<table>
<thead>
<tr>
<th>Regional Insights (Regional LLs) or NERC Lessons Learned reviewed: NERC LL20151201</th>
<th>NERC Lesson Learned: SOL and IROL Monitoring Tool Leads to Unnecessary Manual Load Shedding</th>
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| **Describe Area of Concern Addressed:** | **Event Description:** A breaker fault on a shunt reactor of a high-voltage transmission line caused the line to trip. This event led to the exceedance of two interconnection reliability operating limits (IROLs). Immediate actions were taken to clear those IROL exceedances within the required 30 minutes.

However, the involved interfaces have both a system operating limit (SOL) and an IROL. This caused the transmission system operator to misinterpret the information by not noticing that the flows were still above the SOLs while the IROL exceedances were being addressed. Since the transmission system operator confused the SOLs for the IROLs, the operator proceeded to manually shed load in an attempt to return the flows back to within what was believed to be IROL values but were really SOLs. This occurred 28 minutes after the start of the event.

**Details:**
During the morning peak, the transmission system operator ordered the de-energization of a shunt reactor connected to a high-voltage transmission line for voltage control. During the operation, a fault occurred in the shunt reactor breaker that caused the high-voltage transmission line to trip, resulting in two IROL exceedances.

The transmission system operator was informed of the IROL exceedances through both visual and audible alarm messages within the energy management system (EMS) and by the control room timer display for SOL/IROL exceedances.

At that point in time, the transmission, balancing, and interchange system operators took emergency operating
control actions to restore the interface flows below the IROLs by:

- The starting of gas turbines
- Curtailment of interchange transactions
- Emergency energy imports
- Regional voltage reduction

It is important to note that each of the interfaces have two limits, an SOL and an IROL, and both of these limits are represented at the same time on the EMS monitoring displays adjacent to the interface flows. The system is normally operated within the SOL limits but, when the “emergency condition” is enabled in the EMS by the system operators initiating an emergency operations control action, the values of the SOLs on the EMS monitoring displays disappear and all the monitoring and assessment tools focus on the IROL limits. This control action is used when the transmission system operator considers the system in an emergency state and ensures the release of any bottled capacity on the interfaces that might be limited by their SOL. That supplemental capacity can then be used to mitigate an emergency condition such as an IROL exceedance.

When the exceedances of the IROL occurred following the loss of the high-voltage transmission line, the transmission system operator did not enable the “emergency condition” in the EMS as stated in emergency operations procedures/instructions. The system operator mistook the value of the SOL as the value of the IROL, which led to a false assessment of actions to clear the IROL exceedances. That assessment, based on the lower SOL value instead of the IROL value, led to the use of more emergency operation control actions than necessary.

After 23 minutes, even though the interface flows were back under the IROLs but still above the SOLs, the transmission system operator became confused with the SOL/IROL distinction. Unfortunately, he was still thinking he was exceeding the IROL even though the alarm messages for IROL exceedances had disappeared. Also, the blinking of the SOL/IROL timer indicated that counting was underway toward the potential SOL exceedances. When an exceedance of both the SOL and IROL occurs, independent timers start for both limits and are superimposed on the control room timer display, which contributed further to the operator’s confusion in this case.
Twenty eight minutes after the event started, the transmission system operator manually shed a significant amount of load even though it was not required.

**Lessons Learned:**
- Clearly differentiate the SOL and IROL limits in the EMS displays and the control room timer display for SOL/IROL exceedances to ensure they will not lead to system operator confusion.
- Review system operator understanding of the SOL and IROL limits and the emergency operations control actions permitted in each situation on a regular basis.
- More simulation training for system operators is needed with added stressful circumstances in order to enhance system operator situational awareness and response during emergency operations.

**TF/ WG Action Taken (if any):** No additional action taken.

**Identify Similar Experience (if applicable):** None identified.

**State Any Supplemental Insights (i.e. any additional lessons that were learned from other experiences or those that can be seen within the existing LL but were missed):** No supplemental insight has been identified.

The reviewers agreed that this LL reinforces the criticality of the operator training. Particularly, stressing the use of simulator exercises, representative of real-time circumstances and conditions that reinforce the understanding of SOL/IROL exceedances (as well as other critical operating conditions and limitations) and applicable control actions. Further, such training should incorporate and ensure a review, an assessment and a refresher of the use and
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<tr>
<th>Understanding</th>
<th>of the tools that serve to enhance the operators’ situational awareness.</th>
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<tbody>
<tr>
<td>As a result of this review, has a Reliability Gap been Identified in a NERC Standard or an NPCC Criterion or Guideline?</td>
<td>None identified.</td>
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<tr>
<td>Where additional specificity can be added to existing NPCC Criteria, Guidelines or procedures, cite reference and propose addition or change:</td>
<td>None identified.</td>
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