Delivery Infrastructure Planning

Contents

This chapter addresses planning for the PSE-owned delivery system that delivers electricity and natural gas within our local service area to more than 1.7 million customers. Merchant-based delivery systems that involve arrangements with outside companies and organizations to transport power and natural gas to our service area are discussed in Chapter 5, Electric Analysis.

1. System Overview

Responsibilities

PSE's delivery system is responsible for delivering natural gas and electricity through pipes and wires safely, reliably, and on demand. We are also responsible for meeting all regulatory requirements that govern the system. To accomplish this, we must do the following.

- Operate and maintain the system safely and efficiently on a year-by-year, day by-day, and hour-by-hour basis.
- Accomplish timely maintenance and reliability improvements.
- Meet state and federal regulations and complete compliance-driven system work.
- Ensure that gas and electric systems meet both peak demands and day-to-day demands.

- Ensure that localized growth needs are addressed when they differ from overall system growth needs.
- Meet the interconnection needs of independent power generators that choose to connect to our system.
- Plan for future needs so that infrastructure will be in place when the need arrives.

Some of these are regional responsibilities. For instance, all PSE facilities that are part of the Bulk Electric System and the interconnected western system must be planned and designed in accordance with the latest approved version of the North American Electric Liability Corporation (NERC) Transmission Planning Reliability Standards. These standards set forth performance expectations that affect how the transmission system – 100 kV and above – is planned, operated and maintained. PSE also must follow Western Electricity Coordinating Council (WECC) reliability criteria; these can be more stringent than NERC standards at times.

PSE must also ensure that the system is flexible enough to adapt to coming changes. Smart Grid components, electric vehicles, customer distributed resources, and demand response programs are some of the effective solutions the industry is moving toward in the near future, and we need to be prepared to integrate them for the benefit of our customers.

The goal of PSE's planning process is to help us fulfill these responsibilities in the most cost-effective manner possible. Through it, we evaluate system performance and bring issues to the surface. We identify and evaluate possible solutions. And we explore costs and consequences of potential alternatives. This information helps us make the most effective, and cost-effective decisions going forward.

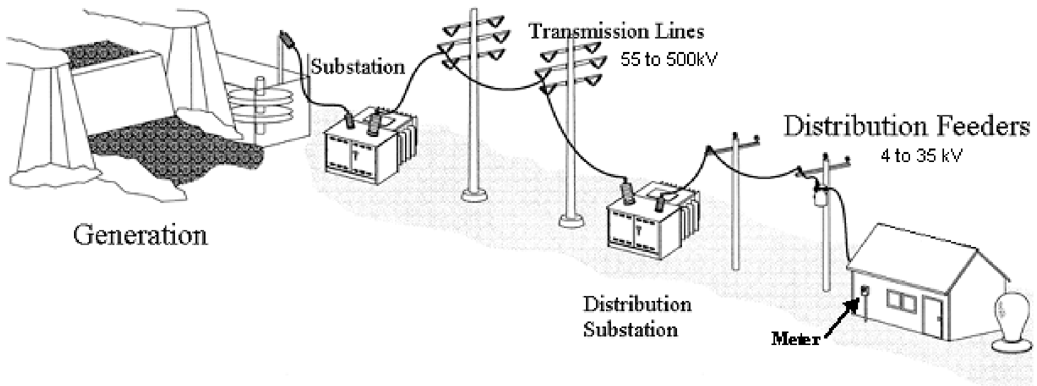
Existing System

The table below summarizes PSE's existing delivery infrastructure as of December 31, 2010. Electric delivery is accomplished through wires, cables, substations and transformers. Gas delivery is accomplished by means of pipes and pressure regulating stations.

Figure 7-1
PSE-owned Transmission and Distribution System as of December 31, 2010

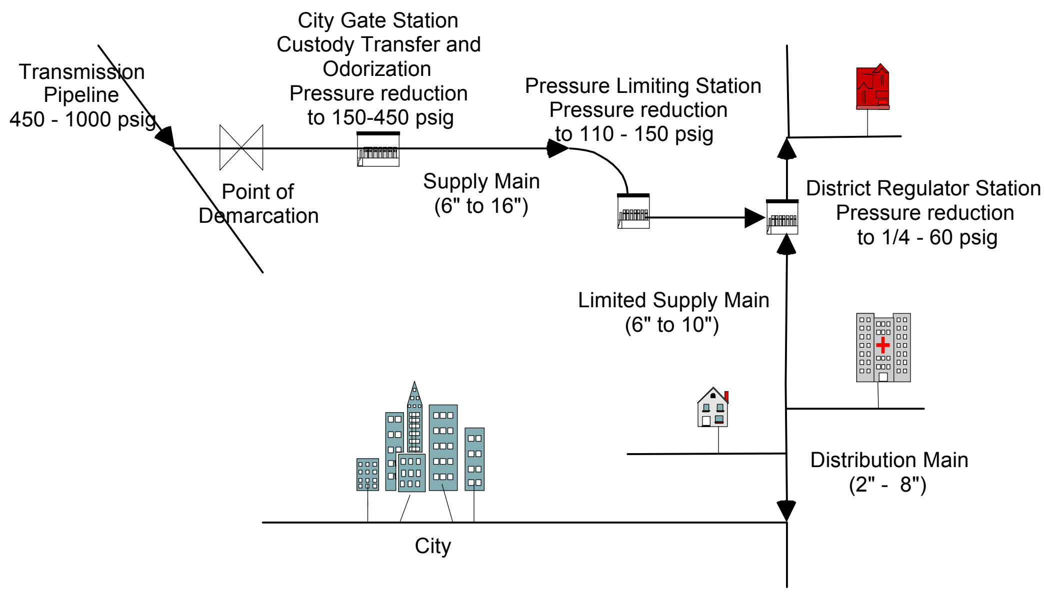
Electric	Gas
Customers: 1,074,992	Customers: 748,835
Service area: 4,500 square miles	Service area: 2,800 square miles
Substations: 354	City gate stations: 40
Miles of transmission line: 2,571	Pressure regulating stations: 652
Miles of overhead distribution line: 10,429	Miles of pipeline: 12,006
Miles of underground distribution line: 9,960	Supply system pressure: 150–550 psig
Transmission line voltage: 55-500 kV	Distribution pipeline pressure: 45-60 psig
Distribution line voltage: 4-34.5 kV	Customer meter pressure: 0.25 psig
Customer site voltage: less than 600 V	

How electric delivery systems work



Electricity is transported from power generators to consumers over wires and cables, using a wide range of voltages and capacities. The voltage at the generation site must be stepped up to high levels for efficient transmission over long distances (generally 55 to 500 kilovolts). Substations receive this power and reduce the voltage in stages to levels appropriate for travel over local distribution lines (between 4 and 34.5 kV). Finally, transformers at the customer's site reduce the voltage to levels suitable for the operation of lights and appliances (under 600 volts). Wires and cables carry electricity from one place to another. Substations and transformers change voltage to the appropriate level. Circuit breakers prevent overloads, and meters measure how much power is used.

How natural gas delivery systems work



Natural gas is transported at a variety of pressures through pipes of various sizes. Large transmission pipelines deliver gas under high pressures (generally 450 to 1,000 pounds per square inch gauge [psig]) to city gate stations. City gate stations reduce pressure to 150 to 450 psig for travel through supply main pipelines. Then district regulator stations reduce pressure to less than 60 psig. From this point the gas flows through a network of piping (mains and services) to a meter set assembly at the customer's site where pressure is reduced to what is appropriate for the operation of the customer's equipment (0.25 psig for a stove or furnace) and the gas is metered to determine how much is used.

2. *What drives infrastructure investment?*

Despite a slow economy and minimal load growth, infrastructure expenditures may stay the same or even increase. This is because load growth is only one of the drivers of infrastructure investment. Aging equipment must be maintained or replaced; regulatory requirements may require spending on upgrades or alterations; public projects can necessitate equipment relocation; and we are required to integrate new generation resources. Below, we describe the six factors that drive infrastructure investment. Some can be known in advance, others can be forecasted, and some circumstances arise from external events.

Load Growth

PSE's first and foremost obligation is to serve the gas and electric loads of our customers; when customers turn on the switch or turn up the heat, sufficient gas and electricity need to be available. Load drives system investment in three ways: We must meet overall system loads. We must meet short-term peak loads. And we must meet point (block) loads

Overall system growth. Demands on the overall system increase as the population grows and economic activity increases in our service area even given the increasing role of demand-side resources. PSE regularly evaluates economic and population forecasts in order to stay abreast of where and when additional infrastructure, including electric transmission lines, substations, and high-pressure gas lines, may be needed to meet growing loads.

Peak Loads. Peak loads occur when the weather is most extreme. To prepare for these events, PSE carefully evaluates system performance during periods of peak loading each year, updates its system models, and compares these models against future load and growth predictions. This prepares us to determine where additional infrastructure investment is required to meet peak loads.

Electric delivery design is based on an expected winter peak of 23 degrees F[1] (which we expect to experience once every two winters), and a summer peak of 86 degrees F (which is a planning criteria used uniformly by electric utilities through western Washington). The gas system is designed to operate on a day with an average temperature of 10 degrees F. The gas system is designed more conservatively than the electric system because during a peak event the gas system pressure is drawn to zero as loads increase. Once gas pressure reaches zero, customers lose gas to pilot lights in their appliances. For this reason, gas outages have much greater public and restoration impacts than electric outages, and must be avoided for all but extreme conditions. The electric system is more flexible. For short periods of time components can often carry more current than their nameplate ratings call for with no adverse effects, and restoration is achieved instantly when power is rerouted and switches are reset.

Point Loads. System investments are sometimes required to serve specific “point loads” that may appear at a specific geographic location in our service territory. Electrical infrastructure to serve a computer server facility is one example, gas infrastructure to serve an industrial facility such as an asphalt plant is another.

Reliability

The energy delivery system is reviewed each year to improve the reliability of service to existing customers. Past outages, equipment inspection and maintenance records, customer feedback, and PSE field input help identify areas where improvements should be made. Additional consideration is given to system enhancements that will improve redundancy (such as being able to provide a second power line from one substation to another). Some of the investments to improve reliability include replacing aging conductors, installing covered conductors (tree wire), and converting overhead lines to underground.

Regulatory Compliance

PSE is committed to operating our system in accordance with all regulatory requirements. The gas and electric delivery systems are highly regulated by several state and federal

[1] *We also evaluate the electric system at 13 degrees F (a one-in-twenty-year condition) for operational planning considerations such as load shifting, the use of a mobile substation, etc., but this lower temperature is not used to justify infrastructure investments.*

agencies including NERC, FERC (Federal Energy Regulatory Commission), the WUTC (Washington Utilities and Transportation Commission), and various safety regulations. Infrastructure investments driven by compliance requirements include electric transmission projects that are aimed at preventing cascading power outages that could extend outside PSE's system. Gas regulations drive very specific inspection and maintenance activities and often require the replacement of assets based upon age and/or condition.

External Commitment

PSE must respond to city, county, and state jurisdictions within our service area when government-sponsored projects impact our facilities. Where PSE gas and electric facilities are installed in public rights of way, we must relocate them to accommodate public projects such as road widening or underground conversion of electrical facilities. We look for opportunities to minimize costs and disruptions in the future when this happens, by using these construction events to install larger or additional infrastructure that will accommodate anticipated load growth.

Aging Infrastructure

With continued maintenance, gas and electric infrastructure can provide safe, reliable service for decades. PSE has a number of programs in place that address aging infrastructure by replacing poles, pipes, and other components that are nearing the end of their useful life. Our goal is to maximize the life of the system and at the same time minimize customer interruptions by replacing major infrastructure components prior to unplanned failure.

Integration of Resources

FERC and state regulations require PSE to integrate generation resources into our electric system per processes outlined in federal and state codes. A new generation plant, whether it is owned by PSE or operated by others, can require significant electric infrastructure investment to integrate and maintain appropriate electrical power flows within our system and across the region.

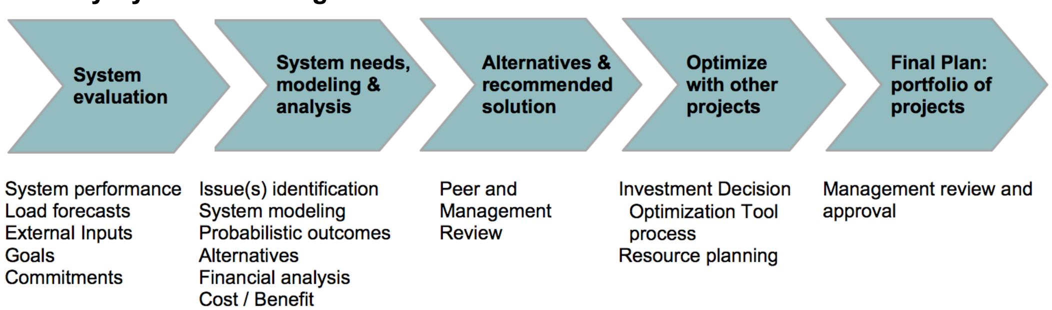
3. Planning Process

The planning process begins with an evaluation of the system's current performance. Next alternatives are developed, those alternatives are vetted and reviewed, and projects are compared against one another. Performance criteria comprises factors including, but not limited to, reliability, compliance, and customer expectations. Finally, a portfolio of projects is adopted. The process is the same for both long-term and short-term planning.

The IRP produces a long-term view, a general 10-year projection of infrastructure investments that can be expected based on today's conditions and forecasts. As the horizon shortens and the actual plan year approaches, those projections are refined based on new developments and actual rather than hypothetical conditions. Even after the portfolio for a given year is approved, we continue to monitor changing conditions and make alterations as necessary.

Figure 7-2

Delivery System Planning Process



System Evaluation

System evaluation begins with an evaluation of system performance, a review of existing operational challenges, and consideration of load forecasts and known commitments and obligations. Performance is measured by the system's ability to maintain quality and continuous service during normal and peak loads throughout the year while meeting the regulatory requirements that govern them.

Performance criteria for electric and gas delivery systems lie at the heart of the process and are the foundation of PSE's infrastructure improvement planning.

Electric delivery system performance criteria are defined by:	Gas delivery system performance criteria are defined by:
Safety and compliance	Safety and compliance
The temperature at which the system is expected to perform	The temperature at which the system is expected to perform
The nature of service and level of reliability that each type of customer is contracted for	The nature of service each type of customer is contracted for (interruptible vs. firm)
The minimum voltage that must be maintained in the system	The minimum pressure that must be maintained in the system
The maximum voltage acceptable in the system	The maximum pressure acceptable in the system
The level of reliability that customers are willing to pay for	The target levels of performance that customers are willing to pay for
The interconnectivity with other utility systems and resulting requirements; including compliance with NERC Planning Standards	

PSE collects system performance information from field charts, remote telemetry units, supervisory control and data acquisition equipment (SCADA), employees, and customers. Some information is analyzed over multiple years to normalize the effect of variables like weather that can change significantly from year to year. For near-term load forecasting at the local city, circuit, or neighborhood level, we use system peak-load and customer growth trends augmented by permitted construction activity for the next two years. For longer-term forecasting, we use an econometric forecasting method that includes population growth and employment data by county (see Appendix H). External inputs such as new regulations, municipal and utility improvement plans, and customer feedback, as well as company objectives, are also included in the system evaluation.

System Needs, Modeling, and Analysis

PSE relies on several tools to help identify and weigh the benefits of alternative actions. Figure 7-3 provides a brief summary of these tools, the planning considerations (inputs) that go into each, and the results (outputs) that they produce.

Figure 7-3
Delivery System Planning Tools

Tool	Use	Inputs	Outputs
SynerGEE®	Network modeling	Gas and electric distribution infrastructure and load characteristics	Predicted system performance
Power World Simulator – Power Flow	Network modeling	Electric transmission infrastructure and load/generation characteristics	Predicted system performance
PSS/E Power Flow & Stability	Network modeling	Electric transmission infrastructure and load/generation characteristics	Predicted system performance
PSLF Power Flow & Stability	Network modeling	Electric transmission infrastructure and load/generation characteristics	Predicted system performance
Probabilistic Spreadsheet	Probabilistic analysis	Outage history; equipment failure probabilities	Outage savings based on probability of occurrence
Estimated Unserved Energy (EUE)	Unserved energy	Growth/load at specific conditions; annual load profile	Annual unserved energy, O&M costs as a result, value of service in cost terms
Investment Decision Optimization Tool (iDOT)	Project data storage & portfolio optimization	Project scope, budget, justification, alternatives and benefits; resources/financial constraints	Optimized project portfolio; benefit cost ratio for each project; project scoping document
Area Investment Model (AIM)	Financial analysis	Project costs; 8760 load data; load growth scenarios	NPV; income statement; load growth vs. capacity comparisons; EUE

PSE's **gas system** model is a large integrated model of the entire delivery system. It uses a software application (SynerGEE® Gas) that is continually updated to reflect new customer loads and system and operational changes. This model helps predict capacity constraints and subsequent system performance on a variety of degree days and under a variety of load growth scenarios. Results are compared to actual system performance data to assess the model's accuracy. Where issues surface, the model can be used to evaluate alternatives and their effectiveness. PSE augments potential alternatives with cost estimates and feasibility analysis to identify the lowest reasonable cost solution for both current and future loads.

For our **electric distribution system**, PSE also uses SynerGEE software. Here, the feeder systems within PSE's service territory are modeled rather than the entire system at once, because of the limited connectivity between regions and the complexity of modeling such a large system. As with gas, PSE uses the model to evaluate system performance and predict capacity constraints on a variety of degree days and under a variety of load growth scenarios.

Modeling is a three-step process. First, we build a map of the infrastructure and its operational characteristics. For gas, these include the diameter, roughness and length of the pipe, connecting equipment, regulating station equipment, and operating pressure. For electric infrastructure, these include conductor cross-sectional area, resistance, length, construction type, connecting equipment, transformer equipment, and voltage settings. Next, we identify customer loads, either specifically (for large customers) or as block loads for address ranges. Existing customer loads come from PSE's customer information system or actual circuit readings. Finally, we vary temperature conditions, types of customers (interruptible vs. firm), time of daily peak usage, and the status of components (valves or switches closed or open) to model scenarios of infrastructure or operational adjustments. The goal is to find the optimal solution to a given issue.

To simulate the performance of the **electric transmission system**, PSE uses three different programs: Power World Simulator, PSS/E (from Siemens Power Technologies International), and PSLF (from General Electric). These simulation programs use a transmission system model that spans 11 western states, 2 provinces in western Canada, and parts of northern Mexico. The power flow and stability data for these models is collected, coordinated, and distributed through regional organizations including Columbia Grid and WECC, one of 8 regional reliability organizations under NERC. These power system study programs support PSE's planning process and facilitate demonstration of compliance with WECC and NERC reliability performance standards.

System Alternatives

The alternatives available to address delivery system capacity and reliability issues are listed below. Each has its own costs, benefits, challenges, and risks.

Figure 7-4

Alternatives for Addressing Delivery System Capacity and Reliability

Electric
· Add energy source
    Substation
· Strengthen feed to local area
    New conductor
    Replace conductor
· Improve existing facility
    Substation modification
    Expanded right-of-way
    Uprate system
    Rebalance load
    Modify automatic switching scheme
· Load Reduction
    Distributed Energy Resource
    Fuel Switching
    Conservation / Demand Response
    Load control equipment
    Possible new tarriffs
· Do nothing

Gas
· Add energy source
    City-gate station
    District regulator
· Strengthen feed to local area
    New high pressure main
    New intermediate pressure main
    Replace main
    · Improve existing facility
    Regulation equipment modification
    Uprate system
· Load Reduction
    Fuel Switching
    Conservation
    Load Control Equipment
    Possible new tarriffs
· Do nothing

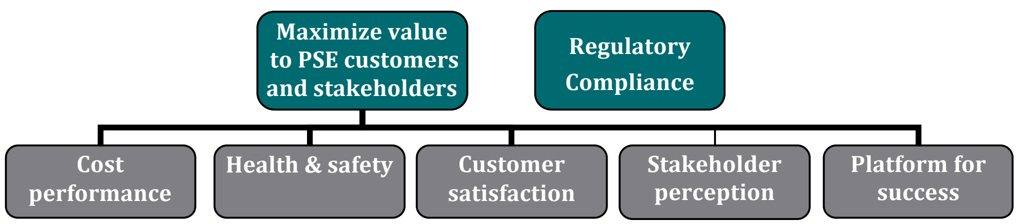
The same alternatives can be used to manage short-term issues like peaking events or conditions created by a construction project. For example:

- Temporary adjustment of regulator station operating pressure, as executed through PSE’s Cold Weather Action Plan.
- Temporary adjustment of substation transformer operating voltage, as done using load tap changers to alter turn ratios.
- Automatic capacitor bank switching to optimize VAR consumption and maintain adequate voltage.
- Temporary siting of mobile equipment such as compressed natural gas injection vehicles, liquid natural gas injection vehicles, mobile substations, and portable generation.

Evaluating Alternatives and Recommended Solutions

When it's time to evaluate alternatives, PSE compares the relative costs and benefits of various solutions (i.e. projects) using the Investment Decision Optimization Tool (iDOT). iDOT allows us to capture project criteria and benefits and score them across multiple factors including reliability, safety, capacity addition, deferred future costs, and external stakeholder inputs. iDOT makes it easier to conduct side-by-side comparisons of projects of different types, thus helping us evaluate infrastructure solutions that will be in service for 30 to 50 years

Figure 7-5
Benefit Structure to Evaluate Delivery System Projects



Project costs are calculated using a variety of tools, including historical cost analysis and unit pricing models based on service provider contracts. Cost estimates are refined as projects move through detailed scoping. Through this process, alternatives are reviewed and recommended solutions are vetted and undergo a peer review process. Further minor adjustments are made to ensure that the portfolio addresses resource planning and other applicable constraints or issues.

In the case of the IRP, a general, long-term projection of likely infrastructure expenditures is produced. Annual plans approved by operations management provide a specific portfolio of projects for the year. While annual plans are considered final, throughout the year they continue to be adjusted based on changing factors (e.g. public improvement projects that arise or are deferred; changing forecasts of new customer connections; project delays in permitting) so that we can ensure the total portfolio financial forecast remains within established budget parameters.

4. 2011-2021 Infrastructure Plans

PSE develops both short-range and long-range infrastructure plans based upon economic, population, and load growth projections, as well as information from large customers and government stakeholders. The plan is reviewed annually and remains dynamic. As the plan year gets closer, the company refines plan projections based on new developments or information, and performs additional analyses to reveal and evaluate additional alternatives. The plan may change as a result of these investigations.

The infrastructure additions described below are intended to indicate the scope of investment that will be required over the next ten years in order to serve our customers reliably and fulfill regulatory requirements. They are expressed in general terms and accompanied by a list of sites where the work is most likely to occur. Previous IRPs listed specific projects, but we felt that presentation was of extremely limited value because specific projects are so dependent on localized economic and physical circumstances that they are likely to be quite different by the time they are implemented.

Electric Infrastructure Plan

Transmission lines. In the next decade, PSE anticipates building approximately 200 miles of new transmission lines (100 kV and above) and upgrading over 300 miles of existing transmission lines to carry greater loads.

Distribution substations. Distribution infrastructure additions are highly dependent on localized patterns of load increases. In the next decade, PSE anticipates the need to build approximately 15 new distribution substations. Many of PSE's existing substations are designed so that additional capacity can be added at a later date. We anticipate that we will upgrade approximately 12 existing substations in the coming decade.

Ongoing maintenance. Based upon current projections and past experience, PSE expects to replace 500 to 1,000 miles of underground cable, approximately 2,000 transmission poles, and up to 10,000 distribution poles over the next 10 years. Additionally, PSE replaces many major substation components on a continuous basis as a result of ongoing inspection and diagnostics.

Gas Infrastructure Plan

Gate stations. PSE plans to build or upgrade approximately 7 gate or limit stations where we take gas from the Northwest Pipeline.

Pipelines and mains. We expect to add approximately 30 miles of high pressure main and 50 miles of intermediate pressure main as loads grow in our service area.

Ongoing maintenance. As with the electric system, PSE is always addressing aging gas infrastructure within the system in accordance with regulatory requirements and prudent operating practices. In the next decade, PSE plans to replace over 100 miles of gas main that is reaching the end of its useful life.

Figure 7-6 lists the potential sites for these upgrade and maintenance projects.

Figure 7-6
Summary of 2011-2021 Infrastructure Plans

Asset	Name	Location
Substations	Boeing Aerospace	King County
	Mt. Si	King County
	Ardmore	King County
	Jenkins	King County
	Grand Ridge	King County
	Autumn Glen	King County
	Lake Holm	King County
	Briscoe Park	King County
	Lakemont	King County
	Bainbridge	Kitsap County
	Lakeland	Pierce County
	Blackburn	Skagit County

Asset	Name	Location
	Carpenter	Thurston County
	Spurgeon	Thurston County
	Maxwelton	Island County
New Transmission	200 miles	Systemwide
Upgraded Transmission	300 miles	Systemwide
Cable Replaced	500 – 1,000 miles	Systemwide
Distribution Poles Replaced	Up to 10,000	Systemwide
Transmission Poles Replaced	1,000	Systemwide
New High Pressure Pipe	30 miles	Systemwide
New Intermediate Pressure Pipe	50 miles	Systemwide
Gate or Limit Station Upgrades	Lake Stevens Gate Station	Snohomish County
	Redmond Gate Station	King County
	East Olympia Limit Station	Thurston County
	Lynnwood Limit Station	Snohomish County
	North Seattle Gate Station	Snohomish County
	East Olympia Gate Station	Thurston County
	Machias Gate Station	Snohomish County
Gas Main Replaced	100 miles	Systemwide

5. Challenges and Opportunities

New Regulations

Regulatory compliance is a significant driver of PSE infrastructure investment, but it is difficult to anticipate what rules may be adopted in the future or to predict how they may impact spending on our delivery systems. NERC, FERC, and the WUTC are among the agencies and organizations that regulate our businesses. Examples from the last decade illustrate the kind of expenditures that regulatory activity can necessitate.

Gas system. Beginning with the Pipeline Safety Improvement Act (PSIA) of 2002 and again in 2006 with the Pipeline Inspection, Protection, Enforcement, and Safety (PIPES) Act, Congress has directed the Pipeline and Hazardous Materials Safety Administration to increase the strength of integrity management programs covering natural gas transmission and distribution pipelines. These programs require PSE to perform detailed inspections and analysis of pipeline systems to gain more knowledge of pipeline integrity risks and to devise measures to mitigate these risks. Numerous actions have resulted from this effort, including expanded pipe replacement programs, enhanced damage prevention activities, and increased inspection intervals. Recent pipeline safety incidents have occurred across the country, and this continues to focus the attention of state and federal regulators and lawmakers on improving pipeline and public safety performance. Proposed legislation includes:

- expanding the mileage of pipelines subject to more rigorous inspection and testing,
- requiring the use of automatic and remote controlled shut-off valves,
- expanding the use of excess flow valves, and
- requiring more timely notification of pipeline incidents.

All require additional investment in processes and infrastructure to support compliance with new regulations.

Electric system. In 2007, new regulations mandated by The Energy Policy Act of 2005 became effective and enforceable by regional electric reliability organizations. This act was triggered by concern about the robustness and reliability of nation's electrical grid, and it moved the industry into an era where system planning, performance, and operating requirements are mandated by law, audited, and enforced by fines and sanctions. Complying with these new reliability standards has required PSE to make significant investments in both hardware and software assets for the portions of our system operating above 100 kV.

Emerging Alternatives

PSE and the region's utilities have a vested interest in finding optimal solutions to transmission constraints and bulk power delivery problems, and we are studying several emerging alternatives that have the potential to help meet today's transmission and distribution challenges. Among them are the following.

Distributed generation. Distributed generation is the name for incorporating small-scale generation into the electric grid close to where the users are (close to load). Many such sources exist: internal combustion engines, fuel cells, gas turbines and micro-turbines, hydro and micro-hydro applications, photovoltaics, wind energy, solar energy, and waste/biomass. The challenge for the delivery system is how to integrate this power into a system that was designed to move electricity in only one direction – typically from large, remote generating plants to far-away end users.

Conservation voltage reduction. Reducing the voltage at an end-user's site by a small percentage can result in significant energy savings without compromising the operation of customers' equipment. In 2006, PSE began a conservation voltage reduction pilot program in conjunction with the Northwest Energy Efficiency Alliance (NEEA). The homes of 10 customers in two locations were fitted with meters capable of monitoring energy usage at the residence and transmitting that information back to PSE every 15 minutes over telephone lines. On alternate days, PSE reduced substation transformer control voltage from a range of 123 volts to a range of 119 volts. This resulted in a feeder voltage reduction of 3%. (Two-way communication helped PSE determine whether the reduced voltage adversely affected any customers.) Results from the study were favorable, indicating a 2% energy savings at both pilot locations with no adverse effects. As technology for two-way communication over the electric grid advances, making it easier to implement this technique, conservation voltage reduction has the potential to play a much larger role in the delivery system. PSE continues to evaluate locations where conservation voltage reduction may be practical to implement and similar energy savings may be realized.

Demand response alternatives. When demand for power is at its highest and customers reduce their energy use in response, utility delivery system planners call it "demand response." PSE estimated demand response capacity for residential, commercial, and industrial customer sectors in its 2009 IRP, and two small-scale, voluntary, demand response pilots are currently in progress. One involves residential loads and the other industrial loads. PSE's primary focus is to direct load control during times of high peak system loads. We expect to gain knowledge about the customer communication and equipment needed, as well as the information and incentives needed to achieve customer participation. We will evaluate the pilots based on how they affect the electric system and how receptive and responsive customers are.

Electric vehicles. PSE's customers are adopting electric and plug-in hybrid vehicles. We have developed estimates of expected energy needs, performed initial assessment of distribution impacts on select circuits, and performed some tests of the effectiveness of curtailed charging. All of these studies determined that initial adoption of electric vehicles and plug-in hybrids would not have significant effects on PSE's energy needs or distribution system. As the trend continues, PSE will expand data collection efforts to develop better models based on real-world conditions. Simulations will be performed to determine when system upgrades are needed.

Smart grid technologies. Smart grid is a term used to describe the integration of intelligent devices and new technologies into the electrical grid to optimize the system to a degree not possible with existing infrastructure. It is less well developed than demand response technologies, but has the potential to connect all parts of the electric power system – production, transmission, and distribution – in ways that would be very beneficial to customers. PSE recently submitted a Smart Grid report to the Washington Utility & Transportation Commission detailing the company's plans for Smart Grid technology and development. The report can found at the following link:

http://wutc.wa.gov/rms2.nsf/vw2005OpenDocket/4E9780AC62CF7D9888257792005A2398