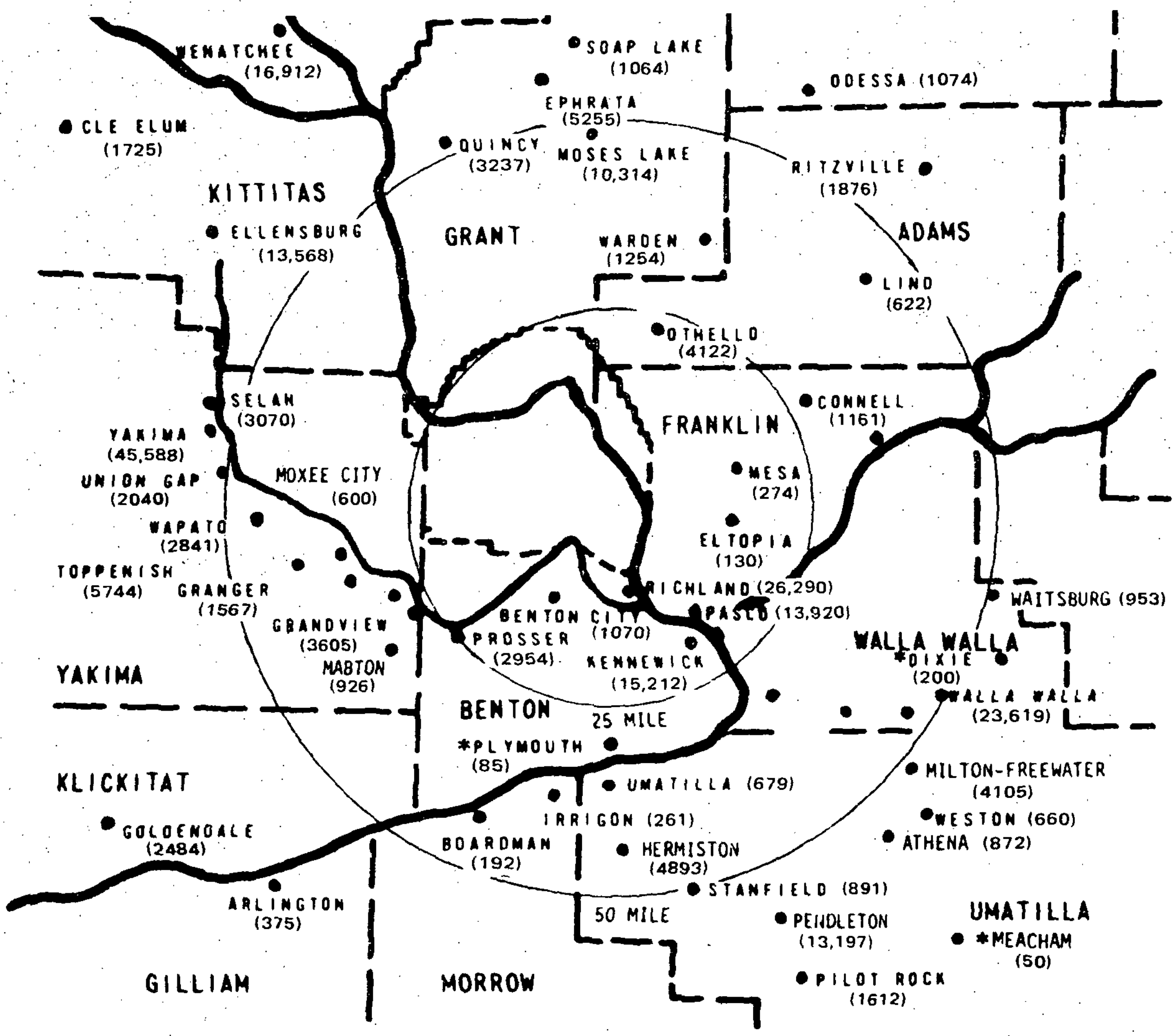
There are no areas of dense residential population within 10 miles of the site. At the present time, there are approximately 480 people living within 10 miles of the site. The number of residents in that area is expected by the applicant to increase to about 520 by the year 1980.

The centers of population within a 50-mile radius of the site are shown in Figure II-2, with populations given by town.[3] In the year 2015, there will be three population centers as defined in 10 CFR Part 100 with projected populations of 25,000 or more within 25 miles of the site; namely, Richland, Kennewick, and Pasco. At present, only Richland's population exceeds 25,000.

Population distribution in 16 directions and for 10 incremental distances up to 50 miles from Hanford No. 2 projected for 1980 is listed in Table II-1.

2. Land Use

The only present uses of the proposed site are for (a) a short-term study of desert rodents by staff members of the University of Idaho, and (b) a study of vegetation regrowth after a fire originated by lightning in July 1970 that covered over 19,000 acres including the site of Hanford No. 2.



SOURCES FOR POPULATION DATA

* RAND McNALLY CO COMMERCIAL ATLAS AND MARKETING GUIDE (1971)

Fig. II-2. Population Centers within 50-mile Radius of Hanford No. 2. Revised from Applicants' Environmental Report.

TABLE II-1. 1980 Population Grid for 16 Directions and 10 Distances around Hanford No. 2

Km:	0.805	2.415	4.020	5.630	7.240	12.080	24.150	40.200	56.300	72.500
Miles:	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
1 N	0	0	0	0	0	0	30	260	275	14,200
2 NNE	0	0	0	0	0	0	330	5,400	1,500	420
3 NE	0	0	0	0	0	4	380	750	425	1,010
4 ENE	0	0	0	0	20	96	590	1,130	410	364
5 E	0	0	0	0	0	96	510	225	330	1,239
6 ESE	0	0	0	0	0	52	660	270	820	5,400
7 SE	0	0	0	0	0	24	2,300	18,500	2,200	1,080
8 SSE	0	0	0	0	0	36	22,800	17,600	860	8,600
9 S	0	0	0	0	0	16	24,000	390	185	9,000
10 SSW	0	0	0	0	0	180	4,000	100	140	2,000
11 SW	0	0	0	0	0	4	200	3,900	350	460
12 WSW	0	0	0	0	0	0	12	1,790	20,250	710
13 W	0	0	0	0	0	0	0	200	4,800	28,000
14 WNW	0	0	0	0	0	0	0	90	205	250
15 NW	0	0	0	0	0	0	0	10	90	310
16 NNW	0	0	0	0	0	0	0	20	300	530

Derived from Preliminary Safety Analysis Report, Table 2.2-4, p. 2.2-6.

The present use of reservation lands surrounding the site is indicated in Figure II-3. The plutonium production areas, some of which are no longer in operation by the AEC, are shown in this figure. Within the Hanford Reservation, Hanford No. 2 is 18 miles southeast of Hanford No. 1, and 2-3/4 miles northeast of the FFTF, which is being constructed for the AEC.

Adjacent to the Hanford No. 2 Site, but not within the confines of the plant boundary, is a nine-acre burial site containing radioactive waste disposed of by the AEC. Known as the Wye burial ground, the area is appropriately marked. The area is under the control of the AEC waste management program and is not considered a hazard to the public or to the plant's operation. Neither the public nor the Hanford No. 2 operating personnel will have access to this burial site.

The AEC has reviewed the information submitted by the Supply System and has determined that the design, construction, operation and maintenance, and use of the plant by the Supply System will not materially interfere with this burial site.[4]

An area (the Arid Lands Ecology Reserve) of 120 square miles in the southwest corner of the Hanford Reservation has been set aside for long-term ecological studies, as shown in Figure II-3.

Islands in the upper portion of the Columbia River adjacent to the Hanford Reservation are excluded by the AEC from public use. They are restricted for several species of wildlife and related uses.

To the north of the Columbia River is a 32,000-acre area that will be developed as a wildlife refuge by the U. S. Bureau of Sport Fisheries and Wildlife. Public access to this area is not permitted.

Also to the north of the Columbia River is a 54,000-acre area where hunting (shotgun and archery) will be permitted during daylight hours. Fishing and other recreational activities will be determined by the Washington State Department of Game at a later date. In addition, there is a smaller (4000-acre) area presently used by the Washington State Department of Game for controlled hunting. It is located on the east side of the Columbia River opposite the original townsite of Hanford. All the above areas are shown in Figure II-3.

Ponds and marshes have developed recently in lands north and west of the Columbia River as the result of the installation of irrigation facilities in the Columbia River Irrigation Project.

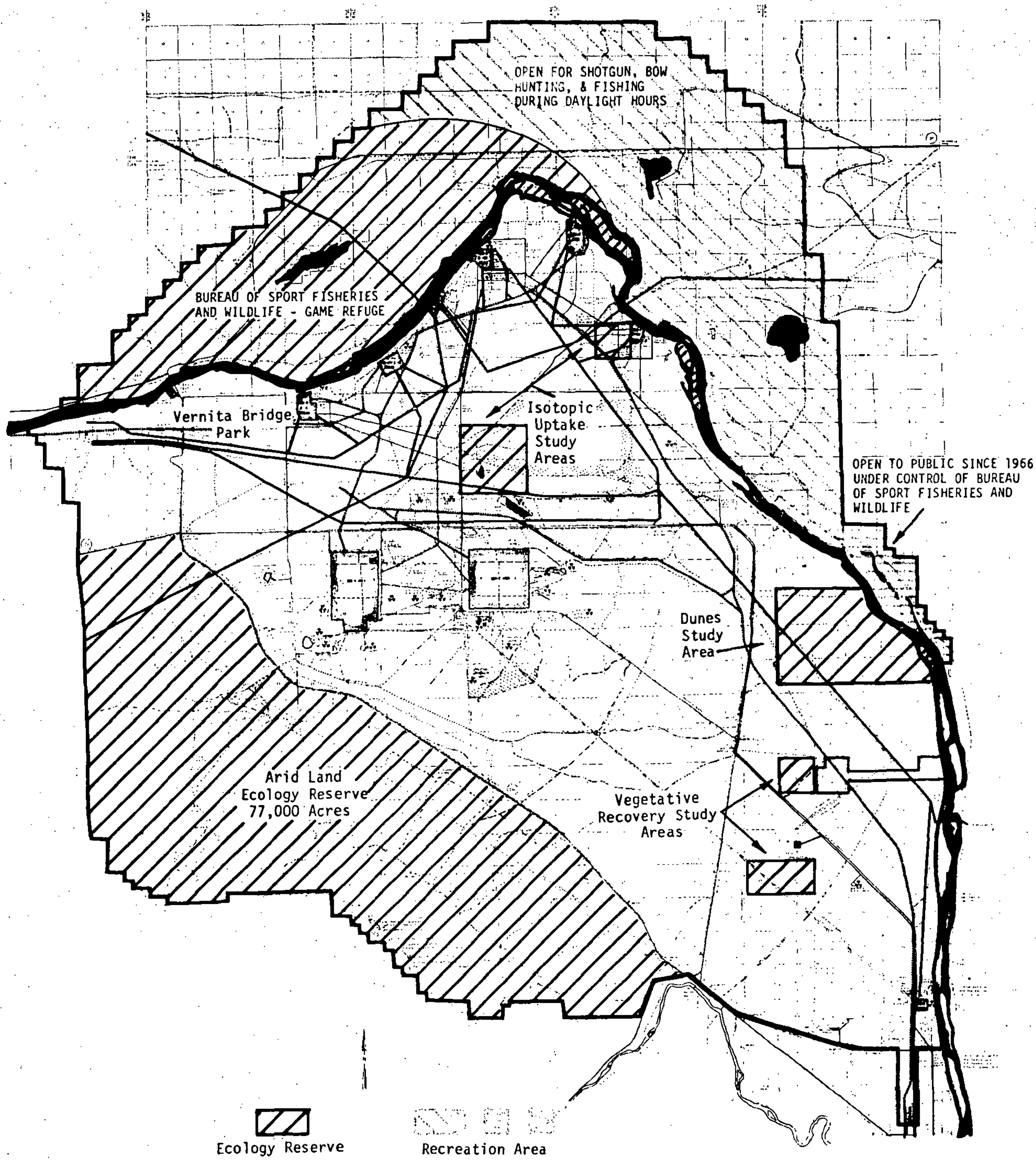


Fig. II-3. Hanford Reservation Land Uses. From Applicants' Environmental Report, Amendment 1.

Land uses within a 30-mile radius of the site include residential and suburban, corporate city, agricultural, industrial or commercial, scenic or recreational, general, and unclassified land areas. The predominant use of lands within 30 miles of Hanford No. 2 is agricultural, with the nearest farms located about 3-1/2 miles east of the plant, along the east bank of the Columbia River in Franklin County. Principal crops are alfalfa hay, wheat, potatoes, and sugar beets.[5]

The Hanford No. 2 reactor is located approximately 1-1/2 miles from an AEC-constructed four-lane highway connecting to the public highway system at Richland, Washington. This four-lane highway is part of a network of approximately 270 miles of AEC-constructed two- and four-lane primary roads, 175 miles of secondary gravel roads and 225 miles of gravel and unimproved roads on the reservation.

The AEC-owned railroad system has a capability of moving approximately 12,000 cars per year over 150 miles of reservation track. The system includes five main lines, 195 subsidiary lines, and two classification yards.

Barges with capacities up to 3000 tons can navigate the Columbia River from the point adjacent to the site to the point where it enters the Pacific Ocean.

The Hanford Reservation, including the site for Hanford No. 2, comprises FAA Restricted Area R-6715, over which air travel is restricted at altitudes below 10,000 feet. Flights at lower altitudes are occasionally authorized for special purposes by the Richland Operations Office of the AEC. The site is about 11 miles north of the Richland Airport and 18 miles northwest of both Vista Field near Kennewick and the Tri-Cities Airport near Pasco. Only the Tri-Cities Airport has regularly scheduled commercial airline service, with the Douglas DC-9 series airplane the largest that can be accommodated. The site is 17 miles from VOR Airway V112W, and 13 miles from VOR Airway V298, both of which radiate from the Tri-Cities Airport.[6]

The school nearest to the site of Hanford No. 2 is the K-12 Complex in Richland. The location of this school is 10.3 miles south-southeast of the site.

D. HISTORICAL SIGNIFICANCE

There are no known archeological or historical sites located within the site nor in proposed transmission corridors. Battelle-Northwest Laboratories has identified the known archeological sites on the Hanford Reservation.

These are not expected to be disturbed by the Hanford No. 2 Plant project. A review of the 1971 Revision of the National Register of Historic Places[7] discloses no listed historical sites on the Hanford Reservation.

The following historic sites are within a radius of approximately fifty miles of the site of Hanford No. 2:[7]

(1) Whitman Mission National Historic Site, six miles west of Walla Walla, Washington.

(2) Lyons Ferry vicinity, Franklin County, one mile north of Lyons Ferry on west side of Palouse River, State of Washington.

The primary historical features of the Hanford Reservation are the first plutonium production reactors, which were built during World War II. If sometime in the future it were decided to make one of these original reactors (none of which is operating today) into a national monument, the presence of Hanford No. 2 would not interfere with such action.

The Supply System will retain the services of a competent archeologist, who will monitor the project for any significant archeological or historical findings. During the course of excavation and construction for the plant, auxiliary facilities, and transmission lines, it will be determined whether archeological or historical sites are being disturbed. Any significant artifacts discovered will be preserved and reports on archeological findings will be made to the Washington State Thermal Power Plant Site Evaluation Council during the course of work on the project. The Council will be consulted on arrangements for preservation of artifacts and interpretation of the significance of any sites that are discovered.[8]

E. ENVIRONMENTAL FEATURES

1. General Terrain Characteristics

The site is situated on a relatively flat and unproductive plain. This portion of the plain is characterized by slight topical relief, with a variation of approximately five feet. In general, the terrain slopes slightly to the northeast toward the Columbia River. The average ground surface elevation at the plant is 439 feet above mean sea level. The maximum variation in elevation within a 7-mile radius of the site is about 200 feet. The dominant topographical features in the area are: Rattlesnake Hills, 8 to 10 miles west-southwest, 3200 feet above the elevation of the plant site; Gable Mountain, 8 miles north of the site and about 670 feet above the site grade; and the steep, river-cut bluffs forming the east bank of the Columbia River, approximately 3-1/2 miles east of the site.

2. Geology

The surficial geology of the site is characterized by a one- to three-foot layer of light brown, fine, slightly silty eolian sand, sparsely covered by vegetation. Although the soil is fertile, it has no agricultural value without irrigation. Underlying the surface sands is a mixture of sand and gravel ranging in depth to about 100 feet, which is loose near the surface and becomes very dense with depth. These soils are underlain by hard conglomerates, predominantly sand and gravel mixtures containing some clay and silt.

Geological studies were conducted by Shannon & Wilson, Inc., and a characterization of the site is found in the Preliminary Safety Analysis Report (PSAR), Section 2.6. An additional series of reports, which are directed to the structural aspects of the area as they relate to seismic activity, are also included in this section of the PSAR.

The Hanford Reservation lies in the Pasco Basin, a structural and topographic low point of Eastern Washington and the Columbia River Basalt Plateau. The region is underlain by three major geologic units: (1) the basaltic lavas and intercalated sediments of the Columbia River Basalt Group at the base; (2) the Pleistocene-age Ringold Formation; and (3) the Pasco (glacio-fluvial) gravels and associated sediments of late Pleistocene age at the surface.

A generalized geologic section which describes the Pasco Basin is shown in Figure II-4. The Columbia River Basalts are about 5000 feet thick under the Pasco Basin and probably as much as 12,000 feet thick in some of the folded uplands. The basalts and their associated sedimentary interbeds are overlain by the Ringold Formation sediments of late Pliocene to Pleistocene age. This formation has been arbitrarily divided into a lower, so-called "blue clays," a middle conglomerate, and an upper fine sand and silt. The "blue clays" are known solely from drilled wells, but samples consistently show that they are largely compact and calcium carbonate-indurated silts.

The conglomerates generally blanket the silts, although they also interfinger with them in part. They are in turn overlain by the silts and sands of the uppermost part of the formation. Those silts and sands are known only from White Bluffs, for they or their equivalent were eroded from the Hanford area. Where exposed to weathering, as in the White Bluffs, the Ringold tends to soften and be subject to sliding and sloughing. However, with appreciable cover and protection from weathering, the Ringold Formation takes on the aspect of bedrock.

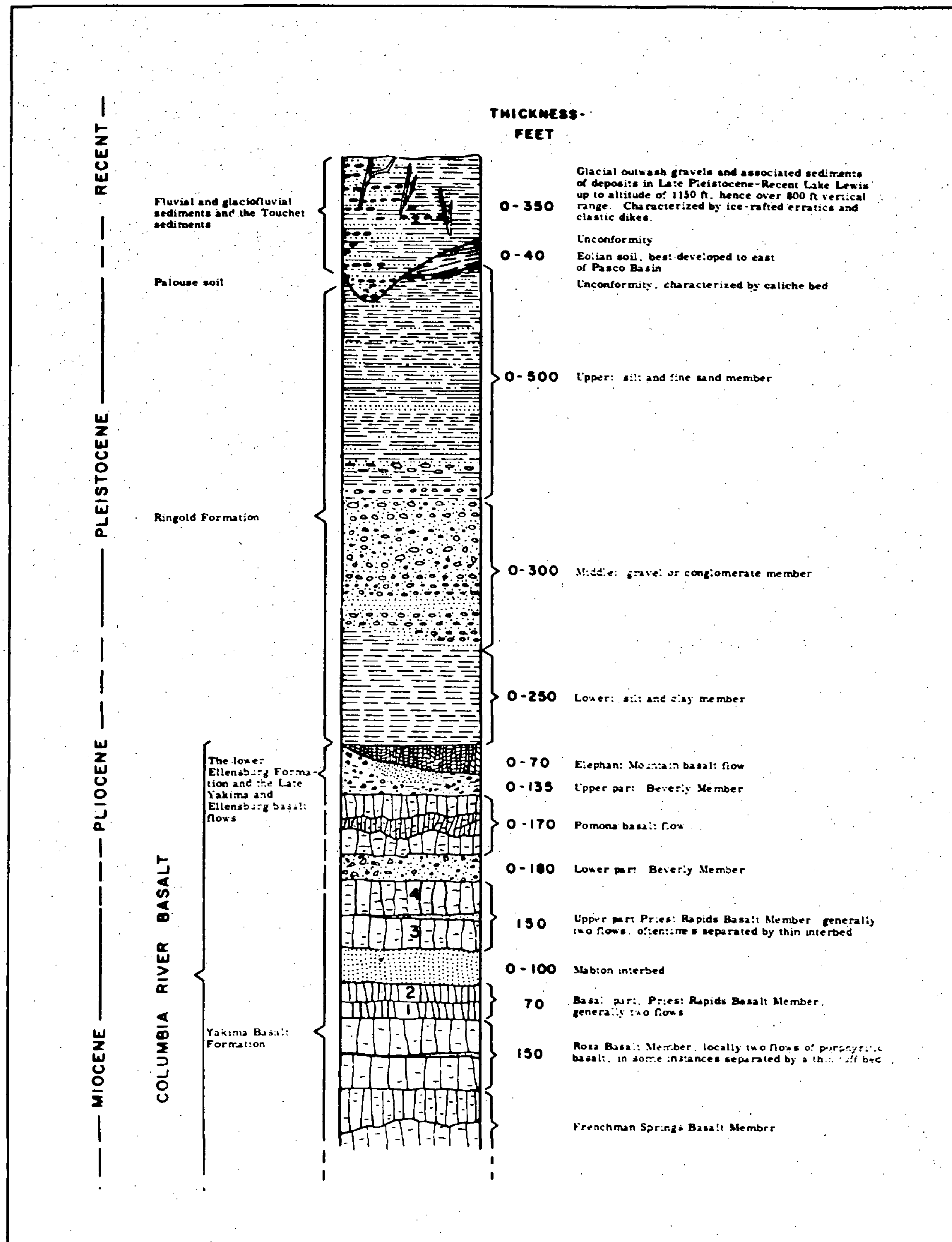


Fig. II-4. Geologic Column of the Pasco Basin. From Preliminary Safety Analysis Report.

The Pasco Gravels are the compact though uncemented deposits of late Pleistocene and early Recent times, which occur at the surface or under a thin cover of loessial materials.

3. Hydrology

a. Surface Water

The Columbia River is the dominant hydrologic feature in the vicinity of the Hanford No. 2 Site. Other more distant features are the Yakima River to the southwest and Rattlesnake Creek to the west.

The Hanford No. 2 Site is located inland, approximately three miles west of the Columbia River, with the proposed intake and discharge structures adjacent to river mile 351.75 (distance upstream from the mouth of the river). River flow rates are influenced by water usage and upstream reservoir projects. The nearest, Priest Rapids Dam at river mile 397, contains about 45,000 acre-feet of active storage. The average flow rate in the Hanford reach is approximately 115,000 cfs. The lowest mean monthly flow is about 62,000 cfs, while regulated flows as low as 36,000 cfs (minimum licensed release for Priest Rapids Dam) may be experienced for short intervals. The mean monthly discharges below Priest Rapids Dam are shown in Table II-2, and have been adjusted to compensate for upstream water usage.[9] The flow duration curves shown in Figure II-5 were derived from data collected over the period 1929 to 1958 (Table II-3) and modified to represent water usage in the year 1970.[9]

The Columbia River water temperatures in the vicinity of the Hanford reach average from 39°F to 64°F, with the low temperatures occurring in February and March and the high in August. Impoundment has created a shift in the seasonal temperature cycle, as well as a reduction in the maximum temperature during the summer and an elevation of the minimum temperature during the winter, but it has not significantly changed the annual average water temperature.[10] Table II-4 summarizes the average and extreme monthly water temperatures at Priest Rapids Dam over the period 1960 to 1968, as well as the average and extreme monthly temperatures for 1969. A diurnal variation in water temperature of about 2.2°F in the spring and summer, and 1.1°F in fall and winter, can be expected to occur as a result of reservoir discharges.

Table II-5 lists the major chemical constituents in the river at a point upstream of the Hanford Reservation. The dissolved oxygen concentrations range from 9.5 to 14.0 mg/1, with 11.8 mg/1 the average.[11] The passage of water over the spillways of upstream dams has caused nitrogen supersaturation in the river water. Values of dissolved nitrogen in excess of 120%

TABLE II-2. Modified Mean Discharges, in cfs, Columbia River below Priest Rapids Dam*

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
1928										224000	109900	90900	
1929	82300	78400	101100	103000	108000	72600	85200	62000	71300	87600	97000	94300	86900
1930	87900	89800	102700	93500	90700	83100	72500	81700	90200	98800	97600	92700	90100
1931	86800	89600	100000	82200	90800	88400	74500	81700	104000	102200	99400	85800	90400
1932	87400	88700	102000	95000	109200	77800	90700	157500	156700	74600	97800	90600	102300
1933	89600	69700	102700	128800	167100	97900	118900	185900	196600	180300	121900	100200	130000
1934	100600	104200	128000	139600	203400	196700	243100	221200	168800	104500	100000	101000	150900
1935	82000	72400	109200	132100	132000	111300	117600	147500	156900	131100	99300	96900	115700
1936	90200	86200	107900	119400	79800	80400	81500	160500	123300	83400	93200	89400	99600
1937	87600	87500	105400	96600	100600	84400	63500	70400	76900	87800	102500	91500	87900
1938	89300	83100	88700	111000	124100	86800	110700	142400	146800	154100	90400	89200	109700
1939	83400	77100	91700	127200	90400	83000	108500	100000	112400	95500	96900	90800	96400
1940	85800	85400	90500	133200	98000	89200	110700	89700	101700	94100	96000	91600	97200
1941	84300	79600	92500	99400	92200	87900	137400	76900	73200	84000	91500	88700	90600
1942	96000	82700	91400	114100	119000	84600	115900	105300	148400	101400	102000	88300	104100
1943	87900	65800	86800	105600	150600	116000	132400	202600	134300	147700	101300	88900	118300
1944	81300	77200	96800	99300	110600	78700	88200	88000	69100	81200	94600	84400	87400
1945	90100	90900	103600	88500	94000	86500	77800	112800	67800	88800	99300	87400	90600
1946	86200	85700	92500	95600	117700	90800	112200	178100	170900	134500	94400	91100	112500
1947	79600	81300	93100	116000	137800	135200	155900	184400	163400	136300	89900	85500	121500
1948	94700	96000	113900	113200	202800	166700	137700	193400	257600	194700	122900	101900	149600
1949	88000	83600	97700	126000	114000	80000	123000	166400	181600	82700	92200	87800	110200
1950	79000	69500	106800	123300	155200	145400	136400	197500	200200	211900	114800	96200	136400
1951	91800	87900	102600	115400	223400	186200	195600	188800	171300	174300	110300	91700	144900
1952	94200	98800	112200	126500	155200	113300	134600	172400	135800	145100	88700	85900	121900
1953	85500	83900	103900	95500	124800	87800	98700	174000	168300	141400	99000	89200	112700
1954	83600	89800	110300	122100	153600	135200	124200	191200	224900	228400	163600	114400	145100
1955	98700	103400	126600	132400	143900	102700	110500	104300	181800	193300	111900	91000	125000
1956	95700	94500	97000	108100	206500	200600	173500	245800	212600	200400	103600	90700	152400
1957	87400	82900	109400	132100	145100	101200	113600	182700	176500	120900	89000	86900	119000
1958	77500	75200	83300	120200	123700	107300	125000	172800	172900				
Mean	87800	84700	101700	113200	132100	108600	119000	147900	147200	132800	102400	91800	114100

*From Application for Washington State Site Certification.

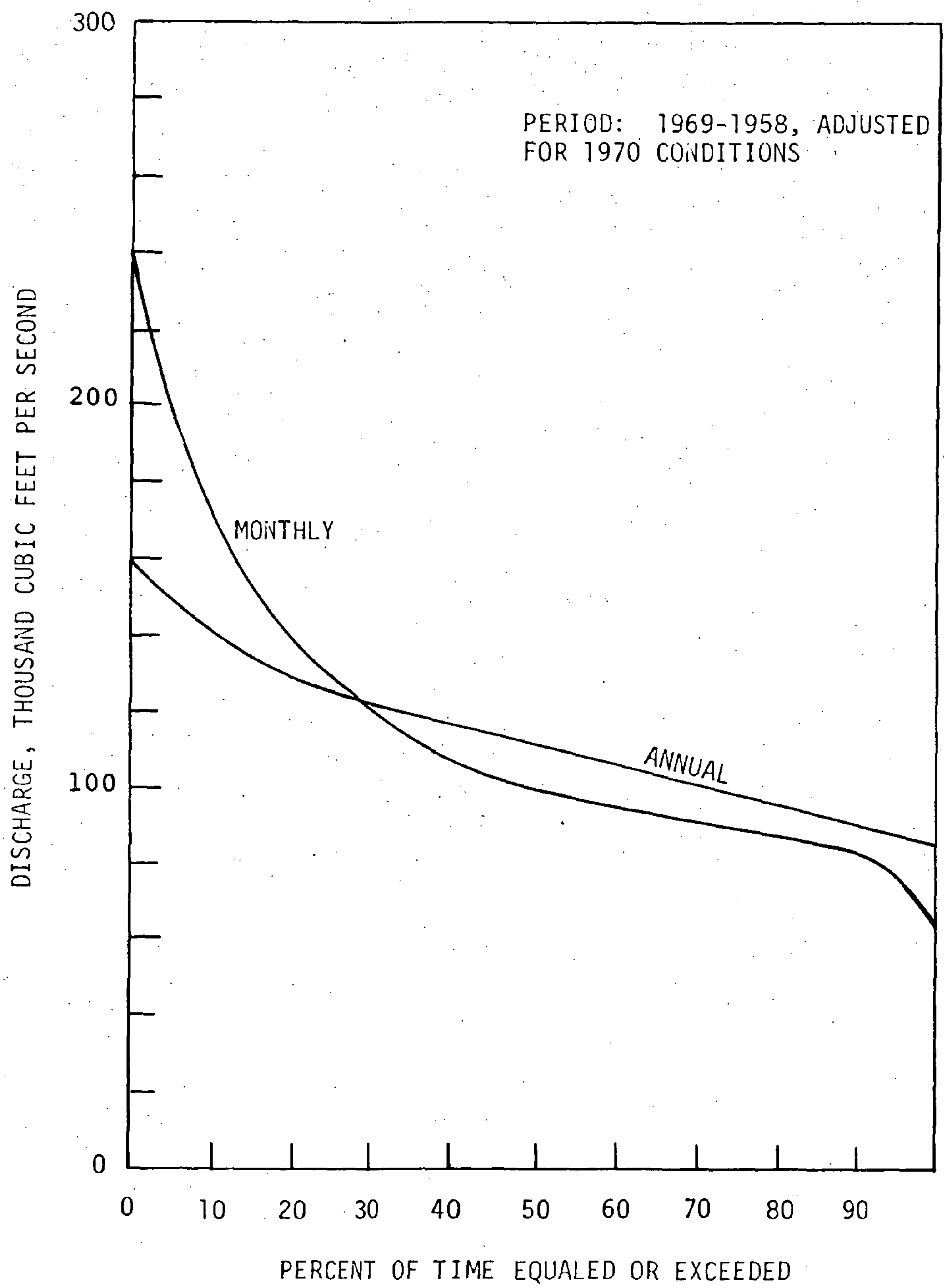


Fig. II-5. Flow Duration Curves for the Columbia River below Priest Rapids Dam. From Applicants' Environmental Report, Amendment 1.

TABLE II-3. Dependable Yield, Columbia River below Priest Rapids Dam

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow (cfs)	Percent of 1929-1958 Mean
1	1937	86,600	75.9
2	1930-1931	89,900	78.8
3	1929-1931	92,900	81.4
4	1929-1932	95,800	84.0
5	1937-1941	96,400	84.5
6	1937-1942	97,300	85.3
7	1936-1942	98,400	86.2
8	1937-1944	99,000	86.8
9	1937-1945	97,900	85.8
10	1936-1945	98,600	86.4
30	1929-1958	114,100	100.0

From Preliminary Safety Analysis Report, Table 025.1c-2.

TABLE II-4. Columbia River Temperatures at Priest Rapids Dam

	Flow Rate (kcfs)		Temperature (F)					
	1969 Avg	1953-1967 Avg	1969 Avg	1960-1968 Avg	1969 Extremes High	1969 Extremes Low	1960-1968 Extremes High	1960-1968 Extremes Low
J	104	71	36.4	41.0	38.8	32.0	45.7	35.2
F	115	78	34.7	39.4	36.3	32.0	43.2	36.0
M	108	79	38.1	40.1	42.1	35.4	44.4	35.6
A	184	104	45.0	44.6	47.1	41.5	50.0	39.7
M	231	205	51.4	50.5	55.6	46.6	55.4	45.5
J	239	347	58.3	55.9	60.6	54.1	59.7	51.8
J	190	246	62.8	61.0	66.2	59.7	66.6	55.6
A	101	123	64.8	64.2	67.4	62.8	67.8	60.4
S	76	82	63.9	63.5	66.4	61.3	67.4	59.5
O	82	72	58.6	59.0	62.8	56.3	65.7	54.1
N	89	70	52.7	52.3	58.1	47.5	57.9	46.8
D	97	67	45.7	45.3	48.6	42.8	50.9	36.1
Y	135	129	51.1	51.4	67.4	32.0	67.8	35.2

From Preliminary Safety Analysis Report, Table 2.4-4.

TABLE II-5. Chemical Characteristics of Columbia River Water*

Constituent	Average	Maximum	Minimum
<u>Cations, ppm as $CaCO_3$</u>			
Calcium, Ca^{++}	58	80	45
Magnesium, Mg^{++}	17	28	8
Sodium, Na^{+}	5 (2)	0 (2)	0 (2)
Potassium, K^{+}			
Iron, Fe^{++}	0.07	0.4	0
Copper, Cu^{++}	0.01	0.08	0
<u>Total Cations</u>	80 (3)	108 (3)	53 (3)
<u>Anions, ppm as $CaCO_3$</u>			
Bicarbonate, HCO_3^{-}	59	66	41
Carbonate, CO_3^{--}	4	10	0
Sulfate, SO_4^{--}	16	29	10
Chloride, Cl^{-}	0.5	0.9	0.2
Nitrate, NO_3^{-}	0.2	0.5	0
Phosphate, PO_4^{---}	0.05	0.2	0
<u>Total Anions</u>	80 (3)	107 (3)	51 (3)
<u>Other Analysis</u>			
Total hardness as $CaCO_3$	74	88	64
Alkalinity M.O.; as $CaCO_3$	63	76	41
Alkalinity P.; as $CaCO_3$	2	5	0
pH	8.7 (1)	9.1 (1)	8.0-8.5 (1)
Silica, as SiO_2	6	9	3

TABLE II-5 (Contd.)

Constituent	Average	Maximum	Minimum
Other Analysis (Contd.)			
Dissolved solids, ppm	87	115	72
Turbidity, APHA	10	170	2

*Samples were taken twice monthly at Vernita Bridge (upstream from the Hanford Project) from July 8, 1969 to June 16, 1970. Forty-six samples were analyzed. From Applicant's Environmental Report.

(1)Calculation.
(2)By difference.
(3)By difference and rounded off.

of saturation have been observed below Priest Rapids Dam and in the Hanford reach of the river.

The water in the Hanford reach of the Columbia River is of excellent quality and is used for municipal drinking downstream at Richland and Pasco.

b. Ground Water

The ground water below the Pasco Basin is in an unconfined water table. The major source is in the Yakima Ridge and Rattlesnake Hills to the southwest, with only a minor contribution from precipitation. The water table occurs, in most locations, in the glacio-fluvial deposits just above the Ringold surface. The principal direction of flow is eastward, discharging to the Columbia River. The Columbia River forms a base level of ground water discharges, with a resultant rapid response of the water table to river levels occurring in the glacio-fluvial gravels. Figure II-6 illustrates the general elevation and configuration of the ground water surface below the site, as well as the wells in which the water table was recorded.

4. Meteorology

The climate of the Hanford No. 2 Site is classified as mild continental steppe, and is controlled to a large extent by seasonal and synoptic variations in the position and strength of the Pacific high pressure cell. The site is subject to low humidities, large diurnal and annual ranges of temperature, and modest annual rainfall amounts occurring mostly as rain in winter. Wind direction is strongly influenced by the terrain; wind speeds are moderate, with occasional calms and gales. The prevailing wind direction is northwest.

Most of the meteorological data used in this report, including all of the wind and stability data, were collected at the Hanford Meteorological Station (HMS), which is located approximately 14 miles northwest of the site. Temperature and precipitation records were collected by a U. S. Weather Bureau cooperative observer from 1912 to 1944 at a site about ten miles north-northwest of the Hanford No. 2 Site. Since 1945, HMS data are used.

The average annual temperature of the site (period of record, 1912-1970) is 53.1°F, with January being the coldest month (29.4°F) and July the warmest (76.4°F). The maximum temperature ever recorded was 115°F (July 1939), the minimum -27°F (December 1919). Maximum temperatures above 90°F can be expected 56 days per year; above 100°F, 13 days per year: below 32°F, 24 days per year. Minimum temperatures below 32°F can be expected on 119 days per year; below 0°F, 4 days per year.

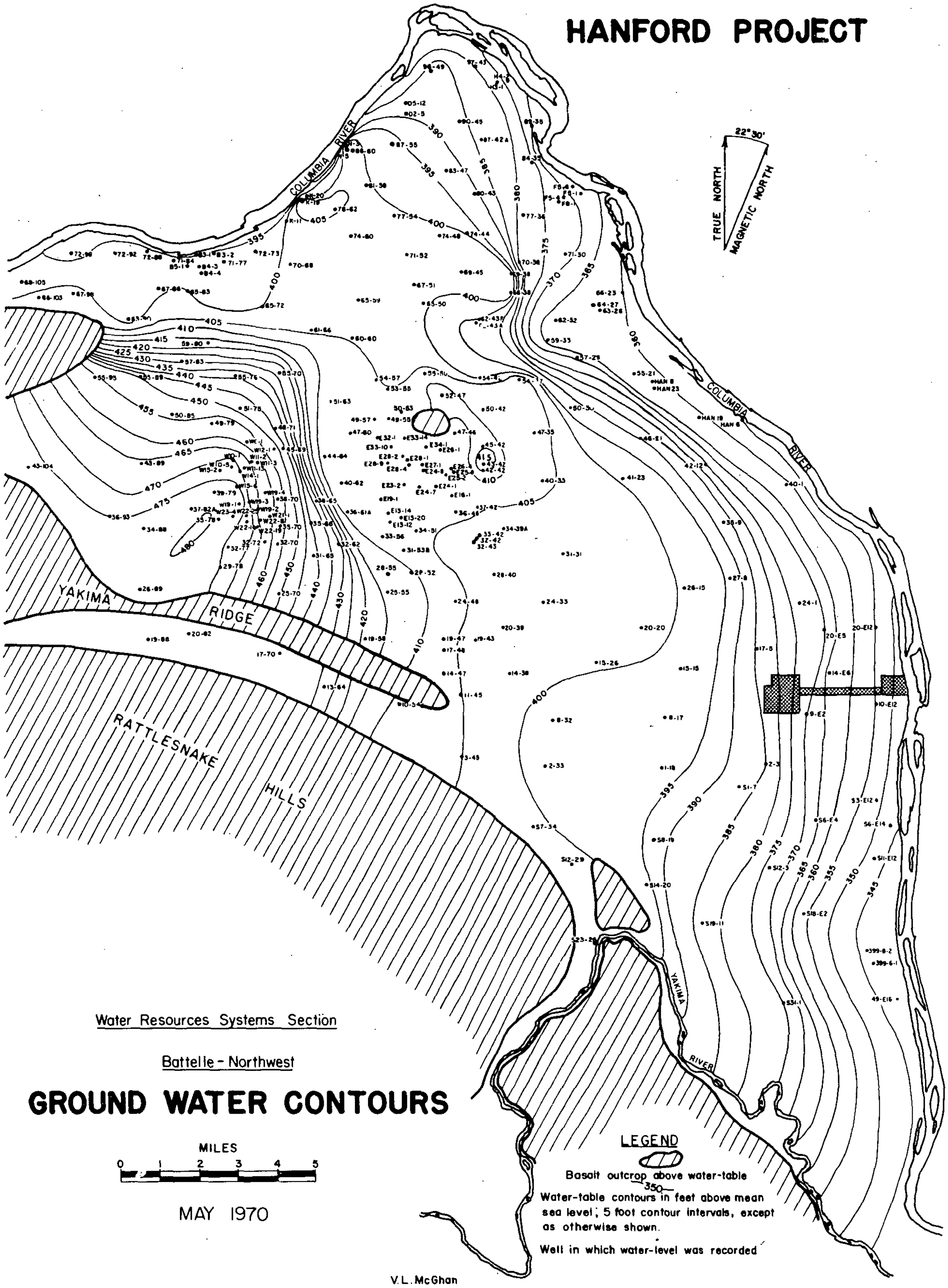


Fig. II-6. Ground Water Contours of the Pasco Basin. From Applicants' Environmental Report.

Precipitation in the Hanford area averages 6.25 inches per year (period of record, 1912-1970). January has the highest average amount of rainfall, with 0.93 inches, July the lowest with 0.14 inches. The highest 24-hour rainfall was 1.91 inches in October 1957, with 1.68 inches falling in 6 hours. Annual rainfall amounts vary from 3.26 inches in 1967 to 11.45 inches in 1950. On the average, 24 days per year have precipitation equal to or greater than 0.10 inches. Snowfall averages 12.7 inches per year, the maximum recorded snow depth was 12 inches. A typical year has five days with one inch or more of snow.

Tornadoes are rare in the area, averaging less than one per year for the entire state. Fourteen tornadoes have occurred within 100 miles of the plant since 1916; no loss of life or major damage was associated with them. Thunder and lightning storms occur on the average of 12 days per year, mostly in the summer. Hail has been observed at the HMS on 16 days in 12 years of record.

Dust has been recorded at the HMS on 2% of all days of observation (84 days in 14 years of record), with a distinct maximum frequency during the spring months. Measurements of particulates on the Hanford Reservation average 100 micrograms per cubic meter with wind speeds less than 8 mph; 1000 units with winds of 12 mph, and 3000 units with winds of 16 mph.

The relative humidity of the area is low, averaging 54% for the year (period of record, 1946-1970), varying from 32% in July to 80% in December. Values as low as 6% have been recorded (July 1951).

Heavy fog (visibility 0.25 miles or less) occurs on the average 24 days per year, varying from 9 days in 1948-1949 to 42 days (1950-1951). Heavy fogs are most frequent on the average in December (8 days), January (6 days), and November (5 days), and have never been observed in June or July. The average duration of fog is 3.2 hours; however, a light fog (visibility less than six miles) persisted for 72.3 hours in December 1947. The dominant wind during fog periods is north-northwest with speeds 0 to 3 mph.

Wind and stability data were collected on the 410-foot HMS tower located 14 miles northwest of the site; 27 years of record are available. A 20-foot tower for wind, temperature, and humidity instruments was placed in service at the site on March 9, 1972. A 245-foot meterology tower will be installed in the fall of 1972 at the site.

As shown in Table II-6, west-northwest or northwest winds prevail every month of the year, and are caused in part by channeling of the air by

TABLE II-6. Monthly and Annual Prevailing Wind Directions and Average Speeds (mph)

	Prevailing Direction	Average Speed	Highest Average	Year	Lowest Average	Year
Jan.	NW	6.1	9.6	1953	3.1	1955
Feb.	NW	6.8	8.4	1948	5.1	1950
March	WNW	8.3	10.2	1955	6.1	1957
April	WNW	8.7	10.3	1954	7.9	1957
May	WNW	8.6	10.5	1951	5.8	1957
June	WNW	9.0	10.7	1949	7.7	1950
July	WNW	8.5	9.4	1946	6.8	1955
Aug.	WNW	7.9	9.1	1946	6.0	1956
Sept.	WNW	7.2	8.5	1945	5.4	1957
Oct.	WNW	6.6	9.1	1946	4.4	1952
Nov.	NW	6.0	7.9	1945	2.9	1956
Dec.	NW	6.2	8.3	1949	4.7	1947
Summary	WNW	7.5	10.7	June 1949	2.9	Nov. 1956

From Preliminary Safety Analysis Report.

topographic features. The average annual wind speed is 7.5 mph, varying from 9.0 mph in June to 6.0 mph in November. This unusual annual cycle of wind speeds is caused by strong drainage winds from the Cascade Mountains during summer evenings and nights. The table also shows the range of mean monthly wind speeds.

Seasonal and annual wind roses from the 200-foot level of the HMS tower for the period 1950-1957 are shown in Figure II-7. During the 8-year data period used to prepare this figure, all winds in excess of 32 mph were from the southwest quadrant, and most of these (59 out of 65 hourly observations) occurred in the cool season (November through March). Gusts of 40 mph or more occur on the average (1945-1970) 26 days per year.

The strongest winds ever observed at Hanford occurred on January 11, 1972. A gust of 80 mph was recorded at the 50-foot level of the HMS tower, 84 mph at the 200-, 300-, and 400-foot levels. The average wind speed for the hour ending at 0900 PST on this date was 51 mph at the 50-foot level, 63 mph at 200 feet, and 67 mph at 400 feet. At the Wye Barricade, about three miles north-northwest of the site, the maximum integrated hourly wind speed 23 feet above ground on January 11 was 43 mph. The peak gust (as seen on a dial recorder for a sensor 25 feet above ground) at the FFTF Site, 2-3/4 miles southwest of the Hanford No. 2 Site, was 65 mph.

Calms (wind speeds 2 mph or less) are quite rare, occurring on 1.75% of all hours at the 200-foot level. Calms are most frequent in winter (4.12%) and fall (2.32%) and are infrequent in summer (0.23%) and spring (0.48%). Table II-7 is a joint frequency distribution of wind speed, wind direction and stability class; this table shows that the dispersive properties of the atmosphere at the site are satisfactory.

Atmospheric stability for the area is defined as the temperature difference between the 200-foot and the 3-foot levels as measured at the HMS tower. Table II-8 shows the annual and seasonal variation of stability classes.

Because of orographic features, wind speed and direction at any one time are known to vary from place to place across the Hanford Reservation (see Figure II-8). This figure, plus wind data of limited duration from the FFTF Site, 2.75 miles southwest, indicate that the Hanford No. 2 Plant will have fewer northwest drainage winds than does the HMS tower, especially in summer, and will experience a greater frequency of south, southeast, and east winds through the Yakima Gap near Benton City.

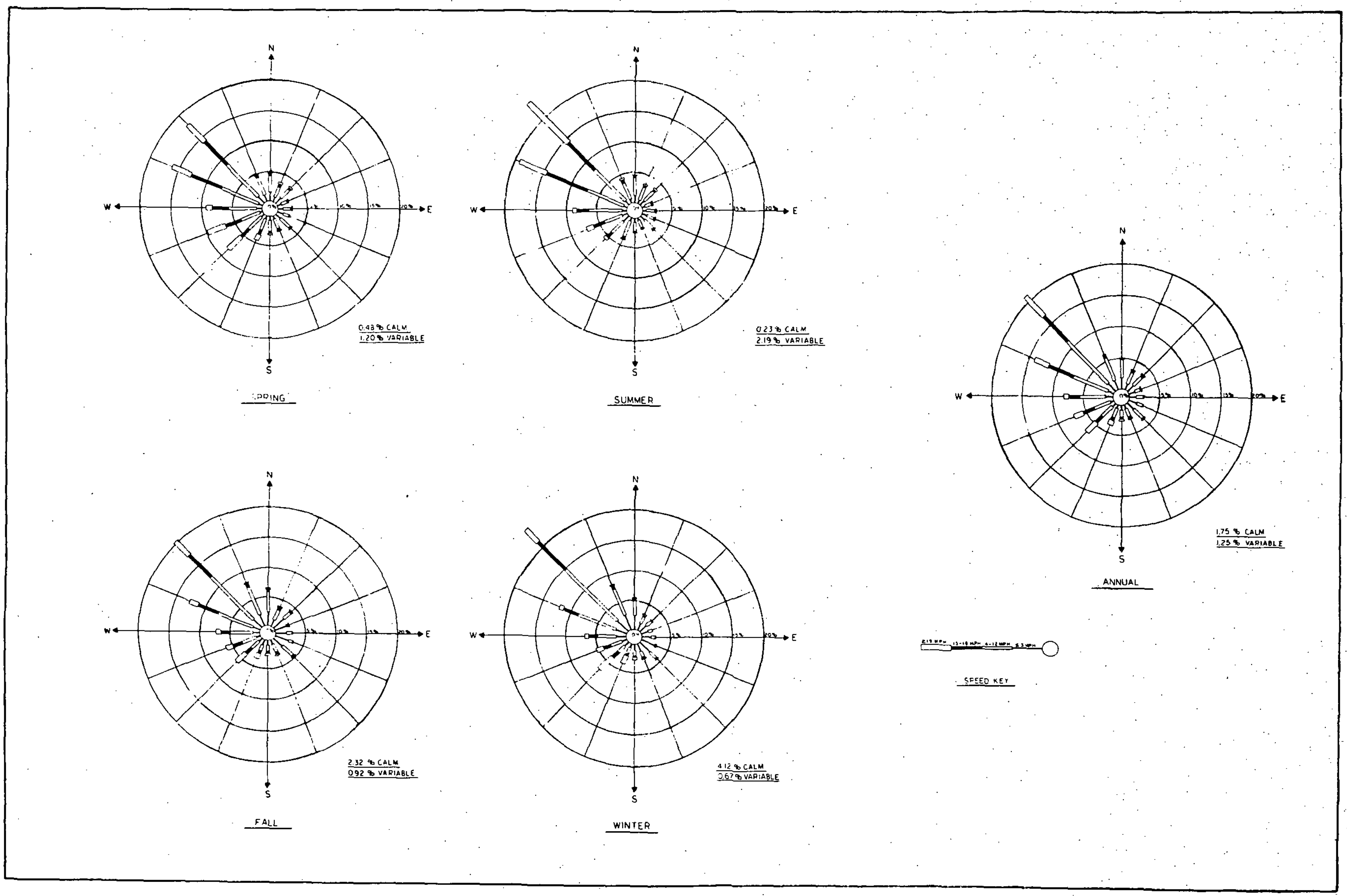


Fig. II-7. Wind Roses for the 200-foot Level, Hanford 622-R Meteorological Tower. From Preliminary Safety Analysis Report.

TABLE II-7. Percentage Frequency Distribution of Wind Speed (MPH) and Wind Direction at 200-foot Level vs Atmospheric Stability (January 1955 through July 1961)

Annual

		NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	VAR.	CALM	TOTAL
0 - 3	VS	0.16	0.20	0.14	0.22	0.24	0.41	0.21	0.24	0.20	0.25	0.24	0.46	0.38	0.53	0.41	0.37	0.15	0.56	5.37
	MS	0.19	0.25	0.19	0.22	0.44	0.48	0.22	0.22	0.13	0.17	0.16	0.23	0.29	0.40	0.37	0.41	0.12	0.67	5.17
	N	0.27	0.38	0.28	0.36	0.40	0.47	0.22	0.18	0.13	0.14	0.12	0.23	0.22	0.44	0.50	0.50	0.15	0.50	5.47
	U	0.38	0.65	0.40	0.45	0.36	0.26	0.11	0.22	0.12	0.18	0.10	0.14	0.16	0.30	0.40	0.64	0.49	0.02	5.38
4 - 7	VS	0.18	0.19	0.11	0.15	0.16	0.31	0.22	0.22	0.21	0.35	0.44	0.93	1.03	1.04	0.65	0.35	0.02	0.	6.57
	MS	0.16	0.12	0.12	0.16	0.22	0.40	0.22	0.18	0.18	0.22	0.26	0.46	0.58	0.81	0.49	0.33	0.01	0.	4.92
	N	0.10	0.13	0.10	0.10	0.15	0.25	0.13	0.11	0.07	0.10	0.12	0.18	0.30	0.66	0.31	0.16	0.02	0.	2.98
	U	0.70	0.77	0.43	0.50	0.43	0.56	0.35	0.47	0.46	0.49	0.38	0.39	0.42	1.09	0.97	1.20	0.28	0.	9.88
8 - 12	VS	0.12	0.10	0.08	0.09	0.05	0.14	0.20	0.10	0.11	0.23	0.55	1.07	1.80	1.88	0.55	0.20	0.	0.	7.28
	MS	0.11	0.09	0.02	0.07	0.07	0.19	0.19	0.15	0.21	0.33	0.48	0.90	1.62	1.89	0.35	0.16	0.	0.	6.84
	N	0.06	0.05	0.03	0.03	0.03	0.06	0.06	0.05	0.06	0.08	0.12	0.12	0.36	0.87	0.17	0.09	0.	0.	2.26
	U	0.47	0.35	0.11	0.06	0.07	0.09	0.10	0.12	0.28	0.	0.54	0.33	0.49	1.33	0.47	0.49	0.00	0.	5.91
13 - 18	VS	0.04	0.03	0.02	0.02	0.	0.05	0.08	0.02	0.03	0.11	0.25	0.41	1.05	1.64	0.22	0.07	0.	0.	4.04
	MS	0.08	0.03	0.02	0.01	0.02	0.09	0.13	0.14	0.26	0.60	0.84	1.07	2.81	2.71	0.18	0.12	0.	0.	9.10
	N	0.06	0.01	0.01	0.01	0.00	0.03	0.03	0.05	0.07	0.15	0.20	0.14	0.28	0.51	0.07	0.04	0.	0.	1.66
	U	0.25	0.15	0.04	0.00	0.00	0.03	0.03	0.04	0.19	0.53	0.64	0.26	0.59	1.00	0.10	0.12	0.	0.	3.97
19 - 24	VS	0.	0.	0.00	0.01	0.	0.01	0.01	0.00	0.01	0.02	0.03	0.03	0.04	0.20	0.00	0.00	0.	0.	0.37
	MS	0.03	0.03	0.01	0.00	0.00	0.02	0.07	0.09	0.23	0.56	0.50	0.35	1.37	1.69	0.04	0.01	0.	0.	5.00
	N	0.01	0.02	0.	0.00	0.00	0.01	0.01	0.02	0.07	0.12	0.14	0.05	0.18	0.30	0.01	0.01	0.	0.	0.96
	U	0.06	0.05	0.01	0.00	0.	0.00	0.01	0.01	0.10	0.30	0.44	0.11	0.26	0.60	0.01	0.03	0.	0.	2.00
Over 24	VS	0.	0.00	0.	0.	0.	0.00	0.00	0.01	0.01	0.01	0.01	0.	0.00	0.	0.	0.	0.	0.	0.04
	MS	0.00	0.00	0.	0.	0.	0.01	0.02	0.08	0.33	0.60	0.24	0.08	0.48	0.84	0.01	0.00	0.	0.	2.70
	N	0.00	0.00	0.	0.	0.	0.	0.00	0.02	0.06	0.15	0.07	0.02	0.10	0.27	0.00	0.01	0.	0.	0.71
	U	0.01	0.01	0.	0.	0.	0.	0.	0.01	0.07	0.37	0.27	0.08	0.11	0.48	0.01	0.00	0.	0.	1.41
Totals	VS	0.50	0.52	0.35	0.48	0.45	0.91	0.73	0.59	0.58	0.97	1.52	2.90	4.30	5.29	1.83	0.99	0.17	0.56	23.67
	MS	0.57	0.52	0.36	0.46	0.75	1.19	0.85	0.87	1.35	2.48	2.49	3.09	7.15	8.34	1.45	1.03	0.14	0.67	33.74
	N	0.50	0.59	0.41	0.49	0.59	0.82	0.46	0.43	0.46	0.73	0.77	0.75	1.45	3.06	1.07	0.81	0.17	0.50	14.04
	U	1.85	1.97	0.99	1.02	0.86	0.95	0.61	0.87	1.22	2.47	2.37	1.32	2.02	4.80	1.96	2.48	0.77	0.02	28.55

From Preliminary Safety Analysis Report.

TABLE II-8. Percentage Frequency of Occurrence of Various Stability Conditions at the Hanford Meteorology Tower

(Based on hourly observations for the period January 1955 through July 1961) $\Delta T = (T_{200} - T_3)^{\circ}F$

Lapse Rate Classification	Season				
	Winter	Spring	Summer	Fall	Annual
Very stable (VS) ($\Delta T > 3.5$)	24	22	17	33	24
Moderately stable (MS) ($3.5 > \Delta T \geq -0.5$)	43	32	29	31	34
Neutral (N) ($-0.5 > \Delta T \geq -1.5$)	24	10	9	13	14
Unstable (U) ($\Delta T \leq -1.5$)	9	36	45	23	28

From Preliminary Safety Analysis Report.

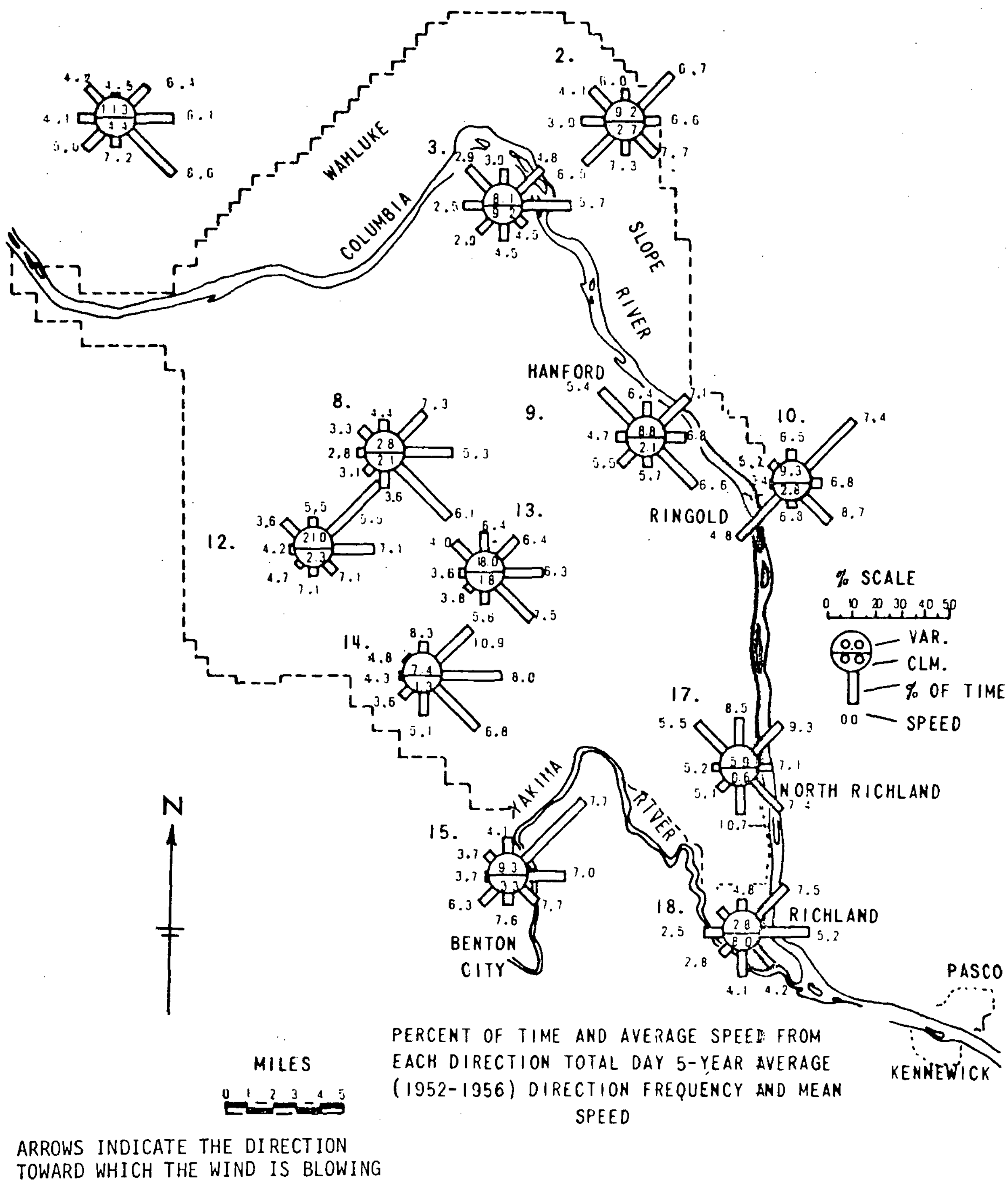


Fig. II-8. Wind Roses for the Hanford Reservation.
From Applicants' Environmental Report.

F. ECOLOGY OF THE SITE AND ENVIRONS

The Hanford No. 2 site is located inland in a relatively flat, desert steppe. A large wildfire occurred July 1970 which encompassed an area of over 19,000 contiguous acres of the Hanford Reservation, including the Hanford No. 2 Site. Initial reports[12] indicated that the greater portion of the shrubs, forbs, and grasses had been destroyed and some populations of the resident fauna severely reduced. Further characterization of the ecological consequences of the burn and the subsequent reestablishment of the flora and fauna communities are currently under investigation.[12]

1. Terrestrial Ecology

The wildfire effectively removed much of the surface vegetation and litter on the Hanford No. 2 Site, leaving areas exposed to wind erosion and dune formation. These burned areas are currently composed of fine, slightly silty eolian sand sparsely covered by annual type vegetation and some remnants of sagebrush and bitterbrush. Wind erosion has impeded to some extent the reestablishment of ground cover.

Initial revegetation has principally involved the encroachment and colonization of annual grasses and forbs, with cheatgrass, Bromus tectorum, the dominant plant. Some flora, as cheatgrass, Russian thistle, and mustard are usually associated with soil disturbances and are common to the burned areas.

The pristine plant communities in this region are dominated by big sagebrush and bitterbrush, with an understory of grasses and forbs. Cheatgrass and sandberg bluegrass typically dominate the understory plant communities. Annual herbage production is estimated to be approximately 100 grams of dry matter per square meter.[13] Studies on revegetation and plant succession in the desert steppe after land disturbances[12,14] indicate that for extended periods after a disturbance, the plant communities are composed principally of annual grasses and forbs, with little or no invasion by the perennial flora. An area studied eight years after a burn supported predominantly annual grasses and forbs, with little or no perennial plant invasion, and that which did occur was dominated by sandberg bluegrass.

The limited vegetation on the site and environs is in early plant successional stages. Because annual plants originate each year from seed, their abundance can be expected to show pronounced fluctuation attributed to yearly and seasonal changes in the environment. The development and productivity of these communities, and likewise the food and cover available to wildlife, will directly influence the composition and abundance of wildlife on the Hanford No. 2 Site.

Small mammals common to the site include the pocket mouse and deer mouse, while jackrabbit and coyote are found scattered throughout the area. During productive seasons, portions of the site could be expected to attract most of the larger and more mobile wildlife species common to the Hanford Reservation (Appendix A). Deer are found primarily near the Columbia River and the islands, with limited use of the more barren, inland desert steppe. In summer, the deer frequent the more distant Rattlesnake Hills. During periods when food and cover are adequate, the site will attract ringneck pheasant and other upland game birds from the surrounding areas. The majority of the wildlife associated with the site resides in the riparian habitats. If germination and seed production of the annual plants are restricted in the area, then marked fluctuation in the resident small mammal populations, particularly the desert rodent, would occur with the larger, more mobile species expected to move to adjacent, more productive habitats.

The most abundant birds in the area are the horned lark and meadowlark. The region is a hunting ground for birds of prey, with the Swainson's hawk prevalent in spring and summer and the golden eagle in the winter season.[15] The bald eagle has been observed on the Hanford Reservation at various times and is the only wildlife species observed to frequent the area that is on the list of endangered species.[16]

2. Riparian Ecology

The areas bordering the Columbia River in the vicinity of the Hanford No. 2 Site are predominantly composed of the annual grass and forb communities, with smaller areas typified by shrub-steppe. The shoreline and islands in this reach of the river are heavily utilized by the waterfowl and shorebirds described in Appendix A.

The islands in the immediate vicinity of the site and downstream have a mixed composition with a substrate of either sand with gravel or cobblestone and gravel. Sagebrush communities and willows are established on the dunes of the larger islands. Approximately 200 pairs of nesting geese produce 700 goslings annually and an estimated 100 pairs of ducks also nest on these islands.[17]

The Columbia River is a natural migration route for the Pacific Flyway waterfowl. Several million ducks and geese use the Columbia River Basin during movement to and from the northern breeding grounds. The waterfowl common to the area are shown in Appendix A. In 1969-1970, the wintering waterfowl population in the Hanford reach of the river was about 220,000 ducks and 24,000 Canadian geese.[18]

Two islands, one near Ringold and another near Coyote Rapids, are used as rookeries by colonies of California and ring-billed gulls. Approximately 6000 nesting pairs produce 10,000 to 20,000 young annually.[17]

A variety of upland game birds and other wildlife also use these riparian habitats for nesting and feeding (see Appendix A).

3. Aquatic Ecology

The main channel in the reach of the river adjacent to the proposed Hanford No. 2 Site is straight and relatively shallow with an island located along the opposite (east) shoreline. The main channel is approximately 1500 feet wide, and the water is typically turbulent with little or no stratification. During periods of low flow, the stream velocity is about 3 feet per second and approximately 6 feet per second during periods of normal flow. The cross-sectional profile of the river is shown in Figure II-9.

The main channel and shoreline, adjacent to the site and in the vicinity of the proposed intake and discharge facilities, are composed principally of cobble and gravel substrate. The riverbed along the island is primarily cobble and gravel adjacent to the main channel, edging into sand and gravel bars on the distal ends. These characteristics (cobblestone and gravel substrate and turbulent flows) have restricted the establishment of rooted macrophytes which are more commonly found in the sloughs and slack water.

The plankton populations in the Hanford reach of the river are predominantly phytoplankton derived in most part from areas upstream, with some contribution from periphyton in the immediate area. Diatoms are the principal form, with the genera *Asterionella*, *Melosira*, *Fragilavia*, *Tabellaria*, and *Synedra* dominating. Other phytoplankton species indigenous to this reach of the river are shown in Appendix B. The abundance of diatom populations varies in an annual cycle, with the greatest density occurring in late spring (approximately 1800 organisms per milliliter in May)[19] and the lowest density in midwinter (less than 100 organisms per milliliter). Total daily plankton transport ranges from 3×10^3 kg to 4×10^5 kg.

Diatoms are also dominant in the periphyton. The periphyton population appear to be maintained in a subclimax condition; i.e., typically in a constant state of recolonization and growth due to erosion by turbulent flow and grazing of aquatic fauna.[20] Productivity of periphyton on artificial substrate ranged from about 0.07 mg per cm^2 per day in the spring and fall, to less than 0.01 during the winter.[19]

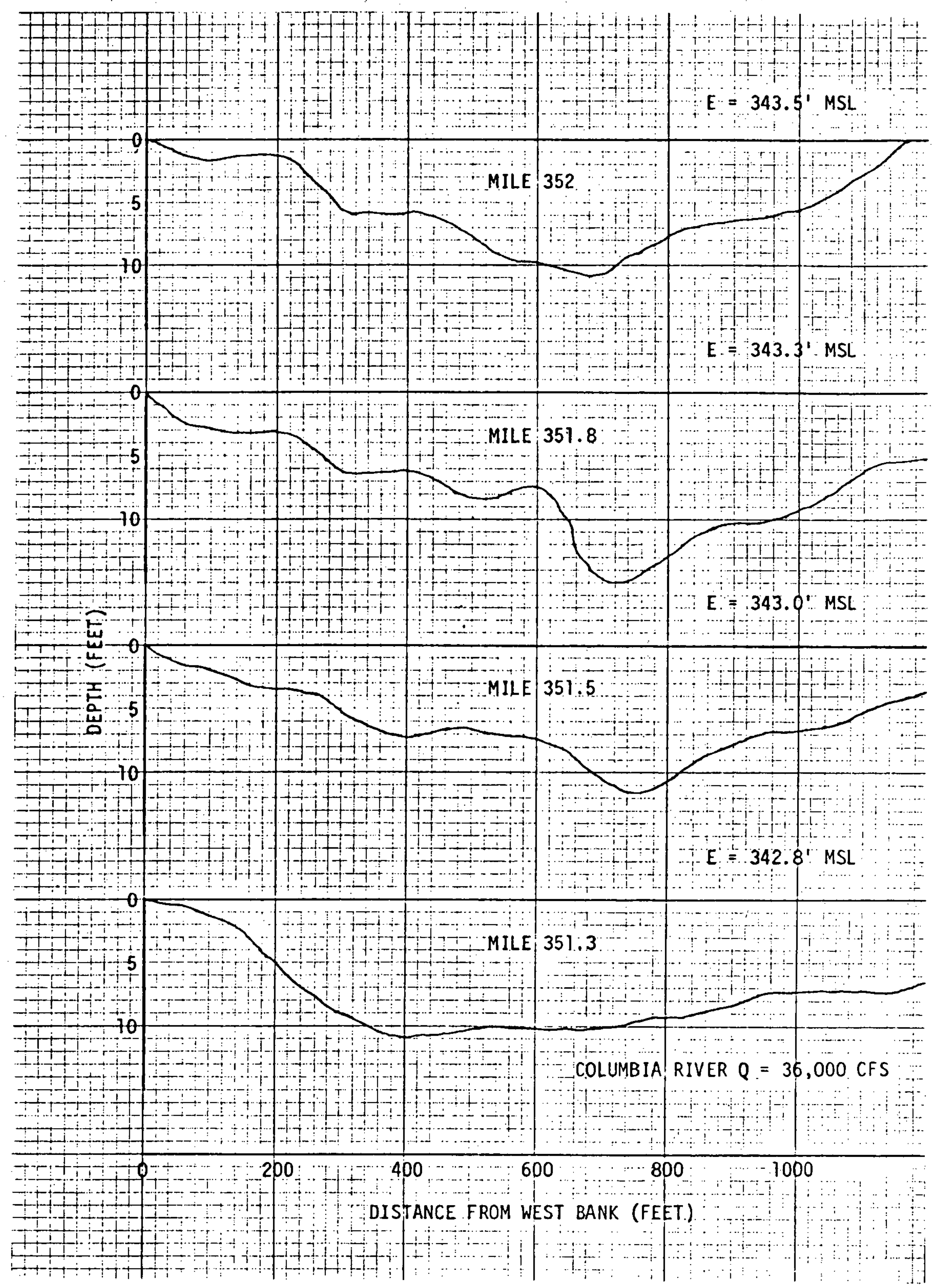


Fig. II-9. Cross Sections of the Columbia River near the Hanford No. 2 Site. From Applicants' Environmental Report, Amendment 2.

Clark and Snyder[21] have characterized the populations of zooplankton for the lower Columbia River and reported that the seasonal occurrence and abundance of specific species was similar to those populations collected in McNary Reservoir (River Mile 292).[22] The largest numbers of zooplankton occurred in September, with a low abundance in winter, which increased in early spring with small peaks in May and July. Cyclopoids copepods and the cladocera Bosmina were the two most abundant zooplankters, with other dominant forms Calanoids, Daphnia and Ceriodaphnia.[23] Although there is no characterization of zooplankton for the section of the river adjacent to the Hanford No. 2 Site, similar species composition would be expected to occur in this reach of the river.

A survey of the benthic organisms in the riffle areas of the river shows insect larvae and molluscs to be the most abundant fauna.[19] Caddisflies, mayflies, and diptera are the major insects present in the benthos. Other benthic organisms which reside in the Hanford reach are shown in Appendix B. In the riffles, the density of benthos ranges from 1.5 to 3.5 grams per square foot.[19] Comparative measurements, using artifical substrates, indicate that the density of benthos in deeper water was about one-half that of the riffles.[19]

Anadromous species of fish in the Hanford reach of the Columbia River are chinook salmon (Oncorhynchus tshawytscha), coho salmon (O. kisutch), sockeye salmon (O. nerka), steelhead trout (Salmo gairdneri gairdneri), American shad (Alosa sapidissima), white sturgeon (Acipenser transmontanus), and Pacific lamprey (Lampetra tridentata). All of the salmonids have similar life cycles, but each species and race matures at a different rate, with differences in the timing and duration of the life stages and activities; i.e., spawning and incubation, rearing, juvenile migration, growth at sea, and adult migration.

Dam construction has caused the majority of spawning grounds of the Columbia River to be inundated, with a reach approximately 50 miles downstream from Priest Rapids Dam the only remaining unimpounded water. This restriction on spawning areas has necessitated artificial recruitment to the stocks, in order to maintain the current populations of salmonids. At present, it has been estimated that about one-half of the fall chinook and the greater portions of the coho salmon populations of the Columbia represent hatchery stock.[28] The Washington State Department of Fisheries and Department of Game operate rearing impoundments and raceways for fall chinook, coho and steelhead trout at Ringold Springs (∿river mile 355), immediately upstream of the proposed Hanford No. 2 site. In 1967, the Department of Fisheries released approximately 322,000 coho and 1,800,000 fall chinook salmon from these facilities.[29] The Department of Game has annually released about 145,000 steelhead smolts all the past five years, with the total annual releases upstream of the proposed site about 700,000.[30]

Maximum numbers of adult salmonid species found to migrate through the Hanford reach and over Priest Rapids Dam approach 67,000 chinook, 170,000 sockeye, 11,900 coho salmon, and 13,000 steelhead trout. The abundance of migrating adult anadromous fish is shown in Table II-9. Although adult salmonid movement through the Hanford reach of the river occurs throughout the year, the greatest numbers pass during spring and late summer-early fall. Studies on the routes of migration through this stretch of the river indicate the preference for the east-northeast bank (across the river from the Hanford No. 2 intake), a pattern which persists from Priest Rapids Dam downstream to Richland.[23]

TABLE II-9. Adult Anadromous Fish Passage at Priest Rapids Dam and Estimated Chinook Salmon Spawning Near Hanford - 1966-1970

Species	1966	1967	1968	1969	1970
Chinook salmon*	66,915	48,918	48,314	40,786	43,934
Sockeye salmon*	170,071	123,786	108,308	39,240	77,422
Coho salmon*	11,903	8,879	13,212	1,351	4,971
Steelhead trout*	13,006	7,354	10,524	6,650	5,442
American shad*	716	239	300	3,440	7,163
Fall chinook** spawning near Hanford	21,707	22,869	24,920	31,556	26,775

*Priest Rapids Fish Passage Reports, Grant Co. PUD, Ephrata, Wash.
**Based on a conversion factor of 7 fish/redd.
From Applicants' Environmental Report.

The free flowing stretch of the Columbia River below Priest Rapids Dam, between river mile 393 and 354, is a major main stem spawning area for the fall run of chinook salmon. Spawning in this area usually extends from mid-October through the third week in November. A marked increase of spawners has been observed in this reach of the river; this is most likely related to displacement of fish due to inundation of previously productive areas. In recent years, the resident spawning chinook population has ranged from about 22,000 to 32,000 fish. This is about 18 percent of the fall chinook spawning escapement to the Columbia River, and nearly 40 percent of the fall run passing McNary Dam, the nearest dam downstream.[24] An estimated 10,000 steelhead trout also spawn in the Hanford reach of the river. In recent years, up to 360 salmon redds have been observed between river mile 349 and 354. In the area of Hanford No. 2, spawning activity is restricted to three redds at the lower end of an island adjacent to the site while there are approximately 85 redds at the upstream end. The closest spawning is approximately 3/4 mile from the proposed discharge structures. Spawning activity has not been observed in the shoreline area adjacent to the proposed plant structures or in the area which would be influenced by the effluent mixing plume.

Young salmon hatch during mid to late winter and emerge from the gravel in February and March. Plankton and various forms of aquatic insects entrained in the stream drift are the major food source for juvenile salmonids. In a recent study,[25] it was reported that aquatic insects form a major part of the diet of chinook fry in the Hanford reach of the Columbia River and of all salmonid species migrating through the lower Columbia River in spring and fall, whereas zooplankton were of major importance in the lower river from July through October. In Becker's[25] two-year study, he observed that during the months of March through July, over 95 percent of the diet of juvenile salmon consisted of various forms of insects, with the order Diptera comprising approximately 80 percent of insects utilized. Larval and adult Tendipedidae were the major food component of both the fry and juvenile chinook salmon. Cladocera and Copepoda were also utilized, but these crustacea comprised less than 0.3 percent of the total diet during the period under study.

The timing and numbers of juvenile salmon and steelhead trout passing the upstream Priest Rapids Dam during the period 1965-1967 are shown in Table II-10. The peak emigration of all juvenile salmonid in the lower Columbia River, including those produced in the Hanford reach, occurs during mid-April to mid-June. However, the outmigration of salmonid produced in areas upstream of Priest Rapids Dam has in the past been delayed apparently by the reservoir complex. During 1965-1967, approximately 40-60 percent of the juveniles migrated past Priest Rapids Dam in August.[26] Studies

TABLE II-10. Timing and Estimated Numbers of Juvenile Salmonids Passing Priest Rapids Dam, 1965-1967

	Sockeye		Chinook		Coho		Steelhead	
Year	Timing	Est. Numbers (millions)	Timing	Est. Numbers (millions)	Timing	Est. Numbers (millions)	Timing	Est. Numbers (millions)
1965	Early May	2.63	Early Aug.	1.62	Mid May	0.22	Mid May	0.27
1966	Early May	4.10	Early Aug.	1.35	Mid May	1.17	Mid May	0.24
1967	Early May	0.95	Early Aug.	2.07	Mid May	1.17	Mid May	0.26

From Applicant's Environmental Report.

on the distribution and movement of juveniles indicate that the smaller fish migrate closer to shore (50-60 percent of the catch per unit effort occurred within several hundred feet of the shoreline), with a preference for a surface zone, while some large fish and selected species are found more evenly distributed throughout the river and in midchannel.[27] Migration occurs during all periods of the day, but the heaviest movement occurs at night.

While the salmonid are the major species of concern, more than 30 other species of fish have been identified in the Hanford reach of the Columbia River. The other resident fish in the Hanford reach of the river are shown in Appendix B.

REFERENCES

1. Discussions between Washington Public Power Supply System and the Richland Operations Office of the AEC, August 5, 1971, cited in the Applicant's Environmental Report, References, Section 2.3.1.

2. Rand McNally Road Atlas, United States, Canada & Mexico, 48th edition, 1972.

3. Rand McNally Commercial Atlas and Marketing Guide, 1971.

4. Letter from T. A. Nemzek, AEC, to J. J. Stein, Washington Public Power Supply System, December 15, 1971.

5. Letter from G. W. Hokanson, Area Extension Agent, Franklin County Cooperative Extension Service, to Markheim, Argonne National Laboratory, March 16, 1972.

6. Seattle Sectional Aeronautical Chart, and L-9 Enroute Low Altitude Chart.

7. National Register of Historic Places, Dept. of the Interior, National Park Service, Federal Register, Vol. 36, No. 35, February 20, 1971.

8. Site Certification Agreement between the State of Washington and the Washington Public Power Supply System for Hanford No. 2 Nuclear Electric Generating Facility, Benton County, Washington, May 17, 1972, p.13.

9. Applicant's Environmental Report, Amendment 1, Section 2.3.2.1, p. 2.

10. R. T. Jaske and M. O. Synoground, "Effect on Hanford Plant Operations of the Temperature of the Columbia River, 1964 to Present," BNWL-1345, Pacific Northwest Laboratories, November 1970.

11. Applicant's Environmental Report, Amendment 1, Section 2.3.2.1, p. 4.

12. T. P. O'Farrell et al., "Wildfire, An Important Natural Modulation of the Desert-Steppe," in BNWL-1550, Pacific Northwest Laboratories, Richland, Washington, Vol. 1, p. 1.1, 1971.

13. Applicant's Environmental Report, Amendment 2, Question 9.

14. W. H. Rickard and R. L. Uhler, "Ground Dwelling Beetles in Abandoned Agricultural Fields," in BNWL-1050, Pacific Northwest Laboratories, Richland, Washington, Vol. 1, p. 1.33, 1969.

15. Applicant's Environmental Report, Amendment 2, Questions 9 and 15.

16. "Endangered Species of the United States," Dept. of Interior, Bureau of Sport Fisheries and Wildlife, U. S. Fish and Wildlife Service, 1970.

17. Applicant's Environmental Report, Section 2.3.6.1, p. 2.

18. W. C. Hanson, "Population Dynamics of Hanford Wildfowl," in BNWL-1306, Pacific Northwest Laboratories I(2) pp. 2.28-2.29, 1970.

19. Applicant's Environmental Report, Amendment 2, Question 15.

20. B. B. Owens, "Columbia River Periphyton Communities under Thermal Stress," in BNWL-1550, Pacific Northwest Laboratories, pp. 2.19-2.20, March 1971.

21. S. M. Clark and G. R. Snyder, "Limnological Study of Lower Columbia River, 1967-1968," U. S. Fish and Wildlife Service Special Scientific Report, Fisheries No. 610, 1970.

22. J. F. Scarola, "Cladocera and Copepoda in McNary Reservoir, 1965-1966," Northwest Sci. 42, 112-114, 1968.

23. W. L. Templeton and C. C. Coutant, "Studies on the Biological Effects of Thermal Discharges from the Nuclear Reactors to the Columbia River at Hanford," in Environmental Aspects of Nuclear Power Stations, IAEA-SM-146/33, pp. 591-612, 1971.

24. Applicant's Environmental Report, Section 2.3.6.1, p. 10.

25. C. D. Becker, "Food and Feeding of Juvenile Chinook Salmon in the Central Columbia River in Relation to Thermal Discharges and Other Environmental Features," BNWL-1528, Pacific Northwest Laboratories, Richland, Washington, 1971.

26. Applicant's Environmental Report, Section 2.3.6.1, p. 12.

27. E. M. Mains and J. M. Smith, "The Distribution, Size, Time and Current Preferences of Seaward Migrant Chinook Salmon in the Columbia and Snake Rivers," Washington Department of Fisheries Research Papers 2:3, pp. 5-43, (1964).

28. Agee, U. L. & Zeller, R. W.: "Environmental Considerations Affecting Nuclear Power Plants in the Pacific Northwest."

29. Salo, E. O. & Nakatani, R. E., in hearings on Application TPPSEC 71-1 before State of Washington Thermal Power Plant Site Evaluation Council, Exhibit 26.

30. Testimony of D. R. Eldred, Department of Game, in hearings on Application TPPSEC 71-1 before State of Washington Thermal Power Plant Site Evaluation Council, Exhibit 62.

III. THE PLANT

A. EXTERNAL APPEARANCE

A plot plan of the Hanford No. 2 site is shown in Figure III-1 and an architectural rendition of the principal site structures in Figure III-2. The major buildings will be clustered into a contiguous set, with the cooling towers approximately 600 feet to the south. The tallest structure is the 220-foot-high reactor building. Other major structures include a 140-foot-high turbine-generator building and lower buildings containing the reactor control console, process computer, critical switchgear, heating and ventilating equipment, and facilities for processing radioactive liquids and gases.

The applicant states that all of the buildings will be constructed and colored to be consistent with the aesthetic standards previously established during construction of Hanford No. 1; and that the landscaping, like the buildings, will serve both a functional and an aesthetic purpose.[1]

The auxiliary pump houses and two spray ponds for emergency cooling will be located southeast of the main building area.

The site will be graded and appropriate grasses, shrubs and trees will be planted where required to control grass fires and erosion and where appropriate to the enhancement of the outward appearance of the plant.[1]

The applicant proposes to provide a visitors' information center. Access to the center, however, will be only by means of passes issued at the applicant's headquarters in Richland.

B. REACTOR AND STEAM-ELECTRIC SYSTEM

The nuclear steam supply system (NSSS) will consist of a forced-circulation boiling-water reactor and the auxiliary equipment required to control, contain, and service the nuclear core. The NSSS will be furnished by the General Electric Company. The normal reactor power output will be 3323 MWt with a stretch level of 3458 MWt and a gross electrical output of 1150 MWe. Burns and Roe, Inc., have been retained to provide engineering, management, and quality assurance services for the design and construction.

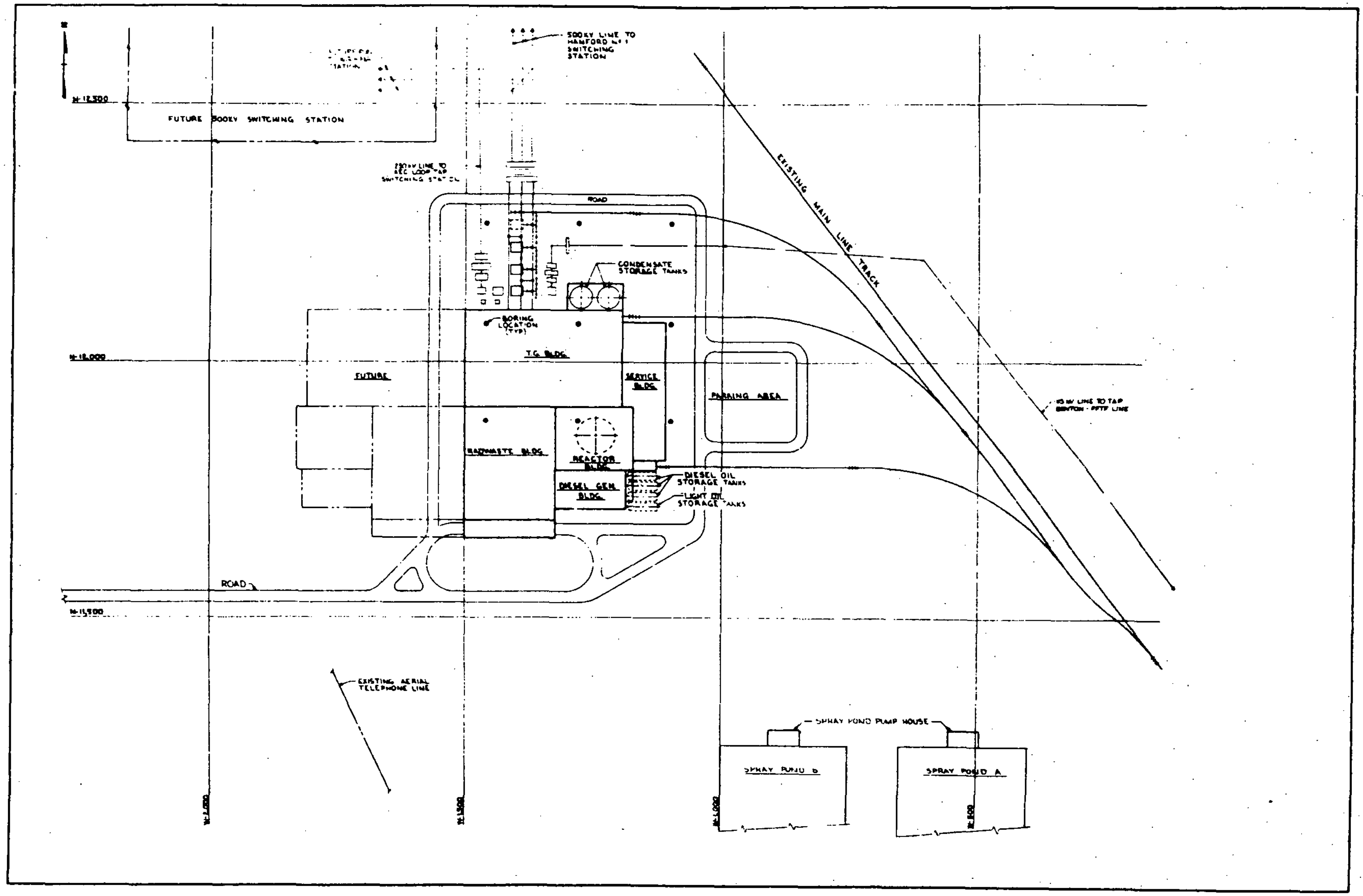


Fig. III-1. Plot Plan of the Hanford No. 2 Plant. Cooling Towers (not shown) are to the South. From Preliminary Safety Analysis Report, Amendment 1, Section I-4.

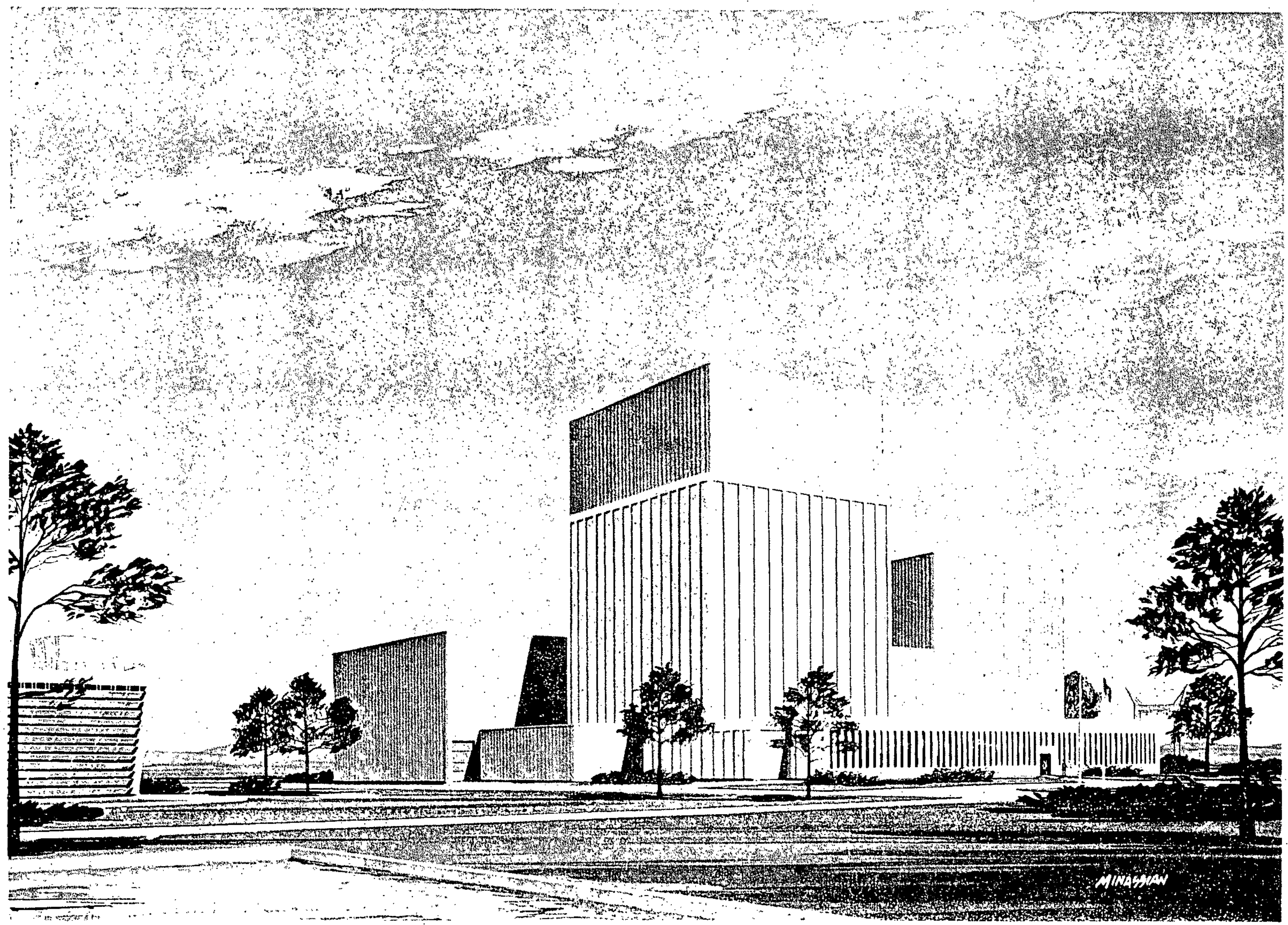


Fig. III-2. Artist's Concept of the Principal Structures of the Hanford No. 2 Plant. From Applicants' Environmental Report, Amendment 1, Section 2.3.9.

The proposed Hanford No. 2 reactor is similar to other large boiling-water reactors under construction and in operation. The core consists of structural components, approximately 764 fuel assemblies, and 185 control rods. The steam generated in the reactor is directed to a turbine where the heat energy is converted to mechanical energy, which in turn is converted to electrical energy by the generator.

The reactor-turbine system will use the Rankine steam cycle with a closed, regenerative feedwater heating cycle. Steam leaves the reactor vessel at 1020 psia and enters the turbine at 970 psia at the rate of approximately 14,295,000 pounds per hour. The turbine-generator will be supplied by the Westinghouse Electric Corporation.

C. EFFLUENT SYSTEMS

1. Heat

The cooling system is designed for a total waste-heat discharge of 2309 MW, or 7.88×10^9 Btu per hour. Cooling water requirements for the turbine condensers are 550,000 gpm, with a temperature rise of 28.7°F. The design pressure of the turbine exhaust to the condenser is an average of 2.5 inches of mercury.

The waste heat is dissipated by means of mechanical-draft cooling towers. (A cooling tower utilizes the evaporation of a small percentage of the condenser coolant water, plus some transfer of sensible heat to the cooling tower air, to dissipate heat from the warm water coming from the condenser.) The design values of the cooling towers are:

Wet-bulb temperature	60°F
Approach to wet bulb	16°F
Range	29°F
Cold-side temperature	76°F

This means that water at about 76°F enters the condensers where it is heated about 29° to about 105°F. The hot water goes to the cooling tower where, in air with a wet-bulb temperature of 60°, it will be cooled back to 76°, which is within 16° of the wet-bulb temperature. The 76° water then returns to the condenser and the circuit is repeated.

Although the individual towers are designed for 60° wet-bulb temperatures, engineers must provide for plant operation at less favorable conditions, so a conservative worst-case value of 70°F wet-bulb temperature was chosen for plant capacity design calculations. This seems reasonable in terms of data published by the Marley Co.,[3] a large designer of cooling towers, which show that the temperature and humidity conditions for the Richland area are such that a wet-bulb temperature higher than 66°F would not prevail more than 10% of the time and one higher than 71° not more than 1% of the time.

The cooling towers will be arranged in two banks of approximately twenty cells each, with fan stack tops about 60 feet off the ground and exit velocities of about 30 fps.

In addition to water lost by evaporation and drift, water is discharged from the system by blowdown of cooled water to the river. This blowdown is needed to limit the concentration of naturally occurring river salts in the cooling water as a result of evaporation. The design values used for blowdown are based on a dissolved solids concentration factor of about five in the cooling tower-condenser water as compared to river water.

Because of evaporation, drift, and blowdown, some makeup water is needed. This is taken from the Columbia River through three 50% capacity pumps, located in a pumphouse on the river. It should be noted that blowdown water does not constitute consumptive use, as it is returned to the river. Therefore, not all the makeup water use is consumptive use.

The nominal blowdown rates calculated for normal operation will vary from about 1500 to 3700 gpm. A higher rate, i.e., up to 6500 gpm, may be needed on occasion to lower the concentration of dissolved solids in the recirculating water system. The maximum makeup rate for blowdown and losses is 23,000 gpm; the capacity of the pumping system is 25,000 gpm.

Nominal expected values of evaporation plus blowdown plus drift rates, evaporation rates, blowdown temperatures, normal river temperatures, and blowdown rates are given in Figure III-3, as a function of time of year.[4] These curves each give an expected average over the month. Actually, a range of values above and below the curves would represent conditions from expected maximum to expected minimum. For example, the blowdown water temperature is shown to be about 74°F in July. In July the range on blowdown temperature extends about 8°F above the average, to a maximum of 82°F. This is the maximum temperature expected at which water would be returned to the river. This maximum value is based on the assumption that heat transferred in the cooling towers is entirely by evaporation, with no transfer of sensible heat from the warm water, since in summer the ambient air dry-bulb temperature could be high.

The following table gives both maximum nominal values and annual average values. Consumptive use is evaporation plus drift. Required makeup is evaporation plus drift plus blowdown.

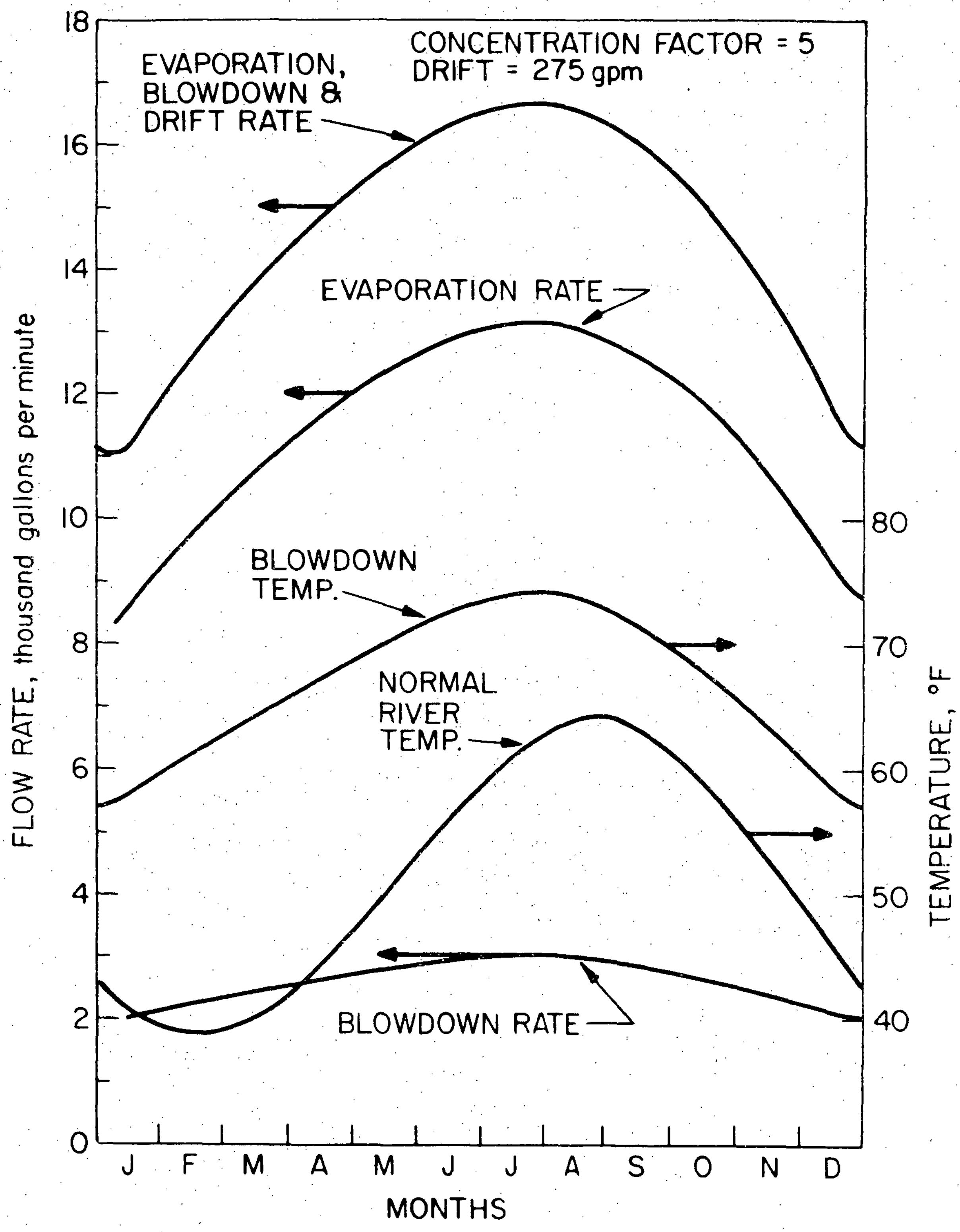


Fig. III-3. Monthly Average Rates and Temperatures. From Exhibit 54, Applicant's "Application for Washington State Site Certification" in hearings before Washington State Thermal Power Plant Site Evaluation Council, Application 71-1, January 1972.

	Maximum Values, gpm	Annual Average Values, gpm
Evaporation	16,225	11,383
Drift	275	275
Consumptive use	16,500	11,658
Blowdown	6,500	2,575
Required makeup	23,000	14,233

It can be noted that the annual average consumptive use is about 26 cfs. The minimum licensed flow of the river is 36,000 cfs.

The greatest temperature excess of blowdown water over river water is expected to be about 25°F, occurring in February. At ultimate maximum blowdown flow of 6500 gpm this represents about 24 MW of heat returned to the river, or about one percent of the heat removed from the turbine condenser. After complete mixing, this would raise the average river water temperature by about 0.01°F at the minimum river flow of 36,000 cfs.

The values of condenser flow, evaporation, blowdown, and drift given here are within the state of the art of present-day cooling tower design, as shown by some published values.[5] Typical average values for a 1000-MWe nuclear plant with a condenser cooling tower range of 25°F are a cooling tower water flow of 540,000 gpm, a drift of 162 gpm, evaporation of 10,125 gpm, and, for a concentration factor of five, a bleed or blowdown flow of 2538 gpm.

When the blowdown is discharged to the river, the water temperature will be increased above the the temperature of the river in an area near the discharge. Calculations of the area, shape, and temperature of this thermal plume in the river have been prepared by the applicant on the following basis:

Flow (blowdown)	6,500 gpm (~15 cfs)
Temperature differential	22°F
Discharge velocity	7 feet per second
River flows	36,000 cfs (low) 90,000 cfs (mean for control period)

The horizontal distribution of the warm-water zones in the thermal plume are shown schematically in Figures III-4 and III-5. Shown are the horizontal planes of the warmed zones for river flows of 90,000 cfs and 36,000 cfs. Isotherms were calculated for 2.5, 0.5, and 0.05°F. Vertical temperature distributions in the thermal plumes are shown in Figures III-6 and III-7.

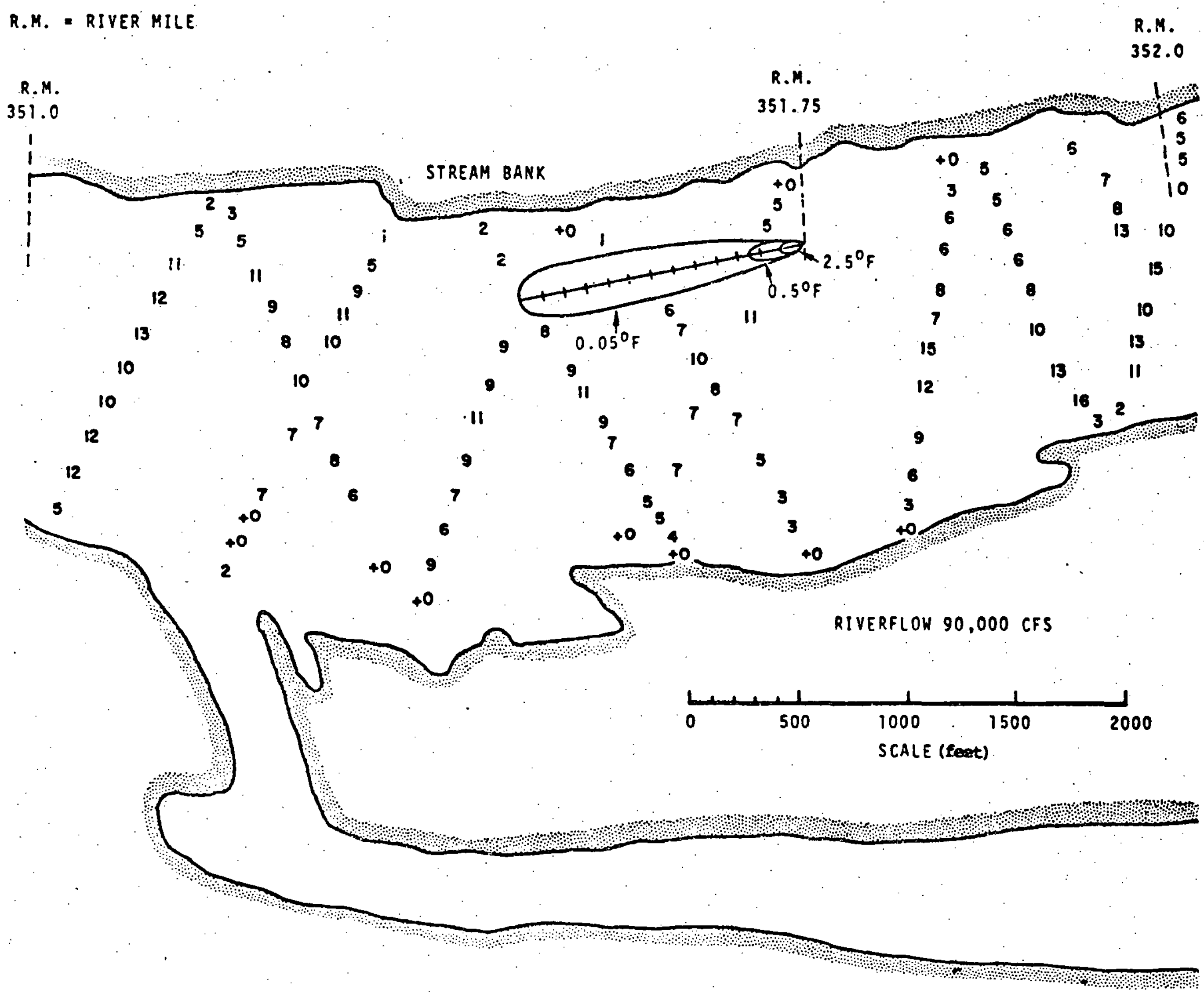


Fig. III-4. Plan View of Mixing Zone of Cooling Tower Blowdown Water. River Flow 90,000 cfs. From Applicants' Environmental Report, Amendment 2, Section 2.3.6.1.

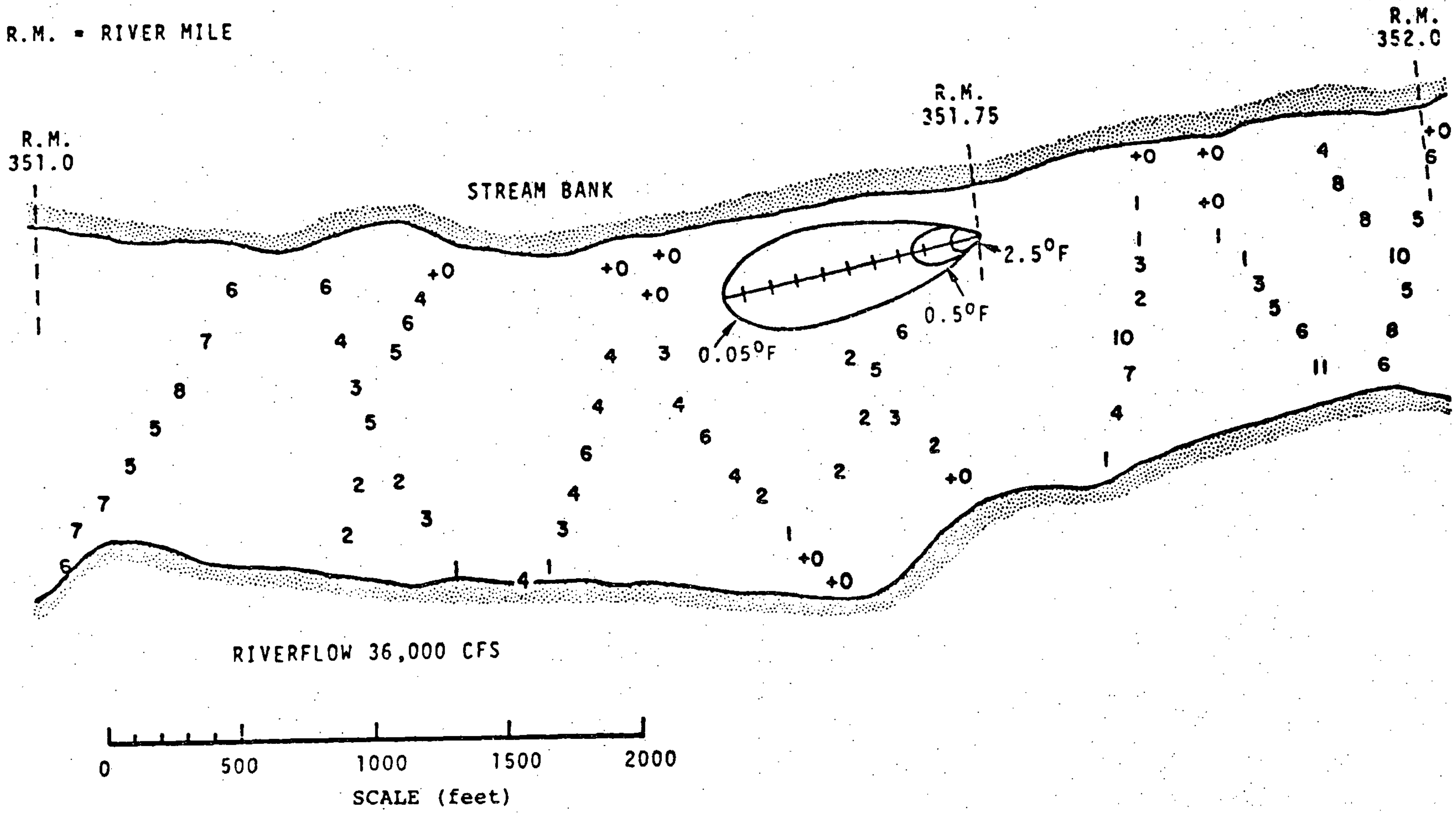


Fig. III-5. Plan View of Mixing Zone of Cooling Tower Blowdown Water. River Flow 36,000 cfs. From Applicants' Environmental Report, Amendment 2, Section 2.3.6.1.

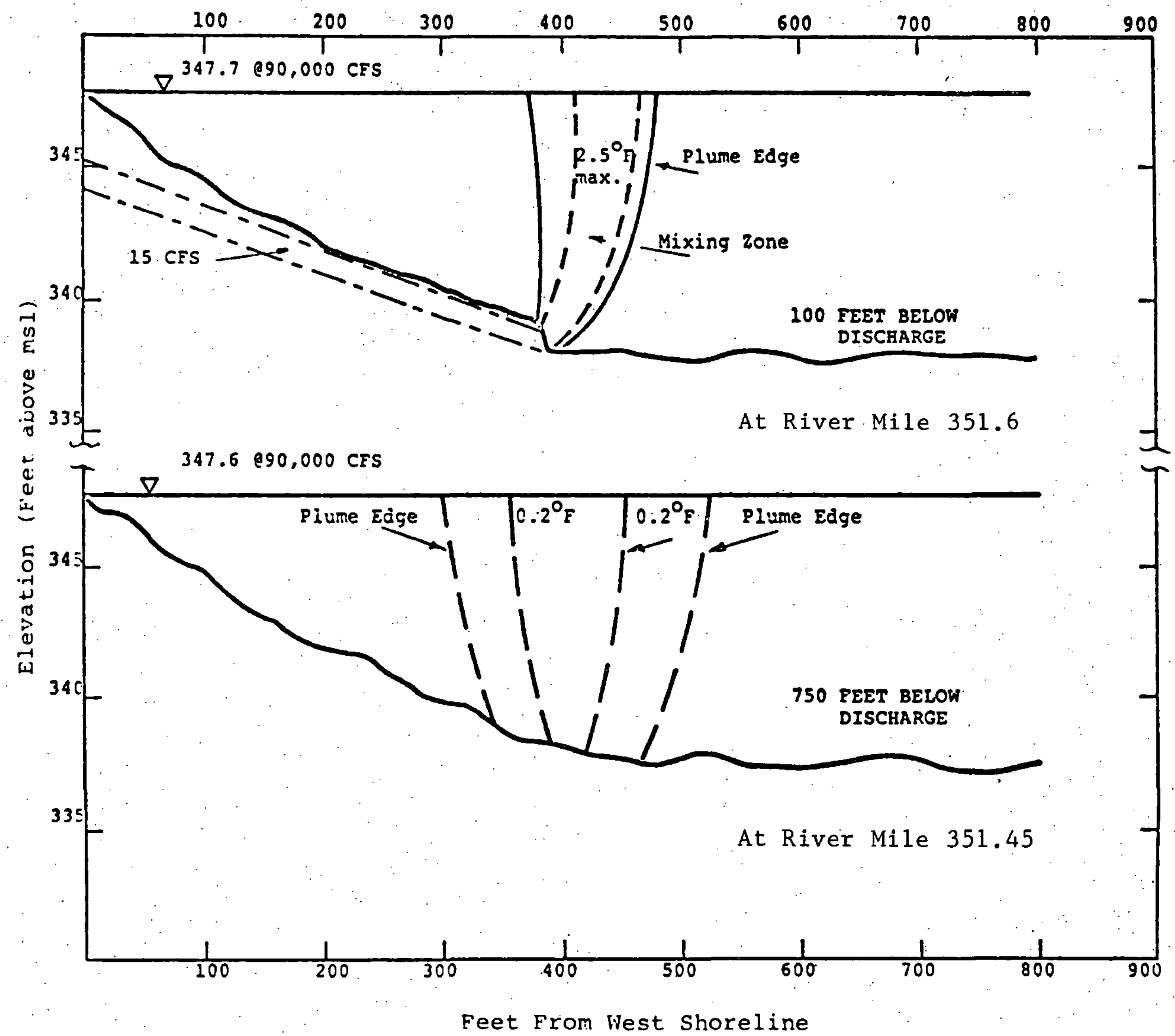


Fig. III-6. Transects of Mixing Zone of Cooling Tower Blowdown Water. River Flow 90,000 cfs. From Applicants' Environmental Report, Amendment 2, Section 2.3.6.1.

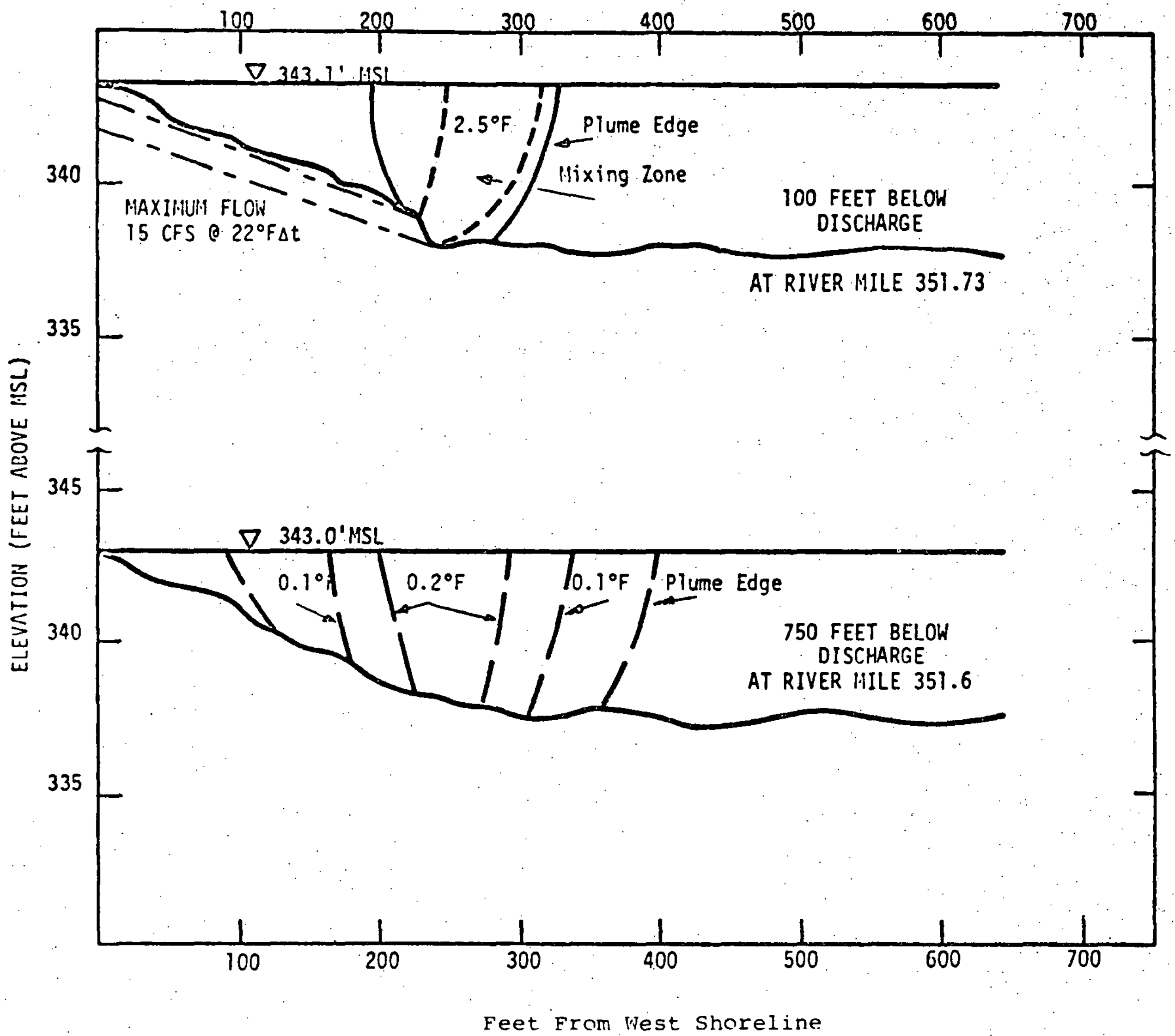


Fig. III-7. Transects of Mixing Zone of Cooling Tower Blowdown Water. River Flow 36,000 cfs. From Applicants' Environmental Report, Amendment 2, Section 2.3.6.1.

Makeup water will be drawn from the Columbia River, using an infiltration technique shown in preliminary outline in Figure III-8. The principal elements are as follows:

(a) A filter bed along the shore, underlain by perforated collecting pipes.

(b) Nonperforated standard pipes extending from the filter bed area approximately 400 feet to a pump structure, located at the high water bank of the river, well inland from the normal river bank.

(c) A structure which will contain only the pumps, associated electrical equipment, and surge protection devices for the makeup water pipeline. There will be no water screens, since the filter bed will prevent all debris and fish from entering the system.

(d) A backflush system to clear the intake system if it should become clogged.

Optimization studies presently underway may result in changes in the details described here, particularly with respect to the filter bed design. A river bottom filter will also be evaluated. The filter bed concept will be retained, however, and any modifications should not change the environmental impact of the plant. The average intake velocity into the filter bed is expected to be less than 0.02 fps.

The outfall structure is much simpler than the intake structure and its approximate location is shown in Figure III-8. It consists of an 18-inch diameter pipe, buried in a common trench with the makeup water piping. This pipe leads from the cold-water side of the cooling towers to the river south (downstream) of the makeup water intake. The intake and outfall are both near the pumphouse, about 3-1/2 miles from the plant. The outfall flow will be (a) nominal, 2000 to 3600 gpm; (b) ultimate maximum, 6500 gpm. A flow of 6500 gpm from an 18-inch pipe has an exit velocity of 7 feet per second.

The outfall structure for the blowdown stream will consist of a single port, 18-inch discharge with the point of release located 280 feet from the shoreline at licensed minimum river flow of 36,000 cfs. The location of the discharge is river mile 351.7 ±0.05, the exact location to be determined following final design survey results. Cross-sectional profiles of the river in the vicinity of the intake and outfall structures are shown in Figure II-9.

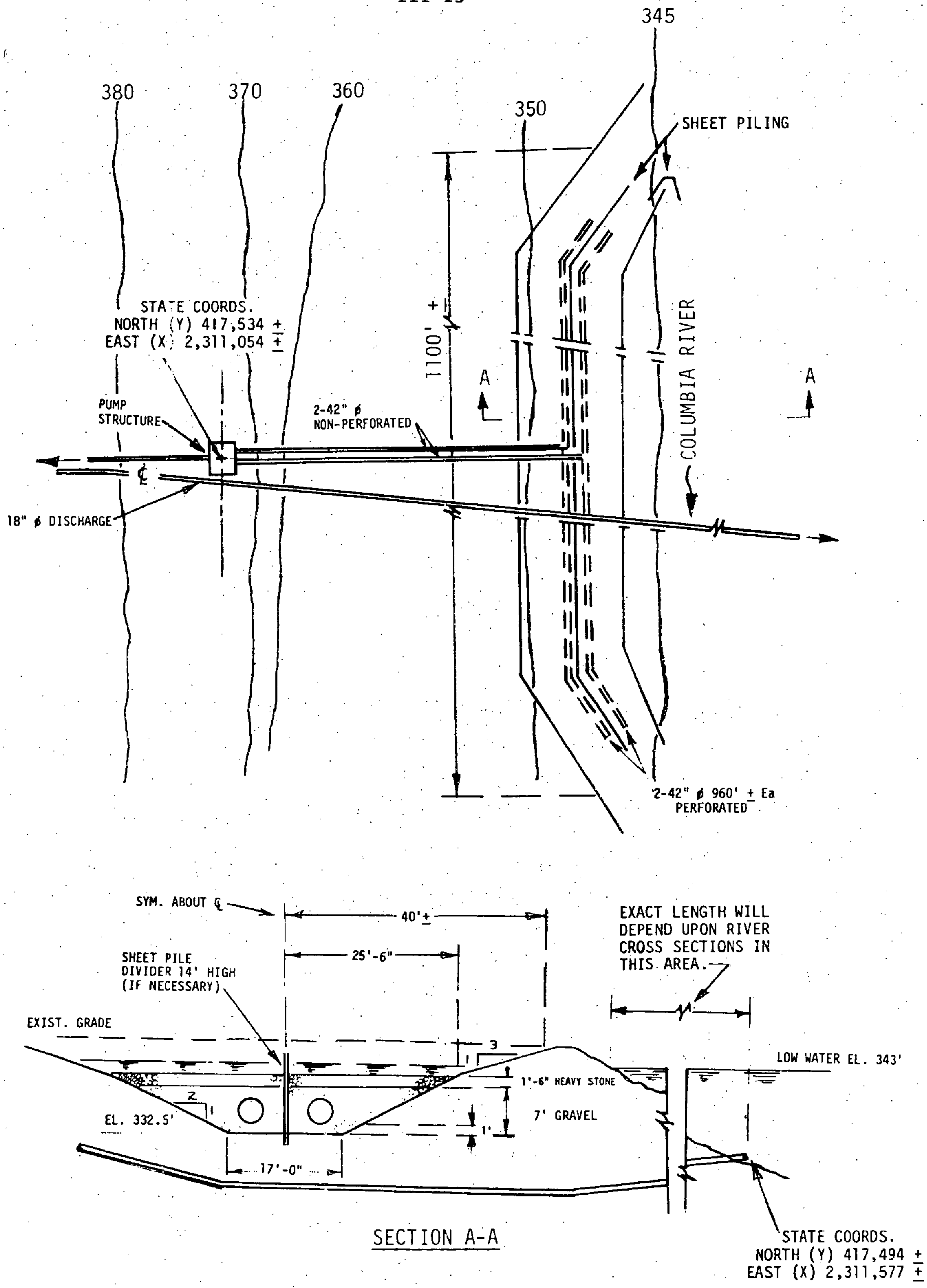


Fig. III-8. Infiltration and Discharge System. From Applicant's Environmental Report, Amendment 1, Section 2.3.6.4.

The discharge of the effluent stream will be perpendicular to the current flow and directed upward at an angle of 15° above the horizontal at the point where the pipe touches the stream bottom. The discharge velocity of roughly 7 fps, or below, is less than the river velocity during the freshet, and no bottom displacement is expected beyond five feet from the pipe's end.

The maximum stretched thermal power level estimated to be reached over the life of the plant will be 3458 MWt, an increase of 6.5% over the initial plant rating. Under these conditions the cooling system will remove a total waste heat discharge of 6.5% more than 7.88×10^9 Btu per hour, or a total of 8.39×10^9 Btu per hour. The thermal impact, however, was evaluated based on a blowdown of 6500 gpm. This maximum possible blowdown is much greater than the normal blowdown range of 2000 to 3600 gpm, and therefore most probably would remain unchanged under the stretched operating conditions. If this 6500-gpm maximum blowdown is not changed, then the impact evaluation remains valid, since the water temperature on the cold side of the cooling tower, which is ambient wet bulb plus approach to wet bulb, will not be appreciably increased by operating at a slightly increased power level.

2. Radioactive Waste Systems

During the operation of the Hanford No. 2 Nuclear Power Plant, radioactive material will be produced by fission and by neutron activation reactions of metals and other material in the reactor cooling system. Small amounts of gaseous and liquid radioactive wastes will enter the effluent streams and then be processed within the plant to minimize the radioactive nuclides that will ultimately be released to the atmosphere and into the Columbia River under controlled and monitored conditions. The radioactivity that may be released during operation of the station will be in accordance with the Commission's regulations, as set forth in 10 CFR Part 20 and 10 CFR Part 50.

The waste handling and treatment systems to be installed at the station are discussed in the Preliminary Safety Analysis Report and in the applicant's Environmental Report, both dated August 1971.

a. Liquid Waste

Liquid wastes which may be subject to possible radioactive contamination will be collected in the liquid radwaste system where they will be monitored, stored, and processed for reuse or for discharge to the cooling tower blowdown stream. The liquid radwaste system will be divided into several subsystems so that the liquid wastes from various sources can be kept segregated and processed separately. Cross connections between these subsystems will provide additional flexibility for processing of wastes by alternate methods. The interrelationships of these systems and their interaction with other components are shown in Figure III-9. The liquid radwastes will be classified, collected and treated as high purity, low purity, chemical, detergent, sludges or concentrated wastes. The terms "high purity" and "low purity" refer to the conductivity and not radioactivity. Table III-1 lists the principal assumptions used in evaluating the waste treatment systems.

High purity (low conductivity) liquid wastes will be collected in the waste collector tank, principally from the coolant piping and equipment drains, and processed through a filter and a mixed-bed demineralizer. After processing, the waste will be collected in a waste sample tank. Normally, it will be transferred from the sample tank to the condensate storage tank for reuse. However, on infrequent occasions a portion of this waste will be processed through a waste concentrator (10 gpm) and discharged to the cooling tower blowdown line. In our evaluation, the staff assumed that 10% of the annual volume would be evaporated and released and the remaining 90% would be recycled.

Low purity (high conductivity) liquid wastes will be collected in the floor drain collector tank, principally from the various floor drain sumps. From the floor drain tank the wastes will be processed through a precoat type filter and a mixed-bed demineralizer and collected in a sample tank. Normally, these wastes will be routed to the condensate storage tanks for reuse. However, some of these wastes may be routed to the chemical waste tanks for processing through the waste concentrator before discharge.

The staff analysis considered a daily input into the low purity system of 8300 gallons, at an activity equivalent to 35% of primary coolant, and that 15% of this waste will be evaporated prior to being released to the circulating water discharge canal. The remaining 85% of this waste was assumed to be recycled.

Radioactive high-conductivity chemical wastes from sampling, laboratory drains, and chemical decontamination solutions will be collected in the chemical waste tanks. These chemical wastes are of such high conductivity as to preclude treatment by ion exchange and will be neutralized and processed through the waste concentrator. The condensate will be routed to distillate tanks from where it will be released to the circulating water discharge.

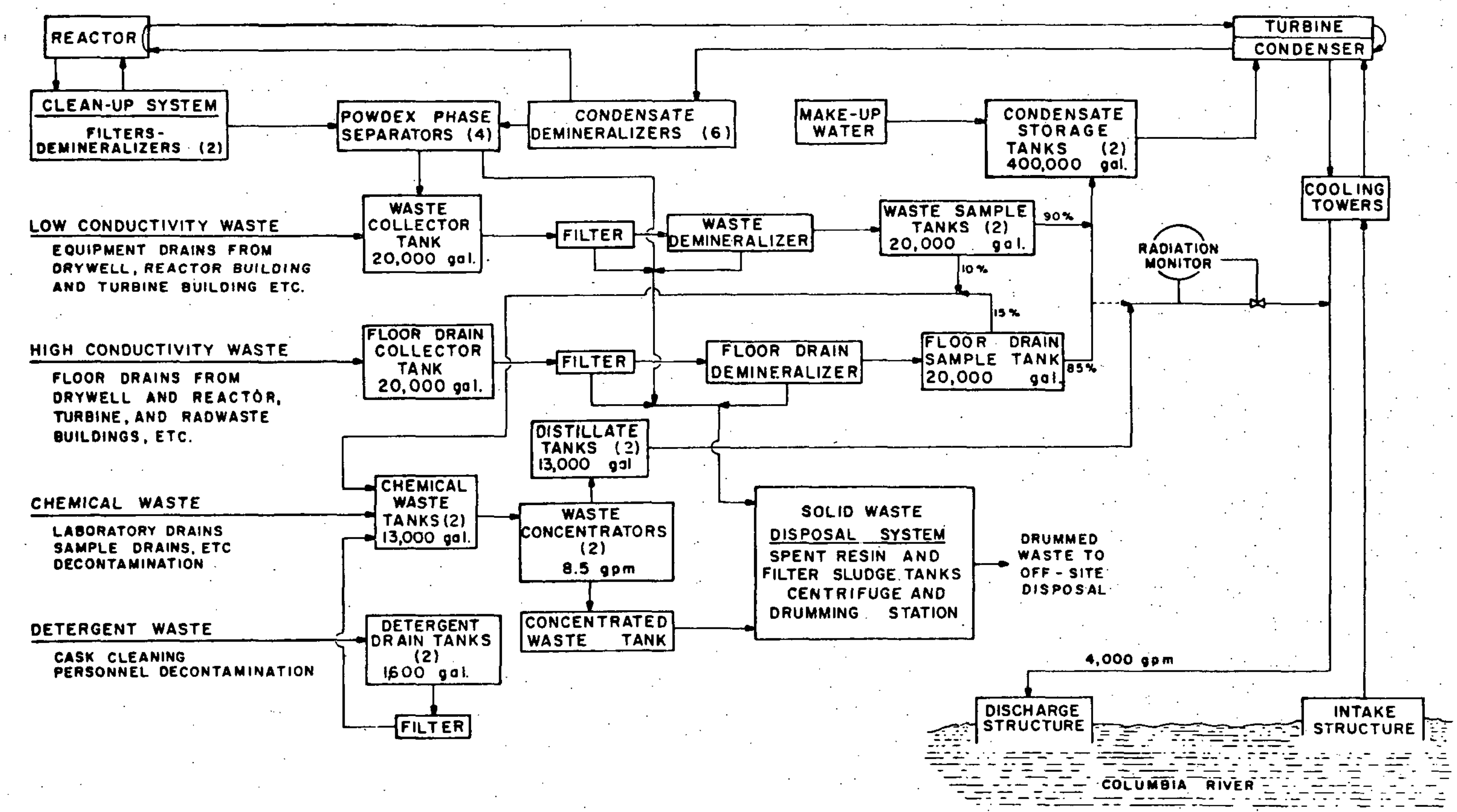


Fig. III-9 LIQUID RADIOACTIVE WASTE SYSTEM FLOW
HANFORD NO. 2

TABLE III-1. Principal Assumptions used in Evaluation of Hanford No. 2 Reactor

1.	Thermal power	3,458 MWt		
2.	Plant factor	0.8		
3.	Failed fuel	Equivalent to 100,000 μCi per second noble gas mixture after 30 minutes holdup decay for a 3400-MWt reactor		
4.	Reactor building leak rate	480 pounds per hour - liquid		
5.	Turbine building leak rate	480 pounds per hour - steam		
6.	Condenser air inleakage	40 cfm - air		
7.	Partition coefficients (for iodine):			
	Steam/liquid in reactor vessel	0.012		
	Reactor building liquid leak	0.001		
	Turbine building steam leak	1.0		
	Air ejector	0.005		
	Recombiner system	0.1		
	Charcoal bed	0.000001		
8.	Holdup times			
	Air ejector gas	10 minutes		
	Xenon isotopes - delay on charcoal beds	17.9 days		
	Krypton isotopes - delay on charcoal beds	24.4 hours		
9.	Decontamination factors:	Anion	Cs,Rb	Others
	Mixed-bed demineralizer	100	10	100
	Evaporator	1,000	10,000	10,000
10.	Removal factors:			
	Mo & Tc	100		
	Y	10		

The staff analysis considered a daily input to this system of 4300 gallons, including 10% of the equipment drain and 15% of the floor drain waste volumes, and that 100% of the condensate will be released to the circulating water discharge.

Liquid wastes containing detergents or similar cleaning agents from fuel-cask cleaning and personnel decontamination will be collected in a detergent drain tank. Processing will consist of passing the waste through the detergent drain filter to remove solids and concentrating it in one of the two waste concentrators. In the staff evaluation, the potential effluents from the detergent system were considered to be a small fraction of the waste from the other systems and were not analyzed separately.

Annual releases of fission product radionuclides from Hanford No. 2 were calculated based on reactor operation at 3458 MWt (maximum power) for 292 full-power days. Corrosion product activities were based on operating experience with boiling water reactors. The applicant expects the normal cooling tower blowdown flow to be 3671 gpm. The staff accepted this dilution flow estimate; and, therefore, rather than total curies released, the annual average concentration of radioactive material in the liquid effluents prior to dilution will be the limiting constraint for the annual liquid waste discharges. Based on the assumptions shown in Table III-1, the annual releases of radioactive materials in the liquid wastes were calculated to be a very small fraction of those shown in Table III-2 (excluding tritium). However, to include compensation for treatment equipment downtime and expected operational occurrences, the values shown in Table III-2 have been normalized to 0.25 Ci per year. This value will limit the annual concentration in the discharge canal to less than 4×10^{-8} μCi per ml. Based on its evaluation, the staff estimates that about 10 curies per year of tritium will be released to the environment. The applicant estimates that 0.16 curies per year of mixed isotopes and 16 curies per year of tritium will be released to the environment in the liquid effluent.

b. Gaseous Waste

During power operation of the plant, radioactive materials released to the atmosphere in gaseous effluents include low concentrations of fission product noble gases (krypton and xenon), halogens (mostly iodines), tritium contained in water vapor, and particulate material including both fission products and activated corrosion products.

TABLE III-2. Calculated Normalized Annual Release of Radionuclides in the Liquid Effluent from Hanford No. 2

Nuclide	Curies	Nuclide	Curies
Rb-86	0.000045	I-133	0.015
Sr-89	0.0087	I-135	0.000044
Sr-90	0.00057	Cs-134	0.028
Sr-91	0.000031	Cs-136	0.0064
Y-90	0.00081	Cs-137	0.019
Y-91m	0.00002	Ba-137m	0.018
Y-91	0.016	Ba-140	0.012
Zr-95	0.0001	La-140	0.012
Nb-95	0.000096	Ce-141	0.00027
Mo-99	0.0014	Ce-143	0.000037
Tc-99m	0.0013	Ce-144	0.000063
Ru-103	0.000068	Pr-143	0.00011
Ru-106	0.000024	Pr-144	0.000063
Rh-103m	0.000068	Nd-147	0.000028
Rh-106	0.000024	Cr-51	0.0017
Te-127m	0.00002	Mn-54	0.00013
Te-127	0.000022	Fe-55	0.0067
Te-129m	0.00018	Fe-59	0.00027
Te-129	0.00011	Co-58	0.017
Te-131m	0.000028	Co-60	0.0017
Te-132	0.00095	P-32	0.000033
I-130	0.000019	W-187	0.000079
I-131	0.084	U-237	0.00002
I-132	0.00098	Np-239	0.00048
Total (excluding tritium)			~0.25 curie
Tritium			~10 curies per year

All releases less than 10^{-5} curies/year have not been listed.

The major source of gaseous waste activity during normal plant operation will be the offgas from the main steam condenser air ejector. Other sources of gaseous waste include turbine gland seal steam exhaust, offgases from the mechanical vacuum pump, ventilation air released from the radwaste, reactor, and turbine building exhaust systems, and purging of the drywell and suppression chamber. A schematic flow diagram of the gaseous waste treatment system is shown in Figure III-10.

Offgas from the main condenser air ejector will flow through one of two catalytic recombiners, where the hydrogen and oxygen recombine to form steam, which is condensed and returned for use in the plant. The waste gas stream will be sent to a holdup pipe, which will be designed to delay the full volume of waste gases for a period of at least 10 minutes to permit the decay of short-lived activity. From the holdup pipe the gases will flow through charcoal beds, after having the gas humidity reduced by moisture separators and desiccant dryers. Xenon and krypton activities will be selectively held up on the charcoal beds. In addition, the charcoal will also retain radioactive iodine and long-lived radioisotopes in the particulate form, such as strontium-89, strontium-90, and cesium-137. The applicant estimated 42 days xenon and 46 hours krypton holdup with 30 scfm air inleakage. In the staff analysis, it was assumed that the xenon radioisotopes are delayed 18 days and that the krypton isotopes are delayed 24 hours on the charcoal beds with 40 scfm air inleakage into the three-shell condenser. The charcoal delay system will consist of eight beds, each containing about three tons of charcoal and will be operated at 0°F.

The steam air exhaust from the turbine gland seal system will pass through a gland seal condenser where the steam will be condensed and the noncondensibles exhausted to the gland seal holdup line. Steam for the turbine gland seal will be generated using effluent from the condensate demineralizer. Based on using this relatively clean steam for turbine gland seal, no radioisotopic discharges were calculated to be released through this route.

The mechanical vacuum pump, used only during startup, will exhaust air and radioactive gases from the main condenser. Normally, operation of the mechanical vacuum pump will be necessary only after the reactor has been shutdown for several days. During these extended shutdown periods, the radionuclides in the condenser will decay to small quantities of Xe-133 and Xe-135. Therefore, offgases from the mechanical vacuum pump will be discharged without treatment.

The primary containment (drywell) is normally a sealed volume. However, during periods of refueling or maintenance it may be necessary to purge the drywell and suppression chamber and when this occurs, the potential exists for the release of airborne radioactivity to the environment. Normally, the purge releases will not be treated before release to the

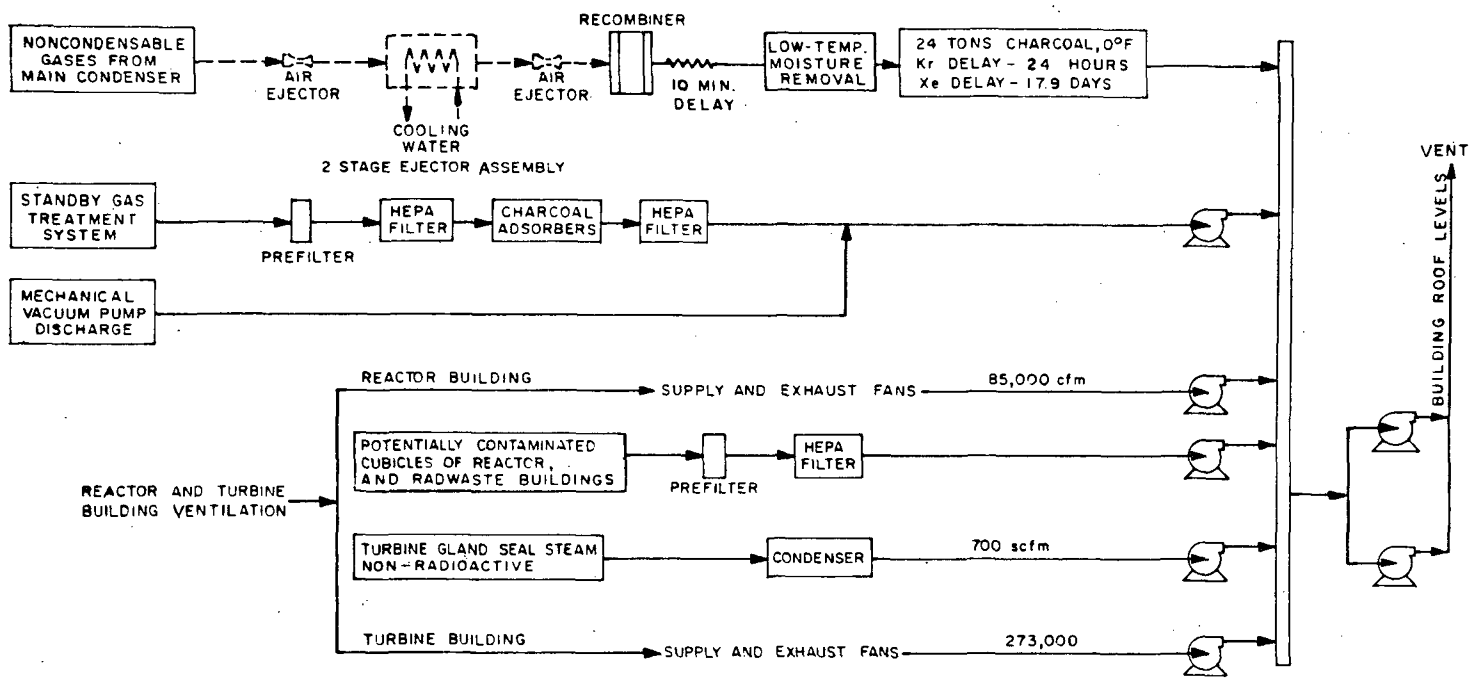


Fig. III-10 SUMMARY OF GASEOUS EFFLUENTS FROM THE HANFORD NO. 2 BOILING-WATER REACTOR environment; however, the system will be designed so that the purge exhaust can be directed to the standby gas treatment system in the event of abnormal air activity levels. The staff evaluation assumed that no treatment occurred before release to the environment. The annual releases from this source are not expected to be a contributing source of activity.

Ventilation air flow will be provided to the reactor building, turbine building, and the radwaste building. Most of the ventilation systems will utilize 100% outside air with no recirculation. Exhaust air from the turbine building and the noncontaminated areas of the reactor building will be released through their respective roof vents without treatment. Air from the potentially contaminated areas of the reactor building and the radwaste building will be filtered through HEPA filters before being discharged to the environment. Because the applicant uses clean steam in the turbine building, the areated steam leak was assumed to be equivalent to 1 gpm condensate in our evaluation.

Table III-3 shows the anticipated annual release of radioactive materials in the gaseous effluent calculated using the staff's model adjusted for the conditions listed in Table III-1. The applicant has prepared an analysis of his treatment system and has estimated the annual effluent releases. The applicant estimated that between 300 and 580 curies per year of noble gases and no iodine will be released to the environment in the gaseous effluent based upon krypton and xenon holdup times of 46 hours and 42 days respectively.

c. Solid Waste

Four types of solid wastes will be packaged for offsite disposal. (1) Dry wastes will be compacted in 55-gallon drums. (2) Spent filter cartridges will be packaged in shielded drums. (3) Evaporator wastes will be accumulated in phase separators and sludge tanks and then pumped into a solidification mixture contained in drums. (4) Resins from the spent resin tank will be discharged to a shielded shipping container.

All solid waste will be packaged and shipped to a licensed burial site in accordance with AEC and DOT regulations. Based on plants presently in operation, it is expected that approximately 900 drums of spent resin filters, flotation wastes and evaporator bottoms will be generated per year. The staff estimates that each drum will contain about 2.9 curies after 180 days decay. In addition, it is expected that 600 drums per year of dry waste containing less than five curies per year will also be generated.

TABLE III-3. Calculated Radioactive Releases in Gaseous Effluents from Hanford No. 2 Reactor, in curies per year

Radionuclide	Turbine and Reactor Buildings	Mechanical Vacuum Pump	Main Condenser Air Ejector	Total for Reactor Unit
Kr-83m	2	-	11	13
Kr-85m	-	-	3,240	3,240
Kr-85	-	-	760	760
Kr-87	10	-	1	11
Kr-88	10	-	1,190	1,200
Kr-89	34	-	-	34
Xe-131m	-	-	230	230
Xe-133m	-	-	40	40
Xe-133	-	1,500	24,700	26,200
Xe-135m	17	-	-	17
Xe-135	15	215	-	230
Xe-137	60	-	-	60
Xe-138	50	-	-	50
Total				32,085
I-131	0.13	-	-	0.13
I-133	0.59	-	-	0.59

3. Chemical and Sanitary Wastes

Water discharges to the Columbia River are authorized and limits specified in the Site Certification Agreement between the State of Washington and the Supply System.[8] The chemicals which are added to the waters in significant quantities come from two sources; sulfuric acid for the control of pH in the cooling tower, and the raw water demineralizer resin regeneration operation.

The amount of sulfuric acid added to control scale in the cooling water is estimated from data in the applicant's Environmental Report[6] to average about 2000 pounds per day, the maximum being 2400 pounds per day. This should add very little to the total dissolved solids in the water because sulfate ions will replace bicarbonate and carbonate ions in the river water. Thus, the total dissolved solids content of the river will not be increased significantly. The sulfate content of the river will increase by about 0.01 parts per million if the river flow is as low as 36,000 cfs (the minimum licensed flow) and the acid addition is 2400 pounds per day. The applicant's Environmental Report gives a range of sulfate content of the Columbia River of 10-29 parts per million, the average value being 16. Therefore, the sulfate content is increased by less than 0.1%.

The chemicals resulting from the regeneration of the resins used to demineralize process makeup water are stated by the applicant to be less than 2310 pounds per month (less than 80 pounds per day), the maximum discharges[6] of specific chemicals in pounds per month being:

sodium sulfate	-	900
calcium sulfate	-	650
sodium carbonate	-	550
magnesium carbonate	-	200
sodium chloride	-	6
sodium nitrate	-	0.2

The average values are 20% of these maximum ones.[6] The constituents of these chemicals are identical to those already in the river. These wastes will be thoroughly mixed with the cooling water of the cooling tower before reaching the blowdown line. The 2310 pounds per month (maximum) discharged to the river is negligible in comparison with the 4.5×10^8 pounds per month of dissolved solids in the river water which pass the plant in one month (at a minimum flow of 36,000 cfs), the ratio being 5×10^{-6}.

The planned operation of the cooling towers is such that the concentration of total dissolved solids (TDS) of the water in the blowdown will be a maximum of 12 times that of the intake water. The TDS concentration in the Columbia River ranges from 75 to 115 ppm[6] but the maximum TDS in the blowdown water returning to the river will normally be less than 1000 ppm, since blowdown rates can be increased when the TDS in the river is high. (The 1000 ppm includes the TDS from all sources including those originating in the regeneration of demineralizer resins.) Assuming the maximum blowdown rate of 6500 gpm, 1020 ppm TDS in blowdown, and 75 ppm TDS in the river water into which the blowdown is discharged, the TDS of the river after complete dilution of the blowdown will be increased by 0.5% at minimum river flow (36,000 cfs) and 0.2% at average river flow (115,000 cfs).

Chlorine will be added to the circulating water at the inlet to the condenser to control algae and slime. The chlorine will be added two or three times a day for periods of about 20 minutes at a rate of 7 ppm. The circulation rate of the water in the cooling tower and condenser circuit is constant at 2.75×10^8 pounds per hour.[7] Assuming a one-hour addition of chlorine per day at a 7-ppm rate, the daily addition of chlorine will be 1.9×10^3 pounds. Using the upper-limiting assumption that all of the added chlorine (1.9×10^3 pounds per day) is converted to chloride ion, it is calculated that the blowdown, after complete mixing with the river, will increase the chloride content of the river by 0.01 ppm if the river is at the minimum licensed flow (36,000 cfs). Therefore, if the river initially contains 0.5 ppm of choride ion (the average value),[8] the diluted blowdown will increase the chloride content of the river water by 2%.

The applicant states,[6] "During the chlorination periods the chlorine content of the water going to the cooling tower will be about 0.5 ppm, but most of this will be dispersed to the atmosphere during passage through the tower." From this statement and the calculated daily use of chlorine, it follows that a quantity of chlorine approaching 110 pounds is dispersed to the atmosphere daily. However, it is the opinion of the staff that the quantity of chlorine dispersed to the atmosphere daily will not be this large, since this calculation and the applicant's statement (above) have not taken into account the consumption of chlorine through reaction with oxidizable substances in the cooling tower portion of the circuit, nor of the nonvolatile nature of hypochlorite, the form in which some of the "chlorine" entering the cooling tower will be found.

Assuming a chlorine content of the blowdown of 0.1 ppm (the upper limit permitted in the Site Certification Agreement)[8] and assuming the maximum blowdown rate of 6500 gpm, chlorine would be added to the river at the rate of 7.0 pounds per day. After complete dilution (minimum dilution factor of 2.5×10^3), the maximum added chlorine burden of the river from this source will be 4×10^{-5} ppm (that is, 4 parts in 10^{11} parts), assuming no reduction of chlorine to chloride ion by oxidizable substances in the river. If all of this chlorine were reduced to chloride ion, the chloride content of the river would be increased by 0.008%.

All of the water that enters the condenser and cooling tower circuit ultimately leaves the circuit as blowdown, water vapor, or drift. Water exiting from the circuit as vapor leaves dissolved substances behind; but that leaving as drift has the same solute content as that of the circuit. On the average, the concentration of river solids in the drift will be five times that in the river. Assuming a drift of 275 gpm, the applicant has calculated[7] that in the zone of maximum deposition, established in the calculation as a region 2.5 miles southeast of the cooling towers, the deposition of drift is equivalent in water content of 0.7 inches of rainfall per year. Since the drift has a TDS content five times that of the river, this deposition rate is equivalent in TDS to 3.5 inches per year of irrigation with river water. This 3.5 inches per year is less than 10% of the approximately 48 inches of irrigation per year used in local irrigation practices. This addition of chemicals to the soil by drift deposition will not be significant.

Certain specific discharges into the atmosphere are covered in the Site Certification Agreement[8] in the statement, "The Supply System agrees to construct and operate the project in such a manner as to not discharge nor cause to be discharged into the ambient air materials resulting from the operation of auxiliary boilers and emergency diesel engines which, measured at the point of discharge, will directly result in: (a) nitrous oxides, measured as nitrogen dioxide, in excess of 0.3 pounds per 10^6 Btu; (b) sulfur dioxide in excess of 0.8 pounds per 10^6 Btu; or (c) ash in excess of 0.2 pounds per 10^6 Btu."

Concerning the disposal of certain other chemical and solid wastes (non-radioactive) associated with plant activities, the applicant states:[9]

> "Chemicals from initial cleaning of installed piping systems and equipment will be discharged to the soil in the vicinity of the plant. The cleaning chemical will be trisodium phosphate (TSP), of which approximately 4000 pounds (expected) or 8000 pounds (maximum) at a concentration of 500-1000 ppm will be discharged."

Sanitary wastes during plant operations will be processed by septic tank, and fluids will be disposed of by means of a tile field similar to tile fields presently in operation on the Hanford Reservation. Chlorination equipment will be provided if found necessary. During plant construction the same tile field septic tank system will be utilized supplemented by local individual chemical toilets. The entire system will conform to Washington State and Benton County regulations applicable to the installation of sanitary facilities.[10] Disposal will be in accord with the

Site Certification Agreement[8] which states that all sanitary wastes shall be disposed of in such manner as to prevent their entry into state waters.

4. Miscellaneous Wastes

Concerning the disposal of miscellaneous wastes, the applicant states:[9]

> "Sediment which collects in the cooling tower basins and cooling tower spray ponds will be periodically removed and used as land fill."

(The sediment in the cooling tower basins will be windblown sand removed from the air as it passes through the cooling tower and entrapped in the water from which it then settles.)[6] Disposal of such wastes must conform to the Site Certification Agreement which states that solid wastes from the applicant's operations, including settled silts and sludges in the cooling tower basins or other waste retention basins, shall be disposed of in such manner as to prevent their entry into state waters.[8]

The applicant further states:[6]

> "Other wastes accumulated at the site such as garbage and trash will be disposed of by burial in a sanitary land fill, or whatever treatment is necessary to comply with state and local laws..."

D. TRANSMISSION LINES

The three transmission lines associated with the plant and their rights-of-way are: a) a 500-kV single circuit primary transmission line (18.3 miles long, 135-foot right-of-way); b) a 230-kV single-circuit plant service transmission line (11 miles long, 125-foot right-of-way); and c) a 115-kV single-circuit "backup" power supply (1 mile long, 90-foot right-of-way). It is currently planned that the Bonneville Power Administration (BPA) will plan, locate, design, and construct these three lines which will be located entirely on the Hanford Reservation.[11] The combined rights-of-way total about 480 acres. Acquisition of the right-of-way is provided for in the Supply System agreement with the AEC.[12]

The major portion of these lines, scheduled to be constructed during the period 1972-1976, will be supported on conventional latticed metal towers. The installation of these lines will comply with federally-adopted guidlines,[13] insofar as they are applicable to the site terrain and vegetation.[11] It must also adhere to the terms of the Site Agreement[8] which specifies that, "Transmission and service lines will be located essentially according to routings indicated in TPPSEC (Thermal Power Plant Site Evaluation Council) Application No. 71-1, as amended and as supplemented; provided that the Supply System may adapt such lines to terrain where conditions indicate that change or variance in location is reasonable or necessary." Under the terms of this agreement the applicant must obtain approval from the Council before implementing any proposed substantial change in the routing or construction of these lines.

There is no need for additional off-reservation transmission lines because those that served the production reactors, all now inactive except for the one supplying steam to Hanford No. 1, are available and adequate. The portion of the transmission system which is beyond the plant's transformers will be under the control of the BPA.[11]

REFERENCES

1. Applicant's Environmental Report, Amendment 1, Section 2.3.9.

2. Applicant's Environmental Report, Amendment 1, Section 2.3.1.2.

3. "Cooling Tower Fundamentals and Application Principles," the Marley Company, 1969.

4. Exhibit No. 54, the applicant's "Application for Washington State Site Certification," hearings before the Washington State Thermal Power Plant Site Evaluation Council, January 1972.

5. J. O. Kadel, "Cooling Towers - A Technological Tool to Increase Plant Site Potentials," American Power Conference, Chicago, Illinois, April 23, 1970.

6. Applicant's Environmental Report, Section 2.3.4.1.

7. Applicant's Environmental Report, Amendment 2, Question 10.

8. "Site Certification Agreement for Hanford No. 2 between the State of Washington and the Washington Public Power Supply System," May 17, 1972.

9. Applicant's Environmental Report, Amendment 2, Question 12.

10. Applicant's Environmental Report, Section 2.3.5.

11. Applicant's Environmental Report, Amendment 1, Section 2.3.1.4.

12. Contract No. AT(45-1)-2269, between the U. S. A., represented by the U. S. Atomic Energy Commission, and the Washington Public Power Supply System.

13. "Environmental Criteria for Electric Transmission Systems," U. S. Dept. of Interior and Dept. of Agriculture, February 1970.

IV. ENVIRONMENTAL IMPACT OF SITE PREPARATION AND PLANT CONSTRUCTION

A. SUMMARY OF PLANS AND SCHEDULES

Construction of the Hanford No. 2 Plant will require preparation of the site; erection of buildings, including a visitor's center, cooling towers, and power transmission facilities; construction of short spurs from existing AEC mainline railroad track; construction of access roads and parking areas; construction of a river water intake and of a water discharge system; control of surface water runoff and restoration of disturbed vegetation; and landscaping of grounds within the fenced perimeter.

A summary of the construction schedule, with key dates, is shown in Table IV-1. The applicant states, "Superstructure construction encompassing the work above the foundations and including . . . the circulating water system, cooling tower structures, makeup water pumphouse and diesel-generator building is scheduled for completion by December 1975. Final grading and paving installation of roads and landscaping will be completed by April 1977."[1]

In all site preparation and plant construction activities the applicant will comply with all federal and state safety and health regulations.[2]

B. IMPACTS ON LAND, WATER, AND HUMAN RESOURCES

Site preparation and construction activities will be confined to an area of approximately 30 acres of which about 10 acres will be utilized for the construction of plant structures and auxiliary facilities. Most of the remaining 1059 acres within the site boundary will remain in the natural state with construction and excavation activity being at least two miles from the river and 2.75 miles from the nearest manned facility, the FFTF construction site, with three exceptions: (1) construction of the site-access road passing closer than 2.75 miles to the FFTF Site, (2) construction of the intake and outfall facilities at the river, and (3) installation of the underground pipes connecting the intake and outfall facilities with the plant.

The lightning-originated fire effectively removed the greater portion of the pristine vegetation on the site. The construction site has a sparse cover of annual vegetation in early successional stages, which is insufficient to stabilize the soil and provides only a marginal habitat for

TABLE IV-1. Construction Schedule for Key Items from an Environmental Standpoint

	Approximate Start Date	Approximate End Date
Initial site preparation, erect temporary facilities and temporary power lines	Aug. 1972	Feb. 1973
Construct reactor and turbine buildings	Feb. 1973	1976
Construct cooling towers	Nov. 1973	Dec. 1975
Construct intake and outfall facilities and makeup pumphouse	Sept. 1973	Sept. 1975
Construct emergency cooling spray ponds	April 1974	Sept. 1974
Construct transmission lines	June 1974	Dec. 1976

From Applicant's Environmental Report, Amendment 1, Section 2.3.8.1.

resident wildlife. The exposed area is subjected to wind erosion and consequently dust storms occur frequently.[3] Site preparation activities will materially increase the windblown dust burden of the air at and downwind of the site, with the predominant winds and particle deposition in the direction of the Columbia River. However, the applicant has stated that measures will be taken to control wind erosion at the site,[4] and such action is expected to negate possible turbidity increases in the river from this source. Since these construction activities will not be visible to the general public, they can have no aesthetic impact with the exception of an added dust burden in the air.

The construction site is in an early state of recovery (from the fire), providing limited food and cover for resident wildlife. Construction activities will destroy the habitats of small mammals, of which the pocket mouse is the dominant species, but are expected to have no measurable effect on the transitory wildlife of the large desert steppe in that the major disturbance and displacement of fauna occurred as a result of the fire. The more productive shrub-steppe and riparian habitats are remote from the site and construction is expected to have no influence on the wildlife associated with these habitats.

Owing to the permeable nature of the surface soils and sparse rainfall, natural surface runoff is minimal. The impact upon the river of any additional runoff from rains during site preparation and plant construction is expected to be too small to be measured, except in those areas at or near the river affected by: (a) construction of intake and outfall facilities, and (b) installation of the pipes connecting the intake and outfall facilities with the plant. During all construction work, the Supply System will take whatever actions are necessary to correct and avoid runoff which may detrimentally affect water quality.

Dredging activities necessary for the placement of the intake and discharge structures will disturb a small portion of the stream bed and cause a short-term increase in turbidity and sedimentation in an area downstream of the excavation site.

In the area of the intake and outfall structures, the stream bed is composed principally of cobble, gravel and sand substrate. The staff anticipates that excavation at a time of low flow will cause only brief turbidity, with the greatest particle deposition (cobble, gravel, and coarse sand) occurring in the immediate vicinity of the excavation site.

Studies[6] on the movement of sediments in the Columbia River at Pasco show that the velocity and turbulence of flows during low water discharges were insufficient to transport sand (particle size greater than 0.062 mm) which was on or in near contact with the stream bed while during periods of freshet the river carries up to 20,000 tons per day of sediment. The spoils from excavation are required to be removed from wetted areas.[5] The sedimentation from this one time excavation is expected to be negligible in this area, as compared to the continual contribution from the watershed during freshet,[6] and from irrigation.

Upon completion of construction, the applicant will dispose of all temporary structures not required for future use and of all used timber, brush, refuse, and inflammable material resulting from construction activities.[5]

The water used during the construction period will be pumped from two onsite wells at a combined maximum withdrawal rate of 500 gpm. This withdrawal rate will not measurably affect the ground-water profile, since ample recharge of the aquifer is available from adjacent sources. See Figure II-6 for ground-water contours as determined from data concerning more than 1500 wells in the Hanford Reservation area, of which 22 are located within five miles of Hanford No. 2.

Because the construction activities are so far removed from any inhabited area[7] or public road and from the nearest manned facility, the FFTF construction site, there will be no measurable noise impact (except from the movement of trucks to and from the site) upon anyone other than the work force.

The work force to be used during construction will average 545 with a peak employment of 900. The applicant states that many of the men to be employed already have their families living in the Tri-Cities area (Richland, Pasco, and Kennewick) and other nearby communities.[7] The demand for additional dwelling units and schooling facilities should not be large and can be accommodated readily. The applicant quotes the Superintendent of the Richland School District, Mr. S. R. Clark, as reporting that due to recent school construction, the Richland schools can handle an additional 500 students.[7]

C. CONTROLS TO REDUCE OR LIMIT IMPACTS

The amount of raw soil erosion in spoil areas will be limited by protecting the exposed faces from erosion by wind and water and through encouraging the restoration of vegetation by natural means (or by reseeding, where it is appropriate). The measures to be taken include grading and shaping of spoil areas so as to minimize soil erosion by wind and by water. (Grading and shaping will be such that the final topography will conform reasonably to natural topography.) Excess excavated material (spoil) will be integrated into the general landscape with provisions for minimizing both wind and water erosion of the soil.[7]

More specifically, the applicant states:[4]

"The following measures will be taken to minimize the environmental effects during the site preparation activities:

1. Excavation for Reactor Building

Soils removed during excavation for the Reactor Building foundation will be placed in stockpiles for use in backfilling operations. If the need is evident, sprinkling of the stockpiles will be done to control dust.

2. Aggregate Stockpiles

Sprinkling of the aggregate stockpiles will be done to control dust if necessary.

3. General Activities

Sprinkler trucks will be used as necessary for dust control on roads and parking lots. Any fine sand exposed cuts will be stabilized with gravel to prevent wind erosion."

In the same letter, the applicant points out that with the desert region and soil, runoff from heavy rains is not a problem. But if abnormal rainfall should occur, a natural retention basin existing at the site has ample storage capacity to prevent damaging runoff. The applicant concludes the treatment of controls by stating that when construction has been completed, a landscaping program will be implemented for the purpose of improving the aesthetics and preventing erosion.[7]

Construction of facilities on the shore and in the bed of the Columbia River is covered by the Site Certification Agreement with the Thermal Power Plant Site Evaluation Council.[5]

Since the pipes connecting intake and outfall facilities with the plant are part of the intake and discharge systems and plans for both intake and discharge systems must be approved by the Council prior to implementation, the installation of these pipes is also covered by the Site Certification Agreement.

During construction of the water intake system the applicant will be required to take measures to keep turbidity in the river at a minimum, to leave no fish traps, and to prevent materials used in construction from being washed away.

The applicant will be permitted to construct outfall facilities after obtaining the necessary lease from the Department of Natural Resources for use of the Columbia River bed and consulting with the Council and its designated representatives in the development of plans for construction of the discharge system. The Council, in turn, agrees to provide a suitable waiver of the turbidity criteria of the water quality standards of the State of Washington, if needed, during construction.

REFERENCES

1. Applicant's Environmental Report, Amendment 1, Section 2.3.8.1.

2. Applicant's Environmental Report, Section 2.3.6.3, p. 17.

3. Applicant's Environmental Report, Amended, Section 2.1.3, pp. 9-12.

4. Letter of March 29, 1972, to Dr. P. A. Morris, Director, Directorate of Licensing, AEC, from J. J. Stein, Managing Director, WPPSS, and attachments (Docket No. 50-397).

5. "Site Certification Agreement for Hanford No. 2 Between the State of Washington and the Washington Public Power Supply System," May 17, 1972.

6. Radionuclides in Transport in the Columbia River From Pasco to Vancouver, Washington, U. S. Dept. Interior Geological Survey, Water Res. Div. Open File Report, Portland, Oregon, 1971.

7. Applicant's Environmental Report, Amendment 3, Section 2.3.8.2.

V. ENVIRONMENTAL IMPACTS OF PLANT OPERATION

A. LAND USE

The area occupied by Hanford No. 2 has not been open to the general public since 1943 and has not had any significant utilization during this restricted access period. The only present uses of the site are as locations for a vegetation regrowth study and a short-term study of desert rodents. It is concluded that the land use of the site and its immediate environs will not be adversely affected by the presence and operation of the plant.

1. Visual Impact

Power plants, by virtue of their massive structures, create a difficult design problem with respect to obtaining both a functional layout for efficient plant operation and a pleasing facade for the public. The staff feels that the Hanford No. 2 Plant has been designed with the goal of attaining both of these design objectives. The various component structures have been so arranged as to break up vertical and horizontal lines and create a step effect leading up to the reactor building, which commands visual dominance. The fluted metal fascia of the reactor building terminates these plain geometric shapes with a band of color that is designed to be pleasing to the eye. The entire group of buildings will visually dominate the flat desert plain.

2. Fogging and Icing

A group of mechanical-draft wet cooling towers will be used to dissipate most of the condenser heat into the atmosphere. Environmental effects of increased fogging and icing caused by the cooling tower discharge during the cool season were studied by the applicant.[1] The cooling tower will emit a plume, which is a volume of air with a higher temperature and a higher moisture content than the ambient air, thereby representing a small modification of the naturally occurring atmospheric conditions. Only when excess water vapor in the plume condenses to water droplets will the plume be visible. The applicant reports conclusions from a study made by Battelle Northwest[1] as follows:

(1) Under the climatic conditions in the Hanford area, excess water vapor in the plume will condense to form a visible plume approximately fifty-six percent of the time during mechanical-draft cooling tower operation.

(2) Under most weather conditions, the visible plume will rise and evaporate near (less than 0.5 km) the cooling tower.

(3) However, under certain atmospheric conditions and in certain areas, it will persist at ground level with a slight potential to interfere with agricultural, industrial, and private activities in the area.

It was concluded from the above study that there would be no induced fogging or icing in the basin area of Hanford and the Tri-Cities and that the cooling tower plumes would not restrict air traffic at the Pasco Airport or at the Richland Airport. However, at higher elevations (higher than the basin area) where the condensed plume may intersect the terrain, some fogging or icing could occur during the winter months. Of particular concern would be induced fogging or icing conditions that could cause increased danger or inconvenience to the public or otherwise interfere with their activities.

In addition to transmission lines, four highways and a railroad are located at altitudes and distances such that they could be intersected by the plume. Estimated annual occurrences for induced fog and ice from the operation of the cooling towers are shown in Table V-1. For comparison, observed annual occurrences of natural fog and ice at selected points or areas are shown in Table V-2.

From a comparison of Tables V-1 and V-2 it may be concluded that, even if none of the induced fog and ice coincides with that which occurs naturally, the estimated induced occurrences are small compared to the frequency and variability of natural fogs. The density of tower-produced fogs could be expected to be much less than that of natural fog.

The primary recreational activities in the area are hunting, fishing, and boating. No hunting is allowed on the Hanford reservation other than in areas indicated in Figure II-3. Fog from the cooling towers will be most frequent (although the occurrence is small relative to the length of hunting and fishing seasons) just before and just after dawn and will coincide occasionally with natural fog and with steam fog from the river. The area covered by the induced fog will be very small compared to the area available for recreation. No interference with these activities because of fog from the cooling towers is expected.

3. Transmission Lines

The new transmission lines associated with the plant, all located on the Hanford Reservation, will be planned, located, designed, and constructed

TABLE V-1. Estimated Annual Occurrences of Fog and Ice at Plume Intersections

Intersection	Occurrence
Transmission lines	70 hours
Highway #240 (18 miles northwest of site)	12 hours
Pasco-Spokane Highway #395 (15 miles east of site)	19 hours
Richland-Benton City Highway #12 (15 miles south of site)	26 hours
Hanford Project Highway (11 miles northwest of site)	21 hours
Northern Pacific Railway (15 miles east of site)	19 hours

From Applicant's Environmental Report, Section 2.3.3.3, p. 4.

TABLE V-2. Observed Annual Occurrences of Natural Fog and Ice at Selected Locations

Location	Occurrence* Fog**	Occurrence* Ice
Pasco Airport	63 hours (1)	72 hours
Hanford Meteorology Station	101 hours (2)	23 days
Hanford Meteorology Station	38 days (3)	
Richland	20 days (3)	20 days
North Richland	20 days (3)	20 days

*Occurrence: listed in hours means duration, listed in days means "occurred at some time during each of these days."

**(1) Based on fogs with visibility less than 1/2 mile.

(2) Based on fogs with visibility less than 1/4 mile.

(3) Based on all fogs with visibility 0-6 miles.

From Applicant's Environmental Report, Section 2.3.3.3, p. 6.

by BPA, which itself is required to prepare an environmental statement[2] discussing the effects of construction, use, and maintenance of these lines. In addition, the staff has made the following assessment of the impact of these lines.

The area occupied by these lines is entirely within AEC property (with the accompanying restricted access and restricted private land development), and it has no other projected use. The area is a generally flat, alluvial plain with the highest order of natural vegetation being sagebrush interspersed with desert grasses. The lines will not cross or otherwise interfere with any areas which are considered to be scenic, recreational, or historical in nature. The lines will avoid steep slopes, will not be near state highways, and will not cross any timbered areas or shelter belts. To assist in the recovery of indigenous plants disturbed in the course of construction of the transmission lines, reseeding of the affected areas will be done in late fall and early winter to provide vegetative cover. It is concluded that the construction of these lines, followed by the restoration of disturbed vegetation, and their use and maintenance will result in a minimal adverse effect upon the surrounding environment.

Construction of the transmission lines will be in accord with the February 1970 "Environmental Criteria for Electric Transmission Systems" published by the U. S. Department of Interior and Department of Agriculture as applicable to the terrain and vegetation of the area. The Supply System will retain an archaeologist if an archaeological site is found to be disturbed by transmission line construction. In consultation with the Washington State Thermal Power Plant Site Evaluation Council, the consulting archaeologist will make arrangements for preservation of the site if deemed necessary and for rerouting of the line if required.

The generation of ozone as a result of corona generated by transmission lines has recently been experimentally investigated in the laboratory and field.[67,68] These investigations indicate that for transmission lines up to 756 kV the maximum ground-level ozone concentration will be well below Federal standards.[67] The National Primary Air Quality Standard for photochemical oxidants as issued by the Environmental Protection Agency is 0.08 ppm by volume maximum arithmetic means for a 1-hour concentration not to be exceeded once per year. Laboratory studies have indicated that 0.0193 ppm by volume of total oxidants might be expected at ground level. Field studies with equipment sensitive to 0.002 ppm by volume indicated no measurable oxidants at either ground or transmission line wire level.

4. Roads and Traffic

Approximately 64 people will be employed at the site during normal operations. This will be a small fraction of the peak 900-man construction work force. The traffic resulting from the operational personnel will produce no impact upon the existing Hanford Reservation traffic using the nearby (within one mile) four-lane AEC highway or upon the public highway system to which the AEC highway connects.

The impact of the additional traffic load due to transportation of fuel and wastes is discussed in Section V-E.

5. Other Effects

The number of permanent employees is small compared to the work force in the Tri-Cities area. Employment on the Hanford Reservation is presently substantially below the peak year (1964), thus assuring adequate capacity of public and private services to accommodate the added workers.

No known archaeological or historical sites are located within the proposed site or proposed transmission rights-of-way; therefore there will be no adverse effect on such areas.

The dominant noise emanating from the site will be that due to the operation of the mechanical-draft cooling towers. Because of the isolation of the plant, there will not be any offsite noise problems. The applicant will be required to monitor noise levels as required by the Occupational Safety and Health Administration.

B. WATER USE

Waste heat from Hanford No. 2 will be dissipated to the atmosphere by means of an evaporative-cooling tower system using water from the Columbia River. After startup, makeup water equivalent in volume to the combined evaporative and drift losses will be in the range 7000 to 16,500 gpm,[3] the drift being 275 gpm.[4] Blowdown will normally be in the range 1500 to 3700 gpm, with the maximum being 6500 gpm.[3] On the basis of maximum values of losses, the water required for makeup will be 23,000 gpm (51.2 cfs). But since the blowdown is returned to the Columbia River, it is not a consumptive loss. Therefore, the maximum consumptive loss is 16,500 gpm (36.8 cfs). The minimum flow rate of the Columbia River in the vicinity of Hanford No. 2, determined by the minimum licensed release of water from Priest Rapids Dam, is 36,000 cfs and the average annual flow is 115,000 cfs.[5] Therefore, the maximum consumptive diversion of water from the Columbia River is about 0.1% of the minimum flow or 0.032% of the average annual flow.

The applicant states, "As of 1967, active water rights in the Upper Columbia Subregion allow consumptive diversions of 6343 cfs of surface water and 1870 cfs of ground water. Essentially all of these diversions occur upstream of Hanford No. 2."[6] The staff has concluded that the additional depletion of 36.8 cfs (maximum value) due to consumptive use of Columbia River water for Hanford No. 2 will have no effect on present or currently projected uses of the Columbia River water resource downstream from the site.

Since water discharges, including blowdown, will be made directly to the river into which the ground water flows and all makeup water is obtained from the river (not from wells or other sources), operation of Hanford No. 2 will not affect the ground water table.

The temperature of the blowdown water will never exceed the river temperature by more than 25°F, and the planned jet discharge provides for rapid mixing of blowdown water with the river. So the maximum increase in river temperature caused by the discharge of blowdown (assuming minimum licensed riverflow of 36,000 cfs, maximum blowdown rate of 6500 gpm, and maximum temperature differential of 25°F between blowdown and river) will be 0.01°F after total mixing.[7]

In the operation of an evaporative cooling tower system as a heat sink, the water which is evaporated leaves its content of dissolved solids behind. Consequently, the concentration of dissolved solids in the tower water increases as water is evaporated. The level to which the concentration of dissolved solids rises is controlled by varying the blowdown rate. This blowdown rate will be at least 1500 gpm (ranging up to 6500 gpm).[8] With a maximum evaporation rate of 16,500 gpm, the maximum concentration factor will be no more than 12.[3] In order to reduce the pH of the normally alkaline river water to between seven and eight, sulfuric acid will be added to the cooling tower water forming soluble sulfate salts. The neutralization of the alkalinity of the river water will normally increase the TDS of tower water less than 10%.[9] The maximum TDS in blowdown water discharged to the Columbia River will normally be less than 1000 ppm, a value to be compared with the 75 to 115 ppm range of TDS in Columbia River water. The chlorine content of this blowdown will not exceed 0.1 ppm, in compliance with the Site Certification Agreement.[10] The turbidity of the blowdown is expected by the applicant to be less than 100 Jackson Turbidity Units, even during severe dust storms.[9] Since the ratio of blowdown discharge rate to riverflow is such that the dilution of blowdown by river water is always at least 2400, blowdown with the maximum TDS (1000 ppm) diluted with river water with the minimum TDS (75 ppm) will raise the TDS of the river by only 0.5% (from 75 ppm to 72.4 ppm). The blowdown will have an average TDS content five times that of the river.[4]

Periodically, aqueous solutions of chemicals accumulated through regeneration of demineralizer resins will be injected into the blowdown lines and discharged to the river. But the total monthly discharge of these chemicals to the river (sodium, calcium, and magnesium cations and sulfate, carbonate, chloride, and nitrate anions), when the plant is in normal operation, will be less than 2310 pounds. (The monthly chloride and nitrate discharge will, respectively, be less than 4 pounds and less than 0.2 pound.) For comparison, dissolved solids initially present in the cooling water withdrawn from the river and returned to the river in the blowdown will be 360,000 pounds per month, assuming 100 ppm TDS in the river.[9] Since the total quantity of these demineralizer-regeneration chemicals introduced to the river is less than one percent of the quantity naturally present in the river and returned as blowdown to the river, the impact of these added chemicals upon the river water will not be measurable.

It, therefore, is concluded that the combined blowdown discharges and discharges of chemicals formed in demineralizer regeneration will have no effect upon the potability of the river water and of the ground water near the shore.

The Columbia River is used for fishing, boating, waterskiing, and other water sports. It has been opened for public use up to the townsite of Hanford. Marinas and waterfront parks are located in Richland and further downstream on both sides of the river. Irrigation withdrawals are made downstream of Pasco, both in Washington and Oregon.

The thermal and chemical releases to the river will have no effect upon these uses of the river. In addition, releases will have no measurable effect upon industrial use of the river, with respect to either quality or quantity of water.

Oregon is the only other state where waters conceivably could be affected by discharges from Hanford No. 2. The Oregon Nuclear and Thermal Energy Council states (in part) in a letter to the Washington State Thermal Power Plant Site Evaluation Council on January 4, 1972:

"Specifically, the Council agrees that the construction and operation of the proposed Hanford-2 nuclear power plant appears to be compatible with Oregon's desire to maintain high quality of environment in this state, and to present no identifiable health hazards to Oregonians." It is noted by the applicant that "Entry of the Yakima and Snake Rivers increases the flow of the Columbia River about 43% between Hanford-2 and the Oregon border, thus providing further dilution."[11] It is concluded that operation of Hanford No. 2 will produce no measurable effects upon the water in the State of Oregon.

The intake, in the Columbia River, for makeup water to be used in the cooling-tower system will involve an advanced concept of filtration, employing perforated pipes buried in the riverbed near the shore. The superficial velocity of the water flowing into this infiltration system will be no greater than 0.02 fps, so no scouring effects should be experienced.

Since both the intake and outfall proper have auxiliary equipment housed in buildings, these buildings have also been considered with respect to their environmental impact. With respect to the total effect of the complete intake and outfall systems, the applicant states: "The method of water removal and return has been designed to minimize visual impact and avoid any disturbance of normal recreational activities.[6]

It is concluded by the staff that no calculable detrimental environmental effect will result from the operation of the intake and outfall or from the presence of the associated physical structures, including the pump houses.

Since all liquid wastes which are discharged are diluted with blowdown water and are then discharged directly to the Columbia River, not to the ground, there is no possibility of ground water contamination by chemical or radioactive wastes from the plant.

C. BIOLOGICAL IMPACT

1. Terrestrial

The biological impact from the construction of the Hanford No. 2 Plant on terrestrial species will be confined to an area of approximately 30 acres of which about 10 acres will be utilized for plant structures and landscaping. The remaining 1059 acres will remain in their natural state. Construction activities will destroy the habitats of some small mammals, of which the pocket mouse is the dominant species, but are expected to have no measurable effect on the wildlife of the large desert steppe.

The more productive shrub-steppe and riparian habitats of the site are associated with the Columbia River. The limited construction activities in this area will cause only minor, short-term disturbances without measurable impact on the wildlife.

During operation of the plant, the cooling towers will cause slight increases in fogging and the dispersion of small quantities of chemicals in the drift.[4] The chemical deposition resulting from the operation of the cooling towers is less than the acceptable levels in irrigation practices.[12]

2. Aquatic

a. Effects of the Intake Structure

The intake for the makeup of water for the cooling towers and condenser cooling system will be an infiltration-bed system along the shoreline of the Columbia River in which the water enters the pumping system through a sand and gravel bed overlain by cobble. The maximum makeup flow is expected to be about 23,000 gpm (approximately 0.16% of the minimum licensed riverflow and 0.05% of the average riverflow), with the velocity through the filter bed less than 0.02 feet per second.[13] Specifications for the intake system includes the requirement for a downstream gradient in the channel "so that waterflow shall be free with a minimum of one foot depth throughout the channel."[10]

The design for the intake structure essentially eliminates entrainment or impingement of aquatic organisms. Although minute organisms may penetrate the filter bed, the quantities will be less than 0.16% of the inventory in in the river, assuming a uniform distribution in the water. The design velocity of water through the infiltration bed is less than that reported as the sustained swimming capability of fish larvae and fry[14,15] and the system is expected to have no measurable effects on fish by impingement or entrapment. The surface composition of the infiltration bed will be overlain by coarse gravel and large cobble and is not a substrate expected to be sought out by spawning salmonids. In addition, some authorities believe that spawning salmon seek out areas of upwelling whereas the water flow in the filter system will be downward and, therefore, not attractive to spawners.[64] (This point is not generally agreed upon by all authorities.)[65]

b. Effects of Elevated River Temperature

As a result of cooling-tower blowdown, heated water will be discharged into the Columbia River with the temperature differential at the point of discharge approximately 17° to 25°F during the months of January to June and approximately 8° to 12°F during the months of July through December (Figure III-3). The maximum blowdown rate will be 6500 gpm and the maximum temperature of the effluent 82°F.[7]

The effluent will be rapidly diluted in the initial mixing zones, with the thermal increment decreased by a factor of 5 within 15 feet, and by a factor of 10 within approximately 100 feet downstream of the outfall. Full vertical mixing will occur within 200 to 300 feet of the outfall during periods of minimum licensed flow,[5] with the temperature differential reduced by a factor of approximately 50. During the most extreme conditions, (i.e., a blowdown of 6500 gpm and the maximum temperature differential of 25°F at the point of discharge during minimum licensed flow) the thermal increment in the river will be less than 0.2°F above the receiving water temperature 750 feet downstream and less than 0.01°F above ambient after complete mixing in the river. The configuration of the plume and expected thermal increments in areas downstream of the discharge are shown in Figures III-4 and III-5. The initial mixing zone will be located in the main channel approximately 280 feet from the west shoreline during periods of low flow.

Temperature differentials greater than 2.5° and 0.5°F will occupy approximately 4 and 7%, respectively, of the cross-sectional area of the main channel during periods of minimum licensed flow and a discharge thermal increment of 25°F. Because of its direct and/or indirect effects, temperature is a principal factor determining the suitability of a habitat for aquatic organisms. The introduction of heated water into an aquatic ecosystem will cause some biological changes with effects on metabolism, development, growth and reproduction, and mortality documented in the literature.[16-18] The tolerance of organisms to any thermal increment is species specific, depending upon the magnitude of the thermal increment and the duration of the exposure, as well as previous temperature acclimation.

Periphyton communities in the Hanford reach of the river are typically at a subclimax level of growth, with turbulent riverflow and seasonally low water temperatures being factors limiting the biomass in the main channel.[19] In both the periphyton and phytoplankton populations diatoms are the dominant form. The discharge of heated water may cause an increase in the growth of periphyton in the immediate vicinity of the outfall in an area within the 2.5°F isotherm, but such an effect is expected to be small and negated by loss from turbulent riverflow. In Columbia River studies by Coutant and Owens,[20] thermal increments of 18°F increased the standing crop of periphyton only during a short period in winter, with the domination by diatom species persisting. Patrick[21] reported that water temperatures less than 50° to 59°F limited the growth and reproduction of phytoplankton populations dominated by diatom forms, while higher temperatures increased the biomass until the temperature of the water reached 84.2° to 86°F. Temperatures exceeding 86° to 93.2° caused a measurable decrease in the number of species and population size as compared to that between 64.4°F to 75.2°F.

The upper temperature limits for the majority of benthic organisms reported to occur in the Hanford reach of the river[5,22] appear to be in the range of 85° to 92°F, with tolerance dependent somewhat on the species, stage of development, and acclimation temperature.[18] Curry[23] found the upper thermal tolerance of several families of aquatic dipterians to be temperatures between 86° and 91.4°F. Caddisfly larvae, and stonefly and mayfly nymphs acclimated to 50°F had a 96-hour median tolerance to temperatures ranging from 70° to 87°F, with mayflies being the most sensitive species.[24] Becker[25] reported that caddisfly larvae acclimated to a river temperature of 67.1°F had a 50% mortality (LD_{50}) after a 68-hour exposure to an 18°F increment, whereas mortality to temperatures 13.5°F above ambient were insignificant. Thermal increase up to a temperature differential of 18°F resulted in well-defined increases in growth for all of the species tested,[25] and Coutant[26] has reported a two-week earlier emergence in heated zones as compared to ambient temperatures in the Columbia River.

Although prolonged exposures to elevated temperatures have been reported to affect the growth rate and species composition of phytoplankton and zooplankton in the area of thermal discharges, the time interval in which plankton will be entrained in the thermal plume is considered too brief to cause significant changes. During low flow and a 25°F temperature differential at the point of blowdown, the time intervals in which organisms would be exposed to temperatures greater than 5° and 2.5°F above ambient would be approximately 5 and 35 seconds, respectively, which are below those levels reported to have measurable effects.[18,21,27]

The ecological consequences of thermal discharges on planktonic and benthic organisms are expected to be negligible, with lethal effects, if realized, being restricted to sessile benthic organisms in an area of the initial mixing, (within 15 feet of the outfall) and any sublethal effects[26,28] to an area within the 2.5°F isotherm. Such changes would have no measurable effect on the abundance and composition of food organisms in the stream drift, and no impact on the fish resources.

Temperature, through both direct and indirect action, is one of the important parameters influencing the fishery resources in the Columbia River, with the anadromous fish, particularly the salmonid, the most economically important species. A review on the tolerance and thermal requirements of fish[17] indicates that, in the Hanford reach of the river, salmonids are the species most sensitive to and directly affected by thermal discharges.

The Hanford reach of the Columbia River is heavily utilized as a spawning and rearing area by chinook salmon and steelhead trout, as well as a major migration route for other adult and juvenile salmonids. A description of the salmon activities in the Hanford reach of the river is shown in Table V-3. Steelheads are essentially present throughout all periods of the year, with spawning activity commencing from late March to June.[29] The optimum temperatures most conducive to salmonid activities have been reported as: 45° to 60°F for migration; 45° to 55°F for spawning areas; and 50° to 60°F for rearing areas.[27] The ambient water temperatures in the Hanford reach are typically below the preferred levels in March and April during the initial emergence of chinook fry, while temperatures during May and June are within those levels reported optimum and the preferred temperature of juvenile salmonids. The most critical period is during the months of July through September, when temperatures rise into the upper zone of thermal tolerance.

The thermal plume from the discharge of cooling tower blowdown does not intersect with any reported spawning areas.[30] The nearest chinook and steelhead spawning areas are approximately 3/4 mile downstream and the

TABLE V-3. Timing of Salmon Activities in the Columbia River near Hanford. From L. O. Rothfus testimony in TPPSEC 71-1 hearings (Exhibit 62).

Species	Fresh-water life phase	Month											
		J	F	M	A	M	J	J	A	S	O	N	D
SPRING CHINOOK	Upstream migration				X	X	X						
	Spawning												
	Intragravel development												
	Fresh-water rearing	X	X	X	X	X	X	X	X	X	X	X	X
	Downstream migration			X	X	X	X						
SUMMER - FALL CHINOOK	Upstream migration						X	X	X	X	X		
	Spawning									X	X	X	
	Intragravel development	X	X	X						X	X	X	X
	Fresh-water rearing	X	X	X	X	X	X	X	X	X	X	X	X
	Downstream migration				X	X	X	X	X	X			
COHO	Upstream migration								X	X	X		
	Spawning												
	Intragravel development												
	Fresh-water rearing	X	X	X	X	X	X	X	X	X	X	X	X
	Downstream migration				X	X	X	X					
PINK	Upstream migration												
	Spawning												
	Intragravel development												
	Fresh-water rearing												
	Downstream migration												
CHUM	Upstream migration												
	Spawning												
	Intragravel development												
	Fresh-water rearing												
	Downstream migration												
SOCKEYE	Upstream migration						X	X	X				
	Spawning												
	Intragravel development												
	Fresh-water rearing												
	Downstream migration				X	X	X	X	X	X			

thermal increment in the river after mixing is expected to have no measurable effect on spawning or on the growth and development of egg and larval stages in these areas. In a study on the effects of temperature on varying developmental stages of salmon eggs and fry, no adverse effects were noted when the thermal increments were less than 2.9°F and only a slight increase in mortality was noted when temperatures averaged 4.9°F above a 5-year mean ambient water temperature in the Hanford reach of the Columbia River.[31] Under worst-case conditions, a temperature differential of 5°F would be restricted to within 15 feet of the outfall and differentials of 2.5°F would occur in the main channel at a distance within approximately 100 feet downstream of the outfall and in an area where no spawning or rearing would be anticipated because of water turbulence and cobble substrate. The thermal increment at the nearest reported chinook and steelhead redds, as well as in areas within approximately 200 feet of the western shoreline, will be less than 0.05°F.

During movement in the main channel, juvenile salmonid could be involuntarily carried through the effluent plume, with their downstream velocity assumed to be essentially that of the riverflow, e.g., 2.9 to approximately 6.0 fps during minimum and average flow rates. Figure V-1 summarizes the average monthly thermal increment at the point of discharge and after initial mixing with respect to ambient river temperatures and the thermal requirements and tolerance of juvenile salmonids.[27,32] During the months of May through September, the temperatures of the receiving water will be above the upper incipient lethal temperature (69.8°F) at the point of discharge. However, these temperature differentials would be reduced by 80% within 15 feet of the outfall, and at minimum flow the temperature of the receiving water would be within the zone of thermal tolerance for juvenile salmonids after a time interval of 5 seconds from the point of discharge. During worst-case conditions (periods of low flow and an ambient river temperature of 68°F) and a maximum effluent temperature of 82°F, temperatures above the ultimate incipient lethal temperature or greater than 71°F in the receiving water would persist for an interval of approximately 5 seconds downstream of the outfall and would be less than that reported as the upper incipient lethal temperature after an interval of approximately 35 seconds.

The preferred temperatures for juvenile salmonids are reported as 41° to 62.6°F,[27] temperatures above 68°F are considered to be adverse for juvenile salmonids,[27] and 69.8° is the upper incipient lethal temperature,[32] i.e., that temperature which will kill a stated fraction of the population when brought rapidly to it from a lower temperature, within an indefinite prolonged exposure. Brett reported that juvenile salmonids (5 species of the genus *Oncorhynchus*), when acclimated to temperatures of 41° to 75.2°F,

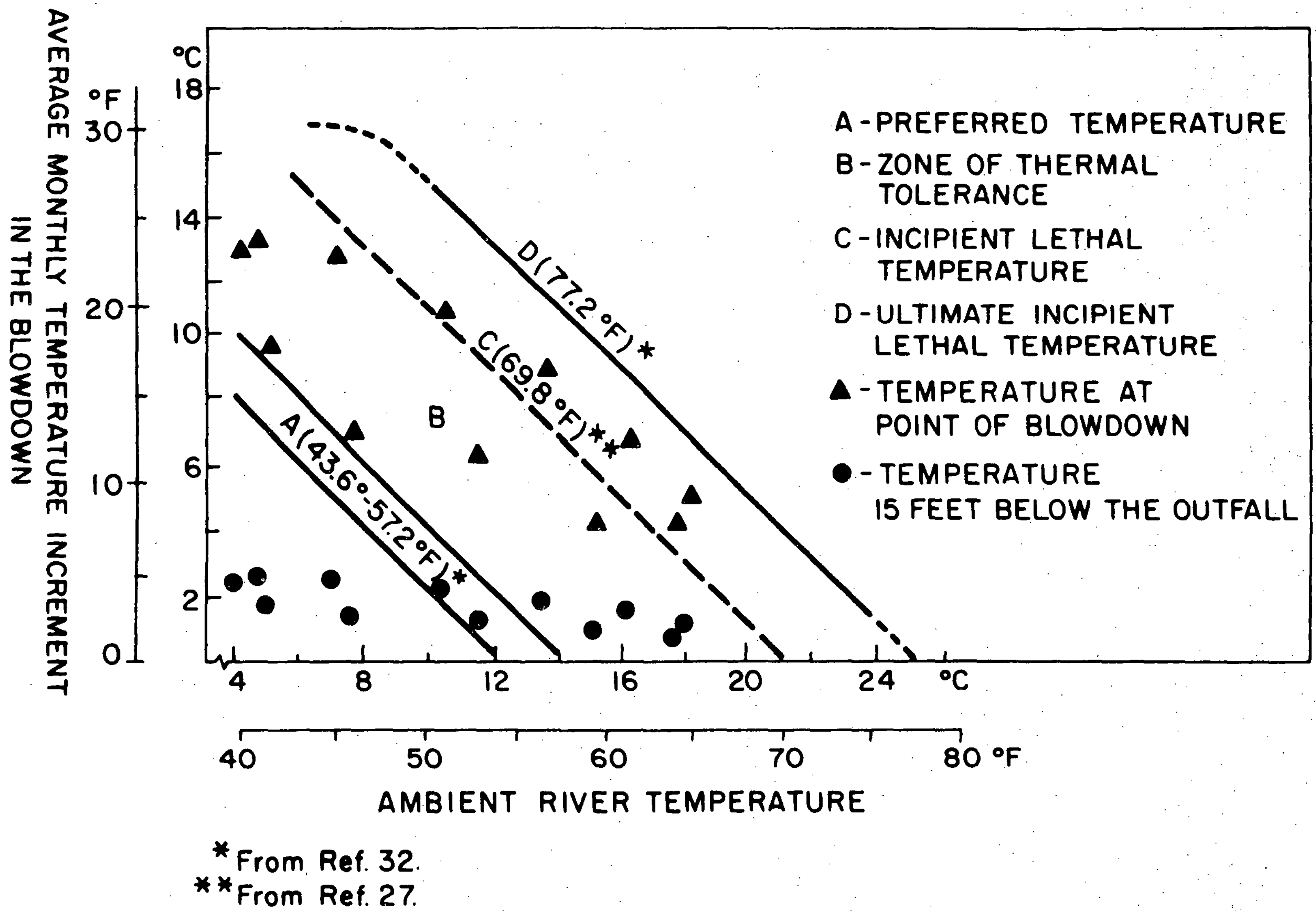


Fig. V-1. Summary of Temperature Exposure and Thermal Tolerance of Juvenile Salmonids.

had a preferred temperature range of 53.6° to 57.2°F and avoided temperatures above 59°F except under conditions of feeding stimuli.[32] In the same study, the ultimate incipient lethal temperature was 74.8° to 77.2°F with juvenile chinook and coho exhibiting the greater thermal resistance. Figure V-2 shows the geometric mean time for loss of equilibrium and death when juvenile chinook are exposed to temperatures above the ultimate incipient lethal temperature.[33] A minimum of 5.4°F below the ultimate incipient temperature has been recommended as the maximum allowable for juvenile salmonids "to avoid significant curtailment of activity," with temperatures near 62.6°F considered the upper optimum temperature.[27] Mean survival time curves based on a review of experimental data on the thermal tolerance of juvenile salmonid to variable temperature increments above the incipient lethal temperature, as a function of exposure duration and acclimation, have been summarized in a recent report.[27] Synder and Blahm[34] reported that juvenile chinook salmon acclimated at 55°F exhibited no mortality within a 72-hour observation period after being suddenly exposed to a temperature of 70°F for one hour, while fish exposed to 80°F exhibited the first mortality after 100 seconds of exposure. Juvenile chum salmon acclimated at higher temperatures (60°F) had no mortality when subjected to temperatures of 75°F; at a temperature of 80°F the first mortality was observed after a 44 minute duration.

Although the temperature increments in the plume at the determined exposures are less than those reported to cause direct lethal effects, indirect effects have been reported to occur at sublethal thermal doses.

In preliminary studies by Schneider[35] juvenile rainbow trout acclimated at 59°F were exposed to temperatures ranging from 68.8° to 86°F to determine the effect of sublethal thermal exposures on the vulnerability of juvenile to predation. Exposure to an elevated temperature of 69.8°F had no effect on the susceptibility of juvenile to predation. At temperatures of 71.6° to 73.4°F an exposure duration of 12 minutes was required to increase the vulnerability of juveniles above that of the control, while exposures for 2.5 to 4 minutes were required when temperatures were 80.6° to 82.4°F. In another study, the thermal dose (temperature and exposure duration) that first initiated differential predation was about 10 to 11% of that reported for the median dose for loss of equilibrium.[36] There was no evidence of an enhanced incidence or infection of C. columnaris disease in fish in areas below the thermal discharges from the early Hanford reactors as compared to areas not influenced by the thermal plumes.[36]

Although juvenile salmonid would encounter potentially lethal temperatures if their route of passage coincided with the area of initial mixing it seems unlikely that the thermal discharges as a result of the operation of the Hanford No. 2 Plant will have any measurable impact on the juvenile salmonids in that the temperatures and duration of exposure are less than those reported to have any direct lethal or sublethal effects.

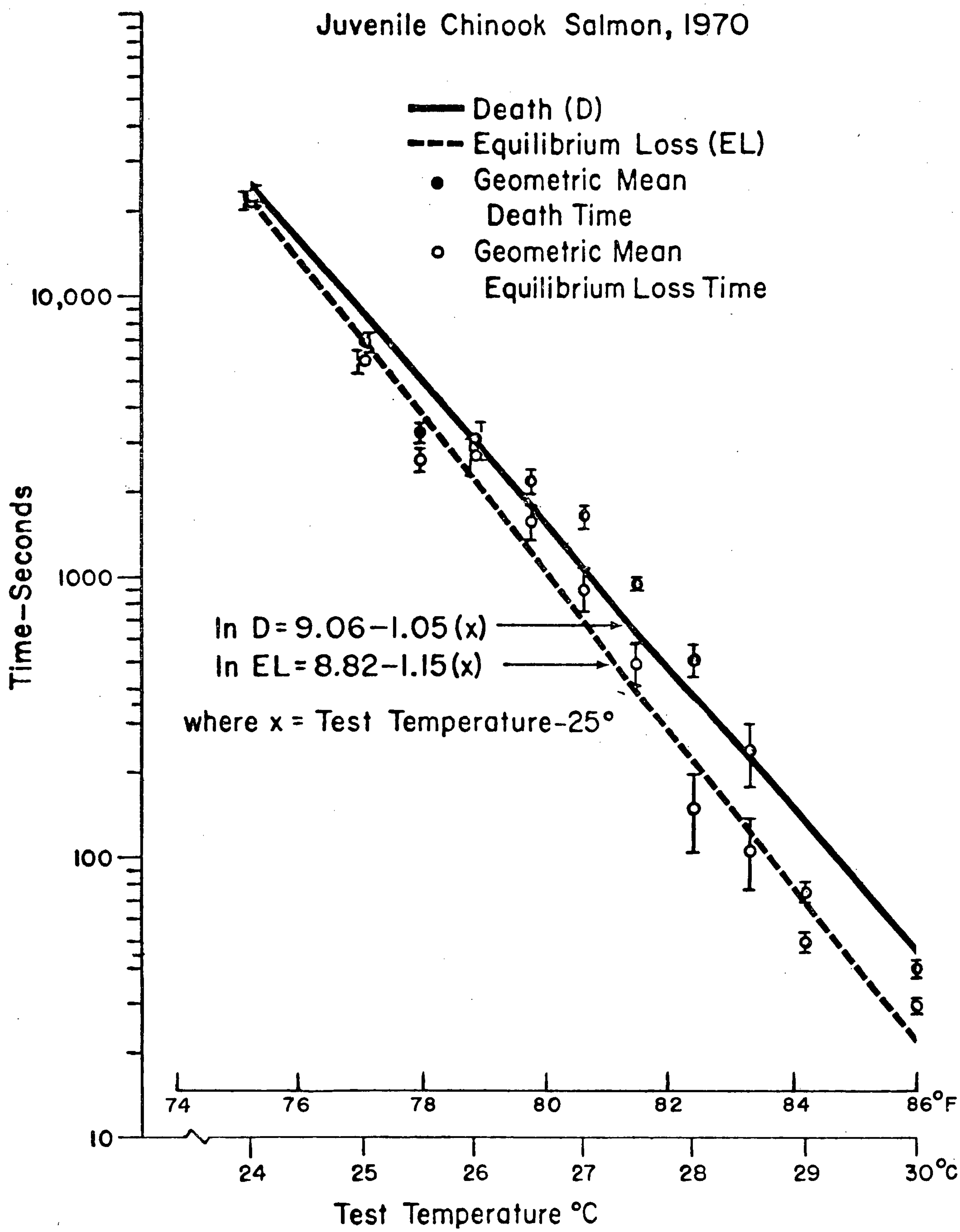


Fig. V-2. Equilibrium Loss and Death Times at Various Temperatures for Juvenile Chinook Salmon. R. E. Nakatani, Exhibit 49, TPPSEC 71-1 hearings.

During periods of migration, adult anadromous fish would be expected to avoid the thermal plume and the potentially lethal temperatures associated with the areas of initial mixing. Ambient water temperatures which exceed 70°F are reported to impede or block adult salmonid migration.[27] The thermal increment is expected to be approximately 2.5°F above maximum ambient temperatures (68° to 70°F), 15 feet downstream of the outfall. During the periods of peak adult salmonid migration, the maximum cross-sectional area of the river which would be expected to evoke an avoidance response is less than 7% of the main channel during worst-case conditions, and assures free passage of adult migrants. Temperatures between 50° and 70°F were reported to cause no avoidance or blockage of migration near the confluence of the Snake and Columbia Rivers, whereas, when the ambient temperatures exceeded 70°F, migration preference was in the lowest temperature zone.[27,34] In a study on the Hanford reach of the river, adult salmonid demonstrated a general preference for migration along the eastern shoreline (across the river from the Hanford No. 2 outfall) from Priest Rapids Dam downstream to Richland.[36] The study also indicated that the thermal discharges from the early Hanford reactors had no significant effects on migration.

c. Effects of Chemical Releases

The principal contribution to increased dissolved solids in the effluent is attributable to evaporation of the river water in the cooling towers. The chemical constituents of the river water (Table II-5) will be concentrated by a factor of two to twelve in the effluent, depending upon the rate of blowdown,[9] with the planned increment a factor of five.[37] Chemical additives comprise less than one percent of the chemical constituents in the effluent and, with the exception of residual chlorine, all of the chemicals naturally occur in the river.

The chemical effluent will be diluted rapidly, with the mixing zones and dilution rates presumed to be similar to the thermal effluent. The increased concentration of the natural chemical constituents in the river water within the effluent plume and at a point of approximately 300 feet downstream would be less than 10 percent. Assuming a maximum discharge rate of 6500 gpm and a riverflow of 36,000 cfs, the increased concentration of dissolved solids in the river after complete mixing from a maximum concentration of 1000 ppm would be less than 0.5 ppm, well below the normal variation in TDS.

With the exception of residual chlorine, the resultant concentration of chemicals in the river after initial mixing will be at a level at which no measurable changes or detrimental effects have been reported.[38,39]

Intermittent discharges of residual chlorine will have rapid dilution and be reduced further by the chlorine demand of the water. During periods of low flow, an effluent concentration of 0.1 ppm would be diluted to 0.02 ppm approximately 15 feet downstream from the point of discharge; while levels of approximately 0.01 ppm would occur in an area represented by the 2.5°F isotherm and less than 0.002 ppm in an area outside of the 0.5°F isotherm.

The tolerance of aquatic organisms to chlorine is species specific, with the effective concentration causing mortality or detrimental effects somewhat dependent on the chemical form, and markedly affected by the duration of the exposure. Arthur and Eaton[40] found that the 96-hour median tolerance limit for the amphipod, *Gammarus pseudolimnaeus*, was 0.22 ppm total residual chlorine. During chronic exposures (15 weeks) the survival of adult amphipods was significantly decreased at 0.035 ppm, with no apparent differences at concentrations of less than 0.016. However, chronic exposure to concentrations of 0.0034 ppm or greater resulted in a decrease in reproduction. A concentration of 0.001 ppm chloramines has been reported to cause 100% mortality of *Daphnia magna* after an exposure of 3 to 5 days.[40]

In recommendations based on a review of the literature and independent studies, the National Water Quality Laboratory has stated that intermittent (2 hours per day) discharges not exceeding a concentration of 0.05 ppm residual chlorine in the receiving water "should not result in significant kills of aquatic organisms or adversely affect the aquatic ecology."[41]

It was also stated that continuous discharges with concentrations of 0.01 ppm in the receiving water "would probably not protect trout reproduction, some important fish food organisms, and could be partially lethal to sensitive life stages of sensitive species," whereas, continuous levels of 0.002 ppm residual chlorine "should protect most aquatic organisms."

Discharges of residual chlorine from Hanford No. 2 Plant are expected to have no measurable impact on the plankton and aquatic invertebrates entrained in the stream drift, in that maximum exposures to a concentration gradient of 0.1 to 0.002 ppm will be for an interval of approximately one minute, and then only when passage coincides with the centerline of the plume during periods of low flow. Intermittent residual chlorine concentrations of 0.1 ppm may have an algistatic effect on periphyton[42,43] and a lethal effect on sensitive sessile benthic organisms in the immediate vicinity of the outfall, i.e., within an area 15 feet below the discharge, but less than that represented by the 2.5°F isotherm; with the area affected depending upon the persistence of residual chlorine in the blowdown. Such losses would be expected to have a negligible impact on the river population, and cause no measurable change in the composition or abundance of food organisms for fish. The abundance of benthic organisms is known to fluctuate widely depending upon the type of substrate and is limited in areas of the main channel due to turbulent flow.

Merkens studied the survival of rainbow trout during exposure to varying concentrations of residual chlorine and reported that a 50% mortality occurred after a 7-day exposure to 0.08 ppm, and estimated from the data a one-year mean period of survival at concentrations of 0.004 ppm. It was concluded that although free chlorine was found to be more toxic than chloramines, toxicity must be of the same order.[44] Holland *et al*.[45] reported that fingerling salmon were immediately distressed, e.g., "head shaking and jaw snapping," when exposed to 0.2 ppm "residual chlorine." The first loss of equilibrium occurred in 2.97 hours, the first death in 3.18 hours, with a 76% mortality after an exposure of 19 hours. In the same study the maximum concentrations of chlorine tolerated by pink and coho salmon in sea water without mortality was 0.05 ppm. Caged rainbow trout held in receiving streams below chlorinated waste discharges had a 50% mortality after a 96-hour exposure to residual chlorine concentrations of 0.023 ppm.[46] Sprague and Drury found that rainbow trout were killed by levels of 0.01 ppm in 12 days and exhibited an avoidance response to residual chlorine concentrations as low as 0.001 ppm.[47] Exposure of brook trout to 0.35 and 0.08 ppm chlorine was found to cause an initial increase in activity which was subsequently depressed after a two-hour exposure.[48] The mean periods of survival at concentrations of 0.35, 0.08, and 0.04 ppm respectively, were 9, 18, and 48 hours, with a level of 0.005 ppm reported as causing no mortality but a slow decline in activity.

Intermittent concentrations of residual chlorine reported to have direct or indirect effects on fish will be restricted to an area of less than 7% of the cross-sectional area of the river and a distance of approximately 250 feet downstream, with the area expected to be reduced markedly by the chlorine demand of the water. The plume placement assures free passage for fish movement and although any potential effects could be negated by avoidance during periods of chlorination, fish could be exposed when their movement intersects the effluent plume. The maximum exposure to fish passively swept through the centerline of the plume, would be an instantaneous exposure to 0.1 ppm residual chlorine, reduced to 0.02 ppm at 15 feet and an interval of 5 seconds. The exposure duration to concentrations of 0.02 to less than those reported to cause any direct or indirect effects would be less than 1-1/2 minutes. The concentrations and exposure durations resulting from intermittent chlorine discharges are less than those reported to cause detrimental effects, and appear reconcilable with current criteria and a judgment of no measurable adverse impact.

3. Effects of Radionuclide Releases

The limitations on the concentrations of radionuclides that may be released to the environment are based on levels established for the protection of man. These dose limits are very conservative when applied to lower organisms.

The dose to the terrestrial biota in the Hanford environs will be within the variance of natural background and much less than that at which organisms are reported to have measurable radiosensitivity. A review of the studies on the effects of irradiation on terrestrial flora and fauna indicates that, with few exceptions, conclusive effects have been shown in terrestrial organisms only at doses approximately three or more orders of magnitude above the dose limits for human population.[49]

Aquatic organisms within and downstream of the effluent plume will be exposed to long term, low-level doses of radiation as a result of external (immersion) exposure, absorption, and the bioaccummulation of ingested radionuclides. Nevertheless, the calculated doses are below those reported to cause demonstrable radiation effects to aquatic organisms.[50,51] In a recent review it was noted that when long term dose rates are no more than one rad per day, other factors affecting aquatic organisms are sufficient to obscure any effects attributable to radiation; and at long term doses resulting from the maximum permissible concentrations of radionuclides, possible ecological effects would be undetectable with the current methodology.[51]

D. RADIOLOGICAL IMPACT ON MAN

During the operation of Hanford No. 2, small amounts of gaseous and liquid radioactive wastes will be released to the atmosphere and to the Columbia River respectively at low concentrations under carefully controlled conditions. The quantity of radioactivity that is released to the environment will be a small fraction of the limits set forth in 10 CFR Part 20 of the Commission's regulations, and the amounts will be kept as low as practicable in accordance with 10 CFR Part 50.36a and proposed Appendix I.

1. Radwaste Treatment System

The waste processing systems for the Hanford No. 2 Plant are designed to collect, process, control, and dispose of liquid, solid, and gaseous radioactive wastes. The radwaste system is detailed in Section III.D-2 of this Statement.

2. Liquid Releases

The liquid radwaste system collects, monitors, treats, and recycles all potentially radioactive liquids. A fraction of the processed liquids will be discharged from the plant only when necessary to maintain an overall plant-water inventory balance.

The staff estimates of the quantities of radionuclides that may be discharged as liquid from the Hanford No. 2 Plant are listed in Table III-4. Based on these estimated releases, the average concentration of fission and activation isotopes will be 3.0×10^{-8} µCi/cc and the tritium concentration will be 1.3×10^{-6} µCi/cc in the discharge effluent. Based on these effluent concentrations, the average concentration of fission and activation isotopes will be 2.3×10^{-12} µCi/cc and the tritium concentration will be 9.7×10^{-11} µCi/cc in the Columbia River after total mixing. Actual isotopic concentrations may differ from the postulated values due to variation in plant equipment, operating experience, and mode of operation.

3. Impact of Liquid Releases

There are four pathways of exposure that require consideration as a result of the liquid radionuclide releases to the Columbia River. These are drinking water consumption, fish consumption, swimming or other similar exposure to the water, and exposures from shoreline activities. A daily intake of 2200 cc (this takes into account water intake via fluids and food[52]) was used to estimate the dose that individuals are likely to receive from drinking water. The dose from the consumption of fish grown in these waters is based on eating 55 g of fish per day.[53] Appropriate bioaccumulation factors for each of the important radionuclides were used to calculate the dose from fish consumption[54] (Table V-4). The estimate of the whole-body dose from swimming is based on the assumption that an individual spends 100 hours per year in the water. The dose from boating, picnicking, and other shoreline activities is based on the assumption that an individual spends a total of 500 hours per year at these activities.

The dose to the GI tract and whole body that can be expected for individuals who drink water or eat fish from the Columbia River are listed in Table V-5. Also included are the doses to the thyroid and bone via these pathways. The dose estimates were made by assuming that a 24-hour delay occurs between plant discharge and the consumption of the water and fish. No credit was taken, in the calculation of drinking water dose, for removal of any radionuclides by municipal water treatment plants.

The whole-body dose from swimming in the Columbia River was calculated to be 3.9×10^{-7} mrem/yr, and results primarily from the radioisotopes of barium, cobalt, cesium, iodine, lanthanum, and yttrium in the effluent mix and also from the inhalation of HTO vapor. The dose from shoreline activities and boating results from the deposition of isotopes in the river water in the sediment and beach sand; and, from estimates of the deposition rate, the annual whole-body dose was determined to be about 5.3×10^{-4} mrem.

TABLE V-4. Bioaccumulation factors for Radionuclides in Fresh Water Species [54]

Radionuclides	Fish	Invertebrates	Plants
Cr-51	200	2000	4000
Mn-54	25	40000	10000
Fe-55	300	3200	5000
Co-58	500	1500	1000
Co-60	500	1500	1000
Sr-89	40	700	500
Sr-90	40	700	500
Nb-95	30000	100	1000
Mo-99	100	100	100
Tc-99m	1	25	100
Ru-103	100	2000	2000
Ru-106	100	2000	2000
I-129	1	25	100
I-131	1	25	100
I-133	1	25	100
I-135	1	25	100
Te-132	1000	10	1000
Cs-134	1000	1000	200
Cs-136	1000	1000	200
Cs-137	1000	1000	200
Ba-140	10	200	500
Ce-141	100	1000	10000
Ce-144	100	1000	10000
Heavy elements	100	100	100
All other	100	100	100
H-3	1	1	1

TABLE V-5. Annual Dose from Hanford No. 2 Radioactive Liquid Discharges to the Columbia River

	Dose (mrem/yr)			
	Whole Body	GI Tract	Bone	Thyroid
Drinking water (2200 cc/day)	4.7×10^{-5}	2.4×10^{-5}	8.2×10^{-5}	1.3×10^{-3}
Fish consumption (55 g/day)				
After total mixing*	5.2×10^{-4}	2.0×10^{-4}	8.0×10^{-4}	3.5×10^{-5}
~100 feet from discharge**	6.8×10^{-1}	2.6×10^{-1}	1.1×10^{0}	4.6×10^{-2}
Swimming (100 hr/yr)	3.9×10^{-7}	-	-	-
Boating, picnicking and other shoreline activities (500 hr)	5.3×10^{-4}	-	-	-

*Discharge dilution factor = 1.3×10^{4}.

**Discharge dilution factor = 10.

4. Gaseous Releases

There are five potential sources of radioactive gas in the boiling-water reactor plant: main condenser off-gas (the major activity source contributing more activity than all other sources combined), mechanical vacuum pump off-gas, dry-well and suppression chamber ventilation, turbine gland-seal steam exhaust, and ventilation air from miscellaneous exhaust systems. The safety design basis for off-gas processing is to delay the gas until a sufficient fraction of the radionuclides has decayed.

Table III-3 lists the staff estimates of the quantities of radionuclides which are expected to be released in the gaseous effluents from the plant.

5. Impact of Gaseous Releases

The nearest potential residence to Hanford No. 2 would be approximately 4 miles east of the reactor building. At this location the maximum offsite exposure from the gaseous effluents would be 0.2 mrem/yr to an individual residing at this point for the entire year. In the event that the Hanford Reservation should ever become open for public occupancy, the maximum offsite exposure would occur to an individual resident at the exclusion boundary (1950 meters); the calculated exposure (ground release, 1950 meters, southeast, $\chi/Q = 1.15 \times 10^{-6}$ sec/m^3) for this point is approximately 3 mrem/yr. At the nearest school (K-12 Complex School in Richland, 10.3 miles south-southeast) the dose is estimated to be less than 0.05 mrem/yr. The dose to the population living near the plant was calculated with the meteorological and population data supplied in the applicant's Environmental Report. The projected 1980 population for the 50-mile radius is given in Table II-1. The cumulative population, cumulative dose, and the average dose from gaseous effluents for various radial distances from the plant are presented in Table V-6.

The annual dose from iodine-131 in the thyroid of a child who drinks one liter of milk per day was estimated to be about 2.7 mrem. This dose results from milk that was produced by cows grazing solely at the nearest likely location (immediately across the river) for a 9 month period. The thyroid dose due to milk produced at any other likely location would be below this value.

6. Dose to the General Population

The total annual dose from noble gases to the 213,700 persons who will reside within 50 miles of the plant in 1980 is expected to be about 2.2 man-rem. This corresponds to an average dose to the individual of 1.0×10^{-2} mrem/yr.

The integrated dose from consumption of fish from the Columbia River, assuming that the total 50-mile population consumes 15,000 kg/yr of fish caught in the Columbia River (the total sport fish harvest in the dilution reach), is estimated to be about 4×10^{-4} man-rem. Approximately 40,000 people (residents of Pasco and Richland) receive their drinking water from the Columbia River. The integrated dose from drinking this water is projected to be 1.0×10^{-3} man-rem.

In assessing the total radiological impact of the proposed Hanford No. 2 Plant, one should make a comparison with the annual average radiation dose from natural "background" sources, which EPA lists as 135 mrem/yr to the individual for the State of Washington. These background sources result in a total dose to the 50-mile population of 28,000 man-rem. Thus, operation of the Hanford No. 2 Plant would add only an extremely small increment (2.2 man-rem, primarily from the radioactive noble gas releases, since the man-rem increment due to liquid release is effectively insignificant as seen in the preceding paragraph) to the radiation dose that area residents receive from natural background (28,000 man-rem). Since 10 to 15% fluctuations in the natural background dose at any one location are to be expected it is evident that the imprecision in the value of natural background man-rem greatly exceeds the small dose increment which would be contributed by the plant. Consequently, this increment would be immeasurable and would constitute no demonstrable risk.

E. TRANSPORTATION OF FUEL AND SOLID RADIOACTIVE WASTE

The nuclear fuel for the proposed Hanford No. 2 reactor is slightly enriched uranium in the form of sintered uranium oxide pellets encapsulated in Zircaloy fuel rods. Each year in normal operation of the reactor, about 180 fuel elements will be replaced.

1. Transport of New Fuel

The applicant has indicated that new fuel will be shipped by truck in AEC-DOT approved containers which hold two fuel elements per container. About 15 truckloads will be required each year for replacement fuel and about 24 truckloads for the initial loading. The applicant has indicated the new fuel for the initial loading will come from Wilmington, North Carolina, a shipping distance of about 3000 miles, and the replacement fuel will come from Richland, Washington, a distance of about 10 miles.

2. Transport of Irradiated Fuel

Fuel elements removed from the reactor will be unchanged in appearance and will contain some of the original U-235 (which is recoverable). As a result of the irradiation and fissioning of the uranium, the fuel element will contain large amounts of fission products and some plutonium. As the

TABLE V-6. Cumulative and Average Annual Doses to Population in Regions Surrounding Hanford No. 2 as a Result of the Plant's Gaseous Releases"

Cumulative Radius (Miles)	Cumulative Population (1980 Projection)	Cumulative Dose (Man-Rem)	Average Dose (mrem)
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	20	2.3×10^{-3}	1.1×10^{-1}
10	528	3.0×10^{-2}	5.7×10^{-2}
20	56,320	1.0×10^{0}	1.8×10^{-2}
30	107,000	1.9×10^{0}	1.7×10^{-2}
40	140,000	2.0×10^{0}	1.4×10^{-2}
50	213,700	2.2×10^{0}	1.0×10^{-2}

radioactivity decays, it produces radiation and "decay heat." The amount of radioactivity remaining in the fuel varies according to the length of time after discharge from the reactor. After discharge from a reactor, the fuel elements are placed under water in a storage pool for cooling prior to being loaded into a cask for transport.

The applicant has indicated the irradiated fuel will be shipped either by rail or truck, most probably by rail. The staff assumes the irradiated fuel would be shipped to one of the reprocessing plants in the East, a shipping distance of approximately 3000 miles.

Although the specific cask design has not been identified, the applicant states that the irradiated fuel elements will be shipped in approved casks. The casks will weigh about 30 tons for truck shipment to 100 tons for rail shipment. The applicant estimates 90 truckload or 10 rail carload shipments per year. An equal number of shipments will be required to return the empty casks.

3. Transport of Solid Radioactive Wastes

The applicant has indicated that spent resins and waste evaporator bottoms will be shipped in drums or truck-mounted shipping containers and soft, solid wastes will be compacted in drums for shipment and disposal. The staff has estimated about 50 truckloads of waste each year. The applicant has not indicated which of the approved burial sites he will use. The staff has assumed the applicant will use the burial ground in Benton County so the shipping distance will be only a few miles.

4. Principles of Safety in Transport

The transportation of radioactive material is regulated by the Department of Transportation and the Atomic Energy Commission. The regulations provide protection of the public and transport workers from radiation. This protection is achieved by a combination of standards and requirements applicable to packaging, limitations on the contents of packages and radiation levels from packages, and procedures to limit the exposure of persons under normal and accident conditions.

Primary reliance for safety in transport of radioactive material is placed on the packaging. The packaging must meet regulatory standards[55] established according to the type and form of material for containment, shielding, nuclear criticality safety, and heat dissipation. The standards provide that the packaging shall prevent the loss or dispersal of the radioactive contents, retain shielding efficiency, assure nuclear criticality safety, and provide adequate heat dissipation under normal conditions of transport and under specified accident damage test conditions. The contents of packages not designed to withstand accidents are limited, thereby limiting the risk from releases which could occur in an accident. The contents of the package also must be limited so that the standards for external radiation levels, temperature, pressure, and containment are met.

Procedures applicable to the shipment of packages of radioactive material require that the package be labeled with a unique radioactive-materials label. In transport, the carrier is required to exercise control over radioactive-material packages, including loading and storage in areas separated from persons and limitations on aggregations of packages to limit the exposure of persons under normal conditions. The procedures carriers must follow in case of accident include segregation of damaged and leaking packages from people and notification of the shipper and the Department of Transportation. Radiological assistance teams are available through an inter-Governmental program to provide equipment and trained personnel, if necessary, in such emergencies.

Within the regulatory standards, radioactive materials are required to be safely transported in routine commerce using conventional transportation equipment with no special restrictions on speed of vehicle, routing, or ambient transport conditions. According to the Department of Transportation (DOT), the record of safety in the transportation of radioactive materials exceeds that for any other type of hazardous commodity. DOT estimates approximately 800,000 packages of radioactive materials are currently being shipped in the United States each year. Thus far, based on the best available information, there have been no known deaths or serious injuries to the public or to transport workers due to radiation from a radioactive material shipment.

Safety in transportation is provided by the package design and limitations on the contents and external radiation levels and does not depend on controls over routing. Although the regulations require all carriers of hazardous materials to avoid congested areas wherever practical to do so,[56] in general, carriers choose the most direct and fastest route. Routing restrictions which require use of secondary highways or other than the most direct route may increase the overall environmental impact of transportation as a result of increased accident frequency or severity. Any attempt to specify routing would involve continued analysis of routes in view of the changing local conditions as well as changing of sources of material and delivery points.

5. Exposures during Normal (No Accident) Conditions

a. New Fuel

Since the nuclear radiations and heat emitted by new fuel are small, there will be essentially no effect on the environment during transport under normal conditions. Exposure of individual transport workers is estimated to be less than one millirem (mrem) per shipment. For the 15 shipments, with two drivers for each vehicle, the total dose would be about 0.03 man-rem per year. The radiation level associated with each truckload of cold fuel will be less than 0.1 mrem/hr at six feet from the truck. A member of the general public who spends three minutes at an average distance of three feet from the truck might receive a dose of about 0.005 mrem per shipment. The dose to other persons along the shipping route would be extremely small.

b. Irradiated Fuel

Based on actual radiation levels associated with shipments of irradiated fuel elements, we estimate the radiation level at three feet from the railcar will be about 25 mrem/hr.

Train brakemen might spend a few minutes in the vicinity of the car at an average distance of three feet, for an average exposure of about 0.5 millirem per shipment. With ten different brakemen involved along the route, the annual cumulative dose is estimated to be about 0.05 man-rem for 10 trips.

The average exposure to the individual truckdriver during a 3000-mile shipment of irradiated fuel is estimated to be about 40 mrem. With two drivers on each vehicle, the annual cumulative dose would be about 7.2 man-rem for 90 trips.

A member of the general public who spends three minutes at an average distance of three feet from the truck or railcar, might receive a dose of as much as 1.3 mrem. If ten persons were so exposed per shipment, the annual cumulative dose for the 90 shipments by truck would be about 1.1 man-rem and for the ten shipments by rail, about 0.1 man-rem. Approximately 500,000 persons who reside along the 3000-mile route over which the irradiated fuel is transported might receive an annual cumulative dose of about 1.3 man-rem if transported by truck, and 0.15 if transported by rail. The regulatory radiation level limit of 10 mrem/hr at a distance of six feet from the vehicle was used to calculate the integrated dose to persons in an area between 100 feet and 1/2 mile on both sides of the shipping route. It was assumed that the shipment would travel 200 miles per day and the population density would average 330 persons per square mile along the route in the East and 110 persons per square mile along the route in the West.

The amount of heat released to the air from each cask will vary from about ten kilowatts (kW) for a truck cask to 70 kW for a rail cask. This might be compared to about 50 kW of waste heat which is released from a 100 horsepower truck-engine. Although the temperature of the air which contacts the loaded cask may be increased a few degrees, because the amount of heat is small and is being released over the entire transportation route, no appreciable thermal effects on the environment will result.

c. Solid Radioactive Wastes

Under normal conditions, the average exposure to the individual truckdriver during the 10-mile shipment of solid radioactive waste is estimated to be about 10 mrem. If the same driver were to drive 50 truckloads in a year, he could receive an estimated dose of about 500 mrem during the year. With two drivers on each vehicle, the annual cumulative dose for the 50 shipments would be about 1.0 man-rem. A member of the general public who spends three minutes at an average distance of three feet from the truck might receive a dose of as much as 1.3 mrem. If ten persons were so exposed, the annual cumulative dose would be about 0.01 man-rem. The dose to a person along the route is extremely small and the number of persons who reside along the route is very small so the cumulative dose to persons along the route is extremely small.

F. MONITORING PROGRAMS

1. Biological Monitoring Program

The applicant's biological monitoring program, as specified in the Site Certification Agreement,[10] consists of three phases: (1) a literature review and preoperational sampling phase, (2) a preoperational survey, and (3) an operational monitoring program.

a. The Literature Review and Preliminary Preoperational Sampling Phase

The literature survey will consist of making a summary of past and current published studies on the aquatic environment of the stretch of the Columbia River from the city of Richland, through the Hanford Reservation, up to and including Priest Rapids Dam, as particularly related to the plant.

This literature compilation will be kept up-to-date as publications are issued throughout the history of the project. This literature survey, along with limited preliminary preoperational sampling, will be used as a base for designing the preoperational survey. To the extent that acceptable base points may be established by this work for the site area, subsequent elements in this program may be deleted.

b. <u>The Preoperational Survey</u>

The following is a preliminary description of the preoperational survey.

(1) A bioassay program utilizing simulated temperatures and concentrations of river salts in the anticipated discharge shall be required. The bioassay should simulate temperatures ranging from 85°F downward, incorporating the different concentrations of river salts that may be found in the blowdown. The bioassay will be performed on fish and invertebrate fauna.

(2) The two-year preoperational survey will be of a qualitative and semiquantitative nature and will include the aquatic organisms listed below. The semiquantitative measurements will include:

(a) Catch per unit of effort.

(b) The mean and variance of numbers of organisms obtained in compatible samples. The organisms will include, but not necessarily be limited to:

- juvenile salmon - coho and chinook (sampled by gill net and beach seine);
- juvenile steelhead trout (gill net and beach seine);
- whitefish (gill net, beach seine, and hook and line);
- squawfish (gill net and beach seine);
- an omniverous-feeding form, such as carp, or possibly sturgeon;
- benthic organisms (manual removal by grab and dredge) would receive particular attention as they may be the best indicator organisms; and
- plankton (metered plankton net).

(c) The sampling would be performed at three sites:

- in an area above the intake;
- at the discharge location outside the dilution zone; and
- in an area downstream of the plume.

(d) Pertinent information such as riverflow, dam discharges, counts of up and downstream migrants from other data-gathering sources would be incorporated as is appropriate.

(3) Thermographs will be available at the intake and discharge locations to record fluctuations in temperature. These thermographs will remain for an indeterminate period of time as a part of the operational monitoring.

(4) Seasonal SCUBA observations, if possible, on typical discharge situations will be taken to record any unusual concentration or dispersion of fishes in the area anticipated to be affected by the discharge plume. Similarly, bottom observations might be recorded by photograph, if necessary.

(5) Sampling will be performed initially at each location approximately eight times a year, or as may be required by application of the "gradient concept."

c. Operational Monitoring Program

An operational monitoring program will be developed based on the results from the preoperational monitoring program. This program will be developed by the Supply System and concurred in by the Council (and the AEC).

d. Water Quality Monitoring Program

That portion of the environmental monitoring program associated with water quality will consist of sampling and analysis of water being discharged through the discharge system, sampling and analysis of river water upstream of and at the boundary of the diffusion zone, and analysis of ground water withdrawals.

This portion may be modified with the concurrence of the Council.

(1) Preoperational Monitoring Phase

No sampling is required for this phase.

(2) Operational Monitoring Sampling

(a) Samples to be taken of the discharge in the blowdown line include:

- Quantity, continuous recording;
- Temperature, continuous recording;
- Dissolved oxygen, once per day;
- pH, continuous recording;
- Turbidity, continuous recording;
- Chlorine sample, continuous recording;
- Coliform, once per week; and
- Dissolved solids, once per week.

(b) Samples taken at the diffusion zone boundary and upstream include:

- Temperature, once per month;
- Dissolved oxygen, once per month;
- pH, once per month;
- Turbidity, once per month;
- Chlorine, once per month;
- Coliform, once per month; and
- Dissolved solids, once per month.

Data will be correlated with riverflow and blowdown conditions.

(c) Ground water sampling is to be made of well waters annually and includes measurements of:

- Temperature;
- pH;

- Coliform; and
- Water table elevation.

(d) Results of operational water quality monitoring shall be reported at the following frequencies:

- Blowdown line discharge, monthly;
- Diffusion zone boundary, quarterly;
- Upstream, quarterly; and
- Ground water, annually.

2. Radiological Monitoring Program

Both inplant monitoring and environmental monitoring will be employed in assessing the effects of radioactive discharges. During periods of limited discharge, surveys outside the plant may show few or no statistically significant levels of activity above background. In such cases, inplant monitoring, which serves to assay the level of activity at or near the point of release, yields data from which the environmental impact of the release may be assessed.

The applicant's inplant monitoring system and the environmental monitoring system are described in the Preliminary Safety Analysis Report[57] and the Applicant's Environmental Report.[58]

In brief, the inplant radiation monitoring system is designed to monitor, at critical check points: (a) sources of air-borne radioactivity (stack gas, reactor building atmosphere, waste gas, turbine building ventilation air, and auxiliary building ventilation air); (b) sources of water-borne radioactivity (service water, radwaste liquids, steam, and blowdown cooling water); and (c) sources of radiation to plant personnel, especially gamma radiation but also including alpha and beta radiations (physical areas in the plant in which it is possible for operating personnel to be subjected to radiation of one or more of the above types). The functioning of this inplant monitoring program must meet the requirements of the AEC's Safety Guide 21.[59]

The applicant will initiate a radiological environmental monitoring program at least two years prior to commercial operation of Hanford No. 2. In the implementation of this program, Supply System will obtain the services of a qualified firm for radiological monitoring of the nuclear plant site. The services of the firm will include:

a. Review of existing radiological monitoring programs and preparation of plans that will complement the existing programs.

b. Supervision and training of Supply System personnel for sampling and analysis.

c. Provision for laboratory testing and analyses of the samples taken at pre-established frequencies and from the pre-established media.

d. Submittal of quarterly reports for review by the Supply System.

The final program will be tailored to the prevailing needs for environmental radiological monitoring and may be supplemented by information from the AEC contractors.

The Supply System's radiological monitoring program will include airborne particulate sampling for alpha and beta radioactivity, together with beta and gamma background levels taken on dosimeters at the same locations. If gamma spectroanalysis indicates a need, specific nuclide analyses will be performed.

Terrestrial and aquatic samples will be taken at a frequency deemed appropriate in each case, depending upon weather, growing seasons, animal and fish activity or other considerations.

The goals of the radiological monitoring program will be to establish preoperational radiation levels of natural surroundings, to determine any future effect on the environment of operation of the plant, and to provide a record to prove compliance with regulatory, public health, and safety requirements.

The environmental radiological monitoring program will be coordinated with a meteorological surveillance program to determine sampling locations. Demographic, hydrologic, and geologic data will likewise provide information on necessary sampling locations. The radiological monitoring program will be coordinated with an area ecology program.[60] Sampling and monitoring will be performed as described (by the applicant) below.[61]

The area within ten miles of the site will be monitored for radioactive gases released to the atmosphere. Air sampling locations will be established on site and within population centers within a ten-mile radius of the site, if any should develop in the future. Special attention will be given to the locations of air samplers within five miles of the site. The zone from five to ten miles of the site will be emphasized where populations are more concentrated, especially that portion that is downwind. The ten-mile radius zone includes parts of Franklin and Benton Counties. Air samplers also will be downwind in these areas and in areas of high population densities.

In the terrestrial monitoring part of this program (vegetation, soil, farm products), the area within a ten-mile radius of the Hanford No. 2 Plant will be of primary concern. In Franklin County, the predominant land use is agriculture. The major crops are wheat, alfalfa hay, sugar beets, potatoes, and sweet corn. The major livestock forms are beef cattle, hogs and sheep. In this terrestrial monitoring program particular emphasis will be placed on the collection of the primary food chain components leading to man. Soil, native and cultivated vegetation, and dairy and poultry products (milk and eggs) will be sampled. Also sampled will be the fleshy portions (meat) of domestic animals normally consumed by man - such as chicken, beef cattle, and hogs - and of wildlife - such as deer and pheasants (if available). The terrestrial monitoring program indicated here will be conducted where the then current AEC-sponsored programs do not cover pertinent components.

In the aquatic program, sampling will include ground-water samples as well as surface-water samples from the Columbia River. There are no towns within ten miles of the site, but the Columbia River supplies municipal water for the city of Richland and the intake is located approximately 11 miles downstream. This supply, as well as private well water supplies, will be routinely sampled and analyzed for radioactivity. The aquatic food chain constituents included in this program will be taken from the Columbia River and will include the collection of bottom sediments, bottom organisms (benthos), plankton, periphyton, and fish.

The sampling frequencies will depend upon the sample being collected. For example, air-borne particulates usually will be collected and analyzed weekly; whereas, well waters, surface waters, bottom sediments, bottom organisms, milk and eggs usually will be collected and analyzed monthly or quarterly. Most vegetation and some sediment and soil samples will be collected and analyzed seasonally or annually. The samples will be taken frequently enough to guarantee that the 10 CFR Part 20 and the proposed 10 CFR Part 50 Appendix I guidelines are adequately met.

Radiochemical analyses will be performed using procedures and counting methods equal to or better than those recommended by the U. S. Public Health Service, Bureau of Radiological Health (<u>Radioassay Procedures for Environmental Samples</u>, January, 1967).

Various aspects of the proposed program, including sample type, sample stations, sample frequency and type of analysis, are described in the following sections. The exact station locations are described in the following discussion of sample types.[62] (Symbols and station numbers keying these listings to Figure V-3 have been added, using information from the applicant's Environmental Report.[63])

(1) Background:

a) Gamma Detectors: Triangles 1-3.

The atmosphere will be continuously monitored for gamma radiation, using a gamma detector and a strip chart recorder, at three stations located on the site boundary.

b) Thermoluminescent Dosimeters: Triangles 1-3, Circles 4-10. Background levels of external radiation will be established by exposing thermoluminescent dosimeters (TLD) for various periods of time at 10 air-sampling stations within a 10-mile radius of the site. Four dosimeters will be maintained at each station, one to be changed and read monthly and the remaining three annually.

(2) Air-borne Particulates: Triangle 1-3, Circles 4-10.

Air-borne particulates will be collected on a weekly basis at 10 sampling stations, the filters being changed weekly. The filter housings will be located 6 to 8 feet above ground level to reduce dust loading of the filters and to minimize the influence on sample activity of radon and its daughters emanating from the soil.

(3) Cooling Water:

Cooling water blowdown will be monitored continuously for gamma activity. A weekly sample will be taken for more detailed analysis and for calibration of the continuous gamma monitor.

(4) River Water: Hexagons 1-5.

Sampling of the Columbia River will be performed on a quarterly basis from five locations extending from 5 miles above the plant intake to 15 miles below the plant.

(5) Ground Water and Rainwater: Circle with center dot.

Sampling of ground water will be performed semiannually from wells near the station. The wells are identified by the following numbers: 15-15, 27-8, 24-1, 20-E12, and S6-E14. Rainwater samples will be collected and analyzed.

(6) Vegetation and Livestock Sampling:

a) Natural Vegetation at Air-Sampling Stations: Triangles 1-3, Circles 4-10.

Samples of the leafy portions of natural vegetation available at each of the ten air-sampling stations will be collected throughout the growing season.

b) Food and Feed Crops:

Edible portions of food and feed crops will be sampled at 10 locations within a 10-mile radius of the station. Four of the air-sampling locations will be used along with the milk stations. Three other samples will be collected at random within the 10-mile radius. These samples should be collected throughout the growing season.

c) Food Animal Samples:

Food animal samples will be collected near five air-sampling stations. These food samples need only be a small portion of a large animal and can be obtained from farmers and ranchers as incidental to their personal or commercial butchering.

(7) Soil:

Soil samples will be collected quarterly at five sampling locations.

(8) Sediment Samples:

Samples of the Columbia River bottom sediment will be collected annually at or near the Columbia River water collection stations and at plant locations as may be required by plant design.

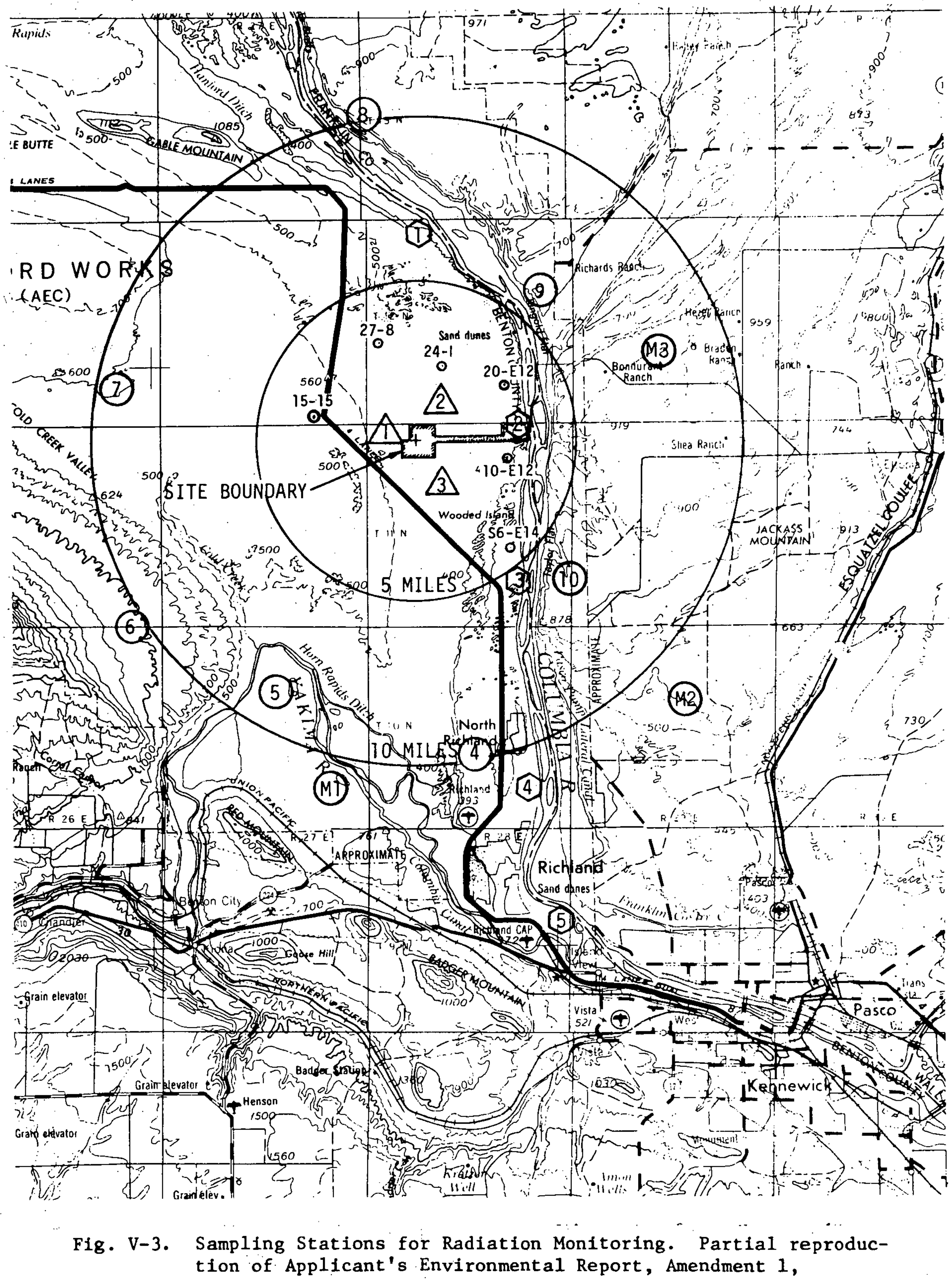


Fig. V-3. Sampling Stations for Radiation Monitoring. Partial reproduction of Applicant's Environmental Report, Amendment 1, Fig. 2.3.6.3-1.

(9) Milk Samples: Circles M-1, M-2, M-3.

Milk will be sampled monthly from the bulk cooling tanks of three milk producers within 10 miles of the plant. In the selection of milk sample locations, an attempt will be make to select established milk producers who are likely to remain in the business of milk production during succeeding years of plant operation. Information regarding sources of feed will also be collected.

(10) Aquatic Biota:

a) Aquatic Life.

Aquatic life will be collected semiannually from the Columbia River at three locations and at any other plant effluent discharge locations as may be required by plant design. An attempt will be made to include fish species that feed from the river bottom and others that feed from the river surface in each sample.

b) Aquatic Vegetation.

Rooted aquatic plants and slime growths on submerged surfaces in littoral locations will be collected semiannually.

(11) Wildlife:

Five rabbits and five resident waterfowl will be collected annually from land adjacent to the plant.

A summary of the proposed program of sampling and analyses is provided in Table V-7.

Concentrations of several radionuclides in Columbia River water at Vernita and Richland, measured prior to and following shutdown on the last once-through cooling production reactor, are listed in Table V-8.

The AEC Hanford Reservation has been monitored for over twenty-five years for effects from the production, reprocessing, and waste storage facilities on the reservation. The Supply System's survey programs will build upon the surveillance work of the AEC, AEC contractors, and other agencies, such as the U. S. Geologic Survey and U. S. Public Health Service. The Supply System, however, assumes responsibility for assuring the continuation of those portions of the AEC program of direct interest to Hanford No. 2 in the event of a discontinuance by the AEC.[63] Existing radiological data will be obtained from those agencies as available. Based upon the Staff's evaluation of the Applicant's proposed radiological monitotitoring program and considering the availability of information from other federal and state programs (existing or planned), it is concluded that the Applicant's program will be adequate, subject to the following:

(1) In order to more clearly discriminate between liquid discharges from Hanford No. 2 and other sources, three additional "close-in" river monitoring stations should be included in the program (as suggested by the Bureau of Sport Fisheries and Wildlife in a letter to the AEC, dated May 31, 1972) -- namely, one-mile upstream, within 500-feet downstream and one-mile downstream of the outfall.

(2) Continual re-evaluations of monitoring locations and analyses should be made during Plant operation, based upon monitoring results obtained. No changes, however, should be made without prior consultation with and approval of the AEC.

TABLE V-7 Summary of Radiological Samplings and Analyses

Sample Type	Stations	Sampling Frequency	Analysis
1. Background			
a) Gamma Sensitive Detector	3	Continuous Recording)	(Background Gamma
b) TLD Dosimeters	10	Monthly ~ Annually)	(Readout and Record (at Noted Frequency
2. Air (particulates & gas)	10	Weekly)	(Gross Alpha (Gross Beta (Gamma Scan & Radioiodine
3. Cooling Water (after plant startup)	1	Continuously)	(Gamma Activity
	1	Weekly)	(Suspended Gross Alpha (Gross Beta (Dissolved Gross Alpha (Gross Beta (Gamma Scan & Tritium
4. River Water	5	Quarterly)	(Suspended Gross Alpha (Gross Beta (Dissolved Gross Alpha (Gross Beta (Gamma Scan & Tritium
5. Ground Water and Rainwater (as available)	6	Semiannually)	(Gross Alpha (Gross Beta
	3	Monthly)	(Gamma Scan & Tritium
6. Vegetation & Livestock			
a) Natural Vegetation	10	3 Samples Annually (during growing season))	(Gross Beta (Sr-90
b) Food and Feed Crops	10	")	(Cs-137 (I-131
c) Food Animals	5	")	(Gamma Scan
7. Soil	5	Quarterly)	(Gross Alpha (Gross Beta (Sr-90 (Cs-137 (Gamma Scan
8. Sediment	5	Quarterly)	(Gross Alpha (Gross Beta (Sr-90 (Gamma Scan
9. Milk	3	Monthly)	(I-131 (Sr-90 (Cs-137 (Elemental Calcium
10. Aquatic Biota			
a) Aquatic Life	3	Semiannually)	(Gross Beta (K-40
b) Rooted Aquatic Plants and Slime	3	Semiannually)	(Sr-90 (Gamma Scan
11. Wildlife			
a) Rabbits	5	Annually)	(Thyroid - I-131 (Femur - Sr-90
b) Waterfowl	5	Annually)	(Gamma Scan (Muscle - P-32, Zr-65

From Preliminary Safety Analysis Report, Amendment 2, Section 2.8, Table 2.8-1.

TABLE V-8. Average Concentrations of Several Radionuclides in Columbia River Water (pCi/l)

Radionuclides	Vernita 1970	Vernita 1971*	Richland 1970	Richland 1971*
H-3	840	1060	1150	690
Sc-46	NA	NA	43	<6
Cr-51	NA	NA	302	109
Zn-65	NA	NA	34	<17
Sr-90	0.44	<0.35	0.50	0.93
Cs-137	NA	<0.41	<12 (4 mo)**	13 (6 mo)
Pu-239	0.55 (2 mo)	0.084	<0.008 (2 mo)	<0.002 (3 mo)
Gross Alpha	0.59	0.83	0.58	1.0
Gross Beta	NA	NA	3.1 (c/m/ml)	<0.02 (c/m/ml)

* Average for 2/71 - 12/71 after last once-through cooling production reactor was shutdown.

** Average for only the number of months shown in parentheses.

NA Not analyzed for this nuclide.

NOTE: Vernita is upriver and Richland is downriver with respect to the formerly-operated Hanford production reactors.

From Private Communication, J. P. Corley to Washington Public Power Supply System, Feb. 3, 1972, as presented in Applicant's Environmental Report, Amendment 2, Table 2.3.6.3-2.

REFERENCES

1. Applicant's Environmental Report, Amendment 1, Section 2.3.3.3, reporting study by R. K. Woodruff et al., "Final Report on a Meteorological Evaluation of the Effects of the Proposed Cooling Towers at the Hanford No. 2 "C" Site on Surrounding Areas," September 1971.

2. The "Final Environmental Statement" for Proposed Fiscal Year 1973 Program, Bonneville Power Administration (March 29, 1972) discusses the 115-kV line. The other two lines will be discussed in future BPA statements.

3. Applicant's Environmental Report, Amendment 2, Question 4.

4. Applicant's Environmental Report, Amendment 2, Question 10.

5. Applicant's Environmental Report, as amended, Section 2.3.6.1.

6. Applicant's Environmental Report, Amendment 1, Section 2.3.2.2.

7. Applicant's Environmental Report, Amendment 1, Section 2.3.3.4.

8. Applicant's Environmental Report, Amendment 2, Question 12.

9. Applicant's Environmental Report, as amended, Section 2.3.4.1.

10. "Site Certification Agreement for Hanford No. 2 between the State of Washington and the Washington Public Power Supply System," May 17, 1972.

11. Applicant's Environmental Report, Amendment 1, Section 2.3.3.7.

12. "Water Quality Criteria," California Water Pollution Control Board, Publ. 3-A, 1971.

13. Applicant's Environmental Report, Amendment 1, Section 2.3.6.4.

14. G. C. Laurence, Comparative Swimming Abilities of Fed and Starved Larval Largemouth Bass (Micropterus salmoides), J. Fish. Biol. 4, 73, 1972.

15. J. R. Brett, Swimming Performance of Sockeye Salmon (Oncorhynchus nerka) in Relation to Fatigue Time and Temperature, J. Fish. Res. Bd. Canada 24, 1731, 1967.

16. C. C. Coutant, Thermal Pollution - Biological Effects, J. Water Pollution Control Fed. 43, 1292, 1971.

17. C. B. Wurtz and C. E. Renn, Water Temperature and Aquatic Life, Edison Elec. Inst. Res. Report, Project RP-49, 1965, 99 pp.

18. L. D. Jensen *et al.*, The Effects of Elevated Temperatures Upon Aquatic Invertebrates, Edison Elec. Inst. Res. Report, Project RP-49, 1969, 232 pp.

19. B. B. Owens, Columbia River Periphyton Communities under Thermal Stress, in BNWL-1550, Vol. 1, No. 2, p. 2.19, Pacific Northwest Laboratories, Richland, Wash., 1971.

20. C. C. Coutant and B. B. Owens, "Productivity of Periphyton Communities under Thermal Stress," in BNWL-1306, Vol. 1, Part 2, p. 3.1, Pacific Northwest Laboratories, Richland, Wash. 1970.

21. R. Patrick, "Some Effects of Temperature on Freshwater Algae," in Biological Aspects of Thermal Pollution, P. A. Krenkel and F. A. Parker (eds.), Vanderbilt Univ. Press, 1969, pp. 199-213.

22. C. D. Becker, Food and Feeding of Juvenile Chinook Salmon in the Central Columbia River in Relation to Thermal Discharges and Other Environmental Features, in BNWL-1528, Pacific Northwest Laboratories, Richland, Wash. 1971.

23. L. L. Curry, "A Survey of Environmental Requirements for the Midge (Diptera: Tendipedidae)," in Biological Problems in Water Pollution, C. M. Tarzwell, (ed.), P. H. S. Publ. No. 999-WP-25, 1965.

24. A. W. Nebeker and A. E. Lemke, Preliminary Studies on the Tolerance of Aquatic Insects to Heated Waters, J. Kansas Ent. Soc. 41, 413, 1968.

25. C. D. Becker, "Response of Columbia River Invertebrates to Thermal Stress," In BNWL-1550, Vol. 1, No. 2, p. 2.17, Pacific Northwest Laboratories, Richland, Wash. 1971.

26. C. C. Coutant, "The Effects of Temperature on the Development of Bottom Organisms," BNWL-714, Pacific Northwest Laboratories, Richland, Wash., 1968.

27. "Columbia River Thermal Effects Study," Vol. I: Biological Effects Studies, Environmental Protection Agency, January 1971, 102 pp.

28. W. D. Pearson and P. R. Franklin, Some Factors Affecting Drift Rates of Bactis and Simuliidae in a Large River, Ecology 49, 75, 1968.

29. Testimony of D. R. Eldred, Dept. of Game, in hearing on Application TPPSEC 71-1 before State of Washington Thermal Power Plant Site Evaluation Council, Exhibit 62.

30. E. O. Salo and R. E. Nakatani, in hearings on Application TPPSEC 71-1 before State of Washington Thermal Power Plant Site Evaluation Council, Exhibit 26.

31. P. A. Olson, Effects of Thermal Increments on Eggs and Young of Columbia River Fall Chinook, BNWL-1538, Pacific Northwest Laboratories, Richland, Wash., 1971.

32. J. R. Brett, Temperature Tolerance of Young Pacific Salmon, Genus Oncorhynchus, J. Fish. Res. Bd. Canada 9, 265, 1952.

33. R. E. Nakatani, in hearings on Application TPPSEC 71-1 before State of Washington Thermal Power Plant Site Evaluation Council, Fig. 13, Exhibit 49.

34. G. R. Snyder and T. H. Blahm, Effects of Increased Temperature on Cold-Water Organisms, J. Water Pollution Control Fed. 43, 890 (1971).

35. M. J. Schneider, Vulnerability of Juvenile Salmonids to Predation Following Thermal Shock, in BNWL-1550, Vol. 1, Part 2, 2.19, Pacific Northwest Laboratories, Richland, Wash., 1971.

36. W. L. Templeton and C. C. Coutant, "Studies on the Biological Effects of Thermal Discharges from the Nuclear Reactors to the Columbia River at Hanford" in Environmental Aspects of Nuclear Power Stations, IAEA-SM-146/33, pp. 591-612, 1971.

37. Applicant's Environmental Report, Amendment 1, Section 2.5.4 p.4.

38. H. T. Kemp et al., "Effect of Chemicals on Aquatic Life," Water Quality Criteria Data Handbook, Vol. 3, 528 pp., 1971.

39. Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, April 1, 1968, Washington, D. C.

40. J. W. Arthur and J. G. Eaton, Chloramine Toxicity to the Amphipod, Gammarus pseudolimimnaeus, and the Fathead Minnow, Pimephales promelas, J. Fish. Res. Bd. Canada 28, 1841, 1971.

41. "Water Quality Criteria Recommendations for Residual Chlorine in Receiving Waters for the Protection of Aquatic Life." Letter to Francis T. Mayo from W. A. Brungs, EPA National Water Quality Laboratory, Duluth, Minn., dated December 20, 1971.

42. Y. Knott and J. Edlis, Effects of Halogens on Algae, Water Res. 3, 251, 1969.

43. A. J. Brook and A. L. Baker, Chlorination at Power Plants: Impact on Phytoplankton Productivity, Science 176, 1414, 1972.

44. J. C. Merkens, Studies on the Toxicity of Chlorine and Chloramines to the Rainbow Trout, Water and Waste Treatment, J. 7, 150, 1958.

45. G. A. Holland et al., Toxic Effects of Organic and Inorganic Pollutants on Young Salmon and Trout, State of Washington, Dept. of Fisheries, Res. Bulletin No. 5, 1964.

46. R. Basch et al., In Situ Investigations of the Toxicity of Chlorinated Municipal Wastewater Treatment Plant Effluents to Rainbow Trout (Salmo gairdneri). Michigan Bureau of Water Management, Department of Natural Resources, Lansing, Michigan. Paper presented at the American Chemical Society on Bioassay Techniques and Environmental Chemistry, September 1971.

47. J. B. Sprague and D. E. Drury, Avoidance Reaction of Salmonid Fish to Representative Pollutants. Adv. in Water Pollution Res., Proc. 4th International Conf., Prague, 1969, Jenkins, S. H. (Ed.), 1969.

48. J. W. T. Dandy, Activity Reponse to Chlorine in the Brook Trout, Salvelinus fontinalis (Mitchill), Can. J. Zool. 50, 405, 1972.

49. S. I. Auerbach, et al., "Understanding the Dynamic Behavior of Radionuclides to the Environment and Implications," in Fourth International Conference on the Peaceful Uses of Atomic Energy, A/CONF-49/P-085 (Session 3.3) Geneva, Switzerland, Sept. 6-16, 1971.

50. W. L. Templeton, et al., "Radiation Effects," in Radioactivity in the Marine Environment, National Academy of Science, Washington, D. C., 1971, pp. 223-239.

51. S. I. Auerbach, "Ecological Considerations in Siting Nuclear Power Plants: The Long-Term Biota Effects Problem," Nuclear Safety 12, 25, 1971.

52. "Report of Committee II (lCPR) on Permissible Dose for Internal Radiation (1959)," Health Physics 3, June 1960.

53. J. K. Soldat, "A Statistical Study of the Habits of Fishermen Utilizing the Columbia River below Hanford," in Environmental Surveillance in the Vicinity of Nuclear Facilities, W. C. Reinig (Ed.) Charles C. Thomas, Publisher, Springfield, Ill., 1970, pp. 302-308.

54. W. H. Chapman et al., "Concentration Factors of Chemical Elements in Edible Aquatic Organisms, UCRL-50564, Lawrence Radiation Laboratory, Berkeley, Calif., December 1968.

55. 10 CFR Part 71, and 49 CFR Parts 173 and 178.

56. 49 CFR, Section 397.1 (d).

57. Preliminary Safety Analysis Report, Sections 2.8, 7.11, 7.12, and 7.13.

58. Applicant's Environmental Report, as amended, Sections 2.3.7.1 and 2.3.6.3.

59. Safety Guide 21, "Measuring and Reporting of Effluents from Nuclear Power Plants," U. S. Atomic Energy Commission, December 29, 1971.

60. Preliminary Safety Analysis Report, Section 2.8, p. 1.

61. Ibid., pp. 2-6.

62. Ibid., pp. 3-6.

63. Applicant's Environmental Report, Amendment 2, Section 2.3.6.3.

64. Application for Washington State Site Certification, Hanford Number Two, 1100 Mw Nuclear Power Plant, January, 1971; Section 025 (2b) - Page 4.

65. "Detailed Statement on the Environmental Considerations by the Responsible Official of the Washington State Thermal Power Plant Site Evaluation Council Related to the Proposed Construction of the Hanford No. 2 Nuclear Power Plant by the Washington Public Power Supply System," Issued January 7, 1972; Supplemented March 24, 1972; Page 52.

66. Hynes, H. B. N., The Ecology of Running Waters, University of Toronto Press, 1970, Page 358.

67. H. H. Scherer, B. J. Ware, C. H. Shih, "Gaseous Effluents Due to EHV Transmission Line Corona," Presented at the IEEE PES Summer Meeting, San Francisco, California, July 9-14, 1972.

68. M. Frydman, A. Levy, and S. E. Miller, "Oxidant Measurements in the Vicinity of Energized 765-kV Lines, "Presented at the IEEE PES Meeting, San Francisco, California, July 9-14, 1972.

VI. ENVIRONMENTAL IMPACT OF POSTULATED ACCIDENTS

A. PLANT ACCIDENTS

Protection against the occurrence of postulated design basis accidents in the Hanford No. 2 Nuclear Power plant is provided through the defense in depth concept of design, manufacture, operation and testing, and the continued quality assurance program used to establish the necessary high degree of assurance for the integrity of the reactor primary system. These aspects are being considered in the staff's safety evaluation for the Hanford No. 2 facility. Off-design conditions that may occur are limited by protection systems which place and hold the power plant in a safe condition. Notwithstanding this, the conservative postulate is made that serious accidents might occur, even though unlikely; and engineered safety features are installed to mitigate the consequences of these postulated events.

The probability of occurrence of accidents and the spectrum of their consequences to be considered from an environmental effects standpoint have been analyzed using estimates of probabilities and realistic fission product release and transport assumptions. For site evaluation in the staff safety review, extremely conservative assumptions are used for the purpose of evaluating the adequacy of engineered safety features and for comparing calculated doses resulting from a hypothetical release of fission products from the fuel against the 10 CFR Part 100 siting guidelines. The computed doses that would be received by the population and environment from actual accidents would be significantly less than those to be presented in the staff safety evaluation.

The Commission issued guidance to applicants on September 1, 1971, requiring the consideration of a spectrum of accidents with assumptions as realistic as the state of knowledge permits. The applicant's response was contained in the Environmental Report Amendments No. 1, 2 and 4, dated Jan. 14, 1972, March 24, 1972 and July 5, 1972.

The applicant's report has been evaluated, using the standard accident assumptions and guidance issued by the Commission as a proposed amendment to Appendix D of 10 CFR Part 50 on December 1, 1971 (Federal Register, Vol. 36, No. 231). Nine classes of postulated accidents and occurrences ranging in severity from trivial to very serious have been identified by the Commission. In general, accidents in the high potential consequence end of the spectrum have a very low occurrence rate, and those on the low potential consequence end are characterized by a higher occurrence rate. The applicant's examples for these classes of accidents are shown in Table VI-1. The examples given are reasonably homogeneous in terms of probability within each class.

Certain assumptions made by the applicant, such as the assumption of an iodine partition factor in the suppression pool during a loss-of-coolant accident and the efficiency assigned to the charcoal filters in the standby gas treatment system, in the staff view, are optimistic; but the use of alternative assumptions does not significantly affect the overall environmental risk.

Staff estimates of the doses which might be received by an individual assumed to be standing at the site boundary in the downwind direction, using the assumptions in the proposed Annex to Appendix D, are presented in Table VI-II. Estimates of the integrated exposure in man-rem that might be delivered to the population within 50 miles of the site are also presented in Table VI-II. These man-rem estimates were based on the projected population (about 214,000) around the site for the year 1980.

To rigorously establish a realistic annual risk, the calculated doses in Table VI-II would have to be multiplied by estimated probabilities. The events in Classes 1 and 2 represent occurrences which are anticipated during plant operation and their consequences, which are very small, are considered within the framework of routine effluents from the plant. Except for a limited amount of fuel failures, the events in Classes 3 through 5 are not anticipated during plant operation; but events of this type could occur sometime during the plant lifetime. Accidents in Classes 6 and 7 and small accidents in Class 8 are of similar or lower probability than accidents in Class 3 through 5 but are still possible. The probability of occurrence of large Class 8 accidents is very small. Therefore, when the consequences indicated in Table VI-II are weighted by probabilities, the environmental risk is very low. The postulated occurrences in Class 9 involve failures more severe than those required to be considered for the design basis for protective systems and engineered safety features. These consequences could be severe; however, the probability of their occurrence is so small that their environmental risk is extremely low. Defense in depth (multiple physical barriers), quality assurance for design, manufacture, and operation, continued surveillance and testing, and conservative design are all applied to provide and maintain the required high degree of assurance that potential accidents in this class are, and will remain, sufficiently small in probability that the environmental risk is extremely low.

The information given in Table VI-II indicates that the realistically estimated radiological consequences of the postulated accidents would result in exposures of an individual assumed to be at the site boundary to concentrations of radioactive materials within the Maximum Permissible

TABLE VI-1

CLASSIFICATION OF POSTULATED ACCIDENTS AND OCCURRENCES

	AEC DESCRIPTION	APPLICANTS EXAMPLE(S)
1.0	Trivial Incidents	None
2.0	Misc. small releases outside Containment	Reactor Coolant leaks (below or just above allowable tech spec limits) outside primary containment or reactor building
3.0	Radwaste System Failures	Any single Equipment Failure or any single operator error
4.0	Events that Release Radioactivity into the Primary System	Fuel defects during transients outside the normal range of plant variables but within expected range of protective equipment and other parameter operation
5.0	Events that release radioactivity into secondary system	Primary Coolant loop to auxiliary cooling system secondary side of heat exchanger leak
6.0	Refueling Accidents inside Containment	Dropping of fuel assembly on reactor core, spent fuel rack or against pool boundary Dropping of spent fuel shipping cask in pool or outside pool
7.0	Accidents to Spent Fuel	Transportation incident involving spent and new fuel Shipment on site but outside Primary Containment or reactor building
8.0	Accident Initiation Events considered in Design-Basis evaluation in the Safety Analysis Report	a. Reactivity Transient b. Loss of Reactor Coolant inside or outside primary containment c. Offgas holdup failure or failure of liquid radwaste tank
9.0	Hypothetical Sequences of failures more severe than Class 8	None

TABLE VI-2

SUMMARY OF RADIOLOGICAL CONSEQUENCES OF POSTULATED ACCIDENTS

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit At Site Boundary 1/	Estimated Dose to population within 50 mile radius, man-rem
1.0	Trivial incidents	2/	2/
2.0	Small releases outside	2/	2/
3.0	Radwaste system failures		
3.1	Equipment leakage or malfunction	0.019	0.8
3.2	Release of waste gas storage tank contents	0.074	3.2
3.3	Release of liquid waste storage tank contents	<0.001	<0.1
4.0	Fission products to primary system (BWR)		
4.1	Fuel cladding defects	2/	2/
4.2	Off-design transients that induce fuel failures above those expected	0.001	0.1
5.0	Fission products to primary and secondary systems (PWR)	N.A.	N.A.
6.0	Refueling accidents		
6.1	Fuel assembly drop into core	<.001	<0.1
6.2	Heavy object drop onto fuel in core	0.003	0.1
7.0	Spent fuel handling accident		
7.1	Fuel assembly drop in fuel storage pool	0.001	<0.1
7.2	Heavy object drop onto fuel rack	0.001	0.1
7.3	Fuel cask drop	0.028	1.2

TABLE VI-2 (contd.)

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit At Site Boundary[1/]	Estimated Dose to populati[on] within 50 mile radius, man-rem
8.0	Accident initiation events considered in design basis evaluation in the safety analysis report		
8.1	Loss-of-coolant accidents inside containment		
	Small break	<0.001	<0.1
	Large break	0.007	2.7
8.1(a)	Break in instrument line outside reactor building	<0.001	<0.1
8.2(a)	Rod Ejection Accident (PWR)	N.A.	N.A.
8.2(b)	Rod drop accident (BWR)	0.001	0.1
8.3(a)	Steamline break (PWR-outside containment)	N.A.	N.A.
8.3(b)	Steamline breaks (BWR)		
	Small break	0.001	<0.1
	Large break	0.003	0.1

1/ Represents the calculated whole body dose as a fraction of 500 mrem (or the equivalent dose to an organ).

2/ These releases will be comparable to the design objective indicated in the proposed Appendix I to 10 CFR Part 50 for routine effluents (i.e., 5 mrem/yr to an individual from either gaseous or liquid effluent).

Concentrations (MPC) listed in Table II of 10 CFR Part 20. The tabulated information also shows that the estimated integrated exposure of the population within 50 miles of the plant from each postulated accident would be much smaller than that from the naturally occurring radioactivity. The exposure from naturally occurring radioactivity corresponds to approximately 71 man-rem per year within 10 miles and approximately 28,000 man-rem/yr within 50 miles of the site. These estimates are based on a natural background level of 0.135 rem/yr. When considered within the probability of occurrence, the annual potential radiation exposure of the population from all the postulated accidents is an even smaller fraction of the exposure from natural background radiation and, in fact, is well within naturally occurring variations in the natural background. It is concluded from the results of the realistic analysis that the environmental risks due to postulated radiological accidents at the Hanford No. 2 Nuclear Power plant are exceedingly small and need not be considered further.

B. TRANSPORTATION ACCIDENTS

Based on recent accident statistics,[1] a shipment of fuel or waste may be expected to be involved in an accident about once in a total of 750,000 shipment-miles. The staff has estimated that only about one in ten of those accidents which involve Type A packages or one in 100 of those involving Type B packages might result in any leakage of radioactive material. In case of an accident, procedures which carriers are required[2] to follow will reduce the consequences of an accident in many cases. The procedures include segregation of damaged and leaking packages from people, and notification of the shipper and the Department of Transportation. Radiological assistance teams are available through an inter-governmental program to provide equipped and trained personnel. These teams, dispatched in response to calls for emergency assistance, can mitigate the consequences of an accident.

1. New Fuel

Under accident conditions other than accidental criticality, the pelletized form of the nuclear fuel, its encapsulation, and the low specific activity of the fuel limit the radiological impact on the environment to negligible levels.

The packaging is designed to prevent criticality under normal and severe accident conditions. To release a number of fuel assemblies under conditions that could lead to accidental criticality would require severe damage or destruction of more than one package, which is unlikely to happen in other than an extremely severe accident.

The probability that an accident could occur under conditions that could result in accidental criticality is extremely remote. If criticality were to occur in transport, persons within a radius of about 100 feet from the accident might receive a serious exposure but beyond that distance, no detectable radiation effects would be likely. Persons within a few feet of the accident could receive fatal or near-fatal exposures unless shielded by intervening material. Although there would be no nuclear explosion, heat generated in the reaction would probably separate the fuel elements so that the reaction would stop. The reaction would not be expected to continue for more than a few seconds and normally would not recur. Residual radiation levels due to induced radioactivity in the fuel elements might reach a few roentgens per hour at three feet. There would be very little dispersion of radioactive material.

2. Irradiated Fuel

Effects on the environment from accidental releases of radioactive materials during shipment of irradiated fuel have been estimated for the situation where contaminated coolant is released and the situation where gases and coolant are released.

a. Leakage of contaminated coolant resulting from improper closing of the cask is possible as a result of human error, even though the shipper is required to follow specific procedures, which include tests and examination of the closed container prior to each shipment. Such an accident is highly unlikely during the life of the plant.

Leakage of liquid at a rate of 0.001 cc per second or about 80 drops per hour is about the smallest amount of leakage that can be detected by visual observation of a large container. If undetected leakage of contaminated liquid coolant were to occur, the amount would be so small that the individual exposure would not exceed a few mrem and only a very few people would receive such exposures.

b. Release of gases and coolant is an extremely remote possibility. In the improbable event that a cask is involved in an extremely severe accident such that the cask containment is breached and the cladding of the fuel assemblies penetrated, some of the coolant and some of the noble gases might be released from the cask.

In such an accident, the amount of radioactive material released would be limited to the available fraction of the noble gases in the void spaces in the fuel pins and some fraction of the low level contamination in the coolant. Persons would not be expected to remain near the accident because of the severe conditions which would be involved, including a major fire. If releases occurred, they would be expected to take place in a short period of time. Only a limited area would be affected. Persons in the downwind region and within 100 feet or so of the accident might receive doses as high as a few hundred millirem. Under average weather conditions, a few hundred square feet might be contaminated to the extent that it would require decontamination (that is, Range I contamination levels) according to the standards[3] of the Environmental Protection Agency.

3. Solid Radioactive Wastes

It is highly unlikely that a shipment of solid radioactive waste will be involved in a severe accident during the life of the plant. If a shipment of low-level waste (in drums) becomes involved in a severe accident, some release of waste might occur but the specific activity of the waste will be so low that the exposure of personnel would not be expected to be significant. Other solid radioactive wastes will be shipped in Type B packages. The probability of release from a Type B package, in even a very severe accident, is sufficiently small that, considering the solid form of the waste and the very remote probability that a shipment of such waste would be involved in a very severe accident, the likelihood of significant exposure would be extremely small.

In either case, spread of the contamination beyond the immediate area is unlikely and, although local cleanup might be required, no significant exposure to the general public would be expected to result.

4. Severity of Postulated Transportation Accidents

The events postulated in this analysis are unlikely but possible. More severe accidents than those analyzed can be postulated and their consequences could be severe. Quality assurance for design, manufacture, and use of the packages, continued surveillance and testing of packages and transport conditions, and conservative design of packages ensure that the probability of accidents of this latter potential is sufficiently small that the environmental risk is extremely low. For those reasons, more severe accidents have not been included in the analysis.

REFERENCES

1. Federal Highway Administration, "1969 Accidents of Large Motor Carriers of Property," Dec. 1970; Federal Railroad Administration Accident Bulletin No. 138, "Summary and Analysis of Accidents on Railroads in the U.S.," 1969; U. S. Coast Guard, "Statistical Summary of Casualties to Commercial Vessels," Dec. 1970.

2. 49 CFR Parts 171.15, 174.566, and 177.861.

3. Federal Radiation Council Report No. 7, "Background Material for the Development of Radiation Protection Standards; Protective Action Guides for Strontium-89, Strontium-90, and Cesium-137," May 1965.

VII. ADVERSE EFFECTS WHICH CANNOT BE AVOIDED

Construction activities will disturb approximately 30 acres and will destroy the habitats of small mammals, principally the desert rodents occupying this area. The limited area of construction and the 480 acres utilized for transmission lines are expected to cause no measurable impact on the wildlife of the large desert-steppe.

During periods in the winter months, operation of the cooling towers may cause an increase in the occurrence of fogging by 12 to 26 hours per year on highways a few miles from the plant where the natural occurrence of fog is up to 38 days per year.

Dredging activities within the river will cause a short-term increase in turbidity and some contribution to the sedimentation in an area downstream of the excavation site. The effects are expected to be localized and will be mitigated by the timing and procedures specified. Sedimentation will occur prior to spawning activities in the downstream areas and is expected to be negligible as compared to the continual contributions from the watershed.

Although the introduction of heated water into an aquatic ecosystem constitutes a significant environmental factor, the possibility of any thermal effects is limited by the small quantity of the blowdown, rapid dilution at the outfall, and the placement of the plume in a turbulent area within the main channel. Chemical and thermal discharges will have some localized effects on sessile benthic organisms in the immediate vicinity of the outfall, but such changes are expected to be negligible and have no measurable effect on the ecological balance of food organisms in this reach of the river. Potentially lethal temperatures for salmonids are restricted to an area within approximately 15 feet of the outfall, with the final increment in the river less than 0.01° F after mixing. The chemical and thermal increments and resulting exposure durations are less than those reported to cause direct lethal or indirect effects, and it is unlikely that effluent discharges will have any adverse impact on the fishery resources. The preoperational studies on the effects of chemical and thermal effluent on fish and invertebrates, are expected to identify any possible interaction or unanticipated effects.

The only consumptive use of river water is for the replenishing cooling tower loss due to evaporation and drift, with the maximum loss about 0.1% of the minimum flow and 0.03% of the annual average river flow.

The operation of the plant will result in a small increase in the radioactivity to the environment during normal operation. The gaseous and liquid radioactive effluents, at the levels projected, are expected to cause no detectable radiological or biological impact in that the resulting doses are within the variance of natural background.

VIII. SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The land to be occupied by the Hanford No. 2 Site has never been used for any productive purpose other than as habitat for wildlife. Only 30 acres of the total 1089 site acreage will be disturbed by construction of buildings and structures and by landscaping. These 30 acres may be restored (dependent upon the final decommissioning procedures adopted) to their original condition after cessation of plant operations.

The maximum consumption of Columbia River water (by evaporation and drift) during operation of the cooling towers will result in a loss of about 37 cfs to downstream river flow (approximately 0.03% of the average river flow or 0.1% of the minimum licensed river flow).[1] This is not a permanent loss to the environment but only a very small change in water distribution. After final termination of plant operation, the river flow will return to normal.

Discharge of heat, chemicals, and radioactive materials to the Columbia River during the lifetime of the plant will cease upon termination of plant operations, with residual accumulated chemical and radiological activities gradually dissipating (due to degradation, decay and/or redistribution) over a somewhat longer period of time. There will be no effect on long-term productivity of the river.

Additions of radioactivity to the atmosphere also will cease at the end of plant operations, although there will be a small incremental long-term impact from some of these additions, due to the presence of some long-lived radionuclides, such as krypton-85 with its half-life of 10.8 years (Section IX).

The impact from increased fog (Section V.A) due to the cooling tower system will cease at end of plant operation.

In summary, the impacts from plant operation are short term (normally coincident with operational lifetime), except for the addition to the inventory of long-lived radionuclides and a possible commitment of a small amount of land.

REFERENCE

1. Applicant's Environmental Report, Amendment 1, p. 3.1.2-7.

IX. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

During the production of power by Hanford No. 2, some of the fuel will be irretrievably lost. Fuel management practices and the actual use made of the plant to meet power needs during the lifetime of the plant will determined the amount of fuel used. Assuming the plant is operated for 35 years at an 85% capacity factor[1] (with a discharge fuel containing 0.625% U-235), approximately 1600 tons of uranium enriched to 2.58% U-235 (corresponding to approximately 7200 tons of natural uranium feed to a gaseous diffusion plant operating with a tails assay of 0.2% U-235) will be required during the lifetime of the plant. The nuclear fuel cycle is designed to allow for recovery of both the unused uranium in the fuel and the generated plutonium. Thus, even though a portion of the uranium is irretrievably lost, at the same time, a new product, plutonium, can be recovered for subsequent use in reactor fuels. The applicant has estimated[2] that if the plutonium generated in the plant is recycled for use in the plant, the required U-235 content of the fuel can be lowered to 2.2% U-235, resulting in a 22% decrease in requirements for natural uranium and for separation work.

Since some of the structural components of the reactor facilities will become highly radioactive through activation (and contamination), they will not be salvageable. The storage of these components, as well as other radioactive wastes (including those produced and accumulated during operation of the plant) will require permanent commitment of some land on- and/or off site, depending upon the decommissioning (dismantling) procedures applied to this plant.

According to a compilation by M. Eisenbud,[3] 116 U. S. reactors have been shut down or dismantled, of which six were civilian nuclear power plants. These six plants are: Hallam Nuclear Power Facility, Carolinas Virginia Tube Reactor (CVTR), Boiling Nuclear Superheater (BONUS) Power Station, Pathfinder Reactor, Piqua Reactor, and the Elk River Reactor.

There are several alternatives which can be and have been used in the decommissioning of reactors: (1) Remove the fuel (possibly followed by decontamination procedures); seal and cap the pipes; and establish (fencing) an exclusion area around the facility. The Piqua decommissioning operation was typical of this approach. (2) In addition to the steps outlined in (1), remove the superstructure and encase in concrete all radioactive portions which remain above ground. The Hallam decommissioning operation was of this type. (3) Remove the fuel, all superstructure, the reactor vessel and all contaminated equipment and facilities, and finally fill all cavities with clean rubble topped with earth to grade level. This last procedure is being applied to the decommissioning of the Elk River Reactor. The Final Environmental Statement[4] for the dismantling operation of the Elk River Reactor concluded that the dismantling "is not expected to result in any significant environmental impact." Alternative decommissioning procedures (1) and (2) would require long-term surveillance of the reactor site. After a final check to assure that all reactor-produced radioactivity has been removed, alternative (3) would not require any subsequent surveillance.

If it is decided that the area occupied by the reactor facilities should be placed on permanent or long-term restrictive access, that area (considering the total area occupied by all the buildings and structures, a maximum of 20 to 30 acres) would be unavailable for other uses; however, this does not preclude complete removal of contaminated materials at a later date. Nevertheless the major portion of the site (including the transmission line rights-of-way) could be reclaimed for other purposes if desirable. Up to the present, the land never has been used for any productive purpose.

Some materials used in construction and the chemicals used in the operation of the plant may be regarded as irretrievably committed, since there is little or no chance of their recovery or reuse. The amounts used, however, will be extremely small in comparison to available supplies.

Operation of the plant according to present plans will result in the addition of a relatively small amount (with respect to quantity and resulting dose - see Sections III.D and V.D) of moderately long-lived radioactive material to the environment, such as Kr-85 and H-3.

REFERENCES

1. Applicant's Environmental Report, Amendment 1, Table 3.1.2.5-1.

2. Applicant's Environmental Report, Amendment 3, p. 2.7-2.

3. M. Eisenbud, "Review of USA Power Reactor Operating Experience," presented as SM-146/15 at the IAEA Symposium on Environmental Aspects of Nuclear Power Stations, New York, August 10-14, 1970.

4. Final "Environmental Statement, Elk River Dismantling," WASH-1516, U. S. Atomic Energy Commission, May 1972.

X. THE NEED FOR POWER

Electric energy needs for the Pacific Northwest are coordinated by the Joint Power Planning Council composed of four private utilities, 104 publically owned agencies, and the Bonneville Power Administration. Studies made of the West Group Area, comprising the states of Washington, Oregon, Idaho, and part of Montana, show that loads are expected to approximately triple over the next 20 years. Part of this increase can be attributed to a growing population, but per capita increases in consumption of electricity are also expected for several reasons. From 1950 to 1970, the number of residential consumers grew by 85 percent while their electric energy consumption increased by a factor of five. This trend is expected to continue as personal income rises and improved living conditions are realized, including greater use of electric heat for homes and the use of more electricity-consuming products. Similarly, commercial customers are expected to increase along with a rise in use of electricity per commercial consumer as has happened in the past. Industrial use of electric energy in the Northwest nearly quadrupled between 1950 and 1970, primarily because of greater usage of electrical equipment. By 1990, an increase of more than 2-1/2 times the 1970 consumption is forecasted. Although representing only a small fraction of the total load, irrigation represents a rapidly growing segment of the power demand. Irrigation loads increased almost 30 times from 1950 to 1970 and are expected to multiply threefold in the next 20 years. Significant increases in use of electricity for pollution abatement is also predicted. Table X-1 summarizes the actual and estimated power requirements by consumer categories in the West Group Area.

To meet the anticipated demands for power as required by law, the utilities of the Northwest, in cooperation with the Federal Government, devised the Hydro-Thermal Power Program providing for integrated use of facilities. Under this plan, the Federal Government will provide most of the high-voltage bulk transmission facilities, hydroelectric peaking capacity, and reserves. Non-Federal participants will provide low-voltage distribution systems and thermal generating plants. The Hydro-Thermal Power Program was approved by the Secretary of the Interior, and then by President Nixon in October 1969. The Public Works Appropriations Act of 1971 provides Congressional approval for the program through 1981.

The Pacific Northwest region's power requirements have been supplied almost entirely by hydroelectric generating plants. Within a few years, however, almost all economically feasible hydro resources will have been developed, and thermal plants will be required to meet growing demands. "Most hydro plants will be operated continually; however, most of the time they will

TABLE X-1. Electric Power Requirements by Major Consumer Categories in the Pacific Northwest (West Group Area)

	Actual			Estimated	
	1950	1960	1970	1980	1990
Population*	4,674,671	5,489,729	6,435,000	7,104,000	8,311,000
No. Domestic Consumers	1,072,628	1,406,903	1,985,569	2,461,000	3,161,000
No. Commercial Consumers	140,401	176,807	241,860	310,000	399,000
KWH Per Consumer					
Domestic	5,112	9,841	13,831	19,300	24,600
Commercial	16,799	29,143	50,035	72,600	95,900
Energy Sales (billions of kwh)					
Domestic	5.5	13.8	27.5	47.5	77.7
Commerical	2.4	5.2	12.1	22.5	38.3
Industrial	11.1	22.3	44.1	74.7	118.0
Irrigation	0.1	1.0	2.6	5.0	9.0
Other	0.6	0.8	1.4	2.0	5.0
Total	19.7	43.1	87.7	151.7	248.0
Losses	3.1	4.7	9.6	15.2	24.5
Total Requirements	22.8	47.8	97.3	166.9	272.5
Ten Year Annual Growth Rates		7.7%	7.5%	5.5%	5.0%

* States of Washington, Oregon, Idaho, and western Montana.
From the Hydro-Thermal Power Program: A Status Report, Bonneville Power Administration, Dec. 1971, p. 3.

perform at less than full capacity. Thermal plants, on the other hand, will normally be operating at close to full capacity continuously to serve base load except when they are down for maintenance or when surplus hydro is available for fuel displacement."[1] Hanford No. 2 is the fourth thermal plant designated under the Hydro-Thermal Power Program. The installation schedule for thermal projects under the Program is shown in Table X-2.

The contribution of the proposed Hanford No. 2 Plant to the region's power resources is shown in Table X-3. The hydroelectric generation capability shown in this table is based on "critical hydro conditions," the historical low water flow, giving a minimum assured value of generating capacity. The amount of water available at the dams for generating power is the critical factor, not the installed generating facilities. In 1977-1978 when Hanford No. 2 is scheduled for operation, a surplus is predicted for both peak and average energy resources. Without Hanford No. 2, the peaking capacity would still exceed needs, but energy supply would be deficient. In all subsequent years, energy resources are deficient with Hanford No. 2 on line, and peaking capacity falls below requirements starting in 1980-1981.

An agreement among major systems of the West Group Area provides for capacity reserves sufficient to protect against loss of load to the extent that the probability of load loss in a Contract Year shall be no greater than the equivalent of one day in twenty years. Forced outage reserves of 2,042 megawatts are needed in the 1977-78 winter peak load period to meet this requirement. A gross reserve margin to provide for errors in load forecasts, scheduled maintenance and other contingencies will be 4,756 megawatts in the winter of 1977-78 (including the forced outage reserve) with Hanford No. 2 Unit in operation. This is 18.0 per cent of peak load. Without Hanford No. 2, the gross reserve margin will be 3,656 megawatts or 13.8 per cent of peak load.

TABLE X-2. Installation Schedule for Thermal Projects, West Group Area*

Plant No.	Plant Name	Type of Fuel	Rating** Unit	Rating** Mw	Date Scheduled+	Sponsor
1	Centralia	Coal	1	700	Sept. 1971	PP&L Co. &
			2	700	Sept. 1972	WWP Co.
2	Trojan	Nuclear	1	1130	Sept. 1974	PGE Co.
3	Jim Bridger	Coal	2	500	Sept. 1975	PP&L Co.
			3	500	Sept. 1976	PP&L Co.
4	Hanford No. 2	Nuclear		1100	Sept. 1977	WPPSS
5	–	Thermal		1100	Sept. 1978	–
6	–	Thermal		1100	Sept. 1979	–
7	–	Thermal		1100	Sept. 1980	–
8	–	Thermal		1100	Feb. 1982	–
9	–	Thermal		1100	Sept. 1982	–
10	–	Thermal		1200	Feb. 1984	–
11	–	Thermal		1200	Feb. 1985	–
12	–	Thermal		1200	Feb. 1986	–
13	–	Thermal		1500	Mar. 1987	–
14	–	Thermal		1500	Mar. 1988	–
15	–	Thermal		1500	Feb. 1989	–
16	–	Thermal		1500	Feb. 1990	–
17	–	Thermal		1500	May 1990	–
18	–	Thermal		1500	July 1991	–
19	–	Thermal		1500	Jan. 1992	–

* All information for plants 5 through 17 is tentative.

** Size of some units may vary from that forecast if a different type of fuel and/or location is selected.

\+ Schedules may be rearranged between projects depending on needs of sponsoring utilities.

From the Hydro-Thermal Power Program: A Status Report, Bonneville Power Administration, Dec. 1971.

TABLE X-3. Summary of Loads and Resources

West Group Area of Northwest Power Pool
Thermal Planning Report

Figures are January Peak and Critical Period Average Energy in Megawatts

	1972-73		1973-74		1974-75		1975-76		1976-77	
	Pk	Avg	Pk	Avg	Pk	Avg	Pk	Avg	Pk	Avg
1. Critical Period - Months		20		42-1/2		42-1/2		42-1/2		42-1/2
REQUIREMENTS										
2. Area Firm Loads	17,983	11,732	19,286	12,469	20,606	13,206	21,841	13,960	22,989	14,603
3. Firm Exports 1/	2,286	1,206	2,412	1,288	2,350	1,121	2,058	695	2,026	678
4. Total Firm Load	20,269	12,938	21,698	13,757	22,956	14,327	23,899	14,655	25,015	15,281
5. Potential Firm Industry	-	-	-	-	-	-	-	-	-	-
6. Reserves for Load Growth 2/	-	-	-	-	574	313	477	320	481	351
7. Total Firm Requirements	20,269	12,938	21,698	13,757	23,530	14,640	24,376	14,975	25,496	15,632
8. BPA Peak Non-Firm Industrial Loads 3/	708	-	596	-	1,054	-	1,143	-	1,143	-
9. Total Area Requirements	20,977	12,938	22,294	13,757	24,584	14,640	25,519	14,975	26,639	15,632
RESOURCES										
10. Hydro 4/	20,064	10,781	20,521	11,380	21,464	11,550	23,763	11,863	23,973	11,897
11. Imports 5/	436	465	789	692	421	405	211	480	211	480
12. Existing Thermal & Miscellaneous 6/	504	332	458	264	458	256	458	256	458	256
13. Hanford #1 7/	-	493	-	471	-	-	-	-	-	-
14. Centralia	1,400	933	1,400	1,194	1,400	1,188	1,400	1,188	1,400	1,222
15. PGE Combustion Turbines 8/	-	-	385	14	385	14	385	14	385	14
16. Trojan	-	-	-	-	1,130	825	1,130	839	1,130	968
17. Jim Bridger	-	-	-	-	-	-	500	352	1,000	780
18. Colstrip	-	-	-	-	-	-	175	148	350	298
19. Hanford #2	-	-	-	-	-	-	-	-	-	-
20. Gross Resources	22,404	13,004	23,553	14,015	25,258	14,238	28,022	15,140	28,907	15,915
21. Forced Outage Reserves 9/	(1,235)	(15)	(1,274)	(12)	(1,490)	(12)	(1,706)	(11)	(1,819)	(12)
22. Hydro Maintenance	(81)	(27)	(84)	(37)	(89)	(39)	(97)	(38)	(99)	(38)
23. Net Firm Resources	21,088	12,962	22,195	13,966	23,679	14,187	26,219	15,091	26,989	15,865
24. Net Firm Surplus or (Deficit) (23-4)	819	24	497	209	723	(140)	2,320	436	1,974	584
25. Total Firm Surplus or (Deficit) (23-7)	819	24	497	209	149	(453)	1,843	116	1,493	233
26. New Potential Hydro	-	-	-	-	-	-	-	-	-	-
27. Reserves Provided by BPA Non-Firm Ind. Loads	377	-	343	-	371	-	429	-	434	-
28. Total Resources	21,465	12,962	22,538	13,966	24,050	14,187	26,648	15,091	27,423	15,865
29. Surplus or (Deficit) Total Load (28-9)	488	24	244	209	(534)	(453)	1,129	116	784	233
30. BPA Non-Firm Industrial Loads	708	547	596	471	1,054	948	1,143	1,090	1,143	1,103
31. Other Non-Firm Area Loads	109	77	105	74	136	91	142	100	143	102
32. Total Area Non-Firm Load	817	624	701	545	1,190	1,039	1,285	1,190	1,286	1,205

	1977-78		1978-79		1979-80		1980-81		1981-82	
	Pk	Avg	Pk	Avg	Pk	Avg	Pk	Avg	Pk	Avg
1. Critical Period - Months		42-1/2		42-1/2		42-1/2		42-1/2		42-1/2
REQUIREMENTS										
2. Area Firm Loads	24,373	15,426	25,656	16,182	27,045	16,989	28,486	17,787	29,940	18,669
3. Firm Exports 1/	2,049	658	1,973	596	1,977	594	1,988	590	1,572	424
4. Total Firm Load	26,422	16,084	27,629	16,778	29,022	17,583	30,474	18,377	31,512	19,093
5. Potential Firm Industry	-	-	65	57	103	94	203	193	203	193
6. Reserves for Load Growth 2/	396	359	428	394	573	389	727	435	855	445
7. Total Firm Requirements	26,818	16,443	28,122	17,229	29,698	18,066	31,404	19,005	32,570	19,731
8. BPA Peak Non-Firm Industrial Loads 3/	1,196	-	1,218	-	1,321	-	1,354	-	1,354	-
9. Total Area Requirements	28,014	16,443	29,340	17,229	31,019	18,066	32,758	19,005	33,924	19,731
RESOURCES										
10. Hydro 4/	25,117	11,902	27,169	11,876	27,265	11,858	27,253	11,831	27,635	11,890
11. Imports 5/	211	487	211	511	211	512	211	514	211	518
12. Existing Thermal & Miscellaneous 6/	485	281	485	281	485	281	485	281	485	281
13. Hanford #1 7/	-	-	-	-	-	-	-	-	-	-
14. Centralia	1,400	1,188	1,400	1,188	1,400	1,222	1,400	1,188	1,400	1,188
15. PGE Combustion Turbines 8/	385	14	385	14	385	14	385	14	385	14
16. Trojan	1,130	974	1,130	974	1,130	974	1,130	974	1,130	974
17. Jim Bridger	1,000	850	1,000	850	1,000	850	1,000	850	1,000	850
18. Colstrip	350	298	350	298	350	298	350	298	350	298
19. Hanford #2	1,100	606	1,100	818	1,100	930	1,100	948	1,100	948
20. Gross Resources	31,178	16,600	33,230	16,810	33,326	16,939	33,314	16,898	33,696	16,961
21. Forced Outage Reserves 9/	(2,042)	(13)	(2,145)	(14)	(2,149)	(13)	(2,149)	(14)	(2,167)	(13)
22. Hydro Maintenance	(101)	(37)	(103)	(37)	(107)	(37)	(112)	(36)	(113)	(36)
23. Net Firm Resources	29,035	16,550	30,982	16,759	31,070	16,889	31,053	16,848	31,416	16,912
24. Net Firm Surplus or (Deficit) (23-4)	2,613	466	3,353	(19)	2,048	(694)	579	(1,529)	(96)	(2,181)
25. Total Firm Surplus or (Deficit) (23-7)	2,217	107	2,860	(470)	1,372	(1,177)	(351)	(2,157)	(1,154)	(2,819)
26. New Potential Hydro	-	-	-	-	-	-	-	-	-	-
27. Reserves Provided by BPA Non-Firm Ind. Loads	545	-	597	-	599	-	599	-	576	-
28. Total Resources	29,580	16,550	31,579	16,759	31,669	16,889	31,652	16,848	31,992	16,912
29. Surplus or (Deficit) Total Load (28-9)	1,566	107	2,239	(470)	650	(1,177)	(1,106)	(2,157)	(1,932)	(2,819)
30. BPA Non-Firm Industrial Loads	1,196	1,177	1,218	1,184	1,321	1,285	1,354	1,317	1,354	1,317
31. Other Non-Firm Area Loads	147	105	148	105	153	110	156	112	157	113
32. Total Area Non-Firm Load	1,343	1,282	1,366	1,289	1,474	1,395	1,510	1,429	1,511	1,430

	1982-83		1983-84		1984-85		1985-86		1986-87	
	Pk	Avg	Pk	Avg	Pk	Avg	Pk	Avg	Pk	Avg
1. Critical Period - Months		42-1/2		42-1/2		42-1/2		42-1/2		42-1/2
REQUIREMENTS										
2. Area Firm Loads	31,517	19,578	33,161	20,531	34,922	21,561	36,772	22,657	38,755	23,812
3. Firm Exports 1/	1,586	232	1,420	168	1,410	164	1,384	113	1,366	106
4. Total Firm Load	33,103	19,810	34,581	20,699	36,332	21,725	38,156	22,770	40,121	23,918
5. Potential Firm Industry	383	360	483	459	583	558	683	657	683	657
6. Reserves for Load Growth 2/	1,028	468	1,188	502	1,374	534	1,570	567	1,768	598
7. Total Firm Requirements	34,514	20,638	36,252	21,660	38,289	22,817	40,409	23,994	42,572	25,173
8. BPA Peak Non-Firm Industrial Loads 3/	1,315	-	1,342	-	1,375	-	1,408	-	1,408	-
9. Total Area Requirements	35,829	20,638	37,594	21,660	39,664	22,817	41,817	23,994	43,980	25,173
RESOURCES										
10. Hydro 4/	27,724	11,864	27,996	11,898	27,996	11,897	27,996	11,898	27,996	11,898
11. Imports 5/	211	521	211	521	211	514	211	498	211	487
12. Existing Thermal & Miscellaneous 6/	485	281	485	281	485	281	485	281	485	281
13. Hanford #1 7/	-	-	-	-	-	-	-	-	-	-
14. Centralia	1,400	1,222	1,400	1,188	1,400	1,188	1,400	1,222	1,400	1,188
15. PGE Combustion Turbines 8/	385	14	385	14	385	14	385	14	385	14
16. Trojan	1,130	974	1,130	974	1,130	974	1,130	974	1,130	974
17. Jim Bridger	1,000	850	1,000	850	1,000	850	1,000	850	1,000	850
18. Colstrip	350	298	350	298	350	298	350	298	350	298
19. Hanford #2	1,100	948	1,100	948	1,100	948	1,100	948	1,100	948
20. Gross Resources	33,785	16,972	34,057	16,972	34,057	16,964	34,057	16,983	34,057	16,938
21. Forced Outage Reserves 9/	(2,170)	(14)	(2,184)	(13)	(2,186)	(14)	(2,185)	(13)	(2,185)	(14)
22. Hydro Maintenance	(115)	(36)	(115)	(36)	(115)	(36)	(115)	(36)	(115)	(36)
23. Net Firm Resources	31,500	16,922	31,758	16,923	31,756	16,914	31,757	16,934	31,757	16,888
24. Net Firm Surplus or (Deficit) (23-4)	(1,603)	(2,888)	(2,823)	(3,776)	(4,576)	(4,811)	(6,399)	(5,836)	(8,364)	(7,030)
25. Total Firm Surplus or (Deficit) (23-7)	(3,014)	(3,716)	(4,494)	(4,737)	(6,533)	(5,903)	(8,652)	(7,060)	(10,815)	(8,285)
26. New Potential Hydro	-	-	500	44	1,500	133	2,600	231	3,600	320
27. Reserves Provided by BPA Non-Firm Ind. Loads	578	-	578	-	578	-	578	-	578	-
28. Total Resources	32,078	16,922	32,836	16,967	33,834	17,047	34,935	17,165	35,935	17,208
29. Surplus or (Deficit) Total Load (28-9)	(3,751)	(3,716)	(4,758)	(4,693)	(5,830)	(5,770)	(6,882)	(6,829)	(8,045)	(7,965)
30. BPA Non-Firm Industrial Loads	1,315	1,276	1,342	1,305	1,375	1,338	1,408	1,370	1,408	1,370
31. Other Non-Firm Area Loads	155	111	155	111	156	111	156	111	157	112
32. Total Area Non-Firm Load	1,470	1,387	1,497	1,416	1,531	1,449	1,564	1,481	1,565	1,482

	1987-88		1988-89		1989-90		1990-91		1991-92	
	Pk	Avg	Pk	Avg	Pk	Avg	Pk	Avg	Pk	Avg
1. Critical Period - Months		42-1/2		42-1/2		42-1/2		42-1/2		42-1/2
REQUIREMENTS										
2. Area Firm Loads	40,847	25,030	43,120	26,340	45,504	27,735	48,054	29,210	50,713	30,763
3. Firm Exports 1/	1,346	99	1,344	99	1,364	99	1,349	99	1,302	99
4. Total Firm Load	42,193	25,129	44,464	26,439	46,868	27,834	49,403	29,309	52,015	30,862
5. Potential Firm Industry	723	693	752	719	752	719	852	818	892	854
6. Reserves for Load Growth 2/	1,982	641	2,213	684	2,453	725	2,717	766	2,987	821
7. Total Firm Requirements	44,898	26,463	47,429	27,842	50,073	29,278	52,972	30,893	55,894	32,537
8. BPA Peak Non-Firm Industrial Loads 3/	1,422	-	1,432	-	1,432	-	1,465	-	1,475	-
9. Total Area Requirements	46,320	26,463	48,861	27,842	51,505	29,278	54,437	30,893	57,369	32,537
RESOURCES										
10. Hydro 4/	27,996	11,898	27,996	11,899	27,996	11,897	27,996	11,899	27,996	11,897
11. Imports 5/	211	474	211	474	211	474	211	474	211	474
12. Existing Thermal & Miscellaneous 6/	485	281	485	281	485	281	485	281	485	281
13. Hanford #1 7/	-	-	-	-	-	-	-	-	-	-
14. Centralia	1,400	1,188	1,400	1,222	1,400	1,188	1,400	1,188	1,400	1,222
15. PGE Combustion Turbines 8/	385	14	385	14	385	14	385	14	385	14
16. Trojan	1,130	974	1,130	974	1,130	974	1,130	974	1,130	974
17. Jim Bridger	1,000	850	1,000	850	1,000	850	1,000	850	1,000	850
18. Colstrip	350	298	350	298	350	298	350	298	350	298
19. Hanford #2	1,100	948	1,100	948	1,100	948	1,100	948	1,100	948
20. Gross Resources	34,057	16,925	34,057	16,960	34,057	16,924	34,057	16,926	34,057	16,958
21. Forced Outage Reserves 9/	(2,185)	(13)	(2,184)	(14)	(2,184)	(13)	(2,185)	(14)	(2,185)	(13)
22. Hydro Maintenance	(115)	(36)	(115)	(36)	(115)	(36)	(115)	(36)	(115)	(36)
23. Net Firm Resources	31,757	16,876	31,758	16,910	31,758	16,875	31,757	16,876	31,757	16,909
24. Net Firm Surplus or (Deficit) (23-4)	(10,436)	(8,253)	(12,706)	(9,529)	(15,110)	(10,959)	(17,646)	(12,433)	(20,258)	(13,953)
25. Total Firm Surplus or (Deficit) (23-7)	(13,141)	(9,587)	(15,671)	(10,932)	(18,315)	(12,403)	(21,215)	(14,017)	(24,137)	(15,628)
26. New Potential Hydro	4,800	427	6,100	542	7,400	658	8,800	782	10,300	916
27. Reserves Provided by BPA Non-Firm Ind. Loads	578	-	578	-	578	-	578	-	578	-
28. Total Resources	37,135	17,303	38,436	17,452	39,736	17,533	41,135	17,658	42,635	17,825
29. Surplus or (Deficit) Total Load (28-9)	(9,185)	(9,160)	(10,425)	(10,390)	(11,769)	(11,745)	(13,302)	(13,235)	(14,734)	(14,712)
30. BPA Non-Firm Industrial Loads	1,422	1,370	1,432	1,392	1,432	1,392	1,465	1,425	1,475	1,434
31. Other Non-Firm Area Loads	157	112	158	112	158	112	158	112	158	112
32. Total Area Non-Firm Load	1,579	1,482	1,590	1,504	1,590	1,504	1,623	1,537	1,633	1,546

March 24, 1972

1/ Firm exports include deliveries under CSPE and peak/energy exchange contracts with California utilities; deliveries to Central Valley Project from Centralia; PGE Co. exchange contract with Southern California Edison Co.; WWP Co. contracts with Idaho Power Co. and Montana Power Co.; BPA wheeling payments to Idaho Power Co.; and BPA contracts with Montana Power Co. for headwater storage payments, geographic preference, wheeling payments, and Hanford exchange.

2/ Peak load growth reserves are computed as 10% of area firm loads less estimated forced outage reserves. Energy load growth reserves are computed as one-half year's load growth of utility-type loads.

3/ Industrial interruptible loads not included above in line 2.

4/ Hydro resources include Seattle City Light's High Ross plant starting in 1983-84. Pending results of hearings the increases in capability could be accelerated to 1975-76.

5/ Imports include energy return under peak/energy exchange contracts with California utilities; PGE Co. exchange contract with Southern California Edison Co.; PP&L Co. transfers from Wyoming and contracts with Idaho Power Co.; WWP Co. contracts with Idaho Power Co. and Montana Power Co.; BPA-PGE-PP&L-So. Cal. Edison Co. contract in 1973-74; and imports from Montana Power Co. for delivery to U.S. Indian Irrigation District.

6/ Existing thermal and miscellaneous includes 54 megawatts peak and 52 megawatts energy for Puget Sound Power and Light Company's two combustion turbines with installation dates of September 1973 and July 1977.

7/ Hanford No. 1 capabilities are based on production of 4.0 billion kilowatt-hours per year through 1973-74. The plant is assumed to be shut down thereafter. However, if it is determined that it is feasible to convert the plant to power-only operation, the estimated additional energy capabilities which could be available are: 1974-75 - 142 mw; 1975-76 - 454 mw; 1976-77 - 295 mw; 1977-78 - 616 mw; 1978-79 and thereafter - 654 mw. The plant is considered not dependable as a peaking resource.

8/ Combustion turbine energy production is based on use as a peaking resource.

9/ Estimated forced outage reserves on peak are computed as 5% of hydro, existing thermal and scheduled combustion turbine capacity and 15% of installed peak capability of new large thermal plants. Forced outage reserves on energy are computed as 5% of existing thermal capability.

NOTE: Energy capabilities of new large thermal plants are computed on the basis of 85% annual plant factor for private utility shares. Public agency and net-billed Federal shares are computed on the basis of a 65% annual plant factor for the first full year of operation, 75% for the second full year, and 85% thereafter.

From Long Range Projection of Power Loads and Resources for Thermal Planning, Pacific Northwest Utility Conference Committee, March 24, 1972.

REFERENCE

1. The Hydro-Thermal Power Program, A Status Report, prepared by the Bonneville Power Administration, U. S. Dept. of the Interior, Dec. 1971, p. 25.

XI. ALTERNATIVES TO THE PROPOSED ACTION AND COST-BENEFIT ANALYSIS OF THEIR ENVIRONMENTAL EFFECTS

A. SUMMARY OF ALTERNATIVES

1. Abandonment of the Project

An alternative to be considered in evaluating the impact of plant construction and operation is abandoning the project.

Aspects of this are the financial investment sunk in the facility, the environmental impact of alternative power sources, and the costs of delaying the date of availability of power from alternative sources. Total unrecoverable investments in the Hanford No. 2 project (up to February 1972) are $27,000,000.[1]

2. Alternative Sources of Power

Power supply alternatives to Hanford No. 2 include purchase of power and fossil-fueled, geothermal, and miscellaneous advanced-concept power plants.

a. Purchase of Power

The applicant has investigated possibilities of purchasing power outside the BPA service area and determined that only a small amount of power (300 average megawatts) might be purchased in fiscal year 1974, but no indication that any firm power would be available in 1978.[2] Purchase of power as an alternative to construction of the Trojan Plant, also part of the Hydro-Thermal Power Program, was considered by BPA. "Bonneville has canvassed the power systems in the western United States and British Columbia with which it is interconnected to determine if any surplus firm power would be available in 1974-1975 or 1975-1976. No firm power is available for purchase from any such power system or systems for these years which could replace power not available from the project (Trojan) due to a delay."[3] Projected growth of power demand in the West Region[4] indicates a continuing requirement for new generating facilities for all systems interconnected to BPA, and no reliable firm energy imports to BPA can be identified.

b. Hydroelectric

At the present time, the bulk of the electric energy consumed in the Pacific Northwest is produced from hydroelectric plants. However, most of the suitable hydroelectric sites have already been utilized, and "within a few years almost all of the economically feasible hydro energy potential in the region will have been built or will be under construction."[5] The generating capacity to be installed at some of the major hydro projects will be fully utilized only occasionally to meet peak loads. The turbine intake capacity of some plants will exceed stream flow most of the year.[6] The region has reached the stage in its development, however, where future electric power plants will increasingly have to be thermal (steam-electric) units. Additional low-cost peaking power will continue to be obtained from hydro resources by installing more generator units at existing hydro projects, but baseline power production must come increasingly from thermal plants.

c. Thermal Electric Generating Plants Using Fossil Fuels

An advantage of using fossil fuel for generating electricity is a higher thermal efficiency than that realized by light-water nuclear plants. This, together with the discharge of heat to the atmosphere through the smokestack of a fossil-fuel plant, means that the amount of waste heat discharged to cooling water is about 35% less for a fossil-fuel plant than for a nuclear plant of the same electrical output.

A serious disadvantage of fossil fuels, however, is the sulfur dioxide, oxides of nitrogen, and particulates discharged from the stacks. Particulate removal of more than 99% can be accomplished with available technology, although the cost is considerable. Techniques used are mechanical or electrostatic collectors, filters, scrubbers, and baghouses. However, oxides of sulfur and nitrogen are another matter. No effective full-scale equipment for use by utility generating plants has been demonstrated to be effective in removing a high percentage of these emissions. Sulfur emissions can be minimized by burning low-sulfur fuels, but such fuels are in short supply.

(1) Gas-fired

Natural gas is the fossil-fuel resource with the smallest proven recoverable reserves in relation to its use. "The overall net supply of natural gas for the West Region is below demand and the area is increasingly dependent upon imports from Texas and Canada. In the Pacific Northwest, gas is little used for electrical power generation and no significant additional use for this purpose is expected because of declining supply anticipated in the future."[7] A gas-fired plant is not further considered as a viable alternative source of electrical power in the Pacific Northwest.

(2) Coal-fired

Of the eleven western states, only five have coal deposits of importance, Montana and Wyoming lying closest to the Pacific Northwest.[8] The deposits at Centralia, Washington, are an exception to this and these are being developed for the 1400-MWe Centralia power plant, part of the Hydro-Thermal Power Program. ". . . fossil fuels, primarily coal, which are indigenous to the states of the Pacific Northwest, are likely to provide only a small part of the electric power development needed in the future."[9] Delivery of coal from Montana or Wyoming was assumed by the applicant to cost $5.15 per ton to transport by unit trains of 120 cars each with 100 tons capacity. One train per day would be required to fuel a plant of 1100 MWe output.

Fuel storage at the plant site must also be considered. For a normal 80-day supply, one report[10] estimates that a pile of coal 100 feet high and 8 acres in area would be needed for an 1100-MWe plant.

In addition, storage, transportation, and disposal facilities would be required for waste ash. Assuming coal with a typical ash content of 10%, and assuming the trapping of most fly ash, the combined furnace ash and fly ash produced from an 1100-MWe fossil plant operating at a capacity factor of 80% would be roughly 330,000 tons per year. Disposal of this on land would require 60 acres assuming an ash pile about 100 feet deep.

It is estimated, based on EPA standards, that 120 tons per day of SO_2, 70 tons per day of NO_x, and 20 tons per day of particulates would be discharged to the atmosphere from an 1100-MWe coal-fired plant.

(3) Oil-fired

The supply of low-sulfur crude oil in the Western United States is limited, although Alaska production is increasing. Low sulfur oil is available from Indonesia, Liberia, South America, North Africa, and (at higher prices) from the Gulf Coast of the United States.[8] Low-sulfur oil delivered by barge up the Columbia River from refineries in Seattle was assumed by the applicant to cost about $4.23 per barrel.[12] One barge load per day (a total annual requirement of 14,000,000 barrels) is required for an 1100-MWe plant.

"It is anticipated that desulfurization of domestic residual fuel oil, although technically feasible, will not be economically attractive in the foreseeable future. Current estimates indicate that this process would add about $1.00 per barrel to the cost of the fuel oil to lower the sulfur content to 0.5% by weight without any accompanying reduction in ash content."[11] Stack gas treatment processes in pilot plant tests can remove about 90% of the sulfur present in stack gases. Depending upon the process employed, from \$0.25 to \$1.00 per barrel is added to the cost of fuel oil burned.

It was estimated, based on EPA standards, that 80 tons of SO_2, 30 tons of NO_x, and 20 tons per day of particulates would be discharged daily from an 1100-MWe oil-fired plant.

d. Geothermal

The major sources of geothermal energy in the U. S. are in California; however, the State of Oregon plans to begin exploration for such resources. Presently, none has been developed to the point where assessment of its potential has been made. Forecasting this potential is uncertain because of lack of knowledge of several influencing factors; namely, availability and extent of geothermal reservoirs; the cost of obtaining steam and generating power from these sources; and resolution of the resulting potential environmental effects such as land subsidence, disposal of the hot water containing chemicals, discharge of noxious gases, and noise from escaping steam. These latter problems have been shown to be manageable with present systems.[13]

e. Other Sources

Other power producing methods, such as breeder reactors, magnetohydrodynamics, fuel cells, solar power, coal gasification, and thermonuclear fusion, are the subject of current research but have not yet attained a practical status for the construction of large power plants for immediate use.

3. Alternative Sites

An alternative site which was investigated by the applicant is at Roosevelt Beach in Grays Harbor County, Washington. Studies at this site include borings, observation wells, refraction seismic surveys, and geologic surface reconnaissance. Attractive features include remote location, cooling-water availability, and a location in a zone of low seismic activity. This site remains a desirable candidate for a nuclear plant some time in the future.

There are a number of possible sites for nuclear plants within the Hanford Reservation. Figure XI-1 shows the location of nine which have been studied for this plant. The location selected on the basis of the original study[14] was Site C in the above figure. A number of factors, among which economics and flood criteria were prominent, were considered. Originally, a cooling

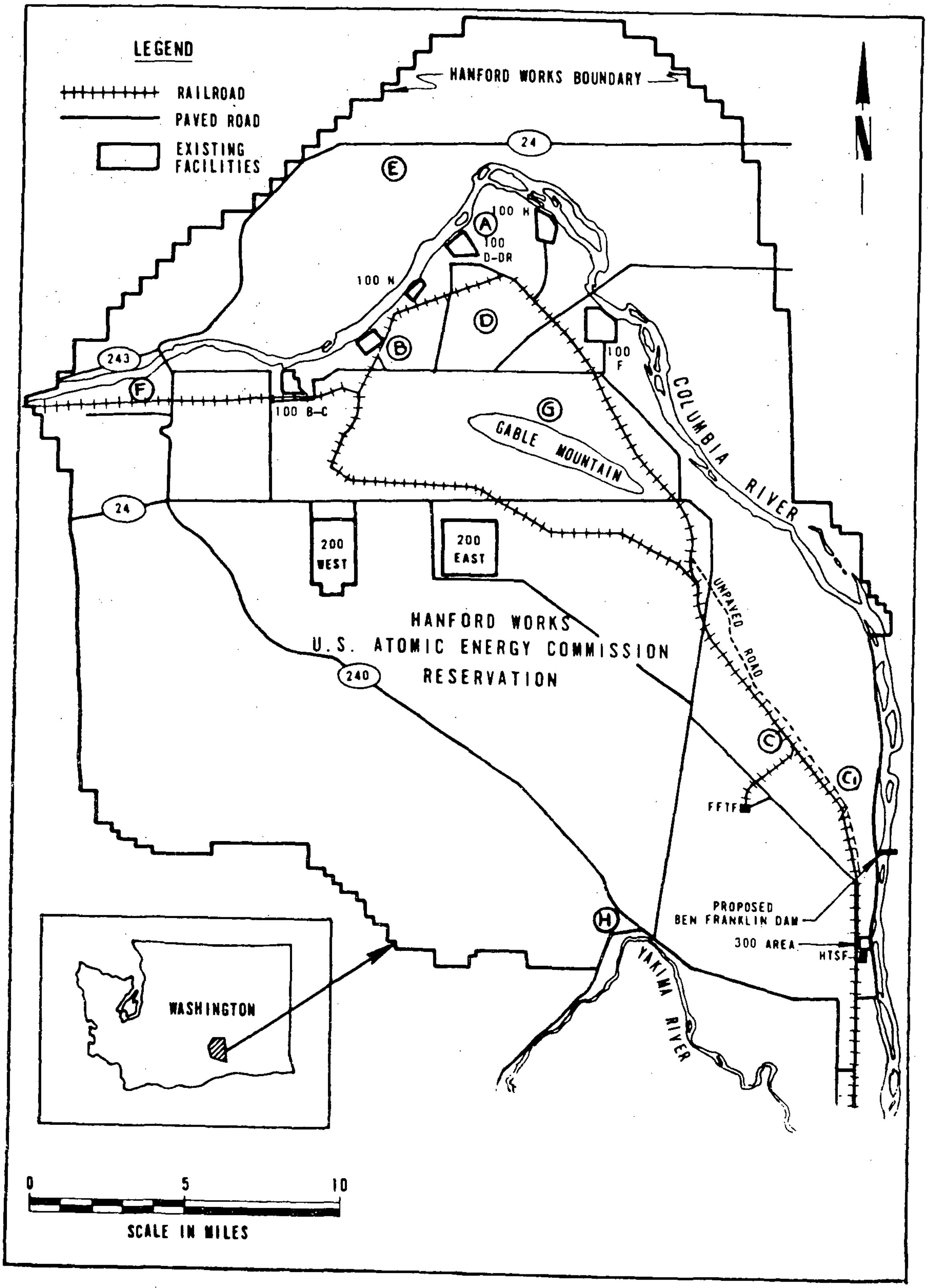


Fig. XI-1. Sites Studied for the Hanford No. 2 Nuclear Plant. From "Updated Site Selection Report for Nuclear Project No. 2" by Burns and Roe, Inc.

pond seemed the most economical means of cooling. However, further studies indicated that a cooling pond would be undesirable at Site C, as well as at most of the other sites on the Hanford Reservation because of possible problems from rising ground water levels.[15] The ability of a lining, constructed at a reasonable cost, to prevent seepage could not be assured. The consequences of a raised water table under portions of the Hanford Reservation include the potentially undesirable effects on buried radioactive wastes. It was therefore decided to use towers for cooling rather than a pond.

By the time this decision was made, studies at Site C, including the important boring work, were substantially completed and consideration of another site would require that the work be repeated. The best alternative therefore appeared to be to remain at Site C, with cooling towers substituted for the cooling pond. A decision to change to another site would delay the start of commercial operation and would require substantial interim financing without any significant economic incentive.

The characteristics of the various alternative sites studied are given below. The suitability of each location for cooling ponds, based on ground water considerations, is listed first.

Site A: Located just south of the Columbia River where it bends and reaches its northernmost position within the Hanford Reservation. Suitability for a cooling pond is questionable. Although it is mostly located within an AEC acceptable water discharge area,[16] it appears that the southern part of the pond would be outside this acceptable area.[17] The plant could not be situated higher than elevation 460 feet at this site. The required plant elevation for a 50% breech of Grand Coulee Dam is 473 feet, and for a 100% breech, 478 feet.[16] Using these flood criteria, the site is not acceptable, and no economic data were developed. However, if the flood criteria were only the Standard Project Flood or the Maximum Probable Flood, this site's elevation would evidently be satisfactory.[17]

Site B: Located approximately two miles southeast of Hanford No. 1. Unsuitable for a cooling pond because of potential ground water problems. Substantial land areas are available. Highway, railroad, and communications facilities are available. Close to existing transmission facilities (N-Plant). Fairly close to the river. Distance from city of Richland and source of employees makes isolation pay necessary.

Site C: (Selected site). Located north of the 300 area, about six miles from the southern Hanford Reservation boundary. Unsuitable for a cooling pond for same reason as for Site B. Proximity to city of Richland makes isolation pay unnecessary. Highway, railroad, and communications facilities available. Shortest time to commercial operation, based on work done to date (this is considered an important advantage by the Supply System). Long distance from existing transmission facilities (N-Plant).

Site C_1: Located approximately one mile west of the stretch of the Columbia River which runs straight north-south and forms the eastern boundary of the Hanford Reservation. Unsuitable for a cooling pond for same reason as for Site B. Substantially the same as Site C, except for the advantage of being closer to the river and for the disadvantage of being further in time from commercial operation based on work done to date.

Site D: Located approximately midway between the 100N location and the 100F location, in the northern portion of the Hanford Reservation. Unsuitable for a cooling pond for same reason as for Site B. Close to existing transmission facilities (N-Plant). Convenient to transportation and communication facilities. Site D was chosen as an alternative to Site B in the original site study.[14] Since Site B proved to be more attractive than Site D in this earlier study, no further consideration has been given to Site D, and no economic data were developed for this site.

Site E: Located across the Columbia River, north of Hanford No. 1. Probably suitable for a cooling pond. Located in AEC acceptable water discharge area. Large expanse of flat land available. Substantial highway, railroad, and communications facilities required. River crossing required to reach existing transmission facilities (N-Plant). Poor access to existing facilities on south side of river. Distance from population center makes isolation pay necessary. Located within the 54,000-acre area where hunting and fishing will be allowed under the Washington State Department of Game.

Site F: Located west of route 240, near Midway Substation. The site could probably accommodate a cooling pond, considering the potential ground water situation. By relocating some transmission towers, this pond could be set at elevation 440 feet. The plant site, however, must be set at an elevation 500 feet or more to comply with a 50% Grand Coulee Dam breech flooding criterion, or 504 feet for a 100% breech criterion. An examination of the contours in this area reveals that there is insufficient level terrain to accommodate the plant, except for an area on top of the bluff just south of the substation. This would place the plant site at about elevation

1000 feet, some 560 feet above the pond, which is not practical. There is, however, a fairly level area on the bluff about two miles southwest of the pond, but here the great distance to the pond and the static circulating waterhead of 60 feet is undesirable. In all, the site was considered unsatisfactory and no economic data were developed. However, it is a possible choice if used with cooling towers instead of a pond.

Site G: Located about one mile southwest of the old 100F area. Unsuitable for a cooling pond for same reason as for Site B. Fairly level area. Highway, railroad, and communications facilities are available. Approximately at the center of the area set aside for ordnance and explosives testing and storage for the Department of Defense.

Site H: Located in the south of the Hanford Reservation, west of a line running approximately along Cold Creek and the Yakima River. Appears unsuitable for a cooling pond. Although there is a possibility of locating a pond along the bed of Cold Creek, approximately four miles in length, the AEC acceptable water discharge area extends only for about two miles. Other than for this small area, the site is too hilly. Far from existing transmission facilities (N-Plant). Some distance from the Columbia River. Within the Arid Lands Ecology Reserve. Average slopes on the hill appear to be about 100 feet vertical to 3800 feet horizontal, or about 2-1/2 percent. This approaches the maximum practical for railroad operation. The plant site would be located about 3-1/2 miles from the Rattlesnake Wallula Fault. Although this is beyond the AEC requirement that a plant cannot be placed within 1/4-mile of a known fault,[18] the location could be exposed to magnified seismic accelerations and a significant increase in the cost of the structures and equipment would result.

In view of the slope and seismic disadvantages, no further consideration was given to Site H, and no economic data were developed.

Table XI-1 gives a summary of some general characteristics of each site. These are: ground water suitability for cooling pond; elevation versus flooding potential; distance from existing transmission facilities (N-Plant); distance to Columbia River for makeup and blowdown water piping; general comments.

As stated in the above discussion, no economic data were developed for Sites A, D, F, and H. For Sites B, C, C_1, and G, cost studies were made.[16] In these, it is assumed that heat would be dissipated by mechanical-draft cooling towers. For Site E, where the ground water situation is probably

TABLE XI-1. Comparison of Plant Sites on Hanford Reservation

Site	Ground Water Suitability for Cooling Pond	Distance from Existing Transmission Facilities (N-Plant) (miles)	Distance from River for Makeup and Blowdown Water (miles)	Elevation vs Flooding Potential	Comments
A	Questionable	3	1	460 feet; OK for prob. max. not OK for Grand Coulee breech	Elevation-flood question
B	Objectionable	2	1	500 feet OK	Substantial land areas available
C	Objectionable	19	4	441 feet OK	Shortest time to operation based on work already done (selected site)
C_1	Objectionable	21	1	441 feet OK	Located closer to river than Site C
D	Objectionable	3	3	OK	Alternative to site
E	Probably OK	4 (across river)	3	447 feet OK	North of river; communication and transportation facilities would be needed
F	Possibly OK	9	1	OK	Terrain problems if pond is wanted
G	Objectionable	6	4	460 feet OK	Fairly level ground
H	Objectionable	21	8	OK	Hill has steep slope near seismic fault

suitable, a value is also given for heat dissipation by cooling ponds, both lined and unlined. Table XI-2 gives the results of the cost study. Capital cost estimates for items which vary with site location are shown.

4. Alternative Cooling Systems

As alternatives to mechanical-draft cooling towers selected by the applicant, the following techniques were considered: once-through cooling, natural-draft cooling towers, cooling pond, spray canal, and dry towers. In addition, a multiport discharge instead of a single-port discharge was considered for the blowdown into the river.

a. Once-through Cooling

Power plants have commonly used once-through cooling in which water is withdrawn from a river to cool the condenser and then returned to the river. Once-through cooling has many advantages including low cost, lack of fog as might occur from a cooling tower, and a smaller consumptive water use since the evaporation from the thermal plume on the surface of the river is generally less than the evaporation from a cooling tower.

However, once-through cooling results in nearly all the plant waste heat being discharged to the river. This added heat load may have adverse effects on the biota in the river. Thermal standards included in the State of Washington water quality standard[19] contain the following special condition applying to the Columbia River between the Washington-Oregon border (river mile 309) and Priest Rapids Dam (river mile 397).

> "No measurable increases shall be permitted within the waters designated which result in water temperature exceeding 68°F, nor shall the cumulative total of all such increases arising from non-natural causes be permitted in excess of $\Delta t = 110/(T - 15)$; for purposes hereof "Δt" represents the permissive increase and "T" represents the resulting water temperature."

The 1960-1968 maximum August temperature of the Columbia River, as measured at the Priest Rapids Dam, was 67.8°F. Thus, on a hot day in the summertime, it can be seen that very little temperature rise might be possible without exceeding the 68°F limit. Also, taking the river temperature as 66°F, the maximum temperature rise allowed from $\Delta t = 110/(T - 15)$ is 2°F. Using 7.88×10^9 Btu/hr as the total waste heat load and taking as a conservative assumption no heat loss by evaporation from the thermal plume on the river, the average temperature rise of the overall river in the vicinity of Hanford No. 2 would be 1.0°F at the minimum licensed riverflow

TABLE XI-2. Plant Capital Cost for Factors that Vary by Site Location

Site	B	C (Selected Site)	C_1	E			G
Cooling	Towers (Mech. Dr.)	Towers (Mech. Dr.)	Towers (Mech. Dr.)	Towers (Mech.Dr.)	Pond (Lined	Pond (Unlined)	Towers (Mech. Dr.)
Estimated capital cost (without interest): Millions of dollars	297.3	296.1	294.7	309.7	315.3	306.2	301.0

Data Source: Updated Site Selection Report for Nuclear Project No. 2, prepared for the Washington Public Supply System by Burns & Roe, Inc., August 5, 1971.

of 36,000 cfs, or 0.3°F at the average riverflow of 115,000 cfs. Also, additional study would be required to more completely evaluate the effect of the temperature rise on the river biota. In view of the above considerations and administrative directives,[23] once-through cooling has been rejected in favor of cooling towers. Interim environmental guidelines published by the Department of the Interior also opposed use of on-stream cooling for new facilities.[24]

About the only atmospheric effect of once-through cooling on the Columbia River would be a slight (few hours per week) increase in steam fog near the point of discharge, especially on cold winter mornings. This fog would be wispy, shallow, and not a hazard to navigation on the river.

b. Natural-draft Cooling Towers

Natural-draft cooling towers are large, hyperbolic structures in which the intake air is warmed and humidified at the bottom of the tower by contact with the condenser cooling water thus creating a chimney effect due to its buoyancy, i.e., lower density. This chimney effect causes the air to flow upward, cooling the water cascading downward through the tower by convection and evaporation. The air discharges from the top of the tower carrying a plume of entrained water droplets (drift) from the tower. Experience with natural-draft cooling towers indicates that ground-level fog and icing from such towers is extremely rare, as the plumes tend to rise to considerable heights (500-1500 feet) above the elevated release level. Elevated plumes can occasionally extend for distances of 10 or more miles on cold, humid days. A natural-draft cooling tower has about the same consumptive water use, by evaporation plus drift, as a mechanical-draft cooling tower.

The natural-draft cooling tower system considered by the Supply System for the Hanford No. 2 Plant consists of two towers, each 430 feet in base diameter and 450 feet high. The additional capital cost would be $8.5 million over the cost of a mechanical-draft tower system. However, this system would fail to operate adequately about 20 to 30 days per year, during periods when the temperature was very high and the relative humidity was very low. This problem arises from the generally arid geographical area where the Hanford No. 2 Plant is to be located. The low humidity causes most of the cooling in natural-draft towers to take place through evaporation with relatively little cooling by conduction of heat to the air to raise its temperature and lower its density. Therefore, the difference in density between air inside and outside the tower is low at times, resulting in poor draft and reduced cooling capacity. Consequently, since natural-draft cooling towers would yield inadequate performance during the summer and since there appears to be no incentive, economic or otherwise, for choosing them, a mechanical-draft cooling tower system was chosen for Hanford No. 2.

c. Cooling Pond

A cooling pond is another possibility for Hanford No. 2. Condenser cooling water would be taken from, and returned to, the pond. The pond dissipates waste heat to the atmosphere by evaporation and convection. The pond would require about 2000 acres of surface area.

The use of a cooling pond would reduce the density and perhaps the extent of surface fog when compared to mechanical-draft towers, due primarily to the larger area of transfer of heat and water to the atmosphere. Experience at existing cooling ponds (Four Corners, Dresden, Mt. Storm) shows that steam fogs over cooling ponds are thin, shallow, and do not seriously reduce surface visibilities at distances 500 feet or more from the pond. There is no drift from cooling ponds.

Icing near cooling ponds poses no problem except within 100 to 200 feet of the shore. The ice that is produced is friable and of low density; it is almost always observed on vertical surfaces, rarely on horizontal ones such as roads.

A major drawback to the use of a cooling pond for Hanford No. 2 is the problem that could result from rising ground-water levels. The integrity of a lining of reasonable cost which would seal the pond and prevent seepage cannot be assured. The current mathematical model of the ground-water beneath the Hanford Reservation indicates that a significant increase in water table can result from percolation of only a few thousand gpm of water from the pond into the ground.[15] Substantial time and effort would be required to assure the absence of any undesirable effect from a rise in the water table under the Hanford Reservation, including potential consequences of a raised water table on buried radioactive wastes. For this reason, the use of a cooling pond for Hanford No. 2 has been rejected.

d. Spray Canal

A spray canal, another possible approach, would require a large number of nozzles to spray water into the air. Heat is dissipated by evaporation, plus a small amount of transfer of sensible heat to the air from the water droplets. For Hanford No. 2, it is estimated that a series of canals approximately two miles in total length, 160 feet wide and 8 feet deep, with 256 floating spray modules, would be required.

The use of spray canals for power plant cooling is a relatively recent development, and experience with large systems is quite limited. The drift from a spray canal is estimated to be from 1 to 5% of total condenser water flow.[20] This is a much higher drift than from a cooling tower, so consumptive water use is somewhat higher than for a cooling tower. The high drift tends to minimize concentration of dissolved solids, so the need for blowdown to the river is reduced. However, the high drift creates a potential problem of deposition of chemical salts on the ground areas in the immediate vicinity of the site.

Operational experience with large spray systems in areas of cold winters is limited to one winter of data at the Dresden spray canal. Since the spray modules reduce the volume of air into which heat and water vapor (for a given plant load) enter, sprays create more and denser fogs than do cooling ponds.

The visible plumes contain more drift (tiny droplets torn from spray drops and carried inland by the winds) than do plumes from ponds and towers. In winter dense ice has been observed at distances of the order of 500 feet from the canal.

The use of a spray canal has been rejected for the same reason as use of a cooling pond, namely the possible problems created by a raised water table in the ground.

e. Dry Cooling Tower

A dry cooling tower is essentially a water-to-air heat exchanger. Heat is transferred convectively to the air as it passes over the coils or heat transfer surfaces which contain the condenser water, in a completely closed system. Consumptive water use and ground fog are minimal with a dry tower, but the heat transfer is very inefficient, requiring large and costly heat-exchange structures. Capital cost of a dry tower is estimated to be about three times that of an evaporative or wet tower.[21]

In addition, a dry tower causes the plant to be less efficient, since the water from the condenser can be made to approach only the dry-bulb temperature of the ambient air, rather than the lower wet-bulb temperature. This means that a dry tower cools the water less effectively than an evaporative tower, with resultant higher condenser temperatures and thus higher turbine back-pressures and lower plant efficiencies. A dry tower would therefore result in significant power loss compared with an evaporative tower.

Thus, the additional high capital and operating costs of dry cooling towers, plus the power loss, was the cause of their being rejected for Hanford No. 2, especially in view of the very small environmental impact expected from the use of mechanical-draft cooling towers.

5. Alternative Discharge Configuration

For the discharge of bleed or blowdown water to the river, the proposed Hanford No. 2 design is a single-port jet discharge. The discharge configuration will be such as to discharge the effluent stream perpendicular to the current flow and directed upwards at an angle of 15 degrees above the horizontal at the point where the pipe touches the stream bottom. The discharge velocity will be approximately 7 fps for rapid mixing with the river.

An alternative possibility would be a multiport jet discharge, sometimes called a multiport jet diffuser. Such a design might have a length of pipe, perhaps 50 to 100 feet long, with small holes in the pipe top or sides, to create small discharge jets all along the pipe length for rapid dilution of the effluent with the river. This design has the advantage of very rapid and diffused mixing of the warm effluent with the river water.

The single-point discharge will mix by a factor of from three to five within four or five pipe diameters from the outlet, at which point it will be fully bent and headed downstream. Five pipe diameters would be about seven feet. With a multiport discharge, the dilution factor seven feet from the pipe would probably be greater than three to five, depending on the length of pipe and the designs aspects of the multiport discharge. However, at a distance of 200 feet downstream, there would be little essential difference in thermal or chemical dilution regardless of whether a single-port or a multiport discharge were used.

A disadvantage of a multiport discharge pipe is the river bottom disturbance in the installation of such a pipe. For example, if the pipe were supported above the river bottom on anchor blocks, the installation of these anchor blocks would disturb the natural riverbed during construction. The Supply System has made an agreement with the State of Washington that it will minimize such construction effects on the river bottom.

Therefore, because of the desire for minimum construction impact on the river bottom for installation and because there is little difference 200 feet downstream, a single-port discharge was chosen over a multiport discharge.

6. Alternative Transportation Procedures

Alternatives, such as special routing of shipments, providing escorts in separate vehicles, adding shielding to the containers, and constructing a fuel recovery and fabrication plant on the site rather than shipping fuel to and from the station, have been examined by the staff for the general case. The impact on the environment of transportation under normal or postulated accident conditions is not considered to be sufficient to justify the additional effort required to implement any of the alternatives.

B. COST-BENEFIT ANALYSIS

1. Summary of Cost-Benefits

A cost-benefit summary is presented in Table XI-3. Only two alternative nuclear plant designs have been included, the proposed Hanford No. 2 Plant and a similar plant with once-through cooling. All other cooling methods have been found unsatisfactory, not feasible, or of excessive cost to be reasonable alternatives. Two alternative fossil-fueled power sources are

TABLE XI-3. Cost-Benefit Summary

Cost and Benefit Factors	Nuclear Plants		Fossil-fueled Plants with Cooling Towers	
	Proposed Design	Once-through Cooling	Coal-fired	Oil-fired
Energy generated @ 80% capacity factor, kWh/yr	7.7×10^9	7.9×10^9	7.7×10^9	7.7×10^9
Direct employment, persons	65	65	62	62
Generation tax, $\$10^6$ per year	1.54	1.58	1.54	1.54
Total financing required, $\$10^6$	410	394*	295	247
Gross annual costs,** present worth at 6% per year over a 30-year period, $\$10^6$	263	222*	474	686
Total cost, $\$10^6$	673	616	769	933
Land required, acres	30***	30***	140	65
Fuel required annually	196 tons U_3O_8 (770 tons U_3O_8 for initial loading)	196 tons U_3O_8 (770 tons U_3O_8 for initial loading)	3.5×10^6 tons	10.7×10^6 bbl.
Chemicals discharged to the air, tons/day	None	None	120 SO_2 70 NO_x	80 SO_2 30 NO_x
Particulates discharged to the air, tons/day	1.3 (0.05% drift)	None	21	21
Heat added to Columbia River (max), Btu/hr	80×10^6	7880×10^6	45×10^6	45×10^6
Chemicals added to Columbia River, lb/day	910	None	4200	4200
Impact on Columbia River aquatic biota	Not measurable	Not completely evaluated		
Impact on terrestrial biota	minor loss of habitat	same	same	same
Artificial radioactivity discharged to river, man-rems/yr	0.002	0.002	None	None
Artificial radioactivity discharged to air, man-rems/yr	2.2	2.2	None	None
Consumptive use of river water, cfs	37 max.	$\sim$ 21	24	24
Transportation (fuel)	105 truck loads/yr	105 truck loads/yr	1 train/day	1 barge/day
Atmospheric effects	Visible plume from cooling towers. Potential for fog and ice on roads.	None	Visible plume from cooling towers. Potential for fog and ice on roads.	Visible plume from cooling towers. Potential for fog and ice on roads.
New transmission lines, miles	31	31	31	31

*Staff estimate.

**Includes cost of fuel, operation and maintenance, insurance, administrative costs, but excludes interest and amortization.

***Land utilized for plant, excluding undisturbed land used for exclusion zone.

considered, coal- and oil-fired plants. Natural gas is not in sufficient supply to be considered a viable alternative for a baseload plant. Gas-turbine systems have operating costs too high to be considered for base-load power generation. All economical hydro sites are planned for exploitation, and other energy sources are not sufficiently developed to be included for further analysis.

The primary benefit to be derived from constructing a power plant in the Pacific Northwest is the electrical energy of 8.18 billion kilowatt-hours per year.

There are a number of benefits that contribute to the local and state economy. The construction of the Hanford No. 2 Plant will provide peak employment of nearly 900 persons with an average employment over the 4-1/2 year construction program of 545. A total payroll of $65,000,000 and $25,000,000 to be spent for materials and services will contribute to the local economy during the construction period. An operating staff of 65 will be permanently employed.

State taxes estimated at $1,540,000 per year will be paid by the Supply System. (This assumes that the power generation tax presently being considered by the legislature of the State of Washington is assessed. This would apply to all plant alternatives.)

The applicant has estimated the capital cost of constructing the proposed 1100-MWe plant to be $288 million; total financing required is $410 million. The present value of the annual operating costs* of $19.1 million over a 30-year period is $263 million using 6% as the cost of capital. (This interest rate is representative of the cost of money to municipal agencies and public utility districts. Washington Public Power Supply System, a public agency, will obtain all its financing by issuing revenue bonds.) The total of these costs is $673 million.

The estimated capital cost of a similar nuclear plant using once-through cooling is $274 million. The staff estimated total financing required would be approximately $394 million. This method of cooling results in lower turbine back pressure and thus greater output from the system. Operating costs (lower without a cooling tower) were estimated by the staff to be $16.1 million with present value over 30 years at 6% of $222 million for a total cost of $616 million. The Supply System chose not to pursue this design because of less well-known environmental factors and administrative directives.[23]

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*Includes fuel, operation, maintenance, insurance, administrative costs, and interim replacements. Excludes amortization, interest, and taxes.

The 30-year costs of both coal- and oil-fired plants (computed on the same basis as for the nuclear plants) exceed the costs of the nuclear plants due to higher fuel costs. Coal is assumed by the applicant[22] to come from Wyoming or Montana at a mine cost of 13.3 cents per million Btu. Transportation cost of $5.15 per ton brings the cost on site to 43 cents per million Btu. Annual operating costs are estimated as $34.4 million. Estimated cost for fuel oil is $4.23 per barrel equivalent to 66 cents per million Btu delivered to the site. Annual operating costs are estimated to be $50 million. Heat rejection to the river is substantially lower for fossil-fuel plants, but large amounts of SO_2, NO_x, and particulates are discharged to the air.

Having selected mechanical-draft cooling towers for the proposed design, the applicant investigated various modifications of these towers to reduce the visible plume during winter months when fog may persist at ground level. With the selected towers as the base, incremental capital costs for these modified tower systems were estimated to be:[22]

Mechanical-draft cooling towers with 60 foot stacks	-- $3,000,000
Mechanical-draft wet-dry cooling towers	-- $4,000,000
Mechanical-draft cooling towers with lined pond	--$30,000,000

The first of these design modifications incorporates 60-foot stacks in place of the 20-foot standard fan stack to discharge the plume at higher elevation. The second has provisions to mix the moisture-laden air with air heated by hot inlet water. The third proposes using a one-square-mile lined cooling pond in the winter months in lieu of the towers. The occurrence of fog of sufficient density and frequency as to create a predictable hazard is so small, that the additional expenditure to reduce it is not warranted.

Land requirements for the nuclear plants do not include the acreage needed for an exclusion area. Only about 30 acres will be disturbed by construction with the remainder essentially untouched. Land requirements for the coal-fired plant include that necessary for the building's coal storage pile and ash disposal, while fuel storage area only is included for the oil-fired plant in addition to the buildings. For the latter, a permanent barge off-loading facility at the riverbank is assumed.

Enriched uranium fuel for the nuclear plants operating at an 80% capacity factor requires the mining and processing of approximately 196 tons of U_3O_8 per year. The initial loading of the reactor requires 770 tons of U_3O_8. Plutonium produced through the fission process is also recoverable for future use. The fuel burned in the coal-fired plant (3.5 million tons/year) is assumed to be delivered by train; one train load per day would be required. One barge load of oil per day (10.7 million bbl/year) would be needed to fuel the oil-fired plant.

Evaporative loss of water from the proposed plant of 37 cfs maximum is only about 0.1% of minimum licensed flow (36,000 cfs) of the Columbia River, or 0.03% of the average annual flow (115,000 cfs). A smaller loss of water can be attributed to the once-through cooled plant. Cooling towers are assumed for the fossil-fired plants which have only about 24 cfs evaporated water loss.

Alternative land uses are not evaluated because of the abundance of barren land on the Hanford Reservation, and the fact that there are no other plans for use of the land. Alternative radwaste systems have not been evaluated because the proposed system meets the requirements of proposed Appendix I of 10 CFR Part 50.

2. Balancing of Costs and Benefits

The environmental costs of constructing and operating the Hanford No. 2 Plant are the use (for the life of the plant) of 30 acres of land not otherwise used or intended for use in an area of thousands of acres of barren land; the destruction of the habitat of small mammals occupying the area; localized temporary increase in turbidity in the river from dredging; the consumptive use of 37 cfs (maximum) of Columbia River water which is about 0.1% of licensed minimum flow; a possibility of increasing fog in winter on highways a few miles from the plant for 12 to 26 hours per year in an area where natural fog occurs up to 38 days per year; the discharge of gaseous and liquid effluents containing radionuclides that will result in an increased exposure to the local population of less than the normal variation in natural background; the discharge of heat and chemicals to the river in such amounts as to cause no measurable effect on overall ecological balance in the river; the use of 480 acres of desert for transmission lines.

These adverse effects must be compared to the benefits of supplying electricity to the Pacific Northwest, a region dependent upon this form of energy for economic growth and the amenities of life. The alternatives of supplying power from fossil-fueled plants would involve incremental present-worth costs of $96 million for a coal-fired plant and $260 million for an oil-fired plant. Fossil-fueled plants would contribute to air pollution through the emission of SO_2, NO_x, and particulates to the atmosphere. An alternative of once-through cooling for the plant would reduce cost by $57 million over the 30-year life of the plant, with attendant unevaluated impact on the Columbia River.

The staff concludes that the benefits from the Hanford No. 2 Plant outweigh the environmental costs associated with it and that the alternatives considered are not economically nor environmentally justified.

REFERENCES

1. Letter to P. A. Morris, Director, Division of Reactor Licensing, USAEC, Washington, D. C., dated February 19, 1972, from J. J. Stein, Managing Director, Washington Public Power Supply System, Kennewick, Washington, Subject: Hanford No. 2 Plant Preparation of Site.

2. Applicant's Environmental Report, Amendment 1, Section 2.5.1.

3. B. Goldhammer, Bonneville Power Administration, Affidavit submitted as testimony at hearings held at Portland, Oregon, May 2, 1972, in the matter of Portland General Electric Co.; The City of Eugene, Oregon; Pacific Power and Light Co. (Trojan Nuclear Plant) Docket No. 50-344.

4. The 1970 National Power Survey, Federal Power Commission, Part III, Appendix 1.

5. The Hydro-Thermal Power Program: A Status Report prepared by the Bonneville Power Administration, December 1971, p. 1.

6. Ibid., p. 25.

7. The 1970 National Power Survey, Federal Power Commission, Part III, p. III-3-50.

8. Ibid. p. III-3-54.

9. E. R. de Luccia, "Fossil Fuels as a Source of Energy in the Pacific Northwest," presented at the Northwest Conference on the Role of Nuclear Energy, Second Annual Governors' Conference on Conservation, Portland, Oregon, December 4 and 5, 1969.

10. Environmental Impact Report: Supplemental Information to the Zion Environmental Report, Supplement II, Commonwealth Edison Company, December 3, 1971.

11. The 1970 National Power Survey, Federal Power Commission, p. XI-5.

12. Applicant's Environmental Report, Amendment 1, Section 3.1.2, p. 4.

13. "Environmental Statement, Liquid Metal Fast Breeder Reactor Demonstration Plant" (WASH 1509), April 1972, USAEC, p. 164.

14. Site Selection Report for Nuclear Project No. 2, prepared for Washington Public Power Supply System by Burns & Roe, Inc., January 1971.

15. Final Report on Hydrology Studies of the WPPS Nuclear Project No. 2 Site, Pacific Northwest Laboratories, July 1971.

16. Updated Site Selection Report for Nuclear Project No. 2, prepared for Washington Public Power Supply System by Burns & Roe, Inc., August 5, 1971.

17. Selection of a Site for a Nuclear Power Plant at Hanford, prepared for the City of Richland, Washington, by Douglas United Nuclear, Inc., October 19, 1970.

18. 10 CFR Part 100.

19. "A Regulation Relating to Water Quality Standards for Interstate and Coastal Water of the State of Washington and a Plan for Implementation and Enforcement of Such Standards," Water Pollution Control Commission, State of Washington, December 4, 1967.

20. S. Malkin, Converting to Spray Pond Cooling, Power Engineering, January 1972.

21. F. L. Parker and P. A. Krenkel, Thermal Pollution: Status of the Art, Vanderbilt University, School of Engineering, Nashville, Tenn., December 1969.

22. Applicant's Environmental Report, Amendment 1, p. 7.

23. Letter, L. B. Day, U. S. Department of the Interior, to H. R. Richmond, BPA, July 24, 1970.

24. "Interim Environmental Guidelines for Thermal Power Plant Site Evaluation - Pacific Northwest," U. S. Department of the Interior, July 1970.

XII. DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT ENVIRONMENTAL STATEMENT

Pursuant to paragraph A.6 of Appendix D to 10 CFR 50, the Draft Environmental Statement of August 1972 was transmitted, with a request for comment, to:

Advisory Council on Historic Preservation
Department of Agriculture
Department of the Army, Corps of Engineers
Department of Commerce
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Department of the Interior
Department of Transportation
Federal Power Commission
Environmental Protection Agency
State of Washington
Chairman, Benton County Board of Commissioners

In addition, the AEC requested comments on the Draft Environmental Statement from interested persons by a notice published in the *Federal Register* on August 30, 1972 (37 F.R. 17578).

Comments in response to the requests referred to above were received from:

Advisory Council on Historic Preservation
Department of Agriculture
Department of the Army, Corps of Engineers
Department of Commerce
Department of the Interior
Department of Transportation
Federal Power Commission
Environmental Protection Agency
Department of Health, Education, and Welfare
Department of Housing and Urban Development
State of Washington
Washington State Department of Commerce and Economic Development
State of Oregon Nuclear and Thermal Energy Council
Natural Resources Defense Council, Inc.

Consideration of comments received and the disposition of the issues involved are reflected in part by revised text in other sections of this Final Environmental Statement and in part by the following discussion. The comments are included in this statement as Appendix C.

A. RELIEF VALVE AUGMENTED BYPASS (REVAB) SYSTEM (EPA, C-18)

A comment was made that the significance of the iodine source from the REVAB system should be presented in the Final Statement.

The REVAB system is expected to operate only on a turbine trip or loss of load. Each time the REVAB system is activated, as much as 8 curies of noble gas and 0.06 curie of iodine may be dumped into the suppression pool. The release of small amounts of primary coolant to the torus with subsequent dilution, decay and treatment of any radioactive gases by the Standby Gas Treatment System make such a source negligible.

As operating data become available from this plant and other operating BWR's, the staff intends to evaluate the potential effect these non-routine operations may have on waste treatment systems and recommend changes as may be necessary.

B. MAGNITUDE OR SOURCE EFFLUENTS RESULTING FROM MAINTENANCE OPERATIONS (EPA, C-19)

As indicated in the DES, the staff expects that releases of radioactive materials in liquid effluents will be a fraction of the values shown in Table III-2. However, to compensate for equipment downtime and expected operational occurrences, including maintenance, the expected values have been normalized to 0.25 curie per year.

Although there is some doubt that the waste handling and treatment system as installed is capable of handling large volumes of liquid wastes such as that from the suppression pool, the concentration of activity in these large volumes is expected to be low enough that releases to the environment will be negligible over the life span of the plant.

C. COMMITMENT TO PROPOSED APPENDIX I TO 10 CFR PART 50 (EPA, C-19)

The applicant committed as a design objective to the limits of proposed Appendix I to 10 CFR Part 50 (36 F.R. 11113). Our evaluation was done for normal operation of the plant and included expected operational occurrences, as well as equipment downtime. The doses from our evaluation are within the proposed Appendix I limits.

D. <u>EFFLUENT MONITORING</u> (EPA, C-21)

A comment was made that the Final Statement should include a discussion of the estimated amounts of radioactive material that could be released from the plant undetected and the capability of the surveillance program to differentiate between releases from the plant and other sources.

The applicant states that the maximum amount of radioactive material that could be released from the plant undetected is 75 μCi. This is based on a minimum detector sensitivity of 10^{-6} μCi/cc and a tank volume of 20,000 gallons. The maximum activity that could be discharged prior to activation of monitoring alarms and before shutoff occurs is about 90 μCi. This is based on an assumed maximum concentration of 3.93×10^{-3} μCi/cc, a 180 gpm pump flow rate and a total time of 2 seconds to completion of shutoff. (This includes a delay of 1 second before initiation of shutoff.)

In addition, the capabilities of the effluent monitoring program were evaluated by the staff in the Safety Evaluation Report issued on September 22, 1972. The staff concluded that monitoring equipment that will be installed to measure the radiation levels in the plant's effluents are acceptable.

The surveillance program will differentiate between radioactivity releases and consequences to the environment from Hanford No. 2 and those resulting from previous and current discharges of radioactive materials from other sources by continual monitoring of Hanford No. 2 potential release points. This information, together with the Hanford No. 2 radiological monitoring program and other complementing monitoring programs on the Hanford Reservation, should pinpoint any accidental radioactive release.

E. <u>METEOROLOGICAL ASSUMPTIONS FOR ACCIDENT ANALYSIS</u> (COMMERCE, C-13)

The meteorological assumptions used in the evaluation of accident consequences are as stated in the proposed Annex to Appendix D of 10 CFR Part 50 (36 F.R. 22851). Such assumptions approximate the dispersion conditions which would prevail at least 50% of the time at the site.

F. <u>ACCIDENTAL RADIATION RELEASES TO WATER</u> (INTERIOR, C-34)

A comment suggested that "the environmental effects of releases to water is lacking. Many of these postulated accidents listed in Tables VI-1 and VI-2 could result in releases to the Columbia River and should be evaluated in detail." The doses calculated as consequences of the postulated accidents are based on airborne transport of radioactive materials, resulting in both a direct and and inhalation dose. Our evaluation of the accident doses assumes that the applicant's environmental monitoring program and appropriate additional monitoring (which could be initiated subsequent to an incident detected by in-plant monitoring) would detect the presence of radioactivity in the environment in a timely manner such that remedial action could be taken if necessary to limit exposure from other potential pathways to man.

G. PRINCIPLES OF SAFETY IN TRANSPORT (INTERIOR, C-33)

A comment suggested that emergency procedures be developed for maximum containment of low-level radioactive wastes, as well as minimum personnel contamination in the event of a spill of such wastes as a result of a severe accident.

Provisions in transportation regulations assure maximum containment of wastes and minimum contamination from wastes in accidents. Shipments of wastes are likely to be made by exclusive-use truck, which means that the vehicle is loaded by the consignor and unloaded by the consignee. In most cases the shipments are made in closed vehicles. Since the shipment is exclusive use, the shipper can provide specific instructions to carrier personnel regarding procedures in case of accidents.

Commission regulations require that an applicant's Preliminary Safety Analysis Report contain a discussion of the applicant's preliminary plans for coping with emergencies. These plans were evaluated by the staff in the Safety Evaluation Report issued on September 22, 1972.

Commission and Department of Transportation regulations provide specific instructions to carriers for segregating damaged and leaking packages, keeping people away from the scene of an accident, and notification of the shipper and the Department of Transportation.

Each package containing radioactive material is labeled with the radioactive material label, a distinctive label which identifies the material and provides a visual warning. The regulations specify placarding on the outside of the truck for identifying the presence of shipments of large quantities of radioactive materials. An extensive program has been carried out over the past several years by which emergency personnel, including police departments, fire departments, and civil defense offices, have been advised of procedures to follow in accidents involving radioactive materials and other hazardous materials. Specific instructions with regard to radioactive materials have been provided through the AEC's efforts as well as those of carrier organizations such as the Bureau of Explosives of the Association of American Railroads, the American Trucking Association, and the Air Transport Association. As indicated in Section V.E.4, an intergovernmental program to provide personnel and equipment is available at the request of persons (truck drivers, police, bystanders or other persons) at the scene of such accidents.

The waste itself is confined either in the form of solidified materials, such as concrete, or compacted solids. The low-level of contamination of the waste together with the form of the waste, serves to minimize the contamination in the unlikely event that there is a spill in an accident.

The staff has concluded that existing applicable regulations already prescribe adequate procedures to mitigate the effects of infrequent accidents which might occur involving shipments of wastes from the Station.

H. HISTORICAL SIGNIFICANCE (INTERIOR, C-31; ACHP, C-65)

The Atomic Energy Commission is cognizant of its responsibilities as a Federal agency under Section 2 of Executive Order 11593 of May 13, 1971. Staff members have been officially designated to initiate and administer those measures necessary to direct Commission policies, plans and programs in such a way that federally owned sites, structures, and objects of historical, architectural or archaeological significance are preserved, restored and maintained. Accordingly, steps were taken to locate and inventory all sites, buildings and objects on the Hanford Reservation that might qualify for nomination for listing in the National Register of Historic Places. At the present time the Commission does not plan to submit nominations from the Hanford Reservation. If sometime in the future nominations from the Hanford Reservation are submitted, the presence of Hanford No. 2 would not interfere with such actions.

The Liaison Officer for Historic Preservation in the State of Washington (Washington State Parks and Recreation Commission) has been given the opportunity to comment on the Draft Environmental Statement. No comments were received (see C-43).

I. CONCRETE BATCHING PLANT (EPA, C-28)

The concrete batching plant is recognized as a potential source of air pollution and the following equipment and procedures will be used to minimize particulate release.

The applicant will transport cement to the site in enclosed trucks. Cement transfer to the storage silo will be made utilizing an enclosed airlift. The silo itself is a sealed building provided primarily for cement protection. However, the silo serves effectively to prevent cement entrainment in air. During batch plant operation, water wets down the drum interior prior to the feed of the concrete components. Water spray continues throughout the period of material addition and mixing and serves to minimize airborne particulates. Additional protection is received from a rubber boot which serves as a chute through which the material travels from the batch plant hopper into the truck drum. Following the mixing operation, particulate release is not considered a problem.

J. SANITARY WASTE (EPA, C-30)

Use of a septic tank and drainage field for the disposal facility was based upon a number of considerations. These included good soil drainage characteristics, a site well above the groundwater table and remote from habitation, and satisfactory operation of similar systems at other Hanford facilities. The system was selected because it appears to meet the dual requirements of satisfactory operation and minimal impact. Additional benefits are low construction cost and minimal maintenance requirements. Use of a package treatment plant of the activated sludge, extended aeration type would have an initial cost factor over five times that of the proposed system and would require substantial operating costs and consequently, would not be justified.

If sludge buildup becomes a problem, excess sludge will be disposed of by a scavenger operator pursuant to contract.

K. ALTERNATIVE SITES (NRDC, C-57)

The discussion of alternate sites in Section 2.5.3 of the Hanford No. 2 Environmental Report (ER) focused on the Roosevelt Beach and Hanford sites. However, this reflects only the latter stages of the site selection process. References 3, 4 and 5 of Section 2.5 of the Environmental Report provide further discussion of alternate sites that were considered.

Reference 3 entitled "Final Report on Nuclear Power Plant Siting in the Pacific Northwest", evaluated 16 typical sites throughout the Pacific Northwest and provided part of the basis for more detailed studies of sites.

Site survey studies were performed for Washington Public Power Supply System in 1967.[1,2] These studies covered 17 potential sites for nuclear power plants.

Reference 4 is a detailed study of two potential sites by the Grays Harbor Public Utility District, a member of the Supply System. This study indicated a slight preference for the Roosevelt Beach site over the Saddle Hill site, based on studies of population distribution, weather considerations, geological and seismological considerations, environmental effects, and costs.

Detailed site investigations were then performed at Roosevelt Beach and were reported in Reference 5. These investigations included 10 borings at the site for evaluation of foundation conditions, geophysical studies, and geological reconnaissance work.

Status reports by Bonneville Power in mid-1969 indicated that southwest Washington was the preferred location, with sites under study at Kalama, Roosevelt Beach, and Sequim Bay.[3]

In summary, the initial selection of the site at Roosevelt Beach was made, in full consideration of all these studies, and work proceeded on that basis. The decision to change to a Hanford site is discussed by the applicant in the Environmental Report, and by the staff in the Draft and Final Environmental Statements. The Supply System considers many of the alternate sites as viable candidates for future thermal plants.

State of Washington agencies were fully informed throughout the site selection process, and their inputs were a factor in the final selection. In addition, the Bureau of Commercial Fisheries was kept fully informed.

L. ENERGY REQUIREMENTS FOR IRRIGATION (NRDC, C-59)

Irrigation loads in the Northwest increased almost 30 times since 1950. Technological developments have made it economical to lift water 800 to 1000 feet from wells or streams to sprinkler irrigate lands never before considered due to lift or distance restrictions. The consumption of electric energy for irrigation is increasing because of several factors including higher lifts, shift to sprinkler irrigation, longer pumping systems, and more acres irrigated.

M. CONSTRUCTION WATER (STATE OF WASHINGTON, C-45)

The Draft Environmental Statement indicates that construction water will be secured from two on-site wells. During construction, water is necessary for both soil stabilization (to prevent wind erosion) and soil compaction. It has been necessary to pump directly from the river, since well water is not yet available. This river water requirement is considered temporary and will be phased out following the soil compaction work and the availability of well water. Presently, the pump capacity for river water withdrawal is 800 gpm. However, it has not been necessary to use this capacity.

Necessary permits for this temporary withdrawal of water from the Columbia River have been obtained by the applicant's construction contractor.

N. OTHER ENERGY SOURCES -- OIL (NRDC, C-56)

A comment was made speculating that the West Coast is expected to have a surplus of domestic oil if the Alaska Pipeline goes forward and that possible modifications of the Oil Import Program could make imported oil available at lower cost or in greater quantities.

Although development of the Alaskan oil fields has already begun, it does not appear likely that oil deliveries from this area will have a significant effect on the domestic supply prior to the operation of Hanford No. 2. Also, transportation costs (tanker or pipeline) will be high, adding substantially to the relatively high cost of production in polar regions. Even if an adequate supply were available for use from their source, it is highly unlikely that costs would be reduced to a competitive level with nuclear fuel.

Residual fuel oil, as the name implies, is a residual refinery product and is used for heavy fuel uses, such as the generation of steam and electric power. In the United States the yield of residual oil from each barrel of crude has been steadily decreasing. It is reasonable to expect that residual oil yields in foreign refineries will follow the United States trend as the world demand for distillate products continues to increase. Therefore, the supply of residual oil can be expected to become tighter and it is highly unlikely that modifications to the Oil Import Program will materially reduce the price of residual oil in view of decreasing supply relative to demand.

O. GEOLOGY AND SEISMIC CRITERIA (INTERIOR, C-32; STATE OF WASHINGTON, C-45)

The function of this statement is to assess the effects of the Hanford No. 2 Plant on the environment. Physical properties of foundation materials and seismic considerations used for design criteria were evaluated by the staff in the Safety Evaluation Report issued on September 22, 1972.

P. HYDROPOWER NAVIGATION PROJECT (AGRICULTURE, C-5; ARMY, C-8)

The proposed Ben Franklin hydroelectric site on the Columbia River is about four miles downstream from the Hanford No. 2 site. It has been noted that the Corps of Engineers advised that this is not a federally authorized project.[5] The present policy of the Commission is to evaluate the additive and/or interactive environmental impacts of a nuclear facility with other existing facilities, but not speculate on the possible additive and/or interactive environmental impacts with proposed or possible future facilities.

Q. BARGE SLIP (COMMERCE, C-11; STATE OF WASHINGTON, C-45)

As indicated in the State of Washington comments, the applicant will not construct a barge slip. The applicant will use a barge facility to be owned and constructed by the Port of Benton.[6]

R. DIRECT RADIATION DOSE ASSESSMENT (EPA, C-20)

The dose at the site boundary has been evaluated for all direct radiation sources, including N^{16} turbine shine and coolant storage vessels. This dose will be less than 1 mrem/yr and the consequent population dose will be less than 0.1 man-rem/yr.

S. CUMULATIVE RADIOLOGICAL IMPACT (EPA, C-20; INTERIOR, C-33)

The staff has chosen not to evaluate the regional impact of multiple plant operation. This decision is related to the considerations upon which proposed Appendix I to 10 CFR Part 50 was based. The proposed site boundary dose of 5 mrem per year was developed on the basis that, from the standpoint of radiation exposure to humans and U. S. projected power needs to the year 2000,[7] regional effects would be minimal.

It is agreed that in some instances consideration of regional effects may be necessary, especially where the impact of plant effluents may not be linear with concentration in the environment. Such is the case with thermal and chemical effects. On the other hand, radiation effects on humans are now assumed to be linear with dose, and it is a simple matter to estimate impact for a region by examining the individual environmental statements or similar documents for plants in the area. It should be noted that the Hanford No. 2 exclusion area does not overlap that of the FFTF.

T. TRANSPORTATION IMPACT OF SOLID RADIOACTIVE WASTES (NRDC, C-52)

In the Draft Environmental Statement the staff assumed that the applicant will use a local burial ground in Benton County for disposal of solid radioactive wastes. Therefore, the exposure impacts presented in Section V.D.5.c were based upon an average shipping distance of 10 miles. Since disposal arrangements are not final, it is conceivable that solid wastes might be shipped to some other burial area more distant than the one assumed.

Under normal conditions, the average exposure to the individual truckdriver during a 1000-mile shipment of solid radioactive waste is estimated to be about 15 mrem. If the same driver were to drive 50 truckloads in a year, he could receive an estimated dose of about 750 mrem during the year. With two drivers on each vehicle, the annual cumulative dose for the 50 shipments would be about 1.5 man-rem. Approximately 100,000 persons who reside along a 1000 mile route over which the solid waste is transported might receive an annual cumulative dose of about 0.3 man-rem.

U. BACKFLUSHING OF INFILTRATION-BED INTAKE SYSTEM (INTERIOR, C-33)

The applicant is presently studying the potential impacts of silting which will result from the periodic backflushing of the intake system. This study is expected to provide input for a final intake structure design which will include as an objective minimizing the effects of silting. The applicant states that the final design will be coordinated with both Federal and State fishery agencies. The staff will evaluate the applicant's studies and final intake structure design in order to determine the scope of an operational monitoring program, if required.

V. GAS TURBINES (ARMY, C-9)

Despite the relatively low capital cost, the very high fuel cost of combustion (gas) turbines makes their use for base-load power generation expensive. Based on the data from the New York State Department of Public Service[8] and assuming annual fixed costs at 18 percent of capital costs, for base-load operation at 80 percent of rated capacity, total generating costs indicate a cost penalty in the range of 30 to 45% for combustion turbines as base-load prime movers.

Moreover, combustion turbines (which are very similar to aircraft jet engines) are expected to offer formidable maintenance difficulties in base-load service. "Both aircraft and industrial type gas turbines require on-line inspection every 500-1000 hours of operation, and a major overhaul after 2000-5000 hours operating time if run at normal loads and reasonable capacity factors."[9] Many combustion-turbine plants have been built for peaking and reserve capacity in recent years but they are not a competitive alternative to steam plants for base-load generation.

W. FLOOD HAZARD (ARMY, C-7; COMMERCE, C-13; INTERIOR, C-32)

The potential for flood damage at the site has been analyzed by the applicant for the probable maximum flood on the Columbia River, for the local probable maximum flood, and for floods due to assumed seismically induced failure of large upstream dams. The effects of these assumed floods were evaluated by the staff in the Safety Evaluation Report issued on September 22, 1972. The staff concluded that all plant facilities, except the river intake structure, are well above the conservatively identified seismically induced flood levels and that design criteria exceed the flood hazard requirements as outlined by Executive Order 11296.

X. ACCESS TO PROJECT (COMMERCE, C-10)

The Commission has granted to the Supply System, under the terms of a lease agreement, the general right to ingress and egress to the site. The Supply System, in turn, will allow reasonable access to the site and to project data for the purpose of evaluating effectiveness of the environmental program. The river is open (up to the high water mark) to the general public up to the old Hanford town site, approximately eight miles north of the plant site.

Y. CONTROL OF SOIL EROSION (AGRICULTURE, C-4)

Because of the low average annual rainfall (6.4 inches) and permeable surface soils, natural surface runoff is small. During construction and operation of the plant, steps will be taken to avoid uncontrolled runoff which might result from disturbing the land. These include proper grading, terracing or landscaping. To limit the erosion of raw soil in borrow pits and spoil areas, exposed faces will be protected to encourage growth of natural vegetation or, if necessary, areas will be seeded. Road cuts which expose fine sands will be stabilized with gravel. Dust will be controlled by sprinkling. In freezing weather, dust is not expected since the wetted soil will be stabilized by freezing.

Z. DISCHARGE DESIGN (EPA, C-24; COMMERCE, C-10)

The applicant considered a diffuser type discharge as well as a single port jet for discharge of blowdown into the river. The differences were found to be quite small for a blowdown discharge of 14.5 cfs into the river at minimum river flow of 36,000 cfs and average river flow of 115,000 cfs. Considering all factors, the applicant found no essential difference in performance of the various alternates from that of the proposed design. The staff concluded that it is unlikely that the proposed discharge system will have any adverse impact on fishery resources (see Section VII).

The staff also considered the possibility of dilution mixing of the cooling tower blowdown water prior to discharge into the river and concluded that it is highly unlikely that incorporation of this concept in the system design would result in a measurable reduction in impact on the river biota.

AA. DREDGING ACTIVITIES (ARMY, C-8; COMMERCE, C-11)

The final plans for the proposed construction of the infiltration intake system and the placement of the discharge structure are subject to the specifications defined in the Site Certification Agreement,[10] and review by appropriate Federal and State regulatory agencies prior to implementation. As proposed, construction of both facilities would be accomplished during periods of low flow and a time which would minimize potential effects on salmon and steelhead spawning occurring in downstream areas of the river. The intake system will be constructed in the dry during low water levels, with the channel isolated from the flowing stream and a settling pond utilized for dewatering operations, as necessary.

Final operations will include the removal of the earthen plugs, which contain a total volume of material estimated to be less than 100 cubic yards. All spoils from this operation are to be removed from the high water level wetted area and stabilized. Excavation for the placement of the discharge structures involves the removal of an estimated 400 yards of material from the stream bed. The excavated material must be removed from the wetted area. Excavated material will be subsequently used as overburden for the discharge pipe.

In the area of the proposed intake and outfall structures, the stream bed is composed of coarse substrate, and it is anticipated that dredging during a period of low flow would have greatest particle deposition in the vicinity of the excavation site. It is difficult to accurately predict the level of turbidity and sedimentation resulting from the construction of both facilities. However, it has been estimated that any reasonable amount of total spoils lost to the river would be negligible as compared to continual contribution from the watershed.[11] Some short-term siltation and localized biological effects, e.g., displacement, will be associated with the excavation and disturbance of the river bed. Studies on the effects of high level, chronic siltation conditions generally indicate that stream biota will be seriously affected. However, available data[12] indicates that although short-term episodes of turbidity and siltation may have some effect on fauna, recovery is rapid, so long as permanent damage is not done. Siltation severe enough to cause permanent damage appears unlikely, and in light of the wide fluctuation in the continual contribution of suspended matter from the watershed any siltation effects should be comparatively small.

BB. CHLORINE (EPA, C-25)

Chlorine will be added to the circulating water at the inlet to the condenser two or three times per day for a period of about 20 minutes each time. The chlorine content of the water entering the cooling tower has been estimated at 0.5 ppm[13] and it is expected to be substantially reduced in passing through the tower. Blowdown to the river is taken from the cooling tower basin and this discharge is restricted by the State Site Certification Agreement[10] to a chlorine content not to exceed 0.1 ppm. The chlorine concentration in the cooling tower basin is expected to reach a maximum value during or shortly after the actual chlorination period and then decrease rapidly with time. If necessary, blowdown can be restricted during the relatively short period of maximum chlorine concentration in the tower basin to assure that the concentration of free chlorine does not exceed 0.1 ppm in the water discharged to the river.

Therefore, the chlorine concentration of the blowdown may be as high as 0.1 ppm for only two or three relatively short periods of time per day and during the remaining time the chlorine concentration is expected to be substantially less.

The current EPA recommendations state that intermittent discharges of 0.1 ppm chlorine not exceeding a total of 30 minutes or intermittent discharges for two hours a day of less than 0.05 ppm <u>in the receiving stream</u> probably will not result in significant kills of aquatic organisms.[15] Limiting the total residual chlorine in the effluent to a maximum concentration of 0.1 ppm, chlorinated effluent would have essentially instantaneous dilution at the point of discharge, with expected concentrations less than 0.05 ppm within eight feet of the outfall without consideration for reduction by the chlorine demand of the receiving water. If the available literature on the acute effects of chlorine on salmonids is instructive, then the possible exposure intervals and concentrations which fish could encounter if their movement intersects the plume, appear to be less than those in which any mortality is predictable.[14,15] Toxicity studies on caged rainbow trout below the outfall of chlorinated municipal wastes demonstrated acute effects several thousand feet downstream. However, in the same study, at a fourth plant in which the discharge represented only about 0.6% of the river flow, no toxicity was demonstrated at any distance from the outfall, presumably due to effective dilution of the waste in the receiving water.[16] Rainbow trout probably represent the most sensitive fish to chlorine residuals.[14] Sprague and Drury[17] observed an avoidance response by this species at concentrations as low as 0.001 ppm, while other field studies indicate that an apparent effect of chlorinated effluent is to reduce the area available to fish rather than direct lethal effects.[14,15]

On the basis of the rapid dilution and the intermittency, and restricted volume of the discharge, the staff concludes that the proposed chlorinated discharges may cause fish to avoid areas in the vicinity of the discharge during periods of chlorination, but predictable exposure intervals to areas of the plume are less than those reported to have lethal effects on salmonids; and if intermittent release of chlorinated effluent is limited to an interval of less than 2 hours per day, the discharges in the receiving water are commensurate with the current EPA recommendations.

CC. DERIVATION OF ASSUMED χ/Q (COMMERCE, C-12; EPA, C-19)

Table II-7 of this statement is a joint frequency distribution of wind direction, wind speed and observed stability class; no attempt was made to equate wind and stability classes. The frequency of the various stability classes listed in Tables II-7 and II-8 are those actually observed at the Hanford meteorological tower; thus, the frequency of unstable conditions is not overestimated.

All gaseous radwastes will be discharged from a short stack at a height of 71 meters. Thus, the measured winds at the 200-ft level are those which best describe the long-range dispersion of gases from the plant.

The applicant and the staff have made two conservative assumptions in calculating χ/Q's. First, the term

$$[\exp - (\frac{h^2}{2\sigma_z^2})]$$

in Eq. 2 of p. 2.3.7.3-7 of the applicant's Environmental Report is assumed to be unity; this is the mathematical equivalent of a ground-level release. At 1950 meters, this term is equal to 0.96 for a Pasquill Type B; 0.86 for Type C; 0.48 for D; 0.18 for E; and 0.015 for Type F. Thus, placing h = 0 rather than =71 m is always a conservative assumption.

Second, no dilution due to a building wake effect was assumed. Wind speeds at 200 ft have been used as they are near the level of actual release.

A standard method of converting wind speeds to another height is the familiar power law:

$$U_2 = U_1 (\frac{Z_2}{Z_1})^p$$

where p is a function of stability.

Going from the 200-ft to 30-ft level,

$$U_{30} = U_{200} (\frac{30}{200})^p = U_{200} (0.15)^p$$

Using Sutton's values of p,[18] the following table results:

Stability	p	$(0.15)^p$
Unstable	0.11	0.81
Neutral	0.14	0.70
Stable	0.20	0.61
Very Stable	0.33	0.53

The ASME guide suggests p = 0.25 for unstable and neutral conditions, p = 0.50 for stable. These values are considerably higher than those suggested by Sutton.

To apply a wind speed correction factor of 0.4 to the 200-ft wind data require that p = 0.50; this implies that the atmosphere is always very stable at the site. Table II-8 shows that stable conditions are present only 58% of the time.

Pasquill[19] states:

> "For distances of 10 and 100 km a speed is adopted midway between this and the 'geostrophic' value as estimated from a chart of the surface pressure distribution. In this way a practical allowance is made for the influence of the wind at greater heights as the vertical spread of the plume increases."

This indicates that a wind speed greater than that at the 200-ft level should be used to measure dispersion rates out to 50 miles in the man-rem dose calculations. Thus, the use of the winds at 200 ft would be a conservative one in the populated areas surrounding the plant.

Pasquill also states:

> "The axial concentrations must then be corrected so as to correspond to the effective wind speed u. This is taken to be the 'surface wind speed' of routine meteorological observation, for distances of 0.1 and 1 km."

Thus, in view of the conservative assumptions made in the calculations (no credit for building wake dilution or elevated stack releases), the staff feels that the use of the 200-foot wind speed is reasonable to estimate doses at the exclusion boundary (1950 meters).

DD. OTHER ISSUES

Recognizing the virtually boundless range of considerations which could conceivably be relevant to an environmental review of a nuclear power reactor, the AEC regulatory staff has endeavored to apply a "rule of reason" in determining the scope of its review. For example, this statement addresses the environmental impact of only those activities in the "nuclear fuel cycle" which are considered proximate to the proposed action. The impact of activities such as uranium mining and ultimate disposal of high-level wastes - which are remote in time and place from the licensed activity, beyond the licensee's control, and to which the licensee contributes only fractionally - are not discussed. This scope is consistent with current policy. See, e.g., In the Matter of Vermont Yankee Nuclear Power Corporation Docket No. 50-271, ALAB-56; In the Matter of Vermont Yankee Nuclear Power Corporation Docket No. 50-271, ALAB-73. Similarly, the statement discusses the subject of demand for energy from the standpoint of actual anticipated demand, and not from the standpoint what the relevant demand should or should not be upon consideration of the desirability or utility of the uses of the energy produced by the plant.

EE. LOCATION OF PRINCIPAL CHANGES IN THIS STATEMENT IN RESPONSE TO COMMENTS

TOPIC COMMENTED UPON	AGENCY COMMENTING		SECTION WHERE TOPIC IS ADDRESSED
Impact of Permanent Employees	HUD	C-6	V.A.5
Effects of Intake Structure on Salmon Spawning	Oregon	C-47	V.C.2.a
Water Usage Tables and Curves	Army	C-7	II.E.3
Assumptions Used in Evaluation of Hanford No. 2	Army	C-7-8	XI.B.1
Bases for Steam and Water Leaks into the Reactor and Turbine Buildings	EPA	C-8	III.C.2.b
Transmission Lines	EPA NRDC	C-28 C-51	V.A.3

TOPIC COMMENTED UPON	AGENCY COMMENTING		SECTION WHERE TOPIC IS ADDRESSED
Salmon-Steelhead Rearing Complex	Commerce	C-11	II.F.3
Radiological Monitoring Program	Commerce Interior	C-11 C-34	V.F.2
Reference to WPPSS as an Agency of the State	State of Wash.	C-45	I
Effluent Systems, Chemical and Sanitary Wastes	State of Wash.	C-45	III.C.3
Temporary Barge Offloading Facility	State of Wash.	C-45	IV
Radiological Impact on Man	State of Wash.	C-46	V.D.6
Fogging and Icing	Interior	C-33	V.A.2
Need for Power	FPC	C-39	X

REFERENCES

1. "Nuclear Electric Generating Station Site Survey, Southwest Washington," Burns and Roe, Inc. Revised June 30, 1967.

2. "Nuclear Electric Generating Station Site Survey, Northwest Washington," Burns and Roe, Inc., June 1967.

3. "Progress Report, Thermal Power Portion of Joint Hydro-Thermal Power Program," H. R. Richmond, Administrator, Bonneville Power Administration, June 18-19, 1969, Northwest Public Power Association Meeting, Idaho Falls, Idaho.

4. "The Hydro-Thermal Power Program - A Status Report," Bonneville Power Administration, December 1971.

5. Letter to M. J. Hroncich from G. H. Fernald, Jr., Department of the Army, North Pacific Division, Corps of Engineers, 14 February 1972.

6. Letter to J. Lightfoot from J. J. Stein of WPPSS, dated August 11, 1972.

7. "The Year 2000 Study," J. F. Fletcher and W. L. Dodson (compilers), WASH.-1209, Westinghouse Hanford Co., 1972.

8. From New York State Department of Public Service, "The New York Power System Generation and Transmission Plans 1971-1980," Table VII, p. 31.

9. The 1970 National Power Survey, Federal Power Commission, Part I, p. I-8-5.

10. "Site Certification Agreement for Hanford No. 2 Between the State of Washington and the Washington Public Power Supply System," May 17, 1972.

11. Radionuclides in Transport in the Columbia River from Pasco to Vancouver, Washington, U. S. Department of the Interior Geological Survey, Water Res. Disc. Open File Report, Portland, Oregon, 1971.

12. Gammon, James R., "The Effects of Inorganic Sediment on Stream Biota," Water Pollution Control Research Series, 18050 DWC, December 1970.

13. ASER 2.3.4.1, page 2.

14. Brungs, W. A., "Literature Review of the Effects of Residual Chlorine on Aquatic Life," Prepublication copy for J.W.P.C.R., (1972).

15. Zillick, J. A., "Toxicity of Combined Chlorine Residuals to Freshwater Fish," J.W.P.C.F., 44, 212, 1972.

16. Basch, R., M. Newton, and G. Fetterolf, In Situ Investigations of the Toxic Toxicity of Chlorinated Municipal Waste Water Treatment Plant Effluents to Rainbow Trout (Salmo gairdneri), Mich. Dept. of Natural Resources, (Grant No. 18050 Gzz) (1971).

17. Sprague, J. B., D. E. Drury, "Avoidance Reaction of Salmonid Fish to Representative Pollutants," Adv. in Water Pollution Res., Proc. 4th International Conf., Prague, 1969, Jenkins, S. H. (Ed.), 1969.

18. O. G. Sutton, The Theoretical Distribution of Airborne Pollution from Factory Chimneys, Quart. J. Royal Meteor. Soc., Vol. 42, No. 3, 190-194, 1947.

19. F. Pasquill, Atmospheric Diffusion, Van Nostrand Co., London, 1962 (p. 210).

APPENDIX A. TERRESTRIAL PLANTS AND ANIMALS IN THE ENVIRONS OF THE HANFORD RESERVATION

Plants

Shrubs

Big sagebrush	*Artemesia tridentata*
Bitterbrush	*Purshia tridentata*
Green rabbitbrush	*Chrysothamnus viscidiflorus*
Gray rabbitbrush	*C. nauseosus*
Spiny hopsage	*Grayia spinosa*
Snow Eriogonum	*Eriogonum niveum*

Forbs

Longleaf phlox	*Phlox longifolia*
Balsamroot	*Balsamorhiza careyana*
Sand dock	*Rumex venosus*
Scurt pea	*Psoralea lanceolata*
Lupine	*Lupinus laxiflorus*
Pale evening primrose	*Oenothera pullida*
Desert mallow	*Sphaeralcea munroana*
Cluster lily	*Brodiaea douglasii*
Sego lily	*Calochortus macrocarpus*
Tansy mustard	*Descurainea pinnata*
Tumble mustard	*Sisymbrium altissimum*
Cryptantha	*Cryptantha circumscissa*
Russian thistle	*Salsola kali*
Fleabane	*Erigeron filifolius*

Grasses

Sandberg bluegrass	*Poa sandbergii*
Cheatgrass	*Bromus tectorum*
Indian ricegrass	*Oryzopsis hymenoides*
Squirrel tail	*Sitanion hystrix*
Six weeks fescue	*Festuca octoflora*
Thickspike wheatgrass	*Agropyron dasystachum*

From Applicant's Environmental Report.

Plants (Contd.)

Riprarian Vegetation

Willow	Salix exigua and others
Cottonwood	Populus trichocarpa
Sedges	Carex spp.
Rushes	Juncus sp.
Horsetail	Equisetum sp.
Cocklebur	Xanthium sp.
Wild onion	Allium sp.

Birds

Mallard	Anas platyrhynchos
Green-winged teal	Nettion carolinense
Blue-winged teal	Querguedula discors
Cinnamon teal	Q. cyanoptera
Gadwall	Chaulelasmus streperus
Baldpate	Mareca americana
Pintail	Dafila acuta tzitzihoa
Shoveller	Spatula clypeata
Canvas-back	Nyroca valisineria
Scaup	N. affinis
American goldeneye	Glaucionetta clangula americana
Buffle-head	Charitonetta albeola
Ruddy duck	Erismatura jamaicensis rubida
American merganser	Mergus merganser americanus
Coot	Fulica americana
Horned grebe	Colymbus auritus
Western grebe	Aechmophorus occidentalis
Pied-billed grebe	Podilymbus podiceps
Canada goose	Branta canadensis
Snow goose	Chen hyperborea
White-fronted goose	Anser albifrons
Whistling swan	Cygnus columbianus
Great blue heron	Ardea herodius
White pelican	Pelicanus erythrorhynchos
Cormorant	Phalacrocorax auritus
California gull	Larus californicus
Ring-billed gull	L. delewarensis
Common tern	Sterna hirundo
Foster's tern	S. forster
Killdeer	Oxyechus vociferus

Birds (Contd.)

Long-billed curlew	*Numenius americanus*
Chukar partridge	*Alectoris graeca*
California quail	*Lophortyx califorica*
Ring-necked pheasant	*Phasianus colchicus torguatus*
Sage hen	*Centrocercus urophasianus*
Mourning dove	*Zenzidura macroura*
Red-tailed hawk	*Buteo borealis*
Swainson's hawk	*B. swainsoni*
Sparrow hawk	*Falco sparverius*
Golden eagle	*Aquila chrysaetos canadensis*
Bald eagle	*Halioetus leucocephalus*
Osprey	*Pandion haliaetus carolinensis*
Burrowing owl	*Speotyto cunicularia*
Horned owl	*Bubo virginianus*
Raven	*Corvus corax*
American magpie	*Pica pica hudsonia*
Red-shafted flicker	*Colaptes cafer*
Horned lark	*Octocoris alpestris*
Western meadowlark	*Sturnella neglecta*
Loggerhead shrike	*Lanius ludovicianus*
Western kingbird	*Tyrannus verticalis*
Eastern kingbird	*Tyranus verticalis*
White-crowned sparrow	*Zonotrichia leucophrys*
Sage sparrow	*Melospiza melodia*
Say's phoebe	*Sayornis saya saya*

Mammals

Mule deer	*Odocoileus hemionus*
Coyote	*Canis latrans*
Bobcat	*Lynx rufus*
Badger	*Taxidea taxus*
Skunk	*Mephitis mephitis*
Weasel	*Mustela frenata*
Raccoon	*Procyon lotor*
Beaver	*Castor canadensis*

Mammals (Contd.)

Muskrat	_Ondatra zibethica_
Porcupine	_Erethizon dorsa_
Blacktail jackrabbit	_Lepus californicus_
Cottontail rabbit	_Sylvilagus floridanus_
Ground squirrel	_Citellus townsendi_
Pocket mouse	_Peromyscus parvus_
Deer mouse	_P. maniculatus_
Harvest mouse	_Reithrodontomys megalotis_
Grasshopper mouse	_Onchomys leucogaster_
Pocket gopher	_Thomomys_ sp.

Reptiles

Northern Pacific rattlesnake	_Crotalus viridus oreganus_
Great Basin gopher snake (bull snake)	_Pituophis melanoleucus deserticola_
Western yellow-bellied racer	_Coluber constrictor mormon_
Northern side-blotched lizard	_Uta stansburiana stansburiana_
Western fence lizard	_Sceloperus occidentalis_
Short-horned lizard	_Phrynosoma douglassi_
Great basin spadefoot toad	_Scaphiopus intermontanus_

APPENDIX B. AQUATIC PLANTS AND ANIMALS IN THE ENVIRONS OF THE HANFORD RESERVATION

Plants

Algae

Class Clorophyceae - Green Algae

Tetraspora spp.
Stigeoclonium spp.
Cladophora spp.
Oedogonium spp.
Ulothrix spp.
Spirogyra spp.

Class Chrysophyceae - Golden-Brown Algae

Hydrurus foetidus

Class Bacillariophyceae - Diatoms

Melosira spp.
Tabellaria spp. — dominant planktonic forms
Fragilaria spp.
Asterionella formosa
Gonphonema spp. — dominant sessile forms
Cymbella spp.

Class Myxophyceae - Blue-Green Algae

Ocillatoria spp.
Phormidium spp.

Vascular Aquatic Plants

Water Numphs Family - Najadaceae

Potomogeton spp.

From Applicant's Environmental Report.

Vascular Aquatic Plants (Contd.)

Frog's-Bit Family - Hydrocharitacae

Elodea spp.

Duckweed Family - Lemnaceae

Lemna spp.

Buckwheat Family - Polygonaceae

Polygonum spp.

Hornwort Family - Ceratophyllaceae

Ceratophyllum demersum

Animals

Phylum Porifera - Sponges

Spongilla spp.

Phylum Coelenterata

Hydra sp.

Phylum Platyhelminthes - Flat Worms

Dugesia dorotocephala

Phylum Bryozoa

Plumatella sp.

Phylum Annelida

Oligochaetae

Leeches

Phylum Mollusca

Clams

Anodonta nuttalliana
Cyclas fluminea

Snails

Stagnicola spp.
Physa nuttallii
Fluminicola nuttalliana
Fisherola nuttallii

Phylum - Arthropoda

Class Crustacea

Water fleas - Cladocera
Crayfish - _Astacus trowbridgii_

Class Insecta

Water boatman	_Sigara_ sp.
Mayflies	_Paraleptophlebia bicornuta_
	Baetis spp.
Stoneflies	_Acrynopferyx paralla_
Caddisflies	_Glossosoma velona_
	Hydropsyche spp.
	Cheumatopsyche spp.
	Hydroptila argosa
	Brachycentrus occidentalis
Aquatic moth	_Argyractis angulatalis_
Whirligig beetle	_Gyrinus_ sp.
Cranefly	Tipulidae
Bloodworm midges	Chironomidae
Midges	Orthocladiinae
Blackflies	_Simulium_ spp.

Class Arachnida

Water mites	Hydracarina

Fish

Pacific Lamprey	Lampetra tridentata (Gairdner)
White Sturgeon	Acipenser transmontanus (Richardson
Chinook Salmon	Oncorhynchus tshawytscha (Walbaum)
Sockeye or Blueback Salmon	O. nerka (Walbaum)
Coho or Silver Salmon	O. kisutch (Walbaum)
Steelhead or Rainbow Trout	Salmo gairdneri (Richardson)
Cutthroat Trout	S. clarki (Richardson)
Dolly Varden	Salvelinus malma (Walbaum)
Mountain Whitefish	Prosopium williamsoni (Girard)
American Shad	Alosa sapidissima (Wilson)
Mountain Sucker	Pantosteus platyrhynchus (Cope)
Bridgelip Sucker	Catostomus columbianus (Eigenmann & Eigenmann)
Largescale Sucker	Catostomus macrocheilus (Girard)
Carp	Cyprinus carpio (Linnaeus)
Redside Shiner	Richardsonius balteatus (Richardson
Northern Squawfish	Ptychocheilus oregonensis (Richardson)
Chiselmouth	Arocheilus alutaceus (Agassiz & Pickering)
Peamouth	Mylocheilus caurinus (Richardson)
Blacknose Dace	Rhinichthys atratulus (Hermann)
Longnose Dace	R. cataractae (Valenciennes)
Speckled Dace	R. osculus (Girard)
Brown Bullhead	Ictalurus nebulosus (Le Sueur)
Black Bullhead	I. melas (Rafinesque)
Channel Catfish	I. punctatus (Rafinesque)
Threespine Stickleback	Gasterosteus aculeatus (Linnaeus)
Yellow Perch	Perca flavescens (Mitchill)
Walleye	Stizostedion vitreum (Mitchill)
Bluegill	Lepomis macrochirus (Rafinesque)
Pumpkinseed	L. gibbosus (Linnaeus)
White Crappie	Pomoxis annularis (Rafinesque)
Black Crappie	P. nigromaculatus (Le Sueur)
Largemouth Bass	Micropterus salmoides (Lácepède)
Smallmouth Bass	M. Dolomieui (Lácepède)
Sculpin	Cottus spp.

__PARTMENT OF TRANSPORTATIO..
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (GWS)
400 SEVENTH STREET SW.
WASHINGTON, D.C. 20590
PHONE 202-426-2262

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Regulatory
Mail Section

24 OCT

50-397

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

This is in response to your letter of 28 August 1972 addressed to Mr. John E. Hirten, Assistant Secretary for Environment and Urban Systems, concerning the draft environmental impact statement and amendments on Hanford Nuclear Plant Number 2 located in Benton County, Washington.

The concerned operating administrations and staff of the Department of Transportation have reviewed the material presented and we have no comments to offer. It is our determination that the impact upon transportation is minimal. We have no objection to the construction of this facility.

The opportunity to review and comment on the draft statement for the power plant facility is appreciated.

Sincerely,

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGION X
ARCADE PLAZA BUILDING
1321 SECOND AVENUE
SEATTLE, WASHINGTON 98101

OFFICE OF THE REGIONAL DIRECTOR

SEP 22 1972

50-397

Mr. Daniel R. Muller
Asst. Director for Environmental Projects
U.S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

Subject: Draft Environmental Statement, Hanford No. 2 Nuclear Power Plant (Docket No. 50-397)

The subject draft statement was sent to this Region Office by the Office of the Assistant Secretary for Health and Scientific Affairs in Washington, for review and comment. We are happy to have this opportunity to review your statement.

This office has no comment on the safety and health aspects of the statement. The long established monitoring and safety practices at the site, if continued to be enforced as described in the statement, should provide a safe, healthy, working climate. We therefore have no objection to the authorization of this project insofar as our interests and responsibilities are concerned.

Thank you for the opportunity to review the draft statement and to coordinate our mutual environmental interests.

Sincerely yours,

W. Phillips Pickerill, Acting
for Bernard E. Kelly
Regional Director

50-397

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20250

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U.S. ATOMIC ENERGY COMM.
REGULATORY
MAIL & RECORDS SECTION

October 17, 1972

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

We have had the draft environmental impact statement for the Hanford Number Two Nuclear Power Plant of the Washington Public Power System reviewed in the relevant agencies of this Department. Comments from the Soil Conservation Service, an agency of the Department, are enclosed.

Sincerely,

T C Byerly

T. C. BYERLY
Coordinator, Environmental
Quality Activities

Enclosure

SOIL CONSERVATION SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE

COMMENTS ON DRAFT ENVIRONMENTAL STATEMENT PREPARED BY ATOMIC ENERGY COMMISSION, DIRECTORATE OF LICENSING, FOR HANFORD NUMBER TWO NUCLEAR POWER PLANT, WASHINGTON PUBLIC POWER SUPPLY SYSTEM.

Comments pertaining to this project are confined to those impacts which, through jurisdiction by law or special expertise, this agency is authorized and qualified to offer comments.

Land within the area leased from AEC for the facility does not have appreciable potential for agricultural production without irrigation. With irrigation and modern soil and water management techniques, the potential of the land for agriculture is moderately high. The statement emphasizes the desert-like environment which presently exists throughout the area, but ignores the long term potential for more intensive use for the land which exists with the addition of water. This consideration is significant since adequate water supplies are nearby.

Control of soil erosion by wind during and following construction will require prior anticipation of control measures required to minimize adverse impacts. References to "sprinkling, if necessary," or, "if the need is evident," would seem to grossly underestimate the real potential for adverse impacts during the extended construction period associated with this project. Wind erosion control during subfreezing periods, as well as at other times, may require the use of mulching or other more complex measures to provide a reasonable level of land protection, as well as control of air pollution. Vegetative programs needed to stabilize residue burial grounds and other unprotected land are not treated in the draft statement.

In view of the desert-like environment and permeable surface soils, soil erosion, sedimentation, and associated water pollution from precipitation runoff is unlikely. This situation will also minimize the effects of any disruption of the natural drainage pattern on the water regime of adjacent lands.

Since access to the area has been controlled since 1943, land developments are nonexistent. The project will not impact on any existing conservation systems or affect adjacent land use significantly. Land severance of existing enterprises is not a factor.

No rare plant communities are known to exist in the area. The bald eagle, the only endangered wildlife species which has been observed at various times within the area, will not be affected. Habitat significant to this species will not be disturbed by the project.

It is noted that the Ben Franklin hydro-electric site on the Columbia River, about four miles downstream from the site of Hanford Number Two, is given only minor consideration in the draft statement and in the Environmental Report submitted by the Washington Public Power Supply System.

The need for utilizing the potential of the Ben Franklin hydro-electric site may eventually arise. The interaction at Hanford Number Two with this potential site would be a pertinent factor. Perhaps the interrelationship of Hanford Number Two and the Ben Franklin hydro-electric development should be discussed in the environmental statement.

50-397

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
ARCADE PLAZA BUILDING, 1321 SECOND AVENUE
SEATTLE, WASHINGTON 98101

September 18, 1972

REGION X
Office of Community Planning
and Management

IN REPLY REFER TO:
MS 307

Mr. Daniel R. Muller
Assistant Director for Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muller:

Subject: Draft Environmental Impact Documentation, Hanford Number Two Nuclear Power Plant, Benton County, Washington

We have reviewed the statement and documentation submitted with your August 28, 1972 letter which has been sent to us from the Chicago Regional Office, since we have jurisdiction in the states of Washington, Oregon, Idaho and Alaska.

We believe you have adequately covered most of our areas of concern. We suggest, however, that the final statement covers the possible impacts of the number and types of the permanent employees on the housing, public services and facilities of the tri-cities area. We also suggest that on the summary of environmental impacts and effects include also the beneficial impacts and effects.

Thanks for the opportunity to comment on your statement.

Sincerely,

John R. Merrill

John R. Merrill
Assistant Regional Administrator
for Community Planning and Management

DEPARTMENT OF THE ARMY
NORTH PACIFIC DIVISION, CORPS OF ENGINEERS
210 CUSTOM HOUSE
PORTLAND, OREGON 97209

50-397

NPDPL-FW

5 October 1972

Mr. Daniel R. Muller
Assistant Director for Environmental
Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, DC 20545

Dear Mr. Muller:

A copy of the Atomic Energy Commission's draft environmental statement, "Environmental Considerations Related to the Proposed Construction of the Hanford Number Two Nuclear Power Plant by Washington Public Power System," was forwarded by the Office of the Chief of Engineers for our review and comment. We have reviewed the statement with respect to the impact the project would have on areas of Corps of Engineers responsibility and interest, and have the following comments to offer for your consideration.

The evaluation of flood hazard requirements as outlined by Executive Order 11296, "Evaluation of Flood Hazard in Locating Federally Owned or Financed Buildings, Roads, and Other Facilities, and in Disposing of Federal Lands and Properties," should be considered during planning and design of all proposed structures and fills adjacent to the Columbia River. We feel a discussion of these requirements and resulting information should be included in Section IA, "Site Selection," or Section II, "The Site."

The statement in the last sentence of the third paragraph on page II-12, "...and modified by the applicant to represent water usage in the year 1970," is incorrect. The flows as well as the tables and curves were developed in the Columbia-North Pacific Framework Study and were not modified by the applicant. Tables II-13 and II-15 and Figure II-5 are taken from Appendix V, Volume 1, "Water Resources," April 1970, of the framework study and should be so referenced.

In Table III-1, "Principal Assumptions Used in Evaluation of Hanford No. 2 Reactor," 0.8 or 80 percent is given as the assumed plant factor for the proposed project. On page III-18 the number of full-power

AIR MAIL

NPDPL-FW
Mr. Daniel R. Muller 5 October 1972

days was calculated on a basis of 80 percent plant factor. However, Table X-3 shows Hanford No. 2 as operating at about 85 percent plant factor once the plant gets into full operation (1980-1981). In addition, Table XI-3, "Cost-Benefit Summary," comparing the proposed plant with other types of facilities, uses an 85 percent capacity factor. The use of 0.8 or 80 percent in Table III-1 and elsewhere in the statement conflicts with the 85 percent which is currently being used as the assumed annual plant factor for base-load thermal plants in regional power planning studies such as the Pacific Northwest Utility Conference Committee load resource analyses. One of the understated impacts of the proposed thermal nuclear facility as a result of using the smaller factor is the output of contaminants.

We suggest that the dredging activities on pages IV-3 and IV-4 be expanded to identify the quantities of material to be excavated and the location of disposal area to be used for the dredged material. The statement recognizes in Section I that Corps of Engineers permits will be required for the installation of the intake and outlet structure and for discharging cooling tower blow down to the river, but there is no mention of the need for a permit to accomplish the proposed dredging. As presently discussed, the statement gives the impression that the Site Certification Agreement with the Thermal Power Plant Site Evaluation Council covers the dredging operations and the construction of the intake and outlet structures.

The Corps of Engineers is studying a possible hydropower-navigation project at a site in the same area of the Columbia River as the proposed thermal nuclear power facility. A brief discussion could be included in the statement as to what effect the two projects might have on each other. The applicant's environmental report does discuss this possibility, but no mention is made in the draft environmental statement.

The concept of entirely foregoing the production of added power is not considered in the discussion of alternatives in Section XI. The abandonment alternative only mentions the unrecoverable financial investments to date which would be lost. We believe the statement should be expanded to address the more general alternative relative to environmental conditions (curtailed power use, etc.) resulting from deletion of the Hanford Number Two projected 1100 MW of power from the West Group Area supply program.

In the discussion of the alternative of coal fired thermal plant on page XI-3, a plant factor of 80 percent was used to indicate what the resulting contaminants would be. Table XI-3 on page XI-16, "Cost-Benefit

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Summary," uses a plant factor of 85 percent. Although the plant factors are different, the estimated quantities of chemicals discharged to the air are the same. These values should be checked out for all alternative power sources to be sure that the same plant factor is used for all computations.

On page XI-7 a comment is made in the first paragraph that gas turbines' operating costs are too high to be considered for a base-load operation. Generally speaking, this is true, but there are examples of gas turbines operating at fairly high plant factors. The referenced comment would be more convincing if cost and benefit factors are cited for gas turbines. Another point to consider is that if Hanford No. 2 should be delayed for a substantial period, gas turbines may be the only real alternative left.

The final statement should make some effort to assess the indirect effects of the power installation. An assessment of the social and economic effects of the additional power on population and industrial growth would furnish a more complete understanding of the total impacts of the proposed project.

The opportunity to review the draft environmental impact statement is appreciated.

Sincerely yours,

K. T. Sawyer

K. T. SAWYER
Major General, USA
Division Engineer

THE ASSISTANT SECRETARY OF COMMERCE
Washington, D.C. 20230

October 11, 1972

50-397

Mr. Daniel R. Muller
Assistant Director for Environmental
Projects
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

The draft environmental impact statement for "Hanford Number Two Nuclear Power Plant, Docket No. 50-397" which accompanied your letter of August 28, 1972, has been received by the Department of Commerce for review and comment.

The Department of Commerce has reviewed the draft environmental statement and has the following comments to offer for your consideration.

Because fishery biologists do not have access to the project site and are, therefore, unable to inspect the facilities, it is rather difficult to assess the adequacy of the EIS in describing the project and its potential environmental impact. In this regard, perhaps the EIS should mention the possibility of routine inspection by fishery biologists of the project during its construction and operation, especially when backflushing of the filtration intake system occurs.

We also suggest that the EIS discuss the possibility of constructing a mixing chamber to be integrated with the intake and discharge systems, similar to that proposed for the Trojan Nuclear Plant, to assure that the blowdown water is mixed with the intake water prior to discharge into the river.

Page II - 34. It would seem appropriate to make some mention of the salmon-steelhead rearing complex at Rhingold Springs.

Page III - 12, item (c). It would be desirable to provide assurance that the filter-bed type of intake structure meets the criteria of, and has the approval of, appropriate State and Federal fishery agencies.

Page IV - 6. We suggest that the time period for dredging of barge slips be subject to approval by appropriate fishery agencies, and that this time period be specified in the EIS to avoid conflicts during future construction.

Pages V-8, V-9. It would seem appropriate to include some discussion to indicate that the design of the intake structures will comply with State and Federal fishery agency criteria.

Page V-17. In the first paragraph, it is stated that the cross-sectional area of discharge is less than 7 percent of the main channel during worst-case conditions, and that most adult salmonids generally migrate through this reach along the shoreline opposite the project site. We suggest discussion be included regarding the effect the discharge will have on those fish that do migrate through the plume.

Pages V-34 to V-42. The environmental radiological program is quite extensive, but could be strengthened by the addition of a few more details. For instance, sampling of aquatic life includes benthic organisms (p. V-36), but the types are not mentioned. On page V-40, proposed collections of aquatic life at three stations are mentioned, but locations are not specified.

Page VII-1. In the third paragraph, the impression is given that the effects of dredging activities will be negligible. Unless evidence to the contrary can be presented, we suggest that this paragraph be revised to indicate that the increased turbidity and sedimentation caused by the project will probably result in a more than negligible adverse effect on spawning activities in downstream areas.

The applicant employed a modified Gaussian distribution as the mathematical model for calculating annual radionuclide doses to the nearby populace contributed by air submersion of irradiated effluents. For this purpose, relationships between the windspeed at 200 feet above the ground and the stability class for the layer between the surface and the 200 foot level were established. These relationships were used to determine the dispersion characteristics in the vicinity of the plant under various meteorological regimes. We question the validity of this approach and suggest that one cannot satisfactorily equate the thermal stability within a layer to the windspeed at the top of that layer. With this in mind, it is inferred that table 2.3.7.3-7 indicates an unrealistically high frequency distribution in the more unstable categories. If so, this would, of necessity, lead to higher diffusion estimates and lower expected doses to the individual and to the population.

The meteorological data presented in table II-7 is the relationship between wind direction and wind speed at 200 feet as a function of atmospheric stability. We have used these data to estimate the maximum annual average site boundary (1950 m) concentration, but have multiplied the wind speeds by a factor of 0.4 in order to approximate a ground level (30 ft) release instead of a 200-ft release. Consequently with winds from the northwest which occur 21 percent of the time we estimate an annual concentration of 3×10^{-6} sec m^{-3} as compared to the staff's value of 1.15×10^{-6} sec m^{-3} (see page V-24).

In this regard, the estimated total integrated dose from radioactive effluents to the population near the site of Hanford Number Two does not include the contribution from Hanford Number One. We have previously reported our interest in having EIS's address the cumulative effect. Should a model be developed to calculate the total effluent concentrations, input data would probably have to be space averaged so that the cumulative effect to the area from both plants could be properly evaluated.

For the analysis of the environmental impact of postulated accidents we are unable to evaluate the results because specific information on the meteorological assumptions, the resulting concentration, and the frequency of occurrence of such a concentration is not presented in the draft statement.

It is suggested that the section on postulated accidents might address the probability of flooding and the impact of various flood crests on plant operation.

We hope these comments will be of assistance to you in the preparation of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

50-397

ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF THE ADMINISTRATOR

RECEIVED OCT 13 1972

OCT 1 1 1972

Mr. L. Manning Muntzing
Director of Regulation
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muntzing:

The Environmental Protection Agency has reviewed the draft environmental statement for Hanford Number Two Nuclear Power Plant, and we are pleased to provide our comments to you.

The Environmental Protection Agency commends the applicant for choosing a closed cycle cooling system for waste heat rejection to the Columbia River. It is not certain, however, that the proposed single port discharge method is the best alternative to assure that there will be no significant adverse impact on the aquatic biota or water quality. Based on subsequent monitoring data, it may be necessary to install an alternate means of discharge.

The radioactive waste treatment systems as proposed by the applicant and described in the draft statement, appear to be representative of current "as low as practicable" technology. We encourage the applicant to develop operating procedures and administrative controls over the use of the equipment which are consistent with "as low as practicable" concepts.

Our comments include several suggestions for additional information especially with regard to the identification and assumed magnitude of potential radioiodine releases which, if implemented, should result in a more complete final environmental statement.

We will be pleased to discuss our comments with you or members of your staff.

Sincerely,

Sheldon Meyers

Sheldon Meyers
Director
Office of Federal Activities

D-AEC-00068-54
TAD-008-73

ENVIRONMENTAL PROTECTION AGENCY

Washington, D.C. 20460

October 1972

ENVIRONMENTAL IMPACT STATEMENT COMMENTS

Hanford Number Two Nuclear Power Plant

TABLE OF CONTENTS

INTRODUCTION AND CONCLUSIONS

The Environmental Protection Agency (EPA) has reviewed the draft environmental impact statement for the Hanford Number Two Nuclear Power Plant, prepared by the U.S. Atomic Energy Commission (AEC) and issued on August 28, 1972. Following are our major conclusions:

1. It is not certain that the proposed single port method for discharging heated water to the Columbia River is the best alternative to assure that there will be no significant adverse effect on the aquatic biota or water quality. Based on monitoring data, it may be necessary to install an alternate means of discharge, such as a diffuser.

2. The radioactive waste treatment systems, as described in the draft statement, appear to be capable of limiting discharges of radioactive material to within the guidelines of proposed Appendix I 10 CFR 50. However, additional discussion regarding the assessment of the halogen source term is requested.

3. Since the Hanford Number Two Power Plant is one of several nuclear facilities located on the Hanford Reservation, the EPA would be interested in the direction of any AEC efforts directed to the evaluation of the cumulative environmental impact of facilities located on the reservation.

RADIOLOGICAL ASPECTS

Radioactive Waste Management

If utilized properly, it appears that the radioactive waste treatment systems proposed for Hanford No. 2 will be capable of limiting releases of radioactive effluents from the facility to within the guidelines of the proposed Appendix I to 10 CFR Part 50. Specifically, equipment capabilities and sizing within the plant's gaseous and liquid radioactive waste treatment systems and the use of demineralized primary coolant water as the source of steam for the turbine gland-seal system are examples of design implementations which apply current "low as practicable" technology. In addition, the plant will be located within the U.S. Atomic Energy Commission's Hanford Reservation about 4 miles from the nearest boundary. Location of the plant within this large controlled area gives added assurance that any radiological exposures to the public will be below dose guidelines of the proposed Appendix I. In the review which follows, suggestions are made for inclusions of additional material in the final statement, and clarifications are requested on certain information presented in the draft statement, the applicant's Environmental Report, and the Preliminary Safety Analysis Report (PSAR).

Gaseous Effluents

The draft statement indicates that the releases of noble gas radioactivity from the air ejector off gas system and mechanical vacuum pump operation during start-up could lead to whole body exposures of 3 mrem/year at the Hanford No. 2 site boundary (1950 meters), and 0.2 mrem/year at the nearest reservation boundary. These calculated dose rates appear conservative since they are based on the assumption of 18 day and 24 hour holdup for xenon and krypton, respectively, in passage through the 0°F charcoal beds of the main condenser offgas treatment system.

The draft statement also indicates that a child's thyroid could receive a potential dose of 2.7 mrem/year if the child were to drink milk from a cow grazing within 4 miles of the proposed plant. Presumably, this dose results from iodine potentially released through steam and water leaks into the reactor and turbine building ventilation systems. The bases for this calculation should be presented. For example, the 480 pound/hour steam leak to the turbine building given in the draft statement is about a factor of 5 less than leakage previously assumed at other similar BWR turbine buildings. It was also noted in the applicant's response to question 9.15 in the PSAR that the release of halogens during startup is currently under study by the General Electric Company. If available, results of this analysis should be included in the final statement.

The draft statement did not address the potential iodine releases due to operation of the Relief Valve Augmented Bypass (REVAB) system. Although any iodine dumped to the suppression pool from such operations would most likely undergo significant decay before containment purging and the potential for treatment of the purged air exists via the standby gas treatment system, this source may still be significant relative to the proposed Appendix I iodine concentration limits. Therefore, the final statement should determine the significance of this iodine source based on (1) frequency of REVAB operation, (2) primary coolant iodine concentrations, (3) iodine partition factors, (4) frequency of purging, and (5) any administrative procedures which would result in the control of this radioiodine source.

The derivation of the assumed X/Q value, apparently based on meteorological data taken at a 200 foot tower level, should be presented in the final statement. Since the releases of gaseous waste from Hanford No. 2 will be from plant vents, the effluents will be affected by the building wake and the releases should be considered ground level sources. Thus, wind speed and direction data characteristics of surface conditions should be used to evaluate the dose consequences.

Liquid Effluents

The statement does not discuss the possible environmental effects of effluents resulting from maintenance operations such as those which may be performed on the suppression pool or the condenser. It is not clear how the large volume of liquids associated with these maintenance operations would be handled. Analyses should be included in the final statement to indicate the magnitude of this possible source and the projected treatment capability. A presentation of relevant details such as: (1) the expected or potential maintenance operations resulting in very large volumes of contaminated liquids, (2) the concentration of radionuclides, (3) the ability of the plant waste systems to receive and treat these liquids, (4) the resulting environmental impact, and (5) the frequency of the events should also be included.

We have also noted that, although the applicant made a commitment to the Appendix I liquid radioactivity concentration limit, the limiting concentration in the discharge canal as presented in the statement exceeds the proposed Appendix I value for average annual discharges by a factor of two. The justification for this change should be included in the final statement.

Recent research conducted by Battelle-Northwest Laboratories has shown that tritated water suppressed the immune response of rainbow trout to Chandıococous columnaris. It is suggested that the relationship between the small tritium release from Hanford No. 2 (10-16 Ci/year) and the observed threshold for this effect be discussed in the final statement.

Dose Assessment

Since the Hanford No. 2 plant is designed with above-turbine piping from the moisture separator to the low pressure turbines and moisture separator-reheaters located on the turbine floor, the direct radiation source term for ^{16}N in the generated steam should be addressed. Although this source term is referred to in the Environmental Report, details of turbine shielding should be presented and the site boundary dose should be calculated. Similarily, the possible additional direct radiation source term for outdoor coolant storage tanks should be addressed. Such evaluations are especially important at this design and preconstruction phase of the station, because, should the evaluations indicate the need for additional shielding or other protective measures, they can be included in the design of the plant at relatively low cost.

Interactions with Other Nuclear Facilities

From figure 1.4-3 of the PSAR and the applicant's answer to AEC question 2.16, it appears that the expanded Hanford No. 2 exclusion area overlaps both the exclusion areas for the Fast Flux Test Facility (FFTF) and that proposed for the Liquid Metal Fast Breeder Reactor. The operating Hanford 1 reactor is also located at a distance of less than 20 miles from Hanford No. 2. Our interest regarding these facilities is to evaluate their cumulative environmental impact. Question 2.16 in the PSAR called for a "... safety evaluation of the effect on the plant of nearby industrial facilities, including AEC facilities." The approach of the applicant's response in discussing radiological consequences at Hanford No. 2 from potential FFTF accidents, if applied to an environmental impact evaluation, would be a worthwhile addition to the final statement.

The Environmental Report also states that "... the supply system will cooperate with others in emergency planning and coordination for the (Hanford Reservation) area." The extent of this effort should be further delineated in the final statement.

Effluent Monitoring

The applicant is commended for formulating the in-plant monitoring program in accordance with AEC Safety Guide 21. In the final statement, the discussion of effluent monitoring should include the estimated amounts of radioactive material that could be released from the plant undetected and the amount of activity that could be discharged prior to activation of monitoring alarms and before shut-off occurs. It is also suggested that the final statement expand the information presented regarding the capability of the surveillance program to differentiate between radioactivity releases and consequences to the environment from Hanford No. 2 and those resulting from previous and current discharges of radioactive materials from other sources.

Transportation and Reactor Accidents

In its review of nuclear power plants, EPA has identified a need for additional information on two types of accidents which could result in radiation exposure to the public: (1) those involving transportation of spent fuel and radioactive wastes and (2) in-plant accidents. Since these accidents are common to all nuclear power plants, the environmental risk for each type of accident is amenable to a general analysis. Although the AEC has done considerable work for a number of years on the safety aspects of such accidents, we believe that a thorough analysis of the probabilities of occurrence and the expected consequences of such accidents would result in a better understanding of the environmental risks than a less-detailed examination of the questions on a case-by-case basis. For this reason we have reached an understanding with the AEC that they will conduct such analyses with EPA participation concurrent with review of impact statements for individual facilities and will make the results available in the near future. We are taking this approach primarily because we believe that any changes in equipment or operating procedures for individual plants required as a result of the investigations could be included without appreciable change in the overall plant design. If major redesign of the plants to include engineering changes were expected or if an immediate public or environmental risk were being taken while these two issues were being resolved, we would, of course, make our concerns known.

The statement concludes "...that the environmental risks due to postulated radiological accidents ... are exceedingly small." This conclusion is based on the standard accident assumptions and guidance issued by the AEC for light-water-cooled reactors as a proposed amendment to Appendix D of 10 CFR Part 50 on December 1, 1971. EPA commented on this proposed amendment in a letter to the Commission on January 13, 1972. These comments essentially raised the necessity for a detailed discussion of the technical bases of the assumptions involved in determining the various classes of accidents and expected consequences. We believe that the general analysis mentioned above will be adequate to resolve these points and that the AEC will apply the results to all licensed facilities.

NON-RADIOLOGICAL ASPECTS

Thermal Effects

The Hanford Number Two Nuclear Power Plant will use wet mechanical draft cooling towers in a closed-cycle cooling system. This will prevent all but a small portion of the plant's waste heat from reaching the Columbia River. In this regard, the applicant has received a certification from the Thermal Power Plant Site Evaluation Council of the State of Washington. This certificate considers the thermal discharge from the plant and supercedes any other certification or comparable pronouncement from the state.

It is not certain, however, that the proposed single port discharge method is the best alternative to assure that there will be no significant adverse impact on aquatic biota or water quality in the Columbia River. For example, our calculations show that there will frequently be a 2-5°F temperature rise in the surface boil. Such a situation could affect migratory (anadromous) fish. The final statement should discuss this and other possibilities in detail.

Should the planned thermal and biological monitoring reveal a significant impact on water quality or aquatic biota, we recommend that an alternative means of discharge be considered. For example, the outfall could be fitted with an appropriate diffuser system (such as that used at the Trojan nuclear plant) that would assure more rapid mixing of the thermal effluent and the receiving water.

Biological Effects

EPA has recommended in the past, that for adequate protection of aquatic biota, residual chlorine concentrations should be limited to 0.1 mg/liter not to exceed 30 minutes per day or 0.05 mg/liter not to exceed 2 hours per day. The draft statement indicated, however, that the maximum chlorine content of the Hanford 2 blowdown is expected to be 0.1 mg/liter for 40 to 60 minutes/day. In our opinion, such a situation would routinely result in chlorine levels near the point of discharge that are in excess of EPA recommendations. As a consequence, it is possible that a significant impact on aquatic biota may occur. In addition, the scope and degree of possible impacts may be increased should occasional accidental overuse of chlorine lead to higher concentations and/or longer exposure times.

It has been observed that many species can exhibit increased mortality rates, impairment of spawning processes, changes in migration, or other alterations in natural life patterns as a result of chlorine exposure. For example, rainbow trout avoid a residual chlorine concentration of 0.001 mg/l under laboratory conditions. Under field conditions of continuous discharge, brook trout were not found in streams that had residual chlorine concentrations as high as 0.015 mg/l. Also, the activity of brook trout was reduced as a result of exposure to a residual chlorine concentration of 0.005 mg/l after 24 hours. In addition, chinook salmon show observable increase in mortality rates at a residual chlorine concentation of 0.25 mg/l for as little as 2.2 hours exposure. Apparently, larval fish are more sensitive than adult fish and trout fry were killed instantly at a residual chlorine concentration of 0.3 mg/l. In addition, it has been shown that residual chlorine affects fish food organisms (e.g. those important to trout and salmon). Although data on short exposure times is limited, in longer test (i.e., 4-7 days) several important organisms were as sensitive if not more so than the trout and salmon under similar exposure conditions. Consequently we may assume that under short exposure conditions there would also be some fish food organisms as sensitive or more sensitive to residual chlorine than the trout and salmon previously discussed.

Because, as indicated above, many aquatic species are known to show significant effects from exposure to chlorine, we recommend that the final statement discuss in detail the possible impacts from the use of this biocide at the Hanford plant. In particular, attention should be given to trout and salmon since one of the few remaining undisturbed spawning areas in the Columbia River system is located in the vicinity of the plant site.

Although the draft statement indicates that chlorine discharges will be monitored, no details are provided on the methods and procedures to be used. Since this program, in conjunction with adequate biological monitoring, is essential to the determination of the relationship between plant discharges and biological impact, the final statement should include such additional details.

In addition, should post operational monitoring reveal that a significant impact from chlorine is likely, we recommend that changes in the methods of chlorination or alternate antifouling techniques be considered. For example, chlorine could be added during periods when blowdown is not occurring so that the maximum amount of time is allowed for consumption of this biocide within the cooling system before discharge.

AIR QUALITY

We recognize that the environmental impact of airborne pollutants, other than radioactive species, is relatively minor; however, such impacts should be documented. Although the subject draft statement and the applicant's Environmental Report cover several air pollution sources, other pertinent information is omitted or not evaluated in sufficient detail. In our previous environmental impact statement reviews, certain questions pertaining to air quality have continually recurred. It is suggested that a standard format could be adopted in environmental statements for all nuclear plants which should include the following general information, requested below in terms of the specific Hanford No. 2 Power Plant:

(1) Ambient Air Measurements of Set I and Set II Pollutants

The Environmental Report Amendment I indicates that sulfur dioxide, nitrogen dioxide, and suspended particulates are continuously measured at a site near Ringold by the Hanford Environmental Health Foundation. The concentrations of these air pollutants are expressed in terms such as sulfur dioxide average quarterly values from 0.002 to 0.01 ppm, 0.029 ppm maximum observed value during one 15-month period, or particulates content averaging 1000 micrograms per cubic meter with winds of 12 mph, etc. Ambient air measurements for set I pollutants [suspended particulates and sulfur dioxide] and set II pollutants [nitrogen dioxide, carbon monoxide, non-methane hydrocarbons, and photochemical oxidants (ozone)] should be expressed in terms as published in the Federal Register, Volume 36, Number 84, Part II, Friday, April 30, 1971, titled "National Primary and Secondary Ambient Air Quality Standards." Designation of pollutant concentrations per time unit and time averaging according to these guides is suggested. The concentrations of sulfur dioxide and nitrogen dioxide appearing in the Environmental Report are interperted to be below the Federal Air Quality Standards; however, more precise values for suspended particulates should be presented.

(2) Contribution from Nearby Facilities and Equipment to Ambient Air Concentrations for Set I and Set II Pollutants

Throughout the draft impact statement, there are references to the Hanford No. 1, FFTF, transmission lines, and other nearby facilities. The impact statement should document the effect of these existing facilities and their contribution to the background ambient air concentrations of set I and set II pollutants.

(3) Air Pollution Emission Release Parameters

The existing vents that may release air pollutants should be documented, in the statement. In addition other parameters should be listed such as release height, volume flow rate, effluent temperature rise, effluent velocity, etc., unless such information can be shown not to be pertinent.

(4) High Voltage Transmission Lines

The draft statement does not discuss the environmental impact generated by high voltage transmission lines. The report documents the length of these lines, and it is expected that ozone will be produced. The statement should estimate ozone production and its possible environmental effects.

(5) Concrete Batching Plant and Pouring Operations

The draft impact statement reports that a concrete batching plant will be used during the construction phase of the facility but there is no discussion of the air pollution potential from this temporary facility. Data provided particulate loading, volumetric flow rate and expected gas analyses of the total effluent should be given in the impact statement.

ADDITIONAL COMMENTS

During the review we noted in certain instances that the draft statement does not present sufficient information to substantiate the conclusions presented. We recognize that much of this information is not of major importance in evaluating the environmental impact of the Hanford Number Two Nuclear Power Plant. The cumulative effects, however, could be significant. It would, therefore, be helpful in determining the impact of the plant if the following information were included in the final statement:

1. The final statement should include an evaluation of alternative sanitary waste handling procedures and indicate the basis for the decision to employ the septic tank processing method.
2. Information should be provided in the final statement on the disposal of sludge from pumpout of the septic tank.

United States Department of the Interior

50-397

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER-72/1052

OCT 31 1972

RECEIVED NOV 1 1972 U.S. ATOMIC ENERGY COMMISSION Regulatory Mail Section

Dear Mr. Muller:

This is in response to your letter of August 28, 1972, requesting our comments on the Atomic Energy Commission's draft statement, dated August 1972, on environmental considerations for Hanford Number 2, Benton County, Washington.

Our comments are presented according to the format of the statement.

Historical Significance

The proposed action would not affect any existing or proposed unit of the National Park System or any site eligible for registration as a National Historic, Natural, or Environmental Education Landmark. However, we think that the statement should include a discussion of steps taken to comply with provisions of Executive Order 11593 of May 13, 1971, concerning Protection and Enhancement of the Cultural Environment.

General Terrain Characteristics

The surrounding land area is referred to on pages i and II-9 as barren. We question the accuracy of this description since grass and sagebrush support some fauna on this land. According to the environmental statement, the land is fertile and would be productive if sufficient water were available. We suggest that the words "relatively unproductive" be substituted for "barren land" on page i and for "barren" on page II-9.

Geology

The brief description of the geology of the site is inadequate for an independent assessment of the geologic environment relevant to the proposed construction of the plant. The data presented in the draft statement are inadequate in regard to the physical properties of the geologic materials on which the plant and its appurtenant structures will be founded. There is no indication of how a knowledge of the physical properties has been used in the design of the facility. The seismic design criteria and the methods of derivation of the criteria are not mentioned. A discussion of these factors should be included in the final environmental statement.

As a result of procedures previously established between the Geological Survey, of this Department, and the Atomic Energy Commission, the geologic aspects of the site presented in the Preliminary Safety Analysis Report are presently being reviewed. This review is being conducted in terms of the AEC "Seismic and Geologic Siting Criteria for Nuclear Power Plants" (10CFR, Part 100, proposed Appendix A). Since there are unresolved issues related to the geology and the natural foundation materials, we do not have a basis to comment at this time on the geologic environment as related to the proposed construction of the Hanford Number 2 Plant. The Geological Survey's completed review and assessment of the Safety Analysis will be released as part of the public record in keeping with established procedures of the Atomic Energy Commission. The results of this assessment should also be summarized in the final environmental statement.

Hydrology

Although the occurrence of flooding appears to be remote since the location of the reactor is 3 miles from the river and at an altitude nearly 100 feet above the present low water level, an analysis of the maximum probable flood level should be included in the statement.

Heat

Dissolved solids will be carried from the cooling towers in the drift. Since the presence of these air-borne solids could result in deposits on structures and corrosion and effects on plant and animal life, an estimation of the amount of solids to be released from the towers and their effects should be given in the final environmental statement.

It appears that the uniquely designed infiltration-bed intake system will protect aquatic organisms from significant entrainment and impingement losses during project operations. If operating experience proves it to be satisfactory, similar intakes at other power plants using closed-cycle cooling may also be considered. However, the effects of periodic backflushing, which may be necessary to clean the intake system, is not discussed. Our major concern is with silting which will result. Therefore, we think that a special operational monitoring study should be conducted by the applicant for at least the first 2 years of project operation to determine the effects. We suggest that the study plan and monitoring should be done in concert with the Bureau of Sport Fisheries and Wildlife of this Department and the Washington Departments of Game and Fisheries.

Solid Wastes and Principles of Safety in Transport

These two sections, beginning on pages III-22 and V-27, contain a description of the procedures for handling radioactive materials and indicate that these procedures are in accordance with AEC and DOT regulations. We think that the environmental statement should also include the emergency procedures for maximum containment of low-level wastes and for minimum contamination of personnel under the circumstances where a severe accident might result in the spill of low-level wastes.

Fogging and Icing

The final statement should discuss the impact of fogging caused by the cooling towers on hunting and other recreational activities. Also, the statement should give an estimate of the number of hours per year that fogging is caused by the operation of the towers.

Effects of Radionuclide Releases

Bioaccumulation of ingested radionuclides was mentioned on page V-20, but it is not clear if the radionuclides discharged to the river from nuclear facilities located on the Hanford reservation and upstream from the plant were also considered. The cumulative effects from all sources of radioactive materials should be considered. The statement should disclose the monitoring methodology which has been or will be used to determine such accumulations. The maximum radionuclide levels, the cumulative impact on aquatic life, and the action which will be taken to ameliorate unacceptable effects of radionuclide contamination should be described in this section.

We do not think that the stations listed on pages V-3 and V-39 are adequate to insure completeness of sampling and analysis for aquatic and other wildlife as related to radioactive releases. We suggest that three additional stations be located 1 mile downstream, 1 mile upstream, and 500 feet downstream from the cooling water outfall. This suggestion was previously made to AEC by letter of May 31, 1972, from the Bureau of Sport Fisheries and Wildlife when they commented on the construction permit application.

Plant Accidents

This section contains an adequate evaluation of impacts resulting from plant accidents through Class 8 for airborne emissions. However, the environmental effects of releases to water is lacking. Many of these postulated accidents listed in tables VI-1 and VI-2 could result in releases to the Columbia River and should be evaluated in detail.

We also think that Class 9 accidents resulting in both air and water releases should be described and the impacts on human life and the remaining environment discussed as long as there is any possibility of occurrence. Class 9 accidents resulting from natural catastrophes, such as earthquakes and floods, should be included. The consequences of a Class 9 accident could have far-reaching effects on land and in the Columbia River which could persist for centuries affecting millions of people.

We hope these comments will be useful to you in the preparation of the final environmental statement.

Sincerely yours,

Secretary of the Interior

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

50-397

IN REPLY REFER TO:

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OCT 30 1972
U.S. ATOMIC ENERGY COMMISSION
Regulatory
Mail Section

Mr. Daniel R. Muller
Assistant Director for Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

This is in response to your letter of August 28, 1972, requesting comments on the AEC Draft Environmental Statement related to the issuance of a construction permit to the Washington Public Power Supply System for the proposed construction of the Hanford Number Two Nuclear Power Plant (Docket No. 50-397).

These comments are made in accordance with the National Environmental Policy Act of 1969, and the Guidelines of the Council on Environmental Quality dated April 23, 1971, and are directed to a review of the need for the facilities as concerns the adequacy and reliability of the affected bulk power systems and related matters.

In preparing these comments, the Federal Power Commission's Bureau of Power staff has considered the AEC Draft Environmental Statement; the Applicant's Environmental Report and amendments thereto; related reports made in response to the Commission's Statement of Policy on Reliability and Adequacy of Electric Service (Order No. 383-2); and the staff's analysis of these documents together with related information from other FPC reports. The staff of the Bureau of Power generally bases its evaluation of the need for a specific bulk power facility upon the load supply situation for the critical load period immediately following the availability of the facility, as well as on long-term considerations.

Need for the Facility

The Washington Public Power Supply System (WPPSS) is a municipal electric utility corporation of the State of Washington empowered to acquire, construct and operate electric generation and transmission facilities. The WPPSS owns and operates the Hanford Generating Plant, a single 860-megawatt electric generating unit which uses steam purchased from the dual purpose NPR reactor located on the AEC's Hanford Reservation, Benton County, Washington. The proposed Hanford Number Two Nuclear Power Plant is to be located on a site about 18 miles southeast of the Hanford Generating Plant and is scheduled to be in commercial operation in September 1977.

The Applicant is a bulk electric power supplier to utility systems in the West Group of the Northwest Power Pool. The output of the Hanford Number Two Unit will be distributed by the Bonneville Power Administration (BPA), a power marketing agency of the Department of the Interior, and will be available to all electric utility systems in the area. The Northwest Pool coordinates the operation of the bulk power generation and transmission facilities of the West Group Area which is comprised of the States of Washington, Oregon, Idaho and part of Montana.

Four private utilities, 104 publicly-owned agencies, and the Bonneville Power Administration have formed the Joint Power Planning Council, to coordinate planning for existing and future thermal and hydroelectric resources for the West Group Area of the Northwest Power Pool. The Council planned the "Hydro-Thermal Program", a generation expansion program designed to produce the most economic power supplies to meet the area's anticipated load growth. The program will coordinate construction of new thermal generating plants with existing Federal and non-Federal hydroelectric facilities and planned peaking capacity to provide an economic and reliable power supply for the West Group Area. It is expected that coordinated planning, while obtaining the economies of scale from large thermal generating units and efficient and economic use of the existing Federal Regional Transmission System, will have as a corollary benefit the preservation of the environment and natural beauty of the area.

The Area's electric power requirements have been met by the extensively developed hydroelectric facilities in the winter-peaking West Group Area of the Northwest Power Pool. Since the regional hydroelectric potential is now almost completely developed, thermal generating facilities are being planned to provide the bulk of the new capacity needed for meeting forecast loads. The Joint Power Planning Council's "Hydro-Thermal Program", designed to meet the expanding power needs of the area, includes new thermal baseload capacity as follows:

Generating Plant	Type	Capacity MW	Date of Commercial Operation
Centralia # 1	Coal-Fired	700	Sept. 1971
Centralia # 2	Coal-Fired	700	Sept. 1972
Trojan	Nuclear	1,130	Sept. 1974
Jim Bridger #1	Coal-Fired	500	Sept. 1975
Jim Bridger #2	Coal-Fired	500	Under Study
Hanford # 2	Nuclear	1,100	Sept. 1977

The program has tentatively scheduled other new units to provide 1100 to 1500 megawatts of new capacity annually during the 1978-1992 period. During the period of 1971-72 to 1981-82 operating years, hydro generating capacity will account for 25 percent and thermal generating capacity for 75 percent of new capacity additions totaling about 15,100 megawatts. Most of the hydroelectric projects scheduled for operation during this period are under construction. During the succeeding period from 1981-82 to 1991-92, hydro generating capacity will account for about 9 percent while thermal generating capacity will provide about 91 percent of the new capacity additions totaling about 25,600 megawatts.

The following tabulation shows the electric system loads to be served by the West Group Area of the Northwest Power Pool. It shows the relationship of the electrical output of the Hanford Number Two Plant to the available reserve capacity at the time of the 1977-78 winter peak load period. This peak load period occurs during the initial service period of the new unit, but the useful life of this unit is expected to be some 30 years or more, and it is expected to contribute to the Applicant's total generating capacity throughout that period. Therefore, the Hanford Number Two Unit will be depended upon to supply power to meet future demands over a period of many years beyond the initial service needs discussed in this report.

FORECASTED 1977-78 WINTER PEAK LOAD-SUPPLY SITUATION

	West Group of the Northwest Power Pool
Conditions with Hanford No. Two (1100 Megawatts)	
Net Total Capability - Megawatts	31,178 1/
Estimated Net Peak Load - Megawatts	26,422 2/
Reserve Margin - Megawatts	4,756 3/
Reserve Margin - Percent of Peak Load	18.0
Conditions without Hanford No. Two	
Net Total Capability - Megawatts	30,078
Estimated Net Peak Load - Megawatts	26,422
Reserve Margin - Megawatts	3,656
Reserve Margin - Percent of Peak Load	13.8

1/ Based upon firm power purchases of 211 MW, and plans that Hanford Generating Plant will be shut down.

2/ Includes firm power sales of 2,040 MW, but does not include interruptible loads of 1,343 MW.

3/ Forced Outage Reserves requirement (see text) is estimated to total 2,042 MW, and estimated scheduled hydro maintenance is 101 MW.

Data Source: Long Range Projection of Power Loads and Resources for Thermal Planning, Pacific Northwest Utility Conference Committee Report Dated March 24, 1972.

The Northwest Power Pool systems serve a large geographical area for which no single minimum reserve criterion has been formulated. Major systems serving customers in the West Group Area are parties to the Pacific Northwest Coordination Agreement, however, and it provides for capacity reserves termed "Forced Outage Reserve". 1/ The Agreement states that "The Coordinated System shall maintain reserve capacity at a level sufficient to protect against loss of load to the extent that the probability of load loss in a Contract Year shall be no greater than the equivalent of one day in twenty years. The determination of such probability shall be based upon characteristics of peak load variability and generating equipment Forced Outage rates". To meet this requirement, the Forced Outage Reserves needed for the 1977-78 winter peak load period have been estimated by the Pacific Northwest Utility Conference Committee to be 2,042 megawatts.

If the Hanford No. 2 unit is available, as currently planned, to meet the 1977-78 winter peak load, the reserve margin on the West Group Area system will be 4,756 megawatts or 18.0 percent of peak load. If the unit is not available, the reserve margin will be reduced to 3,656 megawatts or 13.8 percent of peak load. This gross reserve margin is to provide for scheduled maintenance and such contingencies as unscheduled (forced) outages of equipment and errors in load forecasting.

The estimated net load at the 1977-78 winter peak includes some 2,049 megawatts of firm power sales but does not include 1,343 megawatts of interruptible loads served in the West Group Area. Capacity reserves include some 211 megawatts of power imports. The capacity resources available at the 1977-78 winter peak represent an increase in capacity of 8,774 megawatts over the estimated capacity available during the coming 1972-73 winter peak load period. Hence, the adequacy and reliability of electric service for the West Group Area of the Northwest Power Pool systems in meeting future loads is dependent upon the timely commercial operation of a number of large new units scheduled in various construction programs. Hydroelectric capacity accounts for 5,053 megawatts of the new capacity additions.

1/ Forced outage reserve is 5 percent of hydro, existing thermal and scheduled combustion turbine capacity plus 15 percent of installed peak capability of new large thermal plants.

The winter-peaking Pacific Northwest and the summer-peaking Pacific Southwest subregions of the West Region are interconnected by a double-circuit 500-kilovolt ac line and a 750-kilovolt dc transmission line for exchange of large blocks of seasonal diversity. The southern terminal and conversion facilities of the 750-kilovolt dc system located at Sylmar, California, were damaged extensively in the February 9, 1971 earthquake but have recently been returned to full capacity service. However, the loss of this transmission system for many months through a natural disaster emphasizes the importance of adequate baseload generating capacity to meet load requirements in any given area.

The Pacific Northwest Utilities Conference Committee's West Group Forecast of Power Loads and Resources dated February 1, 1972, predicts that interruptible industrial loads will have to be curtailed during the 1973-74 and 1974-75 winter peak periods. It is obvious, therefore, that planned new thermal capacity will be needed to meet the demands forecast for area systems and to provide a reasonable level of capacity reserves to insure reliable electric service to area customers. Further, the new thermal capacity additions will require larger commitments for reserve capacity than have been required for the predominantly hydroelectric system of the past to maintain the adequacy and reliability of the electric service in the West Group Area.

Transmission Facilities

Three overhead transmission lines will be designed, constructed and operated by Bonneville Power Administration to integrate the Hanford Number Two Nuclear Power Plant into the BPA System. One 18.3 mile 500-kilovolt line will deliver the plant's output to the existing Federal Regional Transmission System. In addition, one 11-mile 230-kilovolt single circuit plant service line and one 1-mile single circuit 115-kilovolt alternate plant power supply line will be constructed. All lines will be located entirely on the Hanford Reservation. Construction is scheduled in the period 1972-1976 and the designs will utilize the guidelines contained in the joint publication of the U. S. Department of Interior and U. S. Department of Agriculture, Environmental Criteria for Electric Transmission Systems.

Alternatives and Costs

The Applicant, in determining the need for additional generation to meet its projected demands, considered purchased power and a number of baseload alternatives including alternate locations, types of plant, fuels and their environmental effects and economics. All economic hydro sites in the area are planned for development and thermal generation was considered the only available baseload alternative. With respect to fossil-fueled alternative plants, natural gas supplies were considered not available in the quantities needed, but coal and oil fuels were considered available alternatives to nuclear fuel for the proposed baseload plant. The economic studies which resulted in the selection of the nuclear-fueled plant indicated capital costs of $288,000,000 for the nuclear-fueled plant, $247,000,000 for the coal-fueled plant and $202,000,000 for the oil-fueled plant, or costs of $262, $225 and $185 per kilowatt of capacity respectively. On the basis of coal fuel costs of 43 cents per million Btu and oil fuel costs of 66 cents per million Btu, estimated power costs resolve to 7.01 mills per kilowatt hour for a coal-fired plant and 8.61 mills per kilowatt hour for an oil-fired plant. Comparable power costs for the nuclear-fueled plant are 5.88 mills per kilowatt hour. The staff of the Bureau of Power finds these costs to be within the range of similar costs reported by the industry.

Conclusions

Although the forecasts of future loads and generating capacities indicate that some slippage in schedule of the Hanford Number Two Nuclear Plant could occur without creating a serious power supply problem, the staff of the Bureau of Power concludes that the electric power output of this plant will be needed to meet future loads of the West Group of the Northwest Power Pool and to provide reserve margin needed for adequacy and reliability of power supply in the Pacific Northwest sub-area. Furthermore, a number of other planned large thermal and hydroelectric units must be completed and in service on schedule if the projected reserve margins are to be attained, and it has been common experience in recent years for large new units to be delayed sometimes for many months in achieving commercial operating status.

Very truly yours,

T. A. Phillips
T. A. Phillips
Chief, Bureau of Power

50-397

WASHINGTON STATE
DEVELOPING THE ECONOMY THRU • TOURISM • INDUSTRY • RESEARCH • FOREIGN TRADE • NUCLEAR PROGRESS
DEPARTMENT OF COMMERCE AND ECONOMIC DEVELOPMENT
GENERAL ADMINISTRATION BLDG.
OLYMPIA, WASHINGTON 98504
Daniel B. Ward DIRECTOR
Daniel J. Evans GOVERNOR

September 18, 1972

Mr. Daniel R. Muller
Assistant Director - Environmental Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muller:

My comments on your draft of an Environmental Statement in respect to the Hanford #2 nuclear power plant have been incorporated in the reply from the Washington Thermal Power Plant Site Evaluation Council of which I am a member.

It is my understanding that the State's comments on the AEC Environmental Statement will be correlated by Mr. Lightfoot, Secretary of the Council, and forwarded through the proper channels to your office.

In AEC nuclear matters involving other than power plant disciplines, such comments as are necessary will continue to be supplied from this office.

Thank you very much for your courtesy.

Sincerely yours,

Lawrence B. Bradley /ks

Lawrence B. Bradley
Executive Director
Office of Nuclear Energy
Development

LBB:17/10

cc: Paul Benson, Office of Program Planning & Fiscal Management
Joe Lightfoot, TPPSEC

SEATTLE OFFICE:
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C-43 50-397

STATE OF WASHINGTON

OFFICE OF THE GOVERNOR

OFFICE OF PROGRAM PLANNING AND FISCAL MANAGEMENT

HOUSE OFFICE BUILDING
OLYMPIA, WASHINGTON 98504

DANIEL J. EVANS
GOVERNOR

JOHN W. McCURRY
DIRECTOR
206-753-5450

October 24, 1972

RECEIVED OCT 30 1972

Daniel R. Muller
Assistant Director for Environmental Projects
Directorate of Licensing
United States Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muller:

Enclosed are the comments of the Thermal Power Plant Site Evaluation Council of the State of Washington on the Hanford No. 2 Draft Environmental Statement. These comments are referenced to the section of the draft environmental statement which they concern.

The Council is composed of state agencies with responsibilities for the range of impacts resulting from construction and operation of thermal power facilities. Member agencies are as follows:

Department of Ecology
Department of Fisheries
Department of Game
Washington State Parks and Recreation Commission
Department of Social and Health Services
Interagency Committee for Outdoor Recreation
Department of Commerce and Economic Development
Washington Utilities and Transportation Commission
Office of Program Planning and Fiscal Management
Department of Natural Resources
Planning and Community Affairs Agency
Department of Emergency Services
Department of Agriculture

In its role as the state clearinghouse agency for federal environmental impact statements, the Office of Program Planning and Fiscal Management accepts the comments of the Thermal Power Plant Site Evaluation Council as the formal state review of the Hanford No. 2 project and conveys this review to your office as the formal response of the State of Washington.

Daniel R. Muller
Page 2
October 24, 1972

Thank you for the opportunity to comment on the environmental impact of this major power project.

Yours very truly,

STATE PLANNING DIVISION

Paul T. Benson, Jr.
Assistant Director

PTB:ms

cc: Joseph Lightfoot, Executive Secretary
Thermal Power Plant Site Evaluation Council

THERMAL POWER PLANT SITE EVALUATION COUNCIL COMMENTS

I. INTRODUCTION

Page I-1. In the first paragraph, reference is made to the Washington Public Power Supply System as an agency of the State of Washington. While the Supply System is a municipal corporation authorized under Washington State law as stated in the second paragraph, it is not an arm of state government as implied by the statement cited above. The Supply System is often referred to as a joint operating agency, a phrase descriptive of its function, and perhaps it is this concept that the referenced statement intended to convey.

II. E. 2. THE SITE - ENVIRONMENTAL FEATURES, GEOLOGY

Page II-10. Reference is made in this section to the geological studies conducted by Shannon and Wilson, Inc. and their incorporation in the PSAR. While cross-reference to the PSAR will disclose the subsequent "Supplementary Soil Investigation" by Shannon and Wilson dated June 30, 1972, it would be helpful to make reference to this supplement in the Environmental Statement and to present a brief discussion of the findings of this study and the design and construction modifications resulting from these findings.

III. C. 3. THE PLANT - EFFLUENT SYSTEMS, CHEMICAL AND SANITARY WASTES

Page III-24. The Department of Ecology has pointed out that the description of the limitations to liquid discharge could be strengthened by a reference to the Site Certification Agreement, Section IV. B., Water Discharge. Such a reference is made to atmospheric discharges in the second paragraph on Page III-26 and a similar reference to liquid discharges would serve to acknowledge the controls imposed by the Certification Agreement.

IV. ENVIRONMENTAL IMPACT OF SITE PREPARATION AND PLANT CONSTRUCTION

Pages IV-1, 3, 5. This section contains numerous references to a temporary barge offloading facility which was anticipated to implement the construction of Hanford No. 2. By letter of August 11, 1972, Mr. J. J. Stein, Managing Director of the Washington Public Power Supply System, has advised the Council as follows: "The Supply System, and Westinghouse Hanford Co., have entered into an agreement for the use of a barge facility to be owned and constructed by the Port of Benton. This agreement makes the provision of Section III. F. unnecessary because the Supply System will not construct the barge slip."

Page IV-4. The third paragraph on this page indicates that construction water will be secured from two on-site wells. We have been advised that the water requirement for the re-compacting of foundation materials found to be necessary by the previously referered to supplemental Shannon and Wilson report dated June 30, 1972, will require that water for this purpose be pumped directly from the Columbia River.

V. D. ENVIRONMENTAL IMPACTS OF PLANT OPERATION - RADIOLOGICAL IMPACT ON MAN

Page V-27. The Department of Social and Health Services has observed that the title of Table V-6 should be amplified to indicate that the doses indicated are attributable to gaseous effluents only.

Page V-25. They have further commented that the summary contained in the second paragraph of this page purports to assess the total radiological impact while referring to the 2.2 manrem value attributable to the expected total annual dose from noble gases only. This should be clarified.

VIII. SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Page VIII-1. The Washington Utilities and Transportation Commission has suggested that the Impact Statement address the effect of the siting of Hanford No 2 upon the future location of additional power plants in the vicinity. It is possible this subject might be more conveniently addressed in another section of the Environmental Statement such as Section XI, but, in any event, it is an area of public interest which does not appear to be discussed.

In general, the subject Draft Environmental Statement is an accurate and thorough compilation of information which parallels that developed by this Council during its 14-month review of the proposed Hanford No. 2 project prior to state certification. Many Council members commented favorably on the quality of the subject draft.

NUCLEAR AND THERMAL ENERGY COUNCIL

4263 COMMERCIAL S.E. • SALEM, OREGON • 97310 • Phone 378-6968

TOM McCALL
GOVERNOR

W. KELLY WOODS
Coordinator

October 4, 1972

Mr. Daniel R. Muller
Assistant Director for Environmental Projects
Directorate of Licensing
United States Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

Subject: Draft Environmental Statement by the Directorate of Licensing, U. S. Atomic Energy Commission, on the Environmental Considerations Related to the Proposed Construction of the Hanford Number Two Nuclear Power Plant by Washington Public Power Supply System (Docket No. 50-397)

Thank you for sending a copy of the subject document in response to our request.

The State of Oregon through its Nuclear and Thermal Energy Council has reviewed this report. The construction and operation of the proposed Hanford No. 2 nuclear power plant appears to be compatible with Oregon's desire to maintain high quality of environment in this state, and appears to present no identifiable health hazards to Oregonians.

However, Oregon and Washington share a common river boundary downstream from Hanford No. 2, and portions of Oregon are within forty miles of the proposed plant and are subject to potential atmospheric contamination. Hence, we have a continuing interest in the Hanford No. 2 Nuclear Power Plant; will you please include the Nuclear and Thermal Energy Council, State of Oregon, in the distribution of subsequent public documents issued by the U. S. Atomic Energy Commission which relate to Hanford No. 2.

Incidentally, we note in the last sentence of the discussion of "Effects of the Intake Structure" (Section V.C. 2.a, page V-9) a statement which appears to be in error but which does not affect the conclusions about environmental effects. This sentence states that a substrate consisting

Mr. Daniel R. Muller
October 4, 1972
Page two

of coarse gravel and large cobble is not expected to be sought out by spawning salmonids. On the contrary, spawning salmon and trout do seek gravel beds with gravel size ranging from 1/4 inch to 6 inches in diameter. The Environmental Report issued by the Washington Public Power Supply System claims that the filter system will not be attractive to spawning salmon for a reason different than that used in your report, namely, because the water flow will be downward from the river into the filter while spawning salmon seek out areas of upwelling. You may wish to clarify this point in your final draft of the Environmental Report for Hanford No. 2.

Very truly yours,

W. Kelly Woods

W. Kelly Woods
Nuclear and Thermal Energy
Coordinator

WKW j

cc: Mr. Joseph F. Lightfoot
Executive Secretary
Thermal Power Plant Site Evaluation Council
Olympia, Washington 98501

Natural Resources Defense Council, Inc.

1710 N Street, N.W.
~~XXXXX XXXXXXXXXXX XXXXXXXX, XX XX~~
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212 986-8310

October 13, 1972

Mr. Ronald R. Loose
Environmental Project Manager
Atomic Energy Commission
Washington, D.C.

Dear Mr. Loose:

Enclosed are comments of the Natural Resources Defense Council (NRDC) on the AEC's Draft Environmental Statement for the Construction of Hanford Number Two Nuclear Power Plant (Docket No. 50-397). As detailed in the comments, NRDC finds the draft statement inadequate to fulfill the purpose of the National Environmental Policy Act. Therefore, the AEC should issue a new draft impact statement.

Sincerely yours,

Thomas B. Stoel, Jr.

Thomas B. Stoel, Jr.

Edward L. Strohbehn

Edward L. Strohbehn, Jr.

TBS/ELS:lcs

dd
cc: Mr. L. Manning Muntzing
Mr. Martin R. Hoffmann
Mr. Howard R. Shapar
Mr. John F. O'Leary
Mr. Timothy B. Atkeson

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Comments of the Natural Resources Defense Council, Inc., on the Atomic Energy Commission's Draft Environmental Statement for the Construction of Hanford Number Two Nuclear Power Plant (Docket No. 50-397)

Submitted by:

Thomas B. Stoel, Jr.
Edward L. Strohbehn, Jr.
October 13, 1972

I. INTRODUCTION

The Natural Resources Defense Council, Inc. (NRDC), finds the draft environmental statement deficient in its discussion of both the environmental impact of the proposed plant and the alternatives to it. These defects are so serious that the draft statement is not adequate to fulfill its purpose as a vehicle for informed comment and review of the proposed action by the public and decisionmakers such as the President and Congress. Hence, the AEC should issue a new draft environmental statement in order to comply with the requirements of the National Environmental Policy Act (NEPA).

II. DISCUSSION OF ENVIRONMENTAL IMPACT

The Draft Statement's discussion of environmental impact is seriously deficient in several respects. While the Statement discusses the environmental impacts which will be caused near the plant by the plant's construction and operation, the Statement simply mentions without discussing in detail the environmental impacts associated with constructing transmission lines and disposing of radioactive wastes and ignores entirely the environmental impacts of producing the nuclear fuel to be consumed in the plant.

The Statement indicates that three transmission lines will be built as a result of constructing the proposed plant and provides a one paragraph summary of their environmental impacts, apparently because the Bonneville Power Administration (BPA) will "prepare an environmental statement discussing the effects of construction, use, and maintenance of these lines." (p. V-2) The problems and risks of disposing of the high level radioactive wastes produced by the plant are substantial, as evidenced by the inability of the AEC to find a means more suitable than surface storage. Decisions to operate additional nuclear power plants exacerbate this storage problem. In addition, the AEC has not required the applicant to indicate where it proposes to bury lower level radioactive wastes and assumes that a relatively close site will be used (p. V-27). Whether this site possesses sufficient capacity to handle all of the radioactive wastes which would be generated by radioactive waste-producing facilities in the area is not indicated, however. Finally, the environmental impacts of producing nuclear fuel are considerable and are a direct consequence of the proposal to build a nuclear plant rather than no plant or a plant using non nuclear fuel. Unless the Statement includes a detailed discussion of all of these impacts, it cannot serve one of its main intended functions: to provide a basis for comparing the environmental impacts of the proposed plant and the impacts of the reasonable alternatives. See NRDC v. Morton, 3 ERC 1558, 1561, 1562 (D.C. Cir. 1972).

III. DISCUSSION OF ALTERNATIVES

A. Reduce Rate of Growth in Energy Demand

One alternative would be to build no power plant and meet the "need" for electricity by reducing the rate of growth in demand. The Statement does not discuss this important alternative at all.

The President's Energy Message of June 4, 1971, cited as a major cause of United States energy problems "the sharp increase in demand that began about 1967", and states that "the needs of a growing economy will further stimulate this demand." The Interior Department estimates that during the period 1970-1985, demand for total energy will increase at an average rate of 4.5 percent per year, and the demand for oil and natural gas at 3.2 percent and 3.8 percent, respectively. The Federal Government has never publicly addressed the question whether long-term growth in energy demand at these high rates is socially desirable, even though the Energy Policy Staff of the Office of Science and Technology has stated that the question of reducing the rate of growth in national power generation capacity "require[s] a great deal of public thought and discussion, for [the answers] will affect both the economy and the environment for decades to come." Electric Power and the Environment (1970).

One method of reducing energy consumption would be for the AEC to refuse to license this plant. The likely result would be a rise in the price of electric power, and a consequent reduction in demand. As the President noted in his Energy Message:

> [The] accelerated growth in demand results partly from the fact that energy has been relatively inexpensive in this country. During the last decade, the prices of oil, coal, natural gas and electricity have increased at a much slower rate than consumer prices as a whole. Energy has been an attractive bargain in this country -- and demand has responded accordingly.

It is noteworthy that electricity has traditionally been cheap in the Pacific Northwest because of the abundant, nonpolluting hydroelectric power which was available in the past. Since increased demand for electricity in the Northwest is now and will in the future be supplied by more environmentally harmful means, it seems appropriate that prices increase. As noted above, one way of accomplishing this would be to deny the proposed license. Another method would be through federal legislation and administrative action to assure that the price of energy fully reflects the environmental costs of producing it. As the Energy Policy staff of the Office of Science and Technology has stated:

> [I]t is highly desirable to include as many of the external environmental costs as possible in the price of all forms of energy . . . . [This] is the most straightforward manner of affording each consumer the opportunity to recognize the costs of environmental protection and to pay his share of these costs in accordance with the amount of energy he consumes. Op. cit. supra.

Another way of reducing electricity consumption would be through Federal legislation or administrative action banning promotional advertising by utilities. Still another, longer-range way of reducing consumption was noted by the President in his Energy Message of June 4, 1971: "We must get back on the road of increasing efficiency -- both at the point of production and at the point of consumption . . . A number of possible governmental actions to increase energy efficiency are outlined in a recent staff study by the Office of Emergency Preparedness titled The Potential for Energy Conservation (1972). All of these must be discussed in detail -- together with the other ways of reducing demand outlined above -- when this impact statement is revised.

B. Other Energy Sources

The discussion of the alternative of an oil-fired plant is inadequate. The nature of the authorities cited in the footnotes -- documents dating back to 1969-70 and prepared for other purposes -- make it clear that the AEC undertook no current research or consultation with respect to this alternative. The discussion of the availability of domestic oil ignores the fact that the West Coast is expected to have a surplus of domestic oil in the late 1970's if the Alaska Pipeline goes forward. Oil cost figures ("about $4.23 per barrel," p. XI-3) are given without any explanation of their relevance or comparison with nuclear fuel costs.

The Statement declares that "[l]ow sulfur oil is available from Indonesia, Liberia, South America, North Africa . . .," but the alternative of an oil-fired plant fueled by imported oil is never discussed. There is no discussion of possible modifications of the Oil Import Program to make imported oil available at lower cost or in greater quantities. NEPA requires that the impact statement include a detailed discussion of this alternative and its environmental impacts. See NRDC v. Morton, supra, at 1561-63. There is no mention of the alternative of an oil-fired plant fueled by Canadian oil, even though the Canadian Energy Minister stated in the House of Commons on April 19, 1972, that Canada could make considerably more oil available to the U.S. if we relaxed our quotas. These alternatives must be discussed in detail in the revised statement.

In addition, the Statement fails to discuss at all the alternative of utilizing a combination of energy resources. The energy that could be produced by the proposed plant could be supplied by a combination of alternatives which might involve less environmental impact than the proposed plant. See NRDC v. Morton, supra, at 1563-64.

C. Alternative Sites

The Statement's discussion of sites outside the Hanford Reservation is limited to six lines, devoted to one site which was "investigated by the applicant." The reader is not told whether the AEC believes this site to be environmentally superior or inferior to the one proposed, much less whether there are other sites in the region which did not happen to be investigated by the applicant where there would be less environmental harm. This does not amount to the detailed discussion of alternative site locations demanded by NEPA. One reason for this inadequate discussion of site alternatives is the decision of the Supply System to advance the operational date of the proposed plant by a year which made it "important for the Supply System to insure approval of a site for Plant No. 4 with a minimum of delay" (p. I-3). The schedule advancement was occasioned by "the voters of Eugene Oregon" delaying the operational date of the originally proposed Plant No. 4 (id.). Sites outside the Hanford Reservation probably were not considered in detail because they too might not meet with public approval, whereas Hanford sites are under federal control. These factors suggest that persons living in the Northwest might approve of public action to reduce the rate of growth of energy demand and that the public utilities and the federal government are not necessarily acting in the public interest by constructing power plants in order to meet their projected demand requirements. Thus the problems associated with constructing the proposed plant at alternate sites and with reducing the rate of growth of energy consumption must be discussed in detail in the revised draft environmental statement.

IV. THE DECISIONMAKING PROCESS

A. The Hydro-Thermal Program

Chapter X of the Statement notes that the proposed plant is part of the Hydro-Thermal Power Program, a coordinated power-development scheme devised by utilities "in cooperation with the Federal Government." The need for the plant is justified by demand projections of the Joint Power Planning Council, composed of private and public utility companies and the Bonneville Power Administration.

Nowhere does the Statement contain a detailed explanation of these demand projections. Table X-1, an apparent attempt to do so, raises more questions than it answers. What price assumptions underlie the demand estimates? What would be the effect on demand of higher prices? Why are energy requirements for irrigation expected to increase 3-1/2 times by 1990, when the country currently experiences crop surpluses? Are utilities in the region now carrying on promotional advertising, and do they charge lower rates to bulk users? What would be the effect on demand if these practices were stopped or substantially modified? None of these important questions are answered, yet they relate directly to the need for this plant.

Even more important, the Statement nowhere discusses in detail the Hydro-Thermal Program of which this proposal is a part. The brief description which is included outlines a past decisionmaking process in which environmental considerations appear to have been neglected. A group of private companies which profit from power sales and government agencies charged with power development -- including at least one federal agency, the BPA -- have gotten together to coordinate power development for an entire region for the next two decades. There is no evidence that the 20-year Hydro-Thermal Program of these agencies and companies was intended to emphasize energy conservation in the interest of environmental protection. There is no evidence that their 20-year Program was designed to make sure that environmental protection would be one of the foremost goals at each stage of its implementation.

Despite the essential participation of BPA in the Hydro-Thermal Program, there is no indication that the enactment of NEPA in 1970 had the slightest impact on that Program. It is certain that no environmental impact statement has ever been issued concerning the Program, though it is plainly an ongoing "proposal[] for major federal action [] significantly affecting the human environment" with respect to which Section 102(2)(C) of

NEPA requires that an impact statement be prepared. Hence, the Program has not been opened up to public scrutiny and debate in the manner contemplated by NEPA, and has not been searchingly reassessed in light of environmental values, as required by NEPA.

B. The Role of the AEC

The AEC has done little to remedy the neglect of environmental values which apparently has characterized past decisionmaking concerning this proposed plant. The AEC has a duty, as the first agency to look at this project from the environmental viewpoint mandated by NEPA, to view the proposal in the broadest possible perspective and discuss in detail all reasonable alternatives. See Greene County v. FPC, 3 ERC 1595; NRDC v. Morton, supra. As pointed out previously, the AEC has not fulfilled this duty but has acted as if its only obligation was to examine the environmental impacts of the plant itself. These obligations are admittedly difficult to fulfill because the AEC arrived on the scene after some $27,000,000 had already been invested in the proposed plant. However, this is a matter within the AEC's control and cannot excuse noncompliance with NEPA any more than the head-in-the-sand attitude so severely criticized by Judge Wright in the Calvert Cliffs' case, 449 F.2d 1115 (1971).

Nothing in the AEC's statutory authorities prevents it from assuring that construction permit applications are received at a time when meaningful consideration of alternatives required by NEPA can take place. See 42 U.S.C. § 3 2131, 2133, 2235. Although applicants may lack information which is required to be filed with the AEC prior to the issuance of construction permits at the time applicants decide to construct a nuclear power plant, applicants could be required to file a notice of intent with the AEC at the time the initial decision to construct a nuclear power plant is made. This would enable the AEC to examine the basis of the applicant's decision, particularly the electricity demand and supply forecasts, and consider alternatives prior to commitment of millions of dollars towards construction of the project by the applicant. See 10 C.F.R. § 50.10, which delineates actions applicants may take prior to receipt of a construction permit. To insure timely filing of such notices of intent by applicants, the AEC could refuse to consider in its decision whether to license the plant any preconstruction costs incurred by the applicant prior to filing of the notice of intent, except costs incident to compiling supply/demand forecasts and other basic data incident to the decision to undertake construction of a nuclear power plant. The relevance of such costs to AEC decisionmaking is reflected in this draft statement where the alternative of abandoning the project is discussed in three sentences in which principal focus is given to the "financial investment sunk in the facility" which is "unrecoverable" (p. XI-1).

V. CONCLUSION

NRDC finds that the Draft Statement's discussion of the environmental impact of the proposed plant and its alternatives is so inadequate that it fails to fulfill its purpose of providing a basis for informed comment and review by the public and decisionmakers. The AEC is therefore required to issue a new draft statement which remedies the deficiencies of this Statement. See Natural Resources Defense Council, Inc. v. Morton, 3 ERC 1623 (D.D.C. 1972). NRDC believes that many of the serious deficiencies, particularly the failure to discuss some alternatives and the use of dated material as sources for the discussion of other alternatives, is due to inadequate consultation with other federal, state, and local agencies prior to preparation of the Draft Statement. Nothing in the Statement indicates that consultation took place, although many of the most important alternatives to the proposed action are within the expertise of agencies other than the AEC. NRDC believes that prior to issuing a new draft statement, the AEC is obliged to consult with (1) government agencies -- federal, state, and local -- other than the AEC which have jurisdiction by law over any of the reasonable alternatives to the proposed nuclear power plant, and (2) federal agencies with jurisdiction by law or special expertise with respect to any environmental impact involved, including the environmental impacts of reasonable alternatives to the proposed nuclear power plant. See Council on Environmental Quality Memorandum: "Recommendations for Improving Agency NEPA Procedures," (May 16, 1972), at pages 11-12.

ADVISORY COUNCIL
ON
HISTORIC PRESERVATION

WASHINGTON, D.C. 20240

50-397

November 13, 1972

RECEIVED NOV 20 1972

Mr. Daniel R. Muller
Assistant Director for Environmental Projects
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council on Historic Preservation has reviewed the draft environmental statement concerning the Hanford Number Two Nuclear Power Plant in Benton County, Washington.

We have consulted with the Liaison Officer for Historic Preservation in the State of Washington and, provided that a competent archeologist is retained for possible salvage work as you have stated, the Council has no further comment. The final environmental statement, however, should specify that your agency has contacted the State Liaison Officer, and a copy of his remarks should be appended to the document.

Should you have any questions or require additional assistance, please contact Mr. Gamble of the Advisory Council staff.

Sincerely yours,

Robert R. Garvey, Jr.

Robert R. Garvey, Jr.
Executive Secretary

THE COUNCIL is charged by the Act of October 15, 1966, with advising the President and Congress in the field of Historic Preservation, recommending measures to coordinate governmental with private activities, advising on the dissemination of information, encouraging public interest and participation, recommending the conduct of special studies, advising in the preparation of legislation, and encouraging specialized training and education. The Council also has the responsibility to comment on Federal or Federally-assisted undertakings that have an effect on cultural property listed in the National Register.

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