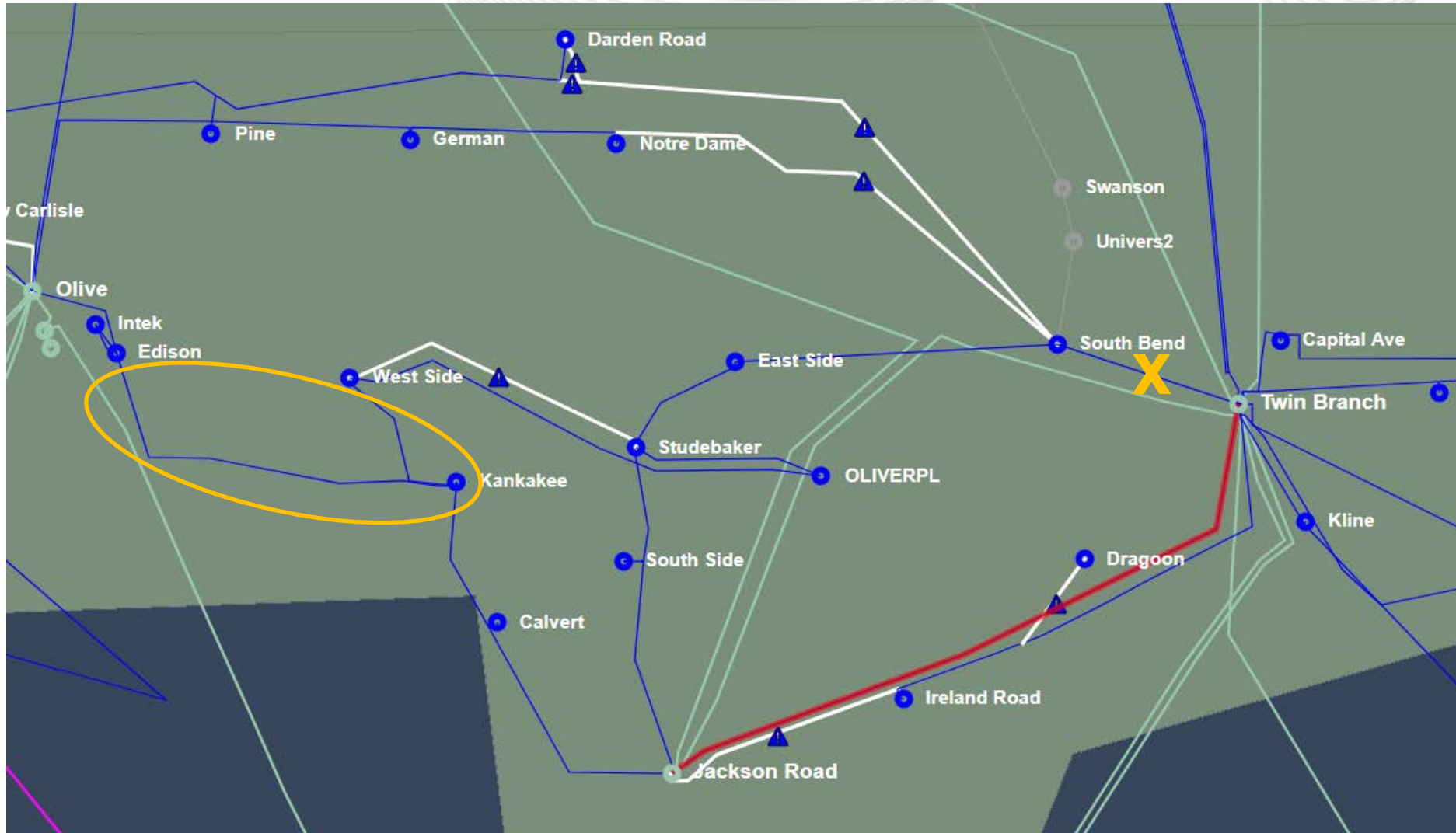




Twin Branch / Edison Area Load Shed Event May 29, 2018

July 5th SOS

- Area overview
- System conditions prior to the event
- Sequence of Events
- PAI Analysis
- Recommendations



Legend:

- Planned outages
- **Unplanned outage**
- 138kV equipment
- 345kV equipment

- Hot Weather Alert issued for the RTO
- Jackson Rd – Ireland Rd 138kV line out of service
 - Supplemental project s1582
 - Outage began on 4/18
- Darden Rd – South Bend 138kV line AND Notre Dame – South Bend 138kV line out of service
 - Supplemental projects s1611.2-.8
 - Pouring new foundations
 - Both outages began on 5/29
 - Hot Weather Alerts request Transmission and Generation owners to defer maintenance, but do not prohibit new outages from starting. Outages are cancelled by PJM if there are any reliability concerns identified in real time (RT) or day ahead (DA) studies:
 - RT and DA N-1 analyses by both PJM and AEP indicated no issues. Outages were both recallable.

- 12:36 - Twin Branch - Jackson Rd 138 kV line AND the Jackson Rd 345/138 kV transformer 3 tripped
 - The Twin Branch-Jackson Rd trip was a result of contact with a tree
 - The Jackson Rd 'J1' CB relayed out due to a momentary reverse fault being detected that subsequently opened the low side of the Jackson Rd 345/138kV transformer.

- 12:48 – Contingency overloads confirmed:
 - Edison-Kankakee 138kV line for loss of Twin Branch #6 & #7 345/138kV transformers at 140% of LTE
 - Due to the breaker configuration, loss of the Twin Branch #6 and #7 transformers concurrently is a single contingency
 - Edison-Kankakee 138kV line for loss of Twin Branch – South Bend 138kV line at 132% of LTE
 - PJM operators begin coordination with AEP operators to review generation and switching options
 - No controlling actions were available, M-13 Section 5.4.1 Cascade Analysis begins

- 12:59 – PJM completes the cascade analysis for loss of the Edison-Kankakee and the Twin Branch #6 & #7 transformers. The analysis indicates this scenario does NOT result in a potential cascade.

- 13:00 – PJM begins second cascade analysis, taking out the Edison-Kankakee 138kV line and the Twin Branch – South Bend 138kV line
- 13:05 – PJM issues a PCLLRW on the Edison-Kankakee 138kV line for loss of Twin Branch #6 & #7 345/138kV transformers
- 13:12 – PJM completes the cascade analysis for loss of the Twin Branch – South Bend 138kV line.
 - The analysis indicated this contingency scenario “did not solve” and may be a cascade condition.
- 13:15 – PJM recalls the Darden Rd - South Bend and Notre Dame – South Bend 138kV lines

- 13:22 – After reviewing the cascade analysis results with AEP, PJM directed AEP to shed load in the impacted area to reduce the contingency flow on the Edison-Kankakee line
 - PAI trigger
- 13:37 - The Jackson Rd 345/138 kV transformer 3 was restored
- 13:46 - PJM analysis confirms the cascade condition has been mitigated by the return of the transformer and cancels the load shed
- 13:55 - AEP completes restoration of load that had been shed (approx. 21 MWs)

- 15:27 – Notre Dame – South Bend restored
- 16:20 – Darden Rd – South Bend restored
- 23:57 - The Twin Branch - Jackson Rd 138 kV line was restored

- **PAI Analysis:**

- There are no Non-Performance Charges or Bonus Credits resulting from the event
- Data confidentiality rules prevent the disclosure of more detailed data to members.

NOTE: There was no possible generation dispatch (online or offline units) that would have mitigated overloads. The overloads were a result of a localized load pocket caused by the transmission outages.

- Recommendations:
 - Relay Settings:
 - AEP reviewed and updated the relay settings associated with the Jackson Rd J1 breaker.
 - Outage Approvals:
 - PJM will review the outage approval process during emergency procedures, including possible N-1-1 analysis.
 - Technology
 - PJM will review tools and technology to develop alternative methods to provide a solution when a contingency ‘doesn’t solve’.
 - Manual language
 - Reviewing M-3 and M-13 language for improvements and clarity based on operator feedback