IDAHO POWER
An IDACORP Company

IDAHO POWER COMPANY
P.O. BOX 70
BOISE, IDAHO 83707

JOHN R. GALE
Vice President
Regulatory Affairs

(208) 388-2887
FAX (208) 388-6449
E-MAIL rgale@idahopower.com

December 30, 2005

IPC-E-02-12

Ms. Jean Jewell
Commission Secretary
Idaho Public Utilities Commission
472 West Washington Street
PO Box 83720
Boise, Idaho 83720-0074

RE: Phase One AMR Implementation Status Report

Dear Ms. Jewell:

Enclosed please find seven copies of Idaho Power's Phase One AMR Implementation Status Report. This report is filed in compliance with Idaho Public Utilities Commission Order No. 29362.

The Company has previewed the report's findings with the Commission's Staff and stands ready to follow up with further information in any manner that the Commission deems appropriate.

If you have any questions regarding this report, please direct them to Maggie Brilz at 388-2848 or me at 388-2887.

Cordially,

John R Gale

John R. Gale

JRG:ma

Phase One
AMR Implementation Status Report

Presented by Idaho Power Company
to the Idaho Public Utilities Commission

December 30, 2005

Acronyms and Definitions

Due to the technical nature of this document, many abbreviations are used throughout to enhance readability. To avoid any confusion, use the table below as a guide to the acronyms and definitions of the terms used in this report.

Acronym	Description	Definition
AMR	Advanced Meter Reading	The components necessary to read a meter remotely using technology to retrieve meter reading data through a communication network.
CAMC	Customer Account Management Center	The group of employees in the Idaho Power Customer Service Department that conduct billing and collections evaluations on customer accounts.
CIS	Customer Information System	Idaho Power's billing and customer system that contains all customer data utilized by Idaho Power employees to provide functionality for customer-related events such as billing, rates, service orders, and meter reading.
CSR	Customer Service Representative	The Customer Service Department employee titles for those employees who assist customers with service requests or inquiries. CSRs exist both in the Idaho Power Call Center and CAMC.
DCSI	Distribution Control Systems, Inc	The vendor who sells the AMR power-line-carrier system Idaho Power implemented during the Phase One project.
EMS	Energy Management System	A software system used to monitor and control switching of the distribution and transmission system at Idaho Power.
EW	Energy Watch	The Critical Peak pricing program Idaho Power implemented in the Emmett area in 2005.
IEE	Itron Enterprise Edition®	The Itron product name of the Meter Data Management System Idaho Power purchased for the Phase One project.
IPC	Idaho Power Company	
IPUC	Idaho Public Utilities Commission	
LCT	Load Control Transponder	A power-line-carrier device that can open or close a circuit at the home, allowing a utility to control devices at the premises from the TNS system.

Acronym	Description	Definition
MDMS	Meter Data Management System	A system that manages meter reading data intended to validate the accuracy and completeness of the data, and provide estimating routines to create billing quality data. The system is also intended to compile the data to billing intervals for time-of-use programs.
MVRS	Manual Meter Reading System	The software package and equipment Idaho Power purchased from Itron that facilitates the current manual meter reading process. This consists of the handheld devices that are used to collect the existing meter reading data and the software to feed the information to the CIS.
MV90	MV90	A software system purchased by Idaho Power from Itron that manages 15-minute interval data for large primary meter customers that converts pulse data to usable quantities.
MWM	Mobile Workforce Management	A project under evaluation at Idaho Power that would assign and distribute service order type work over a wireless network to field employees.
OASys	Outage Assessment System	A separate software program sold by DCSI to enable the collection of meter outputs that can indicate outage events at the meter location.
Nexus	Nexus Energy Software	A hosted internet based tool that Idaho Power contracted with Nexus Energy to provide customers with access to their hourly energy usage via the Idaho Power Website.
O&M	Operating & Maintenance	The costs associated with operating the Company after implementation of capital-related expenditures.
OMS	Outage Management System	The software system Idaho Power implemented separately from the Phase One project that is used to manage outage information, crew assignment, customer to transformer alignment in the distribution system that uses algorithms to identify and track distribution outages to control devices.
PLC	Power Line Carrier	The AMR technology used during the Phase One AMR Project that uses the electrical distribution system as the communication medium between the meter and the controlling software.
RCE	Remote Communication Equipment	The modules installed in the meters that coordinate the meter information to be communicated over the electrical distribution alternating cycle.
SCE	Substation Communication Equipment	The equipment placed in an electrical distribution substation that converts communication data from the electrical distribution alternating cycle to another type of medium that can be communicated over a network to the host servers.

Acronym	Description	Definition
TNS	TWACS® Network Server	This is the host software sold by DCSI that controls the signaling of information between the meter through power-line-carrier.
TOD	Time of Day	The Time-of-Use pricing program Idaho Power implemented in the Emmett area in 2005.
TWACS®	Two-Way Automatic Communication System	The DCSI AMR system Idaho Power installed during Phase One. The system uses power-line-carrier technology to communicate with the meter.
VEE	Validate, Estimate, Edit	A primary functional requirement of the MDMS system to validate meter data for accuracy and completeness, and provide estimates for any missing interval data. This function also provides validation of any anomalies in the data and edits the data accordingly to achieve billing quality data.
VSD	Variable Speed Drives	Customer equipment at the meter location that allows the customer to change the load of energy required to operate a piece of equipment.
XM	Extended Memory	A new meter module proposed for development for TWACS® that will have 7 days of memory.

Table of Contents

Part 1—Executive Summary

1. Project Overview

Idaho Power Company (IPC) implemented a Phase One Advanced Meter Reading (AMR) Project in 2004 and 2005 pursuant to Order No. 29362 issued by the Idaho Public Utilities Commission (IPUC). Order No. 29362 required IPC to file an AMR Phase One status report by the end of 2005.

The Phase One AMR Project consisted of the implementation and evaluation of AMR technology for approximately 23,500 customers in IPC's Emmett and McCall operating areas. The power line carrier based AMR system has operated successfully since its completed installation in November of 2004. In addition to the AMR technology and infrastructure that included the meters, substation technology, and AMR software, IPC installed a Meter Data Management System (MDMS), which is required for validating the data and providing the data for billing purposes, and an Internet-based data presentment software system, which makes usage data available to customers via the IPC Web site. Customer programs offered during the summer of 2005 included:

1. Time-variant pricing programs for residential AMR customers in the Emmett area (Time-of-Day and Energy Watch pilot programs), and
2. A/C Cool Credit program for residential AMR customers in the Emmett area utilizing the load control functionality of the AMR technology.

2. Project Scope and Exclusions

AMR was installed in IPC's Emmett and McCall operating areas. AMR installation in the Emmett operating area included the communities of Emmett, Sweet, Montour, Horseshoe Bend, Banks, Crouch, Garden Valley, Lowman, and the surrounding rural areas of each of these communities. AMR installation in the McCall operating area included the communities of McCall, Lake Fork, Donnelly, Cascade, New Meadows, Riggins, and the surrounding rural areas of each of these communities.

AMR was installed for residential, small and large general service, and irrigation customers taking service under Schedules 01, 07, 09, and 24. A total of 23,474 AMR meters were installed with 10,742 AMR meters installed in the Emmett operating area and 12,732 meters installed in the McCall operating area.

Certain exclusions were made when installing the AMR meters. These exclusions included the following: primary service level accounts, dairies, accounts with load research meters, Tamarack substation customers, and single-phase substation customers. In total, these exclusions equal approximately 650 customers.

3. Major Systems Installed

The Phase One AMR Project included the installation of three separate, but related, systems. No single system or vendor was able to provide all the functionality to meet the objective of the Phase One project. This required IPC to evaluate multiple vendors and build the necessary interfaces between systems to meet the functionality requirements.

a. TWACS® AMR Power Line Carrier System

The Two-Way Automated Communication System (TWACS®)AMR system, consisting of software and physical equipment in the field, is the meter data collection system. TWACS® uses two-way communications via power line carrier technology to retrieve meter reading data. The TWACS® system is a multi-tiered technology that uses specific TWACS® meter modules, substation equipment, a communication network, and software to operate the system. The TWACS® system was chosen as the best match for the IPC service territory to achieve mass meter coverage of the geographical areas.

The installation of the single-phase AMR meters for residential and small commercial customers was contracted to Terasen Utility Service Inc. of Milwaukee, Wisconsin. Terasen was responsible for providing the supervision and resources necessary to install the single-phase AMR meters. IPC provided meters that were purchased from Itron that included the TWACS® meter modules installed at the factory during manufacturing. Terasen conducted meter exchanges and provided data collection of exchange readings from old to new meters. Teresen also provided IPC with electronic data to enable the record keeping of the meter exchanges within IPC's systems. IPC meter technicians completed approximately 1,200 meter exchanges of Current Transformer Rated and Poly-phase applications. The TWACS® substation equipment was installed by IPC personnel. The communication infrastructure was a combination of local phone service provider equipment and IPC infrastructure. The TWACS® Network Server (TNS) software application was installed by Distribution Control Systems, Inc. (DCSI) and jointly tested with IPC.

b. Itron EE® Meter Data Management System

The TWACS® system is not designed to validate the meter data or accumulate it into time-variant billing determinants. To provide billing quality data for time-variant pricing programs requires a secondary system beyond the AMR system. The Itron EE Meter Data Management System (MDMS) was implemented in order to provide the Validating, Editing, and Estimating (VEE) function for the hourly interval consumption data retrieved by TWACS® and converting this interval data into billing data for time-variant pricing programs.

The intended system operation for MDMS is to receive hourly interval data and daily meter reading data from the TNS software. The MDMS is then intended to run the appropriate VEE routines and algorithms on each day's data. Depending on the quality of the data provided, this VEE process can take several hours each day.

For those customers on a time-variant pricing program, MDMS was intended to aggregate the interval data into the appropriate billing determinants and pass this accumulated kWh data to IPC's customer information system for customer billing. For customers not on the time-variant pricing programs, the MDMS was intended to VEE the data for customer inquiry through the Nexus Energy Software system.

c. Nexus Energy Software

Nexus Energy Software is an Internet-based software system used for data presentment in which customers can access their AMR hourly energy use data through a Web site. The Nexus Energy Software system is a vendor-hosted Web application accessible via links on Idahopower.com. Services are provided to residential and business customers with expanded options for customers with AMR meters. Information from CIS *PLUS*® (IPC's current customer information system, or CIS) and MDMS is compiled and transmitted via the Internet to the Nexus Web site for customer presentation and analysis.

Figure 1 below illustrates how each of these three systems interrelates within IPC's overall AMR system:

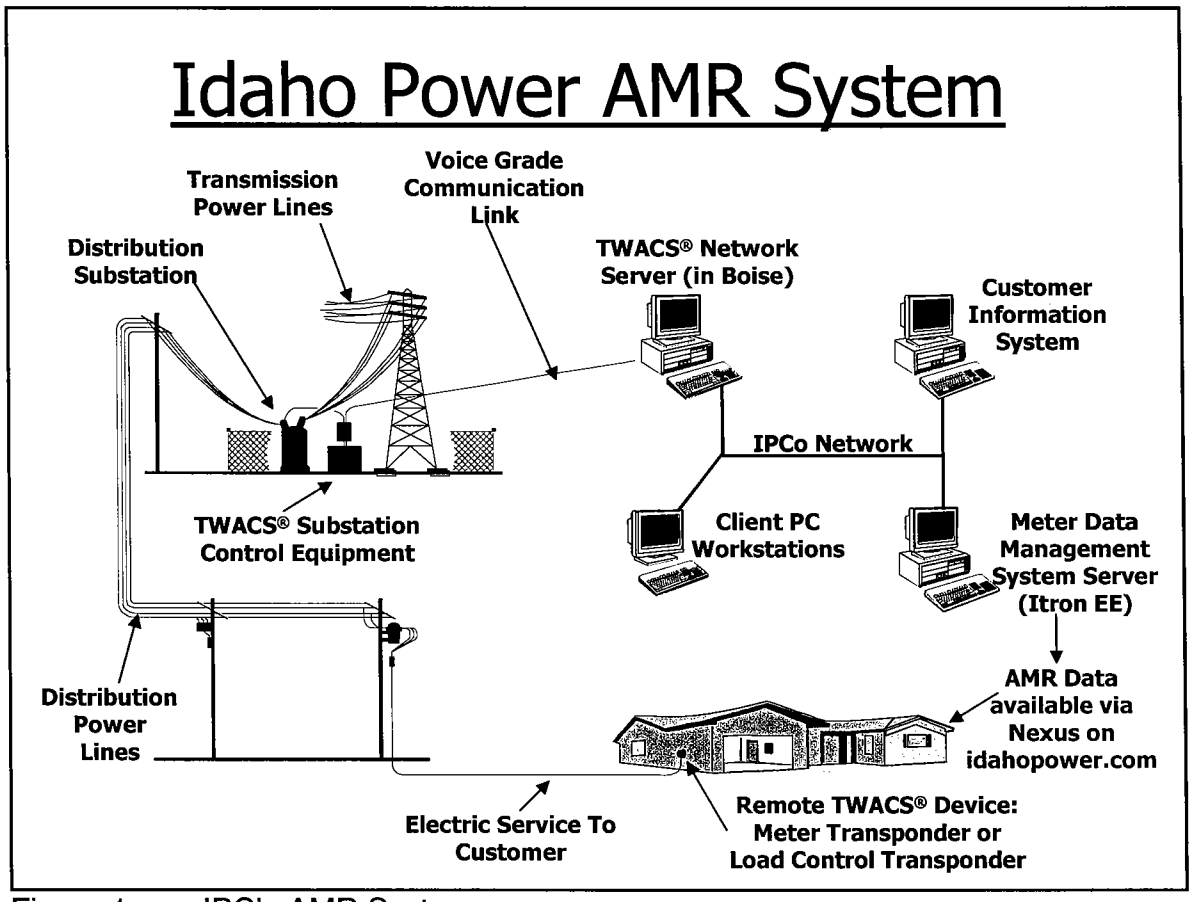

Figure 1 IPC's AMR System

4. System Performance

a. TWACS® AMR Power Line Carrier System

IPC has a near 100 percent success rate in collecting daily reads through the TWACS® system. It has an approximately 98 percent success rate in collecting hourly usage information. The meter modules used in Phase One have a 24-hour memory that is used in 8-hour blocks. Any problems with the electrical system, phone lines, software or the servers can usually be resolved in time to capture the daily readings that are stored in the meter for 24 hours. To ensure accurate data collection, it is necessary to communicate with the meter in no greater than 16 hours timeframes prior to the data being over-written in thememory. Individual meter failures or problems that cannot be fixed within 16 hours are rare, but do result in the loss of daily readings and hourly data.

The system does have limitations in its bandwidth capabilities. This limitation presently exists at the substation equipment level in which the equipment is not able to listen to multiple substation bus, feeder, and phase configurations. For the Phase One Project, IPC placed an emphasis on collecting the meter usage information at the hourly level, which required IPC to contact each meter a minimum of three times daily to obtain the information in the 8-hour time blocks. The bandwidth limitation causes concern when other services may be used on top of meter data collection, such as load control signaling or polling for outage verification, in which the communication network may become over burdened creating conflicts in functionality. IPC also upgraded its own communication network at the Crane Creek substation to enable increased communication capacity to improve reliability of data gathering.

IPC consistently experienced meter failures on irrigation pump locations using variable speed drives (VSD). To date, nine meters installed at service points with VSD have failed. As of this status report, DCSI has not diagnosed the problem which causes this failure or provided a resolution to the issue. During the Phase One project, IPC was required to reinstall standard meters on these installations and manually read them to obtain usage data.

On November 18, 2005, IPC received a service announcement from DCSI to immediately discontinue the use of 480-volt meter operation and installations due to safety concerns of thermal overheating. This directive raises a serious concern regarding the viability of the AMR technology for irrigation and commercial installations where the collection of interval usage data is required or desired. In the IPC Phase One project, this issue impacts approximately 330 meters. IPC is continuing to work with the vendor to understand the problem and potential options for resolution. In the mean time, IPC is not collecting hourly or daily reads from the 480-volt AMR meters and is limiting its operation to the collection of monthly reads only.

b. Itron EE Meter Data Management System

IPC's criteria for VEE required some very complex calculations and algorithms for hourly interval data for the 23,474 meters. When the MDMS request for proposal was issued in early 2004, there were no identified vendors providing MDMS systems

currently in a production status that had the functionality and volume requirements for hourly interval data management that IPC specified. Given this, IPC contracted with Itron, to implement an existing product that they believed could be modified to meet IPC's criteria. Actual modification of the Itron Enterprise Edition product to fit IPC's criteria proved to be much more difficult than anticipated and Itron experienced significant difficulty meeting IPC's acceptance test criteria for VEE. Itron has not been able to deliver acceptable VEE functionality for the MDMS product installed, IEE version 4. While Itron has diligently worked with IPC during this time, this vendor delay has prevented IPC from utilizing the MDMS functionality during the Phase One project period. The two time-variant pricing programs offered in the Emmett area required hourly data to be VEE'd for billing purposes. Because of the Itron MDMS failure, all billings for these two pricing programs for the months of June, July, and August were manually extracted, reviewed, and entered into IPC's billing system. The manual process was manageable due to the small scale of the two pricing programs, but any expansion of the pricing programs is not recommended until a MDMS solution is tested and in production.

A major upgrade (version 5.0) of the MDMS VEE functionality was released by Itron in November 2005. This new release requires a new implementation, testing, and acceptance process prior to its being placed in production. The final assessments and evaluations of the MDMS technology are not expected to be complete until April 2006.

c. Nexus Energy Software

The Nexus Energy tools were implemented in phases. Beginning on April 4, 2005, AMR customers were able to use the Nexus system to view hourly usage information, and on July 11, 2005, all residential and small commercial customers were able to access usage data and receive information on energy savings tips.

Customer interest in viewing and examining AMR provided hourly data was minimal during the time-variant program period in Emmett in 2005. During the solicitation period for the time-variant pricing programs in April and May, IPC sent out direct mailing pieces to approximately 5,000 targeted customers. These mailings provided the Internet address where customers could log-in to review their previous summer's hourly data and load profiles and also use the Nexus calculator to help them see if there were potential savings by participating in the program. Of the 5,000 targeted customers, only 35 accessed their data using Nexus. Of the 170 eventual program participants, 24 looked at their previous summer's usage prior to signing up for a program. IPC was able to track specific AMR customer Web site traffic to those who viewed portions of the Web site that contained hourly AMR data; in total only 58, or .25 percent of all AMR customers, viewed 93 reports and 481 charts containing hourly data.

5. Programs Offered

IPC offered two different time-variant pricing programs and one demand response program in the Emmett AMR area during 2005. IPC solicited approximately 5,000 Emmett Valley customers simultaneously for participation in the three programs: the Time-of-Day (TOD), the Energy Watch (EW), and the A/C Cool Credit programs. The

TOD program had 97 customers apply to participate and the EW program had 80 customers apply to participate. Customers were restricted to participation in only one of the three programs offered to Emmett Valley residents during the summer of 2005.

a. Result of Time-of-Day and Energy Watch Programs

The Company has contracted with RLW Analytics to evaluate participants' peak impacts, energy impacts, and bill impacts for the Energy Watch and Time-of-Day participants.

RLW Analytic's preliminary analysis results of the TOD program indicate that for all three months and the summer season in aggregate, there was not a statistically significant change in the usage patterns of the TOD participants when compared to the control group. However, there was some indication that there was some reduction of load during the on-peak periods and an increase in load during the off-peak periods. Preliminary bill comparisons for the TOD participants indicate that participants' average bill might have been slightly less for the summer season when compared to the control group's average bill under the standard residential rate.

The preliminary results of the analysis of the EW group by RLW Analytics indicate that on average a statistically significant level of peak load reduction was realized from the EW participants during the nine EW Events. The preliminary bill analysis indicates that for both the control group and the participant group the average bill at standard residential rates was slightly higher than the average bill under EW rates.

Overall, the preliminary analysis of the TOD and EW pilot programs demonstrates that these programs were reasonably successful for both the participants and the Company. As required by the Commission in Order No. 29737, the Company will submit a final report upon the completion of the programs in April, 2006.

b. A/C Cool Credit using AMR Technology

The TWACS® Load Control Transponder (LCT) is a device that can be installed at service points and used as a switch for load control applications. The LCT is a completely separate and independent device from the AMR enhanced meters. It is controlled by TWACS® software and is capable of two-way power line carrier based communications as are the AMR meters. Each LCT has the ability to cycle two appliances at the installation location. Approximately 170 Emmett customers enrolled in the A/C Cool Credit program in the Emmett area.

IPC used the same contractor to install the LCTs for its Emmett AMR customers as it did to install the radio pager technology in other A/C cycling areas. During the data evaluation period, IPC discovered that the LCTs were wired to the low-voltage connection, which is the normal procedure for radio-controlled switches, not the high-voltage connection, which is the normal procedure for the LCTs. This wiring configuration gave IPC a false impression that the air conditioners were being cycled through the AMR technology, when in fact they were not being physically cycled on and off. Further testing is currently underway to correct the switching issue for the 2006

season. Despite this error, all indications from industry and vendor sources are that the AMR technology and LCTs can effectively conduct load control of appliances using on-demand technology.

6. Programs Evaluated

IPC evaluated, or is continuing to experiment with, other AMR-related services, functions, and benefits.

a. Account Aggregation and Customer Choice of Reading Dates

Account aggregation, also known as summary billing, has been offered by IPC since 1997. AMR technology would enable customers with multiple meter points to change their current monthly meter reading date so that all meters would be read on the same date regardless of their geographical location. In addition, customer choice for reading and billing dates could also be implemented with AMR. A concern exists for both the aggregate and customer choice of reading dates in relation to AMR and other processes. IPC prepares approximately 450,000 bills balanced over 21 billing cycles each month. This process of using billing cycles spreads the workload into manageable allotments. If customer choice or bill aggregation were to create unbalanced cycle volumes, the processes, systems, and employee scheduling could lead to inefficiencies that outweigh the benefits.

b. Remote Connect/Disconnect

The TWACS® remote connect/disconnect device is a single-phase 200-amp switch mounted in a socket meter base extension. The device is installed between the meter and the customer's meter base; it is totally separate and independent from the AMR-enhanced meter.

IPC did not install any of the remote connect/disconnect switches. There were only 15 residential service points company-wide with four or more actual connects or disconnects in 2004. Over 70 percent of customer requests for service establishment or service disconnection do not require the physical connection or disconnection of the meter, but only a reading to transition the customer responsibility. The TWACS® remote connect/disconnect devices cost approximately $200 each. IPC's average cost for the field work associated with a site visit within the Emmett and McCall operating areas to perform a disconnect or connect is $18. Given these costs, any remote connect/disconnect device installed on an average service would have to be operated more than 10 times to break even on the purchase of the device.

Although IPC did not install remote connect/disconnect switches, it did use the AMR system to avoid trips to AMR related accounts to obtain transition readings between customers when a physical connect or disconnect was not necessary. IPC was successful in building interfaces between its CIS and AMR systems to capture the readings while reducing the cost of labor and mileage in these cases.

c. Theft Detection

The AMR system provides three different pieces of information that can be analyzed to identify possible energy theft. The Phase One project allowed IPC to collect data on all three elements of information.

The volume of information collected from these primary theft detection elements has not led IPC to identify any theft detection in the Emmett or McCall operating areas. Software products to assist in evaluating this type of information to identify possible theft situations have not been made commercially available or were not evaluated during this phase of the project.

d. Outage Confirmation

IPC is continuing to evaluate a secondary DCSI software package that is designed as an outage assessment tool named the Outage Assessment System (OASys) (). The features provided by OASys include: a) The ability to report meters that do not reply to the automated meter polling; b) Blink Count, an outage accumulator within each meter; and c) the ability for a meter system operator to select a meter (or group of meters) to initiate a polling of the meter(s).

e. Voltage Monitoring

The three-phase AMR enhanced meters provide a revenue-accurate voltage reading. However, the single-phase residential AMR enhanced meter provides a voltage measurement within the communications module. This voltage is specified to have an accuracy of +/-five percent. For our evaluation, 30 meters were selected near each regulating device and along each branch of the feeder. Four of the 30 meters indicated 26 voltage readings outside of the given ANSI C84.1 standard of 114 and 126 volts.

7. Costs

Projected final capital costs, including all vendor costs, contract costs, IPC labor and costs, loadings, overheads, and AFUDC for each of the three major project components of the Phase One AMR Project are as follows:

TWACS® AMR System	Projected Cost
Installed Cost of Meters, Substation, Software, Servers, including labor	$5,855,144
Installed Cost of Itron EE MDMS System Software & Servers including labor	$ 770,000 (Still in Progress)
Installed Cost of Nexus Energy Software including labor	$ 234,280
Total Projected Phase One Project Cost	**$6,859,424**

These costs result in an average cost of $292 per installed meter point for the Phase One project.

8. Benefits

IPC evaluated the benefits provided by AMR in relation to both real cost savings and service related results.

IPC realized a $303,000 annual savings in manpower in the Emmett and McCall operating areas. IPC reduced its manpower for meter reading and service orders by four employees as a result of the Phase One project. This savings includes loaded labor and reductions in travel costs associated with meter reading and service order work that were replaced with AMR functionality.

IPC also identified benefits associated with billing accuracy related to AMR. Specifically, estimated readings were reduced 92 percent from 2003 levels, while corrected billings in the same areas were reduced by 45 percent. Because the overall volume of AMR meter readings in Phase One was five percent of the meter readings in the IPC operating area as a whole, no cost savings were obtained in labor reductions in the customer service area as the described benefit was not significant enough as a whole to reduce labor. IPC could not statistically ascertain that any call volume reductions were contributable to AMR directly. IPC did evaluate customer contact rates in the AMR areas versus the remainder of the Company. This information did show a decrease in overall customer contacts for AMR areas, but as noted, IPC could not statistically ascertain that the decrease was directly tied to AMR improvements.

9. Customer Feedback

IPC contracted with Northwest Research Group, Inc. to conduct a survey with Emmett area customers to determine awareness and perceptions of IPC's service since installing AMR technology. A telephone survey was conducted with 533 of IPC's Emmett area customers.

Objectives of the study were to help IPC understand the perceptions of these customers with regard to service and the customer's ability to gather relevant energy usage information from IPC. Customers who participated in one of the two pricing programs offered in the Emmett area during the summer of 2005 were asked an additional battery of questions. Information from this portion of the research will be included with the final program report to be filed in April 2006.

Overall satisfaction with the level of service received from IPC was high with 61 percent of customers in this study stating they were "very satisfied" and 33 percent stating "somewhat satisfied." When asked if their level of satisfaction with IPC had changed within the past twelve months, 84 percent of these customers indicated their satisfaction level had stayed the same. Survey respondents indicated that IPC does a good job of providing information to customers about how and when to use electricity (mean score of 4.33 on scale of "1" to "5").

Most of the customers interviewed in the survey were aware that an AMR meter had been installed at their residence and that they no longer have a meter reader coming on to their property monthly. When asked if they had a need or interest in knowing daily or hourly electricity usage, 43 percent of those surveyed said they were interested in knowing their daily usage and 37 percent said they were interested in knowing hourly usage.

Only nine percent of the customers included in this study said they had ever gone to IPC's Web site for electricity usage information. The majority of survey participants who had gone to IPC's Web site for energy usage information indicated they found the information useful and it met their needs. When asked where they would prefer to get electricity usage information, 87 percent of the customers involved in this research said they would prefer to see it on their power bill rather than on the IPC Web site.

General conclusions of the research are that customers in the Emmett area are satisfied with the level of service they receive from IPC and that Emmett customers' satisfaction level has stayed constant within the past 12 months. Customers are generally aware that they have AMR meters but most aren't aware of the amount and type of usage information available to them.

10. Conclusions

The AMR project has shown potential benefits, but before any decisions can be made about expanding this program more work is needed with respect to economic analysis, business requirement definition and planning, monitoring of the maturity of AMR technologies, an AMR industry analysis, and defining and understanding customer needs and behaviors. This work should acknowledge the following conclusions reached as a result of the Phase One project:

- The cost of the Phase One project was $6.8 million, or $292 per meter point. The associated realized benefits are $303,000 annually. In combination, these values do not reflect a positive cost benefit analysis. AMR will require time to mature in its technology lifecycle; IPC will continue to analyze increased and other realizable benefits, along with further evaluation of implementation cost options. By continuing to monitor and develop these items in combination, IPC will be able to monitor any change in the balance between costs and benefits.

- The TWACS® system performs well when asked to provide monthly or daily reads. The system and its limited bandwidth of communication start to show limitations in the collection of hourly reads. This limitation required dedicated manual oversight to collect hourly reads.

- Meter reading accuracy has increased and estimated readings are significantly reduced. This demonstrates that AMR can improve bill quality. IPC was not able to translate these soft benefits into a hard dollar savings during the Phase One project.

- The AMR system provides an abundance of data to evaluate for theft detection and outage events. The volume of data will require either advanced software, or added labor costs to evaluate the data for effective determination of any benefit.