Rocky Mountain Power

Advanced Substation Metering Program

Sustainable Transportation and Energy Plan

Utah Innovative Technologies Team

1 Executive Summary

As part of the Sustainable Transportation Energy Plan (STEP), a Utah statute, Rocky Mountain Power (the Company) should authorize $1,100,000 to deploy an advanced substation metering program that includes, but is not limited to, installing advanced meters at approximately fifty circuits connected to distribution substations in Utah where limited or no existing communications exist. This project will enable higher data visibility on the distribution system by providing for the installation of advanced meters, setting up remote communication paths with all installed meters and the purchase of a data management and analytics tool to automatically collect, analyze, interpret and report on the available data. This program will allow for the development of a more progressive grid.

2 Purpose and Necessity

Substation monitoring and measurement of various electrical quantities is seen by the Company and its customers as a necessity to provide for the integration of distributed energy resources into the existing electric grid. Enhanced monitoring helps resolve the following challenges for the Company and its customers:

- Limited visibility on power flow, loading levels, load shape, and event information needed to develop thorough interconnection studies, determining safe switching procedures and cost effective capital improvement plans.
- The company is in the process of striving to make the grid more progressive and this program will enable a greater understanding of these innovative solutions.
- Single phase distributed energy resources can exacerbate load imbalance on a distribution circuit, causing three phase voltage imbalance issues and increasing the potential for unintended circuit breaker operations from elevated neutral currents.
- Detrimental impacts on transient and steady state voltage levels due to growing interaction between distributed energy resources and distribution system equipment. Understanding the production levels on a circuit can accurately determine the need for effective grounding and fault clearing control schemes, which if not installed appropriately can cause temporary over voltages to customers or circuits improperly protected during fault conditions.
- Potential harmonic issues from inverter-based distributed energy resources can cause customer motor damage and interfere with high frequency communications.
- The need for measurement of per-phase vector quantities to improve optimization opportunities for capital costs and system losses.

3 Benefits

- Enable increasing levels of distributed energy resources on the power grid in an affordable and reliable way by providing increasing visibility on loading levels, load shape, and event information needed to develop thorough interconnection studies and hosting capacities for customers, determining safe switching procedures and cost effective capital improvement plans.
- Assists in preventing load imbalance on a distribution circuit caused by single phase distributed energy resources which can result in three phase voltage imbalance issues and increasing potential for unintended circuit breaker operations from elevated neutral currents.
- Understand harmonic issues caused by distributed energy resources and take appropriate steps to resolve issues, if any, in a proactive way.
- Improve optimization opportunities for capital costs and system losses by providing measurements of per-phase vector quantities for voltage and current.
- Identify service quality issues early and allow timely development and implementation of cost effective mitigation.
- Enhance understanding of intermittent generation resources and their impact on the power grid.
- Reduce time delays of approvals for customers seeking distributed generation interconnections.
- Provide customers with circuit information with a higher level of accuracy.
- Identify and control risks associated with the integration of significant penetration of distributed energy resources. This includes controlling claims from power quality issues, customer equipment failure, utility/customer equipment damage or impact on customer generation levels.

4 Public Interest Justification

In the state of Utah, Rocky Mountain Power continues to experience rapid growth in penetration levels of distributed energy resources. In fact, the rate of net energy metered interconnections has doubled annually. For example in 2012, 478 net metered customers interconnected to the Rocky Mountain Power system. We anticipate that close to 12,000 customers will interconnect in 2016. To further facilitate the integration of distributed energy resources of different types and sizes in a cohesive and cost effective manner, data collection at substations will be of paramount importance. This will create a win-win situation for both the Company and its customers in the following ways:

- **Modernized Grid:** Data collection, synthesis and interpretation is a cornerstone for building a smarter energy infrastructure that will enable accurate load/generation forecasting and planning as well as help understand the interaction between the power grid and the distributed energy resource units.

- **Higher Levels of Distributed Energy Resources**: Substation metering will provide the necessary data required to perform interconnection studies and help to seamlessly interconnect distributed energy resources in an affordable and reliable way.
- **Improved Customer Service**: Data availability will enable the Company provide prospective interconnection customers with ample circuit information to help them make effective decisions at lower costs. Additionally, enhanced data availability can improve outage restoration efforts.
- **Situational Awareness:** Information collected from substation metering will help boost situational awareness thereby enabling the Company to invest proactively to efficiently deliver affordable, reliable and energy to all customers.
- **Maintain Grid Integrity**: Communication-enabled substation metering products can maintain the integrity and reliability of the electrical system in the face of massive load characteristic changes being experienced with the increasing levels of distributed energy resources being interconnected to the distribution system.
- **Cybersecurity:** This program will comply with all NERC CIPS requirements.

5 Compliance with SB115

The substation metering program meets the legislative intent of SB115 54-20-105-1(h) that pertains to "any other technology program" in the best interest of the customers in the state of Utah. This project falls under the STEP's discretionary allotment of funds as part of the Utah Innovative Technology category.

6 Alternatives Considered

- Alternatives considered that do not resolve the critical issues/needs:

— Line mounted ammeters were considered during evaluation; however, they do not provide direct access to voltage and harmonics measurements. These measurements are critical to ensure compliance with delivery thresholds and for any power flow or power quality analysis.
— Do nothing. However this will not provide the company with the information needed to develop a more progressive grid.

7 Purpose and Necessity – Risk Analysis

Company Impacts without this project:

- Lack of historical real-time circuit data on loading/generation levels and power quality introduces major assumptions and inaccuracies while developing interconnection studies,

determining safe switching procedures, and cost effective capital improvement plans.

- Ignoring the changing load characteristics due to the advent of distributed energy resources on distribution circuits *may* lead to *unwarranted* capital expenditures in system upgrades and retrofits *or the absence of needed infrastructure to maintain a reliable system.*
- Performing advanced distribution planning studies such as "hosting capacity" analysis cannot be performed in the absence of detailed distribution circuit loading information.

Customer Impact without this project:

- Increasing levels of distributed energy resources in the absence of substation loading and power quality information might delay the assessment process of interconnection projects.
- Customers may have to pay for unnecessary equipment upgrades that could potentially be avoided in the presence of accurate substation metering.
- Increased customer dissatisfaction due to lack of interpretive data supporting the Company's requirements

Other Impacts:

- In an event that the circuit experiences power quality issues due to the presence of high levels of distributed energy resources, the Company will have no way of proactively addressing such issues.

8 Major Project Milestones

- Anticipated project start date or actual project start date: January 2017
- Final in-service date: December 2019

This project has multiple in-service dates related to the installation of the advanced meters and communications equipment at numerous substations. The installations will be scheduled according to a prioritized need starting with areas with high penetrations of distributed energy resources. Additional work will include installing the communication network and integrating the meters to the data management and analytical tool.

The project team is aware of the need to record the assets as technically complete in SAP as the assets are put into service. The Work Breakdown Structure (WBS) will be setup accordingly.

9 Program Closure, Retirement and Removal Information

In 2021, the Company will report back to the Utah Public Service Commission regarding lessons learned and how it plans to maintain and manage the infrastructure deployed as part of this

program. If it is necessary to report more often to comply with the STEP statute or other reporting requirement, the Company will comply with those requirements.

10 Project Delivery Risk Factors

The project will be managed to mitigate typical project risks (design and construction resources, permitting material deliveries, weather, etc.) as it applies to scope, schedule, and budget. Appropriate documentation will be created, tracked and communicated to properly manage the project. The appropriate risk mitigation measures will be identified and resolved in the project development phase.

One critical and unusual project risk factor has been identified that will need special attention in the project development phase.

- There is a risk associated with the integration of data management software with the field-deployed substation metering devices

11 Target Costs

Costs	Prior Years	2017	2018	2019
10 Year Plan Budget:-STEP discretionary funding	N/A	$500,000	$350,000	$250,000
APR (Gross):	N/A	$500,000	$350,000	$250,000
- Reimbursements:	N/A	N/A	N/A	N/A
- Contingency:	N/A	N/A	N/A	N/A
APR (Net):	N/A	$500,000	$350,000	$250,000

12 Accounting Issues or Regulatory Recovery Issues

All expenses towards this project will be recovered through the accounting workflow setup for the Utah Innovative Technologies under the Sustainable Transportation and Energy Plan. For detailed information, refer the overarching Utah STEP Accounting document.

13 Financial Analysis

It is recommended to spend $1.1 million to deploy an advanced substation metering program that includes installing advanced meters and required communication at distribution substations in Utah where limited or no existing communications exist.

Project	2017	2018	2019	2020 - 2041	Total
Proposed Solution - Capital	$500,000	$350,000	$250,000	--	$1,100,000
Proposed Solution - OMAG	$4,800	$21,880	$25,000	$25,000/year	$601,680

The financial analysis was based on the following assumptions:

- The recommended solution includes $25K of OMAG per year after the assets are in-service (2019 - 2041).
- The financial analysis was completed over 25 years.
- The communication assets are allocated to Utah.
- The in-service date is December 2019.
- The financial analysis results presented below are based on the project's revenue requirement. This is based on a capital structure of 49% debt and 51% common with a 5.21% debt and a 9.74% common rate.
- A 1.29% Utah property tax rate was used.
- A 6.57% discount rate was used.
- A 37.95% tax rate was used.

Project	Dollars	Present Value of Revenue Requirements
OMAG	$601,680	$272,472

14 Procurement and Project Delivery Strategy

- In order to satisfy business requirements, ensure best value, and minimize risk, purchases and construction contracts shall be procured through a competitive bid process.
- Project specifications shall be developed in accordance with applicable engineering specifications and standard designs.
- Bidders shall be screened to meet credit and procurement requirements. This process is being managed by the PacifiCorp procurement department.
- Project delivery strategy to be determined by project team.
- A communications outreach plan will be followed to ensure an increase in customer understanding is achieved. The communications plan can be seen in appendix C.

15 Recommendation

- Purchase and install advanced substation meters at distribution substations with limited or no communications
- Ensure all substation meters installed as part of this program are enabled with remote communication capabilities

- Implement a data management system to automatically download, analyze and interpret data downloaded from all installed substation meters
- Develop a process to ensure all data collected is used to improve the interconnection study process in addition to improving long-term and short-term distribution and transmission planning studies

APPENDICES

- Appendix A – Initial List of distribution circuits
- Appendix B – Technical requirements
- Appendix C – Communication Plan

APPENDIX A – INITIAL LIST OF DISTRIBUTION CIRCUITS

The following table is the initial list of circuits that were selected based on existing communication capabilities at the substation and the level of distributed energy resources interconnected to the circuit:

Substation	Circuit	Area	DER (~kW)
AMERICAN FORK	AMF13	N Utah Co.	105
AMERICAN FORK	AMF12	N Utah Co.	71
BANGERTER	BGT17	Jordan Valley	1490
BLUFFDALE	BLF11	SL Valley	118
BRICKYARD	BRK11	Ogden	77
BROOKLAWN	BKL11	Dixie	2208
BUSH	BSH11	Tremonton	126
CASTO	CAS11	SL Valley	114
COLEMAN	CLM18	Dixie	78
DAMMERON VALLEY	DMR11	Dixie	100
DEWEYVILLE	DEW12	Tremonton	88
ENERY CITY	EMR11	Price	75
ENOCH	ENO11	Cedar	14021
ENOCH	ENO12	Cedar	3000
ENTERPRISE VALLEY	ENV12	Cedar	3500
ENTERPRISE VALLEY	ENV11	Cedar	200
HIGHLAND	HIG13	N Utah Co.	135
HIGHLAND	HIG12	N Utah Co.	121
HIGHLAND	HIG11	N Utah Co.	113
LINCOLN	LIN14	NUT	509
LINDON	LDN12	N Utah Co.	134
LINDON	LDN14	N Utah Co.	123
MIDDLETON	MDD24	Cedar	6000
MOAB CITY	MOA12	Moab	387
MORONI	MOR12	Richfield	81
MOUNTAIN GREEN	MTG11	S Ogden	126
NORTH LOGAN	NOL12	NUT	80
OAKLEY	OKY11	Park City	96
PARKSIDE	PKD03	N Utah Co.	156
PARKSIDE	PKD06	N Utah Co.	95
PARKSIDE	PKD02	N Utah Co.	90
PARKSIDE	PKD04	N Utah Co.	69
PARLEYS	PAR12	Park City	334
PARLEYS	PAR13	Park City	117
QUAIL CREEK	QUA12	Dixie	105
QUARRY	QRY14	SL Valley	300
RIDGELAND	RDG14	SL Valley	285
RIDGELAND	RDG12	SL Valley	265

ROCKVILLE	RCK11	Dixie	95
SALINA	SAL13	Richfield	1225
SANDY	SDY13	Jordan Valley	1770
SOUTH PARK	SPK13	SL Valley	83
SOUTHWEST	SWT12	SL Valley	83
SPANISH VALLEY	SPA11	Moab	50
SPRINGDALE	SPD11	Dixie	171
SUMMIT PARK	SUM11	Park City	223
TOOELE	TOO11	SL Valley	85
VERNAL	VER11	Vernal	71
Welfare	WLF11	S Utah Co.	600
WINCHESTER HILLS	WNC11	Dixie	73

APPENDIX B – TECHNICAL REQUIREMENTS

1) All installations will be engineered, prints issued, and as-built drawings processed.
2) Meters will use existing current transformers, potential transformers and meter panel cutouts where available. Panel modification will be limited to control costs.
    a. Alternate designs will be available where no convenient panel space is available, possible using transducer only versions of available meters.
3) All meters will be configured to measure and record all phase quantities in all quadrants.
4) Meters will be configured so that that the recorded phases are consistent with system vectors.
5) Installed stand-alone meters will be easily upgradable so that they can be incorporated into SCADA when it becomes available at the metering point at a future time.
6) The meters will support DNP and IEC 61850 Ethernet and provide at least six analog outputs each.
7) Meters will have the ability to record waveforms of all phases at the same time.
8) Meters will read and store internally per phase: kW, kVAR, current, power factor, frequency, accumulated energy, harmonics, and recorded waveforms generated when programed limits are exceeded.
9) Meters will have the ability to be read by cellular phone.
10) Meters will have adjustable data and storage rates to allow for different levels of granularity and data intervals.
11) Meters will have the ability for live and periodic data reads to be moved into MV90 so they can be transferred into the SCHOOL PI database.

APPENDIX C – COMMUNICATIONS PLAN

Utah Innovative Technologies
Plan will be customized to each Utah Innovative Technologies project

Project Team: Chad Ambrose, Erik Anderson, Ian Andrews, Ryan Anthon, Nathan Bailey, James Campbell, James Johnson, Bob Lively, Douglas Marx, Robert Meredith, Clay Monroe, Lucky Morse, Rohit Nair

Communications Team: Barb Modey, Paul Murphy

Background:
Utah Senate Bill 115, Sustainable Transportation and Energy Plan, was signed into law March 29, 2016. The legislation establishes a 5-year pilot program to provide mandated funding for electric vehicle infrastructure and clean coal research, and authorizes funding at the commission's discretion for solar development, utility-scale battery storage, and other innovative technology, economic development and air quality initiatives.

SB 115 also authorizes the development of a renewable energy tariff for large customer loads. The legislation also allows PacifiCorp to change its accounting for energy efficiency services and programs from expense to capital and to create a regulatory liability for accelerated depreciation of its coal-fired plants. The legislation also mandates full recovery of Utah's share of PacifiCorp's prudent costs of variable energy. The UPSC previously allowed PacifiCorp to recover only 70 percent of its incremental fuel, purchased power and other variable supply costs through an energy balancing account that are not fully in base rates.

Utah Innovative Technologies (UIT) has identified the following work streams:

- **Solar Incentive:** Deployment of a solar incentive for commercial customers wherein a direct benefit to identified distribution voltage circuits can be derived. These customers will be net energy metered. This benefit is reducing the circuit peak, thereby deferring capital spend and providing a public relations benefit for continuing an incentive program

- **Centralized Battery Systems:** Use of centralized battery systems (CBS) located on identified distribution circuits or substations where in a direct benefit can be achieved. This benefit includes, through the use of solar or grid energy to charge the battery system to be dispatched during circuit peak hours to reduce load on transformer and circuit equipment. This reduction will help defer capital spend on the circuit, may provide improved power

quality and gives the utility and opportunity to understand the use of this innovative/emerging technology.

- **Special Pilot Projects:** Identification and targeting of special circumstances that require unique innovative technologies to improve circuit or substation performance. For example, the installation of high-end metering equipment with communications at locations with a high penetration of distributed energy resources. This will help the company better understand the impact of generation resources on loading patterns and other power quality and reliability impacts, if any.

The engineering team assigned to this initiative is identifying the most cost-effective and viable approach for implementation. The first year could be a battery-only option within a substation, or it may be a combination of battery and commercial customer solar incentives on specific circuits.

This communications plan focuses on the UIT initiatives within the larger STEP Communications Plan. It is intended to be a working document that will evolve as UIT initiatives change based on emerging needs, technology available and team evaluation.

Communication Objective:

To gain acceptance and understanding of the UIT project benefits and to position Rocky Mountain Power as an innovative solutions provider to integrate and provide renewable power options.

Target Audience (Stakeholders):

Regulators
Communities wherein substation metering will be installed
Regional Business managers
Opinion leaders and elected officials
Media and general public

Communication Strategy for target audience:

- Prepare communication materials that are transparent, contain clear facts, and present mutual benefits and opportunities for the identified measures on identified distribution circuits.
- Manage the conversation about why STEP funds are used for these enhancements, so we can establish the context around the benefits to all customers and to the environment, rather than the company being put on the defensive.

Core Messages:

- Rocky Mountain Power is providing options towards a sustainable energy future.
- Rocky Mountain Power's Innovative Technologies initiative will help bring renewable resources on-line where they are most needed and beneficial to the overall system. This will help hold down rates for all Utah customers by reducing the need for additional infrastructure upgrades.
- Rocky Mountain Power has identified key electrical circuits in Utah with significant distributed generation penetration and will install substation metering in order to better understand the impacts of distributed generation on the system. In addition, this understanding will greatly aid in providing customers and solar contractors with more precise distribution information upon application for interconnection.

Tactics:

Key Audience	Tactic	Timing	Responsible
Regional Business Managers	Attend regular staff meeting to **explain changes to RBMs** and answer questions about the substation metering initiative	Nov. 2016	Ambrose
Call Center Agents	Update t**alking points for agents** and net metering personnel at call center	Nov. 2016	Anderson Modey
Targeted communities	Develop a **handout/brochure** explaining the benefits of the substation metering initiative. This handout can be included with a direct mail letter and/or used in meetings.	TBD	Modey Nair Ambrose
Opinion leaders (media government officials, business leaders, community leaders)	Talking points, op-eds, news releases, fact sheets, direct contact with executives, government relations and regional business managers and external communications, **opportunities to proactively communicate the benefits of UIT**	TBD	Murphy Gravely
General public/press	Monitor social media channels for	Ongoing	Murphy

	comments and discussion on UIT		Puglia
General employees	Develop an **article for employee newsletters**, and Utah intranet postings	TBD	Zukin
Utah employees	Host a **Power Hour** in SLC about Utah Innovative Technologies	TBD	Ambrose Belmonte
Regulators	Provide timely information to regulatory bodies.	Aug/Sept.2016	Lively
General public/press	After substation metering projects have been installed; arrange to have **press release; post to website; social media**	TBD	Murphy Modey Puglia

Budget:

Allocate roughly $30,000 per year for funding to cover mailings and collateral materials, photography and other communications.

Evaluation:

- Track ability to reach customers regarding the substation metering program
- Monitor abilities of customers and Company to benefit from the program
- Track public opinion and social media activity

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