Appendix A – Key Research Objectives
Oregon PUC Presentation
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Energy Storage Management

PGE's forthcoming Energy Storage Facility (ESF) sited in Salem, Oregon, will test a 5 MW, 1.25MWh storage resource designed to increase distribution system reliability and decrease peak-price risk. The ESF is a fundamental aspect of PGE's Salem Smart Power project associated with the Pacific Northwest Smart Grid Demonstration Project test phase which begins September, 2012, with the demonstration test period ending in 2015. Our innovations result from dramatic advances in energy storage technology and new opportunities for software applications linking geographically and systematically disparate energy system infrastructure, customer systems and real-time information. Generally, PGE expects energy management and utility-scale storage system use to contribute to decreases in the cost of energy: first, by reducing the consumption of energy in real-time. The use of energy storage for peak shaving directly reduces the exposure to price risk throughout the daily peak periods, which can also vary dramatically from season to season. Second, PGE may dispatch its MW-scale ESF using many charge and discharge states over time, effectively shifting demand from one market-time-period to another, also decreasing price risk, or for increasing reliability. Finally, energy storage is being tested as a resource optimization technology, where the MW-scale system may be used to follow an intermittent renewable resource, such as solar or wind. In this way, the benefits from renewables may be extended forward to meet future demand, decreasing the likelihood of curtailment at the interconnect bulk-electrical-system, and contributing to least cost methods of meeting the energy demands of the consumer.

Locational Marginal Price

PGE's participation in the Smart Grid Demonstration project with Battelle – DOE is a conceptual test of the use of locational marginal pricing. The research focuses on the use of a "Transactive Node". A Transactive Node (TN) is a location within an electric power grid and an associated software object that facilitates a *5-minute price signal processor* which responds to a central authority (Battelle) with a 72-hour dynamic schedule of the load behavior of the grid location. PGE's research is centered on the development of a state-of-the-art computational intelligence designed for resource optimization and micro-grid forecasting tasks. The signal from Battelle is called a Transactive Incentive Signal (TIS) as it represents the locational marginal price (an incentive) for power for that grid-location looking forward 72-hours. Other "nodes" in the system are the other project participants, such as Avista, and are distributed across the regional transmission system. Each of these nodes shares information about their individual distributed loads, effectively informing the central system (at Battelle) of potential for energy bottlenecks while calculating a dynamic price across the regional grid. The system "calculates" the next signaled price of the energy based on a series of complex algorithms designed to accommodate the existing infrastructure, electrical constraints, market conditions, and generation resource conditions.

High-Reliability Zone (HRZ) Operations

PGE's participation in the Smart Grid Demonstration project with Battelle – DOE is a test of the use of HRZs, or intentionally shielding and potentially isolating a distribution feeder from otherwise detrimental power conditions found outside the HRZ in the larger distribution grid or transmission network. These detrimental conditions could be related to power outages, power-quality, or transmission availability. In creating an HRZ, a utility opens and closes the breakers or re-closers between the substation and the distribution network, isolating a feeder or feeder segment from system events. Thus, the power supply for that HRZ is provided solely by *distributed power supply resources* within the new "micro-grid".