

Analysis of Alternatives (WAC 463-42-645)

WAC 463-42-645 ANALYSIS OF ALTERNATIVES.

The applicant shall provide an analysis of alternatives for site, route, and other major elements of the proposal.

[Statutory Authority: RCW 80.50.040(1) and chapter 80.50 RCW. 81-21-006 (Order 81-5), §463-42-645, filed 10/8/81. Formerly WAC 463-42-150.]

9.1 ANALYSIS OF ALTERNATIVES (WAC 463-42-645)

9.1.1 INTRODUCTION

As a part of developing the proposed Phase II Satsop CT Project, Duke Energy Grays Harbor, LLC, and Energy Northwest (the Certificate Holder) considered alternatives for cooling technologies and water discharge. The discussion on discharge alternatives is located in Subsection 2.8.5. The discussion on alternative cooling technologies is included below in Subsection 9.1.2.

No alternative sites were considered for Phase II for the following reasons:

- The existing Satsop CT site is being developed for gas-fired power production and is appropriately zoned.
- The Certificate Holder owns the site, and therefore is able to maintain site control.
- There is adequate space within the existing approved site for the construction of Phase II.
- Locating within the existing site will maximize the use of an already disturbed site, and eliminate the need to use more land.
- The natural gas pipeline line and electrical transmission lines installed for Phase I are adequately sized for Phase II, eliminating the need to establish new utility line corridors as would be the case for an alternative site.
- The electrical transmission lines provide the ability to wheel power to BPA or other utilities using the BPA transmission system.
- The plant site is located near regional load growth centers, minimizing the need to wheel power over long distances and contributing to the stability of the BPA transmission system.
- There is an existing infrastructure on the property, including access roads, water wells developed for the nuclear program, and a discharge line and approved NPDES outfall.

9.1.2 ALTERNATIVE COOLING TECHNOLOGIES

Four cooling system alternatives were considered: once-through cooling, mechanical draft (wet) cooling, parallel condensing (wet/dry), and dry (air) cooling. The Certificate Holder has determined that a mechanical draft (wet) cooling tower system, identical to that being installed for Phase I, is the most appropriate for the site.

9.1.2.1 Consideration of Alternatives

The consideration of alternatives focused on several factors: (1) whether the cooling system would fit within the space available at the site; (2) whether sufficient water was available; (3) whether the

cooling system would increase noise levels associated with the project; (4) how the system would affect capital and operational costs; (5) the effect of the system on the project's electrical output and efficiency (i.e., its parasitic load); and (6) the visual effects of the system.

Space Available

The Satsop CT site has approximately 10 acres available for construction of Phase II. The site is bounded on the west side by Keys Road, and on the east side by a wildlife mitigation area. The wildlife mitigation area was established for the Satsop nuclear power plants and is maintained by the Grays Harbor Public Development Authority (PDA). The PDA owns the land surrounding the site.

Available Water Supply

The nuclear projects were authorized to withdraw 80 cfs of water, of which approximately 88 percent was to come from the Chehalis River, and approximately 12 percent from groundwater. Ranney wells were installed to provide the water supply. With the amendment to the Site Certification Agreement (SCA) for the Satsop Combustion Turbine (CT) Project (Phase I), the Washington Public Power Supply System (Supply System) agreed to relinquish all but 9.5 cfs if the two nuclear plants did not go forward. The 9.5 cfs was allocated in the SCA to the Phase I project. Subsequently, the Satsop power plant site, with the exception of the CT site, was transferred by Energy Northwest (formerly the Supply System) to the PDA, and the Washington State Legislature agreed to allocate 20 cfs of water to the PDA for industrial uses at the Satsop Development Park.

With the wet cooling system proposed in this Amendment Application, Phase II will require the same amount of water as Phase I (a maximum instantaneous flow of 9.5 cfs). The PDA has agreed to sell the Certificate Holder 9.5 cfs of water from its authorization of 20 cfs. No new water rights or authorization would be required, and there is sufficient water available for the proposed wet cooling system.

Additional Noise Impacts

Noise levels were another consideration. There are no residences directly adjacent to the site, but there are homes located to the west and north. As part of the Phase I development, a 25-foot-high noise wall, with a 12-foot-high landscaped berm on the street side of the wall, are being installed. The projected-related noise levels are discussed in Section 4.1 - Environmental Health, WAC 463-42-352, and assume that the proposed wet cooling system is used. Air cooling or parallel (wet/dry) systems that use more fans would result in higher noise levels.

Capital and Operating Costs

Relative capital and operating are an important consideration in determining whether a project is financed and built. Although a once-through cooling system might be less expensive, the Certificate Holders have proposed mechanical draft (wet) cooling to reduce water use. Air-cooled and parallel cooling systems are considerably more expensive to construct and operate.

Parasitic Load

The Certificate Holder also considered the relative effect of different cooling systems on the electrical output and efficiency of the facility. All mechanical cooling systems require some form of power to operate, and this "parasitic load" reduces the amount of net power generated by the facility. The more fans that are required for cooling, the higher the energy demand. Parallel cooling systems use approximately 7 MW of power, while an all-dry cooling system would require 10 or more MW of power. This is power that could otherwise be added to the area's energy supply. The corresponding reduction in the facility's efficiency would also result in an increase in regulated and greenhouse gas emissions per unit of electricity produced.

Visual

Although these power plants are somewhat large in scale and are industrial in nature, much as been done with the Satsop site to reduce the visual appearance. Visual impact reduction started with the construction of the 12-foot-high landscaped berm along Keys Road. This visual barrier is supplemented with the 25-foot-high noise wall directly behind the berm. Equipment will be painted in earth tones to reduce visual contrast with the surrounding wooded areas. Cooling fans for either a parallel system or an air cooling system need to be approximately 100 feet in height to provide adequate clearance for air movement.

For the reasons described in more detail below, wet cooling was selected as most appropriate for the site, and the other three alternatives were rejected.

9.1.2.2 Once-through Cooling

This alternative was rejected because it would require more water than is currently available. Once-through cooling systems use a large water body, such as the Chehalis River, as a heat sink. Water from the Chehalis River (or the Ranney wells if they could provide a sufficient volume of water) would be continuously circulated through a heat exchanger to transfer waste heat to the cooling water, which would be discharged to the river. This system would require the use of a large volume of water from the Chehalis River or the Ranney wells, likely requiring water rights in addition to those held by the Grays Harbor PDA or the 9.5 cfs allowed for Phase I by the Site Certification Agreement.

In addition, without the use of a cooling tower, it is unlikely that the temperature of the water returned to the river could comply with the temperature limitations in the existing NPDES permit. The discharge temperature could also be sufficiently high to result in impacts to the aquatic resources of the river. If the Ranney wells could not provide the required volume of water, this alternative would also require construction of large intake and discharge structures, the operation of large pumps to maintain the correct water flow rates, additional water rights, and a major revision to the NPDES permit.

Another method of accomplishing once-through cooling would be to construct a large cooling pond in the vicinity of the project site. However, the volume of water required for cooling would be enormous, and it is unlikely that the Certificate Holder could obtain sufficient water rights to fill the

cooling pond and maintain the appropriate water level during operation. In addition, the project site does not have enough space to construct a large cooling pond, and the potential environmental impacts associated with such a pond would be much greater than those associated with the proposed system.

Once-through cooling was rejected due to potentially higher environmental impacts as compared to the proposed method of heat dissipation, the anticipated difficulties in meeting permit requirements, and the anticipated difficulty of acquiring additional water rights.

9.1.2.3 Parallel Condensing (Wet/Dry) Cooling

The parallel condensing (wet/dry) cooling system is a method of condensing steam from the steam turbine using both a standard steam surface condenser (SSC) and an air-cooled direct condenser (ACC). This system, known as the PAC System™, a registered trademark of GEA Power Cooling Systems, Inc., is also sometimes called a hybrid cooling system. The PAC System can become a viable alternative to the standard all-wet cooling system in areas where water is in scarce supply.

The Certificate Holder selected the mechanical draft (wet) cooling system instead of the parallel (wet/dry) cooling system because the wet/dry cooling system would have required additional property, increased noise levels, reduced the facility's output and efficiency, and substantially increased costs.

Land Requirements

There is not sufficient space available on the project site to construct the PAC System. Construction of the air-cooled portion of the PAC System would require encroachment into the wildlife mitigation land to the east of the Satsop project site as shown in Figure 9.1-1. It is estimated that approximately 2.25 acres of mitigation land would be needed. It is also likely that additional mitigation land would be necessary for construction, startup, and testing of the ACC. Further, to allow proper airflow into the ACC, the mitigation area immediately surrounding the structure would need to be cleared of trees and shrubby vegetation.

Noise Impacts

Noise impacts due to the ACC portion of the PAC System are of concern for several reasons. First, a significant number of fans are necessary to meet cooling requirements and, secondly, the fan modules operate at an elevation up to 100 feet above grade. This latter concern means that barrier walls are not effective in controlling the noise because the necessary barrier benefit could only be achieved with an unreasonably high wall structure.

Noise data estimates provided by the vendor indicate that typical noise emissions from a 35 to 40 fan system are in excess of 68 dB(A) at 400 feet from the perimeter of the ACC, and in excess of 62 dB(A) at 800 feet. Noise inside each fan module can be as high as 109 dB(A). The noise attributed to the ACC would require that additional noise mitigation be installed. Since external noise controls (such as boundary barrier walls) are not practical or effective, noise control for

ACCs is essentially limited to inherent design changes for reducing noise emissions. These potential design changes may include lowering each fan’s rotational tip speed and/or using special-design blades. In both cases, each fan would need to be enlarged or the array would need to have more cells, so as to provide the necessary total cooling capacity. Therefore, the array size would have to increase and additional plot space would be required (over and above the nominal array size which would already necessitate incursion into the adjoining wooded area to the east). Also, additional or larger drive motors would be needed that could increase the noise from this part of the overall ACC system, as well as add to the cost and auxiliary loads (decreased net power output and efficiency).

To quantify the increased noise impacts from an ACC-based cooling system for Phase II, an analysis similar to the process described in Section 4.1 was performed. The results of that ACC analysis are summarized in Table 9.1-1 below.

**TABLE 9.1-1
SUMMARY OF MODELING RESULTS FOR THE CUMULATIVE PHASE I
AND PHASE II PLANTS WITH ACC COOLING OPTION**

Location	2001 Nighttime Ambient Noise Level, L_{eq} dB(A)	Maximum Allowable Contribution from Combined Project Site, dB(A)	Predicted Cumulative Contribution from Combined Projects (Ph. I + Ph. II) with water cooling, dB(A)	Predicted Cumulative Contribution from Combined Projects (Ph. I + Ph. II with ACC cooling), dB(A)	Total Predicted Future Noise Environment (Measured Ambient plus Proposed Combined Projects, Ph. I + Ph. II with ACC cooling), dB(A)
Plant W (#1)	42.8	70	52	52	52
Plant S (#2)	35.8	70	70	71	71
Plant N (#3)	34.7	70	53	53	53
Plant E ^(a)	No data	70	75	78	78
#4	42.4	50	40	43	46
#5	32.4	50	41	43	43
#6	41.2	50	37	40	44
#7	35.0	50	40	44	45

^(a) Note that with the PAC System, the east property line would be moved farther to the east to accommodate the additional space required for the PAC System. Therefore, while both measurements are predicted for the “east property line” the east property line for the PAC System would be farther to the east than the east property line for the wet system. A noise measurement taken for the PAC System at the original east property line would find noise levels approximately 10 decibels higher than predicted for the wet system. Compare Figure 9.1-2 with the figures found in Section 4.1.

Figure 9.1-2 shows combined project contributions in the mid-50 dB(A) range along the west and north property lines. With ACC, the south property line noise levels would increase to slightly over 71 dB(A); compared to the wet cooling tower system at 70 dB(A). The new, expanded site along the east would be expected to generally have noise levels in the upper-70s to low-80s range of A-weighted levels with the ACC system. The area in the adjacent wooded parcel receiving

noise levels about the 70-dB(A) limit would extend approximately 500 feet east of the original Satsop CT Project site boundary. The distant residential receptors are predicted to experience total site contributions in the mid-40s dB(A).

The table shows that compliance with the WAC noise level limits would not be achieved with the nominal ACC noise emissions along the south and east boundaries. Further, when compared to the predicted modeling results for the cumulative Phase I and Phase II plants, the change from a wet tower cooling system to an ACC cooling system for Phase II results in a 2- to 4-dB(A) increase at the distant residential receptors and a 1- to 3-dB(A) increase at the south and east ends of the plant site (for the latter, the increase would also be on top of the additional land area that would be taken by the ACC footprint). Thus, the potential site expansion to the east would have to be significantly increased to accommodate both the additional physical incursion and the higher noise levels of the ACC-based cooling alternative.

The projected ACC-based noise environment is shown graphically in Figure 9.1-1, which gives a noise map, in terms of the constant, A-weighted sound level contours in 5-dB increments on the currently planned project site from the combined Satsop CT Project, Phase I plus Phase II with the ACC configuration (including the contributions from the measured ambient noise levels).

Visual Impacts

Typical design estimates for the ACC portion of the PAC System include a structure approximately 100 feet high by 270 feet long and 200 feet wide containing between 35 and 40 fan modules or cells. The ACC structure must be elevated above grade to allow air to flow under, up, and through the condenser. Each fan module is 30 feet in diameter and contains a 200-horsepower electric motor.

Reduced Electric Generation and Efficiency

Due to the operational nature of the air-cooled portion of the cooling system, the turbine back pressure would be elevated above normal conditions and thereby reduce steam turbine output by approximately 4.9 MW with chiller on and full duct firing. In addition to the reduction in steam turbine output, the parasitic load requirement for the 35 to 40 fan modules is estimated by the vendor to be an additional 5.3 MW. In total, the net plant output would be reduced by 7.3 MW, with chiller on and full duct firing, if the PAC System were chosen as the method for cooling. The resulting loss of 7.3 MW would have to be replaced by the addition of more power plants in the region. The reduced efficiency would also result in more emissions of regulated pollutants and greenhouse gases being emitted per unit of electricity being produced.

Increased Project Costs and Construction Schedule

Estimated capital costs for constructing the PAC System are \$45 to 50 million dollars more than the capital investment for an all-wet cooling system. Currently it is believed that the timeline from time of purchase of the PAC System to commercial operation is at least 24 months. The resulting increased capital costs and carrying costs associated with a 24-month construction schedule for the PAC System would translate directly into higher production costs for energy

from the facility. Yearly operating and maintenance costs are estimated to be \$30,000 higher for the PAC System than for the proposed mechanical draft (wet) cooling system.

9.1.2.4 Dry (Air) Cooling

This alternative was eliminated because insufficient space was available at the site, it would substantial increase noise associated with the facility, it would significantly decrease the facility's power output and efficiency, and it was substantially more expensive than the proposed mechanical draft (wet) cooling system.

Construction of an entirely air-cooled system would have required an additional 4 acres of space. This would have required expanding the project site into an area currently set aside for wildlife mitigation.

As explained in regard to the parallel cooling system discussed above, the fans associated with an air cooling system generate significant amounts of noise. Although a detailed analysis was not conducted regarding the noise associated with an air cooling system, it would involve at least the 3- to 4-dB(A) increase associated with the parallel cooling system.

An air cooling system utilizes large quantities of fin tubes for the heat transfer surface. Large fans are used to transfer the heat from the finned tubes (cooling water inside the tubes) to the atmosphere. This type of cooling system can be impacted by temperature extremes that can lower power production and it has higher auxiliary power consumption. The result is a reduction in the output of the facility of approximately 10 MW. The reduced efficiency would also result in more emissions of regulated pollutants and greenhouse gases being emitted per unit of electricity being produced.

Finally, it is expected that an air cooling system would require capital expenses approximately \$45-\$50 million capital cost greater than those associated with the proposed mechanical draft system.