Single Element Derates

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Background

- **Single Element Derates:** Under certain circuit breaker outage conditions, lines/transformers may be isolated on single transmission elements whose rating is less than that of the line/transformer rating
  - Single element could be a CB, disconnect, transformer, etc.

- **Transmission Owners derate lines/transformers** to account for single element limitations or separately model single elements to account for more restrictive ratings

- **Single Breaker Derates:** PJM Operations has identified and is operating to an order of 1500 CB outage conditions where lines/transformers must be derated to account for more restrictive CB ratings
Example 1
- 5019 line rating = 2940N/3733E MVA
- When CB 2-4 opens, line 5019 is in series with CB 3-4 and is limited to that rating of 2707N/3016E MVA

Example 2
- 123 line rating = 394N/453E MVA
- When either CB B or CB C opens, there is a meter limit in series with the 123 line of 367N/382E MVA that limits that path to the new rating.
PJM Planning conducted a survey of PJM TO planning and modeling of ratings and there are potential instances in the RTEP models where single element derates modeling may be improved.

In order to ensure consideration of single element derates, some combination of the following three approaches can be taken:

1. Derate lines/transformers to account for adjacent limiting equipment in the power flow model
   - **Pros:** Conservative approach, doesn't require model expansion  **Cons:** Overly conservative, will produce false positive violations

2. Derate lines/transformers to account for adjacent limiting equipment in the analysis input files
   - **Pros:** Efficient approach, doesn't require model expansion  **Cons:** Technically challenging, may require support from software vendors, modeling issues may be difficult to find and fix

3. Discretely model potential single element derates
   - **Pros:** Detailed approach  **Cons:** Requires significant model expansion
Technical Solution Alternatives for Example Bus CBs 2-4 & 3-4

1. Derate 5019 line rating in power flow to 2707N/3016E MVA.
   - Does not account for worst case conditions, i.e., CB 1-3 is open and 5019 flows are less than CB 2-4 rating but combined 5019 flows and transformer flows are greater than CB 2-4 rating

2. In monitor element / contingency file
   - Derate 5019 line rating to 2707N/3016E MVA whenever CB 1-3, 2-4 or 3-4 opens.
   - Include 5019 line and 500/230 transformer as interface with 2707N/3016E MVA rating whenever CB 1-3 is open.

3. Discretely model CBs 1-3, 2-4 and 3-4 in the power flow model with the appropriate rating.
   - Most accurate solution + can eliminate “50/50 current split” assumption, but will involve large scale changes to the power flow model if not combined with the other options