Regional Need for Power

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April 11, 2000

Introduction

The purpose of this report is to assess the current power supply situation in the Pacific Northwest. The Northwest region includes the states of Idaho, Oregon, Washington and the western portion of Montana. This area was defined as the "region" in the Northwest Power Planning and Conservation Act, 1980, and is geographically represented by roughly the Columbia River basin. Small portions of Wyoming, Utah, Nevada and California are included in the definition of the "region."

The primary reason for evaluating the current and likely future power supply conditions in the region is to be able to assess overall system reliability and to allow determination of the need for additional power supplies.[1] This report reviews several different approaches taken by the region's planners and utilities to assess the need for new generating resources. The results of these studies are reported and key findings are compared to provide a comprehensive picture of the region's current power supply situation. Based on these studies, estimates of the current and likely future needs for new generation are provided.

Background

There are numerous planning efforts by individual utilities, regulatory bodies and planning commissions in the region. In this report, the work of three key groups that develop long term regional forecasts of both loads and generating resources are reviewed. The implications of these studies on overall system reliability and the need for additional generating resources are discussed. The studies that are included in this report have been developed by the Bonneville Power Administration (BPA), the Pacific Northwest Utilities Conference Committee (PNUCC) and the Northwest Power Planning Council (Council). For more than 20 years these organizations have developed load forecasts, resource assessments and power plans for the region.

[1] Establishing the need for additional power supplies in this report recognizes that both supply and demand side resources could be acquired to fulfill the needs identified in these studies. The region's utilities are continuing to secure demand side conservation and these efforts are in most cases included in the load forecasts submitted by the utilities and developed by the Northwest Power Planning Council and the Bonneville Power Administration.

The BPA and PNUCC forecasts began in the early 1970s and are developed annually. These forecasts are used to determine the power supply conditions for the region's major utilities and for the region as a whole. The primary basis of these forecasts is the assessment of the region's annual energy generating capability as compared to the forecasted annual energy requirements of the region's consumers. This type of energy supply adequacy analysis is often called "critical water planning" and it has historically been used for estimating the need for new generation in the region. Critical water planning has been the basis for planning new generation because the large degree of flexibility in the region's dominant hydropower system allows us to meet rapid changes in load by simply releasing more water from the region's storage reservoirs. However, hydropower is constrained by total annual energy production, which is determined by the amount of water stored behind dams at any point in time. In conducting this type of energy analysis, the hydropower system is assumed to be capable of producing the amount of energy (measured in average megawatts - MWa) that it produced during the worst water supply conditions in a 50 year historical hydrologic record.

The Northwest Power Planning Council (Council) was formed in 1980 by the Northwest Power Act (Act). The Council is given responsibility under the Act to plan for the electric power needs of the region. The Act provides the Council with specific statutory responsibilities that are focused on developing regional power plans and on BPA's authorities to acquire new conservation or generating resources to meet BPA's obligations to regional utilities and industries. The Council, like BPA and PNUCC, has historically developed long-range power plans based on critical water planning criteria. However, recently the Council has undertaken the development of a new type of power system modeling based on the combined probability of critical water occurring during a severe cold snap. Under these conditions, electric loads increase rapidly at the very time when the output capability of the hydro system is reduced. This probabilistic analysis provides an important perspective on system reliability because it explicitly addresses problems in meeting loads over shorter time periods than are analyzed in critical water planning.

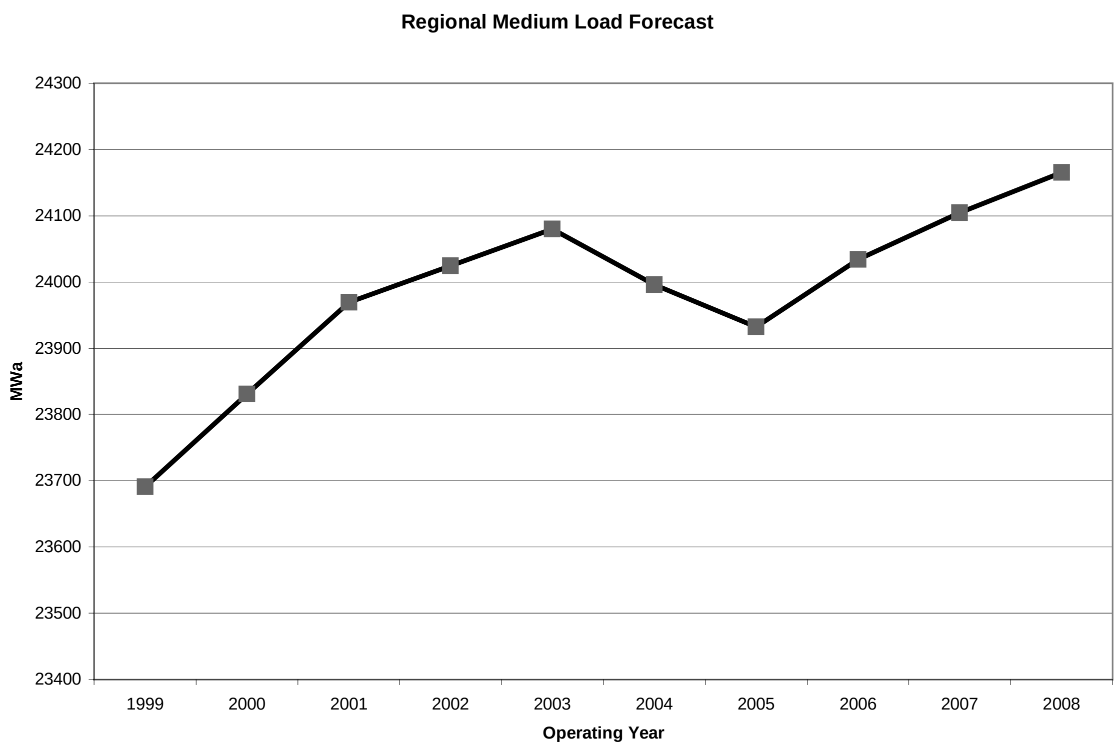
BPA's Assessment of Regional Load/Resource Balance

BPA annually prepares a report called the "White Book." The report develops a regional load forecast based on individual load forecasts for the largest regional utilities and aggregated forecasts for the remainder of the region. The purpose of the White Book is to focus on those loads that are BPA's legal and contractual responsibility to serve and to determine if there are sufficient resources available for BPA to meet the Administrator's obligations under the Act and through contracts to other customers. The report also provides BPA's assessment of regional loads served by other utilities because it is physically impossible to separate BPA's customers from the regional power grid.

The White Book includes detailed analysis of both forecasted loads and available generation. Determination of available generation is based on a current evaluation of changes that have occurred to power generating capability of the hydro system and any known changes in thermal power plant availability. Regional load forecasts are developed for all of the region's utilities. The combination of the assessment of available generating capability and forecasted loads allows BPA to prepare an overall load/resource balance. This load/resource balance provides an estimate of the size of any surplus or deficit in generating capability.

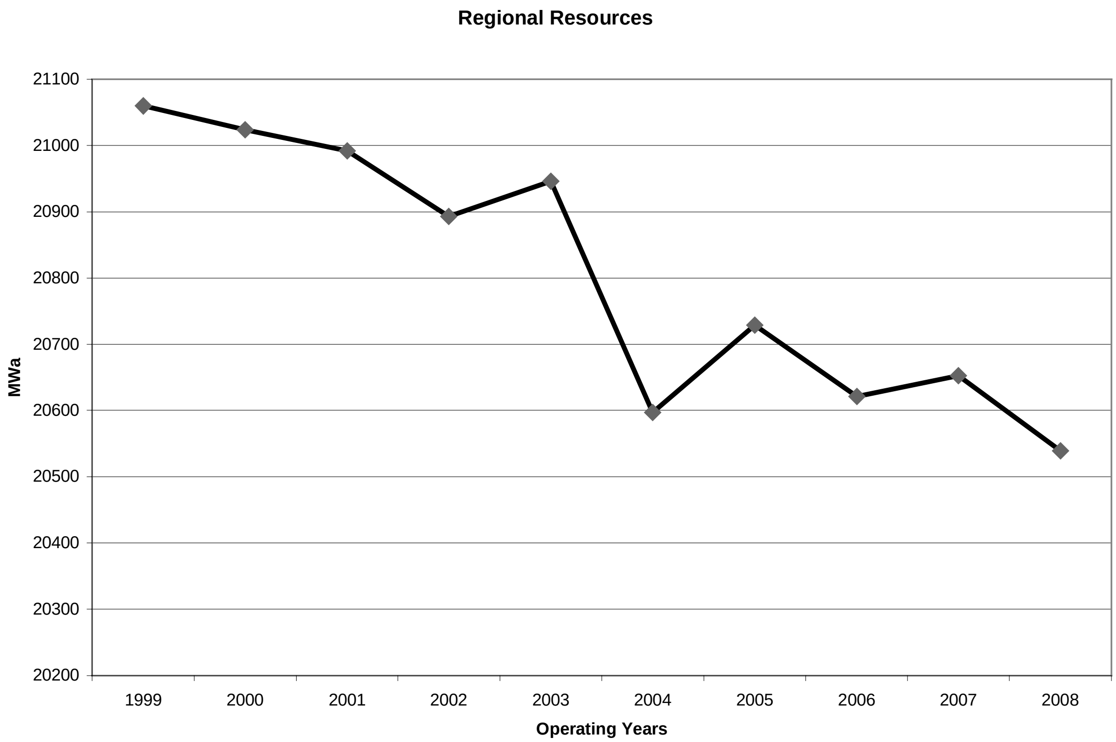
The following figure illustrates BPA's medium forecast of regional firm loads for the period beginning with operating year 1999-2000 through the operating year 2008-09. As the title of "medium" implies, this forecast represents BPA most likely load growth. In addition, BPA prepares a range of load forecasts from low to high. These more extreme forecasts provide a basis for performing risk assessments that are beyond the scope of this paper.

Figure 1 – BPA's White Book Forecast of Regional Loads



BPA also prepares a detail inventory of available generating resources in the region. This assessment includes any known changes to the availability of the hydropower system due to changing fish and wildlife or other non-power requirements. BPA also inventories all of the region's thermal resources and the non-utility generation that is serving loads in the region. The available generating resources that BPA estimates will be available to meet the region's loads over the next ten years are shown in Figure 2.

Figure 2 - BPA's White Book Forecast of Available Generating Resources



The BPA White Book combines the forecasts of regional loads with the assessment of available generating resources to estimate the most likely surplus (if generation exceeds loads) or deficits as are shown in Figure 3.

Figure 3 - BPA's White Book Forecast of Regional Deficits

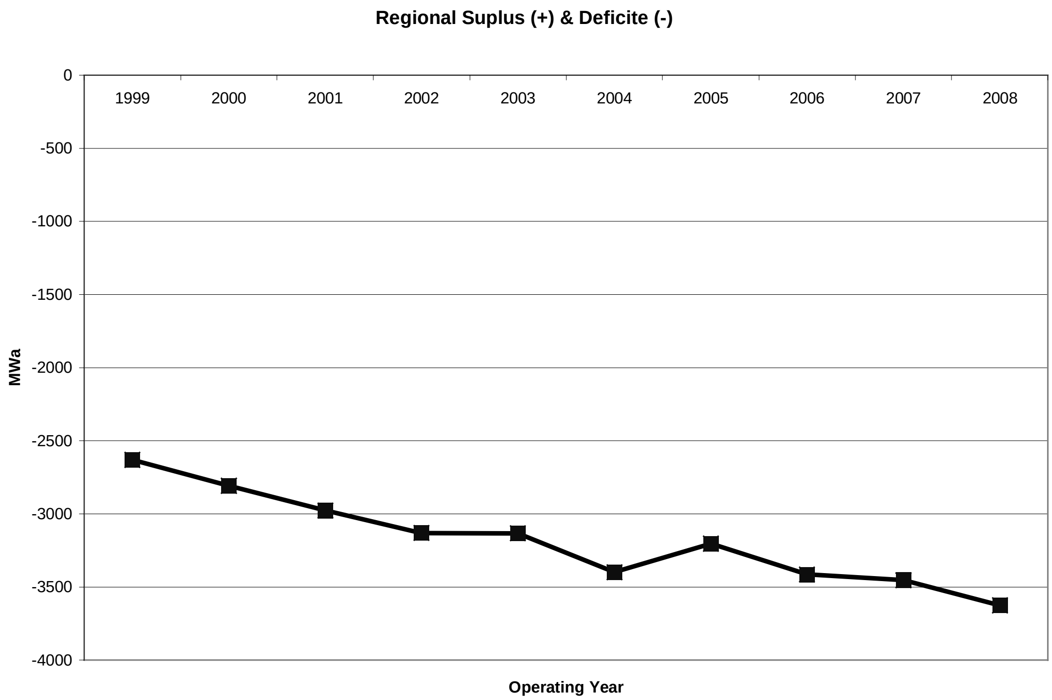


Figure 3 illustrates the growing regional energy shortage using the historical critical water planning standard. This shortage has worsened since the electric power industry's regulatory and policy shift to competitive power markets which began in 1992 with the passage by Congress of the National Energy Policy Act. Changes in national energy policy and FERC regulatory changes that flowed from national legislation have made it particularly difficult and risky for traditional electric power utilities to build new generating resources. It is primarily for this reason that there has been little resource development in the region since the mid-1990s. New resources, if they are built, will most likely be constructed by independent power producers, like NESCO, and will have to compete in wholesale power markets to economically survive. Even if utilities construct new generation it is clear that new regulatory policies will require these to be treated as "merchant plants." These merchant plants will survive or fail based on the sale of their output into the competitive power market.

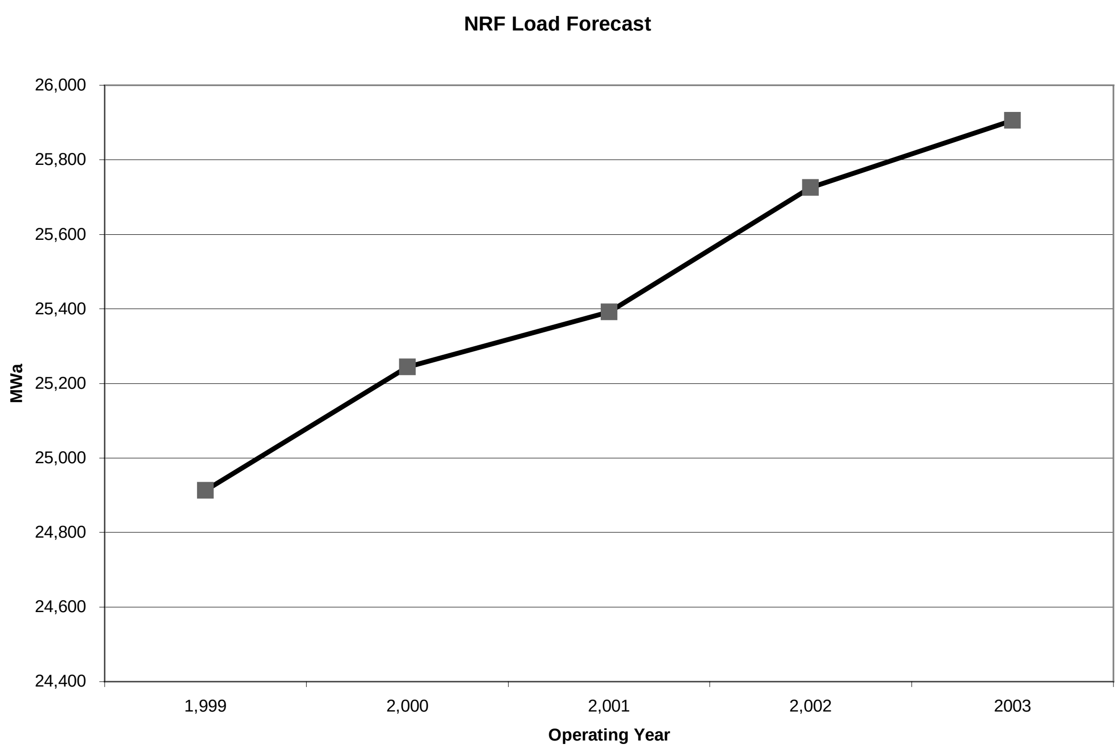
The size of the deficit predicted by BPA is unprecedented in the region. During the 1970s, the region forecast rapid rates of load growth for the 1980s but there were plans in place to construct a large number of thermal power plants to maintain load resource balance. Also, the forecasts of deficits during the 1970s were 10 or more years in the future, making them much less immediate than are today's predictions.

PNUCC's Northwest Loads and Resources Forecast

The Pacific Northwest Utilities Conference Committee (PNUCC) prepares and maintains an annual database containing individual utility forecasts of loads and resources. This database and the associated report are called the Northwest Regional Forecast (NRF). The NRF provides a different perspective, than BPA's White Book, because it is a compilation of individual forecasts prepared by the region's utilities of their loads and resources. Because the NRF compiles the individual utility forecasts it is sometimes called the "sum of utilities" forecast. The NRF provides a degree of independence from BPA's White Book because it is created by the utilities for their own purposes and does not have the BPA power contract implications of the White Book.

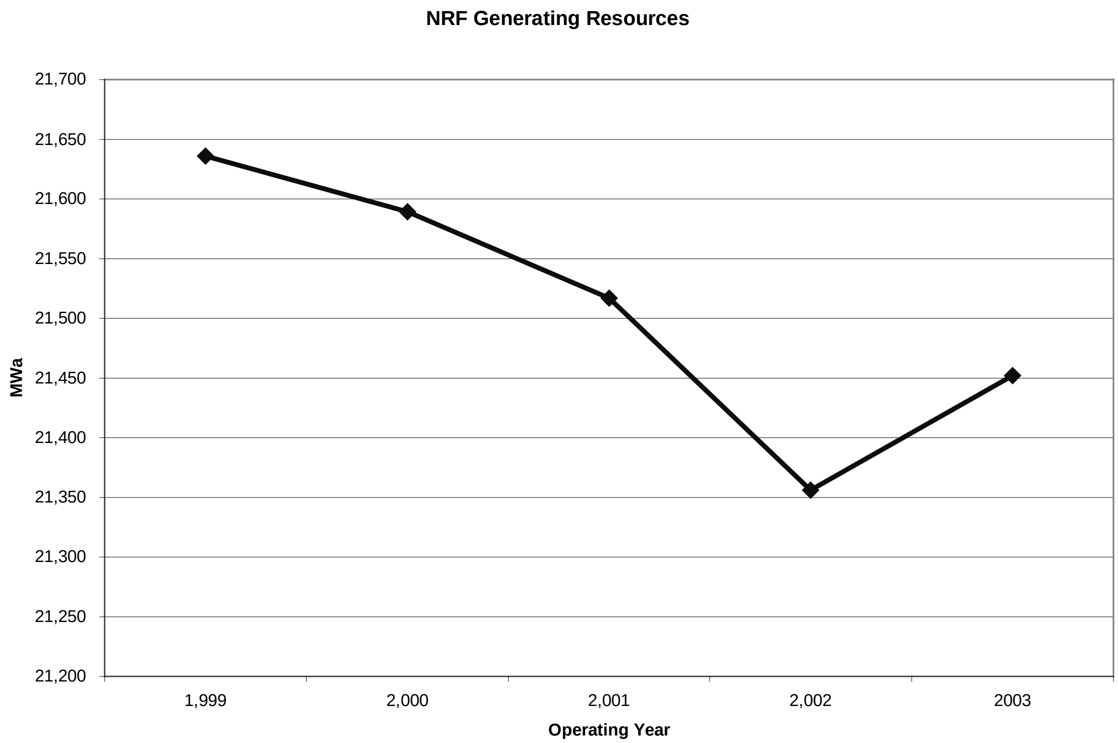
Figure 4 illustrates the NRF forecast of regional loads for the period from operating year 1999 to operating year 2003. The PNUCC forecast is similar to the BPA White Book forecast in that it represents the most likely rate of load growth that each utility forecasts. These loads are not directly comparable to those predicted by BPA due to differences between the forecasting methods used by the individual utilities and BPA's approach to forecasting regional load growth.

Figure 4 – NRF Load Forecast



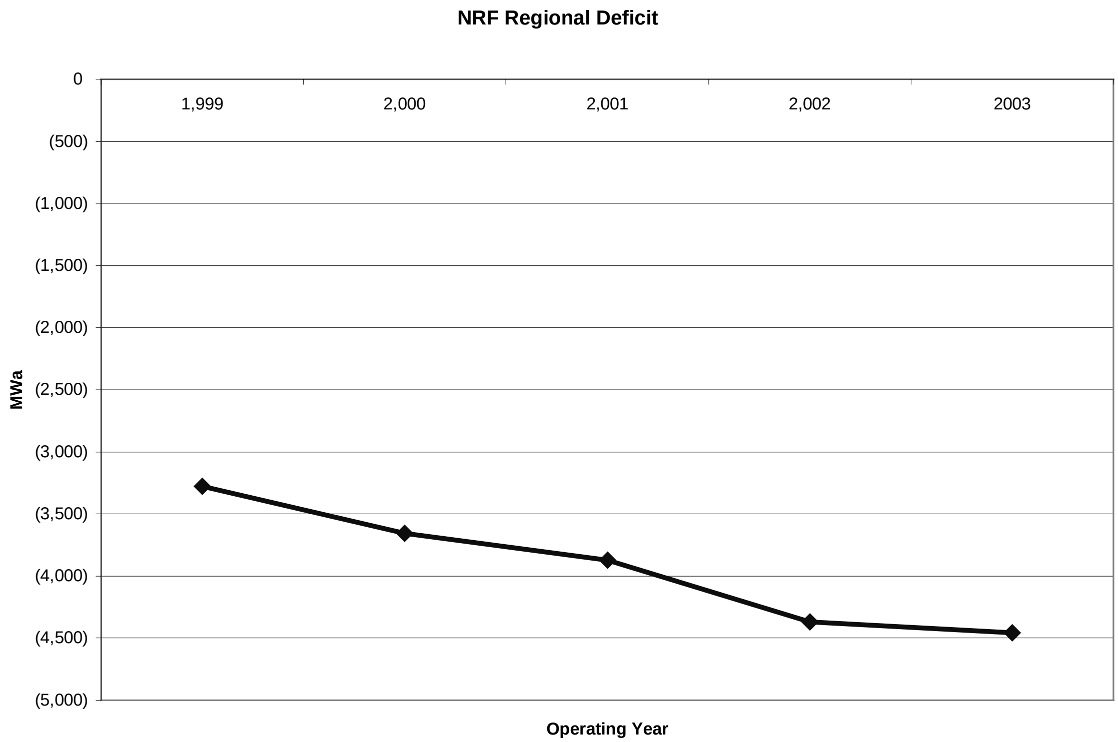
PNUCC also forecasts the available resources to meet regional loads. However, the NRF resource assessment is also not directly comparable to BPA's resource assessment. This occurs primarily from a difference in accounting for extra-regional power sales and purchases and estimates of the changes to the hydropower system from additional fish and wildlife requirements. Figure 5 shows the NRF forecast of generation resources available to meet regional loads.

Figure 5 – NRF Generation Resources



The NRF also combines the previous forecasts of loads and resources to estimate the size of any regional surplus or deficit. The NRF's estimate of the resulting regional deficit is shown in Figure 6.

Figure 6 – NRF Regional Deficit



NW Power Planning Council's Power System Reliability Studies

For more than a year, the NW Power Planning Council (Council) has been working on the development of a new regional power system model. The purpose of this model is provide the Council with a more detailed assessment of how regional power system reliability has changed with the advent of competitive power markets that have removed incentives for the region's regulated utilities to develop new generating resources. This work is currently underway and the first phase of the Council's analysis has been completed. The Council's first phase analysis is reviewed in this report and it has been presented to the public where it is under considerable discussion at this time.

The basis of the Council's analysis is a new probabilistic model of the region's power system. This model explicitly simulates the hydro system's ability for meeting load excursions caused by severe cold weather in the region. When severe cold weather events occur, electric loads in the region far exceed the levels that are normally experienced and all of the region's generating resources are called upon to meet a very rapid and large increase in electric loads. The hydropower system has historically had enough flexibility to meet these load excursions because the system was closer to load/resource balance under the conservative critical water planning standard that is used by both BPA and PNUCC. However, the current large energy deficit, assuming critical water, means that it will be increasingly difficult to meet a cold snap, should one occur.

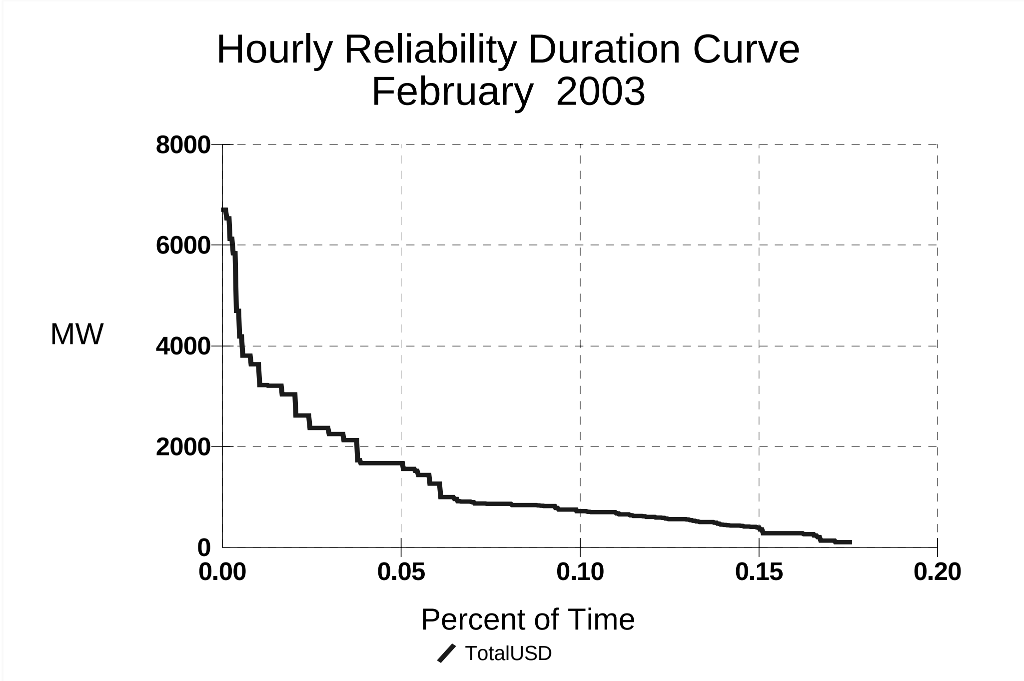
During the winter of 1989, the region experienced a two-week cold weather event that was called the Siberian Express because a large mass of very cold air moved rapidly into the region from the north. This extreme weather event put significant stress on the region's generation and transmission systems. BPA needed to obtain special permission to draft Grand Coulee at more than 2 feet per day to meet the region's electric loads. However, such a rapid rate of drawing down Lake Roosevelt runs the risk of causing land slides into the reservoir so BPA had to secure special permission from the Bureau of Reclamation. Should a "Siberian Express" occur again it will much more difficult to meet the region's needs because there is a much larger energy deficit today and the hydropower system has undergone significant changes to respond to listings of salmon and steelhead under the Endangered Species Act. These changes have greatly reduced the flexibility of the hydropower system from the levels that were used to meet past load excursions and abnormal events.

The region was able to meet loads during this event because the Council estimated that the region was 900 MWa surplus on a critical water basis! With the current critical water deficit of from 2631 MWa forecast by BPA to the 3277 MWa forecast by PNUCC, the region's ability to meet the requirements of a repeat of the 1989 Siberian Express would be seriously degraded. In my opinion it would be impossible to meet the region's needs if there is another Siberian Express similar to the one that occurred during 1989. Another Siberian Express would necessitate significant curtailment of loads in order to maintain the integrity of the electric grid for critical services.

The Council's analysis of the region's ability to meet loads during a cold snap shows that over the next few years there is a 24 percent probability of not serving all loads during the winter months of December, January and February. Utilities commonly call this the "loss of load probability" because it includes both small short duration events as well as shortfalls of a couple thousand megawatts that last over 3 or 4 days. During these simulated events there is insufficient generation to meet projected loads. This will typically result in the need to shed load or the entire electric grid will become unstable and a blackout will occur.

The Council prepared Figure 7 to illustrate the types of outages that their analysis shows the current system could experience. This graph is an outage duration curve that shows both the magnitude and frequency of outages that the Council predicts for the month of February 2003. The curve shows that there were some simulated events where the system was short by over 6000 MW! However, this was a very low probability event. The curve also shows that about 0.10 percent of the time there is an imbalance between available generation and load by more than about 700 MW and that there is about a 0.17 percent probability of there being less generation than there is load. While these estimates are for only one month the system is in jeopardy of missing load during each of the three winter months of December, January and February. Therefore, the combined probability of failing to meet load is far greater than that shown in Figure 7.

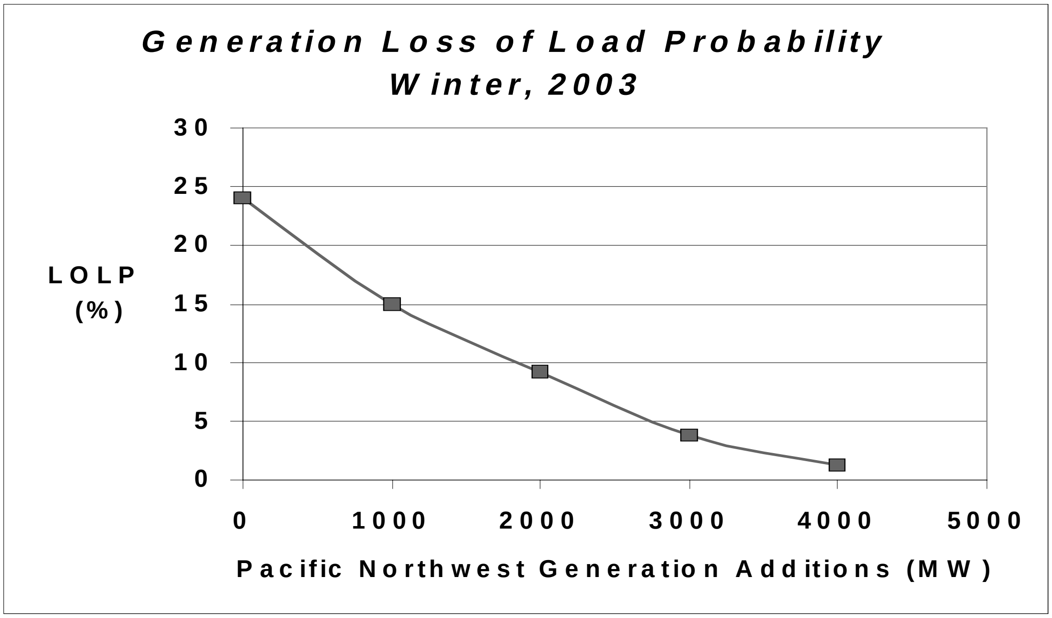
Figure 7 – Council's Estimate of the Magnitude and Frequency of Outages



The Council evaluated the likelihood of failing to meet load during the three winter months during the 2002 to 2003 period. To estimate the loss of load probability the Council simulated 1,080,000 winter hours by repeating the probable combinations of loads and generation availability for 500 simulations. This analysis found that over the 500 simulated winters there was a problem meeting loads in 120 of the simulations. This represents a loss of load probability of 24 percent.

The Council then conducted a series of studies to determine how the loss of load probability changed assuming new generation resources are added to the system. Figure 8 shows the relationship that the Council found as they assumed new generating resources are built. The curve shown in Figure 8 illustrates that to achieve a reliability standard of a 5 percent loss of load probability, 3000 MW of new generating resources would need to be added.

Figure 8 – Relationship between Reliability and Addition of New Generation



Based on its latest analysis, the Council has concluded that a 24 percent loss of load probability is unacceptable and has set a standard of one year in 20, or 5 percent as a goal for the region. To achieve a 5 percent standard in 2003, the region would need to develop about 3000 MW of new capacity. This will only be possible if there are substantial incentives for siting and constructing new generation in the region.

Conclusions

This review of three independent evaluations of the need for new electric power generation in the region has found that they each conclude that there is a very significant need for new generation. The BPA White Book predicts that the region's current need of about 2600 MWa will grow to more than 3500 MWa in ten years. This compares to the PNUCC Northwest Regional Forecast, which predicts a current regional deficit of more than 3200 MWa increasing to over 4500 MWa in five years. Although the PNUCC forecast is more pessimistic, both BPA and the NRF indicate a substantial need for new generation in the near term.

The Council's studies take a completely different approach to the question of resource adequacy in the region. However, the Council's studies have found that to restore historic levels of system reliability the region would need to add about 3000 MW of new generating capacity. Although the Council's studies are based on the need for new generating capacity, and both the White Book and the NRF are based on critical water need for additional energy generation, the addition of new combustion turbines as proposed at SE2 would help to satisfy both power supply requirements.

These three independent evaluations of the region's needs are in remarkable agreement. The BPA and PNUCC evaluation of system reliability based on historical critical water planning criteria indicate that from 2600 to 3300 MWa of new energy generating capability is needed to achieve load/resource balance and restore historical levels of system reliability. To acquire this amount of energy generation, the region would need to develop about 2900 to 3700 MW of capacity, assuming an 90 percent capacity factor for new combustion turbines. The Council's estimate of needing to acquire 3000 MW of new generating capacity to reduce the loss-of-load probability to 5 percent is at the low end of the amount that critical water planning would indicate. Given the fundamentally different approach to estimating system reliability used by the Council there is remarkable agreement that at least 3000 MW of new generation is needed to restore historical levels of system reliability.

Although there are several power plant projects in the siting, licensing or planning phases, there are no plans to construct anything close to the 3000 MW that these studies indicate is needed. For this reason, I believe that the region's system reliability will continue to degrade as loads grow and the hydro system continues to be modified to respond to ESA listings for salmon and other species. This will leave the region vulnerable to another Siberian Express until substantial amounts of new generation are sited and constructed.