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April 1, 2014

Dr. Burl Haar
Executive Secretary
Minnesota Public Utilities Commission
350 Metro Square Building
121 7th Place East
St. Paul, MN 55101-2147

**Re: In the Matter of Otter Tail Power Company's Smart Grid Report
Minnesota Docket No. E999/CI-08-948
Compliance Filing**

Dear Dr. Haar:

Otter Tail Power Company respectfully submits the attached report on Smart Grid projects in compliance with the Minnesota Public Utilities Commission ("Commission") Order dated June 5, 2009 in the above referenced docket.

A copy of this filing has been served on the Department of Commerce – Office of Energy Security and the Office of the Attorney General – Residential Utilities Division, and on all persons on the attached service list by electronic service or by First Class mail.

Should you or Commission staff have any questions or require any more information, please feel free to contact me at (218) 739-8371 or hkonynenbelt@otpc.com.

Very truly yours,

/s/ HEIDI KONYNENBELT

Heidi Konynenbelt, P.E.
Manager, Special Projects, Metering, and Construction Services

jce
Enclosures
By electronic filing
c: Service List

**BEFORE THE
MINNESOTA PUBLIC UTILITIES COMMISSION**

Docket No. E999/CI-08-948

**Otter Tail Power Company's
2013 Smart Grid Investments
and
Information Report**

April 1, 2014

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Past, Current and Planned Smart Grid Technology at Otter Tail Power Company

The Minnesota Public Utilities Commission (“Commission”) Order dated June 5, 2009, in Docket No. E999/CI-08-948 included the following requirement at ordering paragraph 1.A.:

“Beginning on April 1, 2010 and annually thereafter, utilities shall file reports on past, current, and planned smart grid projects, with a description of those projects, including: total costs, cost effectiveness, improved reliability, security, system performance, and societal benefit, with their electric service quality reports.”

In the same Order the Commission adopted the following definition of smart grid:

“A Smart Grid encompasses information and control technology to improve the reliability, security, and efficiency of the electric grid. A smart grid allows deployment and integration of distributed and renewable resources, “smart” consumer devices, automated systems, and electricity storage and peak-shaving technologies.”

Otter Tail Power Company (“Otter Tail” or “the Company”) has used technology to improve employee productivity and customer service for many years. Smart grid investments occur in many aspects of the Company’s work. Otter Tail’s philosophy supports the smart grid concept, as stated in the Company’s mission:

“To produce and deliver electricity as reliably, economically, and environmentally responsibly as possible to the balanced benefit of customers, shareholders, and employees and to improve the quality of life in the area in which we do business.”

The following is a list of some of the smart grid type applications that are in use at Otter Tail and are further described in the following sections.

- Peak-Shaving Technologies
- Energy Storage Systems
- Time-varying Rates
- Electricity Metering
- Protective Relaying
- Power Profiler
- Interruption Monitoring System
- Mobile Data
- Bill Analyzer
- Opower Energy Reporting
- Fleet Tracking
- Geographic Information System (GIS)

Peak-Shaving Technologies

Otter Tail has a long history of installing peak-shaving technologies at customer premises. This legacy started with electric water heaters back in the 1940s that were controlled with time-clocks set to avoid energy usage during the morning and evening highest load periods each day. In the 1980's this legacy system was updated with a radio control system. Beginning in 2003, Otter Tail began to replace the radio control system with an updated radio control system. This update was completed in 2007. The updated system allows Otter Tail to send a signal out to groups of customers during periods of high demand, which includes capacity constraints or high energy prices. When the signal is received by a radio typically near the customer's meter socket, the customer's system automatically reduces their controllable load.

Several peak-shaving tariff options are available to work with various technologies installed by customers and controlled by Otter Tail. Technologies include: electric storage water heaters, dual fuel heating systems, thermal storage systems, heat pumps, air conditioning systems, and whole-house residential demand controllers, and commercial demand control.

The system and supporting tariff that allows the most flexibility for the customer is the Residential Demand Controller ("RDC"). A radio receiver mounted near the customer meter socket receives the signal when system demand is high. A demand controller installed in the home reacts to this signal by reducing the customer demand to a level preselected by the customer. A set station installed in the living area identifies that the customer is being controlled, shows the demand level that is being maintained by the demand controller, and in cases where the connected load does not reduce home demand to the preselected level, the set station signals to the customer that further action is required to reduce non-controlled load. At this point the customer has the choice to either increase their preselected demand or reduce demand by turning off lights, electric appliances, or any heating equipment that may not be connected to the demand controller. Customers are billed based on their highest winter-season demand level measured during a control event. The RDC rate is under evaluation because it was originally designed to reduce winter capacity needs whereas now, Otter Tail is participating in MISO, which is summer peaking.

Otter Tail has an average of 40,839 meters installed associated with demand response tariffs and has demonstrated over 130 MW of control during the coldest days in the winter. Winter demand response total capacity is based on the load management events and system tests and varies by month and season. Otter Tail accredited through MISO 90 MW of demand response capacity for January and 18 MW of demand response capacity for the 2013 summer season, June through September. Otter Tail's internal costs directly related to marketing and sales to grow demand response participation are approximately \$1 million each year.

Energy Storage Systems

As noted above, Otter Tail's Peak-Shaving Technologies include Energy Storage Systems which are most commonly known as "Thermal Storage" or "Deferred Load" systems. These include water heating, under floor heating, brick storage furnaces, and brick storage room heaters. Customers and contractors are advised to size storage systems to heat or cool adequately during the maximum control period allowed by the tariff on which it is installed (14-16 continuous hours depending on the tariff used). These systems store energy by charging during off-peak

periods, and heat is available for discharge into the home or business as needed. Otter Tail continues to explore opportunities associated with distributed energy storage systems.

Time-varying rates

Otter Tail’s definition of time-varying rates includes any tariff that charges based on when electricity is used and/or controlled. Table 1 below presents the rates, tariff sections, and average number of meters by state currently provided by Otter Tail. As shown, there are on average 1,185 meters on Time of Use Rates and 738 of these are served in Minnesota.

Table 1: Time of Use Rates						
Time of Use Rate	Tariff Section	MN Average Meter Count	ND Average Meter Count	SD Average Meter Count	Total Average Meter Count	Program Started
General Service Time-of-Use	10.03 MN, SD; 10.04 ND	44	1	0	45	1978
Large General Service - Time of Day	10.05	27	1	3	31	1993
Standby Service - Option A Firm	11.01	0	1	0	1	1993
Irrigation Service	11.02	200	32	12	244	1974
Real Time Pricing Rider	14.02	0	1	0	1	1996
Fixed Time of Delivery Service	14.07	468	320	76	863	1996
Total Time of Use		738	356	91	1,185	NA

Demand response tariffs require the customers to limit or stop usage during peaking periods in response to an automated control system signal provided by Otter Tail. Otter Tail may require a control period in response to capacity, economic, or reliability conditions. Table 2 below presents tariffs that are part of Otter Tail’s accredited demand response and the meter count by state that for each tariff. Otter Tail’s direct control demand response consists of 40,839 meters across the Company’s service territory, of which 18,938 are in Minnesota.

Direct Control Rate	Tariff Section	MN Average Customer Count	ND Average Customer Count	SD Average Customer Count	Total Average Customer Count	Program Started
Water Heating - Controlled Service (Off-Peak)	14.01	8,529	6,395	2,236	17,160	Before 1970 – with subsequent revisions
Controlled Service, Interruptible Load, CT Metering Rider (“Large Dual Fuel”)	14.04	197	280	30	507	1980s – with subsequent revisions
Controlled Service, Interruptible Load, Self Contained Metering Rider (“Small Dual Fuel”)	14.05	6,073	6,955	935	13,962	
Controlled Service Deferred Load Rider (“Thermal Storage”)	14.06	842	703	185	1,730	
Residential Service-Controlled Demand	9.02	2,393	3,482	424	6,300	
Air Conditioning Control Rider	14.08	904	199	77	1,180	2006
Total Direct Control		18,938	18,014	3,887	40,839	NA

Electricity Meters

As of December 31, 2013, Otter Tail had 170,448 active retail electricity meters across a three state area that includes Minnesota, North Dakota and South Dakota. Nearly all of the meter readings are collected by Otter Tail employees or contracted meter readers by entering meter readings into a handheld meter reading processor. The handheld processor also has a probe that allows the meter reader to collect time of day meter readings electronically by attaching the probe to a port on the face of the meter.

Otter Tail has installed 60 meters with an encoder receiver transmitter (“ERT”) register that allows the handhelds with a special transmitter receiver module to read meters as the meter reader walks by the area, which is an example of a mobile Automated Meter Reading (“AMR”) application. These special meters have been installed in areas where access to the customers meter was difficult and time consuming.

¹ With the exception of Residential Demand Control, all customer counts shown in Table 2 are based on meter counts for direct control rates.

Over several years, Otter Tail has developed a group of AMR type meters that can be read remotely using cell phones or land lines to collect interval kWh and demand meter information. These meter installations allow Otter Tail to contact the meter and download meter interval data on a daily, weekly or monthly basis. There are 453 meters that are read remotely and, of these, 98 meters are used for billing data. The remaining meters are for measuring other loads such as generation, substation, and tie metering. The data is used for calculating and reporting Otter Tail's load to MISO, as well as tracking voltage data at Company substations, observing anomalies in load behavior, and forecasting day-ahead loads. The cost to support these AMR devices in 2013 was \$136,630 for software and labor.

Approximately 0.30 percent of Otter Tail electricity metering is operating in a way that Otter Tail would describe as AMR. Table 3 below presents the category of meters based on how they are read, the number of meters in each category, and the corresponding percentage that each category is of the total meters. Otter Tail has no Advanced Metering Infrastructure ("AMI") or two-way capable meters. The Company has been actively investigating AMR/AMI technology and evaluating the potential costs and benefits of a system-wide investment.

Table 3		
Category of Meters	Number of Meters	% of Total Meters
Automated Meter Reading (AMR) - read from general office using landline, cellular, or TCP/IP communications	453	0.26%
AMR – drive or walk by (mobile)	60	0.03
Manually read meters	169,935	99.70%
Total Meters	170,448	100%

In 2014, Otter Tail will conduct a pilot of 10 AMI meters. The purpose of the pilot will be to explore the reliability of cellular coverage for meter reading, understand the customer portal and tools related to usage, trial the head-end AMI and back-end Meter Data Management (MDM) systems, perform load management measurement and verification, and assess reliability measurement and reporting capabilities. The cost of the pilot is being paid by the vendor.

Protective Relaying

The first "smart" protective relays were developed and installed in the mid 1980's. Otter Tail was involved with the first installation on high voltage transmission lines of the devices designed by Schweitzer Engineering Labs ("SEL"). These devices provided system data during faults, giving personnel information on fault location. The SEL relays also provide sub-cycle information about the fault that enables engineers to review the fault record and evaluate whether the relay tripped the breaker properly. This information is used by the Company's System Operations department to isolate the faulted line section quickly and reduce outage duration on the Company's transmission system.

Before the use of the SEL fault locating relays, each time a line tripped, it required a long process of switching and re-energizing the line section by section to determine which section of the transmission line experienced the fault.

The technology used for remote communication to protective relays in Otter Tail's substations has improved greatly since the mid 1980's, allowing advance monitoring of the transmission grid by Otter Tail and the Midwest Independent System Operator ("MISO").

Otter Tail has been participating in the North American SynchroPhasor initiative by installing special relays and related communications in one substation in 2010, two substations in 2011, five substations in 2012, and five substations in 2013/2014. This reliability project is being coordinated by MISO for the region. Otter Tail incurred costs of about \$325,000 in 2013/2014. This initiative expires on March 31, 2014. These costs will be reimbursed to Otter Tail by the Department of Energy through MISO's coordination.

Synchrophasors are precise grid measurements now available from monitors called Phasor Measurement Units ("PMU"). PMU measurements are taken at high speed, typically 30 observations per second compared to one observation every four seconds using conventional technology. Each measurement is time-stamped according to a common time reference. Time stamping allows synchrophasors from different utilities to be time-aligned (or "synchronized") and combined together providing a precise and comprehensive view of the entire interconnection. Synchrophasors enable a better indication of grid stress and can be used to trigger corrective actions to maintain reliability.

Power Profiler

The Power Profiler is a fee-based on-line program offered to customers with interval metering. Commercial or industrial customers are the main users of this program.

The program allows "day after", "week after" or "month after" 15-minute interval energy and demand usage to be displayed in a variety of graphical formats. Otter Tail's larger customers have found this data to be valuable to identify and reduce demand peaks by fine-tuning equipment operation and altering work schedules.

The Power Profiler has nine detailed reports as bar graphs, line graph or data output.

- Peak day demand
- 24 hour profile
- kVA / power factor
- Daily peaks
- Detail profile
- Daily totals
- Peaks report
- Statistics report
- Comparison graph

Customers using Power Profiler are learning how to manage their energy and demand profiles based on information from this online tool. Otter Tail's ongoing charge by the software vendor for system maintenance and updating Power Profiler was \$9,543 for 2013.

Interruption Monitoring System

In order to monitor and improve the reliability of Otter Tail’s electrical system, an Interruption Monitoring System (“IMS”) was installed and commissioned in mid-2004. Voltage and interruption monitoring devices manufactured by Sensus have been installed on each of the 725 distribution feeders in the Otter Tail system. These intelligent field devices report interruptions, over and under voltage alarms and power reliability status using the commercial cellular networks (GPRS and 1XRTT).

Web based analysis and application tools allow reporting, alarm notifications and graphical status updates. As of 2012, all service representatives receive interruption alarms when feeders they are responsible for, experience an outage. Otter Tail’s reliability engineer uses the IMS for reporting reliability indices and for further analysis as he works with the Company’s Area Engineers to propose projects to improve reliability. These devices are also utilized for power quality analysis at some of Otter Tail’s industrial and commercial customer locations to aid in the investigation of power quality issues and allow for alarm notifications to be sent directly to customers.

Otter Tail also has the capability of providing graphical interruption information to all customers on Otter Tail’s web site. Graphical data, at the feeder level, is merged with Google Maps and linked to the home website.

The current IMS communication platform utilizes 2G commercial cellular network. The supplier (Sensus) has no plans for upgrading the current monitors to 3G or 4G networks. Otter Tail has begun investigating NextGen IMS solutions for implementation in the 2017-2020 timeframe. Several options are being investigated.

Operating costs associated with the IMS for 2013 were for maintenance and communications. Maintenance dollars dealt with the replacement of defective devices as well as GPRS device replacement with 1XRTT. Network solution replacements will intensify in the future due to transition from GPRS to 1XRTT availability. Costs totaled \$130,000 and are detailed below:

2013 IMS Maintenance:	\$40,000
2013 IMS Communications:	\$70,000
2013 IMS Software maintenance and updates:	\$20,000

Mobile Data

The vehicles used to move information among employees and between employees and customers is changing. The original scope of our mobile data project was limited to email communications for Service Representatives, but the availability and capability of technology has evolved quickly, as have the needs of employees and customers.

Service Representatives and Line Crews

The goal of this project continues to be to improve productivity and efficiency while enhancing customer satisfaction by providing Service Representatives with “real time” information with the use of mobile technologies. The development of Smartphones and tablets will allow the

Company to provide information beyond the truck, giving us the ability to access information at the meter, customer premise, substation, or other site.

Service Representatives currently use laptops, voice only phones, and hand held meter reading devices to perform work in a mobile environment. Laptops provide employees remote access through Citrix, a secure channel, to the Company network. These laptops are reaching end-of-life, prompting the Company to evaluate an asset replacement plan. Therefore, Otter Tail is evaluating alternative hardware combinations beyond the laptop, including smart phones and tablets. Considerations around security, employee uses, and Company requirements make the evaluation complex and highlight the need for the Company to prepare thoughtfully for the future. Mobile app solutions, Mobile Work Force Management solutions, and other mobile services such as Mobile Device Management software, are all factors that must be considered prior to selecting and implementing an asset replacement plan. In addition, considerations of data systems that the mobile device can tie to and the potential capability of those systems, such as CIS or GIS, are also being evaluated.

Current data available through the laptops includes:

- Company email
- Customer Information Systems (the Company's billing system)
- Customer Service Guide
- Geographic Information System (GIS)
- Load management real time control information
- Interruption monitoring system
- Ability to display and update maps and prints of Otter Tail's electrical system
- Otter Tail Power Company website
- Bill Analyzer, and other on-line tools

Issues with the present mobile solutions for field personnel have included lack of network connectivity, speed of the connection, getting "dropped" when working online, varying computer skill levels and the need for training and support.

Technicians

Otter Tail has several groups of technicians that perform a variety of work in Communications, Electrical System Maintenance, and Metering. A small pilot of a mobile app on iPad mini devices is being deployed in 2014 for four meter technicians to perform CT Meter Testing. The application was developed in-house using Fulcrum, an Apple approved application. The cost of this pilot in 2014 is expected to be roughly \$5,400. Through this project, the Company aims to reduce vehicle drive time, optimize routing, eliminate paper processes, illuminate "dark data" that previously was filed on hard copies in filing cabinets, error-proof the testing process as much as possible, and eliminate redundant site visits. The Company also aims to learn about the iPad and its strengths and weaknesses for other Company uses by the technicians.

Bill Analyzer

Bill Analyzer is a program that is available to residential customers through the Otter Tail website, which allows customers to analyze their energy usage and billing, input home profile data, and compare their usage with other comparable customers. The purpose of this tool is to

help residential customers, who have the desire to better understand their energy bill, to understand what steps they could take to reduce energy use and manage cost.

After a simple registration process a customer can review 25 months of billing history, provide personal information about their home, appliances, and living habits, and review payment information. The analytic engine uses weather data and customer provided information to calculate probable reasons for changes in usage. By entering their home profile, the customer can determine how their usage is broken out by applications and see how their usage compares to other customers with comparable size homes. Bill analyzer is an Aclara tool and features include:

Bill center - Customer account with amount due, due date, last payment, and graphs to compare energy use.

Bill highlights - Factors that may have contributed to a change in the electric bill. If customers need more details they can dig deeper with bill analysis.

Bill history and analysis - Provides 25 months of history and allows customers to compare statements from any two billing cycles.

My energy center - Includes an energy audit for the home. After the audit is complete, customers can create a plan to save energy.

A counterpart to the Bill Analyzer web self-service tool is a version used by Customer Service employees to answer customer questions about energy use and billing.

Results

In 2010, 2012, and 2013 Otter Tail contracted with Integral Analytics to conduct measurement and verification of energy savings associated with the Bill Analyzer program.

- The 2010 evaluation indicated that Bill Analyzer saved an average 296 kWh per year per participant overall, or approximately 1.5 to 2 percent of their energy usage.
- The 2012 evaluation refined participation levels and indicates savings of 529 kWh per participant or approximately 3 percent of their energy use.
- The 2013 evaluation indicates Bill Analyzer saved an average of 715 kWh per year per participant, or approximately 4 percent of a customer's annual energy usage.

Opower Energy Reporting

Otter Tail has contracted with Opower to procure its patented Home Energy Reporting System for use with Minnesota residential customers as a part of a pilot program included in the company's Conservation Improvement Program. The Home Energy Reporting System is a vetted energy efficiency program that leverages large-scale consumer engagement to drive measurable, predictable, and sustainable demand reduction.

The Home Energy Reporting System is based on a software platform that combines energy usage data with customer demographic, housing, and geographic information data to benchmark energy

use and develop specific, targeted recommendations that educate and motivate consumers to reduce their energy consumption.

Home Energy Reports are delivered through direct mail to selected residential customers. The reports provide specific, personalized, evaluative information and recommendations to motivate recipients to reduce their energy consumption.

Otter Tail sent out the first reports to customers in June of 2011. In 2012 a total of 28,286 Minnesota residential customers received reports. Results for 2012 showed energy savings of 163 kWh per participant household. In 2013 a total of 33,649 Minnesota residential customers received the report. The evaluation reflects energy savings of 144 kWh per participant household.

Bill Analyzer (see Bill Analyzer section above) and Opower are included in the Energy Feedback Pilot program with a combined budget of \$391,400 for 2013. In 2014, the combined annual budget for Opower and Bill Analyzer is \$370,600.

Fleet Tracking

Otter Tail owns many vehicles that are used by employees for the purposes of servicing our electrical system. In 2012, a sample group of these vehicles were equipped with a fleet tracking device as part of a three year pilot project to provide real time geospatial information on Company vehicles. Vehicles selected for the pilot included some vehicles that are assigned to Otter Tail field meter technicians, communications specialists, the hot line crew, project management, and electrical technicians. Overall, 39 mobile devices (27 in Minnesota) are in the field; 38 vehicles and one light tower/trailer have been upgraded with this capability for purposes of the pilot study. In 2013, the Company spent \$14,737 on fleet tracking services.

Fleet tracking enhances reliability by assisting in dispatch decisions to optimize the Company's responses to service interruptions or service needs. Fleet tracking also enhances safety by providing the ability to know the current location and identification of staff when they are in the field working on Otter Tail's electrical system. The ability to track Company vehicles is also an additional tool for managers to manage staff and enables the Company to decrease operation and maintenance expenses and optimize work allocation. Fleet tracking has provided reports that accurately present mileage for tax purposes to each state for qualifying vehicles, ensuring the Company pays exactly what is owed, not more or less. Otter Tail will continue to evaluate the benefits, challenges, and usefulness of the fleet tracking service over the course of the pilot project. Upon successful pilot completion, the Company will look to expand the implementation of fleet tracking throughout the system and integrate it with several key activities and systems at Otter Tail, specifically:

- System operations' dispatch activities,
- A potential outage management system,
- The evolving GIS, and
- Customer service applications for premise visits.

Geographic Information System (GIS)

Otter Tail has developed a Geographic Information System to track and manage Company assets. In 2012, the Company pursued converting nearly 4,000 maps from an AutoCAD format to GIS and the conversion of these maps was completed in January 2013. Also in 2012, Otter Tail developed applications in anticipation of a fully developed GIS for use in future ground line inspections, line patrols, and vegetation management activities. The GIS development activities in 2013 cost \$299,386 and included the charges for the conversion of the 4,000 CAD maps, geospatial cleanup, and required survey efforts, as well as the development of tools to perform tax reporting, export data for distribution electrical studies, and to apply attributes to assets connected geometrically. Mapping services from the GIS were published for Company use in the first half of 2013 and have displaced the previous CAD mapping service. The GIS is used to track units of property for every circuit for use in determining tax deduction eligibility for repair work.

The goal of the GIS is to enhance communication with employees and customers, leverage existing data systems to track and manage the Company's assets more efficiently, and provide geo-spatial information of the Company's assets along with related attributes and detail. The GIS will ultimately provide a single, interactive map for asset information thereby eliminating inefficiencies related to having information in disparate locations. Because maps will be electronic and linked to the GIS, data will be more current than the existing paper maps.

Spatial business intelligence through the GIS is expected to provide a platform for data management, strategic planning and analysis, and engineering and operational support. Longer-term, the Company envisions the GIS as a foundational tool for automating work flow management, distribution automation and outage management, and providing enhanced situational awareness.

For 2014, the GIS will continue to be cleaned and maintained. New survey data will be added and the GIS will be used for tax reporting, publishing maps for field work, and electrical studies.

CERTIFICATE OF SERVICE

**Re: In the Matter of Otter Tail Power Company's Smart Grid Report
Minnesota Docket No. E999/CI-08-948**

I, Jana C. Emery, hereby certify that I have this day served a copy of the following, or a summary thereof, on Dr. Burl W. Haar and Sharon Ferguson by e-filing, and to all other persons on the attached service list by electronic service or by First Class mail.

**Otter Tail Power Company
Compliance Filing**

Dated this **1st** day of **April, 2014**

/s/ JANA EMERY

Jana Emery
Regulatory Filing Coordinator
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