NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

# Meeting Notes
## Project 2010-13.2 Phase 2 of Relay Loadability: Generation Standard Drafting Team

August 30, 2012
Conference Call

**Administrative**

1. **Introductions**

The meeting was brought to order by the Mike Jensen, acting vice chair, at 1:00 p.m. ET Thursday, August 30, 2012. The vice chair provided a summary of the last meeting's actions. The draft was edited from three requirements to one. The team considered the feedback from the Electric Power Supply Association and the North American Generator Forum. The vice chair also reviewed the changes to the standard, including, but not limited to the applicability, requirements, and attachment. Most importantly, the team had good discussion about the options A and B in the attachment and brings the team to today's meeting.

The chair, Charlie Rogers commented the team accomplished a tremendous amount of work during his absence. He also recognized the team's two new members, Steven Hataway and David Youngblood. Those in attendance were:

| Name | Company | Member/ Observer |
|---|---|---|
| Charlie Rogers | Consumers Energy | Chair |
| S. Bryan Burch | Southern Company | Member |
| Steven Hataway | Florida Power and Light Company | Member |
| Jonathan Hayes | Southwest Power Pool | Member |
| Mike Jensen | Pacific Gas and Electric Company | Member |
| Xiaodong Sun | Ontario Power Generation Inc. | Member |
| Benson Vuong | Salt River Project | Member |

| Name | Company | Member/ Observer |
|---|---|---|
| David Youngblood | Luminant Energy | Member |
| Ken Hubona | Federal Energy Regulatory Commission | FERC Staff |
| Daniel Woldemariam | Federal Energy Regulatory Commission | FERC Staff |
| Scott Barfield-McGinnis (Advisor) | North American Electric Reliability Corporation | NERC Staff |
| Phil Tatro (Technical Advisor) | North American Electric Reliability Corporation | NERC Staff |

2. **Determination of Quorum**

   The rule for NERC Standard Drafting Team (SDT or team) states that a quorum requires two-thirds of the voting members of the SDT. Quorum was achieved as eight of the eleven total members were present.

3. **NERC Antitrust Compliance Guidelines and Public Announcement**

   NERC Antitrust Compliance Guidelines and public announcement were reviewed by the advisor. There were no questions raised.

4. **Review of the Roster**

   There were no changes or revisions.

## Agenda

1. **Review of Meeting Notes from Previous Meetings**
   August 21-23, 2012 – The notes were not ready. The advisor advised they would be sent to the chair and acting vice chair for review before posting. The notes would be presented at the next team meeting.

2. **Open Business from Last Meeting**

   Phil Tatro and Benson Vuong – Discuss the findings and simulation results using Attachment 1, options two and three. The question was whether or not there is an appreciable difference in either load point option, if so; decide if the team wants to use only one load setting for simplicity.

3. **Discussion of the RBS Draft Standard**

   Team members Mr. Vuong and Mr. Sun provided computations concerning the light load operating point (40 percent) and the full load operating point (100 percent) to the team for discussion. Mr. Phil Tatro, NERC staff shared his technical opinion that the full load operating point achieves an overall conservative setting and the additional Option B (40 percent) that the entity would be required to determine is the more conservative load point. The 40% point was not substantively different from the 100% or full load point and provided no additional reliability benefit and only made standard more difficult to understand when to apply the two options. The full load point is sufficiently conservative to achieve the reliability goal of the standard and the option to use simulation is generally the most conservative load operating point. The team concurred that the light load point does not add a reliability benefit and should be removed from the Attachment 1, Table 1: Relay Loadability Evaluation Criteria. The advisor removed all the occurrences of Option B (40 percent) from Table 1. See Attachment A for Mr. Vuong's computations and analysis. The Attachment B mho circle illustration provided by Phil Tatro plots the full, low, and simulated load operating points. This illustration demonstrates that the light load point is the least conservative and that the full load operating point is more conservative.

   Second, the team discussed the language in the Attachment 1, Table 1: Relay Loadability Evaluation Criteria. For the *Generator Buss Voltage* column, the team wanted to make certain each option accurately reflected the appropriate voltage quantity at the generator bus terminals. For the *Pickup Setting Criteria* column, the team wanted to make certain each option accurately reflected the Real Power and Reactive Power output, including those options where the entity may use quantities determined through simulation.

4. **Discussion of Questions for the Comment Period**

   The team reviewed the questions and had no changes.

5. **Action Items**

   a. Advisor – Review the Guidelines and Technical Basis for not including the light load (40 percent) point.

   b. Advisor – Need to recruit assistance with developing the technical basis for asynchronous settings.

6. **Review of the Schedule**

   The advisor noted the schedule is 11 weeks behind following the August 21-23, 2012 meeting. Every effort to get the project back on schedule is paramount to not having to request a second extension from the Commission. The schedule will be reviewed later in the process to determine if alternative action is needed to extend the schedule.

7. **Next Steps**

   Obtain team consensus on the changes and post for the first formal 30-day comment period.

8. **Future meeting(s)**

   Member, Mr. Vuong, advised the team that Salt River Project in Phoenix, Arizona is available the weeks of October 2nd, 9th, 23rd, 2012 to hold a meeting. The advisor noted that considering the need to address the Guidelines and Technical Basis and allow sufficient time for the Quality Review process that the dates may not work and the October 23, 2012 date is most likely. The advisor will communicate the change with Mr. Vuong should the timetable change.

9. **Adjourn**

   The meeting adjourned at 3:07 p.m. ET on August 30, 2012.

# Attachment A

**Machine Data**:

- 905 MVA Unit at 0.85 power factor
- Generator rated voltage: 26kV line-to-line
- Reported Unit MW to Independent System Operator: 800 MW
- Generator Step-up (GSU) Transformer Impedance: 12.00% on a 905 MVA base
- Generator Step-up Transformer tap ratio: 511kV/24.7kV
- High-side nominal system voltage: 500kV
- Current transformer ratio: 4400/1
- Potential transformer ration: 130/1

**Option 1: simplest method:**

The MVAR in this calculation is 150% of the machine rated MW:
Q = 150% * Machine MVA * Power Factor = 1.5 * 905 * 0.85 = 1153 MVAR
The MW in this calculation is the MW reported to Independent System Operator:
P = 800 MW
The low-side voltage is 0.95 p.u. of the GSU high-side nominal system voltage multiplied by the GSU tap ratio:
V = 0.95 * High-side system nominal voltage * Tap Ratio = 0.95 * 500 kV * 24.7 kV / 511 kV
= 23.0 kV
Apparent power:
S = P + j Q = 800 MW + j 1153 MVAR = 1403 /_ 55.2˚ MVA
Primary Impedance:
Z primary = V * V / S = 23.0 kV * 23.0 KV / 1403 MVA = 0.38 /_ 55.2˚ Ω
Secondary impedance:
Z secondary = Z primary * Current Transformer Ratio / Potential Transformer Ratio
= 0.38* 4400 / 130 = 12.7 /_ 55.2˚ Ω
To satisfy the 115% margin in the requirement:
Z secondary limit = Z secondary / 1.15 = 12.7/1.15 = 11.1 /_55.2˚ Ω
Assume a Mho distance impedance relay with a Maximum Torque Angle set at 85˚, then the maximum allowable impedance reach is:
Z maximum = Z secondary limit / COS (Θ maximum torque angle – Θ transient load angle)
= 11.1 / COS (85.0 – 55.2) = 11.1/ 0.87 = 12.7 /_55.2˚ Ω

**Option 2: required calculating low-side voltage taking into account voltage drop across the generator step-up transformer:**

The MVAR in this calculation is 150% of the machine rated MW:
**Q =** 150% * Machine MVA * Power Factor = 1.5 * 905 * 0.85 = 1153 MVAR
The MW in this calculation is the MW reported to Independent System Operator:
**P =** 800 MW
Using the formula below, calculate low-side generator step-up transformer voltage (V1) using 0.85 p.u. high-side voltage V2) and estimate initial low-side voltage to be 0.95 p.u. Repeat the calculation if necessary until V1 converges:

$$\theta_1 = \arcsin\left(\frac{P_{12}|X_{TR}|}{|V_1||V_2|}\right) \qquad |V_1| = \frac{|V_2|\cos(\theta_1) + \sqrt{|V_2|^2\cos^2(\theta_1) + 4Q_{12}X_{TR}}}{2}$$

**Θ =** arcsin ((1.0 * 0.12) / (0.95 * 0.85)) = 8.5˚
**V1 =** (0.85 * cos (8.5˚) + SQRT (0.85 * 0.85 * cos (8.5˚) * cos (8.5˚) + 4 * 1.5 * 0.12)) / 2
= (0.84 + 1.19)/ 2 = 1.02 p.u.
To account for system high-side nominal voltage and the transformer tap ratio:
**V =** 1.02 * High-side system nominal voltage * Tap Ratio = 1.02 * 500 kV * 24.7 kV / 511 kV
= 24.6 kV

**Apparent power:**
S = P + j Q = 800 MW + j 1153 MVAR = 1403 /_ 55.2˚ MVA
Primary Impedance:
Z primary = V * V / S = 24.6 kV * 24.6 KV / 1403 MVA = 0.43 /_ 55.2˚ Ω
Secondary impedance:
Z secondary = Z primary * Current Transformer Ratio / Potential Transformer Ratio
= 0.43 * 4400 / 130 = 14.6 /_ 55.2˚ Ω
To satisfy the 115% margin in the requirement:
Z secondary limit = Z secondary / 1.15 = 14.6 / 1.15 = 12.7 /_55.2˚ Ω
Assume a Mho distance impedance relay with a Maximum Torque Angle set at 85˚, then the maximum allowable impedance reach is:
Z maximum = Z secondary limit / cos (Θ maximum torque angle – Θ transient load angle)
= 12.7 / COS (85.0 – 55.2) = 12.7/ 0.87 = 14.6 /_85˚ Ω

# Attachment B