# Smart Grid Report

## October 1, 2014

# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF APPENDICES

# ACRONYM LIST

| | |
|---|---|
| **A/C** | Air Conditioning |
| **ACC** | Automated Capacitor Control |
| **ANSI** | National Service Voltage Standard |
| **AMI** | Advanced Metering Infrastructure |
| **ARRA** | American Reinvestment and Recovery Act |
| **ATC** | Available Transfer Capability |
| **CGI** | CGI Group Incorporated |
| **CIS** | Customer Information System |
| **CHIP** | Charging Impacts Project |
| **CR&B** | Customer Relationship and Billing |
| **CRM** | Customer Relationship Management |
| **CSPP** | Cogeneration and Small Power Producers |
| **CSR** | Customer Service Representative |
| **CVR** | Conservation Voltage Reduction |
| **DMS** | Distribution Management System |
| **DOE** | Department of Energy |
| **dQ/dV** | Delta-Q/Delta-V |
| **DR** | Demand Response |
| **DSM** | Demand-Side Management |
| **EDW** | Enterprise Data Warehouse |
| **ENGO** | Edge of Network Grid Optimization |
| **ETC** | Expected Transmission Commitment |
| **EV** | Electric Vehicle |
| **FERC** | Federal Energy Regulatory Commission |
| **GIC** | Geomagnetic Induced Currents |
| **GMD** | Geomagnetic Disturbance |
| **HAN** | Home Area Network |
| **IEE** | Itron Enterprise Edition |
| **ILC** | Irrigation Load Control |
| **INL** | Idaho National Lab |
| **IPC** | Idaho Power Company |
| **IRP** | Integrated Resource Plan |
| **IT** | Information Technology |
| **kV** | Kilovolt |
| **kW** | Kilowatt |
| **kWh** | Kilowatt-hour |
| **LLC** | Limited Liability Company |
| **LSE** | Linear State Estimator |
| **LTC** | Load Tap Changer |

| | |
|---|---|
| **MDMS** | Meter Data Management System |
| **MVAr** | Megavolt-ampere-reactive |
| **MW** | Megawatt |
| **NEEA** | Northwest Energy Efficiency Alliance |
| **NERC** | North American Electricity Reliability Commission |
| **OMS** | Outage Management System |
| **OPUC** | Public Utility Company of Oregon |
| **OSI/PI** | OSIsoft, LLC/PI enterprise infrastructure management software platform |
| **PLC** | Power Line Carrier |
| **PMU** | Phasor Measurement Unit |
| **PUD** | Public Utility District |
| **PURPA** | Public Utility Regulatory Policies Act of 1978 |
| **PV** | Photovoltaic |
| **RC** | Reliability Coordinator |
| **RD&D** | Research, Development and Deployment |
| **RIT** | Renewable Integration Tool |
| **SE** | State Estimator |
| **SGIG** | Smart Grid Investment Grant |
| **SGM** | Smart Grid Monitoring |
| **TOD** | Time Of Day |
| **TVP** | Time Variant Pricing |
| **VAr** | Volt Ampere Reactive |
| **VSMS** | Voltage Stability Monitoring System |
| **VVMS** | Volt/VAr Management System |
| **WECC** | Western Electricity Coordinating Council |
| **WSU** | Washington State University |
| **YE** | Year-End |

# EXECUTIVE SUMMARY

Idaho Power Company (Idaho Power or company) is pleased to present its 2014 Smart Grid Report in compliance with Order No. 12-158 issued by the Public Utility Commission of Oregon (Commission or OPUC) in Docket UM 1460. The Commission's smart grid goal and objectives as set forth in this order are as follows:

> *The Commission's goal is to benefit ratepayers of Oregon investor-owned utilities by fostering utility investments in real-time sensing, communication, control, and other smart-grid measures that are cost-effective to consumers and that achieve some of the following:*
>
> - *Enhance the reliability, safety, security, quality, and efficiency of the transmission and distribution network*
> - *Enhance the ability to save energy and reduce peak demand*
> - *Enhance customer service and lower cost of utility operations*
> - *Enhance the ability to develop renewable resources and distributed generation.*

This document presents Idaho Power's second annual *Smart Grid Report* and addresses the company's efforts toward accomplishing the Commission's goals. This report explains the company's overall strategies, goals, and objectives as they pertain to its smart grid efforts. It provides a review of current smart grid projects, initiatives, and activities being performed by the company and describes additional projects the company plans to undertake in the next five years. Opportunities the company has identified, as well as potential constraints, are also discussed.

Idaho Power evaluates new smart grid technologies and opportunities in a systematic process to determine if they solve an existing problem, improve efficiency, increase reliability, safety or security, or enhance customer satisfaction. Opportunities for funding smart grid projects are evaluated using common criteria alongside other capital projects being considered by the company.

In addition to fulfilling or meeting Commission reporting requirements, this document serves as a high level strategic document for Idaho Power to plan and track its smart grid projects. It acts as a company-wide repository of all smart grid projects, reports, and studies underway or planned in the near-term future.

The Commission's specific recommendations for this report included in Order No. 13-481, Docket UM 1675, are reviewed in Section V, Targeted Evaluations.

Also included as Appendix A is Idaho Power's Status of Smart Grid Initiatives – 2013 and 2014.

## Solicitation of Stakeholder Input

In preparation for filing this report, Idaho Power provided the public and other parties with opportunities to contribute information and asked for ideas on smart grid investments and applications. Idaho Power enhanced the stakeholder input process this year in an effort to get more meaningful public input and to respond to OPUC Staff's recommendation as included in page 2 of Appendix A, Order No. 13-481, UM 1675. Staff recommended that "in the future, it may be beneficial for the Company to circulate a draft version of the report at the same time they solicit comments." Idaho Power compiled a draft report which was available for review by the public and other stakeholders during the review period.

To solicit input from the general public, Idaho Power placed an advertisement—Share Your Ideas About Smart Grid—in the two newspapers with the best coverage in Idaho Power's Oregon service area. An advertisement was placed in the *Argus Observer* (Ontario) on August 1 and 10, 2014, and in the *Hells Canyon Journal* (Halfway) on August 6 and 13, 2014. On August 1, 2014, Idaho Power sent an email soliciting comments to all parties on the service lists for the Smart Grid docket, UM 1460; Idaho Power's last general rate case docket, UE 233; Idaho Power's last integrated resource planning docket, LC 58; and Idaho Power's 2013 Smart Grid Report docket, UM 1675. Idaho Power requested comments be submitted by August 31, giving parties 31 days to provide responses. Idaho Power included a web link in the newspaper ads that accessed a copy of the draft Smart Grid Report and attached a draft Smart Grid Report to the email solicitation. Idaho Power did not receive any comments or suggestions as a result of the newspaper advertisement or email solicitation. Copies of the newspaper advertisement and email solicitation are provided in Appendix B.

# I. Smart Grid Goals, Objectives, Strategy, and Process

The smart grid is a concept whereby utilities deploy new technologies to reduce costs and improve the operation of the electrical power system. As an industry, utilities have been doing this for years; it is not new. What is new is the speed in which new technologies are becoming available and the abundance of data now available through smart meters and monitoring devices.

This document represents a vision of what Idaho Power's future may look like in the near to mid-term and presents various projects and programs that Idaho Power is undertaking or may undertake to prepare for that future. Some of the projects are already underway while others are for future implementation. The Smart Grid Report is a vision paper supported with concrete studies and analysis created by a working group of Idaho Power senior managers and senior staff. The vision represented herein is forward looking and as such, may be adjusted in some areas as the years progress.

## A. Goals and Objectives

### *The Smart Grid is Customer Centered*

The smart grid concept provides customers easier access to their energy use information and empowers them to act on that information. It provides real-time signals to customers and in general, serves them in a manner that allows them to be more involved and proactive in managing their energy use. Idaho Power believes that the customer will expect utilities to provide a different experience than the traditional paradigm of service provided today. One driver of this paradigm change is motivated by the increasing use of technology in our everyday lives. Idaho Power believes customers will and do expect a different experience than what has been traditionally provided. Customers will seek an experience that includes information that enables them to make choices in their energy use.

### *The Smart Grid is Data Rich*

The smart grid is a data rich environment with embedded sensing devices located throughout the electric system that allows for automation of protection and control while providing the information needed to more efficiently operate the system. It provides two-way flows of information between devices and between Idaho Power and its customers. It gives the utility the ability to more efficiently integrate distributed resources. It provides resiliency in utility response to storm or event driven outages, speeding up restoration efforts.

### *Edge of Network*

The smart grid is moving to the edge of the network – an area where utilities have traditionally not gone. This edge goes all the way down to the secondary side of the service transformer and even into the homes and businesses served by Idaho Power. The ability to control power quality down to the customer level enables the system to become more efficient and responsive to customer needs while maintaining customer privacy.

The smart grid represents an opportunity to enhance the value customers receive from the electric system. Idaho Power is committed to helping customers realize this value through good planning and making wise investments, considering both costs and benefits associated with any smart grid project. Idaho Power must accomplish what is required to realize this vision while maintaining the safety and reliability expected of it by both customers and employees. By optimizing and modernizing the power system, Idaho Power can enhance customer service, improve power reliability, promote energy efficiency, and more efficiently integrate renewable resources.

At Idaho Power, the smart grid vision consists of seven major characteristics:

1. Enhance customer participation and satisfaction
2. Accommodate generation/energy storage
3. Enable new products/services/markets
4. Improve power quality
5. Optimize asset efficiency
6. Anticipate and respond to disturbances
7. Provide resilient operation/robustness

## B. Strategy

The company's strategy for realizing the smart grid vision consists of focusing investments in the following areas:

### *Operations*

Idaho Power will make considerable investments in the coming years in real-time sensing, diagnostic, communications, and control equipment to increase the efficiency and reliability of the system and make the system more resilient. Simultaneous with these investments, Idaho Power must mold together planning activities, field work, and operations. Actions will be taken to integrate new operations tools into existing tools that are familiar to system operators.

Determining a strategy for communicating with the many devices to be installed on the electrical system is critical to the smart grid's long term success. While Idaho Power has operated a number of different communication systems for many years, many of the systems are becoming outdated or have reached capacity. A distribution system communications strategy must provide speed, bandwidth, and high security while minimizing costs.

Some specific operational projects that will be undertaken and are described more fully in this report are:

- Replace the Outage Management System (OMS)
- Refine the renewable energy (wind) integration tool
- Install a transmission line situational awareness tool
- Pilot a substation fiber-based protection and control pilot
- Enhance the existing Conservation Voltage Reduction (CVR) program
- Replace the Automated Capacitor Control (ACC) system
- Develop a distribution communications strategy

### *Customer Systems*

Idaho Power believes that its customers' expectations are changing and they want more information about their energy use. In order to provide customers easier access to information about their energy use and enable them to take actions based on that information, many background activities must take place.

Some specific customer systems projects that will be undertaken and are described more fully in this report are:

- Refine the Enterprise Data Warehouse (EDW)
- Develop a Customer Relationship Management (CRM) system

### *Advanced Metering Infrastructure (AMI)*

With most Idaho Power meters now having AMI capabilities, Idaho Power seeks to more fully utilize the tremendous amount of information received to improve service offered to its customers. These meters also possess additional functionality that needs to be investigated.

Some specific projects that will be undertaken and are described more fully in this report are:

- Implement automated connect/disconnect through the AMI system
- Upgrade station communications
- Upgrade the Meter Data Management System (MDMS)
- Upgrade Irrigation Load Control (ILC)
- Investigate the ability of AMI to control line devices

Integrating these projects enhances Idaho Power's ability to manage peak demand, integrate renewable resources, maintain low electricity rates, offer Time Variant Pricing (TVP), increase energy efficiency, and improve grid reliability.

## C. Process

Idaho Power has a systematic process for evaluating smart grid projects. The Research, Development, and Deployment (RD&D) department is the primary department responsible for the assessment of new grid technologies, including smart grid opportunities. Project leaders are responsible for tracking and evaluating industry technologies, managing technology pilots, and assessing pilot-project outcomes.

The project leaders plan the utility-wide deployment of successful technologies and submit these plans for capital funding. Smart grid technologies are collected and evaluated with all other ideas. The high-level process is shown in Figure 1.

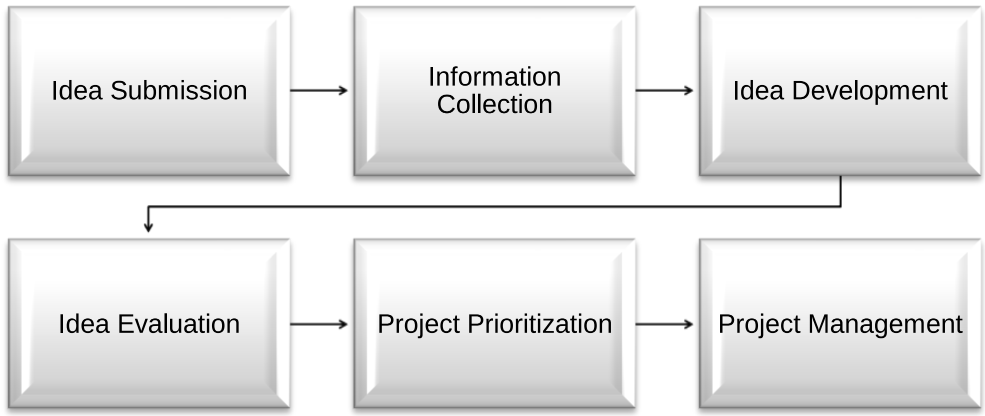


**Figure 1. Idea Processing**

Smart grid ideas are analyzed to determine if they solve an existing problem, improve efficiency, increase reliability, safety or security, or enhance customer satisfaction. The RD&D leaders also develop smart grid ideas into deployable pilot projects and evaluate the cost/benefit of the project. The pilot project is submitted to a review team to ensure all aspects of the project have been included in the initial design and to evaluate external impacts of the project (e.g., communication infrastructure and operating capabilities). The project is then evaluated for funding against all other projects. After the pilot project is funded and deployed, it is evaluated against the projected costs and benefits determined in the initial evaluation stage. If the pilot project meets expectations, a project plan is developed for utility-wide deployment.

# II. STATUS OF SMART GRID INVESTMENTS

The following sections describe the smart grid projects, initiatives, and activities currently underway and the results to date.

## A. Transmission Network and Operations Enhancements

### *Transmission Situational Awareness Project*

Several pilot projects are underway to expand the Transmission Situational Awareness Project described in the 2013 Smart Grid Report. These projects are described in more detail in the Future Smart Grid Investments section. More specifically, the projects are:

- Transmission Situational Awareness Oscillation Monitoring Pilot
- Transmission Situational Awareness Voltage Stability Monitoring Pilot
- Transmission Situational Awareness Grid Operator's Monitoring & Control Assistant

### *Transmission Situational Awareness Peak Reliability (RC) Hosted Advanced Application*

The western system RC, now titled Peak Reliability, maintains a Western Electricity Coordinating Council (WECC)-wide State Estimator (SE) data model for real-time transmission system contingency analysis so its operators can perform their primary function of maintaining system-wide reliability. "Contingency" refers to changes in the modeled system due to non-normal events such as a line or generator outage.

Maintaining a WECC-wide SE data model has proven very difficult for operators and planners due to system complexity and differences in the models used by the various utilities in the WECC. Peak Reliability developed a slate of advanced applications to maintain the system estimator. These advanced applications provide users with an assessment of the current state of the transmission system including:

- Voltage magnitude and angle at all modeled buses
- Megawatt (MW) and megavolt-ampere-reactive (MVAr) flow on all lines and transformers
- MW and MVAr flow on loads and generating units
- Transformer load tap changer (LTC) tap position
- Phase shifter tap position
- Identification of pre- and post-contingency facility rating, System Operating Limit, and Interconnection Reliability Operating Limit exceedances
- Identification of network islands
- Identification of potential post-contingency cascading outages
- Identification of potential post-contingency islanding conditions

The advanced application tools used by Peak Reliability consist of:

- Real-Time Network Analysis tools:
  - State Estimator
  - Real-Time Contingency Analysis
- Network Study Applications
  - Power Flow
  - Study Contingency Analysis
- Fast Network Analysis

Several years ago Idaho Power proposed that it be given the ability to remotely use an instance of the Peak Reliability advanced applications for real-time contingency analysis by installing a system for remote access and retrieval of the SE solution. By September 2014, it is expected that the hardware and applications for remote support will be installed at Idaho Power. Additionally, seven other utilities in the WECC are now using the advanced applications tool with a number of other utilities expected to join in 2015. Other utilities currently using the hosted advanced applications tool are Avista, Northwestern Energy, Grant County Public Utility District (PUD), Chelan County PUD, Douglas County PUD, Tucson Electric Power, and Seattle City Light.

## *Available Transfer Capability (ATC) Calculation Tool*

As described in the 2013 Smart Grid Report, Idaho Power, in collaboration with Pacific Northwest National Lab, developed a probabilistic-based method and tool flexible enough to allow Idaho Power to determine the ATC for any existing and future transmission path. Different from the deterministic approach, this tool considers stochastic variations of wind generation and load and the impacts of such variations in calculating ATC.

Calculating ATC is critical to knowing how much power can be reliably transferred over the interconnected transmission network. An overestimation of ATC can jeopardize the reliability of system operation or cause unexpected congestion, while underestimated ATC can lead to inefficient transmission system utilization.

The initial ATC tool has been developed and evaluated by Idaho Power. The calculations and methods have been verified; however, the software does not have sufficient flexibility to model future system changes. Idaho Power has contracted with North Carolina State University to develop a graphical user interface to adjust the program inputs to expand the applicability of the tool. There are four key features being implemented:

1. Visualization of statistic characteristics of input data sets
2. Parameter selection
3. Results: Expected Transmission Commitment (ETC) statistics
4. Results: ETC confidence interval

This phase of the project is expected to be completed in 2014.

## *Dynamic Line Rating Pilot*

As described in the 2013 Smart Grid Report, Idaho Power and the Idaho National Lab (INL) are collaborating on a system that predicts wind speed and direction along the transmission line from an area-specific wind model using real-time weather station information located along the transmission line. The software program calculates the actual line limits based on the measured ambient conditions and wind model. A pilot system with 17 weather stations has been installed in a test area monitoring a portion of the 230 kilovolt (kV) and 138 kV transmission lines between Hagerman, Bliss, and Glenns Ferry, Idaho.

Since last year's report, the pilot project has progressed with the installation of several new weather stations. INL is developing the software to calculate operating line limits and should be completed in 2014. Idaho Power/INL has begun to gather data to assess the potential to dynamically rate transmission line operating limits in the Hells Canyon area. Data gathering is expected to continue through 2014 and will be assessed by the end of the year. If necessary, additional data gathering may continue into 2015. Due to the extreme topology of the Hells Canyon area, this is a very challenging endeavor. Idaho Power and INL continue to work closely together to further this technology and approach.

For a more complete description of this project, Appendix C contains a paper written by the INL titled, "Dynamic Line Rating: Concept, Case Study, and Regulatory Review."


**Figure 2. Dynamic Line Rating Equipment Installed in Hells Canyon**

# B. Substation and Distribution Network and Operations Enhancements

## *Transmission Transformer Geomagnetic Disturbance (GMD) Monitoring*

As described in the 2013 Smart Grid Report, Idaho Power has analyzed the transmission substations in its system to determine those that may be susceptible to geomagnetic induced currents (GIC). GIC are created when a space weather event (solar storm) interacts with and creates variation in the earth's magnetic field that could potentially damage some electrical power equipment. This analysis has identified three Idaho Power substations that may experience GIC during a large GMD. Two GIC sensors have been installed to date. The data is periodically gathered and aligned with GMD events to assess if the event resulted in measureable GIC.

The Federal Energy Regulatory Commission (FERC) and North American Electricity Reliability Commission (NERC) have also begun to address GMD. In May 2013, FERC issued Order No. 779 directing NERC to develop reliability standards to address the potential impact of GMDs on the reliable operation of the Bulk Power System. FERC Order No. 779 issued directives to NERC to develop reliability standards in two stages. Stage 1 standards require applicable entities to develop and implement operating procedures that can mitigate the effects of GMD events. Stage 2 standards require applicable entities to conduct initial and ongoing assessments of the potential impact of benchmark GMD events on their respective systems.

Stage 1 standards have recently been approved under NERC Project 2013-03 Geomagnetic Disturbance Mitigation as NERC Standard EOP-010-1. The Stage 2 standards will be drafted as NERC Standard TPL-007-1. Experience gained through the model development and study process will be used to help develop the operating procedures required in EOP-010-1 and the transmission planning processes and procedures that will be required in TPL-007-1.

## *Conservation Voltage Reduction Enhancements*

As reported in the 2013 Smart Grid Report, Idaho Power participated with 12 other utilities in the Northwest Energy Efficiency Alliance's (NEEA) CVR pilot study in 2007. This study, using statistical sampling, determined that system peak power demands and overall energy consumption can be reduced by CVR. Idaho Power implemented a CVR program in 2009 at eight substations and is now in the process of measuring and analyzing the program's effects and determining how the program can be enhanced.

A more detailed description of Idaho Power's CVR Enhancements Project is included in the Future Smart Grid Investments section.

# C. Customer Information and Demand-Side Management (DSM) Enhancements

## *Advanced Metering Infrastructure*

In 2011, Idaho Power completed the installation of AMI hardware and software, an MDMS, a metering data warehouse, and approximately 500,000 digital smart meters (including 18,000 meters in Oregon) for a total investment of $73 million. The AMI system is currently collecting hourly energy consumption data and daily kilowatt-hour (kWh) and kilowatt (kW) readings for all smart meters deployed in Idaho and Oregon. The AMI system provides two-way communications to 99 percent of Idaho Power's metered retail service customers (90 percent in Oregon). The remaining metered retail service customers did not meet Idaho Power's business case requirements at the time the implementation plan was initiated. Idaho Power continues to manually read meters in these locations and periodically reevaluates the business case for installing smart meter equipment in substations located in sparsely populated areas.

Idaho Power has begun leveraging the AMI system for uses beyond consumption data collection. These additional uses include:

- Outage Detection – If a meter stops communicating, a trouble order is issued.
- Partial Power Detection – The phase voltages on all three-phase services are measured three times a day. If one of the phase voltages shows as missing, a trouble order is initiated. It is often found that one of the phases is de-energized on the customer's premises.
- System Voltage Reads – Voltage data is collected three times a day at all active three-phase services and other locations as requested by company planning or field operations (currently 40,000 sites).
- Select Load and Voltage Studies – In place of installing additional field monitoring devices, voltage and load information can be collected upon request.
- Customer Load Control – The AMI system communicates commands to both the A/C Cool Credit and Irrigation Peak Reward demand response (DR) programs.
- Reverse Power Flow Detection – The AMI system detects unauthorized customer generation, attempted energy diversion activities, and metering errors.
- Transformer Rated Meter Installation Verification – Operations periodically validates system current and voltage.
- Investigations of non-communication issues have uncovered service issues including unintended distribution circuit field ties, distribution capacitor issues, distribution line regulator issues, overloaded circuits, and power quality issues.

## *Time Variant Pricing*

Beginning in April 2012, Idaho Power invited Idaho residential customers through a direct mail offering to sign up for an optional Time Of Day (TOD) pilot plan. Invitations were sent to approximately 132,000 customers throughout the summer of 2012. The offering resulted in over 1,600 customers enrolling in the pilot. Descriptions of the pricing plan structure, marketing collateral, rollout plan, and preliminary study findings were compiled in June 2013 and were included in the Appendix of the 2013 Oregon Smart Grid Report. Idaho Power planned to perform a behavior impact study after participants had been on the plan for a full year.

In July 2014, Idaho Power concluded the final impact study of the residential TOD pilot. This customer behavior study evaluated how the TOD pricing impacted energy consumption for participants in the plan. Participants' response to the TOD pricing signal was determined using a quasi-experimental study design structure with a TOD participant treatment group and a closely matched non-participant control group. The study timeframe included participant usage for the 12 months prior to when participants enrolled in the plan (April 2011 through March 2012) and 12 months after participants signed onto the plan (September 2012 through August 2013). The study used a two-tier stratification approach to obtain data for participants in four different usage categories to allow mapping of response rates to total population results. Idaho Power also calculated the billing revenue impact of this pilot by calculating a shadow bill for each customer on the TOD pricing plan versus the standard residential three-tiered pricing plan.

Key findings are summarized below:

<u>Overall Conservation</u>

- There was no statistically significant change in overall energy consumption observed in the study participants on the TOD rates.

<u>Overall Shifting of kWh</u>

- For the study group as a whole, the data analyzed showed a ***reduction*** in energy use from peak time periods by the analyzed participants of the pricing plan versus the control group. All but two months out of 12 months showed statistically significant reductions in energy use during peak periods. Over the 12-month study period this combined reduction in peak time period consumption was approximately 3 percent of total kWh use.
- For the study group as a whole, the data analyzed showed an ***increase*** in energy use during off-peak time periods by the analyzed participants of the pricing plan versus the control group. Five months out of the 12 months showed statistically significant increases. During the 12-month study period this combined increase in off-peak time period consumption was approximately 1 percent of total kWh.
- Figure 3 below graphically shows these results. The red bars show, in kWh, the estimated increase or decrease of usage by month and time of day of the TOD pricing plan participants. The left axis indicates the peak and off-peak results panels of the graph. The top half of the chart shows the average kWh reduction of peak time block usage. As can be seen on the chart, every month shows a reduction in usage from approximately -8 kWh (January) to approximately -26 kWh (month). The light grey bars behind the red bars represent a "not significant" band. Where the red bar does not extend beyond the light grey bar, then the estimated increase or decrease is small enough that it is within the range of what we might expect to see due to normal random variation and is not statistically significantly different from zero. Where the red bar extends beyond the light grey bar behind it, the results for that month are statistically valid at the 90 percent confidence interval. The bottom half of the chart shows the average kWh increase (or

reduction for December and February) of off-peak time block usage. Although in 10 months out of the year the average off-peak usage of participants increased, only in five of these months were the results statistically significant.

.

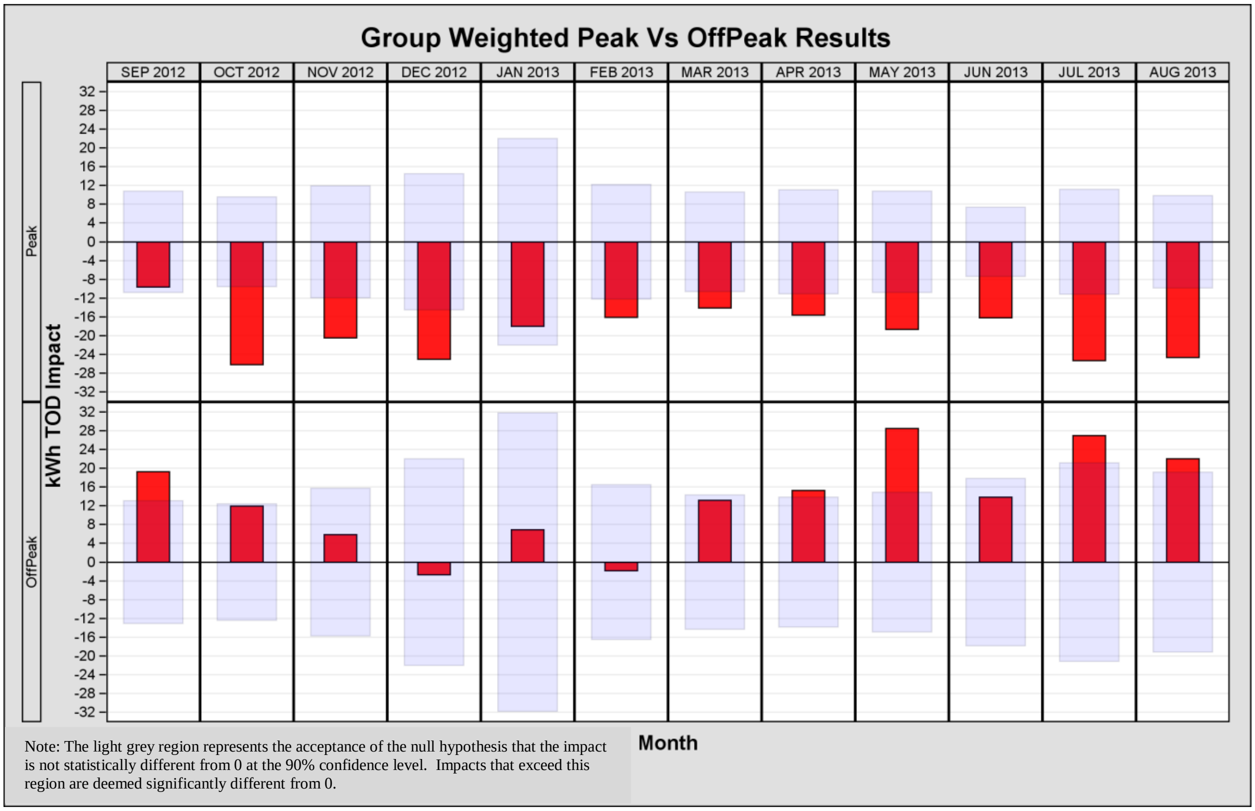


**Figure 3. Group Weighted Peak Versus Off-Peak Results**

<u>Response Rate</u>

- The overall response rate to the residential TOD pricing pilot plan solicitation was 1.3 percent.
- Study findings indicate that if the company were to expand the TOD offering to the remainder of the residential customer population across the company's service area using the same parameters and in exactly the same manner as in the TOD pilot, approximately 4,000 additional customers would likely volunteer to participate.

<u>Billing Impact</u>

- The study estimates that there was a revenue reduction of $119,000 when the actual TOD energy billings of all TOD pilot participants were compared with standard plan shadow energy bill calculations for all TOD pilot participants during the 12 months of the study, September 2012 through August 2013.

The company's evaluation and future plans for the TOD pricing plan are described in Section V, Targeted Evaluations. Appendix D contains the Time Of Day Final Study Report.

## *myAccount*

As a way to empower customers to make informed choices about their energy use and to use energy wisely, to increase customer on-line transactions, and encourage customers to access their hourly AMI data, Idaho Power examined how the on-line tool, Account Manager, could be made more effective. In April 2014, the company launched an awareness campaign for the Account Manager on-line tool was launched. The focus was to drive more customers to register and to increase usage by those already registered.

Through customer research, Idaho Power learned many customers were confused with the Account Manager name and employee focus groups results indicated that the name "My Account" was more appealing. They also confirmed the timing should be in conjunction with the awareness campaign. Following an extensive evaluation of the impact a name change would have on the company's website, social media, existing publications, and other customer facing communication, the decision was made to implement the change.

The ongoing campaign focuses on three key messages related to the benefits of using myAccount: Pay Your Bill, Get Account Information, and Understand Your Use. The campaign shows a variety of images representing our customers — by age, professions, or targeted customer groups.

The new name now appears on Idaho Power's website and social media sites. The awareness campaign began in the May issue of Connections with myAccount benefits noted on customers' bills and envelopes. As the campaign rolls out, instructional videos, advertising, a brochure, and updates to presentations and other existing materials will be utilized. Throughout the year, there will be ongoing myAccount reminders, with emphasis prior to high bill periods. An Idaho Power Connections article concerning myAccount can be found at:
https://www.idahopower.com/pdfs/newscommunity/News/CustomerConnection/201405.pdf


**Figure 4. Web Promotion Icon**

As depicted in Figure 5, customer registrations during April – June 2014 were higher than during the same period last year when Idaho Power was not advertising sign-ups (beyond the bill and website).

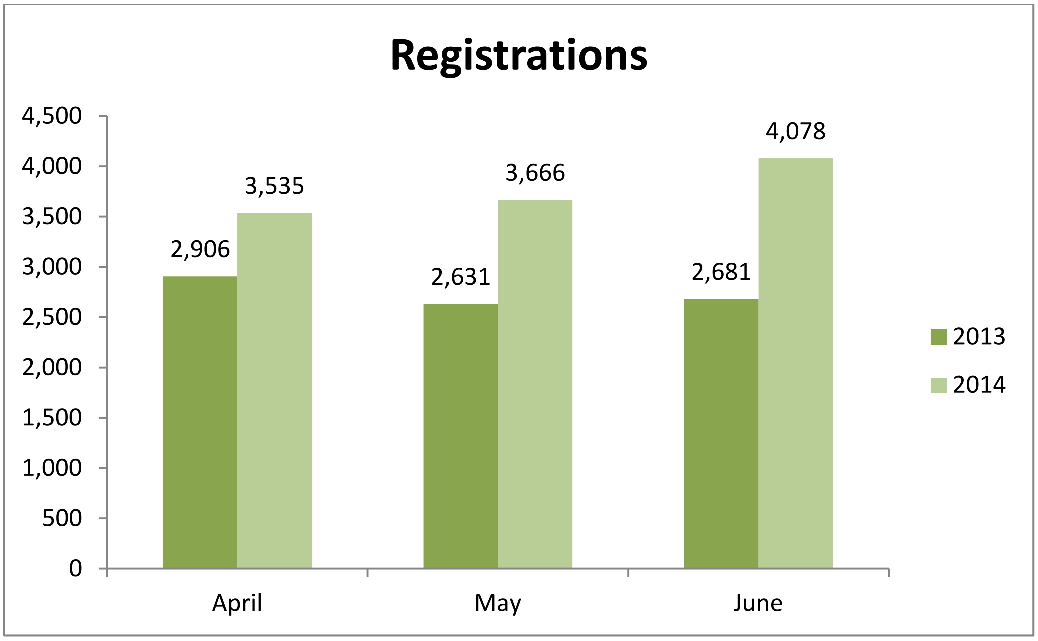


**Figure 5. myAccount Registrations April – June 2013 Compared to April – June 2014**

## *Direct Load Control*

Idaho Power has offered optional direct load control, or DR, programs since 2004 and to all of its customer segments since 2009. The company has offered an air conditioning (A/C) cycling program, A/C Cool Credit; an irrigation direct load control program, Irrigation Peak Rewards; and a commercial/industrial DR program, FlexPeak Management. The A/C Cool Credit and Irrigation Peak Rewards programs utilize the smart grid technology, more specifically the power line carrier (PLC) technology to activate load control devices installed on customer equipment. Both programs also have used the hourly load data made possible by AMI to help determine the load reduction achieved during a DR event.

### Irrigation Peak Rewards

The Irrigation Peak Rewards program is a voluntary program available to agricultural irrigation customers. The purpose of the program is to serve as a peaking resource during times of extreme load on the Idaho Power system by turning off participants' irrigation pumps with the use of one or more load control devices during the program season, June 15 through August 15. A control device attached to the customer's individual pump electrical panels allows Idaho Power to remotely control the pumps.

During 2014 approximately 2230 customer sites were enrolled in the Irrigation Peak Rewards program, of these 31 are located in Oregon. Irrigation Peak Rewards was used three times during the summer of 2014, on July 2, 10, and 14. Preliminary results indicate the program's peak reductions at generation level was 286 M July 2, 294 MW July 10, and 275 MW on July 14.

### FlexPeak Management

FlexPeak Management is a voluntary program designed for Idaho Power's industrial and large commercial customers capable of reducing their electrical energy loads for short periods during summer peak days. Participants are notified of a demand reduction event two hours prior to the event and in most cases reductions are achieved by the participants manually turning off equipment or otherwise changing their operations. The program objective is to reduce the demand on Idaho Power's system during periods of extreme peak electricity use.

Ninety-four participant sites were enrolled in FlexPeak Management in 2014. FlexPeak Management was used three times during the summer of 2014, on July 14, 31, and August 11. Preliminary results indicate the program's maximum peak reductions at generation level were achieved on July 14 and again on July 31 at 32.5 MW of load reduction.

### A/C Cool Credit

The A/C Cool Credit program is a voluntary, dispatchable DR program for residential customers. Using communication hardware and software, Idaho Power cycles participants' central A/C or heat pumps on and off via a direct load control device installed on the A/C unit. Participants receive a monthly monetary incentive for participating in the program during the summer season.

Approximately 31,539 PLC controlled switches are installed on customers' A/C units in Idaho Power's service area. Of these, 392 are installed in Oregon. These switches allow Idaho Power to cycle customers' A/C during a cycling event. A/C Cool Credit was used three times during the summer of 2014. Preliminary results for the program's maximum load reduction at the generation level were 42.94 MW on July 14, 29.59 MW on July 31, and 34.78 MW on August 11.

### Irrigation Load Control Pilot

Idaho Power predominantly uses cell phone and web-based technology to enable the company's Irrigation Peak Rewards program. The objective of the ILC Pilot is to investigate using grid-enabled PLC communication to activate load control devices on agricultural irrigation service locations to turn off irrigation pumps during program events. As part of the American Reinvestment and Recovery Act (ARRA) Smart Grid Investment Grant (SGIG), Idaho Power began conducting a pilot using grid-enabled PLC communication that would provide a reduced cost and more secure environment for program communication. The company currently has 130 AMI-enabled load control switches installed on participants' service points. To use the load control switches, Idaho Power added a transformer to the switches and tested the communications to these devices.

In 2014, Idaho Power resolved a few installation issues and utilized the AMI-enabled technology successfully at the sites on which it was installed. Overall, Idaho Power has proven it is a viable method; the load control devices will work on irrigation installations and can be used in the Irrigation Peak Rewards program. In the future, Idaho Power will continue to evaluate whether to fully move to this technology for the program or stay with the cell phone technology.

# D. Distributed Resource and Renewable Resource Enhancements

## *Renewable Integration Tool (RIT)*

As reported in last year's smart grid report, the Idaho Power SGIG funded the RIT project. The RIT project is intended as a set of tools to allow grid operators and power supply transaction specialists to efficiently and reliably integrate variable renewable resources with traditional generation resources.

To account for the variability in generation resources, the RIT project integrated variable renewable resources from large generation interconnections and Public Utility Regulatory Policies Act of 1978 (PURPA) wind projects.

In 2014, the RIT was split into two tools: the Wind Forecast Tool and the Load Forecast Tool. A number of enhancements have been made to the original RIT in 2014 and are described in Section IV.

## *Photovoltaic (PV) and Feeder Peak Demand Alignment Pilot*

As discussed in last year's report, Idaho Power has installed three solar-intensity monitoring stations along a distribution feeder to determine the impact of installing PV panels to maximize PV output with feeder peak demand. An update concerning this pilot project can be found in section IV.

## *Renewable and Other Energy Contracts*

Idaho Power purchases wind generation from both cogeneration and small power production (CSPP) and non-CSPP facilities, including its largest non-CSPP wind power project – the Elkhorn Valley wind project with a 101 MW nameplate capacity. As of August 31, 2014, Idaho Power had contracts to purchase energy from on-line CSPP wind power projects with a combined nameplate rating of 577 MW and an additional 50 MW of CSPP wind power projects not on-line and scheduled to come on-line by year-end 2016. In addition to its power purchase arrangements with wind power generators, Idaho Power has contracts for the purchase of generation from other CSPP and non-CSPP renewable generation projects, such as biomass, solar, small hydroelectric projects, and two geothermal projects. As of August 31, 2014, Idaho Power has signed CSPP-related agreements in both Oregon and Idaho with terms ranging from one to 35 years as set forth in the following table.

**Table 1. CSPP-Related Contracts**

| Status | Number of CSPP Contracts | Nameplate Capacity (MW) |
|---|---|---|
| On-line as of August 31, 2014 | 104 | 781 |
| Contracted and projected to come on-line by year-end (2016) | 18 | 240 |
| Total under contract | 122 | 1021 |
| | | |
| Oregon Contracts | 17 | 131 |
| Idaho Contracts | 105 | 890 |

## *Net Metering*

As of August 31, 2014, Idaho Power's net metering service consisted of 464 active systems, with applications pending for an additional 37 systems. Cumulative nameplate capacity from active systems totaled 3.28 MW, with an additional 0.379 MW associated with pending applications, for a grand total of 3.66 MW. The majority of net metering systems are solar PV at 2.95 MW, followed by wind at 0.56 MW, and small hydro/other at 0.15 MW.

The tables below provide the total number of active and pending net metering systems and nameplate capacity by resource type, jurisdiction, and customer class.

**Table 2. Number of Net Metering Systems - Pending and Active as of August 31, 2014**

| | Solar PV | Wind | Hydro/Other | Total |
|---|---|---|---|---|
| **Idaho** | | | | |
| Residential | 324 | 60 | 6 | 390 |
| Commercial & Industrial | 84 | 9 | 4 | 97 |
| Irrigation | - | 1 | - | 1 |
| **Total Idaho** | **408** | **70** | **10** | **488** |
| | | | | |
| **Oregon** | | | | |
| Residential | 3 | 2 | - | 5 |
| Commercial & Industrial | 6 | - | - | 6 |
| Irrigation | 2 | - | - | 2 |
| **Total Oregon** | **11** | **2** | **-** | **13** |
| | | | | |
| **Total Company** | | | | |
| Residential | 327 | 62 | 6 | 395 |
| Commercial & Industrial | 90 | 9 | 4 | 103 |
| Irrigation | 2 | 1 | - | 3 |
| **Total Company** | **419** | **72** | **10** | **501** |

**Table 3. Nameplate Capacity (MW) - Pending and Active as of August 31, 2014**

| | Solar PV | Wind | Hydro/Other | Total |
|---|---|---|---|---|
| **Idaho** | | | | |
| **Residential** | 1.30 | 0.34 | 0.06 | 1.71 |
| **Commercial & Industrial** | 1.38 | 0.18 | 0.09 | 1.65 |
| **Irrigation** | - | 0.04 | - | 0.04 |
| **Total Idaho** | **2.68** | **0.56** | **0.15** | **3.39** |
| | | | | |
| **Oregon** | | | | |
| **Residential** | 0.01 | 0.00 | - | 0.01 |
| **Commercial & Industrial** | 0.14 | - | - | 0.14 |
| **Irrigation** | 0.11 | - | - | 0.11 |
| **Total Oregon** | **0.26** | **0.00** | **-** | **0.27** |
| | | | | |
| **Total Company** | | | | |
| **Residential** | 1.31 | 0.35 | 0.06 | 1.72 |
| **Commercial & Industrial** | 1.52 | 0.18 | 0.09 | 1.79 |
| **Irrigation** | 0.11 | 0.04 | - | 0.15 |
| **Total Company** | **2.95** | **0.57** | **0.15** | **3.66** |

In terms of growth, Idaho Power's net metering service continues to expand. The chart below details cumulative net metering system counts from 2002 to year-to-date 2014.

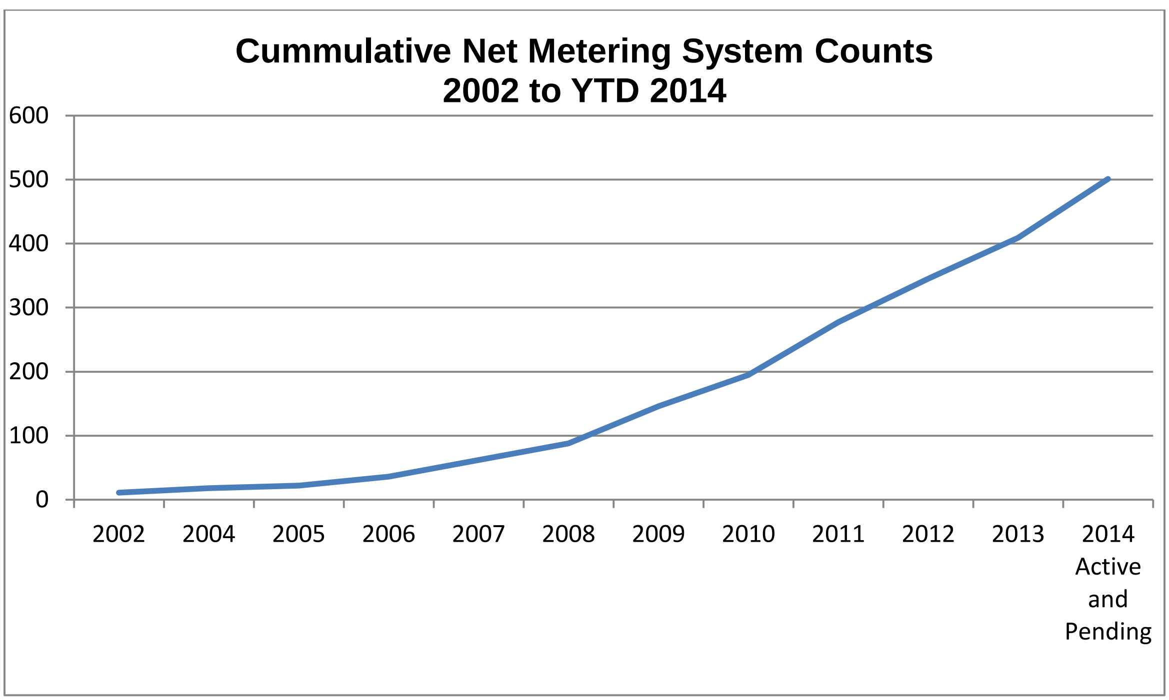


**Figure 6. Cumulative Net Metering System Counts 2002 to Year-to-Date 2014**

The chart below details cumulative capacity growth from 2002 to year-to-date 2014.

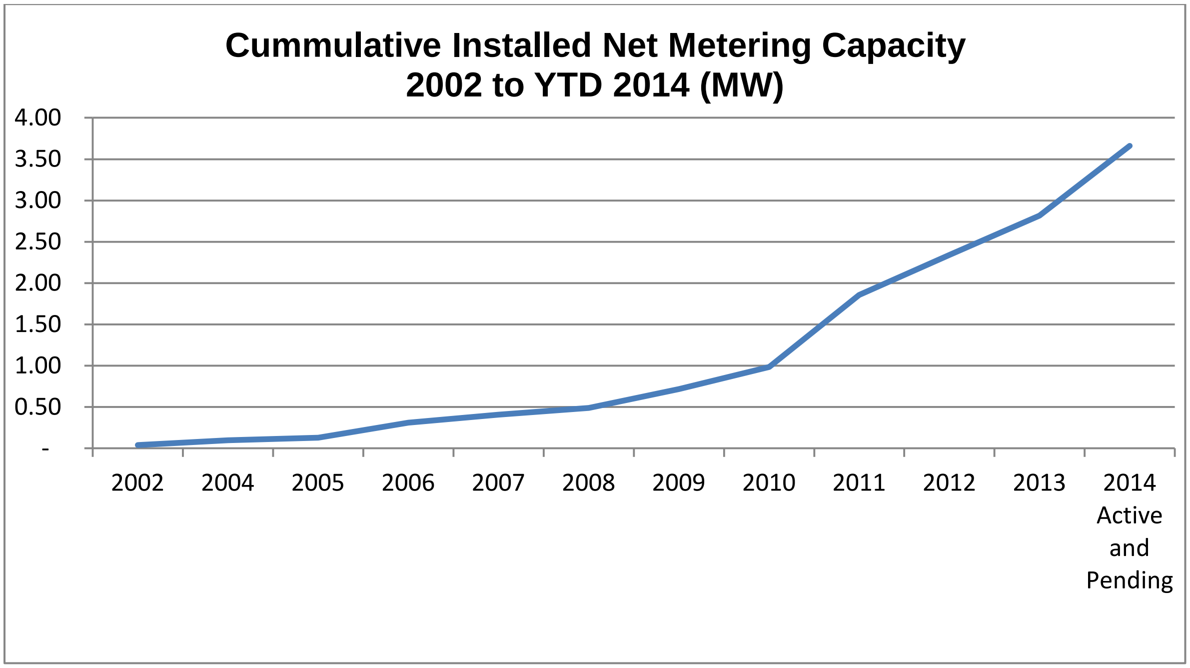


**Figure 7. Cumulative Installed Net Metering Capacity 2002 to Year-to-Date 2014 (MW)**

The exponential growth in net metering service since 2002 demonstrates how the company's grid is evolving, and underscores the importance of ongoing evaluation of the associated service provisions and pricing to ensure that Idaho Power continues to offer safe, reliable, and fair-priced electrical service.

# E. General Business Enhancements

## *Idaho Power Enterprise Data Warehouse (EDW)*

The EDW provides an analytic database to store customer and meter data. The EDW supports the company's analytical and reporting needs by providing a location combining information from both legacy and current customer information systems. It also ensures that reporting activities do not adversely impact performance on the metering, MDMS, and Customer Relationship and Billing (CR&B) source systems.

The first phase of this project was completed in November 2011 and entailed collecting, organizing, and providing meter data for reporting and analysis. The second phase combines customer data extracted from CR&B, as well as the legacy customer information system (CIS+), for reporting and analysis. This phase began with the implementation of CR&B on September 1, 2013. In December 2013, DSM information was added to the EDW. In June 2014, access to basic customer information for approved users was enabled. Additional releases to populate required customer information into the data warehouse are planned for the remainder of 2014 and into 2015.

Idaho Power currently has daily and hourly energy-use data stored for all AMI metered service points. Basic customer information data including Customer Master, Premise, Billing, and address information is also stored in the EDW. The EDW has enabled:

- Customer portal viewing of energy use via myAccount
- Available data for internal load analysis and development of broader system analysis capabilities
- Energy-use data available to internal functions with approved business access
- Basic customer information available for viewing through a portal with approved business access
- Ad-hoc access granted to authorized employees for approved business access

# III. FUTURE SMART GRID INVESTMENTS

This section describes smart grid investments and meetings to be undertaken over the next five years (including pilots and testing). In addition to reporting requirements, this section serves as a high level strategic document for Idaho Power to plan its smart grid projects. As such, the format of this section is different from the other sections in this report. The description for each of the following projects is laid out in the following format:

*Present* – What Idaho Power's present system looks like with regard to the individual project described.

*Objective* – What the objective is of the individual project described.

*Pilot or Project Description* – A description of the proposed or existing pilot or project.

*Benefit* – How the investment will reduce costs, improve customer service, improve reliability, facilitate demand-side and renewable resources, or provide other system benefits. Also, how it fits with the annual construction budget for major distribution and transmission investments.

## A. Transmission Network and Operations Enhancements

### *Transmission Situational Awareness Oscillation Monitoring Pilot*

#### *Present*

The Washington State University (WSU) Oscillation Monitoring System software monitors system-wide oscillations using Idaho Power Phasor Measurement Unit (PMU) data. The Oscillation Monitoring System software identifies the oscillation mode frequency(ies), damping ratio (signal reduction factor), mode energy in the signal, and the confidence level or quality of the signal. Idaho Power has 24 PMUs at 14 substations collecting PMU data for oscillation monitoring within the Oscillation Monitoring System software. The majority of the effort to date has been focused on using archived PMU data within the Oscillation Monitoring System software both for software development and for analysis of system performance.

Idaho Power is also studying the option of integrating the output data of the WSU Oscillation Monitoring System software into the OSIsoft, LLC/PI enterprise infrastructure management software platform (OSI/PI) real-time data management system for visualization of the Oscillation Monitoring System results for use by transmission operators and transmission operations engineers in order to increase transmission system situational awareness and for system planning engineers to conduct post-event analysis. The OSI/PI software is commercially available software that Idaho Power already uses which could display the PMUs signals and the processed data of the Transmission Situational Awareness Oscillation Monitoring System software. Appendix E contains a presentation prepared as part of the North American SynchroPhasor Initiative.

#### *Objective*

The project objective is to install sufficient PMUs to identify and monitor system-wide oscillations. This would require monitoring interconnection points between Idaho Power and other utilities, as well as generation sites internal to the Idaho Power transmission system. The software would have the capability to identify power system oscillations using real-time PMU data and display the modes of oscillation, damping ratio, mode energy, and calculation confidence level. The software is also expected to use archived PMU data so modal analysis of system oscillations can be performed as part of a post-event analysis.

### Pilot or Project Description

Idaho Power initiated the Oscillation Monitoring Project in 2012 in collaboration with WSU. The intent of the project and Oscillation Monitoring System software is to identify frequency oscillation modes, oscillation signal damping ratio and energy level, and present an indication of the severity of the observed oscillations. Additionally, the software also identifies a confidence level or accuracy estimation of the calculation results. The oscillation energy level can be used to determine potential sources contributing to the oscillations detected by the software. Idaho Power budgeted to install six additional PMUs at generation sites within the Idaho Power transmission system. The designs on these projects are expected to be completed in 2014 along with construction of the PMU panels with anticipated installation in 2015. These projects are intended to provide additional PMU measurements that can be processed by the Oscillation Monitoring System software in addition to the existing PMU signals to better determine potential sources of poorly damped oscillations detected by the Oscillation Monitoring System software.

### Benefit

The Oscillation Monitoring Project identifies system-wide oscillations. One of the goals is to identify/distinguish between inter-area, inter-unit, and local-area oscillations. Some oscillations exist within the WECC system that do not present concerns because the known behavior of these oscillations is well damped. Identification between known oscillation modes, changes in the damping energy of known oscillation modes, identification of new oscillation modes and their associated damping behavior, as well as potential sources of poorly damped oscillations, provide the opportunity for early warning of potentially unstable power system conditions. Early warning of poorly damped oscillation modes provides transmission operators the opportunity to make system adjustments to improve transmission system stability. An additional benefit of oscillation monitoring is the ability to perform post-disturbance analysis of power system oscillations and overall system performance.

## Transmission Situational Awareness Voltage Stability Monitoring Pilot

### Present

The WSU Voltage Stability Monitoring System (VSMS) software monitors voltage and current signals to determine substation voltage stability indices. Developed at WSU, the software calculates the change-in reactive power with respect to the change-in voltage or the delta-Q/delta-V (dQ/dV) sensitivity for each network branch element monitored by the software. A voltage stability index for a substation bus is determined by summing the dQ/dV sensitivities of all the branches at a single substation bus together to create composite dQ/dV sensitivities for each substation monitored by the VSMS software. The only substation bus Idaho Power is currently able to monitor using the VSMS software is the Kinport substation 345 kV bus due to lack of PMU measurements of all network branches at other Idaho Power substations.

### *Objective*

The project objective is to install sufficient PMUs to monitor voltage stability at Idaho Power substation buses. This requires PMU monitoring of the network branch elements (i.e., transmission lines, transformers, reactive compensation devices, etc.) at substation buses of interest for voltage stability analysis using the WSU VSMS software. The expectation for the VSMS software would be to monitor real-time voltage stability, as well as have the capability to utilize archived PMU data to perform post-event voltage stability analysis. System operators could utilize real-time voltage stability data for transmission system situational awareness and system planners could utilize archived PMU data for voltage stability pre/post disturbance analysis.

### *Pilot or Project Description*

Idaho Power initiated the Voltage Stability Monitoring Project in 2012 in collaboration with WSU. The intent of the project and the VSMS software are to monitor transmission system voltage stability and provide indicators of substation buses approaching unstable operating points. Idaho Power will gain six additional PMUs for voltage stability monitoring in 2015 by using signals from the new PMUs described in the Oscillation Monitoring Pilot described above. The addition of the six PMUs provides the capability for voltage stability monitoring at four 230 kV substation buses and two 138 kV substation buses in addition to the presently monitored Kinport substation 345 kV bus.

### *Benefit*

The voltage stability monitoring program identifies the change in reactive power with respect to the change in voltage or dQ/dV sensitivity. The VSMS software monitors the dQ/dV sensitivity of each branch element that has available PMU measurements. A composite voltage sensitivity index is calculated for a substation bus by summing the sensitivities of each monitored connected branch element. If system conditions are approaching an unstable operating point, the VSMS software would be able to provide situational awareness to Idaho Power transmission operators. One project benefit is increased situational awareness of transmission operating conditions which would allow Idaho Power to detect unstable operating conditions in real-time so system adjustments could be made to return system conditions to stable operating points and thus improve transmission system reliability. A secondary benefit provided by the project is that Idaho Power would also have the capability to perform post-event analysis that could lead to the development of new or improved operating procedures when operating near voltage stability limits.

## *Transmission Situational Awareness Grid Operator’s Monitoring & Control Assistant*

### *Present*

Idaho Power system operators rely on day-ahead power flow analysis and some real-time analysis tools to manage the grid.

### Objective

The goal of this project is to advance grid reliability by improving the quality and use of the synchrophasor data received from more than 584 PMUs installed throughout the Western Interconnection by participating utilities by developing an application to manage the grid.

### Pilot or Project Description

Idaho Power, Southern California Edison, Peak Reliability, California Independent System Operator, Bonneville Power Administration, San Diego Gas and Electric, and V&R Energy have received a U.S. Department of Energy (DOE) research and demonstration grant for a new synchrophasor-based software application "Grid Operator's Monitoring & Control Assistant." See Appendix F for Peak Reliability's press release. The funding matches dollars committed by the seven participants to extend and deploy synchrophasor technologies. Peak Reliability will use the grant to improve the quality and use of the synchrophasor data it receives from the PMUs referenced above.

The proposed software application will consist of the following major components:

a) Use of Linear State Estimator (LSE) for the following purposes:
   - Validating the results of conventional model-based SE
   - Determining the observability of the network in terms of voltage stability
   - Utilizing cases created by LSE for voltage stability analysis
b) Automatic computation of advisory optimal corrective actions for voltage stability preservation.
c) Computing phase angle difference limits in real-time using a new methodology for line/path stressing based on maximized loading of transmission lines/paths.
d) Displaying easy-to-understand visualization of synchrophasor data, voltage stability analysis results, and optimal corrective actions on a custom-built situational awareness wall.

V&R Energy will perform a demonstration of the software tool. Idaho Power will prepare and provide data to V&R Energy, respond to the data-related questions, review and provide feedback on the functionalities of the tool, test the software tool in-house, and attend required meetings and training sessions on the software application.

### Benefit

The software will validate the SE, perform computation of corrective actions to maintain voltage stability, compute phase angle difference limits, and provide operator visualization of synchrophasor data. The overall goal of the project is to improve grid reliability.

# B. Substation and Distribution Network and Operations Enhancements

## Substation Fiber-Based Protection and Control Pilot

### Present

Present technology and practices require numerous multi-conductor copper cables to connect pieces of substation yard equipment to the control building for protection and control. These copper control cables represent a significant percentage of the overall cost of a new substation.

### Objective

Newly built Idaho Power substations would use fiber optics in lieu of copper wires to connect pieces of substation yard equipment to the control building for protection and control.

### Pilot or Project Description

Idaho Power and Schweitzer Engineering Laboratories are collaborating to develop the digital equipment needed to implement a highly reliable substation fiber optic network. The pilot project will install a system that parallels an existing substation protection and control system to demonstrate the reliability and viability of this technology. The fiber optic-based protection and control demonstration project at Hemingway substation is progressing. The conceptual design is complete and the various components are being selected. The digital equipment needed is being developed and will soon be available. Construction is anticipated to begin in fourth quarter 2014 with the fiber optic cable, yard cabinets, and control rack installation. This project will not only demonstrate the protection and control over fiber optic concepts, but will implement very accurate time distribution over a highly reliable fiber optic network – a necessary development for this standards-based approach to proceed.

### Benefit

Once demonstrated, not only will this technology potentially reduce costs for Idaho Power and its customers in future installations by decreasing the amount of copper wire installed, but it could prompt industry-wide adoption of this approach.

## Automated Volt/VAr Management System (VVMS) Pilot

### Present

Idaho Power currently operates an ACC system that effectively controls reactive power flow (Volt-Ampere reactive power or VAr) at substation transformers by controlling distribution feeder capacitor banks. In place since the late 1990s, the ACC system is installed at 76 distribution substations. It uses one-way radio communications to command capacitor banks on and off with the goal to be near unity power factor at the substation transformer at all times with a slightly leading power factor at heavy load and a slightly lagging power factor at light load. Control is performed via computers at each substation; the system is not currently centrally controlled.

As effective as the system has been, the aging ACC system components are beginning to fail leading to a system that is progressively less reliable. Direct replacement of the components is difficult because many are obsolete and no longer vendor-supported. Additionally, the present system is not suited to future growth.

### *Objective*

Idaho Power's distribution system would have fully automated capacitor banks communicating two ways with a centralized control system. The capacitor banks would be controlled via a dedicated VVMS which may be part of a complete Distribution Management System (DMS). The VVMS would monitor reactive power flow at the distribution substation level and would maintain near unity power factor (at the substation) in order to support the reactive power requirements of the bulk electrical system. Additionally, voltage would be monitored along distribution feeders and capacitor banks would be switched on and off in a coordinated fashion to maintain adequate voltage level to customers while maintaining adequate reactive power flow.

New solid state reactive compensation devices may be installed on the customer side of service transformers to provide voltage support in areas where low voltage exists. Additionally, new solid state voltage regulators may also be placed on the customer side of service transformers that would be able to both buck and boost voltage levels in response to voltage variations caused by customer-owned distributed generation devices.

The entire VVMS would operate to smooth voltage variations along a distribution feeder caused by variable and intermittent distributed generation sources at customer sites.

### *Pilot or Project Description*

Idaho Power has identified a project beginning in 2015 or 2016 that will pilot a new central server-based VVMS combined with bidirectional communications to replace the existing ACC system. The VVMS will control distribution substation transformer LTCs, line regulators, and distribution capacitor banks. The piloted system will be chosen with the intent of integrating it into a future, as yet to be defined, DMS. The pilot is expected to last one to two years.

### *Benefit*

In order to provide customers with adequate voltage to operate their devices, it is important to control reactive power flow and voltage on feeders. Utilities have traditionally done this by manually switching capacitor banks on and off seasonally and installing voltage regulators at strategic locations along distribution feeders. More recent technology allows utilities to automate and communicate with the capacitor bank switching and voltage regulator controls thus flattening the voltage profile along the feeders. Additionally, this communication and automation will provide the means Idaho Power needs to more efficiently integrate small distribution system-based generating customers.

## Conservation Voltage Reduction Program Enhancement Project

### Present

CVR is a term used to describe a method for decreasing energy use and/or demand by decreasing the voltage on a feeder. By reducing feeder voltages by a minimal amount, significant energy can potentially be saved. Idaho Power implemented a CVR program in 2009 at eight substations. This CVR program was instituted at minimal cost by simply changing the tap settings on distribution substation transformer LTCs. Only a small number of feeders qualify for CVR using this method because of low voltage issues that can result at certain locations along the feeder. Also, by controlling only at the transformer LTC, all the feeders connected to an individual transformer must qualify for CVR status. So, even if only one feeder has low voltage issues, the entire group of feeders connected to a given transformer would not qualify.

Idaho Power has identified a number of other feeders that could qualify for CVR if upgrades were made to either the conductors or the voltage regulation equipment. However, these upgrades are expensive and the benefits have not been fully quantified such that they can be applied to new feeders.

### Objective

CVR would be in effect at all feeders where it can be effectively and cost-efficiently implemented. The CVR would be dynamically controlled such that voltages on feeders are minimized while maintaining customers' voltage levels meet National Service Voltage Standard (ANSI C84.1). CVR would also be able to reduce demand on feeders during peak load periods in response to capacity requirements. Voltage control on the feeders would be accomplished in a coordinated fashion by substation transformer LTCs, feeder capacitor banks, voltage regulators, and low voltage control devices located on the secondary side of service transformers. CVR may be controlled by an application within Idaho Power's Volt/VAR Management System, a dedicated system operated under a DMS or a standalone CVR management system.

Solid state reactive compensation devices would be installed on the customer side of service transformers and would be used to provide voltage support in areas where less than adequate voltage may exist.

### Pilot or Project Description

Idaho Power has initiated a project that began first quarter 2014 and is expected to be complete mid-2016 to:

1. Validate energy savings associated with CVR using measured instead of modeled values
2, Quantify the costs and benefits associated with implementing CVR
3. Determine methods for expanding the CVR program to additional feeders
4. Pilot methods for making Idaho Power's CVR program more dynamic
5. Determine methods for ongoing measurement and validation of CVR effectiveness

The outcome of this project would be a cost-effective CVR program that can be more fully utilized across the Idaho Power system. It is anticipated that control of the CVR program would be embedded in the new VVMS previously described. The project plan for the CVR Enhancement Project can be found in Appendix G.

### *Benefit*

If successfully implemented, CVR can reduce customer energy use thus saving customers money. In concert with a Volt/VAr Management system, it can also act to flatten the voltage profile along a feeder thus providing a more stable voltage at customers' premises and potentially lowering feeder losses.

## ***Edge of Network Grid Optimization (ENGO) Solid State Reactive Power Compensation Device Pilot***

### *Present*

Idaho Power currently provides voltage support on feeders using capacitor banks and voltage regulators. The capacitor banks do not dynamically react to voltage change. The voltage regulators react to voltage changes on the feeder and attempt to maintain a stable voltage. However, there are still areas on some feeders where low voltages may occur and the utility's normal recourse is a costly feeder upgrade.

### *Objective*

Areas of low voltage on feeders with an otherwise good voltage profile would be resolved using small, inexpensive, dynamic voltage support devices. These devices would be located on the customer side of service transformers and would react to voltage changes in a sub-cycle manner.

### *Pilot or Project Description*

Varentec's ENGO unit is a solid state (static) VAr compensation device that provides dynamic or variable voltage control at the secondary side of distribution service transformers. These units have been deployed in pilot projects by a few utilities.

In 2014, Idaho Power deployed a number of ENGO units to evaluate their viability for voltage support on feeders with spot voltage problems with the intent to use ENGO units in place of more expensive solutions such as reconductoring or small voltage regulators. The ENGO units may also be piloted on feeders presently involved in the CVR project where a more dynamic or aggressive voltage setting is desired. Additionally, the evaluation included in this pilot will include determining what, if any, affect the ENGO units have on Idaho Power's Two-Way Automated Communication System communications signal used by the AMI system. The pilot project is expected to be complete at the end of 2014, though the devices may be moved to other feeders in 2015 to further evaluate their effectiveness. The project plan for the ENGO Project can be found in Appendix H.

### *Benefit*

If successfully implemented, ENGO devices can flatten the voltage profile at customers' premises and may be used to defer or replace more expensive methods for resolving voltage issues.


**Figure 8. ENGO Unit Being Installed Beneath a Distribution Transformer**

## *Distribution System Communications Strategy*

### *Overview*

Idaho Power currently communicates with a diverse group of distribution system devices, i.e., reclosers, capacitor banks, line fault indicators, meters, and outage monitors using a variety of communications systems. These systems include licensed radio frequencies, public unlicensed radio frequencies, telecommunication company landlines, cellular systems, and PLC. The communication system used is evaluated based on the control or data requirements for the various distribution system devices. The need for one-way or two-way communications, data transfer, and control requirements (bandwidth and speed) dictates which communication system most cost-effectively fits the need.

The project below is an example of this strategy.

## *Ability of the AMI System to Control Line Devices*

### *Present*

Idaho Power currently communicates with the capacitor banks associated with the ACC program using one-way radio communications. As this program shifts into a more robust Automated Volt/VAr Management System, two-way communications will become necessary.

### *Objective*

Idaho Power will test its AMI system to determine if it has the capability to perform simple command and control functions on distribution capacitor banks.

### *Pilot or Project Description*

Idaho Power is in the early stages of feasibility testing the automated control of distribution capacitor banks.

### *Benefit*

Using Idaho Power's AMI system to communicate with capacitor banks could provide a robust communications solution that is more resistant to obsolescence than the present system. Using a communications system that is already installed everywhere Idaho Power has AMI would provide control of capacitor banks without the need to install additional communications equipment in substations.

## *Replace the Existing Outage Management System*

### *Present*

Idaho Power's existing OMS is aging and is no longer supported by the original vendor. In 2010, Idaho Power started the effort to select a vendor and implement a new OMS. Following a market search and analysis of several request for proposals, the company contracted with General Electric to install their Power On OMS product. The project was progressing until early 2012 when critical Idaho Power resources assigned to the OMS project were needed to support the higher priority CR&B project. In fall 2012, Idaho Power suspended the OMS project and will begin work again in late 2014.

### *Objective*

Idaho Power requires an OMS that can integrate into existing control and operating software platforms and that can be used with Idaho Power's geographical information system. The OMS would be used primarily to efficiently and accurately capture customer outage information that would be used for coordinating restoration work and reporting activities.

The company desires the OMS to enable a direct interface to Idaho Power's meters to validate outage scope and restoration. Through the OMS application, OMS operators will query specific meters in suspected outage areas. The OMS application will provide outage data presentation through direct communications with AMI meters, verify the scope of customer-reported outages, and provide confirmation of power restoration. Additionally, Smart Grid Monitoring (SGM) System devices (described in the Implement Additional AMI Outage Scoping and Restoration Confirmation Functionality project below) may be used for advance notice of outages. Verification of an outage prior to dispatching resources to repair the outage will allow the repair crew to be more efficient in terms of customer restoration times, and confirming restoration will eliminate the chance of repair crews leaving the area before service is restored to all customers.

### *Pilot or Project Description*

This project will develop the requirements and operational characteristics of a new OMS using previously developed requirements and more up-to-date information. Because of advancements in OMS software platforms since 2012, this project will begin the vendor search anew. It is anticipated that vendor selection will occur first quarter of 2015 followed by implementation during the remainder of 2015. Project completion is projected to be mid-year 2016.

### Benefit

A new OMS platform will aid in customer service restoration after power system interruption events. It will allow more efficient use of repair crews and thus decrease costs.

## Implementation of Automated Connect/Disconnect Capability at Selected Locations through the AMI System

### Present

Idaho Power's AMI project that concluded in 2011 did not include the installation of remote controlled connect/disconnect switches. Idaho Power was not able to justify the cost of installing these switches at all metering points on its distribution system. Company representatives continue to physically visit customer service locations to manually connect and disconnect services as needed.

### Objective

Idaho Power has always recognized the capability of the AMI system to remotely control service connect/disconnect switches. After the initial AMI installation, the company analyzed the costs and benefits of installing AMI controlled service connect/disconnect switches at a select number of locations. The Company believes that the capital costs are more than offset by eliminating manual corrects/disconnects at locations that have multiple visits to manually connect or disconnect service each year.

### Pilot or Project Description

Approximately 14,500 residential service locations in Idaho Power's total service area (772 in Oregon) have multiple actual connect/disconnect events each year. The company has begun replacing the current meters at these locations with new meters equipped with remote controlled connect/disconnect switches. Meters removed from service will be used for new business and maintenance activities, reducing the need to purchase additional standard AMI meters. Below is a list of project milestones:

1. Begin installing remote connect/disconnect AMI meters - April 21, 2014
2. Complete installations of remote connect/disconnect AMI meters - December 31, 2014
3. Implement the necessary Information Technology (IT) system configuration to support the connect/disconnect process - February 1, 2015
4. Hold stakeholder meetings and obtain necessary regulatory approvals for the process changes required to implement automated connect/disconnect capability in Idaho - Fall 2014/Winter 2015
5. Implement the automated connect/disconnect process - Spring 2015

### Benefit

By installing this technology as described, Idaho Power expects to realize the following benefits:

1. Reduce the annual cost of connecting and disconnecting services
2. Improve customer service by consistently completing the connect/disconnect function in a more timely manner

3. Remove a potential safety risk for employees traveling to customer locations, accessing service locations and removing and installing energized meters as is currently done for connect and disconnect activities
4. Reduce the environmental impact of driving hundreds of thousands of miles each year to perform this function manually
5. Gain experience with this capability and establish a foundation for evaluating the possibility of offering an optional prepaid service at some future date

## *Implement Additional AMI Outage Scoping and Restoration Confirmation Functionality*

### *Present*

Formerly known as the Sentry System, Idaho Power has implemented an SGM System that monitors system reliability. The SGM System has approximately 1,400 monitored sites that record momentary and sustained outage activity. At present sustained outage notification from the SGM System is fed directly into Idaho Power's OMS which notifies operators when a sustained outage is detected. Once aware of the outage, the OMS operators can request a manual query of AMI meters in the affected area to more precisely identify the location of the outage.

In 2013, Idaho Power tested AMI integration with the SGM System and found that the systems can exchange sufficient data to provide the OMS with outage information related to event origination and tracking of outage restoration activity.

### *Objective*

Idaho Power desires to more fully automate outage locating through the use of technology. The SGM System used in conjunction with the AMI system can quickly and accurately locate outages on the distribution system to improve system outage restoration efforts.

### *Pilot or Project Description*

This project will develop an interface to allow the SGM system to identify a list of meters to be interrogated based on known system outages and/or restorations. The project will then enable the AMI System to interrogate the meters identified by the SGM and inform the OMS of any meters that remain in an outage condition. This will limit the need for manual query for outage scoping.

The project will enhance the work completed in 2013 to provide an SGM to AMI interface and will be ready for implementation by 2016.

### *Benefit*

The main benefit will be improvement in system outage restoration performance. Additionally, this would allow Idaho Power to utilize momentary outages to locate open fuses if fuse saving is being implemented, or could be implemented, in areas to improve System Average Interruption Frequency Index (SAIFI). Currently, if a fuse tap is in an outage condition, Idaho Power relies on customer notification of the outage to begin restoration activities.

# C. Customer Information and Demand-Side Management Enhancements

## *Customer Relationship Management*

### *Present*

Idaho Power desires to enhance current internal marketing applications and processes to increase its ability to effectively provide analytics, reporting, and information for communication efforts.

### *Objective*

The objective of incorporating a single system, integrated with the CR&B system, will allow Idaho Power to manage and track customer interactions related to energy efficiency and other customer relations activities with the ultimate goal of increasing the effectiveness of Idaho Power's program and service offerings.

### *Pilot or Project Description*

Using the CRM capabilities of the CR&B system, the CRM application will retrieve data from a variety of data sources (meter usage data, customer data, demographics, program data, etc.). The software will provide the ability to query and report both formally and ad hoc. Customer preference management (opt-out, marketing frequency, topic choice, etc.) will also be a component of the system.

### *Benefit*

The information will allow Idaho Power to better market its customer programs and service offerings. Systematically using various sources of data to reach customers should result in reduced printing and postage costs through more effective customer segmentation and targeted marketing. The information will aid the company to reach customers more efficiently through the gradual shift to electronic channels such as email.

## *Integrated Demand Response Resource Control*

### *Present*

Idaho Power manages three DR programs as describe in Section II of this report. The dispatch associated with each program is unique to the program and requires various steps of generation dispatch employees utilizing multiple systems.

### *Objective*

An opportunity exists to reduce operator confusion and gain efficiencies when dispatching DR programs during events.

### *Pilot or Project Description*

The project would include a review of the potential to electronically tie each DR program's dispatch software into one software interface. If it is determined that electronically connecting the systems into one software is possible, then development of criteria for a customized front-end screen would take place. Functionality would also include the ability to manage individual customer opt-out by event.

#### *Benefit*

A single-interface dispatch solution would create efficiencies for dispatch employee training and knowledge through one system rather than three. It can also provide an environment where it is less likely for incorrect program dispatch to take place which can have direct impact on customer satisfaction with the program.

## D. Distributed Resource and Renewable Resource Enhancements

### *Renewable Integration Tool: Potential Future Projects*

#### *Present*

The Idaho Power SGIG funded the RIT project. The RIT project was intended to develop tools to allow grid operators and power supply transaction specialists to efficiently and reliably integrate variable renewable resources with traditional generation resources.

To account for the variability in generation resources, the RIT project integrated variable renewable resources from large generation interconnections and PURPA wind projects. The project's goal was to yield three wind forecast intervals: a short-term demand forecast, an enhanced regulating margin forecast, and a spinning reserve forecast.

The initial plan for the RIT project was to purchase an off-the-shelf variable generation balancing tool that required an external wind forecast. However, by evaluating different options, Idaho Power determined an internally produced forecast was more accurate than third-party forecasts. After discussing options with other utilities and research facilities, Idaho Power created its own forecast tool for the Idaho Power service area using weather research and forecast data from the University of Arizona.

The pre-schedule and real-time forecasts were successfully implemented and are providing forecast values that more accurately predict wind generation. Idaho Power determined the one-hour wind forecast was unable to forecast more accurately than persistence without significant additional effort. (In this case, the term persistence means using the previous observed condition.) The short-term demand forecast was successfully implemented and is providing forecast values at intervals not previously available. Calculations for the regulating margin and spinning reserve forecasts were implemented and incorporated into the more accurate short-term demand forecast. However, because efforts to develop a wind forecast for intervals of less than one hour were unsuccessful in improving on persistence, the full capabilities of this tool were not realized.

In 2014, the RIT was split into two tools: the Wind Forecast Tool and the Load Forecast Tool.

#### *Objective*

Idaho Power will be operating a fully functional RIT to allow grid operators and power supply transaction specialists to efficiently and reliably integrate variable renewable resources with traditional generation resources. The RIT will yield three wind forecast intervals: a short-term demand forecast, an enhanced regulating margin forecast, and a spinning reserve forecast.

### *Pilot or Project Description*

Idaho Power has made the following changes or is considering the following projects for potential improvements of the RIT:

**Incorporating new forecasting model types.** Idaho Power continues to look for improvements to the current weather model, new weather models, and techniques to improve the wind forecast.

- Idaho Power now uses the Boulac microphysics package for the 6z and 18z model runs. Additionally, Idaho Power accesses the National Center for Atmospheric Research snow analysis data for model initialization. The University of Arizona is conducting research on both temperature and wind forecasts after a study uncovered a significant problem with the Global Forecast System snow forecasts in higher terrain. This was previously unknown in the modeling community and the University of Arizona will be working with the National Center for Environmental Prediction to determine how to correct this problem. The University of Arizona expects to publish its report sometime in 2015.
- Idaho Power has tested the model using 30 meter terrain resolution as it is believed that the present terrain resolution in the model significantly affects wind forecasts in mountainous terrain. Idaho Power will implement the new terrain resolution into the model later this year.

**Early warning system based on physical indicators.** To detect approaching changes in wind speeds through the use of observations upstream of wind parks or other real-time meteorological gauges and create an early warning system based on these observations.

**Additional high-speed cutout warnings.** To develop an algorithm to apply to all system wind developments that would use reasonable high-speed cutout indicators.

- Idaho Power is currently working on improvements to test in the fourth quarter of 2014.

**Forecast refinements.** Investigate several other weather parameters to determine correlations with wind generation. Some of these correlations may detect ramps or weather fronts, and others are related to generation accuracy.

**Thunderstorm detection.** Thunderstorms moving through the system cause rapid spikes in wind generation; however, exact thunderstorm prediction is difficult. Create a warning system that will let operators know when thunderstorms and resulting generation spikes are possible.

**Interactive user forecast adjustments.** To allow operators to manually adjust the real-time forecast to match the current state of the system and correct errors.

**Missed forecast analysis.** Developing a forecast-analysis log is essential to identifying missed forecast events and determining how to create better future forecasts.

- A daily accuracy report was created which allows easier detection of forecasting issues.

**Real-time turbine availability and known maintenance schedules.** Better incorporate real-time turbine availability and known maintenance schedules of third-party providers into the wind forecast.

**Streamlining the addition of new wind generation facilities.** The addition of new wind generation facilities into the RIT, although better, is still a slow process.

- Fewer new wind generation facilities are currently being developed. The only new wind generation facility in the near-term future will be in Baker County, Oregon.

**Short-term demand forecast.** The mid- and short-term demand forecasting tool will improve over time as other weather variables are added to the model.

**Reserve calculations.** If a short-term wind forecast method becomes available, the values would be included in regulating margin and reserve calculations.

### *Benefit*

A fully functional RIT (now known as Wind Forecast Tool and Load Forecast Tool) will allow grid operators and power supply transaction specialists to efficiently and reliably integrate variable renewable resources with traditional generation resources to meet customer loads.

# E. General Business Enhancements

## *Upgrade the Mobile Workforce Management System*

### *Present*

Since 2007, Idaho Power has been using CGI Group's (CGI) PragmaCad mobile workforce management system. This system is integrated with several other major systems necessary to automate and support field service personnel. The version of PragmaCad in operation at the company is several years old, and although still supported by CGI, it is multiple versions behind the latest release supplied by CGI. The latest release has increased functionality that may improve the efficiency of field personnel.

### *Objective*

Upgrade the existing version of PragmaCad to the latest version to maintain vendor support and realize the benefits of increased functionality that will improve the efficiency of field personnel.

### *Pilot or Project Description*

Idaho Power plans to upgrade the existing version of PragmaCad in 2015.

### *Benefit*

Upgrading the PragmCad to the latest version will improve the efficiency of Idaho Power's field personnel thus reducing costs.

## Upgrade the Meter Data Management System

### Present

The Itron Enterprise Edition (IEE) MDMS receives the raw data from the AMI system, ensures the accuracy and integrity of the data, and processes the data to the CR&B system and the EDW. The current version was installed in 2008 as a part of the AMI implementation. It is limited in its capability to handle unique pricing plans. In addition, the current version of IEE runs on the Windows XP operating system. Microsoft support for Windows XP is limited to security patches and incident support available on a case-by-case basis until June 2015. Maintaining continued support of the IEE client on machines with Windows 7 operating systems requires an upgrade of IEE.

### Objective

Upgrade from IEE version 7.0 to the latest commercial release 8.1. Coordinating this project with the proposed effort to optimize the IEE and CR&B interface is the most efficient use of business and IT resources.

### Pilot or Project Description

Upgrade the current version of IEE to the latest commercially available version of this software. Where possible, coordinate this project with the proposed effort to optimize the IEE and CR&B interface to best utilize the company’s technical resources.

### Benefit

Upgrading the current version of IEE from 7.0 to 8.1 will comply with Idaho Power’s Enterprise Technology Advisory Board technology roadmap that seeks to achieve a sustainable technology portfolio capable of meeting the requirements of Idaho Power. Idaho Power will also take advantage of previously paid software maintenance fees that permit software upgrades without additional licensing costs. Software upgrades will ensure appropriate vendor support and increase potential customer billing and pricing options.

# IV. Smart Grid Opportunities and Constraints

This section describes other smart grid opportunities the utility is considering for investment over the next five to 10 years and any constraints that affect the utility's investment considerations.

## A. Transmission, Substation, Operations, and Customer Information Enhancements

### *DOE ARRA Smart Grid Grant Projects*

All DOE ARRA smart grid grant projects are considered complete with no additional information to provide. This report represents Idaho Power's smart grid approach going forward.

### *Home Area Network (HAN)*

Idaho Power is not currently using any HAN technologies. The AMI meters installed are not equipped with wireless HAN communication capabilities. Due to the infancy of HAN technologies and a lack of standard communication protocols, Idaho Power has chosen to limit energy management services beyond the meter for the present time. Idaho Power provides energy management advice and data supporting third-party energy management systems.

### *Personalized Customer Interaction*

Today, Idaho Power's customers can register and log-in to myAccount using the Energy Use Advising Tool to receive information regarding their energy use. Idaho Power envisions that its customers will want to use smart phones and tablets to inform them of energy use thresholds in their homes or businesses. Customers will want Idaho Power to proactively send them personalized information via text or phone applications that has been customized by the customer to thresholds the customer has determined. Upon receiving this information, the customer will be empowered through the technology to adjust energy using devices in their home or business to manage utility costs. Examples of applications in which customers will seek more interactive engagement include:

- Outage applications
- Energy management applications
- Mobile workforce management
- Business transactions

Idaho Power does not currently have established systems to proactively engage customers or personalize thresholds for the customer. Nor does the company have applications to interact on a tablet or smart phone. Idaho Power will begin exploring opportunities and system improvements to more actively engage its customers using the technologies preferred by customers.

### Analyze Use of Technology and Process Changes to Improve Workforce Efficiency

Today Idaho Power distribution line design and construction processes utilize minimal technology in the field. Designers travel to meet the customer to evaluate the service location and confirm the customer's request, travel back to the office to design the job, and enter the design in the work management system. Similarly Customer Representatives providing energy-related services to customers utilize minimal field technology. Company representatives manage their work via paper orders and exchange information with customers via hard copy print outs.

Idaho Power will determine what technological and process improvements will improve efficiency and services provided by field employees in customer-facing positions.

For example: The company will evaluate if tablets that are wirelessly connected to Idaho Power systems would improve the efficiency of Distribution Designers as they meet with customers in the field. The devices could electronically send the information obtained to a centralized organization that designs the customer's request. The revised draft could then be sent back to the field Distribution Designer who meets with the customer and finalizes the arrangement, including digitized signatures via the tablet for documentation purposes. A similar example could include Customer Representatives with tablets meeting with customers and accessing customer information to provide proactive analysis on pricing, usage, and programs to satisfy customers' needs.

Other technologies and process improvement ideas would be evaluated in a similar manner. Using mobile computing devices could increase the efficiency of Idaho Power's field employees

and potentially provide customers with proactive energy use information.

## B. Evaluations and Assessments of Smart Grid Technologies

This section describes evaluations and assessments of smart grid technologies and applications the company has undertaken or plans to undertake.

### Electric Vehicle (EV) Charging Impacts Study

Idaho Power's Charging Impacts Project (CHIP) is an optional customer program intended to evaluate the impact of residential EV charging on Idaho Power's distribution system. An AMI meter in the customer's garage-based charging station circuit allows Idaho Power to analyze how these customers are charging their cars. These meters are not used for billing purposes but only for remote monitoring of charging patterns.

In operation for two years, the project has recorded valuable data. The natural behavior of EV owners is to plug in their vehicle as soon as they arrive home from work, allowing it to charge immediately. Because of this, CHIP is showing a significant increase in customer peak energy use as shown below in Figure 9. The energy used to charge the EV could potentially be shifted to off peak through time-based rate signals. In fact, one EV owner in the project who is also participating in Idaho Power's TOD pricing plan shifts his energy use to off peak quite successfully. All mass-produced EVs on the market allow the owner to easily program their vehicle to either begin or end charging at an owner-specified time.

Figure 9 shows the increase in one customer's household demand due to plugging in an EV in the early evening upon returning from work. This graph is a snapshot taken on a hot summer day in 2013.

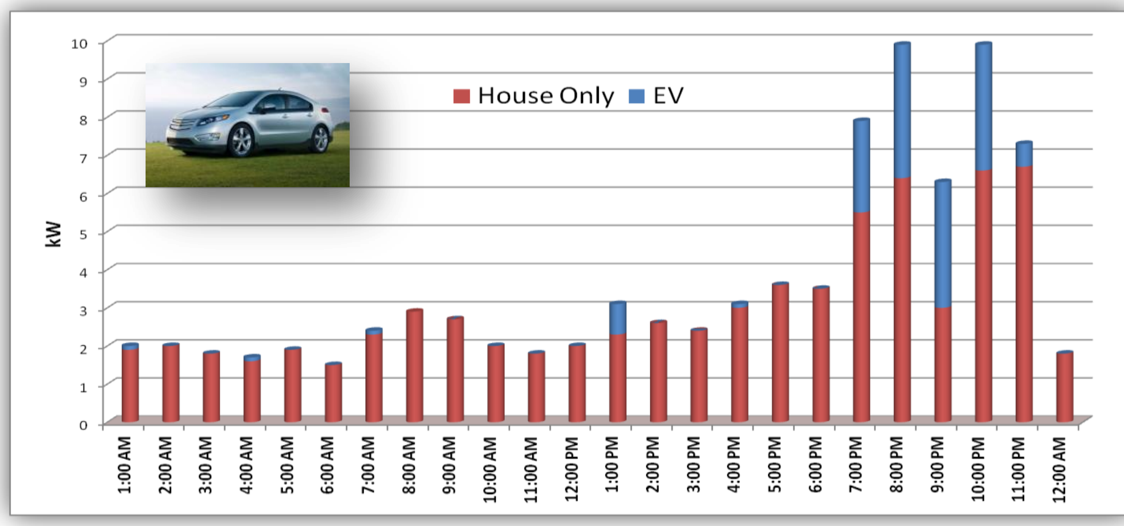


**Figure 9. Demand Increase Due to EV on Summer Peak Day, Non-TOD Customer**

The following figure shows how one customer is willing and able to respond to TOD price signals, both with his house and EV charging. Note, this graph should be viewed as an exceptional example of price response and not what might be normally expected.

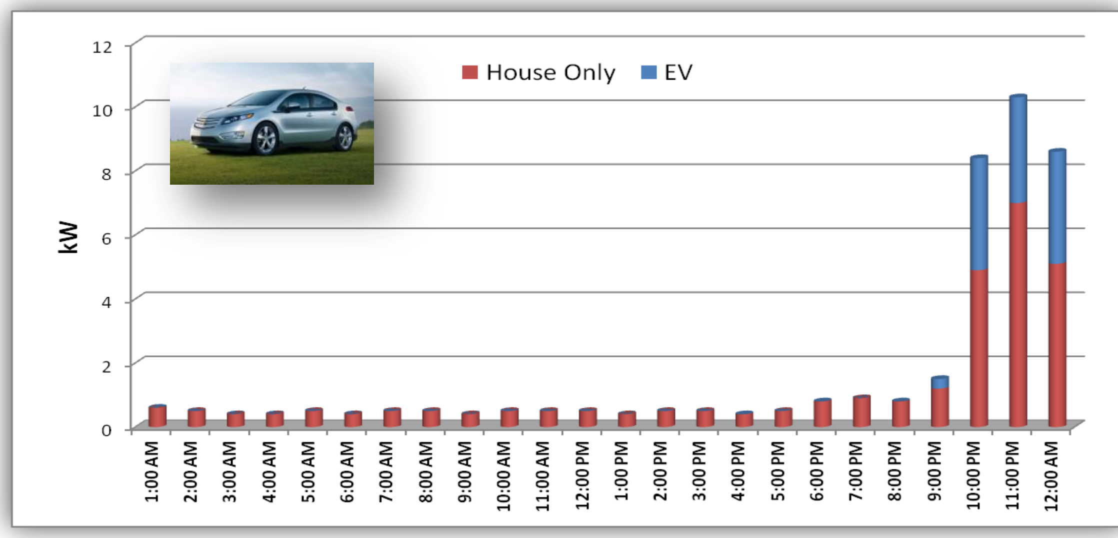


**Figure 10. Demand Increase Due to EV on Summer Peak Day, TOD Customer**

## *Photovoltaic and Feeder Peak Demand Alignment Pilot*

Idaho Power has installed three solar-intensity monitoring stations along a distribution feeder to determine the impact of installing PV panels to maximize PV output with feeder peak demand. Each monitoring station is comprised of three solar-intensity monitors with the following orientation: south for maximum annual energy output (typical customer orientation), west for maximum output coincident with feeder peak demand, and horizontal for the global solar-intensity reference.

Solar intensity data was gathered at three locations in West Boise during the summer of 2013. Initial analysis of the data indicates that there is indeed a relationship between solar intensity and electrical load under some circumstances. It was not a surprise that a stronger correlation exists between ambient temperature and electrical load. The data also indicates that PV panel orientation can be aligned to more closely follow the peak demands on a summer afternoon; however, more study is needed to assess overall benefits as well as the detriments to this approach. Solar data continues to be gathered and is finding uses in impact and integration studies. It will be interesting to review the panel orientation data gathered during the winter and compare it to the analysis of the data gathered during the summer.

## *Demand Response as Operating Reserves Feasibility*

In settlement agreements filed in both Idaho and Oregon (Idaho Case No. IPC-E-13-14 and Oregon Case No. UM 1653) and approved by the Idaho Public Utilities Commission (IPUC) and the OPUC in Order Nos. 32923 and 13-482, respectively, Idaho Power agreed to investigate the feasibility of using DR as operating reserves and to make a determination on the feasibility by the end of the third quarter of 2014.

The company filed a Demand Response as Operating Reserves Feasibility Report (DR Report) with the IPUC and OPUC on September 30, 2014, which is provided as Appendix I. The DR Report provides a background of the company's operating reserves requirements, and identifies that DR could only be used for the non-spinning portion of the company's Contingency Reserves Obligation (CRO). It describes each of the DR programs the company currently operates, discusses the applicability of using DR as CRO from a compliance perspective, and describes the implementation requirements for the company to use its DR programs as CRO. The DR Report then examines each of the DR programs and discusses whether or not each one has potential to be used as CRO. The DR Report concludes with the company's financial analysis and recommendation.

Based on its analysis, Idaho Power concluded the risks outweigh the benefits to utilize DR as CRO because: (1) the economic benefit of using DR as CRO is too small to provide incentives at a level that would attract participation and provide for program costs, (2) the risks for failure to meet NERC standards is far greater than the economic benefit that might be derived, (3) the period of testing that would be required to provide operational certainty of compliance with NERC and WECC requirements would require carrying substantially more than the reserves actually needed for contingency, at a cost to all customers, and (4) the number of CRO events would put too heavy of a strain on the DR participants, thus risking participation in the company's DR programs.

As described in the DR Report, the economic benefits, excluding payments to participants, of using DR as CRO are insignificant when compared to the capacity benefit the current DR programs provide. While having a dual-purposed program may be conceivable from a technical and compliance perspective, the company believes that it is not practical from an economic and DR program participant perspective. The company believes that the economic, DR program participation and other operational risks identified in the DR Report, are too great to proceed with a pilot at this time.

## Electric Vehicles for Idaho Power Circulator Route

Idaho Power is purchasing two new battery-electric vehicles for employee use when travelling between company facilities in the Boise area. Funded as a Sustainability Program project, the EVs will promote employee use of public/alternative transportation to get to and from work then use a company EV when travel between facilities is required. Additionally, the EVs will help to demonstrate the viability of electric vehicles to the general public. As part of this project, Idaho Power is installing five charging stations at various facilities to augment the existing charging stations at the Boise Operations Center.

## Solar-Powered Parking Lot Lighting

In August 2013, Idaho Power replaced existing high-pressure sodium lighting in an employee parking lot with high-efficiency LEDs. Solar panels mounted on each light pole feed energy back onto Idaho Power's distribution system with the intent that the lights will consume net-zero energy on a yearly basis. Manufactured and installed by Boise-based Inovus, the PV panels produced as much energy as they consumed over the course of one year. Compared to the old high-pressure sodium units, the high-efficiency LEDs provide better light and bring substantial energy savings. Whereas the old lights consumed approximately 4,250 watts, the new system requires just 1,552 watts. The following figure shows a profile of energy used versus energy produced by the old and new lighting systems. This demonstrates potential new technology that can enable energy using devices to become energy producers.

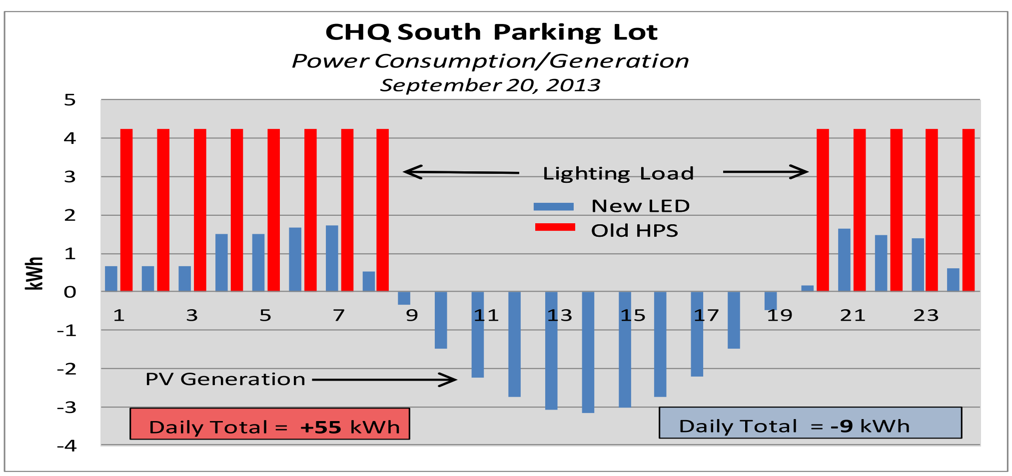


**Figure 11. Solar-Powered Parking Lot Lighting Energy Consumption/Generation**

## C. Smart Grid Pilots and Programs

Although not organized or managed as a specific project, Idaho Power monitors smart grid-related technology advancements, related articles, research, reports, demonstration projects, and demonstration results as applicable. As energy generation, consumption, and management technologies continue to improve, additional opportunities for the deployment of smart grid-enabled devices/appliances will become available. As these technologies continue to improve, it may be possible to create new products and services to help Idaho Power manage and optimize its system and help its customers manage their energy use and consumption. The areas being monitored include the management and integration of EVs, distributed resources, and microgrids.

## D. State of Key Technologies

Idaho Power's customers are increasing their use of electrical technologies while at the same time some customers are desiring to generate their own power. They also want to know more about the energy they use and have the ability to more finely control their usage. The enabling technologies that allow Idaho Power's customers to do this are present today and only limited by cost and maturity. As costs come down, the company can expect that the technologies will be used and may change our interactions and relationships from what they are today.

Key technologies Idaho Power is tracking include:

- Cost and technical maturity of PV generating resources
- Cost, technical maturity, and availability of EVs
- Communications technology relating to microgrid components
- Smart inverters used for PV integration
- Technical maturity of tablet computing devices and available applications for energy tracking
- Energy storage technologies

# V. TARGETED EVALUATIONS

This section responds to the three stakeholder smart grid-related recommendations adopted in Commission Order No. 13-481, Docket UM 1675.

**Recommendation No. 1:**

> *(1) The Company should circulate a draft version of future smart grid reports at the same time they solicit comments and prior to filing at the Commission.*

Idaho Power complied with this recommendation as described in the Solicitation of Stakeholder Input section.

**Recommendation No. 2:**

> *(2) In the next Smart Grid report, IPC provide an update and timeline for current analysis of CVR. The Company should also detail the criteria it will use to gauge success and expandability of CVR efforts.*

This information is provided in the CVR project description in Section III of this report.

**Recommendation No. 3:**

> *(3) In the next Smart Grid Report, Idaho Power provide:*
>
> > *(a) An update on the current Time of Day (TOD) pilot;*

This information is found in the TVP section included in Section II.C of this report.

> > *(b) A time line and specific criteria for how the company will analyze critical peak pricing and seasonal pricing structure as potential options for IPC customers; and*

Critical peak pricing rate plans are often viewed as a form of DR which acquires capacity from customers. This capacity could be valuable when peaking resources are needed. Idaho Power currently has approximately 391 MW of available DR peaking resources in three existing programs: Irrigation Peak Rewards, A/C Cool Credit, and FlexPeak Management. At this time these three programs are adequate to provide the dispatchable DR resource needed on the Idaho Power system. Idaho Power will monitor future additional DR peaking resources needs on the system and will evaluate whether a critical peak pricing plan should be implemented.

Idaho Power believes rate plans that incorporate TOD and/or seasonal pricing should reflect the costs to serve customers on the Idaho Power system and considers a TOD rate plan to be a seasonal rate plan. Idaho Power currently has in place seasonal pricing for all customers system-wide, except for residential customers in Oregon. During its last two Oregon general rate cases, UM 213 in 2009 and UM 233 in 2011, Idaho Power proposed seasonal pricing for Oregon residential customers.

*(c) Criteria for how the TOD pilot will be evaluated and what participant behavior modifications and revenue impact outcomes would lead to decisions to expand the pilot or not.*

The primary goal of the TOD 2014 pricing study is to determine if participants changed their electric usage behavior in response to hourly changes in prices and to evaluate any revenue impact. The study results indicted:

- For the study group as a whole, the data analyzed showed both a reduction in energy use from peak time periods and an increase in energy use during off-peak pricing period by the analyzed participants of the pricing plan versus a carefully matched control group.
    - This finding indicates that the TOD pricing plan may impact customer behavior in a way that causes them to shift some of their usage to off-peak times.
- The TOD pricing plan structure was designed to more accurately reflect cost-of-service pricing as compared to the Standard rate pricing.
    - Therefore, the TOD rate plan offers a fair and appropriate rate plan.
- The study estimates that there is a reduction in revenue of $119,000 when actual TOD energy billings are compared with Standard plan shadow energy bill calculation for all TOD pricing plan participants during the 12 months of the study, September 2012 through August 2013.
    - If the TOD rate plan is optional, the company may be unable to collect its allowed revenue requirement as customers migrate to the TOD rate.
- The study findings indicate an overall response rate to the Idaho TOD pilot solicitation of 1.3 percent.
    - These study findings indicate that if the company were to expand the TOD offering to the remainder of the residential customer population system-wide in the exact same manner as in the Idaho TOD pilot, that approximately 4,000 additional participants would likely volunteer to sign up.

Due to these findings, Idaho Power is considering offering an optional residential TOD rate plan to its Oregon service area customers. Before implementing this wider TOD offering, considerations such as timing issues and whether there may be system barriers or implementation issues (i.e., billing, metering, information technologies issues, etc.) must be resolved before offering the plan to more customers. Commission approval will also be required to implement a TOD rate plan.

# VI. Related Activities

This section discusses activities that relate to smart grid operations.

## A. Cyber and Physical Security

All smart grid-related projects or plans conform to Idaho Power's Information Security Standards which are in place to secure its cyber assets. Idaho Power's aim is to strengthen its long-standing tradition of electric reliability while fostering a culture of compliance and satisfying a broad set of reliability standards.

Smart grid projects also conform to the requirements of Idaho Power's Physical Security Program which prevents unauthorized access to personnel, equipment, material, and documents while safeguarding against espionage, sabotage, acts of terrorism, damage, and theft. Physical security is an integral part of all critical infrastructure protection, safety, fire, and crime-prevention programs.

## B. Privacy

Idaho Power is committed to protecting the company's systems and the data within them as stated in its *Corporate Security Policy* and evidenced by the company's Corporate Security program. For confidential data, such as customer information and energy usage data, Idaho Power limits access using a need-to-know approach enforced by role-based access controls for employees and contractors and supported by periodic required training. The policies and controls undergo periodic reviews to ensure they support applicable mandates and guidance.

Idaho Power recognizes that new risks are emerging from smart grid technologies, both from the increase in data and the increasing interconnectivity of systems. To stay current on these, Idaho Power has joined collaborative public/private partnerships such as the National Institute of Standards and Technology Smart Grid Interoperability Panel Cyber Security Working Group.

Idaho Power customers can access their energy usage data electronically via a registered and password-protected login (myAccount) on the Idaho Power website. Customers can also request Idaho Power provide hard-copy usage information via fax, email, or mail.

Idaho Power provides customer usage data to entities other than the customer only under one of the following conditions:

- Receipt by Idaho Power of a court-ordered subpoena
- Presentation by a third-party of legal documentation substantiating the power of attorney for the customer of record
- Receipt by Idaho Power of written authorization from the customer of record identifying the third-party to whom information is to be released and specifying the information to be released
- Notification by a public utility commission that the customer of record has filed a complaint

- In addition to the above conditions under which information for an individual customer may be provided, Idaho Power has several contractual business relationships with third-parties for the procurement of services essential to the operation of the business (e.g., bill print services) that are subject to non-disclosure agreements and data security requirements.

# C. General Customer Outreach and Education

## *Overview*

Over the past six years as AMI installation has been completed, Idaho Power has provided residential, small commercial, and irrigation customers self-service options at www.idahopower.com. The self-service options help customers learn about energy, how they are using it, and how they can save it. This technology gives customers the ability to view their hourly and monthly meter data with additional energy tools and analytics technology. Most residential, small commercial, and irrigation customers can also view their meter data at www.idahopower.com and use self-service features and information 24 hours a day, seven days a week.

Idaho Power CSRs have the ability to answer residential and small commercial customers' questions about their detailed energy usage. This specific data is available for TVP rate structure (residential), while using features in the Customer Service Representative (CSR) tool, the Meter Highlights tool (with bill-to-date functionality), and the Rate Comparison tool for residential customers. The CSR tool will allow authorized, internal employees to see the same data as the internet self-serve customer. This helps the CSR to consult with the customer about energy usage and high bill complaints.

## *Customer Outreach and Education Events*

Idaho Power further increased its energy efficiency presence in the community by providing energy efficiency and program information through 154 outreach activities, including events, presentations, trainings, and other outreach activities documented in 2013 in the Outreach Tracking System. In addition to these activities, Idaho Power field staff throughout Idaho Power's service area delivered 174 presentations to local organizations addressing energy efficiency programs and wise energy use. In 2013, Idaho Power's Community Education team provided 80 presentations on *The Power to Make a Difference* to 2,291 people. The community education representatives and other staff also completed 53 senior citizen presentations on energy efficiency programs and shared information about saving energy to a total of 1,235 seniors in the company's service area.

At these events, Idaho Power employees cover a wide range of information, answer customer questions, and assist customers in registering for the company on-line self-help services. The company also promotes www.idahopower.com, using myAccount to help customers learn more about using energy, tips and ideas to save energy, energy efficiency program information, smart meter information, payment options, and general company information.

## *Communications*

Idaho Power communicates frequently with customers through a variety of channels, including, but not limited to, billing statements, bill messages, bill inserts, *Connection* articles, customer letters, doorknockers, postcards, brochures, web content at www.idahopower.com, hold messaging on the company's 1-800-488-6151 phone line, social media, public events, and customer visits.

## *Summary*

Idaho Power has successfully leveraged the functionality of AMI and especially the hourly meter data to enable the majority of its customers to learn more about their energy usage and how to use energy wisely. The company has used events and other channels to provide customers relevant information on a frequent basis about energy efficiency, company and program information, and updates about smart metering. Idaho Power also sends a new customer welcome letter inviting them to visit www.idahopower.com to learn more about their energy usage and to register on myAccount.

# VII. CONCLUSION

Idaho Power has developed a vision that anticipates what the future energy delivery system will look like and how it will meet customer expectations. Along with the vision, a strategy has been developed to test and deploy the technologies needed to facilitate the transition to a smart grid future. Much has been done in the past few years and much remains to be done.

Building upon the successful deployment of the automated metering infrastructure, the task now becomes using AMI as a communications and data backbone to enable more proactive customer interaction. Idaho Power will also deploy technologies that can control devices both on the distribution system and the transmission system to provide for a high level of power quality, reliability, and robustness. The system will also be able to accommodate renewable generation and integrate it into the power system.

The smart grid will provide Idaho Power's customers with an efficient, reliable, and safe power system that fits with customer expectations of a more interactive experience.

# Appendices