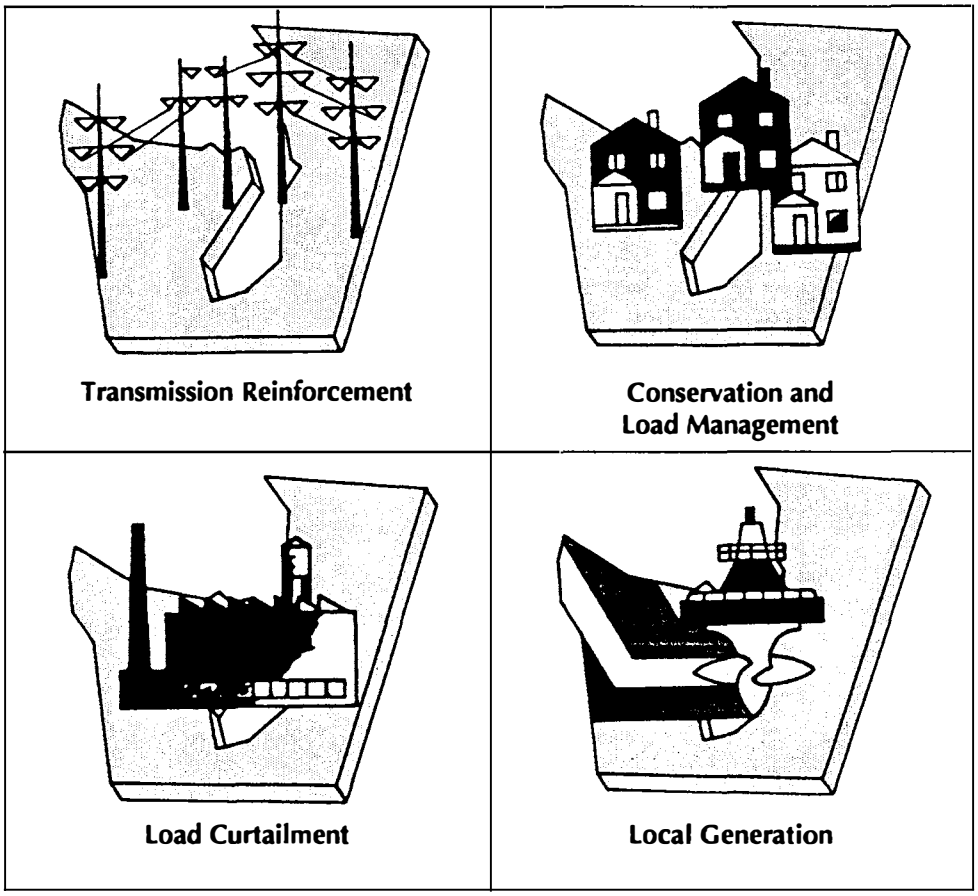
Puget Sound Area Electric Reliability Plan

Environmental Analysis Appendix F



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1.0 Overview

This appendix describes in more detail, the environmental process and analysis conducted for the Puget Sound Area Electric Reliability Plan. For a review of the problem, purpose of and need for action, see Sections 1.1 - 1.3 in the Draft Environmental Impact Statement (EIS).

1.1 Two-Step National Environmental Policy Act (NEPA) Strategy

A two-step decisionmaking strategy has been adopted to address the underlying need for this project. The first step involves the preparation of a long-range plan which will meet the underlying need. It will be called the Puget Sound Area Electric Reliability Plan (PSAERP). The basis for the plan is the PSAERP EIS which evaluates trade-offs associated with alternative ways to meet the underlying need in a timely, cost effective, and environmentally responsive manner.

The EIS has used early and extensive public involvement to define potential solutions, evaluate the widest possible range of solutions, identify several realistic solutions, and finally recommend a long-range plan. Participating utilities have taken part in the planning and decisionmaking process, have commented on the preferred and alternative strategies, and have had a chance to recommend their preferred strategy.

The second step is to tier specific proposals to the long-range plan. The nature of the proposal will determine whether a follow-up EIS or other environmental coverage is appropriate. Siting issues, site specific impacts, and impact mitigation for example will need to be addressed if, for example, a transmission line is proposed. Likewise, environmental effects of additional or intensified conservation programs and/or new load management programs could require analysis through a program EIS or EA. The second step is activated when BPA or a utility proposes a site-specific action. BPA or the utility would then prepare any environmental documents following their normal practices. Subsequent site specific EIS's or other documents would be prepared to meet the requirements of both the Washington State Environmental Policy Act (SEPA) and NEPA to avoid duplication of effort.

1.2 Scoping

Scoping is the first step in fulfilling the requirements of NEPA. This 1969 law requires a federal agency like BPA to study potential environmental effects of a project like the PSAERP. Scoping determines the proposed scope of the Draft EIS. In regards to this project, scoping had several objectives:

- confirming the voltage instability problem
- notifying the public of the problem and involving them in developing solutions
- identifying environmental issues to study and consider
- defining the nature and extent of the problem for analysis
- identifying measures for test cases
- performing preliminary feasibility studies on identified measures

In December 1989, BPA announced by letter and by advertisements in area newspapers, four public scoping meetings to be held on January 3 and 4, 1990, in Wenatchee and Seattle, Washington. The purpose of the meetings was to:

- introduce and clarify the problem in Puget Sound
- receive input on the decision process
- invite participants to join a Technical Review Group (TRG)
- identify solution options

Members of the general public, special interest groups, businesses and utilities attended the scoping meetings. Comments were recorded, summarized, and presented to the public in Scoping Report, Part A, Summary of Public Comments.

During scoping, a long list of measures to solve the problem were identified and divided into four categories:

- conservation, load management, and fuel switching
- local generation
- load curtailment
- transmission

Utility study teams were formed early on to address the problem and study the measures identified through scoping. Screening criteria were developed to limit the universe of measures considered to be the most feasible. Members of the utility study teams used the criteria as rough guidelines, not absolutes. After screening, team members began to analyze in detail the measures which passed the first screen. For each measure, they gathered information about potential for generating or saving power, costs, and impacts to the environment. Preliminary results are summarized in Scoping Report, Part B, Preliminary Technical Analyses.

A Technical Review Group (TRG) representing state and local government, business and industry, public interest groups, and the public itself was formed to help identify measures and critique utility study team methods and results. The TRG met on January 17, March 2, April 19 and August 2, 1990. A more in-depth report on the proceedings of each meeting is given in Scoping Report, Part A, Summary of Public Comments.

Scoping defined Phase I of the project.

2.0 Description of Methods

A method for environmental analysis was developed during Phase II of the project, drawing from many sources including previous work, environmental expertise provided by both BPA and the other utilities, and the public as represented by a "Sounding Board". Information was gathered and recorded on a Macintosh computer system using various software packages.

2.1 Environmental Work Group Description

Similar to other utility study teams, an environmental work group was formed to primarily review results obtained through the environmental analysis. Members included one representative from each of the utilities. They helped to refine the analysis method and assisted in determining levels of impact for each measure. In addition, members were a source for needed publications and utility reports, and often used as a contact for relaying information to their utility representative to the Steering Committee. The work group met periodically after Scoping was completed and throughout Phase II until the Draft EIS was completed for public distribution.

2.2 Computer System Utilized

A Macintosh IIci system was used to prepare the Draft EIS. Hypercard was primarily used to create a system to keep track of comments and organize and display the environmental analysis. Adobe, Canvas, Table Editor, and Excel were used to create graphics and Microsoft Word and Pagemaker were used for editing and text display.

2.3 Scale of Analysis

The environmental analysis was planned on four levels. The first level focuses on applying the environmental screening factors to each measure. These factors recognize unique habitats and protected sites as well as environmental quality standards that any proposal must meet to be approved. A complete list of the environmental screening factors can be found in the Puget Sound Area Electric Reliability Plan EIS Implementation Plan, Appendix F.

The second level of analysis provided a generic assessment of environmental impacts. Information on environmental impacts of alternatives are based largely upon published findings of past projects. These are shown in the Environmental Impact Data Base which is an attachment to this appendix. The references are listed in Section 6.0.

The third level of analysis used information gained through the first two levels of analysis and combined it with the expertise of the environmental work group. The process is most closely related to an iteritive mathematical process. As more research was done and more information was gained, it was continually applied to the analysis of each measure. This analysis is explained in more detail in Section 2.8.

The fourth level of analysis is a comparative impact assessment. Once the impacts of each measure are identified, analyzed, and understood, an overall comparison of each alternative strategy is made. Impacts, as described in Section 2.6 of this appendix, are qualitative, rather than quantitative. The advantage of this is explained in Section 2.9.

A locational impact assessment was also planned as part of the analysis. This analysis would have provided a geographical context to the impact analysis. It's based on a geographical data base composed of natural resource and cultural resource data. The data is used to build impact sensitivity models for each of the measures being considered. The result would be a series of impact advisory maps that predict environmental sensitivity as high, moderate, or low. As the analysis progressed, it was found that with the lack of a site-specific proposal, little can be said with any accuracy about how an action will affect actual environments. It was decided that this type of analysis be used if a subsequent site-specific document is needed.

2.4 References Selected

Reports that documented environmental impact of measures were gathered and used simultaneously to provide new evidence for environmental effect on living and non-living resources and to verify observations and conclusions proposed by the environmental work group. Most of the documents are previously prepared and approved environmental assessments (EAs) and EISs from BPA or participating utilities. Remaining documents include visual assessments, Northwest Power Planning Council issue papers, journal articles, conference proceedings and reports prepared by Batelle and other outside contractors for BPA (see Section 6.0 of this appendix for a reference listing).

2.5 Environmental Evaluation Factors

The environmental analysis method identified resources, both living and non-living, that would most likely be effected by the implementation of a measure. The degree to which a resource was effected was identified by a minimal, low, moderate, or high impact. In this way, the resources became a factor by which the measure would be evaluated in terms of its environmental effect. Using information gathered from references described above and the expertise of the environmental work group, environmental factors were identified for general categories such as land use and natural resources (living and non-living). Land use factors included residential, commercial, industrial, agricultural, forestland and recreation. Living resources included wetlands, fish, wildlife, and vegetation. Non-living resources included water, soils, and groundwater. Remaining factors included cultural resources, aesthetics, noise, health and safety, and socio-economics.

2.6 Impact Definitions

As mentioned above, measures were evaluated using a scale with four impact levels. A high impact level is defined by a significant adverse change in present environmental conditions. A significant adverse change in present environmental conditions would satisfy one or all of these outcomes:

1. Create an effect that cannot be mitigated.
2. Significantly reduce the quantity or quality of a regionally or nationally significant resource.
3. Pose a clear risk to human health or safety.
4. Affect the long-term productivity of the affected environment.
5. Irreversibly or irretrievably damage the environment.
6. Consume significant quantities of non-renewable natural resources.

A moderate impact level is defined by a significant adverse change in present environmental conditions by one or more of these outcomes:

1. Create an effect that could be mitigated partially.
2. Cause a localized reduction in the quantity or quality of a resource.
3. Create a possible, but unlikely risk to human health or safety.
4. Reduce marginally the productivity of adjacent resources.
5. Removing the facility or stopping the action can partially reverse the impacts.
6. Consume small but not negligible amounts of non-renewable resources.

A low impact level is defined by a significant adverse change in present environmental conditions by one or more of these results:

1. Create an effect that could by largely mitigated.
2. Reduce the quantity or quality of resources confined to the site of the action.
3. Create insignificant or very unlikely health and safety risks.
4. Cause no effect on productivity of adjacent resources.
5. Removing the facility or ceasing the action will reverse the impacts.
6. Consume negligible amounts of non-renewable resources.

2.7 Assumptions

The following assumptions underlie the environmental analysis of measures under consideration. The impact levels assigned rely both on these assumptions and potential impacts reported in the environmental studies and impact statements for similar projects.

2.7.1 General Assumptions

- Load growth will follow the medium load growth curve from 1994-2003.

- The existing transmission system of the Puget Sound basin will require some upgrading in response to load growth regardless of the method used to meet peak capacity needs. Different needs than those of the Puget Sound Area Electric Reliability Plan underlie this upgrading.

- The electrical system is being planned from a single utility perspective.

- System performance will be planned to maintain existing reliability standards.

2.7.2 No Action

•Without a coordinated plan to solve the problem black outs occur sometime within the 1993-2003 time frame. The duration of the outage would be about four hours (average outage time).

2.7.3 Conservation

- Conservation applied here is accelerated base case conservation.
- Measures included are voluntary and/or incentive programs.
- Impacts reported are the incremental impacts attributed to accelerated conservation programs.
- Residential conservation measures applied are residential weatherization and low flow shower-heads. Other measures were eliminated by screening criteria.
- Commercial conservation measures applied are commercial weatherization, refrigeration and lighting improvements.
- Industrial conservation measures applied are motor efficiency, lighting, and process efficiency improvements.
- Literature on conservation affects focuses on indoor air quality impacts. Modern techniques can significantly reduce indoor air quality impacts but the technology may not always be applied.
- The incremental impacts of raw material production and manufacturing of conservation products are not expected to change substantially.

2.7.4 Load Management

- Load management is achieved by means of water heater controls and time-of-use price changes.

2.7.5 Fuel Switching

- Fuel switching measures to be applied are within the residential sector, and include water heater and space heating change outs (from electric to natural gas).
- Natural gas service will be available at the street, or gas feeder lines would need to be installed.
- Natural gas availability in Puget Sound is ample to meet fuel switching demands.
- Air quality impacts assigned to fuel switching will be localized and small in magnitude.
- The incremental impact associated with natural gas extraction and delivery is not expected to change measurably if a fuel switching policy is adopted. These facilities are preexistent and no new facilities are expected (other than feeder line construction).

2.7.6 Transmission

• The type of transmission line type assumed for the analysis is a double-circuit 500kV line similar to the Grand Coulee Raver line.

• Mountain Pass portions of a new transmission line would be either built along side of existing lines (requiring a new right-of-way) or an existing line or lines would be removed and a new line built on existing right-of-way.

• In addition to existing or expanded right-of-way usage, new line corridor segments are under consideration at eastern and western segments of a new transmission line. New corridors offer opportunities to reduce costs and/or increase reliability. Existing corridors offer a continuation of present conditions.

• The eastern terminal for a new line would be an existing BPA substation (Chief JA Substation).

• The western terminal for a new line again would be an existing BPA substation. Echo Lake (assumed built in 1992) and Monroe substations are likely termination stations.

• Transmission lines are traditionally upgraded to higher voltage and or replaced with multiple circuit lines rather than decommissioned. Impact predictions are thus made with the view that transmission line rights-of-way are permanently dedicated to this use.

• The incremental impact of materials used for towers (steel), conductors (steel and aluminum), insulators (glass or porcelain) and hardware (steel) is of such small quantity (on a national or regional scale) that no significant effects are expected.

• Transmission line construction related impacts are reported for the following topics: water, soil, air, fish, groundwater. Little or no impact to these resources is expected during operation and maintenance of the line.

• The environmental screening factors: 1) Avoids Protected Sites and Environmentally Unique Habitats; and 2) Meets Environmental Quality Standards; will be applied to transmission line proposals. This would reduce environmental conflicts.

2.7.7 Voltage Support

• Static Var Compensating Devices would be located on existing BPA substation property. Some expansion of the fenced yard would be required but no land would need to be acquired.

• Static Var Compensating Devices would use oil in cooling systems. Volumes would be similar to that of typical 230-kV transformers.

• Static Var Compensating Devices would create noise much like that produced by 500kV transformers. Noise levels would comply with Washington noise standards.

• Series capacitors would be added at existing substations under the reactive support plan and additionally 2-5 new compensation stations would be built.

• Higher transmission line current levels are a side effect of the reactive option. Existing magnetic fields would increase proportionately with current.

• Capacitors would be newly purchased and would not contain PCB in their insulating fluids.

• The incremental impacts of producing and manufacturing materials required for voltage support additions are of such small quantity (on a national or regional scale) that no measurable impacts are expected.

• The environmental screening factors: "1. Avoids Protected Sites and Environmentally Unique Habitats"; and "2. Meets Environmental Quality Standards," will be applied to all voltage support proposals. This would reduce significant environmental conflicts.

2.7.8 Local Generation

Hydroelectric

• A hydroelectric facility that would impound 100 acres or more above the river or stream's high water mark is termed a large impoundment hydroelectric facility. No large impoundment hydroelectric resources would be built within during the study timeframd (1993-2003). Hence,no assessment of large impoundment hydroelectric facilties was made.

• Cowlitz Falls Hydroelectric generation is assumed to be included in the base case analysis and thus is not evaluated.

• Hydroelectric generation facilities impounding less than 100 acres above the high water mark are termed "small impoundment" hydroelectric resources.

• No hydroelectric facilities would be built within river stretches termed "protected areas" by the Regional Planning Council.

• No anadromous fish runs would be eliminated or affected by small impoundment hydroelectric resources or run-of-the-river hydroelectric resources.

• Run-of-the-River(ROW)Hydroelectric resources are those which do not create an impoundment above the high water mark of existing rivers or streams. ROW installations do not alter the existing flow characteristics of the water feature but utilize natural flows to turn turbines and generate electricity.

• The environmental screening factors: 1) Avoids Protected Sites and Environmentally Unique Habitats; and 2) Meets Environmental Quality Standards; would be applied to all potential hydroelectric proposals. This would eliminate sites having significant environmental conflicts.

• In reviewing the hydro data base, out of the total number of potential hydro projects (about 150) in the study area, 28 show that an impoundment would be required. Six of the potential sites show surface impoundments above 100 acres. They are 1750 acres (Howard Hansen-City of Tacoma), Wynoochee(1170) and Thunder Creek(1577 acres), Mud Mountain (970 acres), Griffin Creek 140 acres, Lake Isabel (265 acres). The hydro data base was built in a manner that includes all sites on which action has been taken. These sites are viewed in a manner that takes into account their probability of being built. Large impoundment sites have lower probability of being built than non-impoundment projects. Based upon the method used in building the data base, 240 megawatts of capacity are still available even if the six large impoundment projects are not built.

Combustion Turbines

• The environmental screening factors: 1) Avoids Protected Sites and Environmentally Unique Habitats; and 2) Meets Environmental Quality Standards; would be applied to all combustion turbine proposals. This would eliminate sites having significant environmental conflicts.

• Combustion turbines would be sized at 70 megawatts. The units would be single cycle turbines.

• Combustion turbines would be located in industrial or agricultural areas. Effects upon other land uses would be indirect and due to adjacency. No residences, commercial establishments or other developments would be replaced by a turbine installation.

• Combustion turbines would be designed to operate using natural gas as the primary fuel source. Oil tanks sufficient to allow up to two weeks of operation would be provided at each site to assure generation capabiltiy should gas supply be interrupted.

• Abnormal winter peak load conditions will cause natural gas supplies to be unavailable to combustion turbines. Oil will be the fuel source at these times.

• Combustion turbines would be located within two miles of both existing transmission lines and natural gas pipelines. This criteria is based upon economic criteria but also reduces environmental impacts associated with fuel delivery and integration of power(including EMF).

• Transmission lines will be needed to integrate the output of CT's. Integration requirements will increase proportionately with the size of the CT installation.

• Sufficient bulk gas and oil supplies and delivery systems exist to serve combustion turbine needs. No additonal impacts beyond a two mile extension of existing gas supply lines are expected.

• The initial 350 megawatts of generation will be provided via 5 - 70 megawatt units on separate sites. These units will operate 15% of the time on natural gas, "firming non-firm",providing firm resource when non-firm hydro is not available. These units would operate an additional 4% of the time in a peaking mode.

• Combustion turbine installations above 350 megawatts would be peaking units operating at a 5% load factor. No load firming would result from installing these units. Again 70 megawatt units are assumed. These units would be operated using oil as gas may not be available during peak load periods

• Operation of the combustion turbines would be in accordance with the Clean Air Act. If air impacts would not be within targeted quality limits offsets would be obtained.

• Assessments of air impacts for combustion turbines are made based upon the environmental effects attributed to pollutant gases normally created by such a facility. We assume emission impacts will vary depending on the site selected.

• The environmental screening factors: 1) Avoids Protected Sites and Environmentally Unique Habitats; and 2) Meets Environmental Quality Standards; would be applied to all potential CT proposals. This would eliminate sites having significant environmental conflicts.

Cogeneration

• There are two classes of cogen. The first we have termed "normal cogen". This is where an existing industry modifies it's facility in a manner that allows heat normally generated for factory uses to be also used to generate electricity. A second class of cogen termed "new cogen" is used for those installations which are built with generation as their primary purpose and which use surplus heat for industrial or space heating purposes in accordance with PURPA.

• Cogeneration in Puget Sound will utilize largely gas and biomass as their fuel source.

• Normal Cogen installations were assumed to require no new transmission lines.

• It is assumed that fuel delivery systems are already in place and these systems could handle the added requirements associated with a switch to cogeneration.

• The cogen oil option is only applicable when gas supply is interrupted.

• The coal cogen option is assumed to be a 250megawatt fluidized bed unit as discussed under the coal plant option. The difference would be related to the added efficiency that would result from 5% or more of the waste heat being used for other uses.

• No new site is required for "normal cogen" installations. Thus no significant construction impacts are expected.

• The coal cogen option will require a new site. Given the volume of coal required the site will be located near railroad lines or a sea port by which coal would be delivered.

• A coal cogen installation (250 megawatts) will require a transmission line to interate it's output.

• The coal source for the coal cogen option is unknown, however the plant's coal requirement would be insufficient to cause measureable changes in existing mine impacts or coal delivery systems. Thus no impacts for coal mining or delivery are accounted for in the analysis.

•It is assumed that a coal cogen plant would be designed to comply with the Clean Air Act.

• Normal cogen facilities are assumed to be in compliance with the Clean Air Act. Such facilities preexist and air impacts are not expected to change substantially.

• Assessments of air impacts for coal cogen site are made based upon the environmental effects attributed to pollutant gases normally created by such a facility. We assume emission impacts will vary depending on the site selected.

• The environmental screening factors: 1) Avoids Protected Sites and Environmentally Unique Habitats; and 2) Meets Environmental Quality Standards; would be applied to coal cogen proposals. This would eliminate sites having significant environmental conflicts.

Coal

• The type of coal plant assumed is a fluidized bed 250 megawatt unit. The same kind of unit is assumed for the coal cogeneration measure, the only difference would be that 5% or more of the waste heat would be used either in an industrial process or for space heating (as required by PURPA).

• The coal plant will require a new site. Given the volume of coal required the site will be located near railroad lines or a sea port by which coal would be delivered.

• The coal source for the coal plant option is unknown, however the plant's coal requirement would be insufficient to cause measureable changes in existing mine impacts or coal delivery systems. Thus no impacts for coal mining or delivery are accounted for in the analysis.

• Assessments of air impacts for a coal plant site are made based upon the environmental effects attributed to pollutant gases normally created by such a facility. We assume emission impacts will vary depending on the site selected.

• The environmental screening factors: 1) Avoids Protected Sites and Environmentally Unique Habitats; and 2) Meets Environmental Quality Standards; would be applied to coal plant proposals. This would eliminate sites having significant environmental conflicts.

Nuclear

• The WNP3 nuclear plant at Satsop would be completed under this option. A nuclear plant at a new site is not contemplated.

• Construction impacts associated with WNP3 have already occurred and are not reconsidered. Fuel mining, processing, transport to the site are impacts yet to occur and relevent to the analysis. Operational impacts, fuel storage and disposal and decomissioning of the plant are also considered in the analysis.

• This analysis acknowledges the potential for radioactive releases to the environment in the ratings made for health and safety and socio-economic impacts. Impacts to land use and natural environmental qualities were made on the basis of normal operating conditions (insignificant radioactive releases).

• Transmission lines required to integrate Satsop have been built, thus only operational impacts are considered.

• Fuel extraction and processing facilities are pre-existing and the incremental effect of a decision to complete Satsop would not have a measureable effect on these processes. No mining or fuel processin impacts are thus included in the analysis.

2.7.9 Load Curtailment

• Voluntary power use reductions or involuntary curtailment (blackouts) are not evaluated. These are elements in annual (short-term) operating plans, not in the long-range Electric Reliability Plan.

• Contract curtailment begins following an outage on the transmission system during winter peak conditions. Early notification prior to curtailment is not assumed. This poses greater social and economic hardships than would be true if advance notice were possible.

• Curtailment contracts with industrial and commercial business cooperatives would require lower off peak use rates, to encourage curtailment. Residential, institutional, or health and safety oriented organizations would not be parties to curtailment contracts.

2.8 Iteritive Impact Analysis

Impact ratings for the various solution measures were made and adjusted several times.. The environmental impact data base was reviewed by BPA's environmental team member. Impacts reported for comparable projects were used to assign impact levels to each evaluation factor. For example, if a transmission line EIS in the references may have reported high aesthetic impacts, a high visual impact rating was recorded in an impact matrix for the measure. After initial impact judgements were recorded on matrices, adjustments to the impact ratings were made to account for differences between the referenced project and that expected in Puget Sound. These reasonings, termed assumptions, were recorded and are listed in Section 2.7. Once the impact matrices were completed for all of the measures , meetings of the 5-utility Environmental Study Team were used to refine the impact ratings. Several meetings of the team were required to complete the impact matrices. Assumptions were clarified through a meeting with the Project Management Team. New assumptions, and the broader expertise provided offered by team members caused many initial impact ratings to change. Meetings with the Sounding Board were used to test the impact ratings. In several instances Sounding Board questions led to reconsideration and changes to the impact ratings. The impact matrices enclosed as the following page reflects the consensus impact ratings of the Environmental Study Team.

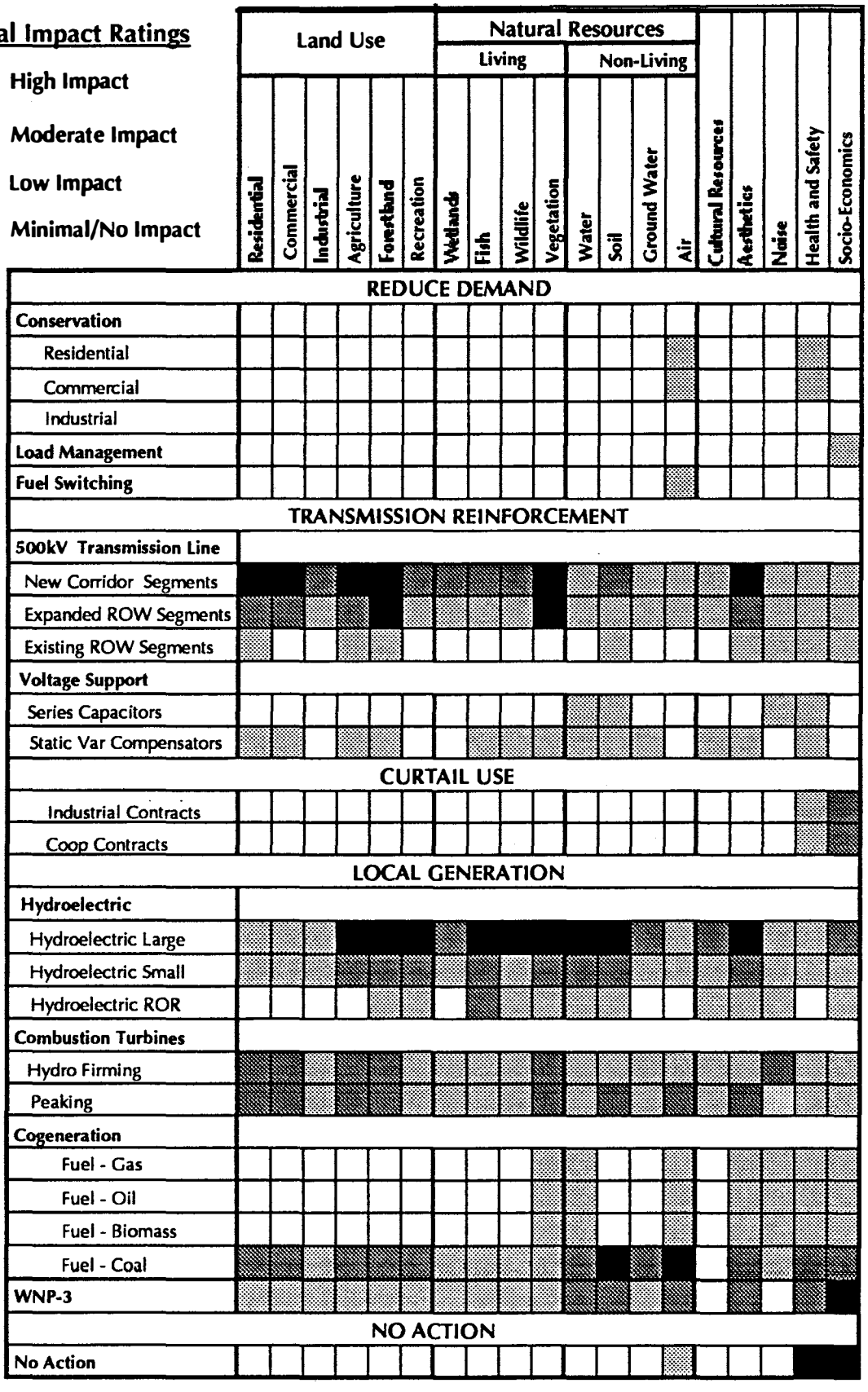
2.9 Comparative Analysis

The base environmental analysis was conducted evaluation factor by evaluation factor. The results are depicted on the opposite page. The Environmental Study Team was united behind this analysis. Once this step was completed, measures were aggregated into 11 measure groups termed "test cases" by the Evaluation Team. The Environmental Study Team was asked to rank the test cases. The environmental study group had trouble reaching consensus on this phase of analysis. To some it seemed a futile exercise. If a measure would pose high impacts in one evaluation factor (air quality for example), low or moderate impacts for other evaluation factors would not diminish this high impact. The approach decided upon was to characterize the measures in terms of their highest predicted impact. For example, a transmission line could create high impacts, if a new corridor or in some instances if existing corridors were expanded. Thus the transmission line measure was ranked a high impact solution (a worst case approach). The result is shown below:

High Impact Measures	**Nuclear Generation, Cogeneration-Coal, No Action, Hydro - Large Impoundment, Transmission Line - New Corridor**
Moderate Impact Measures	**Hydroelectric - Small Impoundment, Combustion Turbines, Transmisssion Line - Expanded Right-of-Way**
Low Impact Measures	**Cogeneration, Transmission Line - Existing Right-of-way, Hydroelectric - No Impoundment**
Minimal Impact Measures	**Curtailment, Voltage Support, Fuel Switching, Conservation, Load Management**

Potential Impact Ratings

- High Impact
- Moderate Impact
- Low Impact
- Minimal/No Impact



The Evaluation Team's evalualtion of test cases followed much the same method as described above. Test strategies with lowest impact measures were favored over those with higher impacts. In addition in discussing the test cases it became apparent that fewer and more "realistic" combinations of measures were needed. The Evaluation Team regrouped the measures into the four alternate strategies discussed in the EIS. The Environmental Teams evaluation of these strategies is provided in Chapter 5 of the EIS. It is perhaps important to indicate that the analysis process was one that tended to sytematically optimize potential solutions. The four alternative strategies discussed in the EIS are magnitudes less impacting than earlier "test cases".

2.10 Public Review and Comment - Sounding Board

The Sounding Board was composed of members of the business community, labor, government agencies, key interest groups and others mostly outside the utility industry. This group met seven times during Phase II to provide opinions and suggestions on elements of the Analysis for the Draft EIS, the Draft EIS and the final Plan.

3.0 Measures Evaluated

During scoping, both the TRG and the public were given the opportunity to identify measures which could potentially solve the problem facing the Puget Sound area. A wide range of solutions were suggested. Suggested solution measures were grouped into four categories:

- conservation, load management, and fuel switching
- local generation
- transmission
- load curtailment

Early in the planning process, screen criteria was used to narrow the universe of alternatives to those which would best solve the identified problem. A list of alternatives eliminated by these criteria is listed in the EIS and in appendix A. Some alternatives were felt worthy of evaluation, however, once the evaluation was complete they were not included in the final alternative strategies. This appendix and the others report on the shortcomings of these measures and explain why they were dropped from further consideration. It should be clear that a great many more measures were evaluated than show in the alternative strategies. Measures evaluated are briefly described below.

3.1 Conservation, Load Management, and Fuel Switching

Conservation programs, with one exception, are basically accelerated versions of the programs now being operated by BPA and utilities. These programs include residential weatherization, commercial retrofit, industrial retrofit, and high-efficiency shower heads.

Load Management programs are new to BPA but have been used by utilities in other areas to reduce peak loads. These programs include water heater controls for single family, multifamily, and manufactured housing, and residential time-of-use rates.

The fuel switching program encourages homeowners to substitute natural gas for electricity for residential space and water heating, both in single family homes and manufactured homes.

3.2 Local Generation

There are many ways to produce electricity using oil or gas. Those technologies which passed the screening criteria are steam plants, combustion turbines and combined cycle plants which are a combination steam and combustion turbine plant.

Washington Nuclear Plant No. 3 (WNP-3) is a 1,250-MW nuclear project near Satsop, Washington. It is a fission reactor plant which ultimately produces steam for electricity. Satsop is 75 percent complete and is being preserved.

Hydroelectricity produced by small or large conventional plants passed the screening criteria. Large hydro facilities may cause large impoundments while small facilities may function as run-of-river plants.

Biomass-fired plants use industrial waste such as agricultural field crops, agricultural food processing, and noncommercial and urban wood residues, to fire boilers which produce electricity.

Municipal solid waste plants use refuse to burn, produce steam and ultimately produce electricity. Mass burn techniques use unprocessed or minimally processed refuse. Refuse derived fuel originates from municipal solid waste smaller than four inches.

Cogeneration plants produce electricity and other useful energy simultaneously from gas, oil, or wood waste, by recovering excess waste energy created by industrial or commercial operations.

Standby generation is predominately used as a backup by hospitals and office buildings. On-site generators frequently use fuels such as gas or oil.

3.3 Transmission Reinforcement

A new transmission line crossing the Cascades from eastern Washington into the Puget Sound area would be built. It could require new right-of-way, or be placed on existing right-of-way adjacent to existing lines. Another option is to rebuild a lower voltage line to 500kV.

Other options which do not require a line include the addition of shunt capacitors at a yet to be completed substation (Echo Lake) and series capacitors at existing substations. A new substation will be built in the area of Ellensburg, Washington.

3.4 Load Curtailment

Load curtailment reduces electricity consumed by end-users. Two types have passed the screening criteria. They are contractual curtailment with industry curtailment cooperatives which are groups of commercial and industrial customers joined to provide specific curtailment amounts.

4.0 Reported Environmental Impacts

As the planning analysis would not define site-specific projects to evaluate environmentally, it was decided to use a reference driven environmental analysis for the PSAERP. Impacts reported in EIS's and other environmental reviews, conference proceedings and journal articles were felt good indicators of potential impacts for similar projects should they be proposed by the PSAERP. The goal was to help pick a strategy that would solve the problem while balancing environmental, cost and engineering factors. Environmental impacts reported for similar projects were used to complete the environmental analysis.

As mentioned an environmental impact data base was assembled using the computer application Hypercard. Impacts for projects like those considered solutions to the Puget Sound electric reliability problem, were extracted as direct quotes from reference documents into what is termed the Environmental Impact Data Base. A list of references consulted is provided in Section 6.0. The Environmental Impact Data Base, is provided at the end of this report.

A few introductory remarks will help in reviewing the data base. The data base is organized by measure (which appear in bold type.) Within the measures material is then organized by environmental evaluation factor (land use, socio-economic, wildlife, etc.) If an environmental evaluation factor does not appear, no reported impacts were found. Each quotation has a reference number which corresponds to the report from which was taken. Reference are listed in Section 6.0.

5.0 Environmental Analysis

The environmental analysis for PSAERP evolved incrementally over about 6 months time, and generally followed five steps. Data on environmental impacts for measures being considered was gathered and entered in the data base first. An environmental analysis of the measures using the data came next. Once the measures were evaluated, the different measures were depicted as either High, Moderate, Low and Minimal impact measures. These conclusions were used to compare 11 preliminary solutions termed "test cases." From the test cases arose four "realistic" Alternative Strategies which are described in the Draft EIS. A no action alternative was defined and analyzed as well. Environmental analysis findings were used in choosing the Preferred Alternative discussed in Draft EIS. Interactions between the five participating utilities, and the Sounding Board were integral to all steps of the analysis.

A few unanticipated changes occurred during the analysis. The first was a decision to throw out the test cases as solutions and define a smaller number of realistic solutions. Another surprise was the realization that some of the measures, namely all those categorized under local generation, would not be built solely to serve peaking needs as their cost was prohibitive compared with other solutions. The solution was to recognize that a certain amount of generating resources would be built independent of the PSAERP, and these resources would reduce dependence on the transmission system. As a result, all local generation measures except peaking combustion turbines were removed as solution measures for PSAERP.

Rather than fully describing the alternative strategies here, the reader is referred to the Draft EIS. After weighing the environmental, economic, and technical trade-offs and carefully considering recommendations of the Sounding Board, BPA and Puget Sound utilities decided Alternative Strategy 2 is preferred as the primary solution to the transmission reliability problem in the Puget Sound area. It ranks second to Alternative Strategy 3 in minimizing environmental impacts. Utilities and the Sounding Board recognized the need for a plan to be broad and flexible to adapt to unanticipated future developments. To provide the flexibility to respond to medium-high load growth, the preferred alternative includes preparing for a transmission line project to be available in 2000 if necessary. A 7-8 year lead time is assumed because a transmission line may be controversial. A decision will be necessary in 1996 to either complete or delay this project. Another contingency element of the Preferred Alternative is combustion turbines. One or more combustion turbines could be sited in the Puget Sound area to respond to a greater than expected peak load deficit. Utilities will also pursue fuel switching and water heater load control pilot programs. These demonstration programs underway or anticipated will provide data on costs, benefits and deliverability.

The Preferred Alternative is actually a hybrid of Alternative Strategy 2 with additional elements from other strategies as contingency measures. Under this strategy, Puget Sound utilities will ramp up conservation programs in 1993 to achieve initial peak reductions by the winter of 1993-94. BPA will complete Voltage Support Option 1 by the fall of 1993, which would provide 600 MW of additional transmission capacity by the winter of 1993-1994. Another voltage support element, Voltage Support Option 2, would be implemented. In Voltage

Support Option 2, BPA would develop a 500-kV substation east of the Cascade Mountains providing 1000 MW of increased capacity by the winter of 1994-1995. This substation would be located near Ellensburg, Washington.

Conservation programs have low health and safety impacts. Voltage Support Option 1 has minimal impacts because additions are in existing substation yards. The impacts of Voltage Support Option 2 are minimal or low and result from establishing a new substation (see appendix G for a detailed environmental evaluation of the substation)

Alternative Strategy 1 includes a cross-Cascades transmission line. This line would provide surplus capacity for a larger peak load deficit than assumed. Contingency measures for higher than expected load growth include using load curtailment contracts before the line is energized, or delaying the transmission line if the deficit is less than expected.

Conservation programs have low health and safety impacts. Voltage Support Option 1 has minimal impacts because additions are in existing substation yards. Transmission line impacts vary from low to high depending on the kind of corridor used (existing, expanded, or new).

Voltage Support Option 2 is added to the power system in Alternative Strategy 2. A new substation containing circuit breakers and series capacitors would be built. Contingency measures include delaying Voltage Support Option 2 if the deficit is less than expected, or adding a line or combustion turbines if the deficit increases.

The impacts of Voltage Support Option 2 are minimal or low and result from establishing a new substation.

Alternative Strategy 3 adds load management programs (water heater control and time-of-use rates) and fuel switching (from electricity to natural gas). Contingency measures include load curtailment and adding Voltage Support Option 2 if the deficit increases, or delaying measures if the deficit decreases.

Load management creates low socio-economic impacts, and fuel switching creates low air quality impacts. This strategy has the fewest environmental impacts.

Alternative Strategy 4 adds peaking combustion turbines used only during peak load periods. Combustion turbines require a site of about four acres. Contingency measures include additional combustion turbines, load curtailment or Voltage Support Option 2 if the deficit increases, or delaying the combustion turbines if the deficit decreases.

Combustion turbines have low to moderate land use and natural environment impacts depending on the site selected. Air quality impacts are moderate.o meet their individual needs. However, these actions may not be coordinated. This alternative is more likely to cause decreasing reliability as loads grow. By 2003, normal winter peak load will stress the power system and minor disturbances could cause instability and blackout in the Puget Sound area.

This alternative could have high health and safety and socio-economic impacts, and moderate air quality impacts. It would avoid impacts of new facilities and it could result in increased utility emphasis on conservation and other demand-side programs.

There are several measures that are included in all alternative strategies. All four include about 200 MW of accelerated conservation by 2003 and 600 MW of additional transmission capacity from main grid reactive additions in the Puget Sound area by 1997. All alternative strategies assume a minimum of 400 MW of new energy resources will be sited in the area by 2003.

6.0 References

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The dominant fuel types will be gas and biomass. The generation unit will most likely be stream driven, however turbine generators are an emerging technology.(personal communication, Mike Berger, 2/5/91

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ENVIRONMENTAL IMPACT DATA BASE

VOLTAGE SUPPORT

- No Impacts Reported

TRANSMISSION

Land Use - Residential

"Specific areas of greater concern [assuming would cause direct developed land use impacts such as disturbance during construction and long term visual intrusion on developed settings] have been identified along the route. In addition, those areas that would experience fairly intense visual and inconvenience effects are identified [a 500 kV line would be quite out -of - scale in a valley]."(T-3)

"Noteworthy problem areas occur in such situations where the route would either cross close to these subdivisions, with possible conflicts with adjacent subdivided undeveloped land, or would be visible from the more densely settled communites along the river itself. Impacts would not be direct (except for conflict with undeveloped subdivided land) and would involve short-term disturbance and long-term visual intrusion."(T-3)

"Noise and electrical interference with TV and radio would constitute long-term effects as well."(T-3)

Land Use - Agriculture

"Most significant impacts are on irrigated farmland, ... Impacts from construction, operation , and maintenance, would be direct and long-term."(T-3)

"Small amounts of land could be removed from production at tower sites. In addition, should towers be located within the irrigation pattern, they could obstruct or prevent overhear irrigation, and could impede or prevent aerial spraying."(T-3)

"It crosses less private land, and crosses the least amount of agricultural land, both irrigated and non-irrigated."(T-3)

"Non-irrigated farmland and Farmland of Statewide Importance would also sustain some impacts where land is removed from production by towers and where the towers might interfere with farm management. Difficulties of farming around the tower bases, problems of weed infestation, safety question, and reduction of crop production caused by compacting and/or erosion comprise impacts on the local level."(T-3)

"Long-term impacts include land permanently lost to production and transmission structure interference with farm operations."(T-1)

"Although impacts may be moderately significant to individual farm operators, overall impacts would not be significant."(T-1)

"None of the alternatives would represent more than a marginal change in the area of productive land lost."(T-1)

(Transmission Continued)

Land Use - Rangeland/Forestland

"Rangeland would be minimally affected by a transmission line."(T-3)

"It best avoids environmentally sensitive areas, although it crosses through rangeland and forest ranges between two developing suburban areas in the ... ."(T-3)

"Between 108 and 142 miles of forestland would be crossed in this section. Impacts could increase in significance when combined with effects on temporary increases in water yield (affecting streams), on wildlife habitat and potential for wildlife disturbance, and on alteration of recreational experiences for dispersed recreation in the forest."(T-3)

"This plan does rank last for impacts on forestry, vegetation, and water resources, as it encounters more heavily timbered land, more highly productive forests, and longer stretches of watersheds serving downslope communities than either the ... alternatives."(T-3)

Land Use - Recreation

"Significant impacts would occur on four resources: roadless areas, National Trails, intensive use sites or areas, and dispersed use recreational areas."(T-3)

"Impacts would be direct and considerable at developed intensive recreational sites and trail crossings and in the immediate vicinity of the line in dispersed use areas."(T-3)

"... would not disrupt or interfere with any recreation activities, and it would not affect any developed recreation sites. It would, however, cross the Ridgeline Trail, causing slight impacts."(T-1)

"Since this alternative would place a line within an existing corridor, the intrusion has already been introduced."(T-1)

"The incremental increase in the size of the structures and the accompanying decrease in number of structures would not affect the trails use."(T-1)

"... the opportunity to grow timber would be foregone, as the right-of-way would need to be kept free of trees."(T-1)

"These amounts [timber removal] are not significant, ..."(T-1)

"Pre-emption of incompatible land uses within rights-of-way."(G-6)

"Interference with land utilization practices such as cultivation and irrigation."(G-6)

"Displacement of buildings within right-of-way."(G-6)

"Disruption of radio and television reception adjacent to the lines."(G-6)

"... towers were to be placed to minimize disturbance of farming practices."(T-5)

"Both figures [land removed from production] are considerably lower than projections."(T-5)

"No land use impacts occurred that were not addressed by the EIS."(T-5)

(Transmission Continued)

Fish

"... the line spanned all streams. No channel degradation occurred at stream crossings. As a result, fisheries were unaffected by this project."(T-5)

"... if any raptor nests were found along the route, construction activities were to be postponed until after the nesting season. ... The hawks, however, did not return. One access road was rerouted to avoid a Turkey Vulture nest. One raptor started to nest in a tower. ... a nesting platform was installed but the raptor has not used it."(T-5)

Wildlife

"Noteworthy impacts on wildlife would occur in areas of big game critical winter range... Habitat alteration due to clearing would be direct and long-term; disturbance from construction would be direct and short-term, but increased access for hunters would be an indirect long-term impact."(T-3)

"Presence of the line could create a potential for waterfowl collisions with the line, an impact of local significance, in segments ... However, these crossings are not considered problem areas because few eagles use them, because haitat would be minimally disturbed, and because collision potential is low."(T-3)

"These effects would be locally important, as big game are socially and economically important wildlife species. Cumulative impacts could occur where vegetation is particularly slow to recover, and where wildlife observation could be esthetically disrupted by the line."(T-3)

"With the fewest river crossings, it minimizes impacts on wildlife and avoids affecting the bald eagle, an endangered species."(T-3)

"The BPA Biological Assessment reports that the proposed action would not affect the bald eagle; the USFWS has concurred with those findings."(T-3)

"... would parallel an existing line and no new access roads would need to be built; also less clearing would be needed."(T-1)

"Impacts from construction along Alternative A would not be significant."(T-1)

"Because of the small amount of major range crossed, Alternative A would have only a slight negative impact ..."(T-1)

"Assuming that the more miles of habitat crossed, the greater the impact on the big game resource, ... , and Alternative A, the least impact."(T-1)

"... there are no listed or proposed endangered species within the area of the project." (T-1)

"Elimination or modification of terrestrial wildlife habitat through vegetation disturbance."(G-6)

"Occasional bird collisions with transmission lines"(G-6)

"A plan for impact mitigation and monitoring was agreed upon by ..."(T-5)

"The study will continue for two more years."(T-5)

(Transmission Continued)

Vegetation

Impacts on vegetation resources in these areas are similar to those described in ... that is , loss of vegetation production, change in composition and density of vegetation due to vegetation removal, disturbance and subsequent erosion and/or compaction. However, in these areas of particular sensitivity, impacts may be intensified, or longer lasting, particularly where extensive clearing occurs or where high access road needs prevail." (T-3)

"This plan does rank last for impacts on forestry, vegetation, and water resources, as it encounters more heavily timbered land, more highly productive forests, and longer stretches of watersheds serving downslope communities than either the ... alternatives."(T-3)

"All trees creating a hazard to the transmission line would be removed. ..., tall vegetation would be removed by cutting and controlled hand application of herbicides."(T-1)

"BPA's herbicide application standards meet or exceed all State and Federal standards"(T-1)

"Alteration of the form, composition, and density of vegetation communities through removal and/or damage during construction and maintenance."(G-6)

"Damage to non-target vegetative foliage from herbicides used in vegetative maintenance."(G-6)

"[Reseeding] ...found that the success rate varied considerably from site to site and from schedule to schedule."(T-5)

"In some cases, the USFS felt that construction schedules prevented application of seed in a timely manner although no evidence of this was found."(T-5)

"At most tower sites and along many of the access roads, the seed is doing exceptionally well."(T-5)

"Most of the project had 80-100% revegetation."(T-5)

Water

"Access road and other construction disturbance could increase stream sedimentation (primarily short-term) through accelerated runoff in areas of problem soils and high erosion potential ..."(T-3)

"Steep terrain and slow vegetative recovery could extend the period of erosion and sedimentation in this segment."(T-3)

"Work at tower sites and for access road construction may compact and disturb soil cover ..., but would not affect the floodplain."(T-3)

"This plan does rank last for impacts on forestry, vegetation, and water resources, as it encounters more heavily timbered land, more highly productive forests, and longer stretches of watersheds serving downslope communities than either the ... alternatives."(T-3)

"... would encounter steep terrain and erosive soils in the hills south of Eugene."(T-1)

"... would have the least impact on water resources since it minimizes the sedimentation risk. It would cross fewer streams (eight) and less terrain (12 miles) rated as having a high or moderate erosion hazard than the other alternatives."(T-1)

(Transmission Continued)

"... would require minimal access road improvement ..."(T-1)

"All water resource impacts would be short-term and would range from slight for Alternative A ..."(T-1)

"The field review found evidence of sedimentation ..."(T-5)

"... restoration of the slope above the creek has retarded further erosion. The USFS indicated that no long term adverse effects occurred."(T-5)

"Spot seeding and straw placement was done at Randolph Creek, and the inside ditches were kept clear of debris."(T-5)

"The USFS indicated that sedimentation was not a problem elsewhere on the project."(T-5)

"Fish baffles, culverts, or rip-rapping called for in the M/M Plan were installed as specified."(T-5)

"... was structure was unavoidably placed in the floodplain. The floodplain was unaffected because the structure was put on concrete footings to minimize water flow restrictions and all disturbed areas were regraded to original contours and replanted."(T-5)

"No significant adverse effects on water quality occurred on the Project."(T-5)

Soil

"On steep slopes combined with moderate erosion potential, more soil may be disturbed, causing increased sedimentation in streams and slowing vegetation recovery, particularly because of decreased soil fertility on disturbed sites. These effects are short-term and primarily caused by construction disturbance."(T-3)

"Problem soils, susceptible to erosion and very susceptible to land slumping, occur in numerous places."(T-3)

"... steep slopes and encounter high elevations in places, areas where erosion is more severe and construction more difficult. Segments ... require a high amount of access road construction. Where these conditions overlap, construction requires more cut-and-fill work, intensifying erosion, hampering revegetation, and increasing sedimentation of nearby water resources, ..."(T-3)

"Although these impacts would primarily be short-term occurring during and for some time after construction, long-term operation and maintenance would require continued use of access roads, thus sustaining the soils impacts over a longer period of time but to a much lesser degree."(T-3)

"Where the line would encounter 14 miles of problem soils near ..., in areas of moderate erosion potential, erosion would increase."(T-3)

"... at elevations over 6000 ft., construction would become more difficult, and soils may be more sensitive to erosion. Similar problems would exist at slopes which are steep (31-55 percent) or very steep (over 55 percent). High access slopes combined with moderate erosion potential, when encountered in the construction process, would sustain more soil disturbance, causing increased sedimentation in streams and slowing revegetation, particularly because of decreased soil fertility."(T-3)

"Problem soils, susceptible to erosion and possessing high landslide capability, would also sustain higher impacts from construction. Although these impacts would primarily be short-term, and due to construction, maintenance would require periodic use of access roads, and may sustain the soils impacts over a longer period of time but to a lesser degree."(T-3)

(Transmission Continued)

"... would require only minimal access road improvement; would cross the fewest miles of soils with high (8 miles) and moderate (4 miles) erosion hazard; and would require only 50 to 70 % as much clearing as the other alternatives."(T-1)

"Impacts would be short-term."(T-1)

"... the overall impact would be low for Alternative A, ..."(T-1)

"Erosion and sedimentation would be expected to increase during and after construction until a new base level is reached upon stavilization of disturbed areas."(T-1)

"Accelerated erosion and changes in soil characteristics (primarily during and immediately after construction)."(G-6)

"Increased sedimentation of surface water resources due to construction and maintenance activities" (G-6)

"..., areas of high erosion hazard and soil instability were to have control measures implemented. ... , in most cases, the erosion was minor and that culverts, dips, rip-rap and other control measures such as reseeding curbed the problems."(T-5)

"The only locations where problems remain are ..., which has unstable slopes. ...agreed to wait and see whether the slope will stabalize itself."(T-5)

"..., numerous efforts by BPA to get seeds to grow have had limited success because of poor site conditions."(T-5)

"The placement of slash material below the access road to ... was effective in preventing soil from going downhill."(T-5)

Air

"Air quality impacts would result primarily from dust and exhaust emissions from construction equipment. The amount of construction for a transmission line depends on the length of the line, the acres of new right-of-way needed, and the miles of new access roads needed."(T-1)

"... would run through more residential area, but would require relatively less construction; it would be the shortest proposed alternative, and would use existing right of way and access roads."(T-1)

"With mitigating measures, air quality impacts for any of the four alternatives would be slight, localized, and temporary."(T-1)

"Air Quality impacts due to combustion of construction debris, creation of dust by construction vehicles, and vehicle exhaust emissions"(G-6)

"Microclimate alteration through the removal of vegetation from the right-of-way."(G-6)

"The production of minor quantities of oxidants in the air immediately adjacent to the electrical conductors during operation of the line."(G-6)

(Transmission Continued)

Cultural Resources

"Impacts on archeological resources in this section would be caused primarily by the following: construction and maintenance, where subsurface sites such as prehistoric campsites, quarries, and activity areas exist; and presence of the line where the visual intrusion may detract from a visitor's experience of a surface site such as rock art or a religious area of significance."(T-3)

"Construction may create direct impacts, particularly should any buildings be directly encountered, a long-term impact. Indirect visual impacts would also be long-term."(T-3)

"Increased access to the sites could increase likelihood of vandalism of any remaining structures."(T-3)

"These sites could be disrupted by construction and use of heavy equipment; bulldozing and excavation for tower sites could totally destroy a site. The physical effects of disturbance or destruction would irretrievable and irreversible."(T-3)

"Historic/cultural resources could be affected by surface or subsurface disturbance during construction activity, or from visual intrusion of constructed facilities."(T-1)

"No archeologic sites have been recorded along segments A and C. However, potential exists for discovery of new historic sites along these segments, based on data available for Lane County."(T-1)

"Visual and esthetic intrusion upon scenic qualities and cultural resources."(G-6)

"Possible physical alteration of cultural resources."(G-6)

"Two site were discovered. ... A report of the findings and additional data was requested by the State of Montana. ... A report to document the findings will be issued... None of those historic sites listed in the ROD was affected by the project."(T-5)

Aesthetics

"Significant esthetic impacts would occur in six areas of the ... These effects would be direct, long-term, and intense due to the large numbers of viewers with high visual sensitivity in the area and to the domination of the line in the landscape."(T-3)

"In segment 119, the line would cross a designated scenic highway ... The line, cutting across the valley floor, would be visible from many vantage points within the valley, an area of high viewer sensitivity. The line would parallel an existing line; however, they would be unmatched as to size, configuration, and spacing, creating a chaotic appearance."(T-3)

"The cumulative effects of the many lines in this stretch would create a chaotic appearance."(T-3)

"Although vegetative patterns and background tend generally to "absorb" the line visually, exceptions occur, most notably ...where the valley narrows and the line is closer to I-90. The out-of-scale towers would be quite noticeable to large numbers of people."(T-3)

"... in the Clinton area.... Towers would be out-of-scale with nearby features; views would be in the foreground and would be of long duration."(T-3)

"... northwest of Clinton ... Highly visible scars would be left, conflicting with the natural setting. Views would be in the foreground to middleground, and would be of long duration."(T-3)

(Transmission Continued)

"In addition to long-term direct disruption of views, construction would cause short-term disruption of the area."(T-3)

"The introduction of another line in the narrow Rattlesnake Valley would add to the visual disruption by cutting across the prevailing land patterns. The additiona line would not match the existing lines as to size, configuration, or spacing, giving the right-of-way a chaotic appearance. The lines would also be out-of-scale with nearby structures, be visible to large numbers of people, and would be an ever-present and dominating element in the valley."(T-3)

"The Taft Plan also minimizes visual impacts, most serious in the Rattlesnake, the Thompson Falls area, and the Clark Fork Valley."(T-3)

"Alternative A would be close to many residents, but its visual impacts would be low because it would place an additional line in an existing corridor, where impacts have already been established."(T-1)

"Also, using improved appearance structures rather than steel lattice structures in critical view areas should reduce visual impacts."(T-1)

"Visual impacts of Alternative A would be localized because most distant views are screened by dense vegetation and other obstructions."(T-1)

"For most of its length, the line would be on the south side of these hills and not visible from points in the metropolitan area."(T-1)

"The line would be visible from the many roads which it crosses;..."(T-1)

"The presence of screening vegetation and the surrounding topography would make the visual impact of the line ... minimal."(T-1)

"As noted above, houses are scattered throughout the area, and the line would be visible in varying degrees at many points."(T-1)

"Visual and esthetic intrusion upon scenic qualities and cultural resources."(G-6)

"Visual impacts resulting from the adverse appearance of herbicide treated vegetation."(G-6)

"Where the facility is highly visible, structures and conductors are the major contributors to that visibiity. Other line components —right-of-way clearing, access roads, or tower site clearing seldom contribute to high visibility. Darkened spacer dampers and insulators are typically insignificant contributors to visibvility; however, with low sun angles and front-lighting, they may be recognized."(T-4)

"Context or setting influences the visual impact level of the facility. Impacts will be increased where a landscape setting, lack of man-made modifications, or other factors focus an observer's attention on the facility."(T-4)

"Where the landscape setting does not focus viewer attention on the facility, or where the foreground is dominated by man-made modifications, the impact of the facility is lessened."(T-4)

"Structures painted for aeronautical safety are recognizable from viewpoints several miles away...however, both marker balls and baffled strobe lights under daylight viewing conditions are inconspicuous from ground observation points more than1/4 to 1/2 mile away."(T-4)

(Transmission Continued)

" Sun angle and view position are controlling variables affecting conductor visibility. Front-lighting conditions with a low sun angle contributed to highly visible conductors. From some viewpoints, conductors were recognizeable. For other viewpoints, they were barely detectable, with the non-specular finish contributing to lower visibility, even with foreground viewing."(T-4)

"For views with backdropped condition, most structures were barely detectable or not detectable at middleground or background distances. For skylined conditions, structures were recognizeable or highly visible."(T-4)

"Darkened towers were highly effective in reducing visibility thresholds."(T-4)

"At sensitive location, selected mitigating measures (raising of towers to reduce right-of-way clearing, tree-topping, and brown porcelain insulators) are effective in reducing visual impact levels"((T-4)

"Improved appearance structures decreased visual impact levels in the Miller Creek and Lolo areas."(T-4)

"... stated that as much vegetation as possible would be left at highway crossings to soften the impacts of the right of way (ROW) and/or towers."(T-5)

"... reviewed crossings at Highways 93 and 90 and determined that no vegetation was removed."(T-5)

"At Highway 10A, too much screening vegetation was removed, partially a result of tower site clearing but also from clearing by Montana Power Company to bring power to the strobe lights."(T-5)

"At the crossing of Highway 461, extensive clearing was unavoidable because ground to conductor clearance was very low."(T-5)

"Review ... showed that tower darkening and the use of non-specular conductors was to be implemented throughout the project. Field review found consistent implementation."(T-5)

"...visual monitoring study for this project found that darkened towers were highly effective in reducing visibility."(T-5)

"Towers viewed against a conifer backdrop were not detectable more than two miles distant from structures."(T-5)

"At sensitive locations, selected mitigating measures (raising of towers to reduce right-of-way clearing, tree-topping) were effective in reducing visual impact levels."(T-5)

"The linear pattern and increased visibility of the segment of access road and cut slope ... would benefit from additional tree and shrub planting, however, low probability of plant survival at this dry site may require measures such as plantings of large numbers of seedlings and supplemental watering of plants ... The Montana DNRC expressed a high concern for this site and would like to see something done."(T-5)

"... tubular steel poles. ... They were placed as specified. ... found that the poles did reduce visual impacts for ... residents."(T-5)

Noise

"Noise and electrical interference with TV and radio would constitute long-term effects as well."(T-3)

"None of the alternatives would produce noise which would exceed the State of Oregon's noise standard..."(T-1)

(Transmission Continued)

"Few complaints about noise are received from people living near BPA transmission lines when noise levels are less than 50 dB(A). However, when a higher-voltage line is added to an established right-of-way where there are nearby homes, residents may notice an increase in noise, compared to the noise from existing lines."(T-1)

"The assessment summary is given in Table 12 where the noise levels reported are for edge of the right-of-way that is noisier. ...; Alternative A, a low impact. Even though the noise increase would be less for Alternative A, Segment 3 ..., it would have a greater potential impact because it passes considerably more housing units than the other alternatives."(T-1)

"Noise impacts from construction activities and the operation of substations and transmission lines."(G-6)

Health and Safety

"Contrary to what one might assume, the addition of a 500 kV line may result in lower magnetic field strengths than existing lines because the two circuits' fields partially cancel each other."(T-1)

"Future facilities could increase electric field levels on the left side of the right-of-way from around 1.5 to 20 times the levels produced by existing lines."(T-1)

"There would be no significant increase in electric field strength on the right side of the right-of-way."(T-1)

"Electrical hazards through transmission line failures, or through accidental contact with transmission lines."(G-6)

"Minor [1980 conclusion] biological effects related to the electrical and magnetic fields surrounding transmission lines."(G-6)

Visibility studies are now underway to determine whether this [marking and lighting of towers, adding marker balls, removing overhead groundwires, painting towers aviation red and white] is warranted"(T-5)

"Airway marking requirements were not identified until so late in the process that it precluded relocation to avoid a hazard designation at ..."(T-5)

"The study was conducted on 232 cases of childhood leukemia occurring in children age 10 and under between 1980 and 1987 in Los Angeles County."(T-8)

"An extensive assessment of exposure to electric and magnetic fields was made by assessing wiring configurations of most subjects, by measuring electric and magnetic fields in various areas of the inside and outside of the home, and by measuring magnetic fields for 24 to 72 hours in the child's sleeping area."(T-8)

"Wiring configuration, as categorized in the Wertheimer-Leeper system, was related to most measures of exposure. Different measures of magnetic field were highly correlated with each other while electric field exposures did not correlate with magnetic fields." (T-8)

"Exposure measured by the dosimeter was not statistically significantly correlated to leukemia risk, although the highest risk was consistently in the highest exposure category."(T-8)

"Univariate analyses revealed several other factors to be associated with risk: parents incense use; inside pesticide use; fathers occupational exposure to spray paint (during wife's pregnancy); and children's exposure to hair dryers, to black and white televisions, to curling irons, and to electric blankets."(T-8)

(Transmission Continued)

"We conclude that our data offer no support for a relationship between measured electric field exposure and leukemia risk, little support for the relationship between measured magnetic field exposure and leukemia risk, some support for a relationship between wiring configuration and leukemia risk, and considerable support for a relationship between children's electrical appliance use and leukemia risk."(T-8)

"The reason(s) why wiring configuration correlates with leukemia risk better than measured exposure are not clear. It is also not clear whether short-term, very high exposure of children to magnetic (or electric) fields from electric appliances are responsible for the observed risk or whether associated exposures are responsible. These latter two issues deserve continued research."(T-8)

"I found no definitive evidence in the professional literature for hazardous human health effects from exposure to extra low frequency electric and magnetic fields."(T-9)

"If there is a health risk from extra low frequency EMF, I feel that it is less than that from cigarette smoking or high radon levels in the home."(T-9)

"There is reason to believe that a number of experiments are currently under way which will greatly improve our understanding of the human health effects of extra low frequency EMF."(T-9)

"The effect of EMF exposure on the secretion of melatonin by the pineal gland is particulary interesting as it is a consistently reproducible in vivo effect."(T-9)

"It could be 10 years or more before this problem is solved."(T-9)

"I do not feel that I am competent to comment further on the epidemiological data, other than to say that I believe that the existing data is sufficient to indicate that more work is needed."(T-9)

"Education of the public is of prime importance. With some urging and oversight I think the utilities could do a respectable job of this."(T-9)

"Many experiments which show no EMF bioeffects have been published. However, with so many possible variables, lack of effects, in many cases, may be explained by an unrecognized difference in technique."(T-9)

"The possibility of setting interim electric and magnetic field standards for large transmission lines should be discussed by the Council."(T-9)

"Not all of the health effects of 60-Hz EM energy are bad."(T-9)

"The ability to explain how EM energy could act to promote cancer incidence would enhance acceptance of this concept. Recent evidence suggests that the answer lies in an effect usually regarded a neurotoxic. Rather than direct genetic damage, EM energy is known to have consistent disrupting effects on chronobiological patterns of metabolism."(T-9)

"Hollow claims are now being made that sufficient research is now in process to answer out questions and to reassure us about the safety of common EM exposures. Unfortunately, such is not the case."(T-9)

"Although we now know enough to know that these effects occur at modest rates in unprotected circumstances, we do not know what the limits of safe exposure are. Such research is extremely important and urgent."(T-9)

The suggestion is not that 60 Hz fields initiate cancer but rather that exposure to fields may serve to 'promote' cancer once it is initiated by other causes (See endnote on promotion).(T-10)

(Transmission Continued)

"Five completed epidemiological studies have addressed the question of association between exposure to ELF [extremely low frequency] fields and cancer in children."(T-10)

"The Wertheimer and Leeper study [Wertheimer 79] ... showed that children exposed to a HCC [high current configuration] configuration residential environment had a 1.6 to 2.2 -fold higher incidence of cancer than controls. ... this means that the risk of children exposed to HCC is double the base rate, or 20 in 100,000 per year."(T-10)

"Four studies have been done since the Wertheimer and Leeper study. Two of them found no association between leukemia and estimated exposure to magnetic fields. These two studies were conducted in Rhode Island [Fulton 80] and Yorkshire, England [Myers 85]. (T-10)

"Two other studies found positive results. The first of these was done in Sweden [Tomenius 86]. ... It was found that homes of cancer cases were twice as likely to have a front-door measurement of 3 mG or above than those of controls. The strongest odds ration of 3.7 was noted for nervous system tumors.(T-10)

"The latest and by far, the most thorough and complete study is that by Savitz et al. [Savitz 87a, Savitz 88]. ... involved children from the Denver Standard Metropolitan Statistical Area ... measured levels of magnetic fields were classified into four ranges ... results showed that the highest field (2.5+ mG) group in each power category showed a increased risk of about 20 to 60% above the controls for all cancers."(T-10)

"...there is now a very large volume of scientific findings based on experiments at the cellular level and from studies with animals and people which clearly establish that low frequency magnetic fields can interact with, and produce changes in, biological systems. While most of this work is of very high quality, the results are complex."(T-10)

"Current scientific understanding does not yet allow us to interpret the evidence in a single coherent framework. Even more frustating, it does not yet allow us to draw definite conclusions about questions of possible risk or to offer clear science-based advice on strategies to minimize or avoud potential risks."(T-10)

"Of the effects discussed, the central nervous system effects including effects in animals and the possibility of cancer promotion appear most worthy of concern with respect to public health effects."(T-10)

"...the brain and central nervous system are natural candidates for interaction with fields."(T-10)

"Field-CNS [central nervous system] interactions may have dependecies which are at very specific frequencies and intensities, and may vary with the background static fields present, the time of day and the duration of exposure."(T-10)

"Developing nervous systems may be particularly susceptible and effects may be latent, manifested only in specific situations or later in time."(T-10)

"More than any other agent known, except perhaps some psychotropic drugs, ELF fields are specific: with respect to the regions of the brain tissue affected and the point of administration in the circadian rhythm."(T-10)

"How and whether these findings have public health implications remains unclear. What is clear is that these findings about subtle and complex effects demand a carefully planned research agenda in this area."(T-10)

"ELF fields are not known to cause any chromosomal damage, and, hence, are not likely initiators of cancer."(T-10)

(Transmission Continued)

"Some cellular level experiments indicate that the cell membrane is the site of the interaction between ELF fields and the cell. The membrane site responsible for this action has also been shown to be a receptor for chemical cancer-promoters."(T-10)

"ELF fields have been shown to increase ornithine decarboxylase (ODC) activity. All known cancer promoters stimulate ODC. However, the converse is not true. Many agents that promote ODC activity are not cancer promoters."(T-10)

"Alterations in protein synthesis, in immunological and hormone status, and in metabolic ... can all contribute to the progress of initiated cancer. To the extent that ELF fields play a role in those, they might have an effect on tumor growth or indeed tumor inhibition."(T-10)

"Pineal melatonin depression has been associated with cancer growth, and administration of melatonin has been found to slow the growth of cancer. ELF fields depress pineal melatonin levels in animals."(T-10)

"Functions of gap junctions are disrupted by ELF fields. Similar disruptions are produced by other known chemical promoters."(T-10)

"Epidemiologic studies of ELF exposures and cancer show a weak association between ELF field exposure and nervous system cancer and leukemia."(T-10)

"While the above arguments are consistent with the hypothesis that ELF fields may play a role in cancer or tumor development, none of these constitutes proof or even necessarily a strong indication that it does."(T-10)

"Three studies have examined the association between adult cancer and exposure to ELF fields from non-occupational sources, two in the U.S. examining residential exposures and one in England examining the proximity of residences to electrical transmission facilities. ... These three studies were varied in concept and have several problems, such as confounding variables and uncertainties in the amount of field exposure, and do not provide enough evidence to judge the possibility of an association between residential field exposure and adult cancer."(T-10)

"About twenty studies have looked for an association between cancer, particularly leukemia and brain cancer and occupational exposure to ELF fields. ...The results of all studies taken together indicate a small positive association or no association."(T-10)

"Based on the set of studies ..., it is fair to say that there is an indication that occupational exposure in "electrical occupations" is associated with enhanced leukemia risk. Remember that "associated" means "occurs together with"; it does not imply a causative link. ... Collectively, the studies do not provide good evidence that ELF field exposure increases the risk of leukemia. At the same time, the evidence precludes categorical statements that no such risk exists."(T-10)

"The association between brain and CNS [central nervous system] tumors and ELF field exposure related to occupation has been examined in about 10 studies, some of which are general cancer studies referred to in the above section on leukemia. ...conclude that although ELF field exposure cannot be definitely or uniquely identified as an causative agent, some aspect of the manufacturing and repair jobs mentioned above does place the workers at increased risk of brain tumors. ...saw no risk for CNS or brain cancer in electrical occupations. ..observed an elevation of liver and brain tumors and leukemia with odds ratios in the range of 1.3 to 2 [Lin 87]."(T-10)

"The question of association between cancer and ELF electromagnetic fields first arose because of the work on childhood cancer in Denver. Studies since then have yielded mixed results. ... Overall, the evidence now available is too weak to allow firm conclusions either way."(T-10)

(Transmission Continued)

"Given the relatively limited number of studies directly addressing property value perceptions, and their rather severe methodological shortcomings, the empirical basis for understanding this issue is still very weak."(T-11)

Socio-Economics

"Because BPA would pay no local taxes on the project, local residents would prefer that a public project be sited on public land."(T-3)

"Larger numbers of people would be exposed to and affected by short-term construction impacts and by long-term operation and maintenance impacts in these areas."(T-3)

"... would also encounter areas with high residential potential; a line there could change future development patterns."(T-3)

"Construction of new access roads across private land may give increased access to public lands by the public (possibly a benefit), but may inconvenience individual landowners in these areas."(T-3)

"Construction and presence of the line in the Missoula-Rattlesnake area would also increase alienation of the public. Local opposition to crossing a densely settle subdivision or the National Recreation Area, a ... is high."(T-3)

"... would involve issues of private land ownership, and would present both short- and long-term inconveniences to irrigated farmland in particular. New corridor and new access road impacts would be low, but high landowner opposition and concern over conflict with ranching operations would mean increased alienation in this area."(T-3)

"Temporary population increases during project construction."(G-6)

"The initial attitude toward the line was overwhelmingly negative. The current attitudes overall, as measured by the Social Monitoring Study, have moderated."(T-5)

"A small number of respondents (primarily those close to the line and those who were extremely critical of the line from the start) still have strong negative feelings."(T-5)

"A number of concerns expressed by the public before construction were reduced to negligible siturations by locating the line away from people and through special mitigating measures such as darkening of towers and the use of improved appearance structures."(T-5)

"The objective of the review was to identify sound, general conclusions in the literature that would be applicable to the socioeconomic impact assessment component of the Garrison-Spokane 500-kV Transmission Project revised EIS being prepared by BPA."(T-6)

"Of the twenty-seven key studies identified, twenty-two concluded that transmission lines had "no effect," "no significant adverse effect," [on land values] or were inconclusive or internally contradictory."(T-6)

"Five of the studies concluded that transmission lines did have adverse effects on land values."(T-6)

"The key adverse effect studies concluded that transmission lines have adverse effects on property values and that the adverse effects were more likely to occur (1) in higher-income subdivisions, (2) as proximity to the line increased, (3) when lot sizes were small, and (4) immediately after the line was constructed."(T-6)

(Transmission Continued)

"The studies were conducted between 1959 and 1981, used several different methodologies, and presented their results in varying levels of detail. These differences were of sufficient magnitude to limit the comparability of the research, leaving many of the key relationships in question and leaving the exact nature of transmission lines effects on land values unclear."(T-6)

"Because the key studies exhibited contradictory conclusions and methodological weaknesses, and because they focused on cases in the eastern and southwestern United States, determination of land value effects in the BPA service area will require further research in the region, ..."(T-6)

"The results of this research could provide evidence that transmission lines have no effect on land values, which would allow BPA to concentrate on other factors in its route planning and environmental impact processes. On the other hand, if the results of the research were to support an adverse effect conclusion, BPA would be in a better position to incorporate land value impacts in its route planning and mitigation processes."(T-6)

"The proposed study will make use of the recent property value and transmission lines literature to provide an evaluation and summary of research since 1975 and to explain the current state of knowledge of the field. The study will also identify important issues that remain unresolved and suggest appropriate research approaches for further examining these issues."(T-7)

CONSERVATION

Land Use - Residential

"The construction phase of conservation has identical environmental effects as the construction of buildings. For new buildings, the incremental effects of installing conservation measures is virtually nil. For existing buildings, there are clearly some effects, but they are too small to be of concern for this paper."(G-3)

Land Use - Commercial

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Air Quality - Residential

"The primary environmental cost of conservation has been identified as potential negative impacts on indoor air quality. However, this impact can be negligible — or even positive — if appropriate provisions are made for acceptable indoor air quality and adequate ventilation when conservation measures are adopted."(G-3)

"The fear is that energy efficient buildings will have less ventilation than ordinary buildings. In buildings with less natural air leakage, the potential exists for higher concentrations of normally occurring indoor air pollutants."(G-3)

"Formaldehyde, radon, and combustion by-products, such as benzopyrene, are the indoor air pollutants considered the major potential health risks. Health effects of inhaling higher than average concentrations of these chemicals can range from headaches and sore throats to increased chances of incurring lung cancer."(G-3)

"Moisture (i.e. humidity) is also perceived as an indoor air pollutant when it becomes excessive, contributing to the growth of molds, mildews and fungi."(G-3)

(Conservation Impacts Continued)

"Although some pollutant sources are unavoidable, many pollutant sources can be avoided or minimized at the time a building is constructed, or remodeled."(G-3)

"Reducing the source of pollution can have significant beneficial impacts in either an energy efficient or a convential home."(G-3)

"... studies are showing that properly built energy-efficient homes are no more prone to indoor air quality problem than non-energy-efficient homes. This is partially due to the fact that even if an energy-efficient home has a lower air exchange rate (ACH), it does not neccessarily have worse indoor air quality. This is because so much depends on the source of the pollutant being present. Studies are showing that very leaky houses can have indoor air pollution problems, while relatively tight homes can have very low levels of pollutants. These findings indicate that strong pollutant sources can overwhelm ventilation."(G-3)

"Residential model conservation standards require mechanical ventilation, radon mitigation packages, and spot ventilation to achieve this goal."(G-3)

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Air Quality - Industrial

No Impacts Reported

LOAD MANAGEMENT

Socio-Economic - Residential

"Load management can help utilities reduce costs..These changes not only reduce or defer the need for new generating plants, but also result in more effective use of existing units. This in turn reduces the capital and operating costs that must be allocated to each unit of power produced."(LM-2)

"The payoffs include fuel savings, operating and maintenance cost reductions, and increased generating plant life."(LM-2)

(Load Management Impacts Continued)

"reduced cycling (power plant starting and stoping) results in more efficient fuel use, which in turn reduces power plant emissions."(LM-2)

"shifting a portion of the load from peak to more efficient baseload and intermediate cycle plants also leads to emissions reductions, (use of the hydro system in the NW)" (LM-2)

" ...potential problem (higher levels of C02 and SO2) with a load managment-induced shift from oil and gas to coal plants" (not an issue in Puget Sound) (LM-2)

"... for it offers both cost savings and reduced emissions under virtually all scenarios."(LM-2)

"The potential social impacts of increased load management (I am assuming that this will involve some form of off-peak or time-of-day pricing as incentive to customers with or without direct utility control of electricity flow) appear to me to fall into six categories.

1. Shifts in energy source and depletion with secondary environmental impacts.
2. Impacts on disposable income with some troublesome equity effects
3. Effects on industry and commerce, unevenly distributed by size of firm and type of firm, with some opportunities for new products and services.
4. Impacts on employment and working conditions.
5. Impact on family life including leisure, comfort, and convenience.
6. Changes in political attitudes."(LM-1)

"The impact of load management on current society and on future generations will be shifts in materials usage resulting from feduction (or unconstrained growth) of peakload generation which is more likely to use coal or nuclear fuel. Such impacts might include reduced import dependency or slowed depletion of petroleum resources, faster depletion of uranium resources, encouragement of development of breeder reactors, increased pollution from coal mining and use, and added risks of nuclear disasters."(LM-1)

"Under income effect, there are first the intended savings for consumers which, although not large, would be highly visible....The income benefits, however, would accrue to the middle income groups rather than to the economically disadvantaged."(LM-1)

"To take advantage of time-of-day or off-peak pricing, consumers will have to purchase thermal storage units, initially more expensive than alternate heating systems."(LM-1)

"To the extent that manufacturers of consumer goods did shift to off-peak use, the reduction in cost would be too small to have significant effect on consumer prices."(LM-1)

"Smaller industries and firms which operate on an 8-hour day would have more opportunity to shift to off-peak operation but, in many cases, this saving would be more than offset by additional labor costs and by resistance form both labor and management."(LM-1)

"Some retail outlets and service industries might be encouraged to remain open at night as some grocery stores, drug stores and department stores already do."(LM-1)

"new industries or firms might result from off-peak pricing: production and sale of thermal energy storage systems"(LM-1)

"Industrial use of off-peak hours would, of course, mean nighttime employment, and this would have secondary effects on family life... In general, impacts on family life, leisure, comfort, and convenience would probably be minor and, on the whole not significantly detrimental."(LM-1)

(Load Management Impacts Continued)

"Finally, I would expect some impact on public attitudes toward utilities... utility controlled delivery of electricity is apt to produce some hostility and resentment—beyond that arising from any real inconvenience to householders. However, if off-peak or time-of-day pricing is generally available, the customer's attitude toward utilities and regulatory commissions would very likely improve by a feeling of greater control over his or her own utility bill."(LM-1)

FUEL SWITCHING

Air Quality - Residential

"Implementation of these policies (Electric Resistance Heat Ban) may result in an increase in the levels of CO, HC and NOx over those levels which would occur in the absense of the ban. These increases are due primarily to the increased use of natural gas....These increases are sufficiently small as to be considered insignificant."(F-1)

"The State Implementation Plan (SIP) suggests that air quality in the study area will be within primary and secondary standards by 1987. The plan does not attribute any significance to conversions from gas and oil to electricity in bringing ambient air quality into compliance with standards."(presumption that conversions to gas would have equally little significance) (F-1)

"Although small, these increases could be potentially significant...areas within the have been designated as nonattainment areas for specific pollutants (i.e., any increase in emissions of the pollutant in this area would be significant)."(F-1)

LOCAL GENERATION

LARGE HYDROELECTRIC

Land Use

"Large hydroelectric projects often require vast amounts of land for their reservoirs. Often this includes productive forest, agricultural, industrial, and urban areas. The impoundment ... alters large areas.. to a lake environment."(G-5)

"There may be a significant change in water level on an annual cycle. The drawing down of the reservoir can result in unattrative and unproductive beach areas."(G-5)

"Large-scale hydroelectric projects may flood existing communities, home sites, or transportation routes." (G-5)

"Displacement of familites from their homes is a negative impact."(G-5)

"Recreational opportunities are altered by impoundment. White-water rafting and other activities dependent on free-flowing water will no longer be available, although the impoundment may offer new opportunities for water sports."(G-5)

"The presence of the Skagit Project facilities limits the potential management regimes possible for the adjacent recreational resources. For instance, most of the areas adjacent to project facilities are not suitable for

(Large Hydroelectric Impacts Continued)

wilderness or wild and scenic river designation, because the modification of the river and adjoining lands would be incompatible with these preservation-oriented designations."(H-6)

"The reservoirs created by the Skagit Project also have a significant influence on the type of recreation facilities present, and therefore upon recreation management of RLNRA. The three Skagit Project impoundments cover an area (at full lake levels) of 12,850 acres (SCL, 1978), which represent recreation settings that are highly desired for fishing and flatwater boating activities. As a result, the reservoirs have a type, and perhaps a level of recreational development that would not have occurred without the project."(H-6)

"The Skagit Project provides a significant recreation resource in terms of the large reservoirs created by the project. The development of campgrounds, boat launches, and other facilities on the impoundments can be attributed to the presence of the project. The provision of facilities attracted recreationists to the resource, as did development of lake fishery resources in Ross and Diablo lakes."(H-6)

"The Ross and Diablo developments have also contributed to vehicular access to previously remote areas of the North Cascades, although somewhat indirectly."(H-6)

"The operation of the Skagit Project affects boating opportunities on the Skagit River below Newhalem. The operating regime of the project results in sustained downstream river flows throughout the summer season, as a result of continuous power production and the large storage capacity of the project."(H-6)

"The Skagit Project developments pose no direct conflict with the goals and objectives found in the State Comprehensive Outdoor Recreation Plan (SCORP)." (H-6)

Wetlands

"...the project did eliminate about 12,400 acres (5,022 hectares) of habitat along the upper Skagit River, including 4,580 acres (1,854 hectares) of riparian forest, 500 acres (202 hectares) of shrublands and grasslands, and 610 acres (247 hectares) of wetlands (Brueggeman et al., 1988). "(H-6)

Fish

"In some cases summer water temperatures may exceed the tolerance of sensitive fish species. Salmonids, for example, may be unable to survive in the warmer waters, and the species composition may shift to sunfish, bass and nongame fish." (G-5)

"Entrainment of air in water flowing through penstocks and turbines or after fallling over a spillway can result in superstaturation of the river with dissolved gases." (G-5)

"Fish populations may be impacted by changes in habitat, changes in water quality, changes in flow regimes, and the physical barrier o the dam as well as by mechanical damage during passage through the power generating facilities or over the spillway of a dam."(G-5)

"they (fish) may be carried out of the reservoir an downstream into an unsuitable environment."(G-5)

"Juvenile outmigrating salmon are subject to losses due to passage through turbines, gas bubble desease, delays in migration, and increased predation, increased travel time through the reservoirs, and weakened condition. These losses may be as much as 20% or more of the population passing each dam."(G-5)

"Adult salmon migrating upstream may be delayed, expend their energy reserves, and be subject to physical injury and disease. Even with fish ladders, there are losses to adult fish and displacement from preferred habitats to less suitable ones."(G-5)

(Large Hydroelectric Impacts Continued)

"Extensive drawdown may stop adult fish access to suitable spawning sites in tributary streams that enter the reservoir"(G-5)

"..fluctuations(water) can exceed 2 m in a day, and can strand fish on the shoreline and in small pools. Fluctuating water levels can also dewater spawning aras (redds), which can be lethal to developing fish larvae..."(G-5)

-Wildlife

"Terrestrial wildlife are also likely to be impacted by a hydroelectric facility. Big game animals may no longer be able to cross the river in their accustomed places and may be displaced from lowland riparian zone habitat important to their winter feeding by the impoundment."(G-5)

"Small mammals may be displaced by the impoundment, although it is likely that their populations will recover along the increased shoreline of the reservoir"(G-5)

"In some cases impoundments increase the available habitat for waterfowl and wintering birds."(G-5)

"...fluctuating water levels can interfere with breeding and nesting areas or alter predator-prey relationships."(G-5)

"Riparian plants may be unable to grow in drawdown zones due to changing conditions throughout their growing season. This loss of productivity impacts wildlife that is dependent on healthy riparian vegetation for shelter and food."(G-5)

"Approximately 12,400 acres were inundated by the Gorge, Diablo, and Ross reservoirs, including 11,600 acres of terrestrial habitat."(H-5)

Prior to construction of the Skagit dams, habitat in the Study Area was 56 percent upland forest, 30 percent riparian forest, 5 percent riverine, 4 percent wetland, 4 percent nonforested (i.e., Grasslands, Shrublands, etc.), and less than 1 percent developed. Upland and riparian Old Growth Conifer covered 26 percent of the Study Area. Currently, 79 percent of the Study Area is reservoir and 19 percent is forest. About 306 acres of upland and riparian Old Growth Conifer remain in the Study Area and there are 11 acres of wetlands."(H-5)

"All of the evaluation species lost habitat (AAHUs) due to the project. Losses were highest for Black-capped Chickadee, Mule Deer, and Marten; intermediate for the Yellow Warbler, Pileated Woodpecker, and Osprey; and lowest for the Ruffed Grouse, Beaver, American Dipper, and Red-tailed Hawk. Net losses for the evaluation species were primarily due to large losses of habitat and not changes in habitat quality."(H-5)

"The impact of the project on Threatened or Endangered Species is unclear and could not be estimated for the peregrine falcon and grizzly bear because no data are available prior to construction of the dams. It is, however, unlikely that the project had a significant impact (i.e., reduced the viability of the regional population) on the bald eagle, since salmon were unavailable or scarce in the upper Skagit River above the site of Gorge Dam."(H-5)

"Post-impoundment catchable trout population estimates ranged from 4 to 27, but were probably between 8 and 27 times higher than pre-impoundment trout populations."(H-5)

"Information indicates that the falls and rapids on the upper Skagit River discouraged anadromous fish from migrating above the current location of Diablo Dam. However, small number of chinook salmon probably spawned at the Falls Creek and Cedar/Reflector Bar areas. A small number of steelhead probably returned to the Reflector/Cedar Bar and lower Stetattle Creek areas."(H-5)

(Large Hydroelectric Impacts Continued)

"The Skagit Project probably did not result in any measurable impacts to peregrine falcons nesting in the study area. Peregrines are not likely to have nested in the area inundated by the project, since higher quality sites are prevalent along ridgetops."(H-5)

"Because the gray wolf population in the North Cascades was greatly reduced by the late 1800's, construction of the Skagit Project probably had relatively little impact on this species. However, the project did eliminate about 12,400 acres (5,022 hectares) of habitat along the upper Skagit River (Brueggeman et al., 1988). Consequently, the loss of these habitats may have reduced the potential carrying capacity of the study area for gray wolves. In addition, the Skagit reservoirs represent a barrier to migration and may interfere with the seasonal movements of wolves, particularly during the winter when wolves often must travel long distances to hunt."(H-5)

"The Skagit Hydroelectric Project inundated about 12,400 acres (5,020 hectares) of upland, riparian, and wetland habitat and created a corresponding amount of lacustrine habitat. In addition, the project dewatered a 2-mile (3.2 kilometers) stretch of the Skagit River between Gorge Dam and Newhalem and altered annual, seasonal, and daily flows. Consequently, it is likely that the project has had effects on nesting and wintering bald eagles."(H-5)

"...the loss of these habitats probably reduced the potential carrying capacity of the study area for grizzly bears. In addition, the Skagit reservoirs represent a barrier to migration and may interfere with the seasonal movements of grizzly bears travelling between the east and west slopes of the North Cacades."(H-6)

Vegetation

"the project did eliminate about 12,400 acres (5,022 hectares) of habitat along the upper Skagit River, including 4,580 acres (1,854 hectares) of riparian forest, 500 acres (202 hectares) of shrublands and grasslands, and 610 acres (247 hectares) of wetlands (Brueggeman et al., 1988)." (H-6)

Water

"Impoundment of water in reservoirs generally alters the temperature of stored waters. Large reservoirs expose the water to additional solar heating because of increased surface area, reduced shading from riparian vegetation, and slow movement of water."(G-5)

"In some cases summer water temperatures may exceed the tolerance of sensitive fish species. Salmonids, for example, may be unable to survive in the warmer waters, and the species composition may shift to sunfish, bass and nongame fish." (G-5)

"There is a potential for increased nuisnace algal blooms and consequent reduction in dissolved oxygen. Lack of sufficient dissolved oxygen is also lethal to fish." (G-5)

"Entrainment of air in water flowing through penstocks and turbines or after fallling over a spillway can result in superstaturation of the river with dissolved gases." Fish exposed to water supersaturated with gases can develop gas bubble desease... that (will) utimately cause death. "(G-5)

"Impoundments result in settling out of suspended matter from the water, and collect fine sediments behind them. The discharged water is likely to contain fewer fine particles than were present in the water flowing into the reservoir. The consequence may be an alteration in the substrate of the river below the dam and shiftrs in invertebrate populations that are eaten by fish." (G-5)

"This spill event led to lower water temperatures in the bypass reach downstream of the large landslide dam pool."(G-5)

(Large Hydroelectric Impacts Continued)

"Water temperatures in the bypass reach are mainly influenced by air temperature, as water temperatures showed a significant drop in September. The long landslide dam pool has a major influence on water temperatures due to it's large volume and surface area relative to baseflow discharge during summer conditions. Temperatures in the bypass reach rarely exceed 19°C. Consequently, temperature stress to fish is minimal. The greatest changes in water temperature were observed during the spill event. Rapid fluctuations in temperatures due to such spill events could cause some thermal stress to fish populations in the lower bypass reach. However, such spill events are relatively rare."(H-6)

Cultural Resources

"Cultural or archaeological sites may be flooded by the impoundment."(G-5)

"A total of 126 prehistoric sites have been recorded in the project area: 13 of these were previously recorded and 113 were recorded during the intensive survey. A total of 53 isolated prehistoric artifacts or features were found. All prehistoric sites are lithic scatters containing stone tools, flaking debris, and hearths. In addition, 17 historic features or sites were located. These results are supporting evidence for the claim that prehistoric Indian populations made intensive use of portions of the upper Skagit River Valley. Wave and shoreline erosion related to operation of the reservoir at its varying levels has affected and is destroying the integrity of many of the archaeological sites (but is also responsible for the visibility and accessibility to investigation of many sites)."(H-6)

Aesthetic Impacts

"There may be a significant change in water level on an annual cycle. The drawing down of the reservoir can result in unattrative and unproductive beach areas."(G-5)

"We have concluded that Ross Dam imposes low visual impact on the Ross Canyon landscape unit—even though it exhibits high visual contrast with its setting—because it can be seen from few locations and is viewed from those locations primarily by persons who are interested in seeing it. As another example, we have concluded that the transmission lines impose high visual impacts on the Bacon Creek to Marblemount unit because they exhibit high contrast with the setting, detract from the visual quality of the setting, are visible to all visitors in the landscape unit, and are highly inconsistent with the visual expectations of many of those visitors, who include persons interested in a remote river experience."(H-6)

"The visual impacts of the Skagit Project dams are moderate to low because of their limited exposure to viewers other than persons who visit the dams with the purpose and expectation of seeing them. The access routes to the dams are generally inconspicuous, helping to reduce the overall visual impacts of the dam installations. Gorge and Diablo dams were built using rail access. The incline lift at Diablo precluded the need to build switchbacks to reach to the top of the dam, which could have been highly visible."(H-6)

"The visual impacts of the powerhouses and switchyards are also moderate to low. Viewer exposure to the Ross and Diablo facilities of this type is moderate, but exposure to the Newhalem powerhouse and switchyard is high. However, the visual contrast of the latter facilities is moderate and their location in the town Gorge is relatively consistent with viewer expectations, so their visual impact is also moderate."(H-6)

"The visual impacts of the Diablo and Gorge Lake shorelines are moderate because the fluctuation of the two reservoirs average 3-4 feet. A large portion of the impacts on both lakes is due to unvegetated road edges along the lake shores."(H-6)

(Large Hydroelectric Impacts Continued)

"In the Gorge bypass reach, the dry appearance of the channel introduces moderate visual contrast and visual impacts. In Newhalem, the rip-rap along the river bank also imposes moderate visual impacts."(H-6)

"The visual impacts of the transmission lines are the greatest of all the project facilities. The overall visual impacts of the transmission lines are high."(H-6)

"Townsites and miscellaneous buildings associated with the Skagit Project impose low to moderate visual impacts."(H-6)

"Indirectly, the Skagit Project affects the Wild and Scenic River corridor through flow regulation, particularly flood control."(H-6)

Health and Safety

"Occupational accidents and catastrophic events such as failure of the dam may cause injury and death."(G-5)

Socio-Economics

"Hydroelectric facilities usually require a temporary construction work force much larger than the permanant operating work force. This can result in a boom and bust situation for local communities, particularly since suitable sites are usually located in rural areas with a small existing population base."(G-5)

"The permanant operation work force can provide a steady, if small, source of employment which is likely to benefit the local economy."(G-5)

SMALL HYDROELECTRIC

Land Use

"Raised groundwater tables would reduce the crop-producing capability of soils if the resultant groundwater tables are too shalllow."(H-2)

"Inundation of some Prime Agricultural Lands would be unavoidable..."(H-2)

"Approximately 1,830 acres of land would be directly impacted by the proposed project. These lands would be converted from the existing uses ... and would be inundated..."(H-2)

"There is the possibility that secondary effects may include elevated grond water levels that could render some agricultural lands (about 170 acres) unfit for continued cultivation or growing of existing crops."(H-2)

"The new impoundment could create additonal development pressure for recreational cottage sites or related types of commercial development in the vacinity of the project."(H-2)

"Construction would cause short-term impacts on existing recreational uses in and around the project area."(H-2)

"The construction would cause temporary increases in dust, noise, soil erosion, and turbidity."(H-2)

"the lost annual productivity of the agricultural lands within the project boundary and groundwater impact area could amount to $100,000."(H-2)

(Small Hydroelectric Impacts Continued)

"the value of yearly timber growth would be diminished on approximately 400 acres of existing commercial timber lands acquire(d) for wildlife management or future recreation."(H-2)

"... the Council adopted a proposal to designate some 44,000 miles of streams throughout the region as protected from new hydropower development, ... the Council concluded that hydropower development in the designated areas would have major negative impacts that could not be reversed and that protecting these resources is consistent with an adequate, efficient, economical and reliable power supply."(G-3)

"Installation of hydropower projects on a previously free-flowing stream also can reduce or eliminate the stream's value for kayaking, rafting, and some types of fishing, as well as reduce the forest land base and affects Indian religious sites."(G-3)

Wetlands

"This seepage may raise the water table ... enough to form new swampy areas or to enlarge existing swamps."(H-2)

Fish

"The river diversion around the dam site would result in the dewatering, for about 1 year, of 2.000 feet of the Cowlitz River. Fishes unable to escape from the affected reach would be lost... and the reach itself would be lost at the time of diversion."(H-2)

"Upstream fish passage through the dam site would be blocked by high water velocities during Phase 1 of the construction period."(H-2)

"Salmon and trout attempting to ascend the River ...would thus be blocked during most of the construction period."(H-2)

"Diversion of flow from 2000 feet of the Cowlitz River would also remove the reach from fishery production, resulting in a small loss of resident fishes."(H-2)

"Modification of about 1 mile of the river channel downstream of the dam site would result in the direct loss of some fishes from blasting, excavation, and high turbidity during the 4-month construction period, although many fishes would probably avoid the area..."(H-2)

Adverse effects of a run-of-river project operation would include: inundation of riverine habitat by the reservoir; obstruction of upstreamn movement of fishes; some mortality of downstream migrating fishes through the powerhouse; transformation of the 1-mile reach of the Cowlitz channel; and, disruption of sport fishing activities now occuring in the proposed project area." (H-2)

"Portions of the river would no longer be suitable for trout spawning and rearing, or for salmon rearing. This would result in the probable displacement of fish to upstream riverine areas, and in the loss of some trout production."(H-2)

"The present upriver migration of salmon from Riffe Lake provides an important sport fishery...The dam would block the salmon migrations and thus eliminate the salmon fishery that now exists..." (H-2)

"The presence of the Cowlitz Falls Dam could be beneficial for a future anadromous fish restoration progrm. The construction of downstream migrant collection facilities at the Cowlitz Falls Dam would allow salmon smolt to be collected at the dam and transported downriver..."(H-3)

(Small Hydroelectric Impacts Continued)

"likely result in a reduction in the native, resident trout populations in the river reach to be inundated..." (H-3)

"Loss of fish spawning and rearing habitat may occur. This effect can be mitigated somewhat by habitat restoration projects downstream."(G-3)

"Among the adverse impacts on migrating and resident fish are turbine-related mortality, migration barriers, dewatering of streams, alteration of flows, inundation of habitat and the effects of increased travel time."(G-3)

"Another impact is nitrogen supersaturation caused by excessive spilling of water over the dam. Though lethal to fish, it can be and has been mitigated with the use of devices that deflect spilled water."(G-3)

Wildlife

"the proposed project would result in the inundation of 439 acres of wildlife habitat, including 366 acres of forest,, 37 acres of clearcut, and 36 acres of agricultural land."(H-2)

"Resident and migratory species dependent upon the inundated areas would be forced to relocate to adjacent areas."(H-3)

"Immobile species and life stages, or species with small home ranges, would be lost."(H-3)

"Displaced wildlife would affect adjacent habitats, which are assumed to be at their capacity, by increasing competition for food and cover. Overcrowding and accompanying stgress would cause the loss of the least fit individuals and habitat deterioration."(H-2)

"Lands inundated would include streambank and riparian habitats in the western third of the project area that are intensively used by wildlife. Riparian and aquatic species that forage, nest, and den in this area would be lost. Nineteen beaver dens(approximately 95 individuals) and an undetermined number river otter, muskrat, and miknk dens would be lost."(H-2)

"Elimination of this critical habitat would greatly reduce deer and elk numbers during severe winters, at least until suitable shoreline vegetation can be established."
(H-2)

"The inundation of the river channel would eliminate wildlife species that are closely associated with rapid and riffle habitats, such as the dipper and common merganser."(H-2)

"New recreation facilities and improved access would also increase human intrusion into adjacent wildlife habits, which would result in additional harassment of wildlife populations. Increased hunting and trapping pressure would also be expected."(H-2)

"Construction of the transmission line would necessitate the clearing of approx. 19 acres of forested wildlife habitat, thus precluding its use by squirrels, cavity-nesting species, and other forest dwelling species."(H-2)

"Construction and operation of project facilities could potentially result in short- and long-term impacts on the small number of wintering bald eagles that forage in the project area."(H-2)

"Construction and operation of the Cowlitz Falls Project would not jeopardize the continued existence of the bald eagle."(H-2)

(Small Hydroelectric Impacts Continued)

"Construction of a hydropower project may result in erosion and sedimentation near the stream, causing increased water turbidity. These effects can reduce the aesthetic quality of the stream as well as harm its value for fish, wildlife, and recreational uses. Sometimes, these effects are limited to the period of construction and are not considered significant enough by themselves to warrent foregoing otherwise feasible hydropower sites."(G-3)

Vegetation

"Construction of project facilities, including the transmission line, would require the removal of approx. 313 acres of vegetation...Construction of the project reservoir would require the removal of about 439 acres of existing vegetated areas.."(H-3)

"If this occurs (Seepage from the reservoir) additional vegetation would be lost initially, but the impacted area would naturally revert to a wetland type vegetation in time."(H-3)

"A major beneficial impact of the proposed project would be the formation of new riparian vegetation along the shoreline of the reservoir .... more riparian vegetation would occur with the project than withour it."

"Unavoidable Adverse Impacts" " The construction of the proposed project facilities and reservoir, excluding the transmission line, would require the permanent removal of about 719 acres of existing terrestrial vegetation, representing a variety of vegetation types. "(H-2)

Water

"Construction of the facility would result in a temporary increase in the suspended solid load of the Cowlitz River. The sediment would originate from exdavbation of the dam foundation, construction and dismsantling of the cofferdams, widening of the tailrace channel, and erosion from haul roads and areas cleared of vegetation that wold be inundated by the proposed reservoir." (H-2)

"The initial inundation of the project lands would introduce organic matter and nutrients associated with the soils int project waters." (H-2)

"Operation of the reservoir is expected to have a negligible impact on the chemical quality of the Cowlitz River because of the retention times of the proposed reservoir."(H-2)

"The concentraion of disolved gases in the river could increase to supersaturation levels...it is not likely that the gas saturation of the river would exceed the maximum allowable state standard of 110 percent."

"Creation of the reservoir would reduce the turbidity of the Cowlitz River under normal operating conditions because of the settling of a portion of the sediment load within the reservoir."

"Construction and operation of the proposed Cowlitz Falls Reservoir could increase the amount of debris that would enter the Cowlitz River."(H-2)

"...accumulation of sediment in the backwater areas of the reservoir could aggravate flooding in the Randle area."(H-2)

".. although the effects of particular projects may be relatively minor, the cumulative effects of several hydropower dams on a single stream or in a single basin, drainage or subbasin can be serious."(G-3)

"Hydropower plants can alter gravel recruitment patterns, because they can block downstream movement of gravel and some sediment."(G-3)

(Small Hydroelectric Impacts Continued)

"Another impact is nitrogen supersaturation caused by excessive spilling of water over the dam."(G-3)

Soils

"Construction ... would disturb soils, alter natural slopes and drainage, and remove protective vegetative cover and supportive root systems, thereby incrasing the potential for erosion..."(H-2)

"Reservoir clearing could also result in some bank sloughing."(H-2)

"Saturation of materials on the steeper slopes...could cause the slope to become weakened and unstable."(H-2)

"The raised water level from the filling of the reservoir would cause an increse in the subsurface flow (or seepage) of water ... High seepage flows ...could result in unstable slope conditions and possible slope failure."(H-2)

"Minor unavoidable bank erosion and sloughing would be expected to occur along the reservoir shoreline."(H-2)

"Adverse groundwater impacts on soils may not be entirely avoidable or mitigatable ..."(H-2)

"Construction of a hydropower project may result in erosion and sedimentation near the stream, causing increased water turbidity. These effects can reduce the aesthetic quality of the stream as well as harm its value for fish, wildlife, and recreational uses. Sometimes, these effects are limited to the period of construction and are not considered significant enough by themselves to warrent foregoing otherwise feasible hydropower sites."(G-3)

Groundwater

"The elevated water level in the reservoir would result in a subsequent rise in the groundwater table within the reservoir banks and adjacent areas."(H-2)

"Increases in the elevation of the water table could also adversely impact domestic water wells and septic systems of the few dwellings in the area."(H-2)

Air

"Construction of the dam and powerhouse would result in the temporary degradation of the air quality of the area by the emission of hydrocarbons, nitrous oxides, and particulates from the construction equipment. Earth moving activities and the burning of slash would also increase particulate levels."(H-2)

"The presence of the reservoir ... would ultimately increase both the occurance of fog and the amount of land area that would be encompassed by the fog."(H-2)

"..., no serious air pollution or solid waste problems are raised by hydropower projects, and they do not rely on a finite fossil fuel."(G-3)

Cultural Resources

"The Satanus (Indian) Homestead, which is thought to be located within the boundaries of Cowlitz Falls South, would be affected similarly by construction activities."(H-2)

(Small Hydroelectric Impacts Continued)

"Three sites in the vicinity of Cowlitz Falls could also be affected by unauthorized relic collecting carried out by construction personnel."(H-2)

"Filling of the reservoir would also impact a number of prehistoric and historic sites."(H-2)

"Installation of hydropower projects on a previously free-flowing stream ... affects Indian religious sites." (G-3)

Aesthetics

"The construction related effects (dust, noise, soil erosion and turbidity) would degeade the scenic quality of the area..."(H-2)

"Construction would preclude further consideration ofsections of the Cowlitz and Cispus Rivers Rivers for inclusion in the National Wild and Scenic Rivers System."(H-2)

"The Department of the Interior recommended that the applicant acquire conservation easements to compensate for the loss of river segments identified in the National River Inventory and Scenic Rivers System."(H-2)

"...there would be about 460 vehicle trips per peak summer weekend day attributable to use of the project's recreation facilities. This volume of traffic would not be expected to adversely affect the local road systems."(H-2)

"The proposed project would eliminater potential white-water kayaking and rafting on the Cowlitz River within the project area. It would also eliminate river bank fishing on 12.3 miles of the Cowlitz River shoreline and about 1.7 miles of the Cispus River."(H-2)

"These changes would alter the existing visual characteristics, but the alterations would not necessarily be adverse."(H-2)

"The rapids of the Cowlitz River and the confluence with the Cispus would be flooded and Cowlitz Falls would be permanantly lost from view."(H-2)

"The proposed channelization downstream of the proposed dam would also drastically alter the existing visual characteristics of the Cowlitz River."(H-2)

"No significantly unusual or unique visual resources would be adversely impacted..."(H-2)

"Construction of a hydropower project may result in erosion and sedimentation near the stream, causing increased water turbidity. These effects can reduce the aesthetic quality of the stream as well as harm its value for fish, wildlife, and recreational uses. Sometimes, these effects are limited to the period of construction and are not considered significant enough by themselves to warrent foregoing otherwise feasible hydropower sites."(G-3)

Noise

"The construction would cause temporary increases in ... noise"(H-2)

"Short-term local increases in noise levels would occur during project construction from the use of heavy equipment and blasting. It is expected that all construction equipment would comply with recommended EPA noise criteria and would be with limits considered safe by OSHA."(H-2)

(Small Hydroelectric Impacts Continued)

"Construction of the facility would increase noise above ambient levels for the duration of the construction period."(H-2)

Socio-Economics

"During the ... three year construction period, the number of on-site personnel,...would range from 15 to 195, averaging 130 workers. In total, construction of the Cowlitz Falls Project would require 4,430 man-months (or approximately 370 man-years) of construction labor and 238 man-months of supervisory engineering, for which a total of 16.2 million ...would be paid." (H-2)

"... project construction ... would result in the influx of 100 persons."(H-2)

" housing availability... is sufficient... to accomodate the expected population influx." (H-2)

"... relocatees ... should not have a significant impact on the demand for local public services..."(H-2)

" local school districts probably would experience only negligible enrollment increases...enrollment gains in any one grade should not exceed 2." (H-2)

"construction-related traffic could cause periodic minor delays on U.S. Highway 12."(H-2)

"Because the applicant is a municipal corportation of the State of Washington, ...the proposed project could result in the loss of local property taxes totaling almost $4,000 per year. (timber lands flooded and removed from tax rolls)."(H-2)

"The tax revenue loss would be completely outweighed by the incremental public utility destrict privilege taxes that would be produced by the proposed project (average $53,440 per year)" (H-2)

RUN-OF-RIVER

Fish

"The risk of short-term increases of sediment rates associated with the Project is characterized as low..." (H-1)

"A variety of methods ... will be used to collect fish and remove them ... prior to constructing in the creek. ... Thus no direct mortalities to fish are anticipated ...."(H-1)

"..due to design and operational features incorporated into the Youngs Creek Project, the impacts upon fish or fisheries habitiat are anticipated to be minimal...."(H-1)

"Rapid flow level fluctuations could occur ... To protect fish from rapidly changing water levels ramping rates will be established with WDF, WDW, USFWS the Tualip Tribes and the powerhouse will be designed to pass the water during a power failure." (H-1)

"Fish screens will be incorporated at the intake to preclude entrainment of resident trout.."(H-1)

(Run-of-River Hydroelectric Impacts Continued)

Wildlife

"Wildlife will be impacted by the loss of 25.3 acres of habitat and by the disturbance of construction activity... will have an insignificant impact on local wildlife."(H-1)

"Bald eagles will probably not be impacted ... The grizzly bear ... should not be impacted..."(H-1)

"Operational impacts to wildlife will be minimal."(H-1)

" The transmission line could impact bald eagles and other large raptors by presenting the risk of electrocution..."(H-1)

Vegetation

"Construction of the Youngs Creek Project will disturb 25.3 acres of young coniferous forest, mature coniferous forest, mixed forest, clearcut, riparian habitat, and stream channel.... The total area of impact will represent less than one percent of the Youngs Creek Drainage.... The Project will disturb no sensitive or special interest plan communities such as old-growth forest or wetland ... Approximately 0.7 acres of riparian forest will be cleared at the diversion site.(H-1)

"No sensitive, threatened, or endangered plant species will be impacted...."(H-1)

Water

"The project has the potential to cause adverse impacts to acquatic resources related to introduction of fine sediments or toxic materials into the stream, and stream flow interruption during construction of the intake" (H-1)

"The weir will trap and store bedload sediment, which could lead to increased scour of the bed downstream of the weir"(H-1)

"Thermal and water quality regimes are not expected to be alter by Project Operation." (H-1)

"Water quality will primarily be impacted by the short-term increase of sediment into the creek during construction." (H-1)

"Project construction could temporarily introduce more sediment into the drainage system. An estimated 645 tons of sediment could be produced and delivered to Youngs Creek during construction. This represents temporary 77 percent increase over total Basin sediment yield." (H-1)

"Road construction near streams could introduce fine sediment into the water..." (H-1)

Cultural Resources

"construction and operation of the ... Project appears unlikely to affect any cultural resources..."(H-1)

Aesthetics

" the transmission line will be well concealed and not visually obtrusive." H-1)

"Few aesthetic impacts are expected to be produced by the Project" (H-1)

(Run-of-River Hydroelectric Impacts Continued)

Noise

During operation the powerhouse will emit a constant noise of an extraneous quality and frequency. The distance ..... audible is estimated to be 200-300 feet." (H-1)

Socio-Economics

"Impacts on local governmental services created by the construction and operation of the Project will be minimal."(H-1)

"Construction workers will be on the site for the 16.5 month period... with a maximum employment of 30...workers."(H-1)

"No effect is anticipated on the local housing supply."(H-1)

COMBUSTION TURBINES - GAS

Land Use

"Impacts on land use will depend on specific location. The 44-acre Frederickson plant is located in an industrial park near an urban area. Thus, the plant's siting is consistent with other local activities. If a similar plant were located in a rural or forest setting, it would contrast with local land uses."(G-5)

"A major environmental impact of operating combustion turbines is noise. The noise level at a distance of 1,200 feet at a typical site where turbines are operating at capacity is estimated at 65 to 70 decibels. Noise-deadening options could lower this level."(G-5)

"The major constraint on siting a gas fired, CT power plant in the Pacific Northwest is to ensure that the facility is located within two miles of a natural gas pipeline. This constraint, developed by BPA, is designed to avoid excessive time delays and costs associated with obtaining rights-of-way and installing lengthy gas feeder lines to the plant site."(G-10)

"Ideally, the best location for a combustion turbine would be in an industrial zone...Problems would occur in an area zoned residential and or recreational, and near the shorelines of most water bodies. Washington has a Shoreline Management Act that protects lands within 200 ft of the shorelines."(G-10)

"Change in existing land use on-site will not occur during fuel extraction, fuel transport, or plant operation."(G-1)

"Change in existing land use on-site is likely to or has occurred during plant construction/decommissioning but the effect will not be significant."(G-1)

"Incompatible with surrounding land uses will not occur during fuel extraction, fuel transport, plant construction/decommissioning, or plant operation."(G-1)

"Loss of agricultural land will not occur during fuel extraction, fuel transport or plant operation."(G-1)

"Loss of agricultural land is likely to or has occurred during plant construction/decommissioning but the effect will not be significant."(G-1)

(Gas Combustion Turbine Impacts Continued)

"Change in recreation use of the site or area will not occur during fuel extraction, fuel transport, plant construction/decommissioning and plant operation."(G-1)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Carbon dioxide is the main component of "greenhouse gases", the gases responsible for global warming."(G-3)

"Transportation by pipeline involves potential spills and can disrupt existing land uses and cause some aesthetic impacts."(G-3)

Wetlands and Fish

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

Wildlife

"Loss of unique, rare, threatened, or endangered species is likely to or may have already occurred during fuel extraction and the effects will be significant."(G-1)

"Loss of unique, rare, threatened, or endangered species will not occur during fuel transport, plant construction/decommissioning or plant operation."(G-1)

"Change in habitat type, species diversity, will not occur during fuel extraction, fuel transport, or plant operation."(G-1)

"Change in habitat type, species diversity, is likely to or has occurred during plant construction/decommissioning but the effect will not be significant."(G-1)

"Damage due to solid waste disposal or fuel spills on-site is likely to or has occurred during fuel extraction and the effect will be significant."(G-1)

"Damage due to solid waste disposal or fuel spills on-site will not occur during fuel transport, plant construction/decommissioning or plant operation."(G-1)

"Large noise increases affecting wildlife will not occur during fuel extraction or fuel transport."(G-1)

"Large noise increases affecting wildlife is likely to or has occurred during plant construction/decommissioning and plant operation but the effect will not be significant."(G-1)

"Acid deposition affecting vegetation and wildlife is likely to or has occurred during plant operation and the effects will be significant."(G-1)

"Oil spills affecting vegetation and wildlife is likely to or has occurred during fuel transport and the effects will be significant." (G-1)

"On-shore exploration and development (of fossil fuels) can intrude on roadless areas and wildlife habitat and affect the aesthetics of natural areas."(G-3)

(Gas Combustion Turbine Impacts Continued)

Vegetation

"Acid deposition affecting vegetation and wildlife is likely to or has occurred during plant operation and the effects will be significant."(G-1)

"Oil spills affecting vegetation and wildlife is likely to or has occurred during fuel transport and the effects will be significant." (G-1)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

Water

"Combustion turbine operation will have little effect on on water quality. What impacts occur will come from the oil or natural gas fuel cycle."(G-5)

"A gas fired turbine requires the use of water in several phases."(G-10)

"The ma jor water quality issues revolve around discharges from the plant into public water sources." (G-10)

"Surface water pollution - sediments and storm runoff, will not occur during fuel extraction or plant operation."(G-1)

"Surface water pollution - sediments and storm runoff, is likely to or has occurred during plant construction but the effects will not be significant."(G-1)

"Surface water pollution - chemical discharges, is likely to or has occurred during fuel extraction and fuel transport and the effects will be significant."(G-1)

"Surface water pollution - chemical discharges, is likely to or has occurred during plant operation but the effects will not be significant."(G-1)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Other effects, whose physical amounts have not been quantified, include methane releases in the exploration, extraction and transportation of natural gas, land and sea use and the related contamination from both, and the environmental effects associated with gas pipelines to deliver the gas to the plant."(G-3)

Soils

"Erosion and/or alteration of existing topography and soil profile will not occur during fuel extraction and fuel transport."
(G-1)

"Erosion and/or alteration of existing topography and soil profile is likely to or has occurred during plant construction/decommissioning but the effect will not be significant."(G-1)

"Soil contamination from acid deposition is likely to or has occurred during plant operation and the effect will be significant for emmissions of sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, particulates and hydrocarbons."(G-1)

(Gas Combustion Turbine Impacts Continued)

"Soil contamination from solid waste or fuel spills is likely to or has occurred during fuel extraction and the effect will be significant."(G-1)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Soil contamination from solid waste or fuel spills will not occur during fuel transport, plant construction/ decommissioning or plant operation."(G-1)

- Groundwater

"Groundwater contamination is likely to or has occurred during fuel extraction and the effects will be significant."(G-1)

"Consumptive water use in terms of water quantity is likely to or has occurred during plant construction/ decommissioning and plant operation but the effects will not be significant."(G-1)

- Air

"The principal air pollutants expected from combustion turbines are as follows: Oxides of Nitrogen...Sulfur Dioxide...Carbon Dioxide... Waste Heat..."(G-5)

""Nitrogen dioxide forms during high temperatures of combustion...The gas irritates mucous membranes and causes cough headache, and shortness of breath. It is a key ingredient in the formation of smog and acid rain. Nitrogen dioxide can react with moisture in the air to form nitric acid, which is highly corrosive to metals. Nitrogen dioxide is also toxic to vegetation at high concentrations." (G-5)

"Sulfur ingredients are a key in the formation of smog and acid rain. Sulfur dioxide can penetrate deep into the lung as a respirable particulate, causing symptons similar to alleric reactions or viral respiratory infections. Sulfur dioxide quickly affects the airways in the lung to restrict airflow, resulting in shortness of breath, cough, and increased secretions. Long-term exposure causes chronic bronchitis and may contribute to asthma. Asthmatics and people with sensitive airways may be a greatest risk.(G-5)

"Spinach, lettuce, and alfalfa are among the plants most sensitive to damage from SO-2. The gas is suspected in the acidification of lakes and can corrode building materials,destroy paint pigments, erode statues, harm textiles, and impair visibility."(G-5)

"Carbon Dioxide, although not listed as a criteria pollutant, is a gas associated with the widespread use of fossil fuels such as coal, oil, and natural gas...Scientists are alarmed about growing concentrations of C0-2 in the atmosphere; they believe that CO-2 is one of a group of gases that may trap heat in the earth's atmosphere. Many fesearchers believe the buildup of these gases...act much like panes of glass in a greenhouse... (and) may cause the earth's average temperature to rise as much as 2 to 4 degrees Celcius in the next 50 years. This warming of the climate may contribute to many environmental problems...."(G-5)

"Two generic 75-MW combustion turbines burning either natural gas or oil will produce 1.4 x 10-12 Btu as waste heat."(G-5)

"Sulfur dioxide, nitrogen dioxide, and particulates have the potential for sizable effects on human health, visibility, ecosystems, crops, and materials."(G-1)

(Gas Combustion Turbine Impacts Continued)

"Sulfur dioxide potentially causes health problems, damages materials, weakens crops, and affects ecosystems. Sulfur dio. also is dangerouse because, through chemical transformation in the atmosphere, it becomes sulfate or sufuric acid. These substances pose potentially large risks to human health, visibility, crops, and ecosystems."(G-1)

"Through chemical transformation, nitrogen oxides can become nitrates and result in formation of ozone, a substance that can cause considerable damage. Ozone may lead to damages to plants as well as minor eye irritation. Nitrate also potentially leads to acide-rain effects and visibility losses."(G-1)

"Though only small quantities are emitted by Fredrickson, particulates in general pose a potential health hazard and a visibility problem."(G-1)

"Although carbon dioxide is not harmful at current concentrations, the production of large quantities may constitute a threat to the global environment (the so-called greenhouse effect). Some scientists have argued that an increase in global concentrations of carbon dioxide could lead to melting of the polar ice caps and a rise in the level of the oceans."(G-1)

"Site emissions-fugitive dust will not occur during fuel extraction or fuel transport."(G-1)

"Natural gas is generally much cleaner environmentally than coal. Distillate fuel oil, which will be used when gas is not available will produce more pollutants than when natural gas is used, but less than if coal were being burned."(G-3)

"Thus, the production of greenhouse gasses from gas-fired plants is about 40% of the amount from coal plants. Gas-fired plants are second to coal in the net production of greenhouse gasses. Because of the global warming issue, gas-fired generators impose some risk to developers of incurring costs for future mitigation of CO2."(G-3)

"Site emissions-fugitive dust is likely to or has occurred during plant construction/decommissioning but the effect will not be significant."(G-1)

"Site emissions-vehicles is likely to or has occurred during fuel extraction, plant construction/decommissioning and plant operation but the effects will not be significant."(G-1)

"Transport vehicle emissions is likely to or has occurred during fuel transport but the effect will not be significant."(G-1)

"Plant emissions for sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, particulates and hydrocarbons is likely to or has occurred during fuel extraction but the effect will not be significant."(G-1)

"Plant emissions for sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, particulates, and hydrocarbons is likely to or has occurred during plant operation and the effects will be significant." (G-1)

"NO2 is a gas that can irritate membranes and can cause coughs and headaches."(G-3)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Carbon monoxide is a colorless, odorless gas. It interferes with the body's ability to deliver oxygen throughout the body. Moderate levels of oxygen deficiencies have caused vision and brain dysfunction. Headaches, nausea, irregular heart beat, weakness, and confusion can also be caused by exposure to high levels of carbon monoxide. At the extreme, exposure to high levels of carbon monoxide can cause death."(G-3)

(Gas Combustion Turbine Impacts Continued)

"Carbon dioxide is the main component of "greenhouse gases", the gases responsible for global warming."(G-3)

- Cultural Resources

"Effects on archeological resources will not occur during fuel extraction or transport, plant construction/ decommissioning or operation."(G-1)

"Effects on historical resources will not occur during fuel extraction or transport, plant construction/ decommissioning or operation."(G-1)

- Aesthetics

"Increased light will not occur during fuel extraction."(G-1)

"Increased light is likely to or has occurred during plant construction/decommissioning and plant operation but the effects will not be significant."(G-1)

"Change in visual nature of landscape will not occur during fuel extraction or fuel transport."(G-1)

"Change in visual nature of landscape is likely to or has occurred during plant construction/decommissioning and plant operation but the effects will not be significant."(G-1)

"Soiling and materials damage is likely to or has occurred during fuel transport and plant operation and the effects will be significant."(G-1)

"Soiling and materials damage is likely to or has occurred during plant construction/decommissioning but the effects will not be significant."(G-1)

"Loss of visibility is likely to or has occurred during plant operation and the effects will be significant."(G-1)

"Acid rain is known to acidify lakes, harm certain key flora, corrode buildings, bridges, and other infrastructure, and is major culprit in impairing visibility. It is also believed to be a carcinogen."(G-3)

"On-shore exploration and development (of fossil fuels) can intrude on roadless areas and wildlife habitat and affect the aesthetics of natural areas."(G-3)

- Noise

A major environmental impact of operating combustion turbines is noise. The noise level at a distance of 1,200 feet at a typical site where turbines are operating at capacity is estimated at 65 to 70 decibels. Noise-deadening options could lower this level."(G-5)

"Increased continuous noise is likely to or has occurred during fuel extraction but the effect will not be significant."(G-1)

"Increased continuous noise will not occur during plant construction/decommissioning or plant operation."(G-1)

"Presence of short-term high level noise and/or significant tonal components will not occur during fuel extraction."(G-1)

(Gas Combustion Turbine Impacts Continued)

"Presence of short-term high level noise and/or significant tonal components is likely to or has occurred during plant construction/decommissioning but the effect will not be significant."(G-1)

"Presence of short-term high level noise and/or significant tonal components is likely to or has occurred during plant operation and the effects will be significant."(G-1)

- Health and Safety

A major environmental impact of operating combustion turbines is noise. The noise level at a distance of 1,200 feet at a typical site where turbines are operating at capacity is estimated at 65 to 70 decibels. Noise-deadening options could lower this level."(G-5)

"Increased continuous noise is likely to or has occurred during fuel extraction but the effect will not be significant."(G-1)

"Increased continuous noise will not occur during plant construction/decommissioning or plant operation."(G-1)

"Presence of short-term high level noise and/or significant tonal components will not occur during fuel extraction."(G-1)

"Presence of short-term high level noise and/or significant tonal components is likely to or has occurred during plant construction/decommissioning but the effect will not be significant."(G-1)

"Presence of short-term high level noise and/or significant tonal components is likely to or has occurred during plant operation and the effects will be significant."(G-1)

- Socio-Economics

"Combustion turbines are usually sited where fuel transportation lines and electric transmission lines meet, which is normally near urban areas. An advantage of this situation, as was shown by the Frederickson Plant, is that the proximity of a large labor force leads to practicallly no socioeconomic effects. However, if a similar plant were built in a more remote area...the impact of importing 100 workers required over an 18-month period could be more substantial."(G-5)

"The small size of the Fredrickson plant and its use as an emergency peaking facility suggest that boomtown effects associated with oil and natural gas extraction and allocable to Fredrickson will be small."(G-1)

"The fact that the plant is located very near a major metropolitan area with a large work force means that boomtown effects associated with construction were non-existant, as are those associated with operation (the plant is operated by remote control)."(G-1)

"Increases in employment, population, housing stock, needs for public services/utilities and revenues to and expenditures by local governments is likely to or has occurred during fuel extraction and plant construction/ decommissioning but the effects will not be significant."(G-1)

"Increases in employment, population, housing stock, needs for public services/utilities and revenues to and expenditures by local governments will not occur during plant operation."(G-1)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

(Gas Combustion Turbine Impacts Continued)

"Carbon dioxide is the main component of "greenhouse gases", the gases responsible for global warming."(G-3)

"Thus, the production of greenhouse gasses from gas-fired plants is about 40% of the amount from coal plants. Gas-fired plants are second to coal in the net production of greenhouse gasses. Because of the global warming issue, gas-fired generators impose some risk to developers of incurring costs for future mitigation of CO2."(G-3)

"Oil and gas are relatively risky, because they both contribute to greenhouse gasses, which could require the plants to be retrofit at some time in the future."(G-3)

COMBUSTION TURBINES - OIL

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Carbon dioxide is the main component of "greenhouse gases", the gases responsible for global warming."(G-3)

The SO2 emitted into the atmosphere either settles out locally or is slowly transported over large distances and converted to sulfuric acid or sulfates. The potential impacts from these emissions include human health effects, crops and forest damage, acid rain, metal corrosion, and visibility degradation."(G-3)

"Carbon monoxide is a colorless, odorless gas. It interferes with the body's ability to deliver oxygen throughout the body. Moderate levels of oxygen deficiencies have caused vision and brain dysfunction. Headaches, nausea, irregular heart beat, weakness, and confusion can also be caused by exposure to high levels of carbon monoxide. At the extreme, exposure to high levels of carbon monoxide can cause death."(G-3)

"Off-shore exploration and development of fossil fuels can interfere with commercial and recreational fishing and could cause aesthetic impacts on shoreline areas."(G-3)

"On-shore exploration and development (of fossil fuels) can intrude on roadless areas and wildlife habitat and affect the aesthetics of natural areas."(G-3)

"If imports are relied on, there also may be increased risk of oil spills from tanker accidents. Transportation by pipeline involves potential spills and can disrupt existing land uses and cause some aesthetic impacts."(G-3)

- Wetlands

"The SO2 emitted into the atmosphere either settles out locally or is slowly transported over large distances and converted to sulfuric acid or sulfates. The potential impacts from these emissions include human health effects, crops and forest damage, acid rain, metal corrosion, and visibility degradation."(G-3)

"Acid rain is known to acidify lakes, harm certain key flora, corrode buildings, bridges, and other infrastructure, and is major culprit in impairing visibility. It is also believed to be a carcinogen."(G-3)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

(Oil Combustion Turbine Impacts Continued)

- Fish

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Acid rain is known to acidify lakes, harm certain key flora, corrode buildings, bridges, and other infrastructure, and is major culprit in impairing visibility. It is also believed to be a carcinogen."(G-3)

- Wildlife

"If imports are relied on, there also may be increased risk of oil spills from tanker accidents. Transportation by pipeline involves potential spills and can disrupt existing land uses and cause some aesthetic impacts."(G-3)

- Vegetation

"The SO2 emitted into the atmosphere either settles out locally or is slowly transported over large distances and converted to sulfuric acid or sulfates. The potential impacts from these emissions include ... forest damage, acid rain..."(G-3)

"Acid rain is known to acidify lakes, harm certain key flora, corrode buildings, bridges, and other infrastructure, and is major culprit in impairing visibility. It is also believed to be a carcinogen."(G-3)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage ...vegetation..."(G-3)

"Carbon dioxide is the main component of "greenhouse gases", the gases responsible for global warming."(G-3)

- Water

"Combustion turbine operation will have little effect on on water quality. What impacts occur will come from the oil or natural gas fuel cycle. Oil spills will soil beaches, kill waterfowl, damage marshlands, and kill fish. A study of the environmental costs of using combustion turbines estimates an average spill rate of 1 barrel per million barels moved. If Frederickson burns oil 1,500 hours per year, annual consumption will total 219,000 barrels. Taken together, these numbers yield an expected oil spill rate of 2.2 barrels per year, on average. There may be additional spills when oils is pumped from beneath the fround or ocean."(G-5)

"Acid rain is known to acidify lakes..."(G-3)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage ... surface water."(G-3)

"Carbon dioxide is the main component of "greenhouse gases", the gases responsible for global warming."(G-3)

- Soils

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage ... soil, "(G-3)

(Oil Combustion Turbine Impacts Continued)

"The SO2 emitted into the atmosphere either settles out locally or is slowly transported over large distances and converted to sulfuric acid or sulfates. The potential impacts from these emissions include human health effects, crops and forest damage, acid rain, metal corrosion, and visibility degradation."(G-3)

"Health effects in humans include shortness of breath, coughs, viral respiratory infections, and allergic reactions when inhaled as respirable particles."(G-3)

"Long-term exposure to sulfur dioxide can cause chronic bronchitis and exacerbate asthma. Other effects include changes in blood chemistry, enzyme levels, lung capacity, and pulmonary resistance."(G-3)

"Sulfur dioxide is also believed to have carcinogenic effects."(G-3)

"Acid rain is known to acidify lakes, harm certain key flora, corrode buildings, bridges, and other infrastructure, and is major culprit in impairing visibility. It is also believed to be a carcinogen."(G-3)

"Carbon monoxide is a colorless, odorless gas. It interferes with the body's ability to deliver oxygen throughout the body. Moderate levels of oxygen deficiencies have caused vision and brain dysfunction. Headaches, nausea, irregular heart beat, weakness, and confusion can also be caused by exposure to high levels of carbon monoxide. At the extreme, exposure to high levels of carbon monoxide can cause death."(G-3)

"Distillate fuel oil, which will be used when gas is not available will produce more pollutants than when natural gas is used, but less than if coal were being burned."(G-3)

"..., the combustion of oil, although it does not result in the levels of pollutants associated with coal plants, is clearly less desitable than burning natural gas. Therefore, the environmental effects of oil-fired power plants fall somewhere between coal and natural gas-fired plants."(G-3)

- Socio-Economics

"Combustion turbines are usually sited where fuel transportation lines nad electric transmission lines meet, which is normally near urban areas. An advantage of this situation, as was shown by the Frederickson Plant, is that the proximity of a large labor force leads to practicallly no socioeconomic effects. However, if a similar plant were built in a more remote area...the impact of importing 100 workers required over an 18-month period could be more substantial."(G-5)

"The cost of fuel for CT's used only for peaking could become quite significant. (this type of unit does not use fuel efficiently). Also the likely source of fuel at peak load times is oil (with greater air impacts than gas)" (G-5)

"Acid rain is known to acidify lakes, harm certain key flora, corrode buildings, bridges, and other infrastructure, and is major culprit in impairing visibility."(G-3)

"Off-shore exploration and development of fossil fuels can interfere with commercial and recreational fishing and could cause aesthetic impacts on shoreline areas."(G-3)

"Oil and gas are relatively risky, because they both contribute to greenhouse gasses, which could require the plants to be retrofit at some time in the future."(G-3)

"Gas-fired plants are second to coal in the net production of greenhouse gasses."(G-3)

(Oil Combustion Turbine Impacts Continued)

- Air Quality

"The principal air pollutants expected from combustion turbines are as follows: Oxides of Nitrogen...Sulfur Dioxide...Carbon Dioxide... Waste Heat..."(G-5)

"The SO2 emitted into the atmosphere either settles out locally or is slowly transported over large distances and converted to sulfuric acid or sulfates. The potential impacts from these emissions include human health effects, crops and forest damage, acid rain, metal corrosion, and visibility degradation."(G-3)

"Acid rain is known to acidify lakes, harm certain key flora, corrode buildings, bridges, and other infrastructure, and is major culprit in impairing visibility. It is also believed to be a carcinogen."(G-3)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Carbon dioxide is the main component of "greenhouse gases", the gases responsible for global warming."(G-3)"Natural gas is generally much cleaner environmentally than coal. Distillate fuel oil, which will be used when gas is not available will produce more pollutants than when natural gas is used, but less than if coal were being burned."(G-3)

"Natural gas is generally much cleaner environmentally than coal. Distillate fuel oil, which will be used when gas is not available will produce more pollutants than when natural gas is used, but less than if coal were being burned."(G-3)

"Oil and gas are relatively risky, because they both contribute to greenhouse gasses, which could require the plants to be retrofit at some time in the future....Gas-fired plants are second to coal in the net production of greenhouse gasses."(G-3)

- Aesthetics

"Acid rain... is major culprit in impairing visibility."(G-3)

"Off-shore exploration and development of fossil fuels can interfere with commercial and recreational fishing and could cause aesthetic impacts on shoreline areas."(G-3)

"On-shore exploration and development (of fossil fuels) can intrude on roadless areas and wildlife habitat and affect the aesthetics of natural areas."(G-3)

"If imports are relied on, there also may be increased risk of oil spills from tanker accidents. Transportation by pipeline involves potential spills and can disrupt existing land uses and cause some aesthetic impacts."(G-3)

- Noise

"A major environmental impact of operating combustion turbines is noise. The noise level at a distance of 1,200 feet at a typical site where turbines are operating at capacity is estimated at 65 to 70 decibels. Noise-deadening options could lower this level."(G-5)

- Health and Safety

"Health effects will result from all phases of the fuel cycle, such as extraction, transportation, plant construction and decommissioning, and from plant operation. Plant operation will produce pollutants that may affect the public's health."(G-5)

NUCLEAR

- Land Use

"Timber will be harvested only from 830 acres .... Those portions of the 1360 acres used for temporary purposes and not eventually utilized for power production or transmission will be revegetated."(G-9)

"Nuclear plants are typically sited near an abundant supply of surface water and distant from major population centers to reduce the population exposure to radiation in the event of an emergency."(G-5)

"The total land area required for the fuel cycle to support a 1000-MW nuclear plant is estimated at 113 acres. Of that amount 13 acres are permanantly dedicated. About 22 acres of the total are disturbed. Typically, nuclear plants have an additional exclusion zone for safety and security purposes. The exclusion zone for WNP-2 is 1000 acres in size."(G-5)

"....many of the same water pollution, air pollution and reclamation problems are encountered in uranium mining as in coal mining..."(G-3)

- Fish

"Assessments of the impact of station operation on aquatic biota and fisheries of the Chehalis River system during the CP review found the impacts minimal and acceptable. Since that time, the termination of WNP-5 has resulted in reduced station requirements for makeup water and a lowering of blowdown volume. Design changes in the effluent diffuser location and in the supplemental cooling system have reduced further the potential for impact. The State of Washington has established limitations upon water withdrawals and discharges and defined an allowable effluent mixing zone for protection of water quality and aquatic biota. Thus, the conclusions of minimal impacts of WNP-3 operation remain valid."(G-9)

"There are no threatened or endangered aquatic species in the WNP-3 site vicinity; therefore, no impacts will result from facility operation."(G-9)

- Wildlife

"The staff believes station operation to have little or no impact on the bald eagle, the only terrestrial threatened species believed to be in the area."(G-9)

"Although not a result of plant operation, detrimental impacts to the terrestrial ecology of the site will occur from logging operations. As a consequence, the applicant will implement a wildlife management plan. This plan ... will help minimize the detrimental impacts of logging."(G-9)

"... at all nuclear plants for which radiation exposure to biota other than humans has been analyzed, there have been no cases of exposure that can be considered significant in terms of harm to the species, or that approach the limits for exposure to members of the public that are permitted by 10 CFR 20."(G-9)

"... evidence to date indicated that no other living organisms are very much more radiosensitive than humans, no measureable radiological impact on population of biota is expected as a result of the routine operation of this facility."(G-9)

"Leachate from uranium mine tailings may be acidic and contain dissolved metals. If leachate is permitted to reach surface waters, it may impact water quality in small streams and be toxic to aquatic life."(G-5)

(Nuclear Impacts Continued)

"Mining and milling operations impact wildlife habitat and may introduce noise and human activity into isolated areas used by wildlife. Wildlife may also be displaced from habitat used for siting the plant...Leachates from mine tailings and thermal and chemical discharges from the plant may be toxic to aquatic life."(G-5)

"Exploration for uranium can involve drilling, blasting and road building that may contaminate groundwater and disrupt wildlife habitat."(G-3)

"Short of accidents or willful sabotage, the transfer of wastes are expected to result in no damage to the environment or to fish and wildlife..."(G-3)

- Vegetation

"The staff presently forsees no significant adverse impact of plant operation on terrestrial biota of the plant site or on lands required for access and support facilities."(G-9)

"However, uncertaintly exists as to the effects of salt drift from the cooling tower on vegetation. ... a monitoring program will be required."(G-9)

"Salts that are concentrated from the cooling water are discharged from cooling towers and deposited nearby. They may impact vegetation that is sensitive to salts. No effects have been reported on vegetation (bigleaf maple, Douglas fir) near Trojan..."(G-5)

- Water

"Changes occurring since the CP review will reduce the discharge of toxic forms of chlorine and of copper into the Chehalis River"(G-9)

"The impacts of water use will be appreciably smaller than evaluated at the CP stage because of the diminished water use resulting from the cancellation of WNP-5."(G-9)

"The only plant-related structures that could be affected by the 100-year floodplain would be the discharge structure, the Ranney well intake structures, the associated band protection, and a barge slip. These structures are considered by the staff to be a relatively minor intrusion on the floodplain of the Chehalis River for which no alternatives are readily apparent. The only likely consequence of these plant-related features would be a small loss in habitat."(G-9)

"Leachate from uranium mine tailings may be acidic and contain dissolved metals. If leachate is permitted to reach surface waters, it may impact water quality in small streams and be toxic to aquatic life."(G-5)

"The primary effluent from a nuclear plant is waste heat. If surface water is used to cool the condensers and returned to its source, about 2000 dfs are required, but that amount is substantially reduced if cooling towers are used to recycle the cooling water. A portion of the cooling water is returned to the surface water, however as blowdown. The blowdown is 5-20 degrees Celcius warmer than the receiving body and contains concentrated salts as well as some radionuclides and other plant effluent...The discharged blowdown may have a thermal effect on aquatic organisms in the receiving water."(G-5)

"Exploration for uranium can involve drilling, blasting and road building that may contaminate groundwater and disrupt wildlife habitat."(G-3)

"Uranium ore processing results in large amounts of tailings that contain radioactive waste materials. These tailing may raise human health concerns and must be disposed of properly to avoid contamination of water sources "(G-3)

(Nuclear Impacts Continued)

"Potential water-related effects of nuclear power plant operation include thermal discharges, release of waterborne chemical pollutants, water consumption and release of waterborne radioactive materials."(G-3)

"Because of potential thermal impacts to aquatic organisms residing in surface waters, either through raising of the temperature of the receiving waters or by thermal shock accompanying changes in plant operation, most contemporary power plants use the atmosphere as a heat sink. (i.e. cooling ponds, lakes or canals, or natural or mechanical draft cooling towers for heat exchange with the atmosphere)"(G-3)

"Because of the concentration of impurities, the blowdown can be environmentally damaging when discharged to receiving waters. Waste water treatment techniques can be used to remove impurities prior to discharge of blowdown."(G-3)

"....many of the same water pollution, air pollution and reclamation problems are encountered in uranium mining as in coal mining..."(G-3)

"Uranium ore processing results in large amounts of tailings that contain radioactive waste materials. These tailing may raise human health concerns and must be disposed of properly to avoid contamination of water sources or transportation by the wind."(G-3)

- Soil

"The volume of solid waste they (Nuclear Plants) produce is much smaller than that produced by a coal-fired plant."(G-5)

"Mine tailings typically contain radon. To protect the public from exposure to radon gas, tailings should be contained and not used for construction (fill) material nor to produce building materials."(G-5)

"Salts that are concentrated from the cooling water are discharged from cooling towers and deposited nearby. They may impact vegetation that is sensitive to salts. No effects have been reported on vegetation (bigleaf maple, Douglas fir) near Trojan..."(G-5)

"Nuclear plants also produce low-level nuclear waste. Contaminated clothing, paper, rags, filter media, spent ion-exchange resins,...as well as discarded plant hardware comprise the low-level waste. A typical plant produces about 30,000 to 40,000 cubic feet of low-level waste annually.

Low-level waste must be prepared for shipment at the reactor site....and transported to the disposal site, where they are buried in shallow trenches. There is one disposal site in the NW, located at Hanford in Washington."(G-5)

"Soil erosion can be a significant problem at a large construction site."(G-3)

- Groundwater

"..., potential releases from severe accidents via the groundwater pathway are much larger for WNP-3 than for typical US power reactors. However, even for WNP-3, the total risk from this pathway is judged to be small compared to the atmospheric pathway. Further, as for the atmospheric pathway, doses from these releases can be reduced if mitigative measures are taken soon after a postulated accident"(G-9)

"Exploration for uranium can involve drilling, blasting and road building that may contaminate groundwater and disrupt wildlife habitat."(G-3)

(Nuclear Impacts Continued)

"Uranium ore processing results in large amounts of tailings that contain radioactive waste materials. These tailing may raise human health concerns and must be disposed of properly to avoid contamination of water sources "(G-3)

"....many of the same water pollution, air pollution and reclamation problems are encountered in uranium mining as in coal mining..."(G-3)

- Air

"Nonradioactive emissions from the plant, excluding cooling tower emissions, will include exhaust gases from the monthly testing of diesel engines. This test, which is planned for 2 hours a month, should not contribute significantly to regional air pollution."(G-9)

"Unlike fossil fueled plants, nuclear plants do not produce substantial quantities of greenhouse gases or other air pollutants."(G-5)

"Mining and milling uranium contributes fugitive dust to the air. "(G-5)

" The largest volume emission to the atmosphere from a nuclear plant is that from cooling towers. Most of that is water vapor from evaporation of the cooling water in the towers. Because the cooling water is recycled, it concentrates the naturally occuring salts in the water as it evaporates, and the effluent plume from the towers contains a portion of the salts. The cooling towers for WNP-2 plant release about 300 gpm of water in drift alone, and 500 tons of salts per year to the atmosphere."(G-5)

"Water vapor plumes from cooling towers condense to form fog. Under some weather conditions, the plume may reach the ground and potentially block visibility on adjacent transportation routes. It may also have a visual impact and dominate the landscape in some siting situations. In sub-freezing weather, the plume may contribute to local icing. These effects are normally restricted to the area immediately adjacent to the plant (within 1/2 mile or less)."(G-5)

"Radionuclides are routinely released to the atmosphere from nuclear plants, but at low levels that are normally not detectable above background levels."(G-5)

"The primary atmospheric impacts resulting from the construction of a nuclear power plant are those common to large construction projects. They include an increase in atmospheric dust leading due to removal of existing ground cover during construction activities and a decrease in air quality due to pollutants related to automobile exhaust."(G-3)

"The potential atmospheric effects of nuclear power plant operation occur as a result of heat and moisture released from the plant cooling system, cooling tower drift, and release of airborne radioactive materials."(G-3)

"Airborne radioactive effluents can be divided into several groups. First are the isotopes of the fission product .... which are not deposited on the ground and are not absorbed and accumulated within living organisms."(G-3)

"A second group ... the fission product radioiodines, as well as carbon 14 and tritium .... tend to be deposited on the ground and/or inhaled during breathing. ... concentrations of iodine in the thyroid and of carbon 14 in bone are of particular significance."(G-3)

"The third group ... consist of particulates.

(Nuclear Impacts Continued)

"....many of the same water pollution, air pollution and reclamation problems are encountered in uranium mining as in coal mining..."(G-3)

- Cultural Resources

"The staff's preliminary determination is that the operation and maintenance of the station will not adversely affects the use and enjoyment of significant historic resources."(G-9)

- Aesthetics

"Water vapor plumes from cooling towers condense to form fog. Under some weather conditions, the plume may reach the ground and potentially block visibility on adjacent transportation routes. It may also have a visual impact and dominate the landscape in some siting situations."(G-5)

"A nuclear plant is a substantial element in the landscape and its cooling towers and their plumes may be seen for several miles. "(G-5)

- Noise

"Because of the distance from the noise sources to sensitive land uses, the staff does not expect noise to be a significant impact."(G-9).

- Health and Safety

"Activities off site that might adversely affect the operation of the nuclear plant (nearby industrial, transportation, and military facilities that might create explosive, missile, toxic gas, or similar hazards) has been evaluated. The risk from such hazards has been found to be negligibly small."(G-9)

"The staff has concluded that with respect to releases from severe accidents via the atmosphere, there are no special or unique circumstances about the WNP-3 site and environs that would warrent special mitigation features or operating procedures for the WNP-3 plant."(G-9)

"... radiation-dose limits are established to be consistent with considerations of the health and safety of the public."(G-9)

"During normal operation of WNP-3, small quantities of radioactivity (fission, corrosion, and activation products) will be released to the environment."(G-9)

"These facility-generated environmental dose levels are estimated to be very small because of both the plant design and the development of a program that will be implemented at the facility to contain and control all radioactive emissions and effluents."(G-9)

"Airborne effluents will diffuse in the atmosphere in a fashion determined by the meteorological conditions existing at the time of release and are generally dispersed and diluted by the time they reach unrestricted areas that are open to the public. Similarly, waterborne effluents will be diluted with plant waste water and then further diluted as they mix with the Chehalis River beyond the plant boundaries"(G-9)

"Most of the dose to nuclear plant workers results from external exposure to radiation coming from radioactive materials outside of the body rather than from internal exposure from inhaled or ingested radioactive materials. Experience shows that the dose to nuclear plant workers varies from reactor to reactor and from year to year."(G-9)

(Nuclear Impacts Continued)

"... the staff has projected that the collective occupational doses at WNP-3 will be 500 person-rems, but annual collective doses could average as much as 3 times this value over the life of the plant."(G-9)

"... the staff concludes that the risk to nuclear-plant workers from plant operation is comparable to the risks associated with other occupations."(G-9)

"The staff concludes that the risk to the public health and safety from exposure to radioactivity associated with the normal operation of the facility will be very small."(G-9)

"The NRC staff has determined that the environmental impact on the US population from radioactive gaseous and liquid releases (including radon and technetium) resulting from the uranium fuel cycle that will support this facility is very small when compared with the impact of natural background radiation. In addition, the nonradiological impacts of the uranium cycle have been found to be acceptable."(G-9)

"Radiation doses to the public as a result of end-of-life decommissioning activities should be small; they will come primarily from the transportation of waste to appropriate repositories. Radiation doses to decommissioning workers should be well within the occupational exposure limits imposed by regulatory requirements"(G-9)

"The environmental impacts that have been considered include potential releases of radioactivity to the environment with resulting radiation exposures to individuals and to the population as a whole, the risk of near- and long-term adverse health effects that such exposures [from an accident] could entail, and the potential economic and societal consequences of accidental contamination of the environment. These impacts could be severe, but the likelihood of their occurence is judged to be small."(G-9)

"Some waste products are highly toxic; much is radioactive and requires special handling for storage, transport and disposal."(G-5)

"Spent fuel is removed from the reactor vessel annually and is treated as high-level radioactive waste. Spent fuel is currently stored at reactor sites under water in deep pools to shield personnel and equipment from radiation exposure while the short-lived nuclides decay. Permanent disposal plans are for construction of a geologic repository for spent fuel. The fuel would be packaged and placed in a repository deep beneath the earth's surface. Some of the fission products in spent fuel have very long half-lives and must be safely isolated from potential release to the environment for at least 10,000 years."(G-5)

"Nuclear plants also produce low-level nuclear waste. Contaminated clothing, paper, rags, filter media, spent ion-exchange resins,...as well as discarded plant hardware comprise the low-level waste. A typical plant produces about 30,000 to 40,000 cubic feet of low-level waste annually.(G-5)

(Nuclear Impacts Continued)

Low-level waste must be prepared for shipment at the reactor site....and transported to the disposal site, where they are buried in shallow trenches. There is one disposal site in the NW, located at Hanford in Washington."(G-5)

"Total estimated occupational fatalities associated with the fuel cycle of a 1000-MW nuclear plant are 0.6 to 1.1 deaths per year. The estimate includes deaths during construction, operation, and decommissioning and as a result of delayed radiation-induced cancer. Occupational injuries and disease are estimated a 10 to 40 per year, most of which are associated with mining and processing fuel. Nonoccupational cancer deaths are estimated at 0.22 to 0.38 per year."(G-5)

"... the radioactive nature of uranium ore poses potential health risks to miners and persons living near uranium mines."(G-3)

"Uranium ore processing results in large amounts of tailings that contain radioactive waste materials. These tailing may raise human health concerns and must be disposed of properly to avoid contamination of water sources or transportation by the wind."(G-3)

"Transport [of waste] to disposal sites or reprocessing plants raises concerns regarding highway accidents, accidental spillage, and theft. Short of accidents or willful sabotage, the transfer of wastes are expected to result in no damage to the environment or to fish and wildlife with the exception of the land developments, which could affect wildlife."(G -3)

"..., most of the environmental effects from nuclear plants fall into the category of accident risk."(G-3)

"Rather than attempting any statistical analysis of this problem, which probably would not be fruitful, staff has chosen to consider the environmental risk associated with nuclear based on a perception of what the public believes, since this perception realistically affects the ability to acquire the nuclear resource. It appears that a large segment of the public believes the environmental risk from nuclear plants is great."(G-3)

"Nuclear's overall effect on the environmental is about the same as natural gas."(G-3)

- Socio-economics

"The socioeconomic impacts station operation are analyzed in .... Changes that have occurred ....The impact of these changes will not be significant."(G-9)

"Because of the gradual buildup of staff and dispersed residential locations, the staff concludes that local public and private services and facilities will have an opportunity to adjust to increased demands and that such demands will not be significant."(G-9)

The construction labor force for WNP-1 is as many as 2000 to 3000, while the labor force required for operation is about 1,450. Thus, there is likely to be a short-lived boom in the local economy and associated demands for services during construction and a substantial decrease when the plant begins operation. In the long term, there would be a modest increasein employment."(G-5)

"Construction of a nuclear power plant is a major undertaking and, because of large plant sizes can create more severe "boom and bust" social and environmental effects than other generating plants. However, the effects are similar for nuclear and large coal plants."(G-3)

COAL GENERATION

Land Use

"The major impact of coal-fired generation on land use is associated with mining the coal. Coal mines disrupt the surface of the land and produces large amounts of waste."(G-5)

"The plant itself requires land for siting."(G-5)

"Several thousand acres more land are required for disposal of waste ash and scrubber sludge over the life of the plant."(G-5)

Agriculture

"Crop losses are also expected as a result of SO2 and NOx releases."(G-5)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"... residential areas, for example, may bring forth opposition because there is a fear of excess noise, gaseous emissions, visible steam or smoke, particulates (both visible and respirable sizes) and traffic changes or other social impacts."(G-5)

"Toxic and hazardous materials frequently become an issue in siting "(G-5)

"... some larger plants may be required to complete an Environmental Assessment or an Env. Imp. State.. Some exemptions may be available for smaller installations from NEPA and FERC, but these installations still must comply with all applicable Federal, state and local environmental laws, rules and regulations."(G-5)

Wetlands

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

Fish

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

Wildlife

"Habitat alterations associated with siting, construction, and operation of a coal plant are expected to impact wildlife. The physical presence of the plant, activities and lighting at the plant, and the additional human activities all contribute to this effect."(G-5)

"Changes in land use are expected to displace populations of small mammals and birds."(G-5)

"The activity at the plant, noise, and lighting are expected to impacts large mammals and birds."(G-5)

(Coal Plant Impacts Continued)

"Cooling ponds may be used by aquatic organisms and waterfowl."(G-5)

"Water intakes may result in impingement and entrainment of aquatic organisms."(G-5)

"On-shore exploration and development (of fossil fuels) can intrude on roadless areas and wildlife habitat and affect the aesthetics of natural areas."(G-3)

- Vegetation

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

- Water

"Runoff of storm water that has been in contact with contaminated surfaces, coal storage, or solid wastes (e.g., ash, scrubber sludge) may enter surface water systems and carry contaminants into them."(G-5)

"Water availability will be a primary factor in siting coal-fired plants."(G-5)

"Pumping water from a surface source potentially causes impacts to aquatic biota through impingement on screens designed to protect pumps and piping systems from debris and through entrainment of smaller organisms through the pumps."(G-5)

"Discharges of heated water to the environment can have a major effect on aquatic productivity and ecosystem health, particularly if the discharge is to a small body of surface water."(G-5)

"... large cooling ponds ... Siting a pond that size adjacent to a plant increases the land use impacts."(G-5)

"Leachate and runoff from waste storage or waste disposal areas can be contaminated and can pollute surface waters, although research has demonstrated that most coal plant solid wastes are not toxic."(G-5)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"If a stream is in the area, people may be concerned that excess heat, contaminated water or other wastes might affect fish and wildlife habitat or public use of the stream."(G-5)

"Unused "heat" may also be a pollutant."(G-5)

"Most boiler blow-down waters contain corrosion inhibitors that can be damaging if discharged to a stream."(G-5)

"Scrubber equipment may have significant water quality problems that have to be treated prior to discharge."(G-5)

"Any condensate lines in the plant may have picked up contaminants that will need removal prior to discharge."(G-5)

"If there is a significant amount of ash, the handling, transport and disposal can create environmental impacts in air, water or to the land."(G-5)

(Coal Plant Impacts Continued)

- Soil

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"If there is a significant amount of ash, the handling, transport and disposal can create environmental impacts in air, water or to the land."(G-5)

- Air

"The primary concerns ... are acid deposition (caused by SOx and NOx), increases in "greenhouse" gases (from CO2 and NOx emissions), and releases of particulate matter."(G-5)

"The primary effect on air quality of extraction, handling, and transporting coal is the release of fugitive dust particulates. The particulates are relatively large and are not thought to cause serious health effects. However, the quantities of dust may be large."(G-5)

"Coal dust accumulating along transportation routes may impact wildlife and their habitat."(G-5)

"Secondary air quality impacts are associated with operation of internal combustion engines to power mining, transportation, and handling equipment. However, these emissions do not represent a large source of air pollutants."(G-5)

"Releases of the combustion gases SOx and NOx result in acid deposition, either as precipitation or as dry deposition. The sulfur content of the coal is an important determinant of SOx releases."(G-5)

"Plants located in areas with soils of low buffer capacity or that are naturally acidic may have greater impact due to acidification of soils or surface water."(G-5)

"Coal (and other fossil fuel) combustion releases the greenhouse gas, CO2, into the atmosphere."(G-5)

"Nitrogen oxides (NOx) also contribute to global warming, but they comprise a much smaller portion of the effluent from a coal-fired plant..."(G-5)

"Impacts [from particulates] are typically isolated to areas near the plant."(G-5)

"Respiration of particulates can lead to their deposition in the lungs and subsequent interference with lung function."(G-5)

"Incomplete combustion may produce atmospheric emissions of organic hydrocarbons, although state-of-the-art burners are quite efficient and oxidize nearly all of the organic compounds present."(G-5)

"The quantity of such materials [heavy metals and rare elements] is dependent on the amount of contamination in the coal and varies with the source of the coal."(G-5)

"Atmospheric releases of water from cooling towers can lead to local fog and icing, although typically such effects are limited to the immediate plant vicinity."(G-5)

"In sufficient quantities, such salt deposits can reduce plant production or limit production to salt-tolerant species of plants."(G-5)

(Coal Plant Impacts Continued)

"Smaller particles referred to Respirable Suspended Particulates are often toxic, because they can carry harmful pollutants which can damage the lining of the lungs."(G-3)

"Particulates also affect visibility because they are part of the smog and haze problems that are epidemic in large cities. Loss of visibility has been shown to be costly to the citizenry ..."(G-3)

"The SO2 emitted into the atmosphere either settles out locally or is slowly transported over large distances and converted to sulfuric acid or sulfates. The potential impacts from these emissions include human health effects, crops and forest damage, acid rain, metal corrosion, and visibility degradation."(G-3)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Carbon dioxide is the main component of "greenhouse gases", the gases responsible for global warming."(G-3)

"Natural gas is generally much cleaner environmentally than coal. Distillate fuel oil, which will be used when gas is not available will produce more pollutants than when natural gas is used, but less than if coal were being bumed."(G-3)

"Thus, the production of greenhouse gasses from gas-fired plants is about 40% of the amount from coal plants. Gas-fired plants are second to coal in the net production of greenhouse gasses. Because of the global warming issue, gas-fired generators impose some risk to developers of incurring costs for future mitigation of CO2."(G-3)

"Contaminants may emit from the fuel source, transport of fuels, fuel handling, fuel combustion, boilers, prime movers, generators and power transmission."(G-5)

"If there is a significant amount of ash, the handling, transport and disposal can create environmental impacts in air, water or to the land."(G-5)

"Air Toxics are not well defined, but the requirements of the Clean Air Act are becoming more restrictive for gases that may impact the ozone layer, directly impact health, or that eventually may contribut to the "greenhouse effect"."(G-5)

"..., high temperatures in combustion from about 2000 to 2200 degrees Fahrenheit will either eliminate or reduce these compounds [dioxins and furans] to acceptable levels if they are present."(G-5)

- Aesthetics

"The large structures of a coal plant are plainly visible in most landscapes."(G-5)

"Stack emissions may reduce visibility, and cooling towers may result in increased fog and local vapor plumes."(G-5)

"Transmission and transportation (rail, highway) rights-of-way may also need to be developed, with concomitant effects on the landscape."(G-5)

"On-shore exploration and development (of fossil fuels) can intrude on roadless areas and wildlife habitat and affect the aesthetics of natural areas."(G-3)

(Coal Plant Impacts Continued)

- Health and Safety

"Occupational and public exposure to atmospheric releases of SO2, NOx, and particulates can lead to increased incidence of illness, particularly respiratory illness, and a small increase in mortality."(G-5)

"Occupational exposure to noise, solvents, coal dust, and other environmental contaminants, as well as risk of industrial accidents, are expected to result in some additional injuries and deaths to works."(G-5)

"Unless solid wastes are properly disposed of in a manner that prevents their being a source of exposure to the general public, they may cause additional health effects. However, current regulatory requirements are designed to prevent such exposure."(G-5)

"Health effects in humans include shortness of breath, coughs, viral respiratory infections, and allergic reactions when inhaled as respirable particles."(G-3)

"Long-term exposure to sulfur dioxide can cause chronic bronchitis and exacerbate asthma. Other effects include changes in blood chemistry, enzyme levels, lung capacity, and pulmonary resistance."(G-3)

"Sulfur dioxide is also believed to have carcinogenic effects."(G-3)

"Acid rain is known to acidify lakes, harm certain key flora, corrode buildings, bridges, and other infrastructure, and is major culprit in impairing visibility. It is also believed to be a carcinogen."(G-3)

"NO2 is a gas that can irritate membranes and can cause coughs and headaches."(G-3)

"Carbon monoxide is a colorless, odorless gas. It interferes with the body's ability to deliver oxygen throughout the body. Moderate levels of oxygen deficiencies have caused vision and brain dysfunction. Headaches, nausea, irregular heart beat, weakness, and confusion can also be caused by exposure to high levels of carbon monoxide. At the extreme, exposure to high levels of carbon monoxide can cause death."(G-3)

"Concerns may be expressed if fuels have to be hauled in or solid wastes hauled out."(G-5)

"Sludges, if present, are usually combustible and there are environmental problems in transporting to a site and in handling at the site."(G-5)

"Odor control may be the biggest problem."(G-5)

"In air, water or solids media there may be possible hazardous substances that are of concern as health problems or are perceived by the public to be health problems."(G-5)

- Socio-economics

"... primary socioeconomic effects are associated with construction of the plant, when a large work force is required. Plants located in sparsely populated areas can thus have a large, temporary impact on local economics."(G-5)

"The plant operating work force is smaller than the construction work force; consequently, the long-term effects are smaller."(G-5)

"The boom associated with construction can place a heavy burden on local services including housing, schools, and utilities."(G-5)

(Coal Plant Impacts Continued)

"Mining operations result in additional employment and economic benefits to the communities near the mine."(G-5)

"Transportation of the coal requires dedicated trains and provides employment for railroad crews."(G-5)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Carbon dioxide is the main component of "greenhouse gases", the gases responsible for global warming."(G-3)

"Odor control may be the biggest problem."(G-5)

COGENERATION - OIL

- Land Use

"Transfer of the plant property to the City Parks and Recreation Department would result in a long term or permanent change in land use from power generation to public park." (G-11)

"Sale of the Flume Area... would mean more intensive industrial development of the north end of Boeing Field. Present zoning already allows industrial use, however, development of the area would be easier if the flume were removed, and with it the City's interest in the property."(G-11)

"Sale of the Georgetown Steam Plant ... would mean a change in land use from power generation to airport ..."(G-11)

"... changes may or may not have land use related impacts depending upon what the ultimate development scheme is."(G-11)

"Redevelopment of the Georgetown Plant as a cogeneration plant involves a long term commitment of public property to an energy facility development. The choice involves a tradeoff between use of the property for increasing Seattle's energy supply versus improving air transportation."(G-11)

"ENERGY MUSEUM OR INTERPRETIVE CENTER ALTERNATIVE - The change would be towards a less intensive land use than the existing use. The use will be compatible with the industrial uses immediately surrounding the plant, and the neighborhood and commercial area to the north."(G-11)

"NO ACTION ALTERNATIVE... continues the existing situation throughout an undetermined time period, ... Land use is unintensive, yet presents ongoing historical impacts upon airport operation that, from a stand-point of air safety, should and can be mitigated."(G-11)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

Transportation by pipeline involves potential spills and can disrupt existing land uses and cause some aesthetic impacts."(G-3)

"Choosing a site for a cogeneration plant is dependent on ... the land must be zoned for this land use and the project plan for the acquisition and use of the land nearly always requires public scruting of the intended use."(G-5)

(Oil Cogeneration Impacts Continued)

"... residential areas, for example, may bring forth opposition because there is a fear of excess noise, gaseous emissions, visible steam or smoke, particulates (both visible and respirable sizes) and traffic changes or other social impacts."(G-5)

"Toxic and hazardous materials frequently become an issue in siting or changing use at an existing site."(G-5)

"... if cogeneration is introduced at a site already zoned or permitted for an existing thermal load, the net balance to the environment is positive."(G-5)

"... some larger plants may be required to complete an Environmental Assessment or an Env. Imp. State.. Some exemptions may be available for smaller installations from NEPA and FERC, but these installations still must comply with all applicable Federal, state and local environmental laws, rules and regulations."(G-5)

- Wetlands

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

- Fish

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

- Wildlife

"If imports are relied on, there also may be increased risk of oil spills from tanker accidents."(G-3)

"Most of the potential effect is related to the transportation of oil. When oil is transported there is always a possibility of a spill. Spill rates have been estimated to be about 2.5 barrels per 219,000 barrels of oil transported. This would translate into about .08 barrels of oil spilled per megawatt-year for a typical plant."(G-3)

- Vegetation

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

- Water

"The existing oil tank located to the east of the steam plant is in need of repair, ..."

"The tank is responsible for seepage of small amounts of oil into the ground. The present rate of oil loss is insignificant, however, continuation of this situation, where the tank is not being maintained, has the potential of resulting in adverse impacts upon ground water."(G-11)

"Thermal discharges warrant the most study for the Georgetown Steam Plant. Even a small increase in temperature of the Duwamish River could adversely affect migratory fish. The installation of a cogeneration system solves a large part of this problem because the thermal discharge otherwise dumped, is utilized."(G-11)

(Oil Cogeneration Impacts Continued)

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"If a stream is in the area, people may be concerned that excess heat, contaminated water or other wastes might affect fish and wildlife habitat or public use of the stream."(G-5)

"Unused "heat" may also be a pollutant."(G-5)

"Most boiler blow-down waters contain corrosion inhibitors that can be damaging if discharged to a stream."(G-5)

"Scrubber equipment may have significant water quality problems that have to be treated prior to discharge."(G-5)

"Any condensate lines in the plant may have picked up contaminants that will need removal prior to discharge."(G-5)

"If there is a significant amount of ash, the handling, transport and disposal can create environmental impacts in air, water or to the land."(G-5)

- Soil

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

- Air

"COGENERATION ALTERNATIVE-The Georgetown Steam Plant is situated in an area which does not attain the National Air Quality Standards for suspended particulate matter, for carbon monoxide and for ozone. ... The use of natural gas as a fuel source is favored because it is possible to meet emission standards."(G-11)

"The SO2 emitted into the atmosphere either settles out locally or is slowly transported over large distances and converted to sulfuric acid or sulfates. The potential impacts from these emissions include human health effects, crops and forest damage, acid rain, metal corrosion, and visibility degradation."(G-3)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Contaminants may emit from the fuel source, transport of fuels, fuel handling, fuel combustion, boilers, prime movers, generators and power transmission."(G-5)

"If there is a significant amount of ash, the handling, transport and disposal can create environmental impacts in air, water or to the land."(G-5)

(Oil Cogeneration Impacts Continued)

"Air Toxics are not well defined, but the requirements of the Clean Air Act are becoming more restrictive for gases that may impact the ozone layer, directly impact health, or that eventually may contribut to the "greenhouse effect"."(G-5)

"..., high temperatures in combustion from about 2000 to 2200 degrees Fahrenheit will either eliminate or reduce these compounds [dioxins and furans] to acceptable levels if they are present."(G-5)

"Carbon dioxide is the main component of "greenhouse gases", the gases responsible for global warming."(G-3)

"Natural gas is generally much cleaner environmentally than coal. Distillate fuel oil, which will be used when gas is not available will produce more pollutants than when natural gas is used, but less than if coal were being burned."(G-3)

"..., the combustion of oil, although it does not result in the levels of pollutants associated with coal plants, is clearly less desitable than burning natural gas. Therefore, the environmental effects of oil-fired power plants fall somewhere between coal and natural gas-fired plants."(G-3)

Other than the airborne pollutants discussed above, there is little additional combustion-related pollution associated with natural gas-fired and oil-fired generation."(G-3)

- Cultural Resources

"If the Georgetown Steam Plant were transferred to the City Parks Department, danger of the plant's demolition would be reduced and any change to its historical value would be a result of activities of the City in adapting the site to become a public place."(G-11)

"If the plant is designated as a Seattle Landmark, the involvement of the City Landmarks Preservation Board secures the City's interest in preservation and tends to rule out or mitigate any potential impacts that could result from use of the plant by its owner."(G-11)

"Maintenance costs to the City would be reduced by the removal of the flume and oil tank in Option B ... the savings in maintenance costs is in the long run, insignificant."(G -11)

"The flume is historically important to traditional operation of the Georgetown Plant and therefore should not be surplused without some attention to its interpretive benefit, were the plant used for an information center or museum."(G-11)

"The more important impact upon the plant's historic significance would result from future use of the main plant structure. Under this option, the rest of the plant would probably be developed as an energy museum or park at some point in the future."(G-11)

"Sale to King County for Obstruction Removal - By far, the most significant environmental impact of Surpluss Option 3 relates to demolition of the steam plant. ... Demolition of the plant would have an irreversible adverse impact upon the state of the nation's engineering landmarks."(G-11)

"It was determined that existing turbine units and acessory equipment should be maintained for historical reasons, but not for use in the cogeneration scheme."(G-ll)

"When considering the existing situation, however, with the utility unable to operate the plant for economic, environmental, and labor reasons, the development would extend the useful life of the plant and benefit preservation ..., even though its original function is lost."(G-11)

(Oil Cogeneration Impacts Continued)

"In the short term, the No Action Alternative has neither adverse nor beneficial impacts upon the historical value of the plant. In the long term however, continuing the existing level of maintenance and security of the plant will lead to irrepairable deterioration and increasingly high restoration costs for public use of the facility."(G-11)

- Aesthetics

"Major changes proposed to the Steam Plant for primarily aesthetic resons are the removal of the concrete cooling water recycling tank and the generator cooling duct on the west facade of the building. From a standpoint of aethetics, these changes are expected to improve the plant appearance by clearing the prime architectural design feature of obstructions."(G-11)

"Off-shore exploration and development of fossil fuels can interfere with commercial and recreational fishing and could cause aesthetic impacts on shoreline areas."(G-3)

"On-shore exploration and development (of fossil fuels) can intrude on roadless areas and wildlife habitat and affect the aesthetics of natural areas."(G-3)

Transportation by pipeline involves potential spills and can disrupt existing land uses and cause some aesthetic impacts."(G-3)

- Noise

"Gas Turbines are noisy and accomodation of the units on the site would need baffling to make noise levels acceptable."(G-11)

"In some cases, these units [generating units] create noises that are a social problem for local people."(G-5)

"Noise is recognized as a major pollution problem when levels are high or are of such a frequency that causes tension in people."(G-5)

"Generators powered by internal-combustion engines can produce on the order of 80 decibels (dB) of noise. Gas turbine units have on the order of 90 dB and a high frequency "whine"."(G-5)

"Mitigation may consist of obtaining larger land sites so that adjacent lands are not impacted adversely. In this case, workers must also be provided with ear protection."(G-5)

- Health and Safety

"Transfer of the plant ... would result in the removal of the 20,000 barrel oil tank east of the steam plant....This would have a beneficial impact upon the hazard presented by location of the oil tank entirely within the approach zone to Runway 13R."(G-11)

"The presence of the Georgetown Steam Plant as an obstruction to landing aircraft is today mitigated by operational guidelines set out by the Federal Aviation Administration."(G-11)

"Another way to mitigate presence of the Georgetown Plant as a navigational hazard is to paint the northerly facade of the structure with a large graphic to make it more noticeable to landing aircraft."(G-11)

(Oil Cogeneration Impacts Continued)

"Were the flume surplused, the oil tank would probably be removed also, because the use of the plant as an emergency facility would be permanently foreclosed without a way to discharge water. This would reduce the hazard associated with location of the tank in the approach zone to Runway 13R and is a beneficial impact."(G-11)

"Risk of explosion would be decreased under this option, by removal of the oil storage tank east of the plant. This is a beneficial impact."(G-11)

"Air safety would be increased by removal of the Georgetown Steam Plant."(G-11)

"... it is not expected that any significant increase in aircraft traffic would result from this option."(G-11)

"Cogeneration Alternative - The design of all new equipment is limited to the height of the existing facility to keep from increasing hazard to aircraft using Boeing Field."(G-11)

"As part of this development it is expected that the oil tank east of the plant will be removed. This would significantly reduce or mitigate the hazard of explosion ... This is a beneficial impact."(G-11)

"Continued presence of the Plant structure ... is considered "generally undesirable from an airport planning standpoint", however, existing conditions will be improved by the development."(G-11)

"Access into the plant for vehicles and pedestrians will be significantly improved by the development." (G-11)

"Use of the Georgetown Steam Plant as an Interpretive Center would remove a potential source of emergency electrical generation, ..., from future use."(G-11)

"..., given the uncertainty of the cost and future energy supplies (including oil the plant runs on) the decision to remove the possibility of future generation is significant."(G-11)

"The presence of the oil storage tank east of the plant, within the Clear Zone to Runway 13R presents a risk to aircraft. ... Painting the north facade of the structure would slightly reduce the hazard [to air traffic], as would improved lighting, distinctive from airport lights."(G-11)

"Long-term exposure to sulfur dioxide can cause chronic bronchitis and exacerbate asthma. Other effects include changes in blood chemistry, enzyme levels, lung capacity, and pulmonary resistance."(G-3)

"Sulfur dioxide is also believed to have carcinogenic effects."(G-3)

"Acid rain is known to acidify lakes, harm certain key flora, corrode buildings, bridges, and other infrastructure, and is major culprit in impairing visibility. It is also believed to be a carcinogen."(G-3)

"NO2 is a gas that can irritate membranes and can cause coughs and headaches."(G-3)

"Carbon monoxide is a colorless, odorless gas. It interferes with the body's ability to deliver oxygen throughout the body. Moderate levels of oxygen deficiencies have caused vision and brain dysfunction. Headaches, nausea, irregular heart beat, weakness, and confusion can also be caused by exposure to high levels of carbon monoxide. At the extreme, exposure to high levels of carbon monoxide can cause death."(G-3)

"Concerns may be expressed if fuels have to be hauled in or solid wastes hauled out."(G-5)

"Sludges, if present, are usually combustible and there are environmental problems in transporting to a site and in handling at the site."(G-5)

(Oil Cogeneration Impacts Continued)

"Odor control may be the biggest problem."(G-5)

"In air, water or solids media there may be possible hazardous substances that are of concern as health problems or are perceived by the public to be health problems."(G-5)

- Socio-economics

"One of the major impacts... is relinquishment of potential energy use of the Georgetown Steam Plant... future energy supplies and their costs are extremely uncertain....Facilities that can be brought on line in a short period of time may have unrealized value in the future....Mitigation ...is possible by establishment of an interdepartmental agreement to re-evaluate the need for the plant as an energy site on a periodic basis."(G-11)

"Surplus Option A would complement this proposal by increasing recreational opportunities for Georgetown residents and city residents as a whole."(G-11)

"Maintenance costs to the City would be reduced by the removal of the flume and oil tank in Option B ... the savings in maintenance costs is in the long run, insignificant."(G-11)

"Odor control may be the biggest problem."(G-5)

"Because cogeneration is a more efficient use of fuel, it is generally cost effective for site-specific power/ heat generation."(G-5)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Carbon dioxide is the main component of "greenhouse gases", the gases responsible for global warming."(G-3)

"Oil and gas are relatively risky, because they both contribute to greenhouse gasses, which could require the plants to be retrofit at some time in the future."(G-3)

COGENERATION - NATURAL GAS

- Land Use

"Redevelopment of the Georgetown Plant as a cogeneration plant involves a long term commitment of public property to an energy facility development. The choice involves a tradeoff between use of the property for increasing Seattle's energy supply versus improving air transportation."(G-11)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Transportation by pipeline involves potential spills and can disrupt existing land uses and cause some aesthetic impacts."(G-3)

"Other effects, whose physical amounts have not been quantified, include methane releases in the exploration, extraction and transportation of natural gas, land and sea use and the related contamination from both, and the environmental effects associated with gas pipelines to deliver the gas to the plant."(G-3)

(Natural Gas Cogeneration Impacts Continued)

"Other effects, whose physical amounts have not been quantified, include methane releases in the exploration, extraction and transportation of natural gas, land and sea use and the related contamination from both, and the environmental effects associated with gas pipelines to deliver the gas to the plant."(G-3)

"Choosing a site for a cogeneration plant is dependent on ... the land must be zoned for this land use and the project plan for the acquisition and use of the land nearly always requires public scrutiny of the intended use."(G-5)

"... residential areas, for example, may bring forth opposition because there is a fear of excess noise, gaseous emissions, visible steam or smoke, particulates (both visible and respirable sizes) and traffic changes or other social impacts."(G-5)

"Toxic and hazardous materials frequently become an issue in siting or changing use at an existing site."(G-5)

"... if cogeneration is introduced at a site already zoned or permitted for an existing thermal load, the net balance to the environment is positive."(G-5)

"... some larger plants may be required to complete an Environmental Assessment or an Env. Imp. State.. Some exemptions may be available for smaller installations from NEPA and FERC, but these installations still must comply with all applicable Federal, state and local environmental laws, rules and regulations."(G-5)

- Fish

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

- Vegetation

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

- Water

"Thermal discharges warrant the most study for the Georgetown Steam Plant. Even a small increase in temperature of the Duwamish River could adversely affect migratory fish. The installation of a cogeneration system solves a large part of this problem because the thermal discharge otherwise dumped, is utilized."(G-11)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Other effects, whose physical amounts have not been quantified, include methane releases in the exploration, extraction and transportation of natural gas, land and sea use and the related contamination from both, and the environmental effects associated with gas pipelines to deliver the gas to the plant."(G-3)

"If a stream is in the area, people may be concerned that excess heat, contaminated water or other wastes might affect fish and wildlife habitat or public use of the stream."(G-5)

"Unused "heat" may also be a pollutant."(G-5)

"Most boiler blow-down waters contain corrosion inhibitors that can be damaging if discharged to a stream."(G-5)

(Natural Gas Cogeneration Impacts Continued)

"Scrubber equipment may have significant water quality problems that have to be treated prior to discharge."(G-5)

"Any condensate lines in the plant may have picked up contaminants that will need removal prior to discharge."(G-5)

"If there is a significant amount of ash, the handling, transport and disposal can create environmental impacts in air, water or to the land."(G-5)

- Soils

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

- Air Quality

"COGENERATION ALTERNATIVE-The Georgetown Steam Plant is situated in an area which does not attain the National Air Quality Standards for suspended particulate matter, for carbon monoxide and for ozone. ... The use of natural gas as a fuel source is favored because it is possible to meet emission standards."(G-11)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Carbon dioxide is the main component of "greenhouse gases", the gases responsible for global warming."(G-3)

"Natural gas is generally much cleaner environmentally than coal. Distillate fuel oil, which will be used when gas is not available will produce more pollutants than when natural gas is used, but less than if coal were being burned."(G-3)

"Other effects, whose physical amounts have not been quantified, include methane releases in the exploration, extraction and transportation of natural gas, land and sea use and the related contamination from both, and the environmental effects associated with gas pipelines to deliver the gas to the plant."(G-3)

Other than the airborne pollutants discussed above, there is little additional combustion-related pollution associated with natural gas-fired and oil-fired generation."(G-3)

"Thus, the production of greenhouse gasses from gas-fired plants is about 40% of the amount from coal plants. Gas-fired plants are second to coal in the net production of greenhouse gasses. Because of the global warming issue, gas-fired generators impose some risk to developers of incurring costs for future mitigation of CO2."(G-3)

"Contaminants may emit from the fuel source, transport of fuels, fuel handling, fuel combustion, boilers, prime movers, generators and power transmission."(G-5)

"If there is a significant amount of ash, the handling, transport and disposal can create environmental impacts in air, water or to the land."(G-5)

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(Natural Gas Cogeneration Impacts Continued)

"..., high temperatures in combustion from about 2000 to 2200 degrees Fahrenheit will either eliminate or reduce these compounds [dioxins and furans] to acceptable levels if they are present."(G-5)

- Cultural Resources

"It was determined that existing turbine units and acessory equipment should be maintained for historical reasons, but not for use in the cogeneration scheme."(G-ll)

- Aesthetics

"On-shore exploration and development (of fossil fuels) can intrude on roadless areas and wildlife habitat and affect the aesthetics of natural areas."(G-3)

"Off-shore exploration and development of fossil fuels can interfere with commercial and recreational fishing and could cause aesthetic impacts on shoreline areas."(G-3)

- Noise

"In some cases, these units [generating units] create noises that are a social problem for local people."(G-5)

"Noise is recognized as a major pollution problem when levels are high or are of such a frequency that causes tension in people."(G-5)

"Generators powered by internal-combustion engines can produce on the order of 80 decibels (dB) of noise.

"Mitigation may consist of obtaining larger land sites so that adjacent lands are not impacted adversely. In this case, workers must also be provided with ear protection."(G-5)

Gas turbine units have on the order of 90 dB and a high frequency "whine"."(G-5)

- Health and Safety

"Cogeneration Alternative - The design of all new equipment is limited to the height of the existing facility to keep from increasing hazard to aircraft using Boeing Field."(G-11)

"NO2 is a gas that can irritate membranes and can cause coughs and headaches."(G-3)

"Carbon monoxide is a colorless, odorless gas. It interferes with the body's ability to deliver oxygen throughout the body. Moderate levels of oxygen deficiencies have caused vision and brain dysfunction. Headaches, nausea, irregular heart beat, weakness, and confusion can also be caused by exposure to high levels of carbon monoxide. At the extreme, exposure to high levels of carbon monoxide can cause death."(G-3)

"Concerns may be expressed if fuels have to be hauled in or solid wastes hauled out."(G-5)

"Sludges, if present, are usually combustible and there are environmental problems in transporting to a site and in handling at the site."(G-5)

"Odor control may be the biggest problem."(G-5)

"In air, water or solids media there may be possible hazardous substances that are of concern as health problems or are perceived by the public to be health problems."(G-5)

(Natural Gas Cogeneration Impacts Continued)

- Socio-economics

"Carbon dioxide is the main component of "greenhouse gases", the gases responsible for global warming."(G-3)

"Oil and gas are relatively risky, because they both contribute to greenhouse gasses, which could require the plants to be retrofit at some time in the future."(G-3)

"Thus, the production of greenhouse gasses from gas-fired plants is about 40% of the amount from coal plants. Gas-fired plants are second to coal in the net production of greenhouse gasses. Because of the global warming issue, gas-fired generators impose some risk to developers of incurring costs for future mitigation of CO2."(G-3)

"Odor control may be the biggest problem."(G-5)

"Adding cogeneration to existing facilities that are already perceived as good neighbors or an essential economic base in a community is usually an environmentally acceptable alternative."(G-5)

"Because cogeneration is a more efficient use of fuel, it is generally cost effective for site-specific power/ heat generation."(G-5)

COGENERATION - COAL

- Land Use

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Choosing a site for a cogeneration plant is dependent on ... the land must be zoned for this land use and the project plan for the acquisition and use of the land nearly always requires public scruting of the intended use."(G-5)

"... residential areas, for example, may bring forth opposition because there is a fear of excess noise, gaseous emissions, visible steam or smoke, particulates (both visible and respirable sizes) and traffic changes or other social impacts."(G-5)

"Toxic and hazardous materials frequently become an issue in siting or changing use at an existing site."(G-5)

"... if cogeneration is introduced at a site already zoned or permitted for an existing thermal load, the net balance to the environment is positive."(G-5)

"... some larger plants may be required to complete an Environmental Assessment or an Env. Imp. State.. Some exemptions may be available for smaller installations from NEPA and FERC, but these installations still must comply with all applicable Federal, state and local environmental laws, rules and regulations."(G-5)

"The major impact of coal-fired generation on land use is associated with mining the coal. Coal mines disrupt the surface of the land and produces large amounts of waste."(G-5)

"The plant itself requires land for siting."(G-5)

(Coal Cogeneration Impacts Continued)

"Several thousand acres more land are required for disposal of waste ash and scrubber sludge over the life of the plant."(G-5)

Land Use - Agriculture

"Crop losses are also expected as a result of SO2 and NOx releases."(G-5)

- Wetlands

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

- Fish

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

- Wildlife

"On-shore exploration and development (of fossil fuels) can intrude on roadless areas and wildlife habitat and affect the aesthetics of natural areas."(G-3)

"Coal dust accumulating along transportation routes may impact wildlife and their habitat."(G-5)

"Habitat alterations associated with siting, construction, and operation of a coal plant are expected to impact wildlife. The physical presence of the plant, activities and lighting at the plant, and the additional human activities all contribute to this effect."(G-5)

"Changes in land use are expected to displace populations of small mammals and birds."(G-5)

"The activity at the plant, noise, and lighting are expected to impacts large mammals and birds."(G-5)

"Cooling ponds may be used by aquatic organisms and waterfowl."(G-5)

"Water intakes may result in impingement and entrainment of aquatic organisms."(G-5)

- Vegetation

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

- Water

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"If a stream is in the area, people may be concerned that excess heat, contaminated water or other wastes might affect fish and wildlife habitat or public use of the stream."(G-5)

"Unused "heat" may also be a pollutant."(G-5)

(Coal Cogeneration Impacts Continued)

"Most boiler blow-down waters contain corrosion inhibitors that can be damaging if discharged to a stream."(G-5)

"Scrubber equipment may have significant water quality problems that have to be treated prior to discharge."(G-5)

"Any condensate lines in the plant may have picked up contaminants that will need removal prior to discharge."(G-5)

"If there is a significant amount of ash, the handling, transport and disposal can create environmental impacts in air, water or to the land."(G-5)

"Runoff of storm water that has been in contact with contaminated surfaces, coal storage, or solid wastes (e.g., ash, scrubber sludge) may enter surface water systems and carry contaminants into them."(G-5)

"Water availability will be a primary factor in siting coal-fired plants."(G-5)

"Pumping water from a surface source potentially causes impacts to aquatic biota through impingement on screens designed to protect pumps and piping systems from debris and through entrainment of smaller organisms through the pumps."(G-5)

"Discharges of heated water to the environment can have a major effect on aquatic productivity and ecosystem health, particularly if the discharge is to a small body of surface water."(G-5)

"... large cooling ponds ... Siting a pond that size adjacent to a plant increases the land use impacts."(G-5)

"Leachate and runoff from waste storage or waste disposal areas can be contaminated and can pollute surface waters, although research has demonstrated that most coal plant solid wastes are not toxic."(G-5)

- Soils

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"If there is a significant amount of ash, the handling, transport and disposal can create environmental impacts in air, water or to the land."(G-5)

- Air Quality

"Smaller particles referred to Respirable Suspended Particulates are often toxic, because they can carry harmful pollutants which can damage the lining of the lungs."(G-3)

"Particulates also affect visibility because they are part of the smog and haze problems that are epidemic in large cities. Loss of visibility has been shown to be costly to the citizenry ..."(G-3)

"The SO2 emitted into the atmosphere either settles out locally or is slowly transported over large distances and converted to sulfuric acid or sulfates. The potential impacts from these emissions include human health effects, crops and forest damage, acid rain, metal corrosion, and visibility degradation."(G-3)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

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"Air Toxics are not well defined, but the requirements of the Clean Air Act are becoming more restrictive for gases that may impact the ozone layer, directly impact health, or that eventually may contribut to the "greenhouse effect"."(G-5)

"..., high temperatures in combustion from about 2000 to 2200 degrees Fahrenheit will either eliminate or reduce these compounds [dioxins and furans] to acceptable levels if they are present."(G-5)

"The primary concerns ... are acid deposition (caused by SOx and NOx), increases in "greenhouse" gases (from CO2 and NOx emissions), and releases of particulate matter."(G-5)

"The primary effect on air quality of extraction, handling, and transporting coal is the release of fugitive dust particulates. The particulates are relatively large and are not thought to cause serious health effects. However, the quantities of dust may be large."(G-5)

"Coal dust accumulating along transportation routes may impact wildlife and their habitat."(G-5)

"Secondary air quality impacts are associated with operation of internal combustion engines to power mining, transportation, and handling equipment. However, these emissions do not represent a large source of air pollutants."(G-5)

"Releases of the combustion gases SOx and NOx result in acid deposition, either as precipitation or as dry deposition. The sulfur content of the coal is an important determinant of SOx releases."(G-5)

"Plants located in areas with soils of low buffer capacity or that are naturally acidic may have greater impact due to acidification of soils or surface water."(G-5)

"Coal (and other fossil fuel) combustion releases the greenhouse gas, CO2, into the atmosphere."(G-5)

"Nitrogen oxides (NOx) also contribute to global warming, but they comprise a much smaller portion of the effluent from a coal-fired plant..."(G-5)

"Impacts [from particulates] are typically isolated to areas near the plant."(G-5)

(Coal Cogeneration Impacts Continued)

"Respiration of particulates can lead to their deposition in the lungs and subsequent interference with lung function."(G-5)

"Incomplete combustion may produce atmospheric emissions of organic hydrocarbons, although state-of-the-art burners are quite efficient and oxidize nearly all of the organic compounds present."(G-5)

"The quantity of such materials [heavy metals and rare elements] is dependent on the amount of contamination in the coal and varies with the source of the coal."(G-5)

"Atmospheric releases of water from cooling towers can lead to local fog and icing, although typically such effects are limited to the immediate plant vicinity."(G-5)

"In sufficient quantities, such salt deposits can reduce plant production or limit production to salt-tolerant species of plants."(G-5)

- Aesthetics

"On-shore exploration and development (of fossil fuels) can intrude on roadless areas and wildlife habitat and affect the aesthetics of natural areas."(G-3)

"The large structures of a coal plant are plainly visible in most landscapes."(G-5)

"Stack emissions may reduce visibility, and cooling towers may result in increased fog and local vapor plumes."(G-5)

"Transmission and transportation (rail, highway) rights-of-way may also need to be developed, with concomitant effects on the landscape."(G-5)

- Health and Safety

"Health effects in humans include shortness of breath, coughs, viral respiratory infections, and allergic reactions when inhaled as respirable particles."(G-3)

"Long-term exposure to sulfur dioxide can cause chronic bronchitis and exacerbate asthma. Other effects include changes in blood chemistry, enzyme levels, lung capacity, and pulmonary resistance."(G-3)

"Sulfur dioxide is also believed to have carcinogenic effects."(G-3)

"Acid rain is known to acidify lakes, harm certain key flora, corrode buildings, bridges, and other infrastructure, and is major culprit in impairing visibility. It is also believed to be a carcinogen."(G-3)

"NO2 is a gas that can irritate membranes and can cause coughs and headaches."(G-3)

"Carbon monoxide is a colorless, odorless gas. It interferes with the body's ability to deliver oxygen throughout the body. Moderate levels of oxygen deficiencies have caused vision and brain dysfunction. Headaches, nausea, irregular heart beat, weakness, and confusion can also be caused by exposure to high levels of carbon monoxide. At the extreme, exposure to high levels of carbon monoxide can cause death."(G-3)

"Concerns may be expressed if fuels have to be hauled in or solid wastes hauled out."(G-5)

"Sludges, if present, are usually combustible and there are environmental problems in transporting to a site and in handling at the site."(G-5)

(Coal Cogeneration Impacts Continued)

"Odor control may be the biggest problem."(G-5)

"In air, water or solids media there may be possible hazardous substances that are of concern as health problems or are perceived by the public to be health problems."(G-5)

"Occupational and public exposure to atmospheric releases of SO2, NOx, and particulates can lead to increased incidence of illness, particularly respiratory illness, and a small increase in mortality."(G-5)

"Occupational exposure to noise, solvents, coal dust, and other environmental contaminants, as well as risk of industrial accidents, are expected to result in some additional injuries and deaths to works."(G-5)

"Unless solid wastes are properly disposed of in a manner that prevents their being a source of exposure to the general public, they may cause additional health effects. However, current regulatory requirements are designed to prevent such exposure."(G-5)

- Socio-economics

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Carbon dioxide is the main component of "greenhouse gases", the gases responsible for global warming."(G-3)

"Odor control may be the biggest problem."(G-5)

"... primary socioeconomic effects are associated with construction of the plant, when a large work force is required. Plants located in sparsely populated areas can thus have a large, temporary impact on local economics."(G-5)

"The plant operating work force is smaller than the construction work force; consequently, the long-term effects are smaller."(G-5)

"The boom associated with construction can place a heavy burden on local services including housing, schools, and utilities."(G-5)

"Mining operations result in additional employment and economic benefits to the communities near the mine."(G-5)

"Transportation of the coal requires dedicated trains and provides employment for railroad crews."(G-5)

COGENERATION - BIOMASS

- Land Use

"Six intersections were analyzed for the traffic volume which will be added by the Steam Plant; no change in level of service is expected as a result of the Plant."(G-12)

"Although the proposed project will increase traffic volumes on the local vicinity street system, but accident rates are not likely to increase."(G-12)

"The marine traffic related to the Plant is expected to be one to two coal barges per month. This would not be a significant increase."(G-12

(Biomass Cogeneration Impacts Continued)

"As an industrial use, the Steam Plant is compatible with existing zoning and surrounding uses."(G-12)

"The Plant is visible from the Shoreline View Area and would be visible from the proposed park on the north shore. However, no conflicts with the uses of these or other park facilities are expected."
(G-12)

"The Plant will burn RDF (Refuse Derived Fuel) thereby reducing the amount of refuse to be added to the City and County landfills. The Light Division will require landfill disposal space for the ash generated by the Plant; its quantity is estimated at 66 to 88 tons per day."(G-12)

"Appropriate precautions have been taken by US West to avoid electrical interference caused by power production at the Plant."
(G-12)

"No religious institutions would directly be affected by the Plant."(G-12)

"The effects of moving wood residues from where they are located to the power plant are minimal. In any case, a similar activity may be required to move the wood residue to an alternative use or to dispose of it if there is not market value."(G-3)

"The incremental effect of fuel handling for refuse derived fuel is zero."(G-3)

"The effects on the land at the waste disposal stage is about the same degree of severity as the effects of waste from coal plants, although the effects are obviously less at the "mining stage"."(G-3)

"... because the alternative of land fills has to be considered, the effects of waste disposal from municipal solid waste plants is not a major incremental concern."(G-3)

"The overall effect on man and his environment (biomass wood and refuse) is considered to be at about the same level as oil-fired plants."(G-3)

"The effects from moving wood residues from where they are located to the power plant are minimal."
(G-3)

"Choosing a site for a cogeneration plant is dependent on ... the land must be zoned for this land use and the project plan for the acquisition and use of the land nearly always requires public scruting of the intended use."(G-5)

"... residential areas, for example, may bring forth opposition because there is a fear of excess noise, gaseous emissions, visible steam or smoke, particulates (both visible and respirable sizes) and traffic changes or other social impacts."(G-5)

"Toxic and hazardous materials frequently become an issue in siting or changing use at an existing site."(G-5)

"... if cogeneration is introduced at a site already zoned or permitted for an existing thermal load, the net balance to the environment is positive."(G-5)

"... some larger plants may be required to complete an Environmental Assessment or an Env. Imp. State.. Some exemptions may be available for smaller installations from NEPA and FERC, but these installations still must comply with all applicable Federal, state and local environmental laws, rules and regulations."(G-5)

(Biomass Cogeneration Impacts Continued)

- Wetlands

"Since runoff is routed through oil/water seperators and a grass-lined swale the impact of the operation of the Plant on the wetland would be minimal."(G-12)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

- Fish

"The amount of suspended solids resulting from deposition of airborne particulates from the Plant will be negligible. Wastewater will not be discharged into the waterways. Stormwater will be filtered. Therefore, no significant impact on fish populations is expected."(G-12)

"The fugitive dust will cause some disturbance in the benthic ecology of the Hylebos Waterway."(G-12)

"Furthermore, barge traffic headed to the Steam Plant on the Hylebos Waterway will be infrequent enough not to disturb aquatic migrations of fish."(G-12)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

- Wildlife

"No significant impacts are expected on animals or the habitats which support animals in the Project area. The salt deposition from the cooling towers will effect the existing species of vegetation within the 2100 feet of the Plant, but the rate of salt deposition is less than the NRC guidelines."(G-12)

- Vegetation

"Ground level fogging and icing are unlikely. Within the vapor of the Plant, there may be dissolved salts that could have an impact on vegetation; beyond 2100 feet from the Plant there should be no damage, and within 2100 feet the vegetation may experience minimal changes due to varying salt tolerance of individual species."(G-12)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

- Water (Biomass Cogeneration Impacts Continued)

"The Plant will require up to one million gallons of fresh water per day which would increase daily consumption in the Water Divisions's Service Area by 1.4%. The Water Division states that this would have an imperceptible effects. In event of a drought, the Plant could reduce its load or shut down."(G-12)

"Current sewer mains and wastewater treatment plant capacity can handle the additional 200,000 gallons of industrial waste expected from the Plant."(G-12)

"Although there is the potential for storm water runoff, there is an extensive storm drainage system within the Plant."(G-12)

"Water quality in the project area could be degraded due to suspended particulates transported in runoff or directly deposited in the Waterway. The amount, however, would be insignificant relative to the total concentration of suspended particulates."(G-12)

If ash were judged to be toxic, plant operators would probably be required to "concretize" the ash to make it less likely to leach out toxins into the ground water."(G-3)

"The emissions of municipal solid waste burning to the air and water are judged to be about the same degree of severity as those emitted by oil-fired plants. "(G-3)"If a stream is in the area, people may be concerned that excess heat, contaminated water or other wastes might affect fish and wildlife habitat or public use of the stream."(G-5)

"Unused "heat" may also be a pollutant."(G-5)

"Most boiler blow-down waters contain corrosion inhibitors that can be damaging if discharged to a stream."(G-5)

"Scrubber equipment may have significant water quality problems that have to be treated prior to discharge."(G-5)

"Any condensate lines in the plant may have picked up contaminants that will need removal prior to discharge."(G-5)

"If there is a significant amount of ash, the handling, transport and disposal can create environmental impacts in air, water or to the land."(G-5)

- Soils

"Trace amounts of arsenic, cadmium, lead and mercury from fugitive dust and boiler stack emissions will be added to the soil as a result of the projects. Concentration will be below the detection rate, therefore, they will insignificantly change the level of metals in the soils."(G-12)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"If ash were judged to be toxic, plant operators would probably be required to "concretize" the ash to make it less likely to leach out toxins into the ground water."(G-3)

(Biomass Cogeneration Impacts Continued)

- Ground Water

"No surface water can permeate to the aquifer layer. Hence, any spills or stormwater washdown resulting from the project will not affect the second aquifer layer, used as a water source. In addition, any potential spill will be constrained."(G-12)

"If ash were judged to be toxic, plant operators would probably be required to "concretize" the ash to make it less likely to leach out toxins into the ground water."(G-3)

- Air Quality

"Control of odors from combustion of RDF can be effectively controlled by the temperature of combustion and other factors of proper design and operation."(G-12)

"Measures to minimize air quality impacts in all of the above mentioned areas have been incorporated in the Project. Control of odors has been incorporated in the operations plan. No additional mitigating measures will be required."(G-12)

"Trucking of RDF to the Plant will take place within enclosed vehicles. Further, the Plant design provides for enclosed waste receiving and storage. Odor impacts from these two operations are therefore not expected to be significant."(G-12)

"Decomposition of RDF may result in low level of odors in the ambient air. RDF will not be stored for longer than three days. Storage areas will be washed periodically to eliminate odor buildup."(G-12)

"With the exception of particulates, no violation of ambient air quality standards is expected. Even though exceedences of the particulate standards are predicted, these exceedences are not caused by the proposed project. In addition, the actual particulates measured during stack testing were less than half the permitted amount."(G-12)

"The violations of the particulate standards currently exist [i.e., the area is designated as not in attainment for particulates] and the impacts of the steam plant, with respect to particulates, are not expected considered to be significant."(G-12)

"Emissions from all vehicles in the projects area are predicted to generate concentrations of carbon monoxide of 6 ppm which are well below the standard of 9 ppm. The contribution from vehicles related to Plant traffic is predicted to be less than 0.1 ppm. No violation of standards is expected as a result of the Proposed Action."(G-12)

"The results of the fugitive dust modeling analysis show maximum concentrations for a peak 24-hours period and for a one-year period to be well below the levels considered to be significant."(G-12)

"Particulates are the major emission of concern from wood-fired boilers ..."(G-3)

"Smaller particles referred to Respirable Suspended Particulates are often toxic, because they can carry harmful pollutants which can damage the lining of the lungs."(G-3)

"Particulates also affect visibility because they are part of the smog and haze problems that are epidemic in large cities. Loss of visibility has been shown to be costly to the citizenry ..."(G-3)

(Biomass Cogeneration Impacts Continued)

"The SO2 emitted into the atmosphere either settles out locally or is slowly transported over large distances and converted to sulfuric acid or sulfates. The potential impacts from these emissions include human health effects, crops and forest damage, acid rain, metal corrosion, and visibility degradation."(G-3)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"Additional environmental effects from wood-fired generation, aside from the major air pollutants discussed above, are not very great."(G-3)

"Production of electricity from refuse derived fuel can cause air pollution. In addition to the major criteria pollutants mentioned above, fuel plants can emit volatile organic matter, mercury, lead, fluorides, hydrogen chloride, tetrachlorinated dioxins, beryllium, polynuclear aromatic compounds, PCB's."(G-3)

"Pollutants can be mitigated to acceptably low levels by exposing the exhaust gases to temperatures in the 1800 to 2000 degree F range for several seconds and by using baghouses and electrostatic precipitators. Residual pollutants remaining after environmental controls have been installed are not well known, because the contents in a stream of garbage is not very consistent."(G-3)

"The emissions of municipal solid waste burning to the air and water are judged to be about the same degree of severity as those emitted by oil-fired plants."(G-3)

"Additional environmental effects from wood-fired generation, aside from the major pollutants discussed above, are not very great. Because cogeneration is more efficient, the amount of pollution per unit of useful work is lower than for a biomass resource producing electricity only."(G-3)

Because cogeneration is more efficient (than biomass generation without secondary use of process heat), each level of refuse derived fuel burned in the process results in more useful work. Therefore, the amount of pollution per unit of useful work is lower when refuse derived fuel is being burned in a cogeneration mode." (G-3)

"Contaminants may emit from the fuel source, transport of fuels, fuel handling, fuel combustion, boilers, prime movers, generators and power transmission."(G-5)

"If there is a significant amount of ash, the handling, transport and disposal can create environmental impacts in air, water or to the land."(G-5)

"Air Toxics are not well defined, but the requirements of the Clean Air Act are becoming more restrictive for gases that may impact the ozone layer, directly impact health, or that eventually may contribut to the "greenhouse effect"."(G-5)

"..., high temperatures in combustion from about 2000 to 2200 degrees Fahrenheit will either eliminate or reduce these compounds [dioxins and furans] to acceptable levels if they are present."(G-5)

- Cultural Resources

"... the project area, although a portion of the original Puyallup Reservation, was not used as a habitation site by the Native American population in the past because the land was unstable and subject to flooding followed by long periods of inundation. Therefore, there are no archaeological resources that will be subject to impact ...."(G-12)

"There are no archaeological or historic resources that would be subject to impact by the Steam Plant." (G-12)

(Biomass Cogeneration Impacts Continued)

- Aesthetics

"There will be no additional visual impacts from the Plant structure because the existing facility would not be changed. The steam plume from the plant will be visible up to 25 percent of the time, mostly in winter. Nightime illumination of the building makes it noticeable; such illumination is required by ..."(G-12)

"Visible plumes of water vapor are expected to be relatively infrequent. When they do occur, they would rise significantly higher than the 11th Street Bridge and Hylebos Waterway and, therefore, would not fog the bridge surface or impair visibility for passing drivers or for ships."(G-12)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

- Noise

"In summary, no long-term impacts (exceeding Washington State Daytime Noise Standards) are expected as a result of the operation of Steam Plant No. 2. Additional noise measurements will be taken to determine if the Steam Plant complies with the nighttime noise standards."(G-12)

- Health and Safety

"The cumulative cancer risk from inhalation of chromium in the area of maximum impact is 2.0 x 10-5 (or approximately two chances per 100,000 exposed individuals). The chemical attributing the greatest risk is chromium, with a lifetime cancer risk of 10-5. For other chemicals, the range is 10-6 to 10-7. By comparison, EPA has typically considered risk levels ranging from 10-4 to 10-7 as acceptable. In comparison "everyday" risks of contracting cancer; however; are far greater than those posed by the emissions from the Steam Plant." (G-12)

"Noncarcinogenic health effects are not expected for individuals exposed to facility emissions over a 30-year period in the area of maximum impact."(G-12)

"The preliminary results of the stack testing confirm that the effects of the stack emissions from the Steam Plant are not significant."(G-12)

"Concerns may be expressed if fuels have to be hauled in or solid wastes hauled out."(G-5)

"Sludges, if present, are usually combustible and there are environmental problems in transporting to a site and in handling at the site."(G-5)

"Odor control may be the biggest problem."(G-5)

"In air, water or solids media there may be possible hazardous substances that are of concern as health problems or are perceived by the public to be health problems."(G-5)

"Health effects in humans include shortness of breath, coughs, viral respiratory infections, and allergic reactions when inhaled as respirable particles."(G-3)

"Long-term exposure to sulfur dioxide can cause chronic bronchitis and exacerbate asthma. Other effects include changes in blood chemistry, enzyme levels, lung capacity, and pulmonary resistance."(G-3)

"Sulfur dioxide is also believed to have carcinogenic effects."(G-3)

(Biomass Cogeneration Impacts Continued)

"Acid rain is known to acidify lakes, harm certain key flora, corrode buildings, bridges, and other infrastructure, and is major culprit in impairing visibility. It is also believed to be a carcinogen."(G-3)

"NO2 is a gas that can irritate membranes and can cause coughs and headaches."(G-3)

"Carbon monoxide is a colorless, odorless gas. It interferes with the body's ability to deliver oxygen throughout the body. Moderate levels of oxygen deficiencies have caused vision and brain dysfunction. Headaches, nausea, irregular heart beat, weakness, and confusion can also be caused by exposure to high levels of carbon monoxide. At the extreme, exposure to high levels of carbon monoxide can cause death."(G-3)

"The results of the fugitive dust modeling analysis show ... impacts well below the levels considered to be significant."(G-12)

"Visible plumes of water vapor are expected to be relatively infrequent. When they do occur, they would rise significantly higher than the 11th Street Bridge and Hylebos Waterway and, therefore, would not fog the bridge surface or impair visibility for passing drivers or for ships."(G-12)

- Socio-economics

"No significant impacts to the Tacoma Police Department are foreseen; however, the service of the Police Department may occassionally be required."(G-12)

"No effects on school enrollment or school bus routes are expected."(G-12)

"Although the plant may use the Fire Department, the Tacoma Fire Department foresees no new burden on existing fire fighting services as a result of adding the Plant to its service area."(G-12)

"Accidents may occur at the Plant; however, current medical and ambulance services in the Tideflats and City areas are expected to be able to handle any such occurrences."(G -12)

"Since the Plant will only employ 34 workers, impacts on employment, housing, and traffic will not be significant."(G-12)

"Property values in the Tideflats area would not be affected."(G-12)

"Financial impacts would occur in several categories: construction costs have generated $2.6 million in sales tax revenue for the City and State; burning solid waste will extend the life of the Tacoma landfill and help maintain garbage disposal rates near their current level for the next ten years."(G-12)

"NO2 can react with moisture to form nitric acid (acid rain), which is known to damage buildings bridges, and other infrastructure, as well as fish, vegetation, soil, and surface water."(G-3)

"The incremental effect of fuel handling for refuse derived fuel is zero."(G-3)

"The effects from moving wood residues from where they are located to the power plant are minimal." (G-3)

"Because cogeneration is more efficient(than biomass generation without multiple use of process heat), each level of refuse derived fuel burned in the process results in more useful work. Therefore, the amount of pollution per unit of useful work is lower when refuse derived fuel is being burned in a cogeneration mode." (G-3)

(Biomass Cogeneration Impacts Continued)

"Odor control may be the biggest problem."(G-5)

"Because cogeneration is a more efficient use of fuel, it is generally cost effective for site-specific power/ heat generation."(G-5)

LOAD CURTAILMENT

Land Use - Industry and Cooperatives

GENERIC SERVICES PROVIDED BY ENERGY (NA-3)

"Loss of illumination
Commercial impacts: safe locomotion, security, paperwork, loss of display
Industrial impacts: safe locomotion, security, paperwork
Transportation impacts: safe locomotion, roads, terminals, runways
Special Problem Areas: evening activities

Space Conditioning
Commercial impacts: comfort/safety, temperature, humidity,smoke,pollen
Industrial impacts: comfort/safety, temperature, humidity,smoke,pollen

Mechanical Drive
Commercial impactst:elevators, food preparation,cleaning,office equipment
fuel pumps
Industrial impacts: elevators, heavy equipment, office equipment, fuel pumps
Transportation impacts: propulsion
Special Problem Areas: high rise buildings, sewage transport, sewage treatment

Cooking and Refrigeration
Commercial Impacts: food preparation, preservation of perishables
Industrial Impacts: preservation of perishables, liquification
Special Problem Areas: morgue, industrial continuous process heat

Other
Commercial Impacts: alarm systems (fire, crime), communication (telephone, radio, television), cash registers.
Industrial Impacts: alarm systems (fire, crime), communication (telephone, radio, television).
Transportation impacts: traffic signals, radio communication
Special Problem Areas: Fire and Police Departments

Health and Safety - Industry and Cooperatives

"If possible, utilities try to identify users who would suffer great hardship and then isolate them in the distribution grid so that their service can be maintained while others nearby are curtailed."(NA-3)

"Generally the longer the warning time prior to an outage, the more selective load curtailment can be. For this reason, planned outages tend to be less costly than unplanned."(NA-3)

(Curtailment Impacts Continued)

GENERIC SERVICES PROVIDED BY ENERGY (NA-3)

"Loss of illumination
Commercial impacts: safe locomotion, security, paperwork, loss of display
Industrial impacts: safe locomotion, security, paperwork
Transportation impacts: safe locomotion, roads, terminals, runways
Special Problem Areas: evening activities

Space Conditioning
Commercial impacts: comfort/safety, temperature, humidity,smoke,pollen
Industrial impacts: comfort/safety, temperature, humidity,smoke,pollen

Mechanical Drive
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Industrial impacts: elevators, heavy equipment, office equipment, fuel pumps
Transportation impacts: propulsion
Special Problem Areas: high rise buildings, sewage transport, sewage treatment

Cooking and Refrigeration
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Industrial Impacts: preservation of perishables, liquification
Special Problem Areas: morgue, industrial continuous process heat

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Commercial Impacts: alarm systems (fire, crime), communication (telephone, radio, television), cash registers.
Industrial Impacts: alarm systems (fire, crime), communication (telephone, radio, television).
Transportation impacts: traffic signals, radio communication
Special Problem Areas: Fire and Police Departments

Socio-Economics - Industry and Cooperatives

"Loss of illumination
Commercial impacts: safe locomotion, security, paperwork, loss of display
Industrial impacts: safe locomotion, security, paperwork
Transportation impacts: safe locomotion, roads, terminals, runways
Special Problem Areas: evening activities

Space Conditioning
Commercial impacts: comfort/safety, temperature, humidity,smoke,pollen
Industrial impacts: comfort/safety, temperature, humidity,smoke,pollen

Mechanical Drive
Commercial impactst:elevators, food preparation,cleaning,office equipment fuel pumps
Industrial impacts: elevators, heavy equipment, office equipment, fuel pumps
Transportation impacts: propulsion
Special Problem Areas: sewage transport, sewage treatment

(Curtailment Impacts Continued)

Cooking and Refrigeration
Commercial Impacts: food preparation, preservation of perishables
Industrial Impacts: preservation of perishables, liquification
Special Problem Areas: morgue, industrial continuous process heat

Other

Commercial Impacts: alarm systems (fire, crime), communication (telephone, radio, television), cash registers.
Industrial Impacts: alarm systems (fire, crime), communication (telephone, radio, television).
Transportation impacts: traffic signals, radio communication
Special Problem Areas: Fire and Police Departments

"Generally the longer the warning time prior to an outage, the more selective load curtailment can be. For this reason, planned outages tend to be less costly than unplanned."(NA-3)

1) ...BPA may request metered requirements customers to operate their resources to assist BPA in meeting its total loads. The effect of this provision depends on the number of metered requirements customers in the Puget Sound region which have generating resources.(EXISTING BPA CONTRACT RIGHT)

RESULT:
For hydro resources, operation to assist in meeting peak loads could result in drafting a project to lower levels, which could result in reduced generation due to reduced head.

For thermal resources, operation to help BPA meet its loads could require delaying anticipated outages to offpeak hours, or until adverse weather conditions end, which could result in increased maintenance costs and heightened risks of forced outages if preventive maintenance is delayed.

2) ... permits BPA to limit peak deliveries to utilities served as computed requirements customers.(EXISTING RIGHT)

RESULT:
Unless the affected utilities were able to take steps to reduce peak loads before the limitation went into effect, though, the total peak load in the Puget Sound region would remain the same, and the affected utilities would be obliged to find other sources to replace the BPA peaking lost to the limitation.

3) ... would be the mutual obligation, between parties to power sales contracts, to provide emergency and breakdown relief, as stated in ...(EXISTING RIGHT)

RESULT:
Unless the affected utilities were able to take steps to reduce peak loads before the limitation went into effect, though, the total peak load in the Puget Sound region would remain the same, and the affected utilities would be obliged to find other sources to replace the BPA peaking lost to the limitation.

4) Interrupt DSI loads(EXISTING RIGHT)

RESULT:
The principal DSI loads are primary aluminum plants, which can endure the agreed types of interruptions with little economic loss other than lost production.

The effect of interruption on the DSI's is to stop or reduce production, unless replacement power can be obtained.

(Curtailment Impacts Continued)

5) Once DSI loads have been interrupted, if additional measures are needed to avoid a voltage collapse, ... BPA may interrupt service or reduce deliveries to any of its customers, including DSI's if ... due to system emergencies. ...Potential interruptions due to system emergencies would most likely follow existing plans for load dropping.

RESULT:
By interrupting some loads, operators may be able to avoid a collapse which would effectively interrupt all loads.

Potential impacts of load dropping would include lost production or sales, spoilage, potential hazards to workers or the public, interruption of pollution control operations, and impacts of use of substitute energy supplies (fossil fuels or wood)

Health and Safety, air quality, indirect effects i.d. for fossil fuels"

Fish

1) ...BPA may request metered requirements customers to operate their resources to assist BPA in meeting its total loads. The effect of this provision depends on the number of metered requirements customers in the Puget Sound region which have generating resources.(EXISTING RIGHT IN BPA CONTRACTS)

Other constraints on hydro operations, to protect fisheries or maintain levels necessary for fish and wildlife or recreation, may limit a project owner's ability to change operations.

NO ACTION

- Health and Safety

"One effect would be increased injury (and death) from falls, especially for the elderly who cannot see well and young children who see well but act wtih poor judgement."(NA-3)

"If possible, utilities try to identify users who would suffer great hardship and then isolate them in the distribution grid so that their service can be maintained while others nearby are curtailed."(NA3)

"Generally the longer the warning time prior to an outage, the more selective load curtailment can be. For this reason, planned outages tend to be less costly than unplanned."(NA-3)

"The number of known deaths resulting from the blackout is two. However an examination of the mortality data suggest that the number of deaths around the time of the blackout increased, particularly for those 65 years old or older."(NA-1)

GENERIC SERVICES PROVIDED BY ENERGY (NA-3)

"Loss of illumination
Residential impacts: safe locomotion, security, paperwork, decoration
Commercial impacts: safe locomotion, security, paperwork, loss of display
Industrial impacts: safe locomotion, security, paperwork
Transportation impacts: safe locomotion, roads, terminals, runways
Special Problem Areas: evening activities

(No Action Impacts Continued)

Space Conditioning
Residential impacts: comfort/safety, temperature, humidity,smoke,pollen
Commercial impacts: comfort/safety, temperature, humidity,smoke,pollen
Industrial impacts: comfort/safety, temperature, humidity,smoke,pollen

Mechanical Drive
Residential impacts: elevators, food preparation,cleaning,hygiene,grooming
Commercial impactst:elevators, food preparation,cleaning,office equipment
fuel pumps
Industrial impacts: elevators, heavy equipment, office equipment, fuel pumps
Transportation impacts: propulsion
Special Problem Areas: high rise buildings, sewage transport, sewage treatment

Cooking and Refrigeration
Residential Impacts: food preparation, preservation of perishables
Commercial Impacts: food preparation, preservation of perishables
Industrial Impacts: preservation of perishables, liquification
Special Problem Areas: morgue, industrial continuous process heat

Other
Residential Impacts: alarm systems (fire, crime), communication (telephone, radio, television)
Commercial Impacts: alarm systems (fire, crime), communication (telephone, radio, television), cash registers.
Industrial Impacts: alarm systems (fire, crime), communication (telephone, radio, television).
Transportation impacts: traffic signals, radio communication
Special Problem Areas: Fire and Police Departments

- Socio-economics

"There are probably as many quality -of-life scales as there are people doing such research, but the one we adopted ...has 14 indicators of the quality of life. When we compare our data with these 14 indicators, we found that, during an outage 6 of the 14 definately deteriorate, 4 probably deteriorate and 4 stay about the same. None would be expected to improve. This supports my personal and professional conclusion that the quality of life and the social well-being of our society depend on the availability of adequate and reliable electric power."(NA-2)

GENERIC SERVICES PROVIDED BY ENERGY (NA-3)

(unavailable if electrical service is curtailed)

"Loss of illumination
Residential impacts: safe locomotion, security, paperwork, decoration
Commercial impacts: safe locomotion, security, paperwork, loss of display
Industrial impacts: safe locomotion, security, paperwork
Transportation impacts: safe locomotion, roads, terminals, runways
Special Problem Areas: evening activities

Space Conditioning
Residential impacts: comfort/safety, temperature, humidity,smoke,pollen
Commercial impacts: comfort/safety, temperature, humidity,smoke,pollen

(No Action Impacts Continued)

Industrial impacts: comfort/safety, temperature, humidity,smoke,pollen

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Transportation impacts: traffic signals, radio communication
Special Problem Areas: Fire and Police Departments

"Generally the longer the warning time prior to an outage, the more selective load curtailment can be. For this reason, planned outages tend to be less costly than unplanned."(NA-3)

"When the power goes off, all users will turn to alternative energy sources. Some must do so by law. Hospitals, nursing homes, federal prisons, essential communications, airports, and drawbridges on essential travel routes are generally required to have standby generators and fuel reserves. Others, such as farms (milking and keeping livestock in confinement), greenhouses, and computer systems, do likewise for economic reasons. Often, however, users cannot afford such equipment because their energy needs are too large." (NA-3)

"Recurrent or extensive shortages may marshal forces for reduced environmental controls"(NA-4)

"Scapegoating — looking for the villian — will undoubtedly occur in the face of significant major or repeated electrical systems failure."(NA-4)

"Many short-term antisocial effects, as evidenced by the wide-scale thefts in the ghettos of New York, might accompany similar furture events."(NA-4)

"Shortages might very well lead to local dislocations for both direct value and symbolic value, as in turning out the lights in Las Vegas or dimming Broadway."(NA-4)

"Recurring long-term serious or intermittent shortages will stimulate desires for federal intervention."(NA-4)

"Many potenial costs have not been included in Table 4-2 because of our inability to determine them with any accuracy within the scope of this study. Example... include the following:

- Losses in retail business

(No Action Impacts Continued)

- City, State, and Federal tax revenue losses
- Procuction time loss
- Computer industry losses
- Total loss interest for the banking industry"(NA-1)

"- Impacts to Business

The direst costs due to a power interruption ... can be attributed to the following:

- Lost production time
- Damaged plant equipment
- "Spoiled" product
- Additional maintenance costs"(NA-1)

"In the NYC experience only about 20% of the total losses to business($34 million) can be attributed directly to the blackout; the balance($155 million) was related primarily to looting and arson of small business establishments."

"In general, the first things that come to mind as potential computer related costs due to a loss of power include:

- Possible damage to the computer and peripheral equipment
- Loss of data
- Costs associated with the inability of the computer to perform important functions or application

There is generally danger of equipment damage or loss of data so long as the outage is of short duration."(NA-1)

" - Impacts on Government

City, state, and federal agencies all faced considerable expense in dealing with the blackout. The major expenses were of course those related to controlling and recovering from the looting , but, due to the duration of the power interruption other expenses such as lost tax and public transportation revenue became significant as well. The major indirect expenses collected to date are:

- Overtime payments to fire, police, and other personnel
- Emergency aid payments not covered by insurance"(NA-1)

" - Impacts on Consolidated Edison

A large financial burden was experienced by Consolidated Edison itself in recovering from the blackout....revenue losses and other restoration costs were reported to be nearly $10 million in additon to overtime payments during the recovery period which were nearly $2 million. New capital equipment and installation costs for prevention of future incidents currently total nearly $65 million. Finally, 118 legal suitsf(then pending) against Consolidated Edison total over $10 billion."(NA-1)

" - Insurance Payments

The combined insurance payments total about $33.5 million. "(NA-1)

(No Action Impacts Continued)

" - Public Health Services

Both public and private hospitals were effected by the blackout. It appears that many backup power systems were inadequate for many hospital activities. To date the only available cost data is that concerning the increased cost to public hospitals($1.5 million)

" - Other Public Services

- The NYC police department reports overtime payment of about $4.4 million
- Suspension of electrified mass transit ... Revenue losses estimated ... $2.6 million
- The NYC fire department $.5 million in overtime payments. New fire stations had emergency power systems, but older stations did not."

"...key impacts that occurred as a result of the blackout:

- changes in transportation patterns, the blackout affected transportation significant distances from NYC. Disturbance in air travel was minor in comparrison to rail and motor traffic. (15,000 people were stranded at Kennedy Airport after 10:00 p.m.)
- The need for increased information flow (and presumably the strain and concern felt by many) was evidenced by the number of emergency news telephone messages requested...over 800,000 calls during the blackout (10,000 normal)"(NA-1)"

"The number of known deaths resulting from the blackout is two. However an examination of the mortality data suggest that the number of deaths around the time of the blackout increased, particularly for those 65 years old or older."(NA-1)

" The most "visible" aspect of the blackout-related social impacts was, of course, the looting, arson and other acts of wanton violence and destruction.