NEWFOUNDLAND AND LABRADOR HYDRO

Technology and Communications Infrastructure

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newfoundland labrador hydro
a nalcor energy company

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EXECUTIVE SUMMARY

Newfoundland and Labrador Hydro (Hydro) has completed a comprehensive review of the events surrounding the supply disruptions on the Island Interconnected System during January 2-8, 2014. The review included an investigation of the rotating outages which occurred between January 2-8, 2014[1] and the transmission/terminal station equipment failures which occurred on January 4 and 5, 2014.

This report outlines the results of Hydro's internal review of the availability and performance of the Energy Management System (EMS), administrative computing systems, telecommunication and network systems, and the Hydro Place (HP) emergency generating system during the electricity supply disruptions.

Hydro has four levels of back-up in the event that power is lost to the Energy Control Centre (ECC): diesel, battery, manual and a remote back-up control centre. On January 4, 2014, Hydro's diesel emergency generation system shutdown shortly after it was automatically activated as a result of the widespread power disruptions, and loss of the Newfoundland Power (NP) distribution feeder to HP. When the diesel emergency power source shutdown, Hydro's Uninterruptible Power Supply (UPS) batteries were activated. The batteries supplied power to the EMS and administrative computer facilities until they were fully depleted and the systems shut down due to complete power loss (11:03). When the EMS shut down, the ECC Operators followed manual protocol, and began voice communication with key stakeholders, including Hydro generation sites, terminal stations, and NP.

Information Technology (IT) on-call support was notified of the resultant system shutdown. Minutes later, the diesel emergency generator was manually restarted by on-site Building Operations Supervisor, providing power to HP.

[1] Rotating outages occurred on January 2, 3, 5 and 8, 2014.

IT on-call support arrived on site within 30 minutes (11:30) and the EMS was restored to operation within 16 minutes (11:46). After the EMS core system was restored, there was further activity required to restore the EMS auxiliary systems and to validate that the data and system integrity checks were complete. After the EMS systems were recovered, the focus shifted to the administrative system recovery. IT support consulted with senior management regarding the order and priority of system recovery in response to the critical business needs identified on site during the power failure. IT staff then began the effort required to implement the required controlled systematic recovery of servers, storage and application systems. Integrity checks took place during recovery to ensure no data loss, data corruption and/or systems damage resulted from the loss of power. This testing identified no significant system or data damage (two hard drives on redundant back-up servers were affected and a minor amount of real time EMS data were recovered and replaced). The critical administrative systems were recovered and operational by 15:00.

In total, EMS was inoperable for 43 minutes between shutdown and restoration due to loss of electrical power, shutdown of the emergency generation system, and depletion of the UPS batteries. Consequently, the EMS system was not able to control and monitor activities at the generating and transmission facilities, requiring the ECC to follow established protocol for the loss of EMS function. Without the administrative systems, certain business functions, such as the ability to update outage information on Hydro's website, electronically manage the Work Protection Code System to track work plans, and send/receive corporate e-mail, were negatively impacted.

Overall, the review found that HP Operations and Information Systems employees responded quickly to the events of January 4, and worked together to restore building power and computer systems. As well, telecommunications and network systems functioned as designed ensuring the availability of data, voice, and teleprotection circuits between the ECC and remote terminal and generating stations. The EMS system and administrative computing systems also performed as designed outside the period affected by loss of power.

Following the events of January 4, 2014 Hydro reconfirmed that the NP distribution feeder to HP be restored on a priority basis. This protocol is now in place in the event of future power outages. Investigation of the cause of the diesel unit failure is complete, and the identified issues have been addressed.

Based on the findings, the following recommendations are being actioned.

- TCI 1: Establish a protocol with Newfoundland Power to have HP power feeder restored as soon as possible if interrupted.
- TCI 2: Investigate the cause of the "under frequency" and synchronization alarms experienced on January 3 and 4, 2014.
- TCI 3: Identify documents related to system restoration including cold start procedures, which need to be available in an offline, hard copy format.
- TCI 4: Investigate and rectify problems with ventilation louver control.
- TCI 5: Investigate options to provide redundant operation of the HP diesel generation room cooling system.
- TCI 6: Review design of emergency lighting at HP.
- TCI 7: Identify documents related to system restoration including cold start procedures, which need to be available in an off-line, hard copy format.
- TCI 8: Establish a process for monitoring critical alarms from the HP UPS on a 24/7 basis.

1 INTRODUCTION

This report outlines the results of Hydro's internal review of the availability and performance of the EMS, administrative computing systems, telecommunication and network systems, and the HP emergency power generation system.

The sequence of events, which resulted in the loss of power to the EMS and administrative computer systems, and the timing of the restoration of power to HP and computer systems are detailed in full. The report presents immediate recommendations that have been implemented, as well as future actions. These recommendations aim to mitigate or prevent similar events.

2 REVIEW PROCESS

In completing the review, Hydro reviewed the data from the local Remote Terminal Unit (RTU), electronic logs from computer systems, UPS systems, and emergency generation system to establish a timeline of events. The input of the employees who were involved in operating and managing key assets, and those who participated in the response and restoration efforts, was also critical in documenting timelines and actions taken. The ECC team, who are the primary users of the EMS, were also engaged to provide their perspective. Additional input was solicited from the maintenance contractors during the review of the HP emergency generation system.

3 BACKGROUND

3.1 EMS and Administrative Computing Systems

Control and monitoring of devices on the interconnected grid is carried out from the ECC, located at HP in St. John's. The EMS is a computer system that supports these functions for the ECC. All components of the EMS are dual redundant, meaning in the event of a failure of the prime component, a secondary component assumes that function within seconds. This system has had a 100% availability factor since its initial deployment in June 2006.

The EMS is powered by a UPS. A UPS is typically used to protect hardware such as computers, data centers, telecommunication equipment, or other electrical equipment where an unexpected power disruption could cause injuries, serious business disruption, or data loss. The UPS is comprised of three units. The UPS was designed to tolerate the loss of a single UPS unit and still meet the EMS power requirements. If the NP distribution feeder to HP is interrupted, the UPS is designed to carry the EMS power load until the emergency diesel generators are operational, and provide stable power, or time to properly shut down the protected equipment.

The administrative computing environment includes all corporate computing systems, for example, financial tracking and planning, supply chain management, human resources monitoring and planning, plant maintenance, work order management, customer service, safety, work protection code, as well as access to shared storage of files (printing, systems access and security, email, Smartphones, Microsoft Office Suite, Adobe, etc.). These systems are located in a separate computer room from the EMS, and are powered by a separate UPS system. There is a comprehensive Disaster Recovery Plan (DRP) to address the loss of administrative computer systems. In the event that the administrative computing systems at HP cannot be recovered in a timely manner, there is a plan in place to relocate critical administrative operations to a data site in Markham, Ontario, which is tested annually.

Similarly, there is a comprehensive DRP, including the option of relocating to a back-up control centre, in place to address the loss of the EMS. This DRP is tested annually.

3.2 Telecommunications and Network Systems

Hydro's owned and maintained telecommunications infrastructure provide teleprotection that is used in conjunction with power system protective relaying to provide the best possible means of isolating faults on high voltage transmission lines. These protection schemes are designed to limit the impact of the provincial power grid during fault conditions by selectively removing the faulted line in the shortest possible time. The protection equipment, in

combination with teleprotection circuits, not only helps to preserve power system stability, but also protects Hydro's transmission and generation assets from damage during fault conditions.

3.3 HP Emergency Power Supply

The ECC, Corporate Emergency Operations Centre (CEOC), engineering and functional support staff, as well as the systems that support electricity operations and other business functions, are located in HP in St. John's.

HP emergency generation system has two diesel generators supported by other systems including fuel, power control, and pneumatic controls. In the event of a loss of building power, both generators will start and provide power to the building's essential services. After 15 minutes of run time, one of the diesel generation units will shut down and the power load will be serviced by the single on line unit. If that on line unit fails, the standby unit starts in order to maintain power supply. Historically, the HP emergency power generation system has met its design criteria of having at least one of the two generators (G1 or G2) available at all times since installation in 1989.

The HP emergency power generation system is tested on a bi-weekly schedule, and any noted issues are addressed by contracted technicians.

4 SEQUENCE OF EVENTS

This section of the report provides the sequence of events (SOE) at HP related to the emergency power systems that resulted in the loss of power to the EMS, and administrative computer systems.

Table 1: Sequence of Events

DEC 27, 2013		
DATE	**EVENT**	**COMMENT**
Dec. 27, 2013		Planned annual maintenance was completed on both HP generator engines (G1 and G2) by Hydro's contractor. Minor issues were addressed accordingly.

JAN 3, 2014		
TIME	**EVENT**	**COMMENT**
06:44	G2 failed to synchronize	While HP emergency generation system was being started to reduce the interconnected system load, G2 failed to synchronize and was shut down. The diesel technicians were unable to immediately determine why G2 would not synchronize so the unit was tagged out of service. G1 was running for 12 minutes when a high temperature alarm forced its shutdown. The high temperature alarm was triggered by lack of cooling air, caused by mechanical failure of the ventilation louver activation system, which allows cooling air to enter the diesel generation room.
08:30		Johnson Controls investigated the cause of the failure of the ventilation louvers. It was determined that the air dryer for the pneumatic system operating the actuator had failed. Parts were not available to repair the failed air dryer so it was bypassed, and a new one ordered.
10:08		G1 was manually started to help reduce the Interconnected System load.

JAN 3, 2014		
20:19		G1 was shut down when the Interconnected System load demand decreased.

JAN 4, 2014		
TIME	**EVENT**	**COMMENT**
08:45 Approx.	Building Operation Supervisor arrives at HP	After receiving supervisory alerts from ADT Security services, Building Operations Supervisor attended HP to ensure no significant events were in progress.
09:05	NP feeder lost to HP	EMS and administrative UPS units were immediately switched to battery power.
		Building Operations Supervisor ensured HP emergency generation system was operating as required, including ventilation louvers.
09:05:45	Emergency generator G1 at HP started	G1 was ready to service HP essential power load including the EMS and administrative computers. G2 was unavailable because of the synchronization failure on January 3, 2014.
09:05:53	All four transfer switches switched to emergency power	EMS and administrative UPS were being supplied from G1.
09:11:54	Main Bus under frequency condition	Automatic load shedding, to stabilize frequency, resulted in the loads on transfer switches 2, 3, 4 being dropped. Administrative UPS and Unit 2 of the three units in the EMS UPS were running on battery.

JAN 4, 2014		
TIME	**EVENT**	**COMMENT**
10:10:00 Approx.	EMS UPS Unit 2 shutdown	Batteries in EMS UPS Unit 2 were depleted. EMS UPS Unit 2 had been running on battery since 09:11. (one-hour run time). Only two units in the EMS UPS were active (Units 1 and 3). These units were still being powered by G1.
10:15 Approx.	Building Operations Supervisor leaves HP	Building Operations Supervisor left HP temporarily to assist ECC Operations Supervisor who was stuck in snow enroute to HP.
10:38:44	G1 Shutdown	Shutdown resulted from a high temperature alarm. EMS UPS Units 1 and 3 were running on battery.
10:40 Approx.	Building Operations Supervisor notified of G1 shut down.	Building Operations Supervisor received call that G1 has shut down, and returned to HP immediately, arriving approximately 10:55.
11:02:50	EMS UPS shutdown	Batteries in the EMS UPS were depleted; resulting in the loss of EMS system and remaining administrative computer systems. Runtime on EMS UPS was 24 minutes. EMS on-call support was contacted by ECC operator.

JAN 4, 2014		
TIME	**EVENT**	**COMMENT**
11:02:50	ECC DRP implemented	ECC operators did not have a direct electronic overview of the status of the power grid. ECC operators activated the initial steps of the DRP, a manual protocol, including voice communication with key stakeholders and consideration of return to service at the backup site. The Standard Instruction 'Contingency Plan for Loss of EMS Function' is included as Appendix 3.
11:03:03	G1 restarted	The Building Operations Supervisor rectified the problem with the generator room vent louvers which resulted in the high temperature alarm at 10:38, forcing G1 to shut down. The unit was manually started by the Building Operations Supervisor, and appropriate actions taken to maintain reliable operation.
11:05	NP feeder restored	ECC called Newfoundland Power to request restoration of the feeder to HP. The feeder was immediately restored.
Approx. 11:08		EMS UPS restarted, requiring manual intervention to restart. Network Services on-call personnel were not on site at this point in time, but others perform restart. Restoration of the EMS and administrative computer systems could have proceeded. This is a manual process and the EMS on call person was not yet on site.

JAN 4, 2014		
TIME	**EVENT**	**COMMENT**
Approx. 11:30		The EMS on-call person was on site within 30 minutes of being called (required to be on site within one hour). EMS took immediate action to recover the EMS.
Approx. 11:40		Other team members arrived on site to provide assistance in restoring the administrative computing systems and assist with the restoration of the EMS.
11:46	EMS on-line	EMS system on line and providing grid control for ECC operators. Normal operations of the ECC resumed within 43 minutes.
	EMS system confirmation	EMS auxiliary systems restored, validated that the data and system integrity checks were complete.
	Administrative Computer Systems	IT support consulted with senior management regarding the order and priority of system recovery in response to the critical business needs identified onsite.
15:00 Approx.	Administrative Computer Systems restored	All critical administrative systems were restored and operational.
SUBSEQUENT RESOLUTIONS TO ISSUES IDENTIFIED		
	Synchronization failure remediation	Subsequent investigation indicated the synchronize failure resulted from a faulty rectifier, which has been replaced, and sticking breaker which is scheduled for service in April 2014.

JAN 4, 2014		
TIME	**EVENT**	**COMMENT**
	Ventilation louver remediation	Ventilation louver actuators are scheduled to be installed in April 2014, replacing the pneumatic system with more reliable electronically controlled equipment. The new activation system will provide redundancy in this area.
	Under frequency alarm remediation	The under frequency condition cleared, and has not recurred since. It is currently under investigation by Hydro contractor Madsen.

5 KEY FINDINGS AND RECOMMENDATIONS

5.1 HP Equipment Performance

The diesel generation units at HP are started and their ability to supply essential load is verified every two weeks. The last test prior to the January 4, 2014 outage being completed on January 2, 2014. In addition, fuel supplies are maintained at HP to run backup generation. After receiving notification of supervisory alerts from ADT, the Building Operations Supervisor attended HP to ensure there were no significant issues related to the inclement weather. The fuel supply was at approximately 8,000 litres, and with the exception of the actuators for the cooling system louvers, all systems operated as designed, including the shut down of G1 for a 25-minute duration due to the high heat alarm. Equipment is regularly tested and maintained. The annual preventative maintenance of the diesel engines was performed on December 27, 2013. Subsequent to the 25-minute shut down due to overheat alarm, the emergency generation system successfully ran in excess of 213 hours between January and March of 2014.

Following the issues with the building emergency power systems on January 4, 2014, there was limited emergency lighting to allow personnel to work and there was no battery powered emergency lighting in key areas, including the stairwells.

A review of the loss of power to HP on January 4, 2014 has identified several opportunities for improvement and areas for further investigation.

RECOMMENDATION		STATUS	
TCI 1	Establish a protocol with NP to have HP power feeder restored as soon as possible if interrupted.	Complete	Protocol includes HP not to be dropped, and in case of interruption, to have priority restoration.
TCI 2	Investigate the cause of the under frequency and synchronization alarms experienced on January 3 and 4, 2014.	In Progress	Cause of synchronization alarms has been determined and repaired. Under frequency is still being investigated by Madsen.
TCI 3	Identify documents related to system restoration including cold start procedures, which must be available in hard copy format.	In Progress	The emergency diesel SOE log is now being reviewed daily to highlight potential issues. Review of Preventative Maintenance (PM) program now complete and in the process of being documented.
TCI 4	Investigate and rectify problems with ventilation louver control.	In Progress	Replacement to be complete by April 2014.
TCI 5	Investigate options to provide redundant operation of the HP diesel generation room cooling system.	In Progress	Replacement of ventilation louver controls will include redundancy protection.
TCI 6	Review design of emergency lighting at HP.	Planned	To be complete by June 30, 2014.

5.2 EMS and Administrative Computing Equipment Performance

The EMS and administrative computing systems performed as expected, other than issues arising from loss of power. On January 4, 2014, Hydro's diesel emergency generation system shutdown shortly after it was automatically activated by the widespread power disruptions. When this diesel emergency power system shutdown, Hydro's UPS batteries were activated. The batteries supplied power to the EMS and administrative computer facilities until the batteries were fully depleted and the systems shut down due to complete power loss (11:03).

IT on-call support was notified of the resultant system shutdown. Minutes later, the diesel emergency generator was manually started, providing power to computer facilities, allowing the process of system restoration to begin upon arrival of the IT on-call support, who arrived within thirty minutes.

The EMS was restored to operation within 16 minutes of the on-call support personnel arrival. Following EMS restoration, further activity required to restore EMS auxiliary systems and to validate that the data and system integrity checks were completed. IT staff then began to implement the required controlled, systematic recovery of servers, storage, and application systems. The abrupt shutdown, due to loss of power, introduced the potential for systems and data damage. Consequently, extra effort was required to ensure integrity checks took place during recovery restart to ensure no data loss, data corruption and/or systems damage. The critical administrative systems were recovered and operational by 15:00.

As a part of storm preparation, the ECC had additional staff working during the morning of January 4, 2014.

With the functional loss of the EMS computing systems, the ECC responded by taking the following actions in order to secure the power system: 1) the ECC coordinated with NP to inform them of the situation and to request that they monitor the power system and to advise

the ECC of any issues on the power system; 2) the ECC contacted the Bay d'Espoir control room to advise them of the situation, requested that they monitor and control the system frequency, and monitor and control the generating units at the hydro plants; and 3) the ECC communicated with the Holyrood Generating Facility control room, terminal stations, and generating stations which had personnel to advise them of the situation and to advise the ECC of any issues at those locations.

Coincident with the above, discussions took place between System Operations and Energy Systems personnel regarding the activation of the Backup Control Centre Disaster Recovery Plan (BCC DRP). The decision was made to stay at the HP ECC.

At the time the EMS function was lost, the ECC were working towards restoring transmission lines and stabilizing the system frequency. Once the EMS was returned to service, the ECC continued to restore transmission lines to service and stabilize the power system.

RECOMMENDATION		STATUS	
TCI 7	Identify documents related to system restoration including cold start procedures, which must be available in hard copy format.	In Progress.	Continuous improvement related to system restoration. The system cold-start procedures are currently being updated and stored as hard copy. To be completed by April 15.

5.3 Telecommunications and Network Systems Equipment Performance

All backup generators and battery supplies for telecommunications and network systems equipment at remote microwave, terminal, and generating sites worked as designed during the January 4, 2014 system outage. As well, all data, voice, and teleprotection circuits functioned

as designed. This performance ensured the availability of data, voice, and teleprotection circuits between the ECC and all remote terminal and generating stations as well as the system protection signalling between terminal stations.

The two UPS systems that provide backup power supply to the EMS and administrative computing equipment in HP also operated as intended on January 4, 2014 and provided backup power to the EMS (24 minutes) and administrative computing equipment (95 minutes), in excess of design criteria.

A review of the January 4, 2014 events highlighted opportunities to improve UPS alarm monitoring and communication. These improvements are required to expedite employee response to ensure controlled shutdown[2] and restoration of the systems if the UPS batteries are depleted.

RECOMMENDATION		STATUS	
TCI 8	Establish a process for monitoring critical alarms from the HP UPS on a 24/7 basis.	In Progress	The critical alarms from the EMS UPS are now monitored 24/7. Methods and protocols are being investigated to provide 24/7 monitoring of the administrative computing UPS. An alternate method is required for the other UPS systems. The EMS critical alarms are now displayed on the operator console in ECC, as well as being e-mailed to on-call staff.

[2] A controlled shutdown of the computer systems would avoid potential damage resulting from an uncontrolled shutdown resulting from loss of power.

APPENDICES

Appendix 1 - Acronyms and Definitions

Administrative Computing Systems –All Nalcor computing services except the EMS.

DRP – Disaster Recovery Plan – A document detailing how computer services will be restored when lost.

ECC – Energy Control Center - Control room at HP that is staffed 24/7 by operators who manage the interconnected power grid.

EMS – Energy Management System - Computer system located at HP that provides control and monitoring of the power grid to the ECC.

IS – Information Systems – The department within Nalcor that is responsible for the EMS and administrative computing services.

NMC – Network Management Center – A room at HP that is staffed during business hours were the Nalcor communications networks are monitored.

NP – Newfoundland Power.

UPS – Uninterruptable Power Supply – A battery system used to supply temporary power.

Corporate Emergency Operations Centre – The Corporate Emergency Operations Centre (CEOC) is located in HP and is the area where personnel will meet to manage Nalcor's response to any emergency.

WPC - Work Protection Code – A safety protocol to provide workers with a safe work area when working around energized equipment. In the absence of the electronic system, a paper-based process is used to ensure worker safety.

Computer Rooms - There are three Nalcor computer rooms.
The EMS computer room is located on the second floor of HP and hosts the EMS and ancillary services related to the control and monitoring of the power grid.
The administrative computer room is located on the first floor of HP and hosts the administrative computing systems.

Mapboard - The front wall of the ECC is comprised of a grid of tiles and lamps referred to as a mapboard. The overall layout of the power grid is depicted on this mapboard; the lamps are color-coded to dynamically represent the status of various devices on the power grid.

Remote Terminal Unit (RTU) - A device used to collect readings from equipment and communicate that data to the EMS. A RTU resides at HP and is used to collect information regarding the status of the emergency power system as well as environmental data such as temperature in the computer rooms.
An alarm is generated at the operators console in ECC when an abnormal condition is detected by the RTU.

HP Emergency Generation - HP emergency diesel generation system is comprised of two generators (G1 and G2), along with supporting systems. In the event of a loss of building power both generators will start and provide power for building essential services including the UPS systems. After 15 minutes of generator run time, one of the generators will shut down and the power load will be serviced by a single on-line generator. If that on-line generator were to fail the standby generator, if available, would start and pick up the system power load.

ECC UPS - This UPS is comprised of three units, it was designed to tolerate the loss of a single unit and still meet the EMS power requirements. It is designed to provide a minimum of 17 minutes run time. The expectation is that the diesel units would have started and picked up system load within that time frame.

Admin UPS - This UPS is comprised of two units, it was designed to tolerate the loss of a single unit and still meet the power requirements. It is designed to provide a minimum of 17 minutes run time. The expectation is that the diesel units would have started and picked up system load within that time frame.

Transfer Switches - Transfer switches automatically control the switch to the emergency generators in the event of the loss of the NP distribution feeder.

There are five transfer switches incorporated in the NLH emergency power system. With regard to the operation of the EMS and administrative computer systems four of the transfer switches are relevant.

- Switch 1 supplies Unit 1 of the three units in the EMS UPS.
- Switch 2 supplies Unit 2 of the three units in the EMS UPS.
- Switch 3 supplies both Units of the Administrative UPS.
- Switch 1 or Switch 2 supplies Unit 3 of the three units in the EMS UPS depending on the position of switch 5.

When diesel generators are supplying power to HP, the voltage and frequency from the generators are monitored. If these values are not within an acceptable range, transfer switches will drop load from the diesels. The switches are prioritized with regard to the order in which loads will be dropped. If after a load is dropped on a particular switch the voltage and frequency are within acceptable ranges higher priority loads will remain on diesel power. The load in transfer Switch 1 which supplies the EMS will never be dropped by this automated system.

Appendix 2 - HP Emergency Generation

The HP emergency generation system is designed to provide power to key areas of HP when power is not available from the NP distribution system. The system was commissioned when HP, which opened in 1989, was constructed.

The generation system is centered on two Caterpillar model 3406B diesel generation sets, designed to provide redundant emergency power supply to the building. They are described as G1, and G2. Each unit is rated to produce 300 Kw, while the typical demand during operation is approximately 180 Kw. As of the 2013 preventative maintenance carried out on December 27, 2013, G1 had 295 operating hours, and G2 had 291 operating hours, for a combined total of 586 hours since their installation in 1989. Both units are installed in an indoor room on level two, at the northwest corner of HP. Both diesel engines are subject to a comprehensive annual inspection, and advanced generator preventative maintenance plan, carried out by Glenn Nichols Engine Services Ltd, a Caterpillar trained technologist.

Fuel is provided by a fuel system including a 9,092-litre above ground tank installed outside of HP, and a 630-litre day tank in the generator room. This system was commissioned in 2005, replacing previously installed underground fuel storage system. Fuel dips are carried out on a weekly basis, at which time there is also a visual inspection of the system. Given the low consumption rate, the fuel in the system is quality tested on an annual basis.

The diesel generation room is kept at a minimum temperature of approximately 20 C during standby to ensure maximum reliability and ease of starting as required. Once the diesel generator units are running, the room is cooled using forced air, driven by fans on the diesel units, and a system of ventilation louvers which are normally closed, but open for cooling purposes when the diesel generation units are running. The ventilation louvers are operated by means of a pneumatic control system installed in the mechanical penthouse of HP. Among other systems in HP, this single pneumatic system provides control for the louvers on both diesel generators, and rooftop exhaust fan in the diesel generation room.

The emergency generation system is controlled through a series of breakers and switches. The recommended service interval on the breakers is three to five years. They were last serviced by the manufacturer's agent in December 2010, and are scheduled for next service in April 2014.

The diesel generation system at HP is tested on a biweekly basis by building operations personnel. This involves initiating a manual test on each of the four transfer switches that starts both diesel generation sets, allowing one of them to take the load, then the second unit to synchronize to the to the first and then share the load. One unit automatically stops after 15 minutes, entering stand-by mode. The diesel generators alternate which unit stays on each time they are operated. This testing procedure lasts approximately 30 minutes.

It is estimated that of the combined 586 hours operating time recorded on these units as of December 27, approximately 450 hours would have been from the testing routine since 1989. As of March 13, 2014, G1 had a total of 482 operating hours, while G2 had 317, for a combined total of 799 hours. Total run time, primarily in support of island load since December 27 has been 213 hours exceeding the total non-testing run time since commissioning in 1989, estimated at 136 hours.

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NEWFOUNDLAND AND LABRADOR HYDRO - OPERATIONS

STANDARD INSTRUCTION

TITLE:	**Inst. No.** 015
Contingency Plan For Loss of The Energy Management System Function	**Rev. No.**
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Introduction

The Energy Management System (EMS) is used by the Energy Control Centre (ECC) to operate the power systems on the Island and in Labrador. If the EMS fails and is unable to function, operation of the power system must be carried out by staffing generation and terminal stations normally operated using the EMS. The details of this plan, which are directed by ECC staff, are included in the Contingency Plan for Loss of EMS Function retained as part of several technical and administrative instructions maintained by ECC. This instruction outlines the responsibilities of operating staff who are required to attend stations, the preparation required, and the frequency for testing the contingency plan.

Preparedness

To ensure that individuals are familiar with the procedures and responsibilities associated with this instruction, this contingency plan will be simulated yearly to measure effectiveness.

Responsibilities

Asset Managers – Generation and Terminal Stations	1.	Managers should ensure that personnel are aware of this procedure and the rationale for its creation.

PREPARED BY:	**APPROVED/CHECKED BY:**	**ISSUED DATE:** 2003-07-15
C. Kirby		**REV. DATE:**

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NEWFOUNDLAND AND LABRADOR HYDRO - OPERATIONS

STANDARD INSTRUCTION

TITLE: **Contingency Plan For Loss of The Energy Management System Function**	**Inst. No.** 015 **Rev. No.** **Page** 2 **of** 4

Responsibilities (cont'd.)

Asset Managers – Generation and Terminal Stations	2.	Managers should ensure that the detailed contingency plan referred to in the introduction, equipment manuals, paper/pencils, functional communications equipment, PPE for switching, and other equipment/materials needed by staff during an EMS outage, to manually monitor and control a station, are available at each station listed in the detailed plan.
Regional On-call Supervisors	1.	When contacted by ECC, supervisors will be required to staff stations with switching personnel, and plant operators where appropriate. ECC will identify the stations or plants that require manual operation.
	2.	When presented with event logs from switching or plant personnel, the logs should be forwarded to the Superintendent of ECC.
Hydro Generation On-call Supervisors	1.	When contacted by ECC, supervisors will dispatch operators to the plants specified by ECC.
	2.	ECC will indicate if personnel are required at flow control structures.

PREPARED BY:	**APPROVED/CHECKED BY:**	**ISSUED DATE:** 2003-07-15
C. Kirby		**REV. DATE:**

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STANDARD INSTRUCTION

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Responsibilities (cont'd.)

Hydro Generation On-call Supervisors	3.	When presented with event logs from plant personnel, the logs should be forwarded to the Superintendent of ECC.
Switching Staff and Plant Operators	1.	When arriving on site contact the Energy Control Centre, identify oneself, location and any unsafe conditions that would require immediate attention. Await instructions from ECC. The priority for communications is Operational Voice, Newfoundland Telephone, then VHF.
	2.	ECC staff will contact station personnel hourly to obtain operating data key to that station, (i.e. generation levels, transmission lines flows, bus voltages, delivery point voltages etc. which ever are appropriate). Station personnel shall maintain an hourly log of information and record the time and nature of any abnormal system event, (i.e. time of alarm/outage and activating device/relay), and contact ECC when such an event occurs.

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Responsibilities (cont'd.)

Switching Staff and Plant Operators	3.	Staff should retain their event logs and present them to the appropriate on-call supervisor.
ECC Superintendent	1.	Shall arrange for an annual simulation of the plan to ensure its effectiveness.

PREPARED BY:	**APPROVED/CHECKED BY:**	**ISSUED DATE:** 2003-07-15
C. Kirby		**REV. DATE:**