Supporting Documentation for Volume 1, Chapter 3

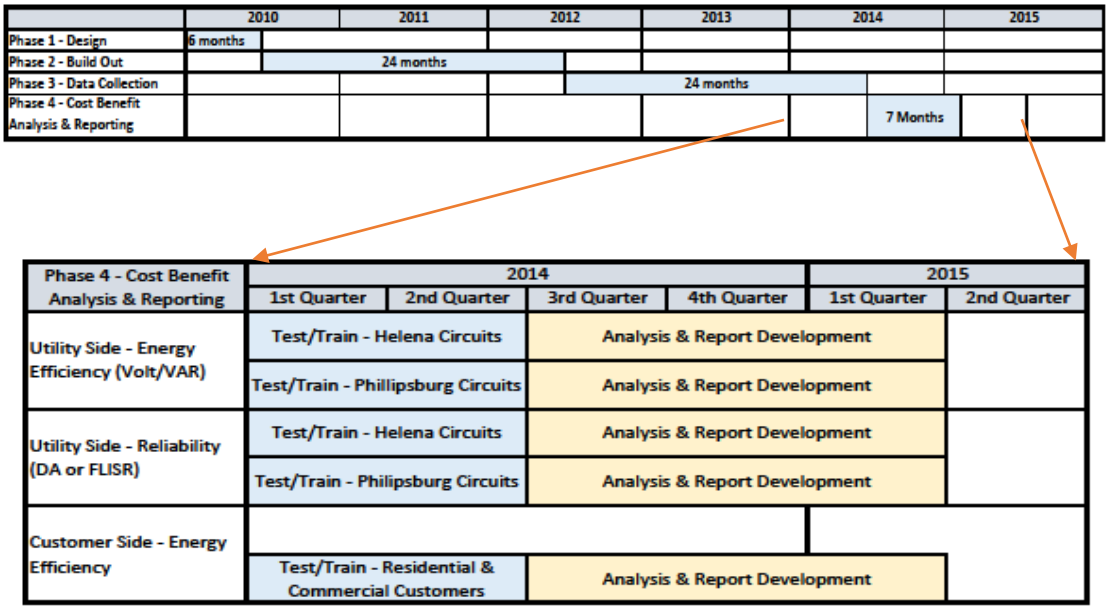
Smart Grid Demonstration Project

In 2009, NorthWestern Energy joined with regional partners to develop a smart grid demonstration project. The project, known as the Pacific Northwest Smart Grid Demonstration Project, was the largest of 16 smart grid demonstration projects funded by the U.S. Department of Energy under the American Recovery & Reinvestment Act. It was a unique demonstration of unprecedented geographic breadth across five Pacific Northwest states: Idaho, Montana, Oregon, Washington, and Wyoming. It involved about 60,000 metered customers, and contained many key functions of the future smart grid. Smart grid is an advanced, telecommunications/electric grid with sensors and smart devices linking all aspects of the current grid, from generator to consumer, and delivering enhanced operational capabilities. Use of technology should bring the region and nation closer to establishing a more efficient and effective electricity infrastructure that is expected to help contain costs, reduce emissions, incorporate more wind power and other types of renewable energy, increase power grid reliability, and provide greater flexibility for consumers.

NorthWestern completed its 5-year (2010-2014) Smart Grid Demonstration Project ("Project") as part of a larger, region-wide effort. NorthWestern's project objectives were to deploy, test, and evaluate various equipment, systems and customer services associated with emerging Smart Grid technology. The scope of the effort included Smart Grid technologies at the electric utility substation, distribution circuit and customer levels of two unique NorthWestern locations in Western Montana, including "urban" circuits in the center of the City of Helena and a "rural" circuit located in the Philipsburg area. The estimated budget for the Project was approximately $4.3 million (50% cost-shared with federal American Recovery and Reinvestment Act funds). The Project generally concentrated on the various aspects of advanced volt/VAR control, distribution automation, automated outage restoration, substation capacity, advanced metering infrastructure, and customer demand response, control and energy management.

There were four major Phases to the Project, summarized in Figure 3-1 below.

Figure No. x-1 Smart Grid Demonstration Project Timeline



In the Project area concerned with Distribution Automation, all activities have been completed. Substation & Line Equipment installations were completed in Helena and Philipsburg. NorthWestern issued a Request for Proposals for control software/systems, subsequently received five proposals, and selected Cooper Power Systems as the winning bidder. The software and systems were purchased and installed and the system acceptance test was completed in the first and third quarters of 2013.

Energy Efficiency (Volt/VAR) substation and line equipment installations were completed in Helena and Philipsburg. S & C Electric software was chosen as the software vendor. The software and systems were purchased and installed and system acceptance test was completed in 2012. Testing on circuits in Helena started in fall, 2012 and continues to provide data although the Smart Grid Demonstration Project ended in January 2015. Testing of circuits in Philipsburg started in fall 2013 and continued through the second quarter of 2014.

Working with ITRON, Inc., NorthWestern completed all activities in Helena, MT that related to the customer side of the meter. These included:

- Installation and testing of 200 CENTRON electric interval meters for project participants in the home area network and Time of Use ("TOU") trial.
- Testing and ongoing maintenance of the fixed wireless network with the installation of 4 Cell Control Units and 10 communication repeaters. These units were installed to collect interval data from residential home area network customers for TOU billing purposes.
- Collection of 15-minute electric interval data and electronic transport of data to ITRON's data center in Spokane, WA where data hosting and meter data management services were performed by ITRON.
- Export and transport of meter data from ITRON to NorthWestern's MV-90 system on regular nightly intervals for further processing into billing determinants for project participants.
- Field installation and maintenance of Home Area Networks ("HAN"), supporting communications links and platforms, and training of participants on use of devices and equipment was completed at NorthWestern's direction. DNV GL (formerly KEMA, Inc.) was contracted to provide HAN installation and training.

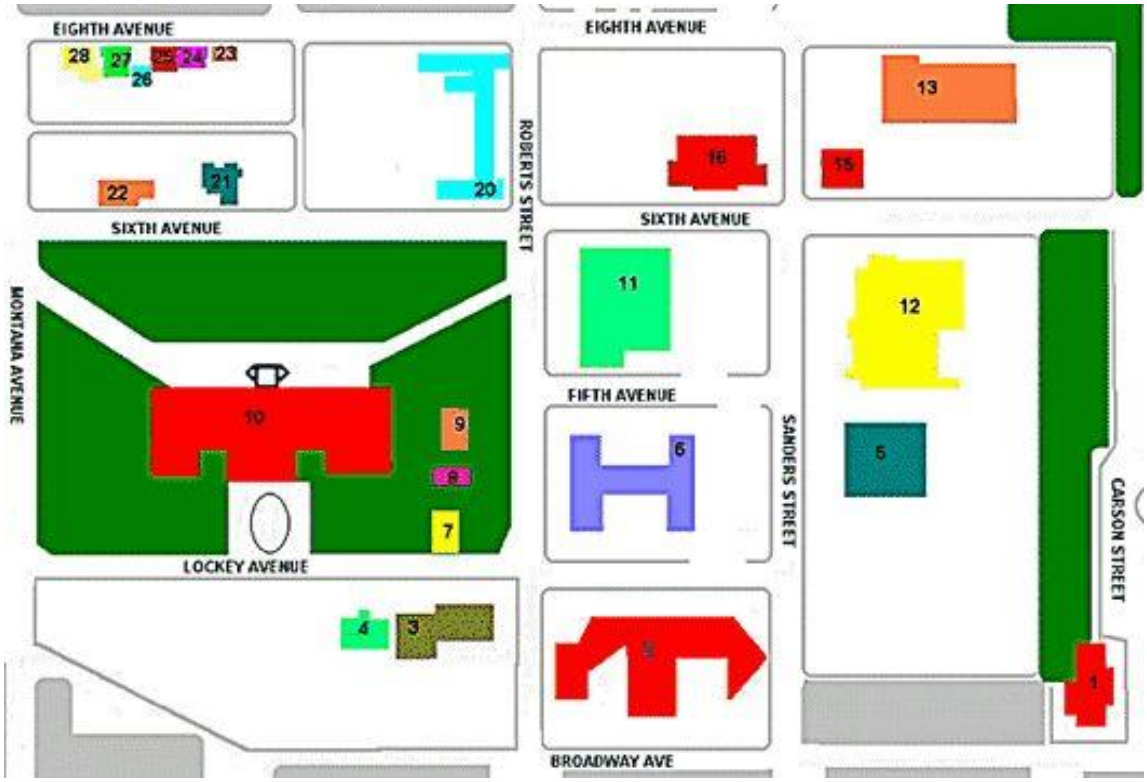
TOU pricing was established for residential participants in the project. NorthWestern met with MPSC staff to present derivation of the TOU rates and discussed this approach to experimental TOU pricing within the Project. Upon advice and guidance from MPSC staff, NorthWestern prepared and filed a TOU tariff for this Project. A Master Time of Use pricing table was established and was reviewed monthly. This table was updated with each monthly update of electric supply prices, and the table was integral to the hourly pricing signals sent to project participants with HAN equipment. Additional steps related to this portion of the Project were completed in the first half of 2012 and included:

- Testing and debugging of all data pathways; Interval meters (Helena) – fixed network – ITRON hosting (Spokane) – MV 90 (Butte) – TOU calculator – NorthWestern billing system.
- Completion of automated extraction of monthly kWh from NorthWestern's MV-90 system that received 15-minute interval data from ITRON's data center.
- Completion of a TOU energy cost calculator using MV-90 output and the Master TOU pricing table.
- Automated export of monthly TOU energy cost to utility billing system.
- Automated calculation of delta between TOU energy cost and normal non-TOU energy cost. This capability entailed:
    - Posting of TOU "credit" to Smart Grid participants' monthly bill. Sent appropriate message via HAN system.
    - Ensuring that no "debit" was be charged to customer if usage increased. Sent appropriate message via HAN system.
- Automated "How am I doing" messages to residential participants based on results of their participation, operation of HAN, and TOU-induced energy usage changes.
- Rigorous exercising of a Test case "customer" in Smart Grid Lab prior to rollout in Helena.

NorthWestern's Smart Grid Project also included buildings at the Capitol Complex in Helena, MT. All equipment, including one interval meter and one cell collection unit were installed in the Metcalf Building. Software checkout of the Lockheed Martin ("LM") SeeLoad/SeeGrid demand response application failed due to interface revision errors. Additional steps planned for completion but not achieved included:

- Integration of LM SeeLoad/SeeGrid demand response application to Metcalf head end building automation control system.
- Survey results of smart grid influence on business practices at periodic intervals throughout the study.

Figure No. x-2 Helena Capital Complex Schematic



Building 13- Metcalf Building 3 – Walt Sullivan

During 2013, NorthWestern continued TOU testing with 200 residential participants in Helena, MT. This testing, along with utility substation and distribution circuit testing, continued until August 2014. Data evaluation and reporting commenced shortly after. A final report by NorthWestern outlining its part of the Pacific Northwest Smart Grid Demonstration Project was completed in December 2014. This report contains data gathered from both the utility system and customer testing undertaken by NorthWestern and encompasses one of eleven utility sections in the larger, region-wide effort. NorthWestern's evaluation of smart grid technology was rolled up into a regional report to the Department of Energy ("DOE") and the BPA. The regional report can be found on the DOE website at http://energy.gov/oe/articles/now-available-pacific-northwest-smart-grid-demonstration-project-technology-performance. Additionally, a Technology Performance Report that highlights the key aspects of the project was developed in June 2015. This

report is included in this Plan's Volume 2. NorthWestern's data and data from other demonstration project participants may be used to evaluate and implement future smart grid technology.

Of note is the successful testing by Avista Utilities to control 39 HVAC fan loads and nine controller chiller loads at Washington State University campus buildings. The successful demand response events closely matched initial predictions of power reduction on the order of 1,500 – 3,000 megawatt hours per year for HVAC and deferred a little more than one-third of a megawatt of load for an hour at a time for chiller loads.