

Transmission & Substation Subcommittee (TSS) Report-Out on Rating Guide Updates

Presented by

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TSS Chairperson

Make Operating Committee, Planning Committee and System Operations Subcommittee aware of:

- New revisions to the PJM Transmission Owner Guidelines;
- Implications of Load Dump Ratings;
- Reductions in Normal and Emergency overhead conductor ratings due to latest published resistances.

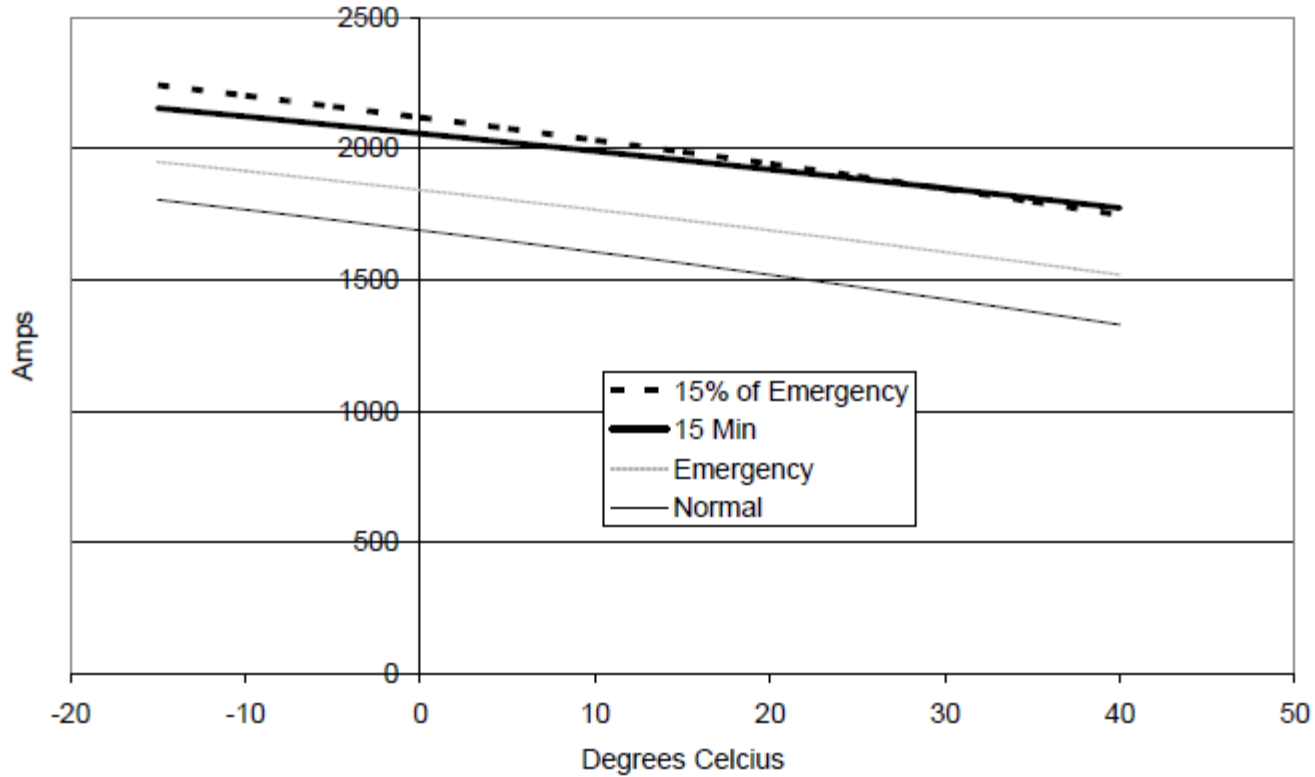
- Originally developed in 1960's to provide a common rating method;
- Per its charter, PJM TSS has updated and maintained these documents;
- Used as a basis for NERC rating compliance by Heritage MAAC companies (PPL, PS, PECO, BGE, PHI); and
- Open for use by any PJM market participant at <http://pjm.com/planning/design-engineering/maac-to-guidelines.aspx>

- PJM Operations Manual M03 required equipment owners to provide Normal (NR), Emergency (ER) and Load Dump (LDR) Ratings:
 - LDR provided must be at least $1.03 \times \text{ER}$;
 - If the provided $\text{LDR} < 1.03 \times \text{ER}$, then PJM lowered the ER to achieve 3% margin; or
 - If no LDR rating was provided, M03 stated that PJM defaulted to $1.15 \times \text{ER}$;
- PJM Operations does not enforce separation between ER and LD requirement
- Progressive increase in the ratings from NR to ER to LDR is desirable and good for operation.

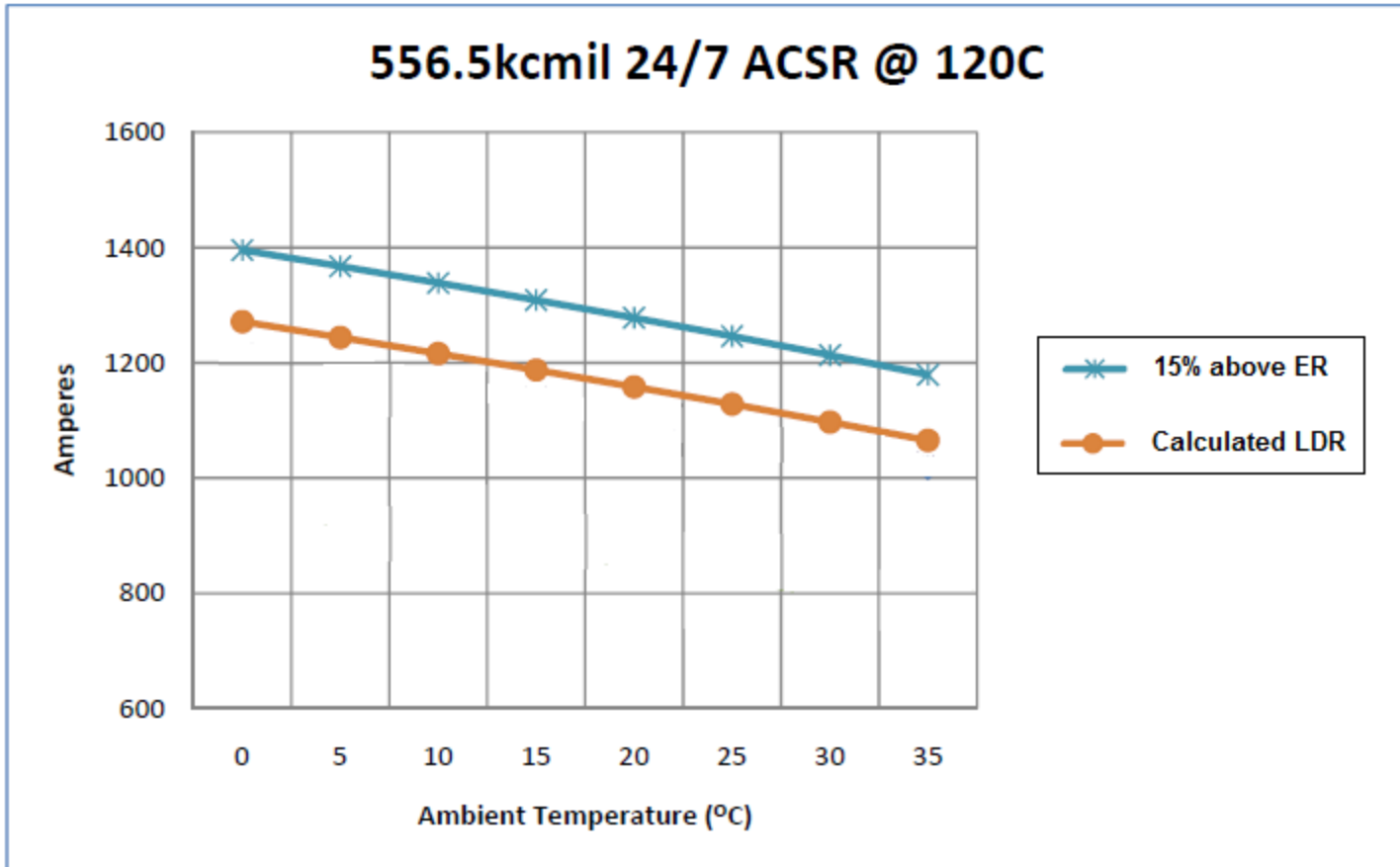
- As part of NERC compliance, all ratings must have a technical basis;
- TSS was requested to provide justification for the Manual M03 15% default increase above ER for the LDR rating;
- The review indicated that 15% above ER was close to the calculated LDR for many equipment types, but was not conservative over all ambient temperatures; and in some cases never conservative.

Disconnect Switch

1200 Amp, 53 Degree Rise over 40 Degree Ambient F06



Overhead Bare Conductor



- While 15% above the ER appears to be a reasonable rule of thumb and works well for higher operating temperature ranges for some equipment, it cannot be justified for all operating temperatures or equipment;
- Manual M03 updates affect rating guide assumptions (e.g. pre-loading assumptions before entering an emergency level);
- 15% above ER is not defensible and TSS recommends calculating the LDR.

- Updated all Rating Guides to list specific NERC FAC-8 and PJM Manual ratings;
- Guides made to be more content consistent;
- For equipment types without a less than one hour method, a load dump method was developed:
 - Overhead Conductor
 - Transformers

The changes, listed below, applied to the following Rating Guides:

1. Circuit Breakers
2. Air Disconnect Switches
3. Outdoor Substation Conductor*
4. Current Transformers
5. Line Traps

Changes:

- Guides made to be specific to PJM Operating ratings' durations
- For planning: 35°C Summer / 10°C Winter
- Exceeding 4 hour period above NR requires evaluation by equipment owner

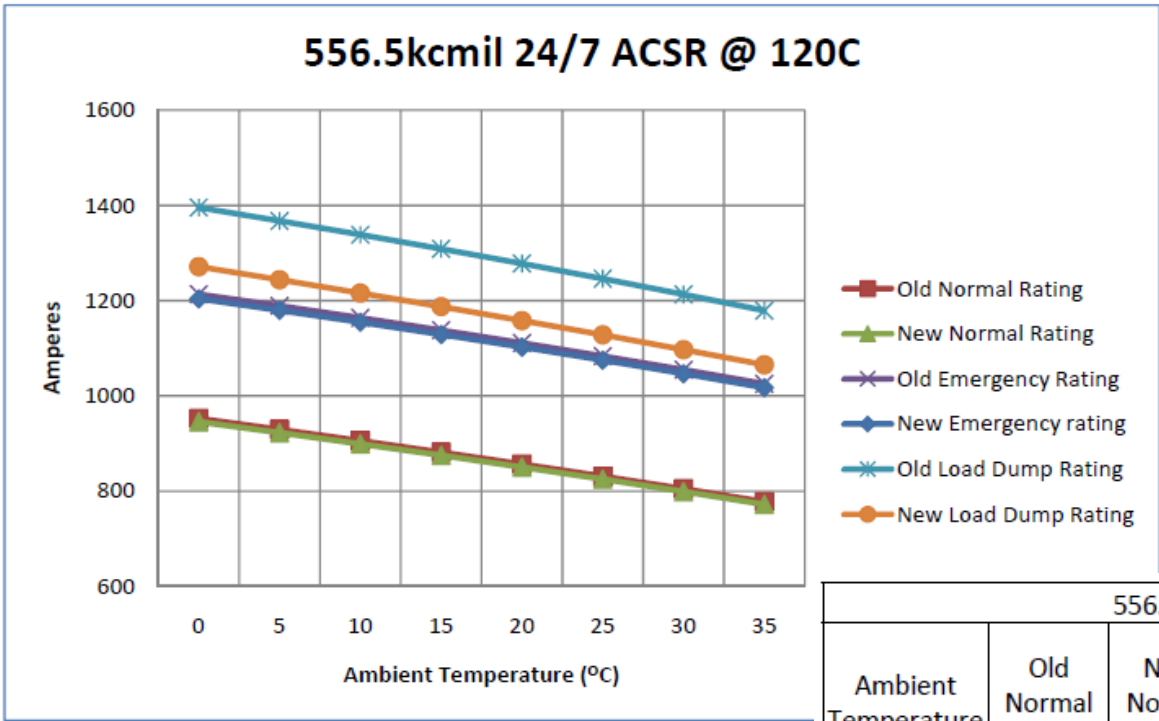
* Added shapes and IEEE 605 alignment.

Changes to the Transformer Rating Guide:

- NR and ER made to match PJM Operating ratings' durations
- LDR based on one hour rating not 15 minute due to formula
- 30°C Average Daily Summer / 10°C Average Daily Winter
- Exceeding four hour period above NR prohibited due to 4 hr. time constant

Changes to the Overhead Conductor Rating Guide:

- NR and ER made to match PJM Operating ratings' durations;
- Iterative process for LDR using pre-contingency assumptions;
- Macro-driven Excel spreadsheet developed for iterative process;
- Conductor resistances updated to latest published data; and
- Exceeding 4 hour period above NR requires evaluation by equipment owner.



Updating overhead conductor resistances impacts all rating levels.

Possible PJM market impacts due to reduction in ratings.

556.5kcmil 24/7 ACSR @ 120C						
Ambient Temperature	Old Normal Rating	New Normal Rating	Old Emergency Rating	New Emergency Rating	Old Load Dump Rating	New Load Dump Rating
0	953	945	1214	1204	1396	1271
5	930	922	1189	1180	1367	1244
10	906	899	1164	1155	1339	1216
15	882	875	1138	1129	1309	1188
20	857	850	1111	1102	1278	1158
25	831	825	1084	1075	1246	1128
30	805	799	1055	1047	1213	1097
35	778	772	1025	1017	1179	1065

- TSS has developed methods for calculating LDR for all the PJM Rating Guides;
- After endorsement from Planning Committee, Operating Committee and System Operations Subcommittee, TSS will make documents publically available for use;
- Manual M03 should be changed to remove 15% increase, and ensure operational limitations match rating guide assumptions:
 - Transformers should not be operated above NR for > 4 hours
 - Equipment owner must be consulted prior to operating any equipment > 4 hours above ER.
- For operating fidelity, TSS recommends TOs provide progressive NR, ER and LDR.