Q. Does the System Control Center ("SCC") have any form of an Energy Management System (EMS)? If Newfoundland Power does not have an EMS system, explain why not, and explain how the SCC predicts transmission loading issues during short-term peak demand conditions or when the system line outages occur either by failures or for maintenance work? How is system frequency monitored? If Newfoundland Power has an Energy Management System (EMS), please describe it. Is it a third party system, or developed within Newfoundland Power? If a third party system, please identify the system's name and vendor. Does Newfoundland Power have a maintenance agreement with the vendor for ongoing support and maintenance? When was the system installed? When was the most recent upgrade? Does Newfoundland Power have any plans to change or install an EMS system?

A. Energy Management Systems ("EMS") are advanced power system applications operating on top of a supervisory control and data acquisition ("SCADA") platform to monitor, control and optimize the performance of generators and transmission networks. Typical EMS applications include automatic generation control, unit commitment, state estimator, online 3-phase load flow, load forecasting and a dispatcher training simulator.[1]

Newfoundland and Labrador Hydro's Energy Control Centre ("ECC") operates an EMS that monitors and controls Hydro's bulk generation and transmission systems. The ECC's primary functions are the economic dispatch of generation and ensuring the balance of electrical system supply and demand for the Island Interconnected System.[2]

Newfoundland Power does not have an EMS. The Company monitors and controls its generation, transmission, substation and distribution assets using a SCADA system. The SCADA system has custom applications that support the Company's small hydro plants and distribution system. These include an automatic generation control application and an under-frequency load shedding application.[3] In addition, planning engineers and technologists support SCC operations in the prediction of transmission loading issues through the use of their load flow and power system analysis applications.[4]

The EMS in Hydro's ECC is linked to the SCADA system in Newfoundland Power's SCC. This link provides each utility with near real time information concerning each other's electrical operations on the Island Interconnected System. Communication and

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[1] EMS applications are necessary to support the bulk transmission system and large generators that are necessary to maintain power system stability and security.

[2] Newfoundland and Labrador Hydro ("Hydro") is primarily responsible for the availability of generation to meet the demand and energy requirements of electricity customers on the Island Interconnected System. Newfoundland Power is responsible for the availability of its generation resources which includes approximately 97.5 MW of hydroelectric generation and approximately 41.5 MW of thermal generation, representing less than 10% of the available generation resources on the Island Interconnected System.

[3] Use of the automatic generation control application has been reduced over time as the Company has refurbished its hydro plants including a water management algorithm in the plant programmable logic controllers.

[4] See the response to Request for Information PUB-NP-266.

coordination between Newfoundland Power's SCC and Hydro's ECC is continuous and is the central feature of daily operational coordination on the Island Interconnected System.[5] This ensures that routine daily electrical system operations such as generation dispatch and switching procedures are performed on a safe and reliable basis.

System frequency is monitored by the SCC operators on the Company's SCADA system display screens. This provides the operators with another data point related to the system conditions and can be trended over time for analysis. System frequency is also displayed by the under-frequency load shedding application used by the SCC operators to restore the electricity system following an under-frequency event.[6] Frequency signals are provided from analog transducers, programmable relays and 3-phase power meters installed at most substations and hydro plants.

In its 2015 Capital Budget Application the Company has included a 2-year project to replace its existing SCADA system. The new system will be capable of advanced distribution management functions including interfaces with a Geographic Information System and to a commercial Outage Management System. The Company does not foresee the need to include EMS applications with the replacement SCADA system. A copy of the 2015 Capital Budget Application report *SCADA System Replacement June 2014* is included as Attachment A to this response to Request for Information PUB-NP-257.

[5] See the response to Request for Information PUB-NP-002 for more information on the daily operational coordination between Newfoundland Power's SCC and Hydro's ECC.

[6] See the response to Request for Information PUB-NP-248 for more information on the under-frequency load shedding application.

SCADA System Replacement
June 2014

SCADA System Replacement

June 2014

Prepared by:

Jack Casey, P.Eng.

NEWFOUNDLAND POWER
A FORTIS COMPANY

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1.0 Introduction

The Newfoundland Power's (the "Company") Supervisory Control and Data Acquisition ("SCADA") System is used by the System Control Centre ("SCC") operators to remotely monitor and control the Company's electricity system.[1] The SCADA system is a critical operational technology necessary to provide reliable least cost service to customers. The replacement of the SCADA System is being undertaken at this time due to the technical obsolescence of the operating system and server hardware platform on which the SCADA application operates. In addition, the SCADA vendor has replaced the application with another product thereby limiting the support available for the current technology. The SCADA application, operating systems and server hardware components are tightly integrated and highly dependent on each other.

The current SCADA system was originally installed in 1999.[2] The server hardware platform for the SCADA system is the Hewlett Packard ("HP") Alpha.[3] The SCADA system's operating system, referred to by the trade name Tru64, is no longer supported by the vendor.[4] The Company has maintained an annual hardware service and support agreement with HP since system installation in 1999. This existing support arrangement will be in place until 2016. However continuing without an extended hardware support and maintenance agreement beyond 2016 for this critical application presents an unacceptable risk to Company operations.[5]

In response to the onset of technical obsolescence of the operating system and server hardware the vendor released a new generation SCADA system referred to as the DNA system. The upgrade path for the existing system to the new DNA system involves the replacement of the SCADA application along with the operating system and server hardware components.[6] The SCADA system is a fully integrated solution, and changing any of the 3 major components requires the remaining components to be upgraded or replaced simultaneously. The requirement to replace all 3 components of the system presents the opportunity for the Company to consider replacing the existing SCADA systems with alternatives supplied by other vendors, ensuring provision of reliable service at least cost.

The Company engaged the services of Quatric Solutions Inc. of Montreal, Quebec (the "SCADA Consultant") to provide engineering expertise for the replacement project. The SCADA Consultant has prepared a detailed report on the SCADA replacement project that is included as Appendix C. In completing this report the SCADA Consultant developed a preliminary

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1 The SCADA system remotely monitors and controls 71 substations, 25 hydro generators, 2 gas turbines, 187 distribution feeders and 78 power transformers. In total there are approximately 40,000 individual data points monitored and controlled through the SCADA system.

2 According to Gartner, shared servers have an average service life of 5 years. Gartner, Inc. is a leading information technology research and advisory company with experience in SCADA systems.

3 HP Alpha is a server platform that supports applications that operate on the OpenVMS and Tru64 operating systems. HP discontinued manufacturing Alphas in 2007.

4 Tru64 is a Unix-based operating system developed by HP and is no longer supported for security updates.

5 Security and integrity of the Company's SCADA system must be maintained to ensure normal operations and effective electricity system control. Moving the SCADA application to a fully supported hardware platform and operating system is a critical component to sustaining a secure application.

6 The existing SCADA system also has a number of custom applications that would need to be redeveloped to function with the new DNA system.

functional specification upon which selected vendors have provided budgetary estimates in response to a request for information. In addition, the SCADA Consultant has worked with Newfoundland Power to develop a detailed project scope upon which internal labour and engineering cost estimates have been prepared.

The Company proposes to replace the SCADA system as a multi-year project starting in 2015. The project will be completed in 2 years at an estimated cost of approximately $5.7 million. The project will involve the acquisition, installation, configuration, testing and deployment of an upgraded SCADA application to ensure the system continues to support Company operations. This includes the conversion and migration of SCADA components such as databases, operator displays, reporting environment and custom applications to the new platform.[7]

2.0 Background

SCADA systems are a category of software application program that monitors and controls the electricity system through the gathering of data in real time from remote locations such as hydro plants and substations. SCADA systems include hardware and software components. The hardware gathers and feeds data into computers that have the SCADA software installed. The computer then processes this data and quickly presents it to the operators. SCADA systems also record and log all events into an application referred to as a historian for both the instantaneous presentation to the operators and for post event analysis by engineering staff. The SCADA system warns the operators when conditions become hazardous through visual changes of state on computer displays and by sounding alarms.

In 1984 Newfoundland Power installed its first SCADA system. The original Automatec SCADA system operated for a 15 year in-service life. In 1999 the Company completed a project to replace the original Automatec SCADA system by an earlier version of the current Schneider/Telvent OASyS™ SCADA system.[8] An upgrade of the 1999 SCADA technology took place in 2004 with the upgrading of the operating system and the real-time server hardware.[9]

The OASyS™ SCADA system installed in 1999 enhanced the Company's ability to monitor and control the electricity system. Since that time the Company has invested in advanced communication infrastructure, including intelligent electronic devices on distribution feeders, transmission lines, along with equipment in substations and hydro plants, including:

- Substation gateway computers
- Digital protective relays

[7] SCADA reporting environment is an application that extracts electricity system data from the SCADA application and creates a version of the SCADA database on the Company's business network. This design ensures that the security of the SCADA application is not compromised while making the necessary information available to other Company employees. Advanced applications include applications such as historical data archiving, under-frequency load shed applications, working alone application and group control application.

[8] In addition to having reached the end of its service life in 1999, the original SCADA system was not Year 2000 compliant which necessitated its replacement at that time.

[9] The capital cost associated with the 1999 OASyS™ SCADA system installation was $3.7 million. The cost to upgrade the OASyS™ SCADA system in 2004 was $1.2 million.

- Digital power meters
- Intelligent feeder reclosers
- Digital under frequency load shedding relays
- Digital tap changer controllers
- Programmable logic controllers for plant control and governors

These intelligent electronic devices collect information at the distribution feeder and transmission line level, including detailed information on the actual cause of electricity system events which result in customer outages. This advancement in technology has allowed the Company to respond more effectively to customer outages and has contributed to the improvement in overall distribution reliability performance over the past decade.

Schneider, the current SCADA system vendor, has had a new generation of SCADA system products available since 2009 referred to as the DNA system that runs on a different operating system and server hardware platform.[10] Standard support for the SCADA Tru64 UNIX operating system ended on December 31st, 2012. Alpha server hardware has not been manufactured since 2007. The vendor of the hardware has made a commitment to provide minimum support for both of these legacy systems until the end of 2016.[11] Since 2009 most utilities operating OASyS™ SCADA systems have migrated to either the DNA system or SCADA systems provided by other vendors.

Table 1 provides information for 46 Schneider SCADA customers with respect to replacement activities for the OASyS™ SCADA system.[12]

Table 1
Survey of OASyS™ SCADA Customers[13]

Customers that have migrated to the DNA SCADA technology	30
Customers migrating to the DNA SCADA technology in 2013	5
Customers that plan to migrate to the DNA SCADA technology	8
Customers that remain undecided	3

Based on the data provided in Table 1, 43 of 46 utilities have already initiated actions to address the migration of their SCADA systems from the unsupported technology to the new platform.

10 This was primarily due to industry changes on hardware and software platforms moving away from Alpha hardware and Tru64 operating systems technologies to x86 and Windows technologies.

11 Industry research suggests that enterprise server hardware should be refreshed at every 5 years, though Newfoundland Power’s experience trends towards the 7 year average for enterprise server replacement. In 2016 the SCADA server hardware will have been in service for 12 years.

12 This data does not include former customers that replaced their OASyS™ systems with SCADA systems supplied by other vendors.

13 Appendix B contains a letter from Schneider providing the information summarized in Table 1.

3.0 SCADA System Replacement Strategy

Technical obsolescence is driving the need to replace the existing OASyS™ SCADA system. The industry has substantially moved away from the OASyS™ SCADA system currently used by the Company, and as time progresses the amount of support available to Newfoundland Power will diminish.

The transition from the existing OASyS™ SCADA system to the updated DNA SCADA system would involve more than replacement of the SCADA application, operating systems and server hardware components. There will be additional work associated with the migration of the actual electricity system database, operator displays and custom applications.[14] As a result the effort and cost associated with upgrading within the Schneider family of SCADA products is comparable to moving to another SCADA vendor's product. This provides Newfoundland Power with the opportunity to go to market for a replacement SCADA system ensuring that competitive market forces will determine the least cost replacement alternative.[15]

In 2015 Newfoundland Power will solicit requests for proposal from qualified SCADA vendors for the replacement of the existing SCADA application, operating systems and server hardware. All existing functionality will be maintained with the exception of automatic generation control and the replacement of the large mimic display monitors.[16] System improvements will involve a fully functioning historian, security upgrades, interfaces to geographic information systems and outage management systems, alarm storm suppression, encryption of the Inter-Control Centre Protocol ("ICCP") link to Hydro and the automation of the operators' diary.[17]

The scope of work for the SCADA system replacement will ensure the transition from the existing technology to the new technology is seamless. The Company's engineers and technicians will work with the vendor to transfer the point database to the new technology. The point database includes all quantities and status information for devices in the electricity system. These may be as simple as the open or closed status of a transmission line breaker, or more complex such as the calculation of MVA load of a power transformer that does not have a real-time telemetry reading associated with it. In total the existing SCADA system has a point database that includes approximately 40,000 items. Similarly, the creation of the new operator displays will involve working with the vendor in display building, verification and testing.

When the vendor's standard system has been customized with Newfoundland Power's point database and displays, the transition from the existing SCADA system to the replacement system can commence. This will involve operating the existing system and the replacement system in parallel for a period of time. During this transition period the electricity system will be

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[14] These custom applications include automatic generation control, under-frequency load shedding and working alone.

[15] Budgetary quotes provided by vendors in response to a request for information issued by the SCADA Consultant suggest that other vendors will be very competitive in pricing compared to the cost of remaining with the existing vendor.

[16] Appendix C includes a functional specification for the replacement SCADA system that describes existing functionality that will be maintained.

[17] The fully functioning historian is an application that archives the real-time data from the electricity system for review following significant events. Appendix C includes a functional specification for the new functionality.

monitored closely to ensure that the integrity of the monitoring and control is not compromised during and after the transition period.

In addition to the actual customization of the system to monitor and control the Newfoundland electricity system, the project will include technical training for the Company's engineers, information technology staff, technicians and power system operators. There will also be some modernization required for the SCC control and computer rooms to accommodate the new technology. This will include desks, computers and displays for the SCADA operators and computer racks to house the SCADA system hardware.[18]

Initially there will be no requirement for the replacement system to provide advanced applications beyond the system improvements stated above.[19] The replacement SCADA system is anticipated to have an in-service life of approximately 15 years, consistent with the Company's experience with its initial 2 generations of SCADA technology. Throughout this 15 year life it is likely that the Company will deploy other operational technologies that improve electricity distribution system operations. The operational technologies that may be integrated with the replacement SCADA system include geographic information systems, outage management systems, work force management systems, automated meter reading and customer service systems. Integrating these technologies with the SCADA system has the potential to improve the Company's ability to serve its customers.

4.0 Project Description

The project involves replacement of the existing SCADA application, operating system and server hardware. All existing functionality will be maintained and some system improvements such as a fully functioning historian, security upgrades, alarm storm suppression, encryption of the ICCP link to Hydro and the automation of the operators' diary will be included. The new system will also have the ability to interface with geographic information systems, outage management systems, and other operational technologies. The Company will work with the vendor to customize a standard product offering to interface with Newfoundland Power's electricity system. Included in the SCADA replacement project are the following items:

i. Engineering design and preparation of the technical specifications
ii. Request for Proposals for the replacement SCADA system
iii. Contract award to successful vendor
iv. Purchase and install new server and workstation computers
v. Migration of SCADA database
vi. Migration of SCADA displays
vii. Testing and commissioning of SCADA system migration
viii. Training
ix. Installation of system onsite at the SCC
x. Transition to new SCADA system

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18 Recent capital projects to upgrade the SCC's standby emergency power and uninterruptible power supply will continue to be used with the replacement SCADA system.

19 The vendors will be prequalified to ensure their technology integrates with commercial Distribution Management Systems (DMS), Geographic Information Systems (GIS), and Outage Management Systems (OMS).

xi. Testing and commissioning of interface between new SCADA system and field devices

5.0 Project Execution

SCADA replacement project is a multi-year project scheduled to begin in 2015 with a 2 year duration. It is estimated that it will take approximately 8 months to prepare the technical specification, prepare the Request for Proposals, and ultimately select the vendor for the replacement SCADA system. It is estimated that the development of the system, training, testing, system integration and final cutover will take another 14 months. Starting the project in the 1st quarter of 2015 will ensure the new SCADA system is operational in the 3rd quarter of 2016. A detailed project schedule including information on the various resources needed throughout can be found on pages 4-36 through 4-38 of the *SCADA System Replacement Study* included as Appendix C. The project schedule is summarized below in Figure 1.

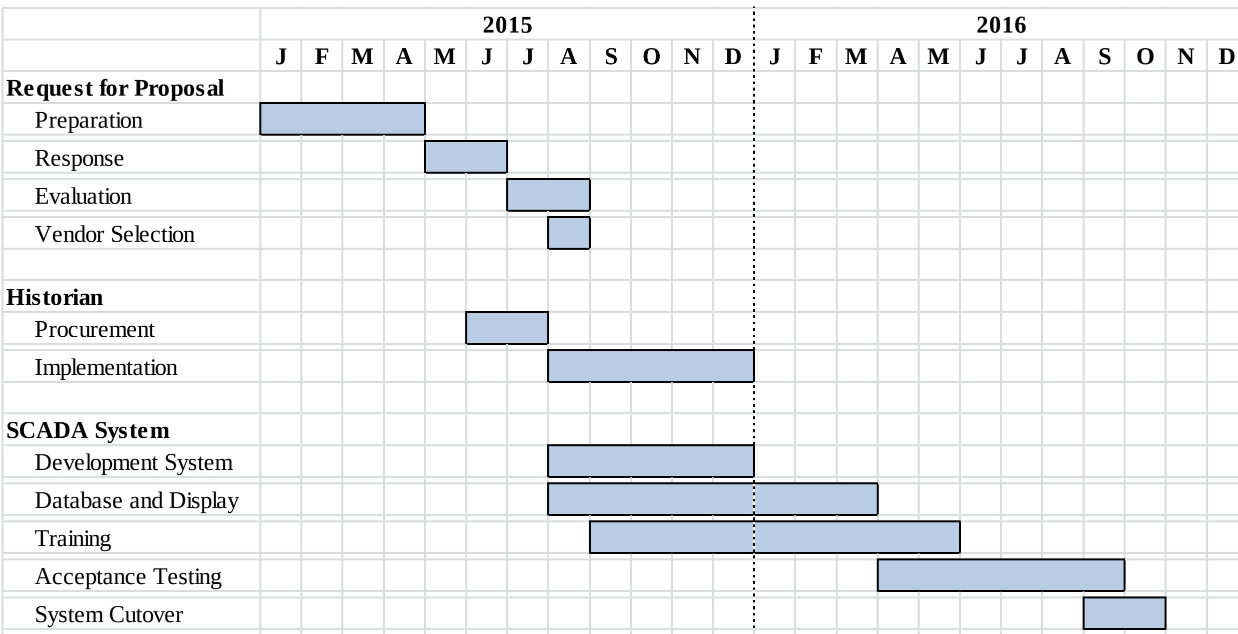

Figure 1 – Project Schedule

6.0 Project Cost Estimate

The estimate to complete all work associated with the SCADA Replacement Project is $5,675,000. Table 2 provides a detailed breakdown of the total project cost by year.

Table 2
Project Cost

Description	**2015**	**2016**
Material	$2,338,000	$2,309,000
Internal Labour	158,000	156,000
Engineering	294,000	332,000
Other	43,000	45,000
Total	**$2,833,000**	**$2,842,000**

7.0 Conclusion

The SCADA system's operating system, hardware platform and application software is no longer supported by the vendor. In response to the onset of technical obsolescence the vendor has released a new generation SCADA technology. Most of the utilities that operated SCADA technology similar to Newfoundland Power have either upgraded to the latest product available from the vendor, or moved to another vendor's SCADA system.

In 2015/2016 the Company will replace its existing SCADA application, operating system and server hardware. All existing functionality will be maintained along with some system improvements and the capability to interface with modern operational technologies such as GIS and outage management systems. Integrating these modern operational technologies with the SCADA system will improve the Company's ability to serve its customers.

Appendix A
Notice from Server and Operating System Manufacturer

United States-English

» HP Home | » Products & Services | » Support & Drivers | » Solutions | » How to Buy

» Contact HP

Search: Alpha systems / All of HP

Servers > Alpha systems

HP Alpha systems

» Servers home
- » HP AlphaServer GS and SC systems (high end)
- » HP AlphaServer ES systems (mid-range)
- » HP AlphaServer DS systems (entry level)
- » **HP AlphaServer systems**

Evolving business value
- » Alpha RetainTrust Program

News
- » Announcements
- » News
- » Newsletters

AlphaServer systems
- » Compare servers
- » Performance
- » Options
- » Documentation and literature
- » Firmware
- » Retired systems
- » Storage products
- » Networking products
- » High availability clustering
- » Server management

How to buy
- » Extended Life products/HP Renew
- » Buying assistance
- » Configuration tools
- » Trade in (EMEA)
- » Trade in (North America)
- » Download HP software

Alpha solutions
- » Software
- » Solutions
- » Support
- » Services
- » Storage

- » AlphaServer roadmaps
- » AlphaServer brochure
- » Technical support
- » Alpha RetainTrust

HP AlphaServer systems with enterprise-class operating system choices of OpenVMS and Tru64 UNIX® continue to offer rock-solid reliability, application availability and performance, simplified management and flexibility. HP proudly supplied AlphaServer systems to leading business, education and government enterprises around the globe from 1992 until 2007. HP will continue to offer Service for Alpha Systems to assure reliable operation for many more years. The Alpha Retain Trust website has procedures, tools, and information about HP Services available to ease the transition from Alpha systems to other HP products.

I want to personally thank you for 15 years of loyal patronage; Ann McQuaid, General Manager, Alpha Systems Division.

News and features

October 2008: AlphaServers are still available within HP as Extended Life Products. Factory-Refurbished Systems and Options with Full Warranty are available through the HP Renew Program in EMEA, AP, and Japan, and available through Technology Value Solutions in the Americas. HP will now offer service (maintenance, repair, and advisory) for all currently selling Alpha Systems for a "minimum" of five years after last new system shipment, (or at least through 2013).

May 2007 and updated Jan 2011: HP has ceased accepting orders for new Alpha Systems as of July 25, 2008. HP will continue to offer factory-refurbished systems and options through the Technology Value Solutions (TVS) in all regions as material is available. HP will offer service (maintenance, repair, and advisory) for all shipping Alpha Systems as of July, 2008 for a minimum of five years after last system shipment, or at least through 2013. Typically, HP offers services much longer than the five year minimum commitment. HP still offers service on all Alpha Systems shipped since their original introduction in 1992.

» February 2007: Oracle E-Business Suite R12 shipped for HP-UX on Integrity at the end of January. HP encourages customers using Oracle E-Business Suite for Tru64 UNIX on Alpha to start moving their business applications to the HP-UX/Integrity platform for capacity expansion and new installations.

» December 2006: Oracle delivers Database 10g Release 2 for OpenVMS on Alpha. HP customers can now install Database 10g Release 2 on both OpenVMS for Integrity and Alpha, as well as Tru64 UNIX on Alpha and HP-UX for Integrity. With the up-to-date Release 2 for all operating systems on both Alpha and Integrity, Oracle Database users can more easily plan migration of their data from Alpha to Integrity systems.

» September 2006: HP OpenVMS version 8.3 is now available providing support for the latest line of HP Integrity servers and AlphaServer systems. OpenVMS version 8.3 delivers even greater flexibility, investment protection, lower total cost of ownership (TCO), and additional virtualization capabilities for HP Integrity servers

» January 2006: For TruCluster Server users - Symantec VERITAS cluster file system integrated HP Serviceguard clusters; shipping now for HP-UX 11i on Integrity servers

» High-end servers | » Mid-range servers | » Entry-level servers

HP Tru64 UNIX Alpha Lifecycle Chart

This chart provides notification of Tru64 UNIX discontinuance.

End of Sale: 1-October-2012

The Tru64 UNIX Operating System and Layered Products will be removed from the HP Corporate Price List (CPL) as of 31-October-2012. Many of the licenses will continue to be available for purchase through HP Financial Service with remarketed AlphaServers or sold separately.

End of Standard Support: 31-December-2012

Tru64 UNIX Standard Support will end on December 31, 2012. After December 31, 2012, customers needing continued support have two options:

(1) Purchase Mature Product Support without Sustaining Engineering (MPS w/o SE) and receive HP Technology Services support (telephone support plus existing patches). MPS is "without Sustaining Engineering Support" which means MPS w/o SE does *not* include new fixes. Under MPS w/o SE, patches for known problems are available; however, no new patches will be created.

(2) Purchase MPS w/o SE plus Tru64 UNIX Extended Engineering Support (EES) and receive all of the above support ***plus new fixes***. EES includes Sustaining Engineering and provision of new corrections. Advance notice of EES purchase is needed in order to plan EES resources. Tru64 UNIX Engineering will work to accommodate all EES requests.

SKU	SKU Description	Comment
	Media	
QA-054JA-H8	DIGITAL SW CDROM LIB/OSF1	*Not all media is available.*
QA-6ADAA-H8	Tru64 UNIX CDROM KIT	
QA-0AFAA-H8	Digl Open3D U/A CDRM KIT	
QA-20YAA-H8	MMS RT U/A CDRM KIT	
QA-30CAA-H8	DECSNA APPC/LU6.2 RT OSF/1	
QA-4KN8A-A8	SW LP LIB U/A CDRM/NO DOC	
QA-MT4AA-H8	Tru64 UNIX Alpha Cdrom	
QA-MT4AQ-H8	Tru64 UNIX Alpha V3 CDRM KIT	
QA-MT4AX-H8	Tru64 UNIX Alpha New HW CD	
QA-MT5AA-H8	DEV TOOLKIT U/A CDRM KIT	

Appendix B
Survey of Schneider Customers

Schneider Electric

October 7, 2013

Chris Wells
Newfoundland Power Inc.
50 Duffy Place
St. John's, NL A1B 4M5

RE: OASyS SCADA Upgrade Information

Chris,

Based on our discussion regarding the number of OASyS customers running on the latest Versions of software, I have compiled the following;

30 customers running DNA 7.4 or 7.5

5 customers upgrading now or just completing an upgrade this year – this is a mix of customers who upgraded from 6.XX or who decided to upgrade from 7.4 to 7.5

8 Budgeting to upgrade in 2014 or 2015 from 6.XX to DNA 7.5, including Newfoundland Power.

3 undecided but thinking about it, along with a few other very old pre OASyS systems upgrading in the future.

All of these are electric utility customers in North America and The Caribbean. We have many more OASyS systems in Europe, South America , Asia and Mexico along with other industries such as Oil and Gas, Water - Waste Water, and Transit in similar situations for upgrading.

I trust this is the information you require, please let me know if there is anything else I can help you with.

I look forward to hearing from you to assist with your future SCADA needs.

Very truly yours,

Mark Atchley
(713) 416-8059
Mark.atchley@Telvent.com

Appendix C
SCADA System Replacement Study
April 16, 2014

QUATRIC

Newfoundland Power
SCADA System Replacement Study

NEWFOUNDLAND POWER
A FORTIS COMPANY

April 16, 2014

Presented to:

Jack Casey
Newfoundland Power
Senior Engineer
Ref. 09-058T

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Document Control

Revision	Date of Issue	Author(s)	Brief Description of Change
1.0	16-Apr-2014	Ian MacCuaig	First release.
1.1	16-Apr-2014	Ian MacCuaig	Minor corrections.

Statement of Confidentiality & Non-Disclosure

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1 Executive Summary

1.1 Background

Newfoundland Power Inc., hereafter referred to as the “Owner”, operates an integrated generation, transmission and distribution system throughout the island portion of Newfoundland and Labrador. The Owner services approximately 86% of all electricity consumers in the province, including the Avalon, Burin and Bonavista Peninsulas and the major centres along the Trans-Canada Highway, including: Gander, Grand Falls-Windsor, Corner Brook, Stephenville, and Port aux Basques. The Owner does not service the Great Northern Peninsula, smaller communities along the coastline, and Labrador; these areas are serviced by Newfoundland and Labrador Hydro.

For over 125 years, the Owner has provided customers with safe, reliable electricity in the most cost-efficient manner possible. The Owner purchases approximately 93% of its electricity from the Crown corporation, Newfoundland and Labrador Hydro (“NL Hydro”), and generates the balance from its own smaller hydroelectric stations. The Owner’s electric system is comprised of approximately:

- 252,000 customers.
- 23 hydro generating plants (32 generators) run of river under 11MW, three diesel plants (2.5MW) and three gas turbine (25, 15, 7 MW) facilities.
- 130 substations (primarily 138 kV and 66 kV).
- 11,000 km of transmission and distribution lines.
- total assets valued at over $1 billion.

The Owner currently operates a Schneider Electric (formerly Telvent), hereinafter referred to as “Current Vendor”, OASyS SCADA System to monitor and control its generation, transmission and distribution system. Initially commissioned in 1999, the system has now reached the end of its service life and needs to be replaced. As a result, the Owner plans to include a capital budget request in its 2015 Capital Budget Application to the Newfoundland and Labrador Board of Commissioners of Public Utilities for a SCADA Replacement Project.

In March 2014, the Owner retained the services of Quatric Solutions Inc. (“QUATRIC”) to act as the Owner’s Consultant, hereafter referred to as the “Consultant”, to perform an assessment of the current SCADA system and evaluate strategies for replacing the existing SCADA system. This report documents the Consultant’s findings, recommended replacement strategy, project timeline, budgetary cost estimates, and recommended next steps.

1.2 Current System Assessment

The current SCADA System was commissioned in 1999 and is based on HP Alpha servers running the TRU64 UNIX operating system, and Intel-based workstations running the Windows operating system. No hardware or software upgrades have been performed on the SCADA system since 2006 and as a result the current SCADA platform is outdated, expensive to support, and failing to meet current organizational requirements. In particular, the following issues were identified:

1) **SCADA Servers:** The HP Alpha servers are now obsolete (discontinued), and spare parts are increasingly difficult to source. Now averaging more than 11 years old, the failure rate of critical server components, such as disk and memory, is expected to accelerate over the next few years.

2) **Operating System:** The TRU64 UNIX operating system was discontinued by HP and is no longer supported by HP. As a result, HP no longer provides operating system patches to correct known issues, including cyber security issues. As a result, it is not possible to follow industry best practices for cyber security while continuing to use this obsolete operating system.

3) **SCADA Software:** The OASyS DNA V6.3 SCADA software currently being used is now obsolete. The Current Vendor has replaced this product with a modern software architecture based on hardware-independent operating systems such as Linux and/or Windows. In addition, many of the core features of the current system, such as AutoCAD display editor, are no longer supported in the latest product from the Current Vendor. This has several implications:

   a) The Current Vendor cannot provide a simple upgrade to its latest product; "upgrading" to the latest version of the product requires a complete system replacement and re-development of the custom applications.

   b) The Owner must pay escalating maintenance costs for its obsolete SCADA software. Although technical support from the Current Vendor has rarely been an issue, maintenance costs have recently escalated and it is anticipated that the Current Vendor will find it increasingly difficult to maintain resources with knowledge of the current SCADA system over time.

4) **Customized Applications:** The current SCADA system includes a number of customized applications that may be difficult to replicate in a commercial, off-the-shelf SCADA product. As a result, some software developments may be required for some critical applications such as control windows and under-frequency load shedding.

5) **Historical Data:** The current use of SCADA historical data on the Corporate network is inflexible and the archive database has limited query accessibility, making it difficult for corporate users to extract the information required. In addition, since only summarized data is stored long-term, data is not always available to the level of detail required.

6) **Web Interface:** The current SCADA system provides web access for up to 20 Corporate users to view near-real-time SCADA displays, with access being granted on a first-come-first-serve basis. This constraint has prevented some corporate users, including senior management, from accessing the SCADA system displays during critical events. In addition, the web interface only runs on an obsolete, unsupported version of the web browser (Internet Explorer 7 or earlier).

7) **Control Room**: The control room work stations are positioned to face a large-screen display along the front wall. This display is no longer functional, and the Owner has acknowledged that it is no longer needed. As a result, the large screen display is occupying valuable real-estate within the control room, and the positioning of the work stations may not be optimal for day-to-day operations at the System Control Center.

1.3 SCADA Replacement Strategy

The primary objective of the SCADA System Replacement project is to update the SCADA System to a supported hardware and software environment with minimal business disruption, while at the same time improving the flow of critical power system static and historical data essential for power system analysis and information dissemination to the organization.

For the existing SCADA system, the Current Vendor cannot provide a simple upgrade to its latest product; “upgrading” to the latest version of the product requires a complete product replacement and re-development of the custom applications. As a result, the level of effort, costs, and risks with an “upgrade” will be equivalent to a product replacement from any competing vendor. In fact, of the three budgetary quotations received for the SCADA System Replacement, the budgetary quote from the Current Vendor was the most expensive. As such, an open bid process should be technically and commercially more advantageous for the Owner rather than negotiating a sole-source contract with the Current Vendor.

The SCADA Replacement Project has been divided into the following major components:

1) **SCADA System Replacement**: This component is divided into a Request for Proposals phase, followed by the project implementation phase. The Owner will need to prepare a detailed technical and commercial specification, identify qualified vendors, issue a Request for Proposals, evaluate proposal responses, perform site visits for due diligence, then negotiate a statement of work and commercial contract with the selected vendor. The general objectives of the SCADA System Replacement are to:

   a) Deliver reductions in the cost of purchasing and maintaining the SCADA hardware. Moving off the HP Alpha Server platform will ensure utilization of lower cost server hardware that is independent of the operating system and SCADA software product. The project will also deliver the opportunity to migrate to the Windows Server operating system, reducing the number of technologies that the organization will need to support, and with trained resources readily available in the marketplace.

   b) Deliver reductions in the total cost of ownership of the SCADA system. Moving to the latest version of a commercial SCADA product, and keeping current with the selected Vendor’s maintenance program, will allow the Owner to stay current with product releases and leverage product improvements financed by the selected Vendor’s user community.

   c) Provide the ability to better secure the functions performed by the SCADA system, following industry best practices, by way of integration of anti-virus, centralized account management, and patch management.

d) Provide modern, best-of-breed tools for the System Operators and support staff to allow them to continue to reliably monitor and control the Owner's generation, transmission and distribution system. This includes preserving, and possibly enhancing, some of the customizations performed on the current SCADA system, such as control windows and under-frequency load shedding.

e) Facilitate the future integration with the Outage Management System. The Owner plans to implement a commercial Outage Management System in the next 3-5 years. As such, the replacement strategy for the SCADA system should take this into consideration and ensure that the SCADA system selected follows industry standards for system integration (e.g. OPC, Multispeak, etc.) and includes the tools needed to easily integrate with a future OMS. The Owner should also evaluate the selected SCADA vendor's OMS product, if any.

2) **Commercial Historian:** The Owner should consider deploying a commercial historian in order to address the issues with historical data storage, analysis, and reporting. With the success of commercial historian products such as OSIsoft PI, SCADA vendors have invested very little research and development effort to improve their native historians, and as such the functionality and performance offered by commercial historians is far superior to native SCADA historians. A commercial historian would improve the flow of critical power system static and historical data essential for power system analysis and information dissemination to the organization, resulting in lower operating costs and improvements in productivity.

3) **Control Room Refurbishment:** Now that the large screen display at the front of the Control Room is no longer functional, there is no need for the operator work stations to remain in their current configuration. Alternate configurations should be considered that may enhance interaction amongst the operators, as well as new ergonomic work stations that will better meet the goals of occupational health and safety, and improve productivity. The Control Room should also be refurbished to remove the large screen display and reclaim this space for the operators.

1.4 Project Plan

The Owner intends to follow the following project plan:

KEY MILESTONES	
SCADA Replacement Program Start	January 2015
SCADA Request for Proposals	
SCADA RFP Start	January 2015
SCADA RFP Documents Complete	May 2015
Proposals Received from SCADA Vendors	June 2015
SCADA System Contract Award	August 2015
SCADA RFP End	August 2015

SCADA System Replacement	
SCADA System Replacement Start	September 2015
Development System Complete	December 2015
Database and Display Validation Complete	March 2016
Factory Acceptance Tests Complete	April 2016
System Installation Complete	July 2016
Site Acceptance Tests Complete	September 2016
Start of Warranty	October 2016
Post Project Activities	October 2016
SCADA System Replacement End	October 2016
Commercial Historian	
Commercial Historian Start	May 2015
Commercial Historian End	December 2015
Control Room Refurbishment	
Control Room Refurbishment Start	January 2016
Control Room Refurbishment End	May 2016
SCADA Replacement Program End	October 2016

1.5 Budgetary Cost Estimates

The following budgetary estimate is based on a detailed analysis of the activities and resources required to execute the SCADA Replacement project, as well as budgetary quotations received from potential suppliers. Estimates have been rounded up to the nearest $1000.

SCADA System Replacement	$4,300,000
Commercial Historian	$976,000
Control Room Refurbishment	$399,000
TOTAL BUDGETARY ESTIMATE (CAD)	**$5,675,000**

2 Current System Assessment

2.1 Methodology

In March 2014, the Consultant travelled to St. John's to hold a series of meetings with the Owner's operational and information technology (IT) staff in order to review the current SCADA system architecture, system interfaces, functional requirements, concerns, needs, risks, and priorities for upgrading or replacing the SCADA system. A series of meeting were held with the appropriate team members to:

1) Review the current system architecture, including system interfaces and quantity of servers / workstations in each of the production environments and locations;
2) Identify any issues or concerns with the existing system such as cyber security, system architecture, system sizing, system performance, or system stability that should be addressed in the new SCADA system;
3) Identify the major functions available on the current SCADA that must be available in the new SCADA system, and document (at a high-level) the custom applications such as the under-frequency load-shedding application, scheduled alarms application, etc.;
4) Identify any new functions that the Owner would like to introduce in the new SCADA system;
5) Identify corporate IT standards, such as preferred hardware or software platforms, that should be taken into consideration in the upgrade or replacement strategy;
6) Quantify the current maintenance and support costs, response times, and service levels.
7) Review the interface between the Owner's SCADA system and the NL Hydro SCADA/EMS system to determine any issues, constraints or opportunities that should be taken into consideration in the upgrade or replacement strategy.
8) Assess the adequacy of the existing control center facilities and backup facilities (rack space, power, air conditioning, etc.).
9) Assess integration of future technologies such as GIS, OMS, WFM, etc.
10) Analyze the Owner's capacity for deploying and maintaining the new SCADA system.

Following these meetings, the Consultant developed a high-level set of functional requirements and solicited budgetary quotations from qualified suppliers for the following major system components:

- SCADA System
- Commercial Historian
- Control Room Desks

2.2 Current System Architecture

2.2.1 System Overview

The architecture of the current SCADA system is standard within the industry, with redundant SCADA servers at the System Control Centre (SCC) and non-redundant SCADA servers at a Disaster Recovery System (DRS) that is synchronized in real-time from the primary system. SCADA data used for web displays, analysis, and reporting is replicated in near-real-time to a Decision Support System (DSS) in a demilitarized zone (DMZ) in order to isolate corporate users from the SCADA production database. Communications to systems external to the control centers are primarily to the substation RTUs / SMP Gateways using DNP3 protocol, and to NL Hydro using the ICCP protocol.

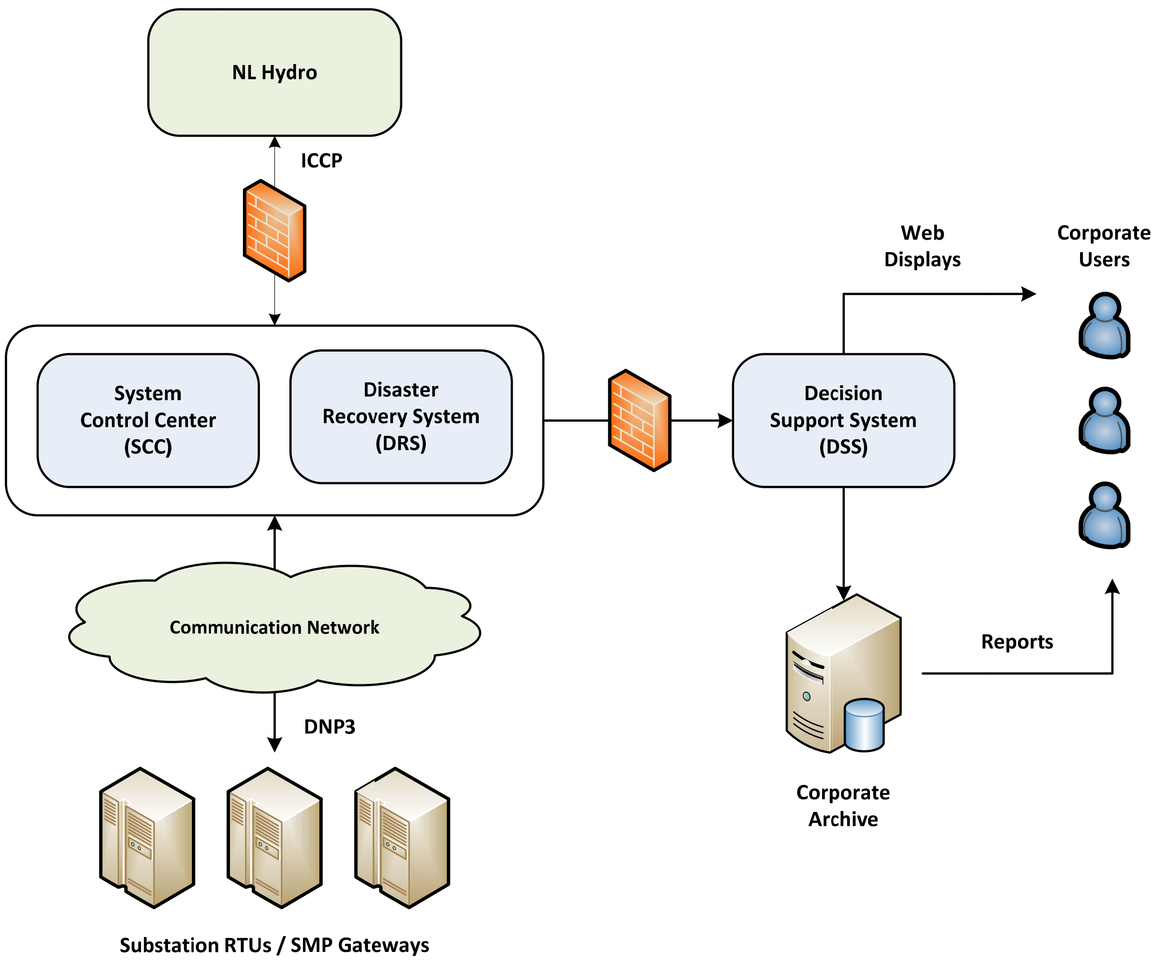


Figure 2-1: System Overview

2.2.2 System Platform

The current SCADA System is based on the HP Alpha servers running the TRU64 UNIX operating system, and Intel-based workstations running the Windows operating system. Since commissioning the system in 1999, a software upgrade was performed in 2004 and the primary SCADA servers were upgraded in 2006 following HP's decision to discontinue the Alpha Server product line. As a result, the current SCADA platform is outdated, expensive to support, and failing to meet current organizational requirements. In particular:

8) **SCADA Servers:** The HP Alpha servers are now obsolete, and spare parts are increasingly difficult to source. Now averaging more than 11 years old, the failure rate of critical server components, such as disk and memory, is expected to accelerate over the next few years.

9) **Operating System:** The TRU64 UNIX operating system is no longer supported by HP. As a result, HP no longer provides operating system patches to correct known issues, including cyber security issues. It is not possible to follow industry best practices for cyber security while continuing to use this obsolete operating system.

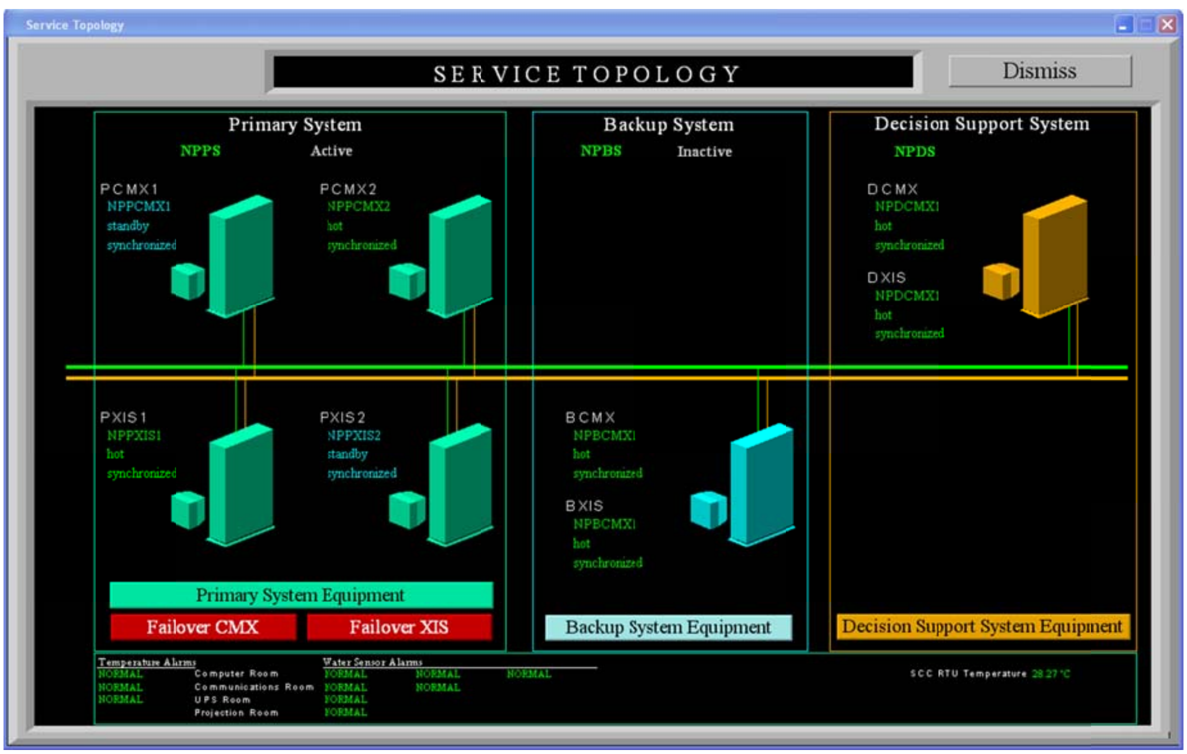


Figure 2-2: System Topology

10) **SCADA Software:** The OASyS DNA V6.3 SCADA software currently being used is now obsolete. The Current Vendor has replaced this product with a modern software architecture based on hardware-independent operating systems such as Linux and/or Windows. In addition, many of the core features of the current system, such as AutoCAD display editor, are no longer supported in the latest product from the Current Vendor. This has several implications:

   a) The Current Vendor cannot provide a simple upgrade to its latest product; "upgrading" to the latest version of the product requires a complete system replacement and re-development of the custom applications.

   b) The Owner must pay escalating maintenance costs for its obsolete SCADA software. Although technical support from the Current Vendor has rarely been an issue, maintenance costs have recently escalated and it is anticipated that the Current Vendor will find it increasingly difficult to maintain resources with knowledge of the current SCADA system over time.

2.2.3 Communications

2.2.3.1 Substations

Communications between the SCADA System and the substation RTUs / SMP Gateways is based on the DNP3 protocol using a variety of communication technologies including the Owner's fiber optic network, Bell-Aliant wide area network, Bell-Aliant digital subscriber lines (DSL/ADSL), Bell-Aliant leased circuits, Bell mobility network (EVDO/HSPA), Globalstar satellite network, and spread spectrum radio. Redundant communication circuits are provided for critical substations, and Checkpoint VPN-1 endpoint devices are used to secure internet-based connections.

No issues were identified with the communications with the substations. Communication costs were not evaluated at this time as it was beyond the scope of this study.

2.2.3.2 NL Hydro

An ICCP link is used to exchange real-time information with NL Hydro. A non-redundant LiveData ICCP server located at the System Control Center provides the interface to NL Hydro. A VPN link between the two systems is used to encrypt the data being exchanged.

2.2.4 Corporate Users

To support SCADA data analysis, reporting, and web displays by Corporate users, SCADA data is replicated in near-real-time to a separate Decision Support System (DSS) in a demilitarized zone (DMZ). This eliminates the need for Corporate users to access the SCADA production database, thereby minimizing SCADA performance issues and data security issues.

The Owner has developed a number of extract routines that move data from the DSS database to Corporate databases to facilitate corporate reporting on SCADA historical data. Various procedures move summarized hourly, daily, monthly and yearly information to an SQL Server database on the

Corporate network for end user reporting, analysis and alerts. In addition, specific subsets of "minute" data are extracted for Corporate applications such as Peak Load management and information displays. Numerous reports and templates have been provided to users on the Corporate network to allow access to specific SCADA data archives.

A number of issues were identified with the current solution:

1. **Historical Data:** The current use of SCADA historical data on the Corporate network is inflexible and the DSS database has limited query accessibility, making it difficult for corporate users to extract the information required. In addition, since only summarized data is stored long-term, data is not always available to the level of detail required.
2. **Web Interface:** The current SCADA system provides web access for up to 20 Corporate users to view near-real-time SCADA displays, with access being granted on a first-come-first-serve basis. This constraint has prevented some key personnel from accessing the SCADA system displays during critical events. In addition, the web interface only runs on an obsolete, unsupported version of the web browser (Internet Explorer 7 or earlier).

2.2.5 Control Room Facilities

System Operators monitor and control the generation, transmission, and distribution network 7 days a week, 24-hours a day from four (4) work stations located at the System Control Center. The two main System Operator workstations, located side-by-side at the front of the room, have 4 x 19" and 2 x 60" monitors connected to the SCADA system, as well as 3 x 19" monitors connected to Corporate systems. The 2 x 60" monitors are mounted from the ceiling. A Shift Supervisor workstation and Support workstation, located side-by-side behind the System Operator work stations, have 4 x 19" monitors connected to the SCADA system as well 3 x 19" monitors connected to Corporate systems (e-mail, outage management, etc.).

The work stations are positioned to face a large-screen display along the front wall. This display is no longer functional, and the Owner has acknowledged that it is no longer needed. The extended viewing area provided by the 2 x 60" displays connected to each System Operator work station is adequate for system monitoring and control.

2.3 Current System Functions

This section provides an analysis of the SCADA functions, support functions, system configuration, system capacity, and system performance constraints of the existing SCADA system.

2.3.1 SCADA Functions

The majority of the SCADA functions available on the current SCADA system are industry standard SCADA functions, though their implementation characteristics vary from one product to the next. The following sections provide descriptions of the functions that were customizations on the existing system, and may not be standard features on some SCADA products.

2.3.1.1 Control Windows

The current SCADA system provides a customized, sophisticated, and efficient user interface for executing supervisory control functions, particularly for the generating units. Figure 2-3: Control Windows provides an example for a circuit breaker and hydro plant / generator control.

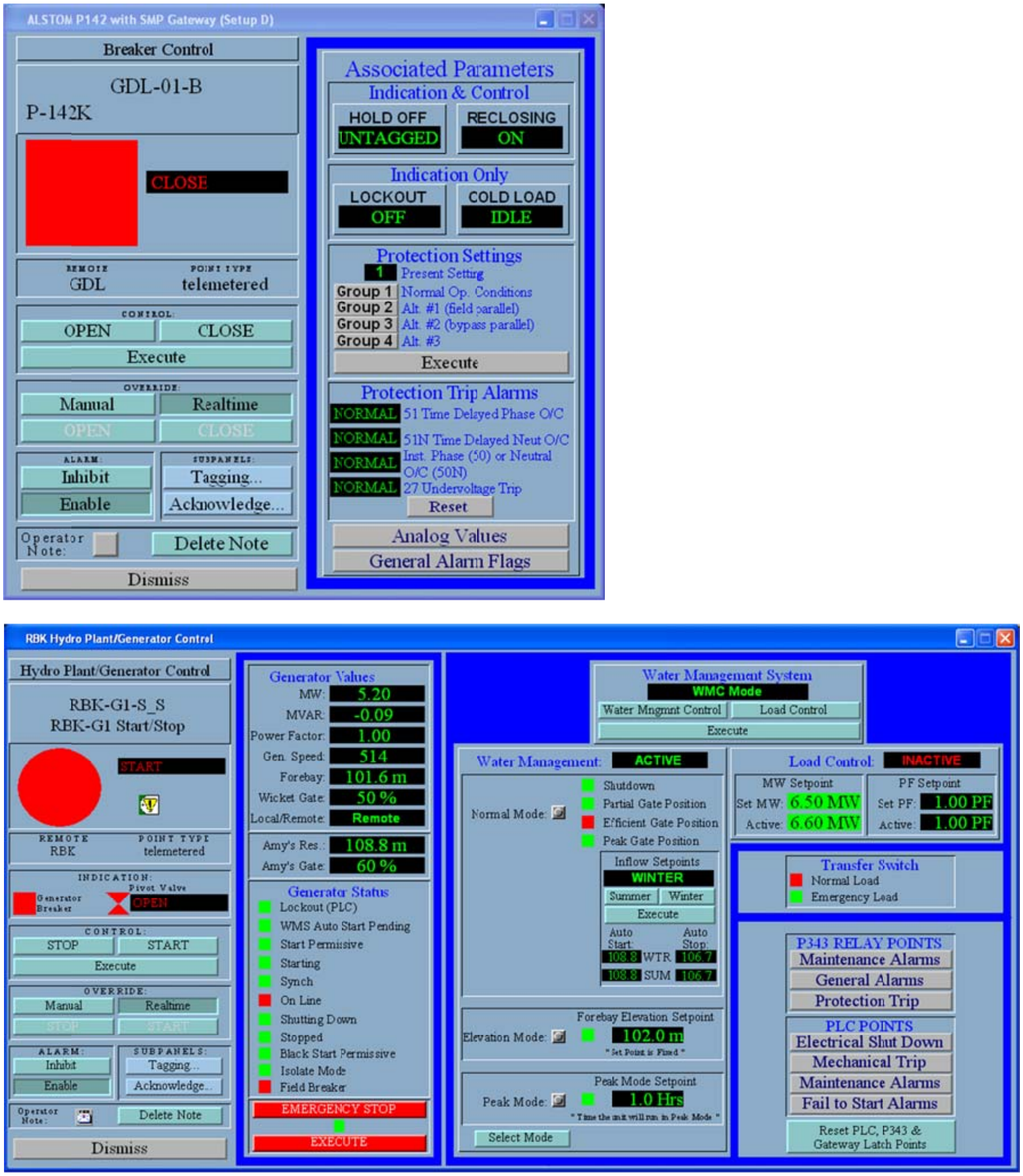


Figure 2-3: Control Windows

The control windows provide a global view of all of the parameters associated with the device selected so that the System Operator can make appropriate control decisions quickly, and with a minimum number of mouse clicks. A side panel is used to display parameters associated with the device, such as the status of the recloser, lockout status, protection settings, etc. These control windows have been customized to recognize the different types of devices in the system.

2.3.1.2 Tagging

The current SCADA system has tagging capabilities whereby tags can be added to status and analog points. Up to 4 different tag types are supported, and multiple tags of the same type can be applied to any point. Different tag types carry with them various limitations on any commands that might be issued to the tagged point, such as inhibit close, inhibit control, etc.

The current implementation is inflexible in that software changes are required to change tag type names in order to conform to the Owner's Worker Protection Code, or to add additional data fields for switching order number or work permit number.

2.3.1.3 Alarm Suppression

The current SCADA system has a functionality referred to as "Device Dependent Alarming" which will allow the delaying of an alarm based upon a prior event – typically designed for use to allow switching transients to settle before generating an alarm. For example, delaying a voltage level alarm for a pre-determined time after a transmission breaker has been opened. The "Device Dependent Alarming" functionality has a timeout period that must be defined and, while you could suppress the alarms for a defined period, they will all alarm after the timeout period expires if they are still in an alarm state.

Although the Device Dependent Alarming function is useful, the Operators require an intelligent alarming capability to suppress alarms, or reduce their priority to event status, when they are secondary alarms resulting from a commanded action. This would eliminate nuisance alarms and allow the Operators to focus on the cause of an event, rather than its side-effects.

2.3.1.4 AGC Lite

The current SCADA system includes an application called AGC Lite to automatically control the MW & MVAR output of the hydro generating units. MW and MVAR setpoints are set by the System Operator and the SCADA system continually monitors the output and issues raise and lower commands as required to keep the outputs within a pre-defined deadband of the setpoints.

Since the SCADA system was commissioned, most units have been upgraded with local PLC control and the AGC Lite application is no longer required for these units. Only 2 units currently remain on AGC Lite, and only one of these is anticipated to be outstanding after the new SCADA System is placed in service. As such, this functionality will likely not be required in the new SCADA System.

2.3.1.5 Under-Frequency Load Shed

The current SCADA system includes a customized, pre-wired, under-frequency load shedding scheme to maintain system stability at times when there is insufficient generation to support all customer load. Custom-built under-frequency load control circuit boards installed in each distribution substation RTU are connected to the feeder circuit breakers providing the ability to trip specific circuit breakers when the frequency drops to a pre-set threshold (e.g. 59.0 Hz, 58.8 Hz, 58.6 Hz, etc.). Up to four different under-frequency thresholds are supported per circuit board, and the levels are pre-programmed in the substation RTU. The Owner has currently defined seven (7) under-frequency thresholds, also called load shed groups or blocks, but more may be required in the future.

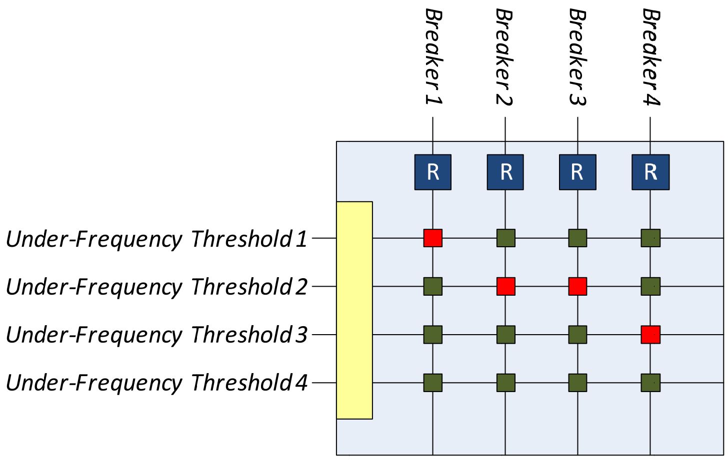


Figure 2-4: Under-Frequency Load Control Board

The current SCADA system includes a custom application to manage the digital relays that implement the multi-stage under-frequency-load shedding scheme. This includes:

- Arming the relays to respond in a controlled fashion to future load shedding events;
- Monitoring the customer load prior to, during and following the load shedding events;
- Restoring each under-frequency group following the load shedding event by issuing a single control output;
- Rotating customers through, and removal from, the different stages of under-frequency load shedding scheme following each event to minimize the outage impact on individual customers. The “rotation” is implemented manually at the SCADA level.

On the current SCADA system, each under-frequency threshold is associated with a load shed “block”. Each feeder breaker can be associated with up to 4 load shed blocks keeping in mind that the configuration of the under-frequency thresholds in the substation RTU must match those assigned at the SCADA block level. Although a feeder can be assigned to up to 4 load shed blocks, it can only be activated, or armed, on one of the blocks at any given time. This provides the ability to dynamically change the feeders affected at a particular under-frequency threshold so that it is not always the same customers affected.

The configuration of the load shed blocks is maintained at the SCADA system. Each time the configuration is changed, controls are automatically issued to the under-frequency load control boards to arm or disarm the feeder on its respective groups. The SCADA system also automatically calculates the load on each group, and historical data is collected for future reference.

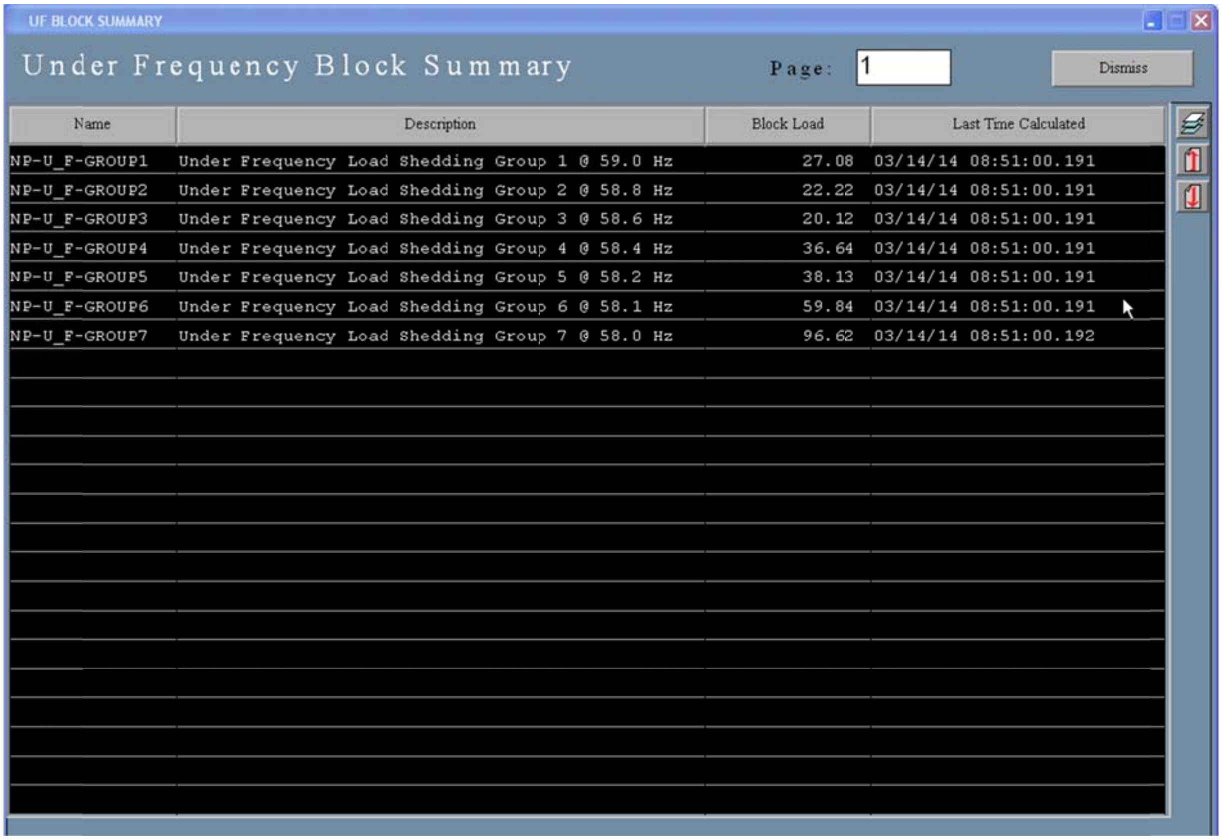


Figure 2-5: Under-Frequency Block Summary

The advantage of this under-frequency load shed scheme is that, once programmed, it will operate autonomously at the substation level, independently of the SCADA system. A disadvantage of the solution is the lack of a user-friendly interface to change the configuration of the load shed blocks.

2.3.1.6 Scheduled Alarms

The current SCADA system supports an application for added security to track employees that are working alone in a dangerous or remote location. An expiry date and time is entered and if the employee reports back before the time expires then the record is marked completed and closed. If the time expires without the employee reporting back then a SCADA alarm is generated and various procedures are followed by System Control Center staff.

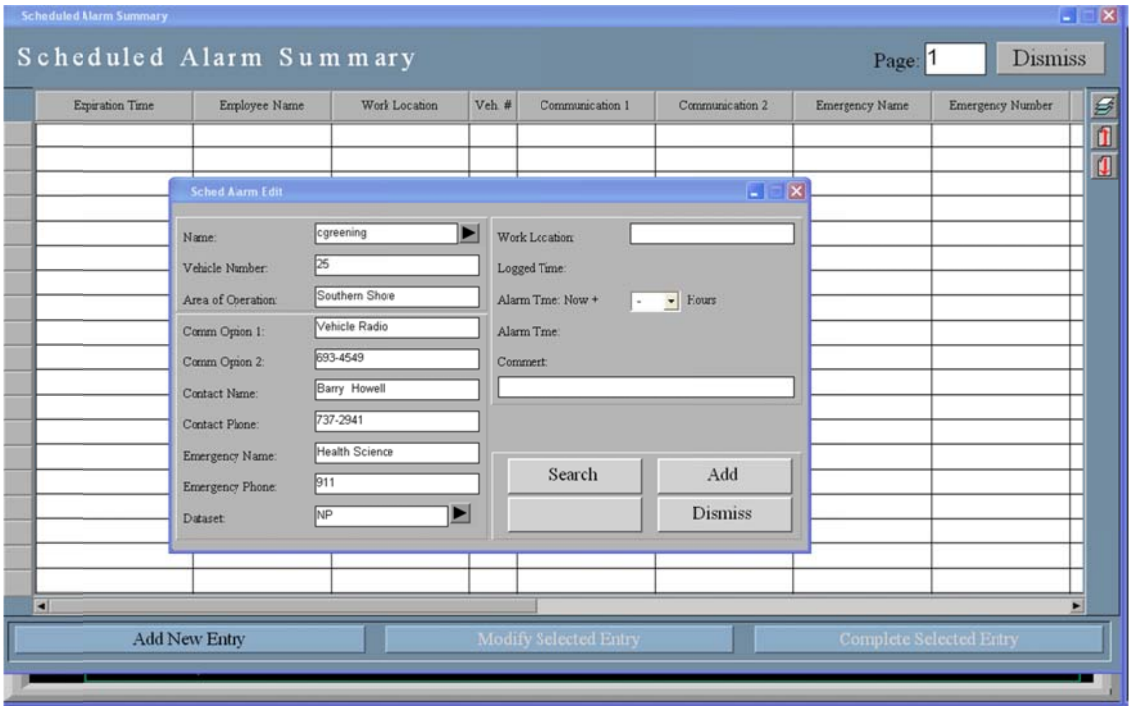


Figure 2-6: Scheduled Alarms

2.3.1.7 Operator Diary

SCADA Operators make judgments daily regarding significant events that occur during their shift. Manually, the operators maintain a chronological log of these events to report to several internal groups including senior management. The logs are individually saved and shared via email when there is time available to do so. During storms and major system events there is not always time to maintain the operator diary.

The operator diary includes free form text with no automation to help report substantial events. The logs cannot be easily searched for content, do not have a standardized method to capture data content and are individually saved on the company's network, making it very difficult to query historically for known or past events.

2.3.2 Support Functions

2.3.2.1 Database Management

The current SCADA system supports online edits that are automatically propagated to all SCADA servers without the need to failover the servers to bring the new database online. An online database editor provides the ability for users to add, modify, and delete database objects.

The Current Vendor has provided some custom scripts to simplify some database transactions, such as the ability to upload a Microsoft Excel file to modify the configuration of the under-frequency load shed groups, and the ability to extract point definitions in Microsoft Excel format on a substation basis.

2.3.2.2 Display Management

The current SCADA system uses AutoCAD as the display editor. This has provided significant advantages to the Owner, as the drawings provided to field crews for on-site work are the same drawings that are available to the System Operators on the SCADA System. In fact, the Owner's processes were streamlined to have one group responsible for maintaining the drawings, as opposed to separate groups. This has reduced costs, eliminated discrepancies, and improved productivity.

2.3.2.3 System Administration

The current SCADA system provides basic tools for system administrators to maintain the system configuration (areas of responsibility, user roles, privileges, etc.) and troubleshoot issues (protocol analyzer, database monitor, etc.)

2.3.3 System Capacity

The current SCADA system is sized to accommodate data acquisition from the existing substations, and data exchange with NL Hydro. Please refer to Table 3-2: System Capacity for a summary of the current and future system capacity.

2.3.4 System Performance

No issues were identified with the system performance and user response times with the current SCADA system.

2.4 Outage Management System

The Owner has a number of Corporate applications that support distribution system maintenance, outage logging, power restoration and customer notification during outages. Specific systems or applications helping support these functions are:

- ESRI ARC FM Geographic Information System (GIS). The Owner is in the process of deploying ESRI ARC FM. The initial phase of this project will provide a GIS-based electrical connectivity model that will maintain and support the Owner's feeder diagram process.
- Microsoft .Net-based Outage Management system, and Informer application. The Owner has designed two .Net applications that support the logging of customer outages and the posting of outage notifications to the company's website and Interactive Voice Response systems. Over time it is planned that these applications will be replaced by a commercial OMS that will integrate directly with the ESRI GIS.

Short-term SCADA requirements include integration capabilities with Microsoft .Net based applications such as the Owner's Outage Management and Informer applications, and more would be required, primarily from a data exchange perspective. The Owner expects to implement a commercial OMS solution within 3-5 years, replacing the existing Outage Management and Informer applications.

2.5 Operator Training

The Owner expects a significant number of System Operators to retire during the life time of the new system. As such, the amount of time spent training new users is expected to increase over the next few years. No specific tools are available on the current SCADA system; new users are trained on the production system.

2.6 Maintenance and Support

The Owner maintains an annual Maintenance & Support Agreement with the Current Vendor. The agreement originally provided for up to 200 hours a year in technical support, but since the Owner had no control on how the hours were spent, the agreement was modified such that the vendor has turn-key responsibility to resolve reported issues. The cost of this annual agreement has recently increased given the obsolescence of the system platform, and the unique functionality of the existing SCADA system.

3 Replacement Strategy

3.1 Objectives

The primary objective of the SCADA System Replacement project is to update the SCADA System to a supported hardware and software environment with minimal business disruption. The general objectives of the SCADA System Replacement project are to:

1. Deliver reductions in the cost of purchasing and maintaining the SCADA hardware. Moving off the HP Alpha Server platform will ensure utilization of lower cost server hardware that is independent of the operating system and SCADA software product. The project will also deliver the opportunity to migrate to the Windows Server operating system, reducing the number of technologies that the organization will need to support, and with trained resources readily available in the marketplace.
2. Deliver reductions in the total cost of ownership of the SCADA system. Moving to the latest version of a commercial SCADA product, and keeping current with the selected Vendor's maintenance program, will allow the Owner to stay current with future product releases and leverage product improvements financed by the selected Vendor's user community.
3. Provide the ability to better secure the functions performed by the SCADA system, following industry best practices, by way of integration of anti-virus, centralized account management, and patch management.
4. Improve the flow of critical power system static and historical data essential for power system analysis and information dissemination to the organization, resulting in lower operating costs and improvements in productivity.
5. Provide modern, best-of-breed tools for the System Operators and support staff to allow them to continue to reliably monitor and control the Owner's generation, transmission and distribution system. This includes preserving, and possibly enhancing, some of the customizations performed on the current SCADA system, such as control windows and under-frequency load shedding.
6. Facilitate the future integration with the Outage Management System.

3.2 General Requirements

The general requirements for the new SCADA system are:

1. **High Availability:** The SCADA system architecture must be fault tolerant so that any single hardware failure does not result in the loss of a critical function. The production SCADA must exhibit an annual system availability of 99.98%. A Disaster Recovery System (DRS) must be provided to function as the main disaster recovery site. It is not required for the equipment at the DRS to be redundant in its initial configuration. However, the system must be designed and built so the Owner can implement a redundant DRS by simply adding equipment and changing configuration parameters without having to modify software code or recompile any programs.

2. **Present Pertinent Information:** It is important that the System Operators and Engineers have access to a full range of high quality real-time and historical data, as well as the tools to interpret the data to aid the staff in performing their jobs.
3. **Compliance with Standards:** The SCADA system must conform to industry standards, especially standards relating to enterprise integration, interfacing and exchanging data between different systems.
4. **Open System Design:** The SCADA system must comply with widely accepted standards for open systems, both from standards organisations as well as de facto standards. This will enable the Owner to select the best-of-breed hardware and software solutions to meet their future needs and greatly enhance the system's ability to communicate with the enterprise systems.
5. **Expandable/Scalable:** The SCADA system hardware and software must be easily expandable and scalable and provide the capability to upgrade and/or add additional processors, disk units, remote terminal units, network plant, etc., and expand application programs or add new functions without major disruption to the operation of the SCADA system.
6. **Security:** The SCADA system must have appropriate security features that prevent unauthorised users from accessing the system and permit assigning various levels of access privilege to the authorised users. In order for the Owner to follow industry best practices for cyber security, the new SCADA system must support the NERC CIP requirements.
7. **Minimal Customisation:** To the greatest extent possible, standard applications must be used to minimise customisation to standard product(s) and thereby lower the risk of implementation schedule delays and reduce the costs of system procurement and system maintenance services.
8. **System Responsiveness:** High performance is required for user interface, data collection, and program execution times as well as the timeliness of making data available to the enterprise.
9. **Maintainability:** State of the art auditing, editing, display building, and database generation tools must be provided for maintaining the system. Ideally the new SCADA system will allow the Owner to continue to use AutoCAD as the primary display editor.
10. **Improved Operator Training:** An offline environment with Operator training tools that are fully integrated with the SCADA system and use the same databases and displays as the production system should be provided to improve Operator training.

3.3 Corporate Standards

The following table identifies the Owner's current corporate IT standards; the new system should be compatible with these standards.

Table 3-1: Corporate IT Standards

CORPORATE IT STANDARDS
Microsoft Windows 7 for workstations with standard keyboard and mouse behavior
Windows Server 2012 for Windows-based servers

CORPORATE IT STANDARDS
Red Hat Linux for UNIX-based servers
HP servers and workstations, 3 PAR SAN
3 PAR Storage Area Network (SAN)
SQL Server RDBMS (Oracle can also be supported)
Trend Micro anti-virus
Middleware (1) BizTalk Server (primarily), (2) Visual Basic .NET, (3) SQL Server SSIS
TCP/IP protocol and SNMP capable network management tools (e.g. Solar Winds)
Cisco equipment for switches, routers, and firewalls.
Ethernet, Fast Ethernet, and Gigabit Ethernet for local area networks
Tivoli Net Backup as a backup tool

3.4 System Architecture

The architecture of the new SCADA system should be similar to the existing system architecture with SCADA servers installed at the System Control Center and Disaster Recovery site. However, the Owner should consider the following enhancements to the system architecture during the SCADA system replacement:

1. **SCADA Servers:** The SCADA servers should follow Corporate IT standards as defined in Section 3.3 in order to facilitate hardware maintenance and support. High-performance server models with redundant processors, power supplies, and cooling fans should be used to maximize system availability. Commercial network management tools, independent of the SCADA System, should be used to monitor all server and workstation components.
2. **Operating Systems:** The operating system of the SCADA servers and workstations should be hardware-independent (i.e. Windows or Linux) allowing the Owner to select the best-of-breed hardware and software solutions to meet their future needs. The operating systems selected should also follow Corporate IT standards as defined in Section 3.3 in order to facilitate software maintenance and support.
3. **Redundant ICCP Servers:** Given the critical nature of the data being exchanged between the Owner and NL Hydro, industry best practice is to use redundant ICCP servers at the System Control Center, and a non-redundant backup server at the Disaster Recovery System.
4. **Pre-Production Environment:** In order to follow industry best practices for cyber security, software patches (operating system, commercial database, SCADA software, etc.) should be monitored, evaluated, and installed regularly. To minimize the risk to the production system, industry best practice is to use a pre-production system to perform regression tests prior to installing the patches on the production system.

5. **Commercial Historian:** In order to address the issues with historical data storage, data analysis and reporting, and to improve productivity, the Owner should consider deploying a commercial historian with the new SCADA system. With the success of commercial historian products such as OSIsoft PI, SCADA vendors have invested very little research and development effort to improve their native historians, and as such the functionality and performance offered by commercial historians is far superior to native SCADA historians. However, native SCADA historians may still be the best choice for short-term history and for archiving alarms and events.

6. **Interface to Outage Management System:** The Owner plans to implement a commercial Outage Management System in the next 3-5 years. As such, the replacement strategy for the SCADA system should take this into consideration and ensure that the SCADA system selected follow industry standards for system integration (e.g. OPC, Multispeak, etc.) and includes the tools needed to easily integrate with a future OMS. The replacement SCADA system must have the ability to integrate with a number of real-time interfaces to external systems including the GIS and a commercial OMS. It would be expected that the SCADA platform would support industry standard interfaces, such as OPC and MultiSpeak, for this purpose. Preference should be given to SCADA products that have an integrated OMS product available. As such, SCADA vendors were asked to provide details of their integrated Outage management System (OMS) product, if applicable, and to provide budgetary estimates for their OMS product.

7. **Operator Training Simulator (OTS):** The Owner expects a significant number of System Operators to retire during the life time of the new system. As such, the amount of time spent training new users is expected to increase over the next few years, and new tools to support this training should be evaluated. It may be better to acquire the OTS with the OMS since more functionality and training will be required with the OMS. SCADA vendors were asked to provide details of their integrated Operator Training Simulator (OTS) product, if applicable, and to provide budgetary estimates for their OTS product.

3.5 System Functions

For this Strategic Plan, the following SCADA Vendors were invited to submit budgetary quotations for the SCADA System Replacement project:

- Schneider Electric Inc., based in Houston, Texas, USA
- Open Systems International Inc. (OSII), based in Minneapolis, Minnesota, USA
- Survalent Technology Inc., based in Mississauga, Ontario, Canada.

The Owner has a preference for standard products with minimal customization in order to minimize costs and to facilitate future upgrades and maintenance. However, the system needs to include some specific functions that are critical to the Owner's day-to-day operations (e.g. under-frequency load shed, control windows, etc.) that may not be standard software in all products. The Owner should consider alternative, standard product solutions that would provide similar functionality. Where customizations are required, the Owner should insist that the customization become part of the Vendor's standard product in the future.

A high-level set of functional requirements was provided to the SCADA vendors. The requirements included typical SCADA functions found in modern SCADA systems as well as functions that were customized on the current SCADA system. The SCADA Vendors were requested to identify their compliance to these requirements as follows:

- Standard (included or not in price) for functions that are available in the standard product and can be enabled through configuration parameters (no software development required to enable, disable, or configure the function).
- Customization (included or not in price) if a similar function exists in the standard product, but customization will be required to support the functionality as described.
- New (included or not in price) if no similar function exists in the standard product, and the function would need to be developed.

3.5.1 SCADA Functions

The following sections provide descriptions of the functions that were customizations on the existing system, and how they should be handled in the replacement project based on feedback from the SCADA vendors. These functions should form part of the product evaluation matrix, with appropriate weights assigned to each function, during product evaluations.

3.5.1.1 Control Windows

The control windows in their current form will be difficult to replicate in the new SCADA system. The Consultant has seen demonstrations of each of the SCADA products proposed and can confirm that none of the products offer the functionality available on the current system. Nonetheless, two of the SCADA vendors indicated that this functionality is standard in their SCADA product which would indicate that they did not take the time to analyze the functionality requested, and are not willing to change their standard product to comply with the Owner's requirements. Only one SCADA vendor (Survalent) recognized that the control window functionality requested would need to be customized in their product and included it in their development efforts.

The Owner will need to carefully analyze of the capabilities of the SCADA products in order to determine the best course of action. For example, in consultation with the System Operators, the Owner could accept the functionality offered in the selected product and plan for operator training; this would likely result in a loss of productivity. Alternatively, the Owner could engage the selected Vendor to develop the control windows per the Owner's specifications. This would simplify the transition to the new system, maintain productivity, and enhance the vendor's product for other utilities.

To ensure that sufficient budget is available to support the implementation of control windows similar to the current functionality, a separate estimate was provided by the Consultant for this customization in the budgetary estimates.

3.5.1.2 Tagging

The ability to easily change tag attributes should be a standard feature in most modern SCADA systems. In fact, all of the SCADA vendors indicated that this is a standard feature of their SCADA product. The Owner should carefully analyze of the capabilities of the SCADA products to configure additional tag fields, or modify existing fields, during product evaluations.

3.5.1.3 Alarm Suppression

Most modern SCADA systems offer some form of intelligent alarm processing. In fact, all of the SCADA vendors indicated this was a standard feature of their SCADA product. The Owner should carefully analyze the intelligent alarming features of the SCADA products during product evaluations.

3.5.1.4 AGC Lite

The Owner anticipates that one generating unit may still be under the control of the existing AGC Lite application when the new SCADA System is placed in service. As such, this functionality will likely not be required in the new SCADA System, but the Owner may want to consider SCADA products that support this capability as a risk mitigation strategy. Each of the SCADA products selected for budgetary quotations have an optional AGC application that could be included with the SCADA system, if required.

To ensure that sufficient budget is available to support this option, a separate estimate was provided by the Consultant for this application in the budgetary estimates.

3.5.1.5 Under-Frequency Load Shed

The new SCADA system will need to support the customized, pre-wired, under-frequency load shedding scheme provided by the current SCADA system. Since the design is somewhat unique, some customization will be required in the new SCADA system to fully support, and possibly enhance, the existing functionality.

Each of the SCADA vendors has proposed their standard, SCADA-level, rotating load shed application in response to this requirement; this will not meet the requirements of this application. As such, some customization will be required to arm and disarm the digital relays on the under-frequency load control boards, as a minimum. The Owner should also consider automating, or at least improving the user interface, for changing the configuration of the load shed blocks.

To ensure that sufficient budget is available to support this critical application, a separate budgetary estimate was provided by the Consultant for customizing the vendor’s standard product.

3.5.1.6 Scheduled Alarms

The application to track employees that are working alone in a dangerous or remote location must be supported in the new SCADA system, but may not be a standard offering. One of the SCADA vendors indicated this functionality was included in their standard product, and two included a price to customize their product to include this function. The Owner should carefully analyze the Scheduled Alarms features of the SCADA products during product evaluations.

3.5.1.7 Operator Diary

The Owner is interested in automating the operator diary function and standardizing the presentation of events. It is recognized that there will be some interaction with the operators to approve the inclusion of some items, but minimizing the operator effort is important. One of the SCADA vendors indicated this functionality was included in their standard product, and two included a price to customize their product to include this function. The Owner should carefully analyze the Operator Diary features of the SCADA products during product evaluations.

3.5.2 Support Functions

3.5.2.1 Database Management

The new SCADA system must provide tools for maintaining the system databases, including support for online edits that are automatically propagated to all SCADA servers without the need to failover the servers to bring the new database online. An online database editor must be provided for System Administrators to add, modify, and delete database objects.

All of the SCADA vendors have indicated that their SCADA product supports this functionality. In addition, each SCADA vendor claims to support user-defined fields on SCADA point definitions, and the ability to extract point definitions in Microsoft Excel format on a substation basis. The Owner should carefully analyze the Database Management features of the SCADA products during product evaluations.

3.5.2.2 Display Management

The Owner has a preference to maintain AutoCAD as the display editor for the new SCADA system, but each of the SCADA products quoted use their own proprietary display editor in order to improve graphic performance. Each of the SCADA products can import AutoCAD files to their proprietary format, but the feasibility of doing this as a standard process only seemed feasible with one of the SCADA products (Survalent). The Owner will need to carefully analyze the Display Management features of the SCADA products during product evaluations.

3.5.2.3 System Administration

The new SCADA system must provide modern, best-of-breed tools for system administrators to maintain the system configuration and troubleshoot issues. Each of the SCADA products quoted include a standard set of tools for configuring, maintaining, and troubleshooting the SCADA system. The Owner should carefully analyze the System Administration features of the SCADA products during product evaluations.

3.5.3 Cyber Security

All of the SCADA vendors have confirmed that their SCADA product complies with the NERC CIP cyber security requirements. The Owner should carefully analyze the cyber security features of the SCADA products during product evaluations.

3.5.4 Multispeak Specification

Although the SCADA vendors confirmed that their products support the Multispeak specification, all of them proposed to use a proprietary interface between their OMS product and the ESRI ARC FM product for importing the distribution network model. Only one of the SCADA vendors (Survalent) included Multispeak in their offering as a standard component, and provided compliance certificates with other products. The Owner should carefully analyze the GIS interface features of the SCADA products during product evaluations.

3.5.5 System Capacity

The Owner plans to implement some feeder automation schemes in the future and interface to an Outage Management System, so the new SCADA system should be sized with this expansion capability. The following table shows the system capacity requirements for the new SCADA system:

Table 3-2: System Capacity

SCADA Database Sizing	Current System	Future System
DNP3 IP Interfaces	150	500
DNP3 Serial Interfaces (RS232)	4	10
Telemetered Analog Points	9,000	25,000
Telemetered Digital Points	22,000	50,000
Non-Telemetered Analog Points	150	500
Non-Telemetered Digital Points	5,000	20,000
Calculated Analog Points	350	2,000
Calculated Digital Points	100	500
Secure ICCP:		
Number of Links (2 way exchange of information)	1	3
Data Values per Data Set	1,500	2,000
Control Scripts	N/A	2,500
Historical Data (all points, one year online retention)	40,000	100,000

Some of the SCADA vendors base the pricing of their product on the system sizing capacity. Only one SCADA vendor (Survalent) indicated that system sizing was unlimited, and would not affect software license pricing or support costs.

3.6 Project Implementation

3.6.1 Responsibilities

The contract should be structured as a turn-key project with clearly defined scope, deliverables, and responsibilities. In general, responsibilities should be divided between the Owner and the SCADA Vendor as follows:

1. All activities related to the installation, configuration, testing, and maintenance of the SCADA software should be the responsibility of the SCADA Vendor with support from the Owner.
2. All activities related to the procurement, installation, configuration, testing, and maintenance of the SCADA hardware should be the responsibility of the Owner, based on the SCADA Vendor's hardware specification. The hardware should comply with the Owner's corporate IT standards.
3. Activities related to the migration of the SCADA database and displays should be the responsibility of the Owner, using tools and training provided by the SCADA Vendor. The tools provided by the SCADA Vendor will need to be customized to meet the Owner's requirements.
4. Activities related to point-to-point testing and commissioning of the system interfaces (i.e. ICCP) should be the responsibility of the Owner with support from the Vendor.

3.6.2 Database and Display Conversion

The transition from the current SCADA system to the new platform will require a carefully planned migration strategy for the databases and displays to ensure their accuracy during the conversion process. The migration strategy should describe the methods, tools, and validation that will be used for the migration of the existing SCADA system databases and displays to the new platform. A Data & Display Migration Plan should be specified as a project deliverable, to be provided by the SCADA Vendor, reviewed and approved by the Owner.

Conversion of the existing SCADA database should be fairly straight-forward, but in order to take advantage of new features available with the new SCADA system, other SCADA attributes may need to be configured. A detailed analysis of the SCADA attributes will be required, and the Data & Display Migration Plan should address each attribute.

Tools provided by the SCADA Vendor to convert the existing displays will likely preserve the basic features of the displays (i.e. lines, symbols, etc.), but will almost certainly result in the loss of functionality. The current SCADA system displays includes a significant amount of custom software (OBEL code) driving specific functionality that will need to be implemented using different technology, such as control scripts, or implemented as software customizations. A detailed analysis of the displays will be required, and the Data & Display Migration Plan will need to address each customization to ensure no loss of functionality.

The System Operators should be consulted regularly throughout the database and display conversion process to ensure the new system is configured to meet their needs, and to provide an opportunity for them to "test drive" the system early on. A Development System should be provided by the

SCADA Vendor early in the project, and it should be installed at the System Control Center for easy access by the System Operators. Given the key role this Development System will have, a payment milestone should be attached to this deliverable.

During the SCADA System Replacement, the Owner will continue to use, and therefore modify, the existing databases and displays. In addition to static SCADA point definitions, dynamic point information needs to be converted prior to system cutover such as tags, notes, manually-entered values, scan overrides, etc. As a result, the migration strategy should take into consideration the fact that data conversions will occur at several key milestones in the project, and finally at system cutover.

Although each of the SCADA Vendors has included the database and display conversion as a customization in their budgetary quotations, the Consultant believes that the level of effort for display conversion has been under-estimated by the SCADA Vendors. To ensure that sufficient budget is available to support this critical item, a separate estimate was provided by the Consultant for database and display migration in the budgetary estimates.

3.6.3 System Cutover Plan

The transition from the current SCADA system to the new SCADA system must be carefully planned in order to ensure a smooth cutover to the new system. The System Cutover Plan should include a period where the new system and the current system run in parallel so that the SCADA Vendor and Owner can verify the database conversion, display conversion, and SCADA functionality prior to cutover.

The System Cutover Plan needs to consider:

- Rack space, air conditioning, and power for the new SCADA equipment running in parallel with the existing equipment for the duration of the transition period;
- Placement (and cabling) of the new workstations such that the users have access to both systems during the transition period keeping in mind that the control room facilities may be refurbished;
- Point-to-point testing of a sample of data to verify the database and display conversion, data acquisition functions, and data processing functions (alarms, events, etc.).
- Testing of system interfaces, such as the ICCP link with NL Hydro and the interface to the new commercial historian.
- Development of a detailed system cutover schedule to ensure no loss of control, real-time data, or historical data during the cutover period. This includes the migrations of dynamic SCADA data such as manually-entered values, tags, scan overrides, etc.
- Maintenance of databases and displays during the parallel run, so that the old SCADA system can be re-started quickly, without the loss of control, real-time data, or historical data, in the event of a major issue with the new SCADA system.

3.6.3.1 Dual RTU Communication Paths

All substation RTUs / Gateways are currently configured to communicate with only one master station, the existing SCADA system. In order to test the new SCADA system prior to cutover, the new SCADA system will need to communicate with the substation RTUs / Gateways in order to verify the system configuration, database conversion, display conversion, and SCADA functionality. There are two alternatives to address this issue:

1. Maintain only one communication port to each substation RTU / Gateway, and coordinate the SCADA tests such that the substation RTU / Gateways required for the tests are switched from the current system to the new system for a few hours to perform the tests. This has the advantage of being easy to configure, but has the disadvantage that the System Operators will not be able to monitor and control the substations under test during the test period, historical data during the test periods will be lost, and testing of the new SCADA system could be delayed if access to the RTUs is not available when needed.
2. Configure a second communication port at each substation RTU / Gateway so that both SCADA systems can communicate with the substation at the same time. This provides a realistic test environment for the new SCADA system and greatly simplifies the validation of the database and display conversion; the same display can be called up on both systems and visually inspected for differences that can result from conversion factors, alarm limits, and other attributes being configured differently on the two systems. Controls are normally disabled on the new SCADA system to prevent testers from operating devices inadvertently.

   The team analyzed each substation's ability to communicate with multiple SCADA masters in order to devise a strategy for the transition phase to the new SCADA system. A majority of the substations can be upgraded fairly easily using existing equipment to configure a second communications port for the new SCADA system. Some substations would require additional hardware to be installed at the substation to provide a second communications port.

   Coordination will still be required with the System Operators during specific tests, such as point-to-point testing, so that they are aware that changes coming from the substation are a result of testing, and not actual field changes. During point-to-point testing, the points assigned to the substation RTU / Gateway under test should be placed in a "TEST" area of responsibility so that the System Operators are not bothered by invalid alarms during the test period.

   Once configured, the second communication port can be configured on the new Pre-Production System in order to provide a realistic test environment for future upgrades.

The Consultant recommends the second option for the majority of the substations (non-critical substations do not need to be dual-ported), and the project plan and budgetary estimates include the activities, resources, and equipment required for the Owner to implement this solution.

3.6.3.2 Point-to-Point Testing

Detailed point-to-point testing should be conducted on a representative sample of devices covering various point types (analog, digital), device types (generators, transformers, switches, etc.), and substation communication devices (SMP Gateway, RTU). The goal of the point-to-point tests are to verify the database and display conversion process. Based on the results observed during the initial tests, the sample size can be adjusted such that the Owner has confidence in the databases and displays on the new SCADA system. The project plan includes the activities and resources required for the Owner to conduct the point-to-point testing on a representative sample of devices.

3.7 Related Projects

3.7.1 Commercial Historian

In order to improve the flow of critical power system static and historical data essential for power system analysis and information dissemination to the organization, the Owner should consider deploying a commercial historian such as the OSIsoft PI Historian. Commercial historians are increasingly being adopted by electric utilities world-wide due to their performance, ease-of-use, and reporting capabilities.

For this Strategic Plan, the following suppliers were invited to submit budgetary quotations for the supply, implementation, and maintenance of a commercial historian:

- OSIsoft Inc., based in San Francisco, California (PI Historian)
- ADM System Engineering, based in Halifax, Nova Scotia (PI deployment)
- GCM Consulting, based in Montreal, Quebec (PI deployment)

For the PI Historian from OSIsoft, the budgetary quotation includes support for 200,000 tags:

- 100,000 tags to support 100,000 SCADA point values, and
- 100,000 tags to keep the corresponding quality (good data, bad data, telemetry fail, etc.)

The PI license and maintenance costs are based on the number of tags. As a result, the Owner may want to consider the follow options with regards to the number of PI tags in order to lower the license costs and support costs:

- Determine the relative importance of keeping the point quality with the point value. Not only does it double the number of tags, but trying to use the quality information in reports and displays makes them more complex to build.
- Consider purchasing a lesser quantity of tags initially (e.g. to support 50,000 SCADA points) and adding tags in the future as the need arises. Adding tags is very easy, and non-disruptive. This would lower the initial license costs and support costs considerably.

Activities to implement the commercial historian have been included in the project plan, and the budgetary estimate includes all hardware, software, and resources required for its successful implementation.

3.7.2 Control Room Facilities

Now that the large screen display at the front of the Control Room is no longer functional, there is no need for the operator desks to remain in their current configuration. Alternate configurations should be considered that may enhance interaction amongst the operators, as well as new ergonomic work stations that will better meet the goals of occupational health and safety, and improve productivity. The Control Room should also be refurbished to remove the large screen display and reclaim this space for the operators.

Activities have been included in the project plan, and a budgetary quotation for new control desks was received from Evans Consoles, an industry leader in control room furniture.

3.8 Maintenance and Support

The installation of a new SCADA system will require a software Maintenance and Support Agreement that includes product enhancements and bug fixes, as well as ensuring appropriate maintenance is performed on a regular basis to ensure compatibility with future operating system updates. Given the criticality of the system, the new support agreement for the SCADA application must cover the system 24/7/365. Maintenance and support for the hardware infrastructure should be similar.

Each of the SCADA Vendors has provided quotations for their standard Maintenance & Support Agreements. Following is a comparison of the services offered by each SCADA Vendor:

Table 3-3: Maintenance and Support Services

Maintenance and Support Services	Schneider	OSII	Survalent
Emergency Support	24x7x365	24x7x365	24x7x365
Standard Support (bug fixes, security flaws, etc.)	8:30AM - 5PM CST	8AM - 5PM EST	24x7x365
Web-based Trouble Ticket System	Yes	Yes	Yes
Technical Support Hours (per year)	40	0	0
On-Site Visit (1-week) (T&L excluded)	No	No	Yes
System Performance Audit (yearly)	Yes	No	Yes
Upgrade License for New Releases (installation excluded)	Yes	Yes	Yes
Refresher Training	No	Yes	Yes
Users Conference	Yes	Yes	Yes

4 Project Plan

A high-level project schedule is provided on page 4-36 showing the major activities related to the following components:

1. SCADA Request For Proposals (RFP)
2. SCADA System Replacement
3. Commercial Historian
4. Control Room Refurbishment

The following sections describe the various activities, dependencies, and resourcing requirements for each component.

4.1 SCADA Request For Proposals

An open bidding process will be used to select the new SCADA product. As such, the Owner will need to prepare a detailed technical and commercial specification, identify qualified vendors, issue a Request for Proposals, evaluate proposal responses, perform site visits for due diligence, then negotiate a statement of work and commercial contract with the selected vendor.

4.1.1 Major Activities

The SCADA RFP phase will take approximately 8 months to complete, as follows:

1. Four (4) months to develop the RFP specifications;
2. One (1) month for the vendors to submit proposals;
3. Two (2) months for site visits, proposal clarifications, and selection of finalist; and
4. One (1) month for statement of work and contract negotiations.

4.1.2 RFP Specifications

The RFP specifications will capture and define the scope of work as well as the terms and conditions that will govern the work. The RFP specifications will also provide instructions to the bidders for preparing their responses so as to ensure a fair bidding environment, and to facilitate the evaluation of proposal responses.

The following sections describe the various documents generally included in the Request for Proposals specifications.

1. **Letter of Invitation**

   This document is addressed to the Sales representative of each qualified bidder inviting them to submit proposals for the scope of work specified. This document generally includes a description of the structure of the RFP package attached to the letter so that the vendor can confirm they have received all relevant documents.

2. **Part 1 - Instruction to Bidders**

   This document provides information related to the RFP process and specific instructions for bidders to follow in submitting their responses. This includes:

   a. A description of the utility and a brief description of the scope of work,
   b. Protocol for data exchange between the Customer and bidders,
   c. Form and method of proposal submissions,
   d. Deadline for proposal clarification questions,
   e. Deadline for proposal delivery,
   f. Date and venue of the Proposal Meeting (if applicable),
   g. Bonds or guarantees to be provided with proposals,
   h. Bid validity requirements, and
   i. Any other information necessary for bidders to submit a qualifying proposal.

   In order to facilitate the evaluation process, all responses should follow the same structure and format as prescribed in the Instructions to Bidders. Forms and schedules to be completed by the bidders are included in the RFP package (see item 6 below).

3. **Part 2 - Terms and Conditions**

   This document contains the commercial terms and conditions under which the products and services are to be provided. These are generally utility-specific standard terms and conditions available from the procurement department. The terms and conditions may be adjusted by the procurement department depending on the nature of the products and services requested. Bidders will be asked to submit a Table of Compliance against the terms and conditions.

4. **Part 3 - Technical Specifications**

   This document contains the technical specifications for the product and services requested. In general this document is outlined as follows, and bidders will be asked to submit a Table of Compliance against each technical requirement:

   a. Introduction

      This section will provide a high-level overview of the project and its background, the project goals and objectives, characteristics of the transmission or distribution system, related projects, preferred implementation strategy, and system maintenance strategy.

b. System Architecture

This section will describe the conceptual system architecture of the system to be delivered and specify the requirements for redundancy and failover, external system interfaces, cyber security, system sizing, system performance, system monitoring, and system availability.

c. SCADA Functions

This section will specify the requirements for data acquisition, data processing, alarms and event processing, calculated points, control scripts, data exchange with external systems, historical data processing, and mapboard interface.

d. User Interface

This section will specify the requirements for user interface functions such as login/logout, areas of jurisdiction, privileges, layouts, fonts, data quality symbols, graphic displays, alarm displays, application displays, tabular displays, display building tools, display navigation, panning, zooming, display features, supervisory controls, control windows, tagging, trending, and study mode.

e. Advanced Functions

This section will specify the requirements for advanced functions, such as load shed and restoration, automatic generation control, capacitor control, and vol-var control.

f. Project Implementation

This section will specify the requirements for project structure and governance, project controls, project schedule, key milestones, database conversion, display conversion, documentation, quality assurance, acceptance testing, system installation, system commissioning, system cutover, and final acceptance criteria. This section will also identify the specific responsibilities of each party, and provide a detailed list of deliverables.

g. Training

This section will specify the training requirements, and identify the specific training courses to be provided during the project.

h. Maintenance and Support

This section will specify the maintenance and support requirements.

5. **Part 4 – Bidder Information**

This document contains a set of questions to further define the solution being proposed by each vendor. The questions are generally structured as follows:

a. Corporate

This section will ask bidders to describe their corporate structure, financial status, primary products and services offered, research and development expenditures, and differentiators.

b. Technical

This section will ask bidders to describe the characteristics of the solution proposed, such as system architecture, cyber security, SCADA, user interface, CIM, external system interfaces, network model, advanced applications, third-party software, database maintenance tools, display maintenance tools, and software configuration management.

c. Implementation

This section will ask bidders to describe their proposed solution as it relates to project management, key personnel, database creation and validation, display creation and validation, acceptance testing, deficiency tracking, documentation, training, installation, commissioning, and software configuration control.

d. Maintenance & Support

This section will ask bidders to describe their approach to maintenance and support of their product including product roadmaps, release schedules, user groups, and forums.

6. **Part 5 – Proposal Submission Forms and Schedules**

This document contains a set of forms and schedules to be used by bidders in preparing their proposal response. The forms and schedules are generally structured as follows:

a. Proposal Submission Form (includes vendor details, proposal checklist, signatures)

b. Table of Compliance Forms (technical and commercial)

c. Price / Payment Schedule

d. Bonds / Guarantees

e. Conflict of Information Statement Form

f. Requests for Clarification Form

A short-list of qualified vendors will be produced once proposals have been received. Site visits will be performed in order to assess each short-listed SCADA system in use at another electric utility in North America, and to assess the SCADA facilities of each short-listed vendor.

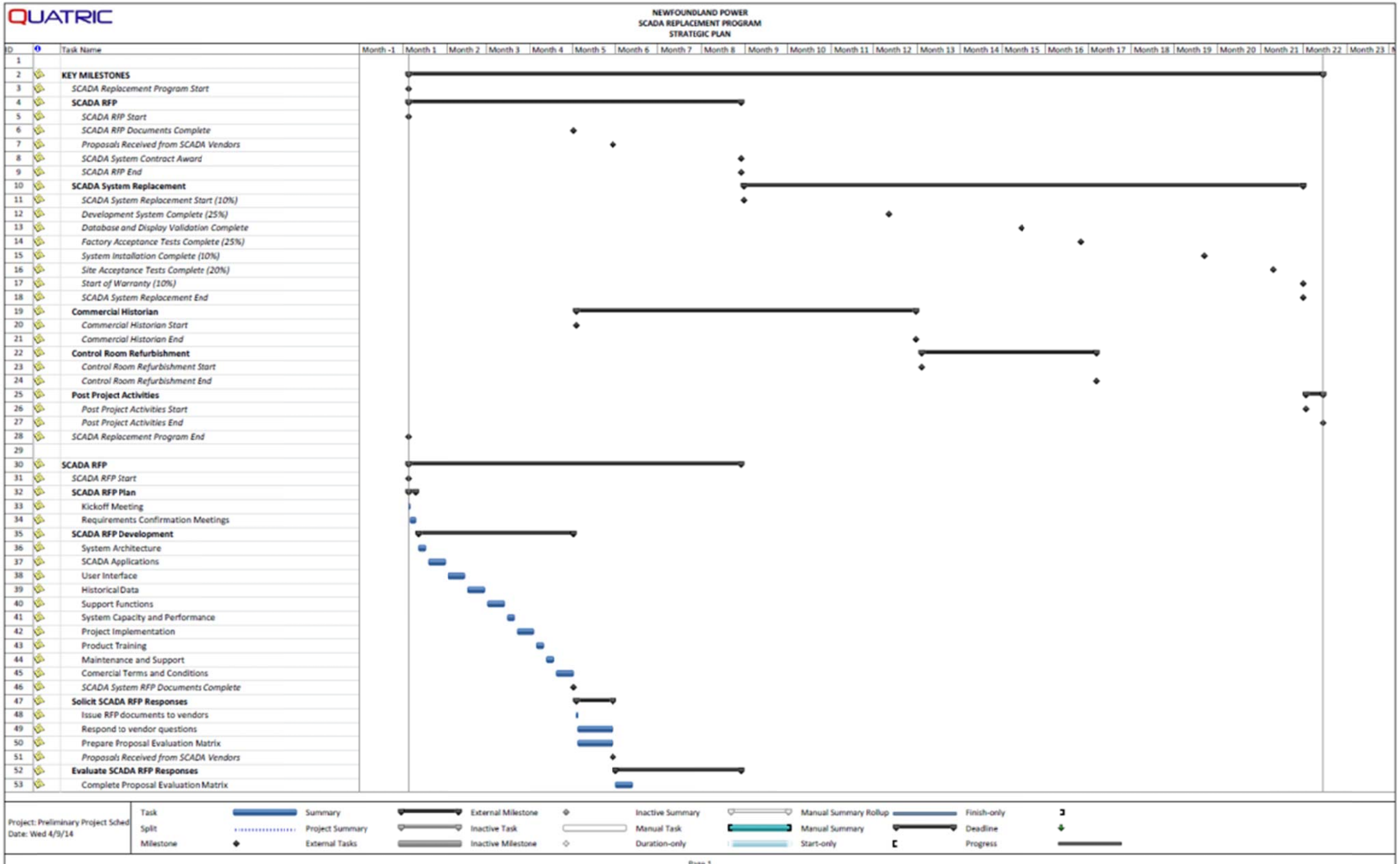
4.1.3 Resourcing

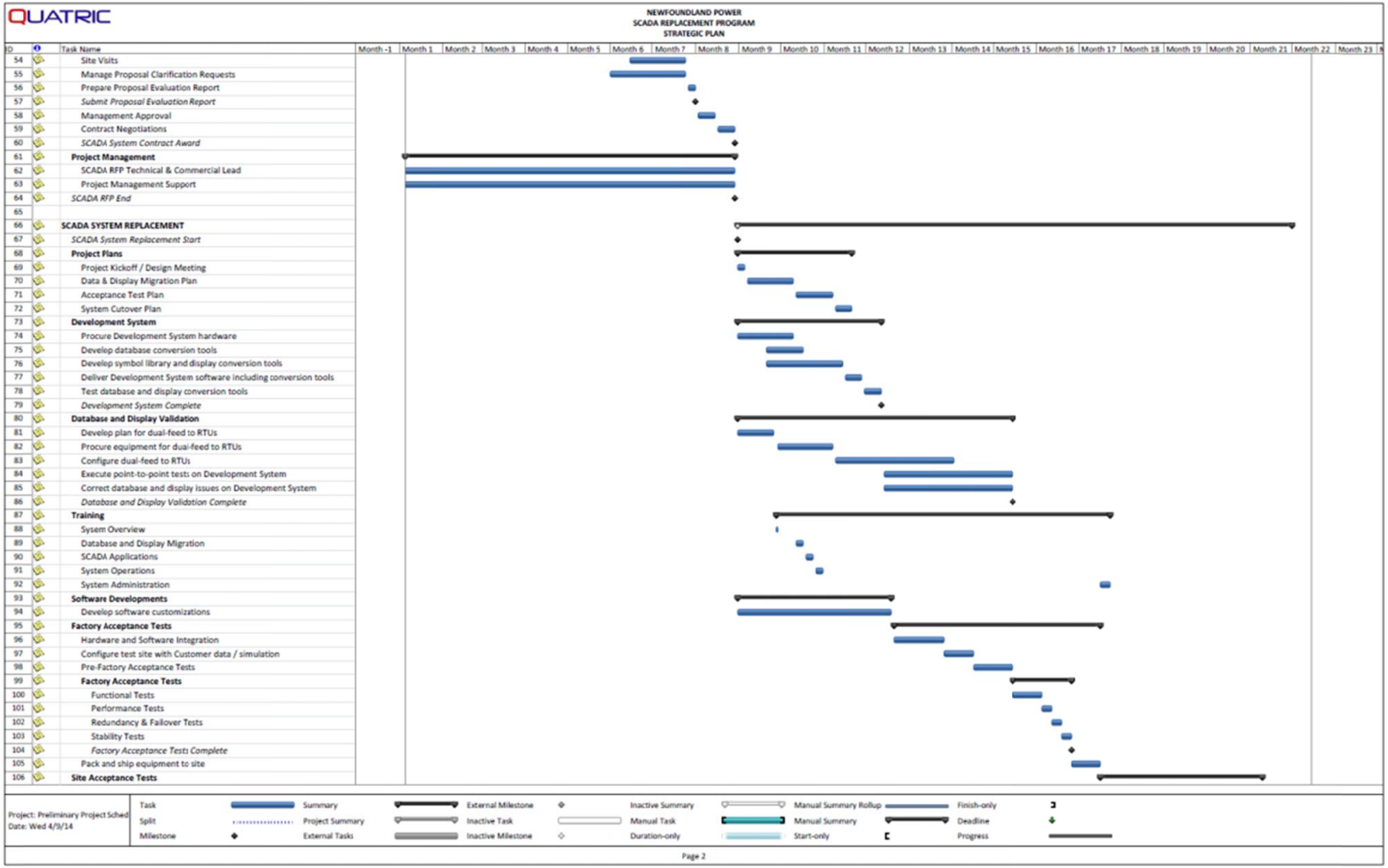
This Strategic Plan assumes that the development of the RFP specifications will be led by an external Consultant with experience developing SCADA RFP specifications, with support and input provided by the Owner's internal resources. Standard text and templates for the various specification documents will be provided by the Consultant, and will be updated to reflect the Owner's specific requirements.

The following roles will be required to support the RFP process (one person may be qualified to fulfill more than one of these roles):

1. **Project Manager**: Will be responsible for reviewing and specifying requirements for project implementation, coordinating the Owner's resources during RFP development, and negotiating the contract with the selected SCADA Vendor. Ideally this Project Manager will also manage the SCADA System Replacement once it has been awarded.
2. **SCADA Engineer**: Will be responsible for specifying and reviewing the requirements for the SCADA database, displays, configuration, and applications.
3. **System Administrator**: Will be responsible for reviewing and specifying requirements for the SCADA software installation and maintenance, including database and display conversion and maintenance.
4. **System Operator**: Will be responsible for reviewing and specifying requirements for SCADA user interface.
5. **RTU Engineer**: Will be responsible for reviewing and specifying the requirements for interfacing with the substations, including requirements for point-to-point testing.
6. **Communication Engineer**: Will be responsible for reviewing and specifying requirements for the communication network, including cyber security.
7. **Hardware Engineer**: Will be responsible for reviewing and specifying requirements for SCADA servers, workstations, SANs, operating systems, etc. to ensure that Corporate IT standards are maintained.
8. **SCADA Consultant**: Will lead the SCADA RFP development and produce the technical and commercial specifications. Will also lead the proposal evaluations, site visits, and proposal clarification questions. Will produce the Proposal Evaluation Report for review and approval by the Owner.

Figure 4-1: Project Schedule




QUATRIC
NEWFOUNDLAND POWER
SCADA REPLACEMENT PROGRAM
STRATEGIC PLAN
ID
Task Name
Month -1
Month 1
Month 2
Month 3
Month 4
Month 5
Month 6
Month 7
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Month 9
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Month 20
Month 21
Month 22
Month 23
54 Site Visits
55 Manage Proposal Clarification Requests
56 Prepare Proposal Evaluation Report
57 Submit Proposal Evaluation Report
58 Management Approval
59 Contract Negotiations
60 SCADA System Contract Award
61 Project Management
62 SCADA RFP Technical & Commercial Lead
63 Project Management Support
64 SCADA RFP End
65
66 SCADA SYSTEM REPLACEMENT
67 SCADA System Replacement Start
68 Project Plans
69 Project Kickoff / Design Meeting
70 Data & Display Migration Plan
71 Acceptance Test Plan
72 System Cutover Plan
73 Development System
74 Procure Development System hardware
75 Develop database conversion tools
76 Develop symbol library and display conversion tools
77 Deliver Development System software including conversion tools
78 Test database and display conversion tools
79 Development System Complete
80 Database and Display Validation
81 Develop plan for dual-feed to RTUs
82 Procure equipment for dual-feed to RTUs
83 Configure dual-feed to RTUs
84 Execute point-to-point tests on Development System
85 Correct database and display issues on Development System
86 Database and Display Validation Complete
87 Training
88 Sysem Overview
89 Database and Display Migration
90 SCADA Applications
91 System Operations
92 System Administration
93 Software Developments
94 Develop software customizations
95 Factory Acceptance Tests
96 Hardware and Software Integration
97 Configure test site with Customer data / simulation
98 Pre-Factory Acceptance Tests
99 Factory Acceptance Tests
100 Functional Tests
101 Performance Tests
102 Redundancy & Failover Tests
103 Stability Tests
104 Factory Acceptance Tests Complete
105 Pack and ship equipment to site
106 Site Acceptance Tests
Project: Preliminary Project Sched
Date: Wed 4/9/14
Task
Split
Milestone
Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
Deadline
Progress
Page 2


NEWFOUNDLAND POWER
SCADA REPLACEMENT PROGRAM
STRATEGIC PLAN
107 Hardware installation
108 Software installation and configuration
109 System Installation Complete
110 Database and display conversion
111 Site Acceptance Tests
112 Site Acceptance Tests Complete
113 System Cutover
114 Final database and display conversion
115 System Cutover
116 Parallel Operation
117 Start of Warranty
118 Project Management
119 SCADA Project Manager
120 SCADA Project Consultant
121 SCADA System Replacement End
122
123 COMMERCIAL HISTORIAN
124 Commercial Historian Start
125 Procurement
126 Develop Requests for Proposals
127 Solicit Proposal Responses
128 Evaluate Proposal Responses
129 Commercial Historian Contract Negotiations
130 Commercial Historian Contract Award
131 Implementation
132 System Installation, Configuration and Training
133 Migrate existing historical data to PI
134 Develop Corporate Reports & Displays
135 Project Management
136 Commercial Historian Technical Lead
137 Project Management Support
138 Commercial Historian End
139
140 CONTROL ROOM REFURBISHMENT
141 Control Room Refurbishment Start
142 Design & Construction
143 Develop control room design
144 Solicit quotations for products and services
145 Construction
146 Project Management
147 Project Manager
148 Control Room Refurbishment End
149
150 POST PROJECT ACTIVITIES
151 Post Project Activities Start
152 Decommission old SCADA hardware
153 Project Management
154 Project Manager
155 SCADA Project Consultant
156 Post Project Activities End
Project: Preliminary Project Sched
Date: Wed 4/9/14
Task
Split
Milestone
Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
Deadline
Progress
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4.2 SCADA System Replacement

Regardless of the SCADA vendor selected, the sequence of events for the replacement of the SCADA system will be similar. This Strategic Plan is based on a 12-month schedule for the SCADA System Replacement, which is in line with the budgetary estimates provided by the SCADA Vendors which ranged from 9 months to 12 months.

4.2.1 Major Activities

The SCADA System Replacement phase is divided into the following major components:

1. **Project Plans**: Although the plans will be developed by the SCADA Vendor, the Owner's resources will be required to review and approve these critical documents.
2. **Development System**: A Development System will need to be delivered to the Owner early in the project in order to allow the Owner to verify and validate the database and display conversion. The Owner will need to work closely with the SCADA Vendor to support the development of the database and display conversion tools.
3. **Database and Display Validation**: Point-to-point testing will be performed on a subset of the SCADA points in order to assess the quality of the database and display conversion process. The Development System from item 2 will be used for this purpose, but dual feeds to the substation RTUs will need to be configured prior to running the tests. These activities will be executed primarily by the Owner's resources, with support provided by the SCADA Vendor if required.
4. **Training**: Training for the Owner's resources will be conducted in a timely manner such that the training is provided "just-in-time". For example, user training for the System Operators will be provided prior to the Factory Acceptance Tests.
5. **Software Developments**. It is recognized that some software customizations will be required to satisfy all of the Owner's requirements. This activity will be undertaken by the SCADA Vendor based on inputs received during the project planning phase.
6. **Factory Acceptance Tests**: In order to ensure that the new SCADA system satisfies all of the Owner's requirements prior to being installed on-site, a Factory Acceptance Test will be executed by the SCADA Vendor. The Owner's resources will travel to the SCADA Vendor's factory to witness the execution of the acceptance test procedures. The tests should include functional tests, performance tests, redundancy and failover tests, and stability tests.
7. **Site Acceptance Tests**: Once the system has been accepted at the SCADA Vendor's factory, the system will be shipped to the Owner's site, installed, and configured. To ensure the system functions correctly with all of the Owner's interfaces, a Site Acceptance Test will be conducted by the Owner and supported by the SCADA Vendor.
8. **System Cutover**: Once the new SCADA system has been certified in the new environment, a final database and display conversion will be performed and the system cutover. The old SCADA

system will not be decommissioned until after a stability period (parallel run), typically 10 days, of uninterrupted execution.

9. **Post Project Activities**: Once the Owner is satisfied with the operation of the new SCADA system, the old SCADA system will be decommissioned. This involves removing the servers, workstations, cables, etc. and recycling the material.

4.2.2 Resourcing

The following roles will be required to support the SCADA System Replacement (one person may be qualified to fulfill more than one of these roles):

1. **Project Manager**: Will be responsible for overall project implementation and status reporting, managing the project budget, coordinating the Owner's resources, and managing the SCADA Vendor, managing risks, and resolving conflicts.
2. **SCADA Engineer**: Will be responsible for verifying and validating the SCADA database, displays, configuration, and applications.
3. **System Administrator**: Will be responsible for verifying and validating the SCADA software installation and maintenance procedures, including database and display conversion and maintenance procedures, and point-to-point testing procedures..
4. **System Operator**: Will be responsible for verifying and validating the SCADA user interface.
5. **RTU Engineer**: Will be responsible for configuring dual ports to each substation RTU for point-to-point testing.
6. **Communication Engineer**: Will be responsible for verifying and validating the communication network infrastructure, including cyber security, and assisting the RTU Engineer to implement dual ports to each substation RTU.
7. **Hardware Engineer**: Will be responsible for verifying and validating the SCADA servers, workstations, SANs, operating systems, etc. to ensure that Corporate IT standards are maintained. Will also procure the hardware that is not provided by the SCADA Vendor.
8. **SCADA Consultant**: The SCADA Consultant will assist the project team with the implementation of the SCADA replacement. Activities will include participation in all project meetings and conference calls, reviewing project documents, participating in the acceptance tests, and providing guidance to the project team.

4.3 Commercial Historian

This Strategic Plan is based on acquiring the software licenses for the commercial historian directly from the manufacturer (e.g. OSIsoft), and using a system integrator with experience with the commercial historian to install, configure, and deploy the software for the Owner. The system integrator will also provide hands-on training for the first 10 corporate displays and reports so that the Owner can then complete the corporate reports and displays.

The Owner has a preference to implement the Commercial Historian in 2015, interfacing with the existing SCADA System initially, and then migrating the interface to the new SCADA system when it is commissioned in 2016.

4.3.1 Major Activities

The Commercial Historian phase is divided into the following major activities:

1. **Procurement**: Once the specifications for the SCADA System Replacement are complete and issued to the qualified SCADA Vendors, the RFP for the Commercial Historian can be started. The timeframe is much shorter since there are fewer requirements and fewer suppliers. Once proposals have been received, a contract will be negotiated for the agreed scope of work.
2. **Implementation**: The Owner will be responsible for procuring the hardware for the commercial historian based on the specifications from the software manufacturer (e.g. OSIsoft). The hardware will be installed directly on-site and the System Integrator will travel to the Owner's site to install and configure the historian software. The Current Vendor will be engaged to install their native interface to the commercial historian. The System Integrator will then migrate the existing historical data and provide hands-on training to the Owner's resources. The Owner will then complete the development of the corporate reports and displays.

4.3.2 Resourcing

The following roles will be required to support the Commercial Historian (one person may be qualified to fulfill more than one of these roles):

1. **Project Manager**: Will be responsible for overall project implementation and status reporting, coordinating the Owner's resources, and managing the suppliers.
2. **SCADA Engineer**: Will be responsible for reviewing the historical data migration, building and validating the corporate reports and displays.
3. **System Administrator**: Will be responsible for supporting the historical data migration, validating the software installation and configuration, and maintaining the commercial historian system.
4. **SCADA Consultant**: The SCADA Consultant will assist the project team with the selection and implementation of the commercial historian. Activities will include development of the RFP specifications and evaluation of proposals.

4.4 Control Room Refurbishment

The primary goal of the control room refurbishment is to remove the obsolete large screen display and to re-allocate and re-fresh the control room floor space to enhance interaction amongst the Operators and Dispatchers, as well as provide new ergonomic work stations that will better meet the goals of occupational health and safety, and improve productivity.

4.4.1 Major Activities

The Control Room Refurbishment phase is divided into the following major activities:

1. **Develop control room design**: A plan for the floor space will be developed in order to identify an optimal layout and to identify the materials (furniture, carpet, etc.) that will be required.
2. **Solicit quotations for products and services**: Quotes for the various products and services needed for the refurbishment of the control room will be obtained and rationalized to ensure the budget is respected.
3. **Construction**: The construction phase is expected to take approximately 6 weeks.

4.4.2 Resourcing

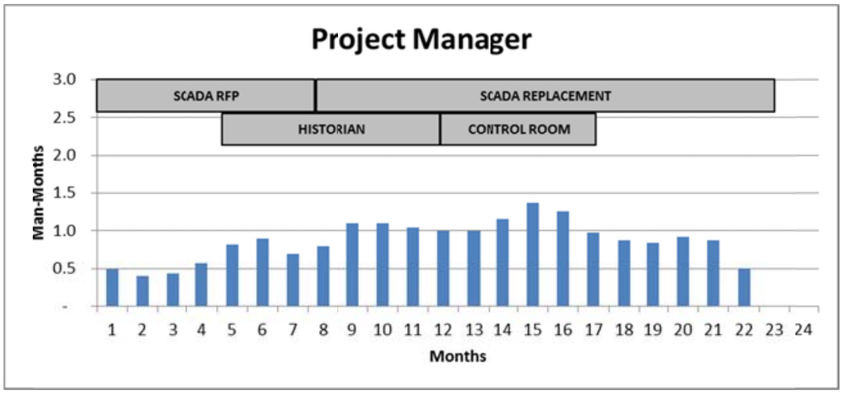
The following roles will be required to support the Control Room Refurbishment (one person may be qualified to fulfill more than one of these roles):

1. **Project Manager**: Will be responsible for overall project implementation and status reporting, coordinating the Owner’s resources, and managing the suppliers.
2. **System Operators**: Will be consulted to ensure the planned refurbishment will meet their expectations and requirements.
3. **Control Room Consultant**: The Control Room Consultant will assist the project team with the design and implementation of the control room refurbishment. The Control Room Consultant will have experience designing control rooms for electric utilities, and understand the ergonomic and human factors for work space layout.
4. **Construction Contractors**: Construction contractors will be engaged to refurbish the control room. The Owner’s facilities team should be consulted for recommended contractors that have done business with the Owner and have a good business relationship with the Owner.

4.5 Manloading

In order to implement the SCADA Replacement Project, the Owner will need to assign operational and IT resources to execute the various activities as outlined in this Strategic Plan. Some resources will need to devote more time to project activities than others, and as a result the Owner will need to ensure that its staffing plan will support the SCADA Replacement project. The following sections identify the various resource requirements during all phases of the project:

1. **Project Manager**: A Project Manager with SCADA experience will need to be assigned to the project full-time, and the budgetary estimate assumes that an internal resource will be used to fill this role. If an internal resource is not available, an external consultant could be used to fill this role, but the labour rate in the budgetary estimate would need to be adjusted to reflect this human resourcing strategy.

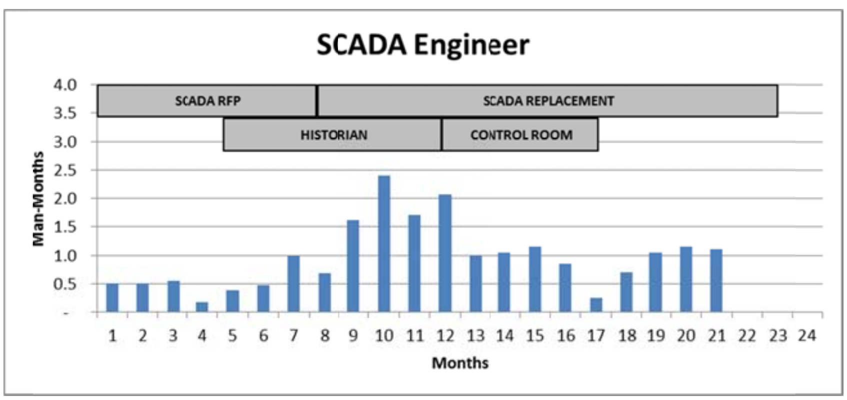


2. **SCADA Engineer**: The SCADA Engineering activities vary during the course of the project and result in the following requirements:

    a. One (1) SCADA Engineer will need to be assigned to the project on a part-time basis (half-time) for the first six (6) months to support the SCADA RFP effort. This requirement can likely be filled with existing resources.

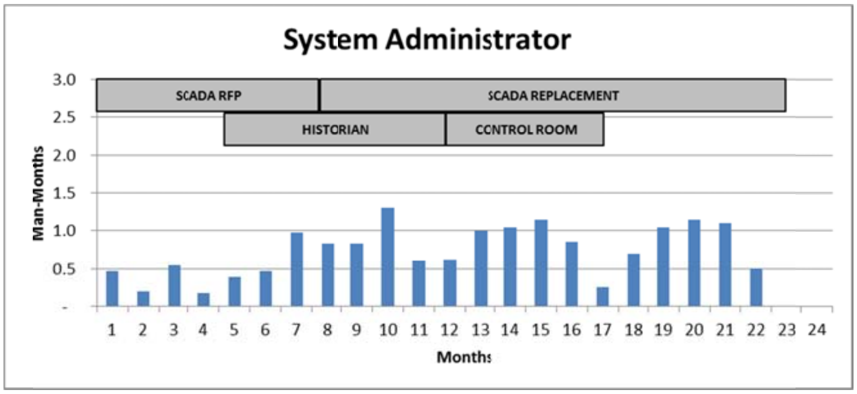
    b. Two (2) full-time SCADA Engineers will be needed months 9 through 12 for database and display conversion, and to develop the commercial historian displays and reports.

    c. One (1) SCADA Engineer will be required for the remainder of the project for acceptance testing, system installation, and commissioning.

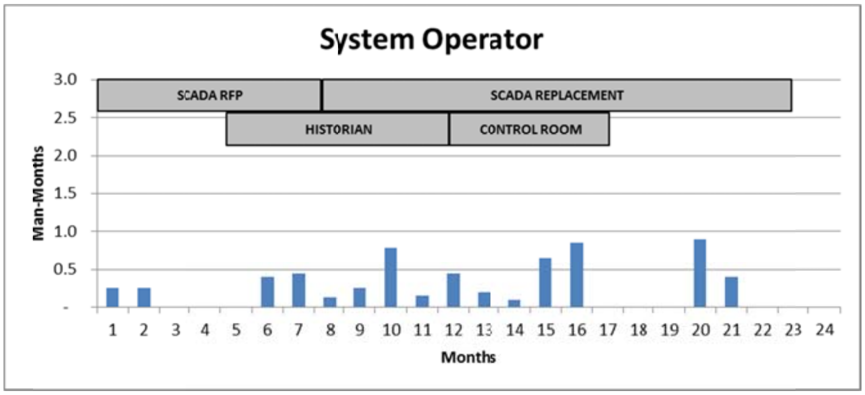


Since the current SCADA Engineer is occupied full-time on the existing SCADA System, additional resources will be needed to support the project. This is a common issue with SCADA replacement projects, and utilities often assign the existing SCADA Engineer to work on the new SCADA System, and bring in temporary resources to perform the SCADA engineering activities on the old SCADA system, and to develop corporate displays and reports. This allows the SCADA Engineer to acquire hands-on experience with the new SCADA system prior to system cutover.

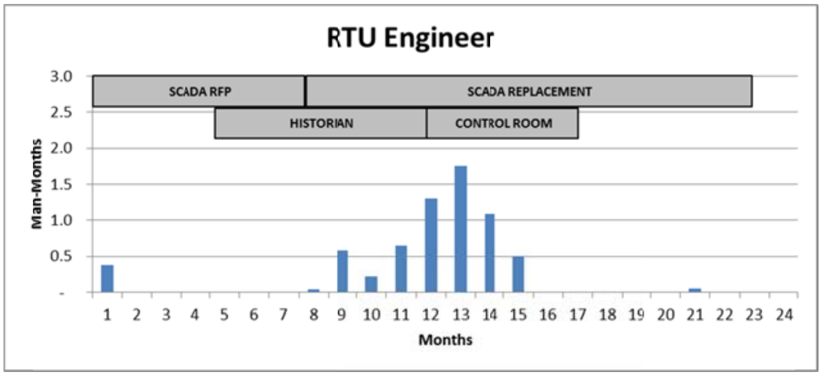
3. **System Administrator**: A System Administrator will need to be assigned to the project on a part-time basis (half-time) for the first six (6) months, averaging out to a full-time position for the remainder of the project. As with the SCADA Engineer, utilities often assign the existing System Administrator to work on the new SCADA System, and bring in a temporary resource to perform the system administration activities on the old SCADA system. This allows the System Administrator to acquire hands-on experience with the new SCADA system prior to system cutover.



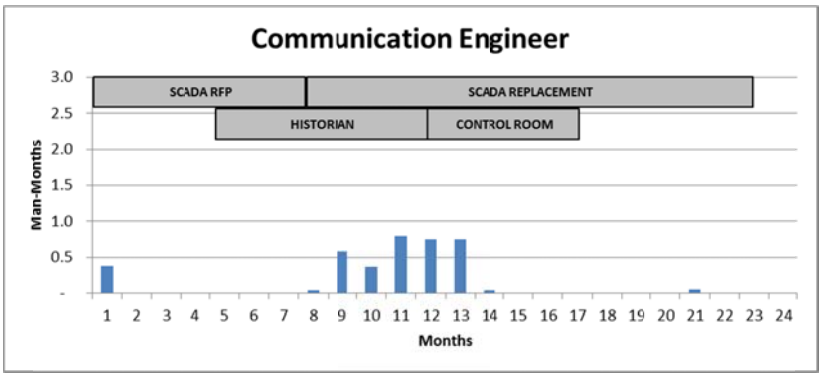
4. **System Operator**: Participation of a System Operator will be sporadic throughout the project, providing inputs during the SCADA RFP phase, and participating in the acceptance testing of the new system. These activities can be performed by existing resources.



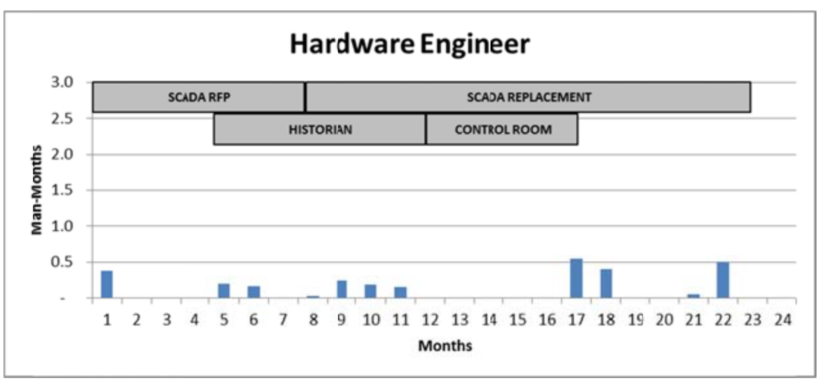
5. **RTU Engineer**: Participation of an RTU Engineer will be required briefly at the beginning to provide requirements for point-to-point testing, then concentrated in months 12 through 14 to configure dual ports on the substation RTUs. These activities can likely be performed by existing resources, provided the work is planned well in advance.



6. **Communication Engineer**: Participation of a Communication Engineer will be sporadic throughout the project, providing inputs during the SCADA RFP phase, and participating in the configuration of dual ports on the substation RTUs. These activities can be performed by existing resources.



7. **Hardware Engineer**: Participation of a Hardware Engineer will be sporadic throughout the project, providing inputs during the SCADA RFP phase, procuring hardware, acceptance testing, and decommissioning the old SCADA system. These activities can be performed by existing resources.



5 Budgetary Cost Estimates

The following budgetary estimate is based on a detailed analysis of the activities and resources required to execute the SCADA Replacement project.

SCADA System Replacement	$4,300,000
Commercial Historian	$976,000
Control Room Refurbishment	$399,000
TOTAL BUDGETARY ESTIMATE (CAD)	**$5,675,000**

These estimates are based on the following global parameters:

SCADA Project Contingency	15%
Commercial Historian Contingency	15%
Control Room Refurbishment Contingency	15%
Project Cost of Capital	6.0%
USD-CAD Exchange Rate	1.10

Details of the individual estimates is provided in the following sections. The Microsoft Excel spreadsheet and Microsoft Project schedule showing the activities, resources, and dependencies have been provided separately.

5.1 SCADA System Replacement

In order to support the estimates for the SCADA System Replacement, budgetary quotations were solicited from the following organizations:

1. Schneider Electric (Houston, Texas) – SCADA System
2. Open Systems International Inc. (OSII) (Minneapolis, Minnesota) – SCADA System
3. Survalent Technology (Mississauga, Ontario) – SCADA System

Following is a summary of the budgetary quotations received from the SCADA Vendors:

Table 5-1: SCADA Vendor Budgetary Quotations

SCADA VENDOR BUDGETARY QUOTES	Schneider	OSII	Survalent
Hardware	$497,600	$305,266	$244,000
Standard Product Licenses	$699,300	$850,000	$429,000
Standard Product Deployment	$740,000	$650,000	$190,000
Data Conversion Tools and Services	$62,000	$64,000	$40,000
Display Conversion Tools and Services	$64,000	$64,000	$50,000
Software Customizations	$115,000	$0	$80,000
Training & Workshops	$97,000	$41,125	$26,000
Travel & Living Costs	INCLUDED	$35,000	INCLUDED
Warranty	$103,000	$28,250	INCLUDED
Maintenance and Support - Year 1	$140,000	$101,250	$24,429
TOTAL	**$2,517,900**	**$2,138,891**	**$1,083,429**

Estimates were adjusted to ensure they offered comparable functionality and performance, and an average of the budgetary quotation components was used as the basis for this budgetary estimate. In addition, to calculate the cost of capital, the following payment milestones were assumed:

- SCADA System Replacement Start (10%)
- Development System Complete (25%)
- Factory Acceptance Tests Complete (25%)
- System Installation Complete (10%)
- Site Acceptance Tests Complete (20%)
- Start of Warranty (10%)

Internal efforts were estimated based on the project plan presented in Section 4, Project Plan.

Table 5-2: SCADA System Replacement Budgetary Estimate

SCADA System Replacement	Total
SCADA Request for Proposals Costs	
SCADA RFP - Engineering Labour	$99,600
SCADA RFP - Internal Labour	$42,840
SCADA RFP - Contract Labour	$0
SCADA RFP - Other Labour (Consultants)	$217,600
SCADA RFP - Travel & Living	$47,500
Subtotal SCADA Request for Proposals Costs	**$407,540**
SCADA Vendor Deployment Costs	
SCADA Vendor - Material (hardware, third-party software, etc.)	$349,000
SCADA Vendor - Standard Product Licenses	$659,500
SCADA Vendor - Standard Product Deployment	$526,700
SCADA Vendor - Data Conversion Tools and Services	$55,400
SCADA Vendor - Display Conversion Tools and Services	$59,400
SCADA Vendor - Software Customizations - Development and Deployment	$97,500
SCADA Vendor - Training & Workshops	$54,800
SCADA Vendor - Travel & Living Costs	$35,000
SCADA Vendor - Warranty	$65,700
SCADA Vendor – Maintenance & Support (Year 1)	$88,600
Subtotal SCADA Vendor Deployment Costs	**$1,991,600**
NP SCADA Deployment Costs	
NP SCADA - Material (hardware, third-party software, etc.)	$301,000
NP SCADA - Engineering Labour	$426,080
NP SCADA - Internal Labour	$178,440
NP SCADA - Contract Labour	$0
NP SCADA - Other Labour (Consultants)	$190,600
NP SCADA - Travel & Living (Project Meetings, Testing, Training)	$56,000
Subtotal NP SCADA Deployment Costs	**$1,152,120**
SCADA System Replacement Subtotal	**$3,551,260**
SCADA System Replacement Contingency	$533,400
SCADA System Replacement Cost of Capital	$214,736
SCADA SYSTEM REPLACEMENT TOTAL (ROUNDED UP)	**$4,300,000**

5.2 Commercial Historian

Budgetary quotations were solicited from the following organizations to support this estimate:

1. OSIsoft – PI Historian
2. ADM System Engineering – PI Historian Implementation
3. GCM Consulting - PI Historian Implementation

An average of the budgetary quotations received from the suppliers was used as the basis for this budgetary estimate.

Table 5-3: Commercial Historian Budgetary Estimate

Commercial Historian	Total
PI Integrator Deployment Costs	
PI Integrator - Material	$0
PI Integrator - Deployment Costs	$61,000
PI Integrator - Training & Workshops	$0
PI Integrator - Travel & Living	$12,000
Subtotal PI Integrator Deployment Costs	**$73,000**
NP PI Deployment Costs	
NP PI - Material (hardware, third-party software, etc.)	$574,368
NP PI - Engineering Labour	$92,480
NP PI - Internal Labour	$18,660
NP PI - Contract Labour	$0
NP PI - Other Labour (Consultants)	$65,200
NP PI - Travel & Living (Project Meetings, Testing, Training)	$0
Subtotal NP PI Deployment Costs	**$750,708**
Commercial Historian Subtotal	**$823,708**
Commercial Historian Contingency	$124,000
Commercial Historian Cost of Capital	$27,707
COMMERCIAL HISTORIAN TOTAL (ROUNDED UP)	**$976,000**

5.3 Control Room Refurbishment

Budgetary quotations were solicited from the following organizations to support this estimate:

1. Evans Consoles – Control Room Desks

Table 5-4: Control Room Refurbishment Budgetary Estimate

Control Room Refurbishment	Total
Control Room - Materials (furniture, desks, carpet, etc.)	$260,767
Control Room - Engineering Labour	$19,280
Control Room - Internal Labour	$2,880
Control Room - Contract Labour	$28,800
Control Room - Other Labour (Consultants, etc.)	$19,200
Subtotal Control Room Refurbishment	**$330,927**
Control Room Refurbishment Subtotal	**$330,927**
Control Room Refurbishment Contingency	$49,800
Control Room Refurbishment Cost of Capital	$17,993
CONTROL ROOM REFURBISHMENT TOTAL (ROUNDED UP)	**$399,000**

5.4 Maintenance and Support

All of the SCADA Vendors offer varying levels of software support for their product. The following tables provide the annual maintenance support costs over the first 5 years.

Table 5-5: Maintenance and Support Budgetary Estimates

Maintenance and Support Costs	Schneider	OSII	Survalent
Maintenance and Support - Year 1	$140,000	$101,250	$24,429
Maintenance and Support - Year 2	$144,200	$106,313	$24,429
Maintenance and Support - Year 3	$148,500	$111,628	$24,429
Maintenance and Support - Year 4	$153,000	$117,210	$24,429
Maintenance and Support - Year 5	$157,600	$123,070	$24,429
TOTAL MAINTENANCE AND SUPPORT COSTS	**$743,300**	**$559,471**	**$122,145**

5.5 Options

SCADA Vendors were asked to provide budgetary quotes for their Outage Management System software and Operator Training Simulator software for consideration by the Owner. The following budgetary estimates were provided:

Table 5-6: Options Budgetary Estimates

Options	Schneider	OSII	Survalent
Outage Management System	$260,000	$309,150	$250,000
Operator Training Simulator	$48,000	$101,290	$30,000
TOTAL OPTIONS	**$308,000**	**$410,440**	**$280,000**

6 Next Steps

Following are the recommended next steps for the SCADA Replacement Project:

1) Submit capital budget request in the 2015 Capital Budget Application.
2) Organize vendor presentations to review products and services. Suggested vendors include:
    a) Open Systems International (OSII) (SCADA)
    b) Schneider Electric (SCADA)
    c) Survalent Technology (SCADA)
    d) OSIsoft (PI Historian)
    e) ADM System Engineering (PI Integration)
3) Conduct site visits at other Canadian electric utilities to assess their tools (SCADA, historian, OMS, GIS, etc.), control room facilities, and support structure. Project references have been provided for the following Canadian utilities that are of similar size to the Owner:
    a) Eastern Canada
        i) Newfoundland & Labrador Hydro, St. John's, Newfoundland (OSI Monarch SCADA)
        ii) Nova Scotia Power (OSI Monarch SCADA / Schneider ADMS)
    b) Central Canada / USA
        i) Duke Progress Energy, Raleigh, North Carolina (Schneider ADMS)
        ii) PowerStream, Vaughan, Ontario (Survalent SCADA)
        iii) Austin Energy, Austin, Texas (Schneider ADMS)
    c) Western Canada
        i) ENMAX, Calgary, Alberta (Survalent SCADA)
        ii) ATCO Electric, Vegreville, Alberta (OSI Monarch SCADA)
        iii) Fortis BC, Trail, British Columbia (Survalent SCADA)
4) Review internal staffing options for key project positions.
5) Identify possible SCADA Consultants to assist the Owner with the project implementation.