2011 Power System Reliability Workshops Summary

December 2011

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1. Executive Summary

This report provides an assessment of our 2011 Power System Reliability Workshops, based on feedback from participants, our own observations and recommendations for enhancing this program in 2012.

Each reliability workshop featured the review of Ontario's bulk electricity system, its operation and IESO/restoration participants' roles in maintaining system reliability in normal and abnormal conditions including implementation of the Ontario Power System Restoration Plan (OPSRP). The facilitated workshops used presentations and drill scenarios to review and practice communication and simulated implementation of control actions to recover and restore the power system. Each emergency operational scenario outlined the objectives of securing generating stations and returning units to service quickly following a system disturbance, and expediting plant recovery and grid restoration.

Our Workshop Experience

Since 2001, we have conducted large-scale integrated emergency exercises in an effort to build our emergency preparedness in Ontario and to help market participants meet their obligations to test their own emergency plans.

To enhance our emergency preparedness program after the August 2003 blackout, we have been conducting yearly power system restoration-related workshops across Ontario. As a result, a total of fifty nine workshops across Ontario have been conducted. The Emergency Preparedness Task Force reviews and is annually requested to endorse reliability exercises and the workshop program.

The workshops built on the success of previous efforts, addressed participant feedback from previous sessions and incorporated drill scenarios to simulate emergency grid operations and the Ontario Power System Restoration Plan (OPSRP) implementation.

On October 26th, 2011 the IESO also organized and coordinated an Ontario-wide which also included simultaneously participating in a multi-regional integrated restoration exercise. The objectives were focussed on system recovery following an intense geo-magnetic disturbance (GMD) event which caused system instability and a blackout. Post-blackout communication and grid restoration with many Ontario participants and all of our neighbouring entities ensued to rebuild the power system.

The 2011 Workshops

We held one 2-day and five single-day reliability workshops:

- **Sarnia** for local industry and generators
- **Ajax** for Pickering A & B NGS's and Darlington NGS, and two distributors
- **Kingston** - including Ottawa & St. Lawrence River hydroelectric, Lennox, Kingston Co Gen and Brookfield Renewable Power
- **Sault Ste. Marie** for NE and NW generators and Lake Superior Power , PUC Distribution
- **London** involving nine generators, and one distributor
- **Bruce Power** for Bruce A & B NGS combined with Beck 2, River Control and Nanticoke GS (2 days).

We addressed operational topics during the workshops based on specific learning objectives, including:

- Recovery capabilities, constraints and timelines specific to each station and their switchyard.
- Ontario's Power System Restoration Plan strategies and priorities.
- Energizing transmission lines out from generating stations to the grid from all four black start stations, one nuclear and two fossil generating stations.
- The recent Ontario Power System Restoration Plan (OPSRP) revisions and enhancements were reviewed and practiced with all affected participants at relevant workshops (Specific Independent Actions, Alternative Arrangements and Enhanced Capabilities).

We requested feedback from all participants so that we could evaluate workshop effectiveness and consider changes for 2012. More than 350 operations staff from companies and organizations participated (ref. 'Appendix A: Participant List').

2011 Workshop Highlights

- Sharing and discussing generating station/transmitter/IESO requirements, constraints and timelines proved very effective, and these workshops reinforced critical steps toward coordinated action.
- The workshops gave operators an opportunity to reaffirm the specifics of their facilities and equipment, especially plant recovery requirements, constraints and timelines, along with an opportunity to practice restoration through simulated responses to abnormal power system frequency and power system events.

- Nuclear and grid operators were able to practice jointly implementing the strategy of a nuclear generating station unit energizing out to expedite unit and switchyard recovery. The workshop helped verify the feasibility of the strategy and associated operating procedure which has been subsequently approved for use.
- The stuck breaker scenario (a circuit breaker that is closed and inoperable) and the operations necessary to recover grid reliability, continues to generate lots of discussion and interaction.
- The overall positive approval rating for these reliability workshops reinforces the need to continue scheduling more for 2012.
- The workshop-associated facility tours are excellent for newer as well as seasoned operators' familiarity to see first-hand the physical transmission and/or generation equipment that make up the key elements for power system operation.
- Petro-chemical Industries found the Sarnia workshop of tremendous value to simulate communication with the IESO and other entities as well practicing implementation of the new OPSRP Alternative Arrangements and internal emergency procedures.

2. 2011 Workshops Enhancements

All feedback and recommendations from our 2010 Workshops were considered and addressed in planning the 2011 Workshops.

We have adopted a modular approach to the workshop breaking down our activities into distinct segments. For a given segment we presented the supporting material, performed a table top drill then led a group discussion to summarize the key points of learning. During each table top drill, operators communicate, one-at-a-time over a microphone so everyone in the room can hear the conversation.

All workshop materials were provided to attendees two weeks ahead of the workshop including a table top drill table listing, per segment, the learning objectives, expected activities and related operating procedure sections. A sample table top drill segments table for the Sarnia workshop is included in Appendix C.

For 2011, we implemented enhancements based on needs and participant feedback. These include:

1. Revising/reducing presentation content to allow for more drill time.

2. Reviewing and simulating applicable new OPSRP procedures, where relevant (Specific Independent Actions, Alternative Arrangements and Enhanced Capabilities).

3. Using new SCADA displays to better illustrate those areas where Alternative Arrangements and Enhanced Capabilities apply, as needed (Sault Algoma and Triangle Recovery respectively).

4. Increasing participation for workshop attendees by introducing a table break-out session related to abnormal frequency independent actions.

NERC Continuing Education (CE) Hours

- As part of the NERC continuous education hour program, these workshops helped eligible participants to meet NERC standard requirements for NERC Certified System Operator certificate renewals.

NERC reliability standards require grid and system operators to be certified, and require that they receive 32 hours of emergency operations training each year. To maintain their certification, operators accredited under this program need NERC-certified continuing education (CE) hours over a 3-year renewal period: Reliability Coordinator = 200 CE hours, Transmission Operator = 140 CE hours.

Each generator/IESO/transmitter workshop allowed each eligible system operator to earn approximately 6.5 continuing education hours that count towards emergency operations, training and contributes to their simulation training requirements. At this year's workshops, operators earned a total of 645.5 continuing education hours.

Company	CE Hours	CE Hours of Simulation
Hydro One	**378**	**235**
Great Lakes Power	**30**	**17.5**
IESO	**237.5**	**146.5**
Total	**645.5**	**399**

Facility Tours

Wherever possible, workshop attendees toured local generating facilities and adjacent switchyards. They also witnessed a nuclear plant simulator session at Bruce Power and OPG's Darlington. These tours offered excellent field training opportunities for operational staff.

We acknowledge the following facility operators for conducting very informative tours:

- **Hydro One** - Cherrywood TS, Lambton TS, Lennox TS, Bruce A switchyards and the Detweiler TS SVC
- **OPG** - Lennox GS
- **TransAlta** – Wolfe Island Wind Farm
- **Great Lakes Power** and **Brookfield Power** - for Mackay TS, Mackay GS, Gartshore GS and Andrews GS
- **Bruce Power** - Bruce B NGS
- **TransCanada** – Halton Hills GS
- **Essar Steel** – Sault Ste. Marie Operations

3. Participation

Over 359 individuals, representing 35 companies and organizations, attended the 2011 workshops (see Appendix A); including:

- 6 industrial customers
- 7 distributors
- 17 generators (included all of Ontario's black-start providers, and nuclear power stations)
- 2 transmitters
- IESO
- Emergency Management Ontario
- Ministry of Energy

Recommendations on Future Participation

We encourage all market participants, especially operations staff, to continue to attend these reliability and system restoration workshops. As in the past, we expect the individuals who attend to share their knowledge with the other operators at their companies.

With rapidly changing employee demographics, there is an incentive for participants to arrange workshop attendance for their newer staff. To gain the most from the workshops, we encourage participants to ensure they have a basic level of knowledge, or are accompanied by an experienced colleague who can coach them during the workshop.

To help meet this challenge, we have posted publically a 29-minute restoration-related recorded presentation and will expect that each workshop attendee view this presentation as a pre-requisite to attending any 2012 workshop. The presentation can be found at the following location:

http://www.ieso.ca/imoweb/marketplaceTraining/showCourses.asp?id=17

If preferred, a restoration guide is also available for printing.

4. Participant Feedback

At the end of each day, participants completed a feedback questionnaire. Overall results were very positive with over 99% responding favourably (ie. score of 3 or 4) to the feedback questionnaire. The comments confirmed the value of the workshops, and offered suggestions for future years.

	1 - being poor						2						3						4- being excellent					
	Sarnia	Bruce	Kingston	Ajax	Sault Ste Marie	London	Sarnia	Bruce	Kingston	Ajax	Sault Ste Marie	London	Sarnia	Bruce	Kingston	Ajax	Sault Ste Marie	London	Sarnia	Bruce	Kingston	Ajax	Sault Ste Marie	London
Workshop pace	0	0	0	0	0	0	0	2	0	3	0	0	24	15	7	17	14	29	35	20	26	16	34	26
Level of interactivity	0	0	1	0	0	1	1	0	0	5	0	0	18	14	6	15	16	32	40	23	26	16	32	22
Module objectives completed	0	0	0	0	0	0	1	1	0	0	0	4	29	7	6	13	13	16	27	29	26	22	35	35
Drill segments were effective	0	0	0	1	0	0	2	0	0	3	7	6	23	3	4	15	17	30	33	31	29	17	24	19
Information presented effectively	0	0	0	0	0	0	0	1	0	2	0	3	19	13	11	16	15	25	39	23	22	18	33	27
Overall quality of training	0	0	0	0	0	0	0	0	0	1	0	0	19	11	6	16	16	27	40	26	27	17	32	28
Presenter knowledgeable	0	0	0	0	0	0	0	0	0	0	0	0	5	5	3	7	7	5	54	32	30	29	42	50
Presentation clear & orgnaized	0	0	0	0	0	0	0	1	0	2	0	0	13	8	4	5	11	22	46	28	29	29	38	33
Slides effective	0	0	1	0	0	0	0	1	0	3	2	5	15	8	4	16	14	21	44	28	28	18	32	29
Handouts appropriate & effective	0	0	0	0	0	0	0	1	0	3	1	3	16	10	4	13	12	18	43	26	26	18	35	32

5. Next Steps

Time and time again, participants expressed overwhelming positive response to the workshops. To build on this momentum and with participant's support, we are continuing the workshop program for 2012 with a strong consideration for participant feedback.

All workshops presently have defined segment scenario objectives. They are designed to achieve the higher overall objectives of the workshop program and have been developed by the IESO and its major participants. These include:

- Engage all participants using interactive scenarios/activities
- Use effective 3-way communication to reinforce system reliability and restoration strategies/priorities/procedures to increase individual situational awareness/knowledge
- Paint the 'big picture' of power system operation
    - What are the IESO's and participants' roles/obligations for system reliability (during normal and abnormal conditions)
    - Familiarize participants with equipment/facility/system constraints/operational standards/rules
- Meet NERC/Market Rule training requirements
- Issue North American Electric Reliability Corporation (NERC) Continuous Educational Hours (CEH), where appropriate

These objectives will continue to be incorporated in designing all workshops. It is important that all attending participants absorb as much learning as possible during the workshop.

2012 Proposed Workshops

After careful consideration of the needs and locational diversity of participants, we have proposed five workshops in 2012 based on OPSRP restoration paths/strategies:

#	Date	Workshop Participants	Location
1.	**April 18/19**	"Triangle Recovery" - combined with OPG Saunders and Ottawa River Plant Group, Northland Power, Cardinal Power – OPG Pickering & Darlington, Toronto Hydro, PowerStream, Hydro One and IESO.	Ajax area
2.	**May 16/17**	Bruce Power, OPG Beck and Nanticoke, Hydro One and IESO.	Kincardine/Port Elgin
3.	**June 12**	NE Ontario Generators including, Brookfield Power, PUC Distribution, Essar Algoma, Vale Inco, Great Lakes Power, Hydro One and IESO.	Sudbury
4.	**Sept. 13**	NW Ontario Generators including Thunder Bay TGS, Atikokan TGS, Hydro One, Manitoba Hydro, Minnesota Power and IESO.	Thunder Bay
6.	**Oct. 4**	Southern Ontario Generators, Hydro One and IESO.	London

In addition to six proposed 2012 workshops, we will help organize, facilitate and participate in a Distributor-specific exercise and a Northeast Power Coordinating Council (NPCC), Reliability Coordinator (RC) restoration exercise, including Hydro One and our interconnected neighbouring entities.

2012 Proposed Exercises

Date	Exercise Participants	Location
Mar. 21	Distributors/Transmitters/IESO	Each participant's normal work headquarters or shadow control room.
Oct. 24	IESO, Hydro One and neighbouring operating entities.	Each participant's normal work headquarters or shadow control room.

Recommendations from 2011 Workshops:

While feedback from the Workshops was overwhelmingly positive, the following opportunities for improvement have been highlighted. We reviewed and summarized their feedback and IESO staff observations to determine ways and opportunities to improve the workshops. Four of the resounding feedback themes are listed below:

#	Comment	Actions Taken
1.	Participant feedback expressed a preference for more table-top drill time. Although the workshops are segmented and well paced, reducing the presentation content remains the only choice to granting more table-top drill time.	Reduce Presentation time to < 30% of total workshop time Change the workshop format/design to allow more drill time
2.	Due to the large attendance at some of the workshops, some participants were not involved in each table-top drill scenarios.	Change the workshop format/design to allow all participants to engage to the drill scenarios Limit the size of the workshop to design effective drill scenarios
3.	We displayed the progress of system restoration during our workshops via IESO SCADA-derived diagram as well as geographical shown on the projector screen.	Continue efforts to enhance the display of system restoration diagrams during our workshops. Consider using individual table laptops using wireless web connection to a webinar.
4.	Due to the large attendance at some of the workshops, implementing new OPSRP content was awkward to implement.	Affected restoration participants to continue to update their operations staff using their internal training programs. Arrange smaller training sessions with affected participants.

Proposed 2012 Workshop Format

Through participant discussions and feedback, we are proposing the following 2012 workshop modifications to address this year's recommendations:

		Description
Morning	**Part 1** Presentations ~ 1.5 hrs	- All tables with mixed company representatives (assigned seating) - High level Reliability structure in Ontario & North America - NERC /NPCC restoration-related updates - Core OPSRP Presentations to review/discuss key restoration-related principles - Other brief participant presentations (as needed)
	Part 2 Table break-out sessions ~ 2 hrs	- Use common reliability issues (i.e. stuck breakers, abnormal freq/volt) with detailed participant class-specific question form to generate large group facilitated discussions. - Have two or three break-out sessions with specific questions to answer (pre-determined table spokesman) - Facilitated summary/conclusions
Lunch		
Afternoon	**Part 1** ~ 0.5 hrs iclicker review	- Reseating arrangements for companies to sit together - Use iclickers to review OPSRP principles (priorities, rules of thumb, independent actions, etc.)
	Part 2 Segmented Drills ~ 2.5 hrs	- Drill scenario segments (flexibly designed to engage participants – some fast forward scenarios, as needed).

Appendix A: 2011 Participant List

Market Participant	No. of Attendees	Type of Participant
Blue Water Power	3	Distributor
Brighton Beach Power	3	Generator
Brookfield Power	6	Generator
Bruce Power	18	Generator
Cardinal Power	3	Generator
Emergency Management Ontario	1	Other
Enwin Utilities	3	Distributor
Erie Shores Wind Farm	1	Generator
Essar Algoma Steel	7	Industry
First Solar	2	Generator
Goreway Generating Station	8	Generator
Great Lakes Power	8	Transmitter
Greenfield Energy	5	Generator
Hydro One	66	Transmitter
IESO	56	N/A
Imperial Oil	3	Industry
Kingston Cogen	4	Generator
Lakefront Utilities	3	Distributor
Lanxess	3	Industry
Ministry of Energy	2	Other

Market Participant	No. of Attendees	Type of Participant
Nova Chemicals	7	Industry
Ontario Power Generation	94	Generator
Orillia Power	2	Distributor
Portlands Energy Centre	2	Generator
PowerStream	5	Distributor
PUC Distribution	9	Distributor
Shell Canada Products	3	Industry
St. Clair Energy	5	Generator
Suncor	1	Industry
Thorold Cogen	3	Generator
Toronto Hydro	5	Distributor
TransAlta	9	Generator
TransCanada	3	Generator
East Windsor Power	1	Generator
West Windsor Power	5	Generator
TOTALS	**359**	**Distributors = 30** **Generators = 172** **Industries = 24** **Transmitters = 74** **IESO = 56** **Other = 3**

Appendix B: 2011 Sarnia Workshop Agenda

Workshop Agenda for Sarnia/Lambton, Industries, Generators, Bluewater Power, Hydro One and IESO Operations staff
(March 3/2011 @ Holiday Inn – Point Edward)

#	Time	Lead	Activity
1.	7:30	IESO	**Registration & Introduction:** **(hot breakfast in conference room)**: Today's Agenda & Workshop Goals
2.	8:00	IESO	• Electricity Sector structure including NERC / NPCC • What led to today's workshop? • NERC Reliability Standards • Current [Ontario] initiatives
3.	8:30	OPG Lambton TGS	• Unit constraints and plant station service requirements • Preferences and timing for system supplied station service • Plant recovery strategies from a blackout • Lambton Energize Out to switchyard and 230 kV circuits
4.	9:00	Nova Chemicals	• Loading profiles • Plant response to a blackout • Priority in plant loads for restoration vs. production loads • [new] 25,000 horse power motor start-up
5.	9:15	IESO	IESO control room setup & functions
6.	9:30	Hydro One	Hydro One Operating setup / sectors
	9:45		**Coffee break**
7.	10:00	All	**Interactive Tabletop Restoration Drill** • Three-way communications • Drill Setup (Each table top drill segment starts with a brief presentation of relevant information (e.g. OPSRP sections), drill activity/role play, then a de brief to identify lessons learned and items for follow up)

#	Time	Lead	Activity
8.	10:15	All	**Drill Segment #1**: A switchyard circuit breaker indicates potential trouble with its operability
9.	11:00	IESO	**2011 OPSRP Revisions overview:** • Plain language re write • Changes to keep us in compliance with NERC/NPCC • New definitions • Alternative Arrangements - their need and rationale • Lambton Specific Independent Actions • Lambton Alternative Arrangement to Energize-out to switchyard to recover unit(s) and energize to Sarnia Scott providing source of power to industries and generators
10.	11:15	All	**Drill Segment #2:** Prepare for system restoration including: • Assess the situation • Develop a restoration strategy • Perform independent actions including those specific to Lambton
	12:00		**Lunch**
11.	12:45	All	**Drill Segment #3:** Commence restoration including: • Initiate and perform Lambton Alternative Arrangement • Energize transmission lines (i.e. Energize Out) from Lambton TGS into Sarnia Scott • Build a stable electrical island • Provide a source of power to local generators and industries
		Agenda item 12 below is **Optional** (time permitting)	
12.	14:00	All	**Drill Segment #4:**

#	Time	Lead	Activity
			• Responses to Abnormal system frequency • Islanded operation
13.	14:30	First Solar	• Overview • Operability (including ramps up & down)
14.	14:45	All	**Summary of Findings** **Interactive facilitated feedback session facilitated by IESO**
15.	15:00	IESO	Preview of 2011 Ontario Integrated Exercise October 26, 2011
	15:15		**Adjourn**

Appendix C: 2011 Sarnia Table Top Drill Segments

The table top drill is divided in segments related to system restoration and involve operating activities consistent with the chronology of a real time system restoration. Each segment has its specific objectives associated with it. These objectives will be used for the NERC Continuing Education Hours assessment check list in support of awarding CE Hours for the presentation periods prior to the drill in addition to the time spent doing the drill.

The table top drill segments constitute the table top drill scenario and shall be made available to all attending operators prior to the workshop to enable them to review relevant procedures and OPSRP sections. Information (e.g. OPSRP content, etc.) will be presented to the group prior to drill activity per each table top drill segment.

Following the completion of each drill segment a facilitated debrief session will be held to capture lessons learned. Each table top drill segment is from 45 minutes to one hour duration.

Items for clarification/follow up pertaining to the generator - grid interface will be captured on a flip chart from the table top drill segments. After the table top drill is completed any 'unresolved' items will be discussed in the post drill debrief session.

The grid and plant conditions prior to the start of each table top drill segment have not been included in the table. It is planned to keep these conditions relatively simple where possible and display them to the group on the projector.

#	Drill Segment	Objectives / Outcomes	Relevant Procedures
1.	Three-way Communications applicable to all drill segments	• Use three-way communications when necessary • Perform three-way communications correctly to exchange operating information and directives	
2.	A switchyard circuit breaker indicates potential trouble with its operability	Given a switchyard circuit breaker that indicates potential trouble with its operability take action including operational communications to: • Determine if the circuit breaker is operable • Assess if the grid is in a reliable operating state • If deemed necessary recover grid reliability per target re preparation times	• Market Manual 7: System Operations Part 7.4 IESO-controlled Grid Operating Policies. Section 6.3, App. B. • SCO: Protection and Auxiliary Outages – section 3.4.

#	Drill Segment	Objectives / Outcomes	Relevant Procedures
3.	Prepare for system restoration including recovery of generation in response to a blackout event with rejected and available units	In response to a system blackout with rejected and available units, take action including operational communications to: **1.** Assess the situation: • ask the critical questions of each other to enable generating station recovery and expedite system restoration • prioritize restoration actions • identify the options for supplying Lambton TGS with grid supplied station service power (i.e. which RSS, from unit or grid) • prioritize timing for resupply of grid sourced station service power to generating stations • prioritize actions to recover units and secure / regain grid supplied station service power **2.** Develop a restoration strategy **3.** Perform independent actions to : • recover/stabilize Lambton unit(s) • enable Lambton TGS Alternative Arrangement • open off potential circuit breakers • determine any optimal approach to opening circuit breakers in order to expedite system restoration	• OPSRP Section 9: Communications • OPSRP Section 8: Black Start Facility Particulars (e.g. West Windsor Power blackstart) • OPSRP Section 4: Restoration Guidelines • OPSRP Section 5. Performing Restoration OPSRP Sections: • 5.3: (For IESO) • 5.7 (for Transmitters) • 5.8 (for Distributors) • 5.9 (for Connected Wholesale Customers) • 5.10 (for Generators) • Section 5.4: Coordination Discussion with Transmitters • Section 10: SW6-S Lambton Specific Independent Actions • Section 5: Performing Restoration • Section 5.2: Opening Off-Potential Breakers

#	Drill Segment	Objectives / Outcomes	Relevant Procedures
4.	Commence restoration - Energize transmission lines (i.e. Energize Out)	**1.** Decide and implement an appropriate restoration path: • Initiate and perform Lambton TGS Alternative Arrangement • Obtain the minimum information you need to allow your generator units to energize transmission circuit(s) out to the grid • Determine the number of generating units required in service for reactive power absorption when energizing transmission lines from Lambton TGS	OPSRP Sections: • Section 10: SW6-AA • Section 5: Performing Restoration • Section 9: Communications • Section 7: Rules of Thumb • Section SW1: Southwestern Ontario Overview • Section SW6: Lambton Energize Out • Section 4.3: Energizing Transmission
	Build a stable electrical island	**2.** Take action including operational communications to: • Determine a targeted loading rate for the unit(s) • Reload units in the electrical island • Identify/apply the OPSRP rule of thumb for restoring load in an electrical island • Assign tasks to generator(s) to regulate frequency and voltage • Request load shed / restored as required Synchronizing units in an island • Determine which units may be synchronized together in the island • Determine where to synchronize the units	• Section 7: Rules of Thumb • Section 5.5: Islands • Section 4.4: Restoring Load • Section 4.5: Dynamic Reserve • Section 4.7: Synchronizing Islands Section 7: Rules of

#	Drill Segment	Objectives / Outcomes	Relevant Procedures
5.	Response to Abnormal system frequency Islanded Operation	Given an abnormal system frequency take action including operational communications to: **1.** Assess the situation **2.** Independently shed load if required **3.** Determine if an electrical island has been created **4.** Stabilize the grid or electrical island **5.** Stabilize units **6.** Manage any risks to generating station plant operations **7.** Regulate frequency and voltage by assigning tasks to generator(s) **8.** Request load shed / restored as required	OPSRP Sections: • Section 6: Operational Action Summary • Section 5.10: Generator Actions During Abnormal Frequency • Section 5: Islands

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