MANAGEMENT AUDIT REPORT

FINANCE, TECHNOLOGY AND SUPPLY CHAIN

SMART METER OPERATIONS AUDIT

Q2 F2019

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Prepared By:

Bridge Energy Group
P. Chang
K. Chan
P. Howard
A. Lagnado

Distributed To:

A. French	K. Morison
A. McCorquodale	L. Sawchuck
G. Doyle	K. Anderson
F. Taylor	M. Daschuk
E. Kiudorf	M. Poweska
A. Hussain	D. Wong
A. Kumar	C. O'Riley

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Legend:

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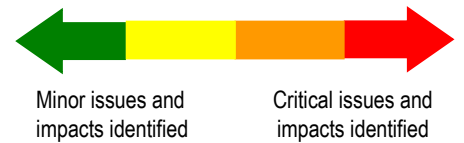
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1a.   Executive Summary

- For each audit, Audit Services provides two separate Audit Reports. The first report is a Summary Audit Report prepared for Senior Management and the Audit & Finance Committee (AFC) of the Board. This Management Audit Report provides additional information and related audit recommendations for management purposes and will not be presented to the AFC.

- Management should also refer to the Summary Audit Report for high level conclusions and findings.

1b.   Background

- In December 2015, the Smart Meter Infrastructure Project successfully implemented 1.9 million Smart Meters, supporting technology and telecommunication infrastructure. It was a benchmark in the utility industry for the speed, complexity and deployment. More than 99% of customers now have a Smart Meter to modernize BC Hydro's electric system.

- Following the implementation, a report to the BCUC concluded delivery of benefits including improved reliability, enhanced customer service, reduced electricity theft, operational efficiencies and a modernized system.

- The business component including Smart Meter Network Operations transitioned to Field Operations and Customer Service. Technical components transitioned to the Information Technology group.

    - A Final Amending Agreement was executed in February 2017 with BC Hydro and the major vendor, Itron, agreeing on remaining deliverables and negotiated amendments.

- In the fall of 2017, BC Hydro began transitioning to a Plan, Build, Operate and Support model resulting in the Smart Metering function distributed across four business groups Integrated Planning, Operations, Technology and Customer Service. Below is a simple diagram illustrating the end to end process.
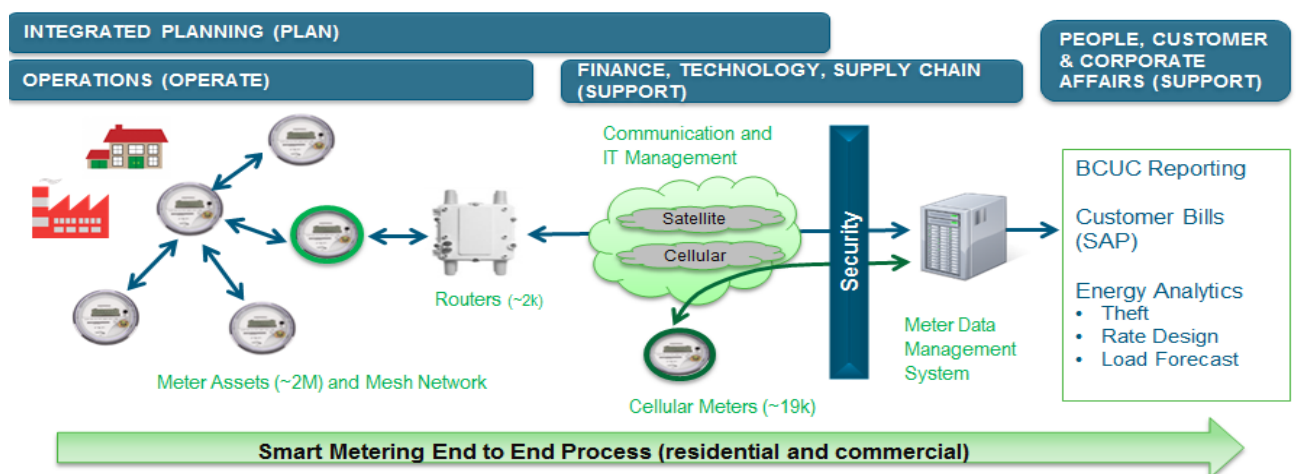
- The Smart Metering Infrastructure Project was audited in F2012 to assess project set-up and progress, and again in F2013 through the Meter-to-Bill audit. This audit reviews whether operations have been successfully embedded across the organization and operating effectively.

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1c.   Audit Objective and Scope

Objective

❑ Assess whether the Smart Meter system is fully operationalized, managed and functioning effectively.

Scope

❑ The audit included review of key elements and processes surrounding the Smart Metering system. Work focuses primarily on the following areas:

   ◆ Governance – management structure, oversight, accountability, interdependencies, and policies and procedures

   ◆ Smart Meter Operations – network performance, controls around data security, access and privacy, resourcing levels

   ◆ Monitoring and Reporting – performance metrics and reporting, leveraging collected data

❑ This audit was conducted in conformance with the International Standards for the Professional Practice of Internal Auditing.

❑ Roy Pratt (P.Eng), Chief Architect, Director of Technology Delivery at Bridge Energy Group was retained as the subject matter expert for this audit. Roy brings extensive experience in technology strategy, enterprise architecture, integration and security to utility clients, and was the subject matter expert on the F2013 Meter-to-Bill Audit.

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1d. Findings, Recommendations and Management Action Plans

Summary

The Smart Metering System is delivering intended services to the stakeholders with controls around data and application security, access and privacy. Operations are effectively governed largely due to legacy relationships from the Project and the system is well monitored.

However, executive sponsorship and strategic governance is not established to align business objectives and priorities resulting in elevated risks and missed opportunities going forward. Other areas that require attention include testing and deployment of the technology, and improved integration of meter data into the Outage Management System.

Governance

Overall Conclusion

Strategic governance is not clear or socialized across the organization. With the Smart Metering operation spanning across four business groups, prioritization and decision making occurs in isolation resulting in inconsistent objectives. There is no long term strategy to realize additional value from the investment in Smart Meters.

Effective operational governance is in place to address and prioritize tactical issues. Rights and obligations are well understood by key stakeholders largely due to legacy relationships established from the Smart Meter project.

Organization Structure

The Smart Metering end to end process is currently managed as follows:

❑ Integrated Planning: Plans and owns the meter and telecommunication assets. Revenue Metering ensures compliance with Measurement Canada requirements. Field Area Network Planning & Engineering (FP&E) manages network communications and growth.

❑ Operations: Trouble shoots and exchanges non-performing meters, and performs compliance testing on meters. Provincial Metering Operations group investigates meter issues in the field.

❑ Finance, Technology, Supply Chain: Operates the Smart Metering network, identifies non-communicating areas and conducts preliminary diagnostics, operates systems that store Smart Meter data, exercises controls over data security and access, and manages the vendor contract.

  ◆ Key business areas include: Smart Metering Network Operations (SMNO), Advanced Metering System (AMS), Integration & Information Management, and Materials Management Business Unit (MMBU).

❑ Customer Service Operations: Issues bills, resolves customer enquiries and claims, manage manual meter readers, tracks billing estimates and reports to the BCUC. The Revenue Assurance group conducts energy analytics to provide input for rate design, load forecast, financial accruals, engineering, and energy balance studies.

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Key Conclusions and Findings

Oversight

❑ With Smart Metering functions now managed across four business groups encompassing ten business units, an executive sponsor has not been identified to oversee the end to end process. As a result, there are competing priorities and no clear alignment of business objectives. This elevates the risk of inefficient and ineffective business processes. For example:

◆ Network communication targets are not aligned between business groups. The Technology group is focused on achieving a higher target to enable future capabilities while Integrated Planning is focused on expanding the network while maintaining existing targets.

◆ Various stakeholders have different expectations on the speed and extent of testing prior to deploying software changes to the production environment.

❑ The Smart Metering Management committee established in 2017, to provide management oversight, has not been fully effective. The Committee involves management from the four business groups however a mandate is not yet defined, meetings are infrequent, and the committee is not endorsed by the executives.

◆ Only two meetings have been held to review performance results and prioritize significant ongoing issues. With operations now stabilized, management has identified that further focus will be placed on oversight through the committee.

❑ Effective operational governance is in place through the Smart Metering Operations Committee established in 2017. The Committee has been more active, and stakeholders have built strong relationships to coordinate and resolve operational issues.

◆ However, a clear mandate needs to be documented to formalize the legacy relationships and facilitate the transition to new members for continuing success.

❑ It is important that the three levels of governance work in unity with clear mandates to govern the enterprise Smart Metering operation.

Long-Term Strategy

❑ A long-term strategy to realize additional value and exploit potential capabilities of Smart Metering technology has not been formulated. Executive leaders are focused on other strategic initiatives and supporting the current government mandate to improve affordability. The priority is to meet performance and functional obligations in the business case, such as outage management within allotted budget.

❑ There is an abundance of Smart Meter data stored in multiple systems, however, there is not a coordinated approach to utilize this asset. It is unclear who is responsible for leading a strategy to leverage the value from data analytics.

Resources

❑ Since transition to operations, there has been no internal or industry resource baselining. For the majority of groups, people, assets and funding appear adequate to sustain current operations but may not be sufficient for future new work.

◆ Management indicates they have the right resource levels and continue to have benchmark discussions at utility industry forums.

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- ◆ Technology teams are challenged to provide resources to regularly participate in technical reviews for new initiatives.

- ❑ Succession planning for key Smart Metering roles has not been sufficiently addressed. Individuals with Smart Metering technology skills are rare and difficult to replace. Many operating employees have significant legacy knowledge, adding to the challenge of replacing them.

- ❑ There is also a significant risk of loss of institutional knowledge with current volume of contractors across the Smart Metering process. In some areas, several contracts are expiring shortly and it is unclear if the contracts will be renewed.

Rights and Obligations

- ❑ Key stakeholders have clear understanding of their rights and obligations due to legacy relationships from the Project. A RACI chart was prepared in 2015 as the project transitioned to operations. This chart is now out of date after corporate reorganizations and staff turnovers.

  - ◆ A new set of rights and obligations based on the new corporate model is not yet developed and communicated to all groups involved. While this has not had a negative impact on operations due to experienced staff and strong working relationships, going forward there is a risk that potential gaps not identified will be overlooked by new employees.

		Recommendations	Management Action Plans
		Governance	
1	❑	Identify an executive sponsor for Smart Metering and complete development of the charters for Smart Metering Management Committee and Smart Metering Operations Committee. ◆ Clarify and align performance, goals and objectives across all business groups	❑ An Executive Sponsor and overall management lead will be identified by March 2019. ❑ The lead will re-confirm the need for and complete the committee charters by June 2019. The charters will include a mandate for all business groups involved to have clearly aligned and prioritized performance objectives and goals.
2	❑	Develop and implement a long term strategy to realize additional value from the investment, including storage and utilization of data.	❑ A long term Smart Metering strategy will be developed, along with an implementation plan, to continue realizing additional value from the investment by December 2019. ❑ All Smart Metering stakeholders will be consulted in developing the strategy.
3	❑	Develop and communicate a comprehensive Smart Metering RACI model to reflect the current organizational model. ◆ Clarify and socialize the Smart Metering handoffs amongst Plan, Build, Operate and Support team including contract management.	❑ Roles and responsibilities of all Smart Metering work groups will be developed and communicated in the form of a RACI or Rights and Obligations, including key handoff points between the various groups, by June 2019.

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	Recommendations	Management Action Plans

4	❑ Develop and implement a succession plan for key individuals and knowledge transfer options for contractors.
	
	   ◆ Baseline resource requirements once stabilization activities are complete.
	
	❑ Consider resource levels required for new initiatives.
		❑ All key Smart Metering roles will be identified and succession plans will be in place, including roles being performed by contractors, by September 2019.
		
		   ◆ Several Workforce Adjustments are currently in progress for certain critical contractor roles.
		
		❑ An overall resource baseline will be developed as a foundation for understanding resource requirements for new initiatives by September 2019.

Smart Metering Operations

Overall Conclusion

The Smart Metering System is delivering intended services to the stakeholders primarily through automated billing and advanced theft detection analysis. Controls are in place around data and application security, access and privacy.

Areas that require attention include more advanced testing and deployment of Smart Metering technology, and improved integration of meter data into the Outage Management System.

Key Conclusions and Findings

Performance

❑ The metering system continues to improve its operational performance by measures beyond those agreed in the Final Amending Agreement with Itron. The agreement defines expected performance around areas such as meter read rates and communication rates. Achievements include:

   ◆ Installation of over two million meters with less than 45 thousand still manually read.

   ◆ Registered read rate of 97.5% (July 2018). This meant BC Hydro received at least one meter read per day during July from the majority of Smart Meters which are used to bill customers.

   ◆ More accurate billing based on automated meter reads with a decreasing need for estimating customer bills.

   ◆ Advanced theft detection, from illegal grow-ops to commercial crime.

❑ A formal action plan is being developed to address outage management expectations. Smart Meter data was integrated with BC Hydro's Outage Management System but did not provide timely and accurate results to automatically generate outage tickets.

   ◆ Management's analysis identified the need for more advanced filtering of outage data. Remediation will be through corrective firmware updates and enhanced data filtering to better

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integrate the two systems. Management is developing a phased plan to improve outage management capabilities by F2020.

Key Operational Processes

❑ Formal processes are in place for key areas such as the Smart Metering network, infrastructure, applications, and meter data. Standard Operating Procedures (SOPs) are documented to define procedural requirements and posted on an internal SharePoint.

- ◆ A sample of SOPs was reviewed in detail and demonstrated a clear, thorough approach to the execution of key operational activities.

❑ An opportunity exists to clarify handoff points for some key activities, and update SOPs to account for recent organizational changes. For example:

- ◆ Management of meter configuration should be a Revenue Metering function but currently resides in SMNO due to resource and expertise constraints.

- ◆ The Itron contract is managed by several stakeholders but the asset owners have limited input or visibility into the contract.

- ◆ The installation and meter investigation process is not clearly defined and appear ad hoc. Communication of investigations is through emails between Revenue Metering and Customer Service. Often, Field Metering is not included in the beginning of the process.

Data and Application Controls

❑ Enterprise controls are in place around data and application security, access and privacy. Periodic audits are performed by Telus to ensure there is no unauthorized access and audit exception reports are reviewed by BC Hydro's IT Security and Infrastructure team.

- ◆ Security controls include automated alarming, alerting and event management by the Security Operations groups. Privacy is controlled through defined user accounts which restrict application access based on employee roles.

❑ Security and privacy policies are reviewed annually by the Cyber Security Operational Committee. Review of relevant policies and standards indicated over 80% had been reviewed within the past 18 months which is acceptable. General best practice is to review every two to three years.

- ◆ The committee, including executive and relevant stakeholders, is responsible for enterprise-wide Cybersecurity oversight and meets quarterly.

Smart Meter Technology Testing

❑ Based on recent experience, the Smart Meter technology requires a more advanced approach to testing and deployment methods to identify firmware defects and mitigate operational impacts. Optimization of the complex system is an ongoing process and a notable challenge has been firmware updates.

- ◆ Firmware is a critical component where higher-level application, communication and security software integrates with hardware devices such as meters, routers and radio.

- ◆ In some cases, there was significant pressure from business units to deploy new releases quickly to correct existing problems. An expedited firmware upgrade deployment in late 2017 resulted in broad mesh degradation which took significant effort to recover from.

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❑ The testing process has recently matured to deploy first through limited meters then progressing to larger populations more cautiously. BC Hydro has also negotiated with Itron to be included in their pre-release field trials to further improve deployment success.

System Change Process

The Change Advisory Board is a key control to ensure only valid IT changes can be implemented. The board is comprised of technical staff and key decision makers who evaluate, prioritize and authorize complex changes with higher impact and risk to the IT environment.

❑ The criteria for Smart Meter technology changes that require approval from the Change Advisory Board is not documented or well understood. In addition, the process to implement changes that do not require board approval is not defined.

◆ For example, new firmware pushes are approved by the Change Advisory Board but firmware configuration changes are not taken to the board for approval.

	Recommendations	Management Action Plans
	Smart Metering Operations	
5	❑ Ensure field trials are part of deeper testing and phased deployment process for firmware upgrades.	❑ BC Hydro will formalize the revised testing approach for participating in vendor pre-release field trials, as part of testing and phased deployment of firmware upgrades, by December 2019.
6	❑ Deliver on the phased plan to improve outage management capabilities, including automatic generation of outage tickets.	❑ Management will review the current plan to improve outage management capabilities. If appropriate (based on a cost-benefit analysis), a project or projects will be initiated to deliver phased implementation of the automatic generation of outage tickets by December 2019.
7	❑ Formalize criteria for what Smart Meter operational changes require Change Advisory Board approval. ❑ Define process and stakeholder involvement for changes not requiring Change Advisory Board approval.	❑ Formal criteria will be in place so relevant Smart Metering changes are reviewed and approved by the Change Advisory Board by June 2019.

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Monitoring and Reporting

Overall Conclusion

The Smart Metering system is well monitored at the operational level but requires enterprise level metrics to assess overall performance. Smart Meter data is leveraged formally in some cases, but many groups are just beginning to understand and develop uses for the data.

Key Conclusions and Findings

Performance Metrics

❑ Each business group has numerous processes to measure and report Smart Metering performance, but a common set of enterprise defined metrics is not available. Stakeholders do not have visibility into the overall health and performance of the Smart Metering system.

  ◆ Operational levels are monitoring many metrics originating from the Project at the granular level which are not easily understood.

  ◆ Each executive receives select metrics from the operational groups. Examples include percentage of bills issued on actual read and consecutive estimates, registered read rate, average communication rate and timeliness of meters exchanges.

❑ Opportunities exist to better document the process to generate performance results. Some dashboards have substantial automation behind them. However in many cases, calculating the metric involves a key person performing manual steps from several data sources. It would be difficult for new staff to replicate the process and results without guidance.

  ◆ A data dictionary is not in place for most dashboards to define the metrics, identify data sources and frequency of calculation.

  ◆ Testing identified that results for two metrics related to "Consecutive SAP estimates" and "Number of legacy meters" were reported inconsistently on two different dashboards.

Leveraging Smart Meter Data

❑ Leveraging the Smart Meter data to optimize operations and customer experience is a high-value opportunity for BC Hydro. Many groups are just beginning to understand and develop uses for the data.

  ◆ The data is leveraged formally in instances such as customer billing and analytics, interval data for rate and program design, alarms and alerts for revenue assurance and voltage profile data for distribution work planning.

  ◆ In other cases, data analysis is ad hoc or on demand with opportunities to formalize and share the data across the organization.

❑ Separate business groups respond to many internal ad hoc data requests without consulting other groups. Steps are not taken to capitalize on results of individual queries and analysis to detect similar situations in the system. Inquiries typically relate to meter or service issues and unusual feeder, transformer or substation distribution grid issues.

  ◆ There are continuous monitoring opportunities which are not being applied.

❑ Other key uses to explore for Smart Meter data include:

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- ◆ Data remains largely untapped to support Asset Analytics and Asset Management

- ◆ Leveraging data to augment outage planning, outage management, switching and loading (grid management)

- ◆ Data for reliability indices calculation based on point-of-use statistics instead of generalized feeder-level estimation

- ◆ Ability for Customer Service Representatives to ping a meter to support analysis and generate more accurate work orders which is a common function for most North American utilities.

		Recommendations		Management Action Plans
		Monitoring and Reporting		
8	❑	Executive sponsor to drive top-down common Smart Meter KPI's and Metrics across the organization	❑	A set of common Smart Metering metrics will be in place for September 2019. The executive sponsor will review and approve these metrics.
9	❑	Formalize (automate where possible) operational metrics and reporting	❑	Operational Smart Metering metrics will be coordinated with enterprise level metrics. The metrics and reporting will be formalized and automated where possible by September 2019.
10	❑	Establish a vetting and communication process to leverage Smart Meter data to a wider audience for decision making and operational benefits.	❑	A process will be in place to leverage Smart Meter data for decision making and operational benefits by December 2019.