Transmission Owner Ratings Development and Reporting in PJM

Planning Committee
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1. NERC Standard FAC-008-3
2. Governance, Risk and Controls
3. A sample rating methodology and implementation process
4. Communicating Ratings to PJM
5. Regional Compliance Audit of FAC-008-3
6. Conclusion
R3. Each Transmission Owner shall have a documented methodology for determining Facility Ratings (Facility Ratings methodology) of its solely and jointly owned Facilities.

R6. Each Transmission Owner shall have Facility Ratings for its solely and jointly owned Facilities that are consistent with the associated Facility Ratings methodology or documentation for determining its Facility Ratings.

Existing NERC Standard FAC-008-3 R3 and R6 already require each TO to have a ratings methodology and use the methodology to determine facility ratings.
Regional Reliability Organizations (RF/SERC) have the responsibility to audit Transmission Owners to ensure that Facility Ratings used in the reliable planning and operation of the Bulk Electric System (BES) are determined based on technically sound principles.

**M3.** Each Transmission Owner shall have a documented Facility Ratings methodology that includes all of the items identified in Requirement 3.

**M6.** Each Transmission Owner shall have evidence to show that its Facility Ratings are consistent with its Facility Ratings methodology as specified in Requirement R3 (Requirement R6).
Governance, Risk and Controls – Facility Ratings

• Governance, Risk and Controls (GRC) already exist around Facility Ratings, including:
  • NERC Reliability Standard FAC-008-3
  • TO Compliance Programs
  • Regional Entity Audit Processes
  • FERC Oversight of Audit
  • PJM Manual 3A
    • PJM Member TO Adherence via Operating Agreement

• GRC is an accepted approach to managing risk in the business environment
  • Conforms to standard industry frameworks
  • Industry guidance from North American Transmission Forum Compliance Practices
  • Implemented in variety of organizational forms – e.g. Compliance Department, Risk Department, Corporate Audit
Governance, Risk & Controls – Facility Ratings

- NERC Reliability Standard – FAC-008-3
  - All NERC Registered Transmission Owners are required to comply with FAC-008-3
  - Per R3, all TOs are required to have a documented Facility Ratings Methodology
  - Methodology must:
    - Use equipment manufacturers nameplate, industry standards, or verified practices
    - Document assumptions, design criteria, methods, and operating limitations
    - Document process to determine ratings, scope of equipment, and normal and emergency ratings
    - Respect most limiting element rating
    - Include solely and jointly owned Facilities
Governance, Risk & Controls – Facility Ratings

- TO GRC Programs
  - Compliance Reviews
  - Internal Compliance Assessments

- Regional Entities (RE), e.g. ReliabilityFirst, SERC
  - Performs Compliance Audit of each TO at least every six years
  - Audit reports are posted on the NERC website
  - Facility Ratings Methodology is reviewed under FAC-008-3 R3, R6, or R8
  - Performs Spot Check, at any time based upon risk
  - Requests performance of a Guided Self Assessment at any time based upon risk
Governance, Risk & Controls – Facility Ratings

• NERC
  • Oversight of Regional Entities
  • NERC Board of Trustees approves Reliability Standards
  • Reviews all audit reports, violations, etc. of Regional Entities
  • Observes/participates in selected audits
  • Link to Regional Entity Audit reports
    http://www.nerc.com/pa/comp/Pages/NERC%20Regional%20Audit%20Reports.aspx

• FERC
  • Oversight of NERC
  • FERC approves Reliability Standards
  • FERC issues NOPRs for changes, improvements
  • Receives rating as part of FERC-715 filing
PJM submits FERC-715 filing each year for each PJM TO

Part of filing is the MMWG cases (supplied by PJM)

- MMWG cases are PSS/e power flow cases and include ratings for each line and transformer (branches)
- Normal, Short-term or Long-Term Emergency, Load-Dump ratings are included
- Winter cases use a 50 degree ratings set
- All other cases use a 95 degree ratings set
Governance, Risk & Controls – Facility Ratings

• PJM GRC
  • PJM Manual 3, 3A and 13 cover Facility Ratings
  • Member TOs adhere to PJM Manuals per PJM Operating Agreement and Transmission Owners Agreement signed by each PJM Member TO
  • PJM Audits Member TOs every three years to ensure compliance to Member obligations
    • Audit scope is documented in the PJM TO/TOP Matrix
  • PJM tracks all Facility Ratings for all PJM Members via TERM application
Governance, Risk & Controls – Facility Ratings

• PJM TO/TOP Matrix
  • FAC-014 requires Member TO establish Facility Ratings
  • IRO-005 requires Member TO operate to the most limiting of Facility Ratings if discrepancy is identified
  • IRO-010 (Matrix V12) requires Member TO update PJM of changes in Facility Ratings

• PJM has internal rating control measures
  • At least 3% difference between Emergency and Load Dump ratings
  • Any TO rating changes over 10% will trigger a PJM review
Implementation Process – Facility Ratings

- TO develops Facility Ratings Methodology
- TO follows their Methodology to determine ratings:
  - Follow internal process, e.g. calculation, documentation
  - Update ratings in the TO’s EMS
  - Provide ratings to PJM via TERM system
- PJM updates the PJM EMS
- PJM posts all facility ratings and temporary ratings on PJM OASIS page:
Identify The Need

• What triggers the need to develop/change Transmission Facility Ratings?
  – RTEP Projects (Regional Transmission Expansion Plan)
  – TLC Projects (Transmission Life Cycle)
  – Damage (Fire/storm/equipment failure)
  – Facility Rating NERC Alerts
  – As-built reviews
Examples of Typical Transmission Elements

- Breakers
- Current Transformers
- Circuit Switchers
- Disconnect switches
- Wavetraps
- Relay Systems
- Shunt Capacitors
- Shunt Reactors
- Bus connections/Substation Conductors
- Transformers/Series Reactors/PARs
- Overhead Transmission Lines
- Underground Transmission Cables
Identifying Transmission elements

- Transmission Facility Ratings Methodology is utilized to calculate ratings of individual transmission elements (circled in green) of a Transmission Facility.

Note: Other relevant transmission elements, like bus connections, relays, were not drawn here to make the illustration simple.
Calculate facility ratings

- Ratings methodology is used to calculate ratings of each transmission facility element.

Sample Disconnect Switch Ratings calculated using one of the TO’s Rating Methodology (for Normal continuous rating in MVA @ ambient temperature 35°C)

Normal Ratings (Amps) \[ I_a = I \left( \frac{\theta_{\text{max}} - \theta_a}{\theta_r} \right)^{1/n} = 3000A \left[ \frac{105-35}{53} \right]^{1/2} = 3447.7 \text{ A} \]

Normal Ratings (MVA) \[ \frac{\sqrt{3} \cdot 230KV \cdot I_a}{1000} = 1373 \text{ MVA} \]

Note: Other relevant transmission elements, like bus connections, relays, were not drawn here to make the illustration simple.
Simplified one-line for developing facility ratings

- Limiting element’s **Normal** ratings identified in **MVA @ ambient temperature 35°C**

Note: Other relevant transmission elements, like bus connections, relays, were not drawn here to make the illustration simple.
Developing the Ratings Sheet

- Normal, Emergency and Load Dump Ratings are calculated for each Transmission element in the BES, at each ambient temperature (0°C to 35°C)
- Limiting Equipment and it’s ratings are identified at each Rating condition and ambient temperature (0°C to 35°C)
- Each Ratings Sheet contains at least 27 Ratings, depending on # of elements in the circuit path (aka Transmission Facility)
  (some TOs just have summer and winter ratings)
PJM Transmission and Substation Subcommittee (TSS) provides thermal rating guidance in the Transmission Owner Guidelines document:

http://www.pjm.com/planning/design-engineering/maac-to-guidelines.aspx
Communicate Ratings

- Facility rating changes are communicated by PJM member Transmission Owners to PJM via “Transmission Equipment Ratings Monitor (TERM)” tickets
- TERM is used to satisfy the Federal Energy Regulatory Commission (FERC) requirement for an auditable tracking method of transmission equipment ratings changes\(^1\)

\(^1\)PJM Course: Online Transmission 101, Module: PJM Scheduling Procedure, Segment: eDART TERM, Rev 7/9/2012
Auditing is one of the primary tools used by RF/SERC to monitor compliance. RF/SERC performs comprehensive Compliance Audits as required by the Compliance Monitoring and Enforcement Program (CMEP) and NERC Rules of Procedure (ROP) that are based on the criteria established by NERC.

Link to NERC Regional Audit Reports
www.nerc.com/pa/comp/Pages/NERC%20Regional%20Audit%20Reports.aspx
Sample NERC audit report

Table 2. Audit Scope

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<th>Standards</th>
<th>Requirement(s)</th>
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<tbody>
<tr>
<td>COM-002-2</td>
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- FAC-008-3
- FAC-008-3
Conclusion

• Under NERC Standard FAC-008-3 R3 and R6, TOs are required to adhere to their established rating methodologies in their facility rating calculations
• TOs have demonstrated that strict processes and controls are already in place to ensure facility ratings used in PJM operation are determined based on technically sound principles
• There are no requirements for PJM to approve or verify a TO’s ratings or do any kind of consistency check