December 5, 2003

IMO's Response regarding ISO/RTO Council Blackout Recommendations

Power System Operations

	ISO/RTO Recommendation	IMO's Response
1.	The reliable operating practices that are already in place must be reinforced with system operators to ensure the electric systems are always operated within studied parameters. These operating practices have been designed to prevent uncontrolled separation and cascading outages and should be followed without hesitation.	The reliable operating practices outlined in the NERC and NPCC documents are reflected in the rules for the Ontario electricity market and the IMO's internal and external operating procedures. These practices are continuously reviewed and reinforced through training of the system operators and other IMO supporting staff. The IMO is mandated by the market rules to ensure that the reliability of the IMO-controlled grid is maintained in accordance with all applicable reliability standards. This includes establishing system security limits and directing the operation of the IMO-controlled grid within appropriate security limits and in accordance with the applicable operating agreements. IMO's internal operating procedures and specifically the Emergency Operating State Control Actions list provide specific instructions to system operators that delineate their authority and responsibilities for preventing uncontrolled system separation and cascading outages. Through a rigorous document change management process and associated training, the IMO ensures that its operating staff is provided with and adopts the latest rules, policies, guidelines and operating practices.
2.	Ensure that system operators understand they have full authority, consistent with NERC Policies, to take whatever action is immediately needed to keep their control area in balance and secure within studied limits, including shedding firm load, and are obligated to shed load to prevent cascading outages. Where applicable, ISO/RTOs will request such confirmation from their respective CA's within 60 days.	The IMO's authority to take whatever appropriate actions to keep the power system in balance and within studied limits, including shedding firm load is stipulated in the market rules. Furthermore, the internal operating procedures detail the specific instructions to be implemented by system operators to maintain the system within applicable limits. The job descriptions of the operating staff specifically indicate as one of their key responsibilities the obligation to approve the use and, when required, to implement the Emergency Operating State Control Actions list, which includes shedding load to maintain system security and prevent cascading outages. System operators are trained to ensure that they understand the control actions required to maintain the security of the power system and prevent cascading outages.
3.	All operating entities should be prepared to take coordinated actions at any time the system operator can not securely monitor a system (i.e. failure of EMS, metering, or communication). For example, if a facility is at or near a limit, it may be prudent to immediately re-dispatch generation, or take other action, such as cut interchange schedules, to unload such facilities	The current internal procedures provide specific instruction for operating the power system when data monitoring and voice communication facilities are impaired. Under such conditions, system operators are required to coordinate the operation of the power system with the appropriate facility operators and neighbouring security coordinators and, to the extent possible, use the existing redundant systems (e.g. backup telemetry, satellite phones). They are also instructed to take whatever actions necessary to maintain the power system within prescribed limits, including generation re-dispatch, curtailment of intertie transactions etc. These practices are reinforced through periodic training of the system operating staff.

Power System Operations

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	and apply more conservative operating limits. Caution must be taken in these instances that any such preventive system posturing does not adversely affect other areas.	
4.	Ensure that data quality, such as stale data or loss of data link, is indicated and alrmed to system operators.	The IMO systems provide alarms to system operators when telemetry data is not current. Failed quantities are colour coded on station displays and listed on an alarm monitor. Contingency procedures are in place and they establish the communication protocol used on loss of critical telemetry.
5.	In conjunction with asset owners, define critical facilities (transmission lines, apparatus, and generators) in the respective operating areas, regions, and interconnections. Ensure that these lists are periodically reviewed with asset owners and neighboring areas and changes are appropriately made as conditions change and generation and transmission equipment is added or removed from service.	The IMO has a process in place to periodically review the new facilities that are added or removed from service. This process includes running joint system studies with the affected neighbouring control areas and updating the Ontario critical facilities listed in Appendix D of NPCC C-13. Interconnection agreements also identify critical facilities and outline the process for exchanging outage information. Such agreements are in place with each of the IMO's neighbouring systems. When an outage occurs to an external critical facility, studies are run to assess if there are any impacts on the IMO-controlled grid. Actions taken are coordinated with the neighbouring entity as required.
6.	Remind generator operators of their obligation to notify their Control Area operator if they are operating in "sliding pressure" mode with their turbine valves open.	The IMO requires market participants to plan and report any outage, derating, restriction or change to dynamic control systems. This includes generation units operating in sliding pressure, since this mode of operation may have a limiting effect on the turbine's governor response.

Emergency Plans and Procedures

	ISO/RTO Recommendation	IMO's Response
1.	Review Emergency Operations plans and procedures with operations staff and make recommendation for possible improvements, as appropriate	The IMO has an annual process in place to review the emergency operation plans and procedures with the system operators. In addition, an Emergency Preparedness Restoration Working Group review is underway, involving Restoration Plan Participants, seeking to identify lessons to be learned following the 2003 blackout.
2.	Review plans and procedures for the loss of the primary control center and back-up operations with operations staff and make recommendation for possible improvements, as appropriate.	The IMO has developed specific plans and procedures to address the evacuation of the primary control centre and the process of continuing system operation from the backup control centre. Facilities at the backup centre are tested monthly. Control room staff simulates backup centre operation and evacuation annually.
3.	Review restoration plans and ensure they are flexible enough to deal with complications that could arise. Plans should include restoration	The Ontario Power System Restoration Plan is a comprehensive document that describes the strategy for recovering the Ontario power system after a partial or complete blackout and re-establishing interconnected operation. In the restoration priority list provided in the Plan, nuclear stations have the

Emergency Plans and Procedures

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	priorities such as providing service to nuclear plants and pre-identified critical communication facilities.	highest priority followed by critical transmission and generation station service loads and key telecommunications facilities. The IMO has an annual process in place to review the restoration plans and procedures. In addition, an Emergency Preparedness Restoration Working Group review is underway, involving Restoration Plan Participants and seeking to identify lessons to be learned following the 2003 blackout.
4.	Train system operators, or initiate refresher training, on basic operating philosophies so they can react correctly to situations that may arise outside of written plans and procedures.	The IMO values the importance of training and therefore allocates extensive resources to provide the necessary training required by the control room staff. The IMO's control room training program is an ongoing commitment that requires each system operator to take at least 20 days of formal training annually. It focuses on developing and maintaining an understanding of the fundamental operating principles, communications protocols, normal and emergency operations and the capability to react effectively in unforeseen circumstances.
5.	Review training and system emergency drills regularly.	In 2001, the IMO initiated a program of annual exercises to simulate restoration from a widespread blackout. This program involves critical market participants and, to the extent possible, factors in the response from neighbouring control areas. The third blackout exercise has just been completed and all parts of Ontario have been covered. Ontario market rules require all market participants to prepare an emergency response plan. Furthermore, market rules require that all restoration participants exercise their restoration plan annually. All system operators and part of the off-shift supporting staff are NERC certified. Furthermore, they participate in mandatory training on voltage control, communications, TLRs, Ontario Power System Restoration Plan etc. Normal training exceeds 20 days per system operator annually.
6.	Review black-start units' capabilities and ensure they are operable. Black start units, systems, and equipment critical to the restoration process should be tested regularly.	Blackstart ancillary services agreements are in place and annual tests are observed by the IMO. New contracts are being finalised for additional blackstart capability in Ontario. Additional restart capability being considered with neighbouring control areas.
7.	Review the adequacy of restoration procedures and drills with respect to coordination within regions and with neighboring regions. Regional and interconnection wide coordination is vital to tying separated systems back together.	NPCC Operator Conference Tabletop restoration exercises are done twice a year. Restoration plan exercises involve other regions as observers. However, opportunities exist to increase participation at the regional level (e.g. involving the whole Eastern interconnection).

Communications

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1.	Reinforce the value of verbal communications to keep adjacent Control Areas informed of abnormal conditions. ISOs and RTOs as Control Area operators and Reliability Coordinators should communicate actively with other CA and RC operators. During all abnormal operating conditions, operators should communicate when emergency assistance may be needed.	The IMO's internal operating procedures complement NPCC documents C-03 and C-20 establishing the communication protocols among the IMO, market participants and the neighbouring control areas in normal and emergency conditions. System operators are trained to ensure that they understand the importance of timely and effective communication for maintaining the reliability of the IMO-controlled grid and the integrity of interconnections. The IMO conforms to the NPCC's communication guidelines with respect to weekly and emergency conference calls as described in document C-13. With MISO, the IMO exchanges information about the power system conditions periodically through ad hoc conference calls, as required.
2.	Confirm communication protocols and paths with and among system operators at Reliability Coordination Centers, Control Area Operation Centers, Generation Operation Centers and Plants, and Transmission System Operation Centers. Test each system regularly. Emphasis should be placed on communications systems that notify the entire interconnection, such as the RCIS in the Eastern Interconnection, and the WECCnet in the Western Interconnection.	As documented in the internal procedures, the IMO performs monthly tests of the communication facilities with selected Generation Operation Centres and plants and Transmission Operation Centres. Monthly tests are also performed on the NERC and LEER Hotline, MSAT facilities, main and the communication facilities located at the backup control centre. RCIS is used daily, therefore additional testing is considered superfluous.
3.	Assess manual and automatic methods and systems to inform neighboring systems when critical facilities trip and lock out of service so that adjacent systems may be aware of potential impacts on their systems. Reinforce with operators the importance of such notifications.	The IMO uses both manual (telephone) and automatic (RCIS and SDX) means to communicate the status of critical facilities with the neighbouring control area operators, reliability coordinators and ISOs. The IMO conforms to the NERC and NPCC requirements with respect to information sharing among reliability coordinators. Internal operating procedures describe the use of RCIS and SDX facilities to communicate specific reliability information with the neighbouring control area operators, reliability coordinators and ISOs. This information generally includes but is not limited to: - equipment status; - system emergencies; - weather advisories; - EEA alerts; - Critical infrastructure protection; and Critical transmission/generation outages. The internal operating procedures, developed in compliance with specific NERC and NPCC requirements, stress the importance of communication during normal and abnormal system conditions. Communication protocols are periodically reviewed during training sessions with the control room staff.
4.	Communicate and coordinate the planned	Interconnection agreements identify critical facilities and outline the process for exchanging outage

Communications

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	(maintenance) outages of critical facilities with neighboring systems.	information. These agreements clearly identify the requirement to coordinate critical outage information with the neighbouring control areas. Interconnection agreements are in place with each of the IMO's neighboring systems.

Voltage Control and Reactive Power Management

	ISO/RTO Recommendation	IMO's Response
1.	Review processes and procedures to ensure generator operators understand the impact of their reactive power output on overall grid voltage control and support. Generator operators must respond to orders from the system operator.	Market rules require generators to operate their units so that they are capable of providing reactive power within prescribed power factor limits. The IMO has the authority to direct these generators to operate in an under-excited or over-excited state within or outside their standard power factor range. Generators are required to respond to IMO's voltage and reactive power requests immediately. When generators are not capable of meeting the reactive dispatch, they are required to inform the IMO immediately.
2.	Verify generator VAR capability assumptions included in system models.	Market rules require market participants to test and monitor their equipment to ensure and maintain compliance with specified reliability standards. Market participants must maintain records of such tests and make them available to the IMO upon request. In addition, the IMO has the authority to request market participants to perform tests to prove their compliance with the reliability standards in the market rules. In particular, the IMO tests the VAR capability of the reactive resources twice a year.
3.	Confirm a process is in place whereby generator's reactive capability is verified periodically through test or audit	As mentioned above, the IMO has the authority to make sure that tests are done and the equipment connected to the IMO-controlled grid is compliant with the reliability standards specified in the market rules. In particular, the IMO tests the generation units reactive capability twice a year.

System Modeling and Real Time Contingency Analysis

	ISO/RTO Recommendation	IMO's Response
1.	Review that system analyses are being done, and frequency of such studies; ensure studies model far enough into neighboring systems to provide adequate study of the impacts on their systems.	The IMO has dedicated staff assigned to run system studies on a regular basis and ensure that these studies model accurately the Ontario power system and that they model far enough into neighbouring systems to adequately study the impact on these systems.
2.	Studies should address voltage/reactive and stability limits in addition to thermal limits.	The scope of the studies mentioned above includes voltage/reactive and stability limits in addition to thermal limits.
3.	Ensure that pre-determined voltage and stability	System operators have the capability to assess and monitor voltage, stability and thermal limits. If the

System Modeling and Real Time Contingency Analysis

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	limits, as well as thermal limits, are being assessed and monitored during real-time operations.	deployment of a specific limit is required, system operators may require assistance from the system limits experts on a 24/7 basis.
4.	Ensure that system limits identified in system studies are communicated to those determining operating limits (operations planning) and the system operators.	System limits are communicated in a timely fashion to system operators and operations planning staff both electronically and in hard copy.
5.	Ensure that potentially critical facilities in neighboring systems are identified and where appropriate mapped in SCADA systems and state estimators.	Critical facilities in the neighbouring systems are identified and listed in appropriate NPCC documents. These facilities are mapped in the IMO's SCADA systems and the State Estimator.

Mitigate Cyber Security Threat Potential

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1.	Review physical and cyber access points into the security perimeter and make sure they are protected.	Access gates to the IMO's market and grid systems have been identified and are secured and monitored through firewall and intrusion detection systems. Recent penetration tests have demonstrated good practice.
2.	Follow the Cyber Security Standard in addition to the guidelines for Process Control System security recently approved by the NERC Board.	The IMO has a program in place to meet NERC's cyber security standards by Q1, 2004. Many elements of the standard are already in place.
3.	Follow the NERC Security Guide: Securing Remote Access to Electronic Controls and Protection Systems.	A recent IMO penetration test confirmed adequate security measures are in place to prevent access to IMO systems. Additional documentation is being prepared to further strengthen the existing procedures.