NEW YORK INDEPENDENT SYSTEM OPERATOR

MANUAL 12

Transmission and Dispatching Operations Manual

April 2016

4.2.9 Adverse Operating Conditions

NYISO Actions

The NYISO may perform the following actions under adverse operating conditions:

1. Notify all TOs and NPCC Control Areas.
2. Reduce RTC/RTD Stability Transfer Limits and RTC/RTD Central East Voltage Transfer Limits to 90% of the Stability Transfer Limit and Central East Voltage Transfer Limits where appropriate.

3. Reduce flows on inter-area and internal NYISO secured transmission lines to a maximum of 90% of the Normal Rating.
4. Cancel in-service relay and hot line work on A-1 transmission facilities. Recommend TO cancel in-service relay and hot line work on A-2 transmission facilities.
5. Restore out-of-service A-1 transmission facilities where possible. Recommend TO restore of out-of-service A-2 transmission facilities where possible.
6. Request TOs to implement appropriate emergency procedures when a contingency occurs.

Transmission Owner Actions

1. Implement NYISO requests to cancel in-service relay and hot line work on A-1 transmission facilities. Evaluate cancellation in-service relay and hot line work on A-2 transmission facilities.
2. Implement NYISO requests to restore out-of-service A-1 transmission facilities. Evaluate restoration of out-of-service A-2 transmission facilities.
3. Notify the NYISO of all actions taken related to this section.
4. Implement Emergency procedures, as requested by the NYISO.

4.2.10 Solar Magnetic Disturbances

Background

The sun emits streams of charged protons and electrons known as the solar wind. The intensity of the solar wind is determined by sunspot activities (solar flares, disappearing filaments, and coronal holes). The solar wind interacts with the earth's magnetic field producing auroral currents at altitudes of 100 kilometers that follow circular paths around the earth's geomagnetic poles. These non-uniform currents then cause time-varying fluctuations in the earth's magnetic field, which in turn induce a potential difference on the surface of the earth. This Earth-Surface Potential (ESP) is measured in volts per kilometer and its magnitude and direction are functions of the change in magnetic field, earth resistivity, and geographic latitude. ESP increases with increasing latitudes and its gradient is highest on facilities having an east-west orientation. ESP is highest in igneous rock areas. The resulting ESP appears as an ideal voltage source applied between grounded neutrals of wye-connected transformers in a power system, causing Geomagnetically Induced Current (GIC) to flow between grounded neutrals via transmission lines.

During a severe Solar Magnetic Disturbance (SMD), the quasi-dc ground induced current superimposed on the normal 60 Hertz power flow can result in half-cycle saturation of the cores of grounded, wye-connected power transformers. This over-excitation may cause the following power system problems:

1. Transformer overheating resulting in premature transformer failure
2. Increased system reactive losses resulting in the depletion of MVAr reserve
3. Decreased bus voltages resulting in a possible system voltage collapse

4. Increased 60 Hertz harmonics resulting in overheating and eventual tripping of static var compensators (SVCs) and shunt capacitors, protective relay misoperations, and interference with communication systems
5. Saturation of current transformers resulting in metering errors and relay misoperations
6. System voltage distortions resulting in improper operation of generator automatic voltage regulators and commutation failures in HVDC terminals and SVCs.

Monitoring

The NYISO receives SMD forecasts and alerts from three agencies:

1. Electronically, via the Solar Terrestrial Dispatch Geomagnetic Storm Mitigation System (STD GSMS).
2. Space Environment Services Center (SESC) in Boulder, Colorado
3. Geographic Division, Geographical Survey of Canada, Energy, Mines, and Resources (EMR) in Ottawa, Canada via the Ontario Control Center.

An SMD forecast indicates that the condition is expected. An SMD alert indicates that the condition has occurred.

These agencies measure the disruption in the horizontal component of the earth's magnetic flux with magnometer. The STD GSMS is kept continuously up to date by Solar Weather Specialists located at www.spacew.com. SESC measures the geomagnetic activity in Boulder, Colorado and EMR measures the geomagnetic activity from 13 observatories in the Canadian Automatic Magnetic Observation System (AMOS). This information is quantified into A and K indices for forecasting and alerting purposes. The impact of an SMD on the power system increases with the intensity of the storm.

Information pertaining to Solar Magnetic Disturbances and the level of the disturbance will be disseminated by means of the STD GSMS.

SMD Forecasts

STD through the GSMS allows for continuous updating on current Solar Magnetic Disturbance activity, as well as 24-, 48- and 72-hour predictions on SMD activity. Currently, the STD uses a Kp Index, but does not specify by level what Forecast or an Alert is issued, merely they are issued depending on the activity seen by their satellite in regards to predicted SMD activity vs. actual observed SMD activity.

SESC (Boulder) issues forecasts in the form of a daily "A" index for up to three days in advance. The "A" index is a measure of the expected geomagnetic activity at Fredericksburg, Virginia. SESC (Boulder) transmits forecasts of the following two classifications of geomagnetic activity to the NYISO:

1. Minor Storm ("A" index 30-49)
2. Major Storm ("A" index above 50)

EMR (Ottawa) issues forecasts based on daily range predictions for up to three days in advance in the sub-auroral zone in which most of the NPCC Areas are located. Ontario and Hydro Quebec receive forecasts for the auroral zones separately. EMR (Ottawa) transmits forecasts of the following two classifications of geomagnetic activity to the NYISO:

1. Active Conditions (approximate "K" index of 5 or 6)
2. Major Storm Conditions (approximate "K" index of 7, 8 or 9)

SMD Alerts

STD through the GSMS allows for continuous updating on current Solar Magnetic Disturbance activity, as well as 24-, 48- and 72-hour predictions on SMD activity. Currently, the STD uses a Kp Index, but does not specify by level what Forecast or an Alert is issued, merely they are issued depending on the activity seen by their satellite in regards to predicted SMD activity vs. actual observed SMD activity.

SESC (Boulder) issues alerts in the form of a three-hour "K" index that is based on the average of the last three hours of disruption in the horizontal component of the earth's magnetic flux measured in Boulder, Colorado. SESC (Boulder) transmits alerts of the following classification of geomagnetic activity to the NYISO:

"K" index of K5 or greater

EMR (Ottawa) issues alerts based on a three hour average range index for the last three hours of disruption in the X (geographical northward) component of the earth's magnetic flux measured by the AMOS system. EMR (Ottawa) issues alerts for the following two classifications of geomagnetic activity to the NYISO:

1. Active Conditions (approximate "K" index of 5 or 6)
2. Major Storm Conditions (approximate "K" index of 7, 8 or 9)

All time references in SMD Forecasts and SMD Alerts received from SESC (Boulder) and EMR (Ottawa) are to Universal Time (which is the same as Greenwich Mean Time), a constant scientific time reference. Eastern Standard Time lags Universal Time by 5 hours. The NYISO converts all time references to prevailing Eastern Time (Standard Time or Daylight Saving Time) as shown in Table 4-2.

Table 4-2 Conversion from Universal Time

If the prevailing Eastern time is:	Then 0600 UTC (GMT) converts to:
Standard Time	0100 EST
Daylight Savings Time	0200 EDT

No NYISO actions are required if:

- SMD Forecast of an A-index is equal to or less than 29 and
- SMD Alert is equal to K4 or less

Minor storm active conditions exist when:

- A-index is greater 29 but less than or equal to 50 and
- Alert is greater than K4 but less than or equal to K6

NYISO Actions

The NYISO shall perform the following actions:

1. Upon notification of an SMD Forecast of an A-index greater than 50 or an SMD Alert of K6 or greater, record the information in the control room log.
2. Notify all TOs and NPCC Control Areas.
   - TOs will notify generators within their areas.
3. If an Alert of K7 or greater has been issued on the STD with significant GIC (Ground Induced Currents) activity observed by a neighboring Control Area or a Transmission Owner, the NYSIO shall initiate the following actions:

Declare Alert State

1. Notify TOs to reduce normal limits on inter-area and internal NYS Power System transmission lines and transformers to a maximum of 90% of the normal rating where appropriate.
2. Request generators (via their TOs) to adjust machine excitation, to maintain the NYISO Controlled Transmission System voltages within acceptable operating ranges to protect against voltage swings.
3. Reduce RTC/RTD Stability Transfer Limits and RTC/RTD Central East Voltage Contingency Limits to 90% of the Stability Transfer Limit and Central East Voltage Contingency Limits where appropriate.
4. Request TOs to implement appropriate emergency procedures, when a contingency occurs.
5. Reduce flows on inter-area and internal NYISO secured transmission lines to a maximum of 90% of the Normal Rating.
6. Activate Thunder Storm Warning cases (TSW) when an alert of K9 has been issued and significant GIC activity has been observed.

Transmission Owner Actions

TOs shall perform the following actions upon notification of an SMD Alert of a Major Storm Condition (K7-K9) or prior to the forecasted arrival of the storm upon notification of an SMD Forecast of a Major Storm Condition (K7-K9):

1. Restore out-of-service transmission facilities, where possible, and avoid taking long transmission lines out of service.
2. Review all in-service work, evaluate the impact of the loss of these facilities on the NYISO secured Transmission System, and cancel in-service work on critical facilities.
3. Monitor the MVAr and voltage displays on their SCADA systems for unusual voltage and/or MVAr variations.
4. Keep area substation capacitor banks in service, where possible, and evaluate the impact of the loss of transmission shunt capacitor banks.
5. Notify the NYISO of all actions taken related to this section.