Automated Transmission Outage Analysis Using Nodal Based Model

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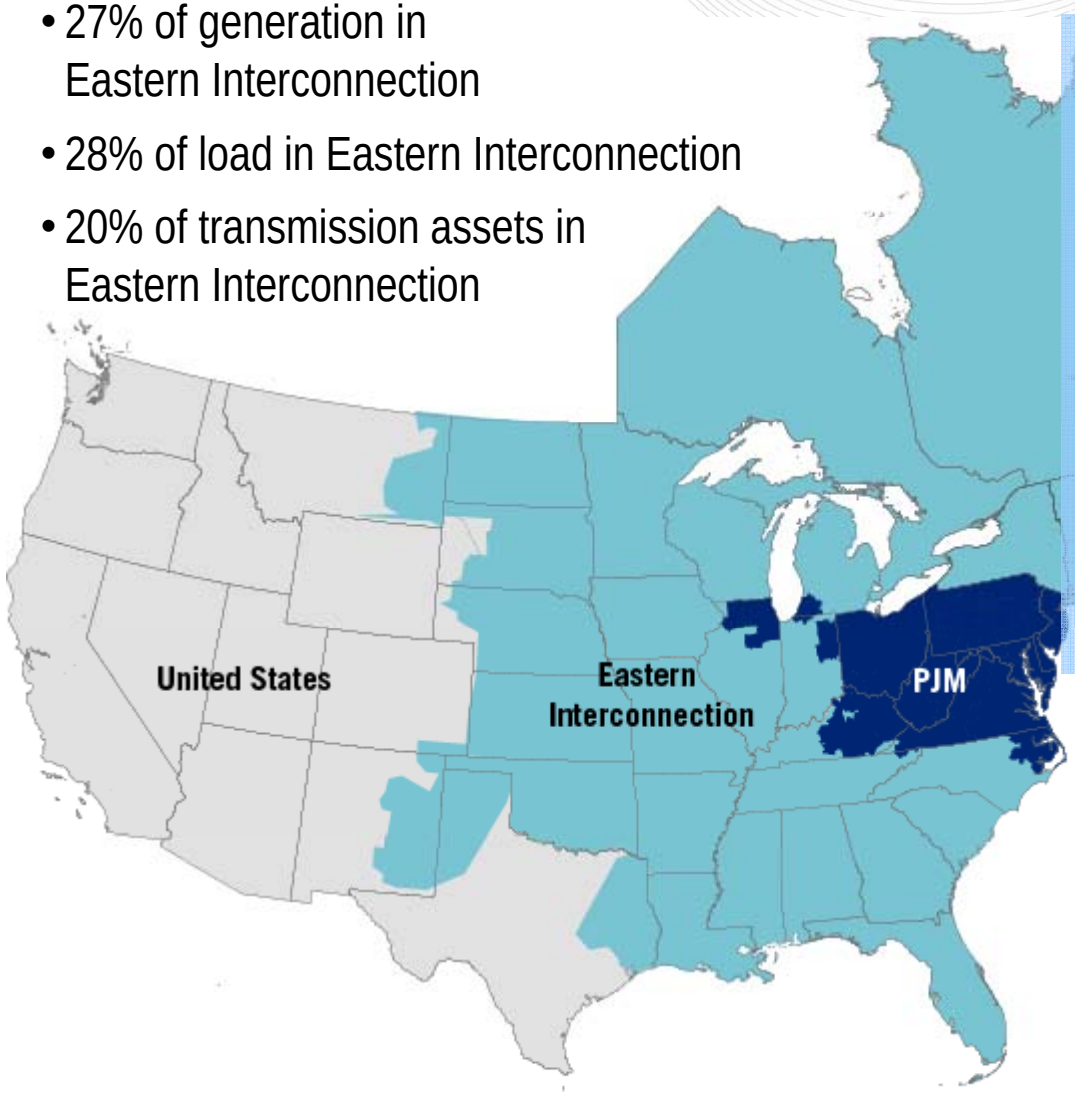
Outage vs. Market Efficiency

Transmission outages can have significant impact on the day-ahead and real-time market outcomes, congestion payments and FTR funding.

PJM as Part of the Eastern Interconnection

- 27% of generation in Eastern Interconnection
- 28% of load in Eastern Interconnection
- 20% of transmission assets in Eastern Interconnection



KEY STATISTICS	
PJM member companies	800+
millions of people served	61
peak load in megawatts	165,492
MWs of generating capacity	183,604
miles of transmission lines	62,556
2012 GWh of annual energy	793,679
generation sources	1,376
square miles of territory	243,417
area served	13 states + DC
externally facing tie lines	191

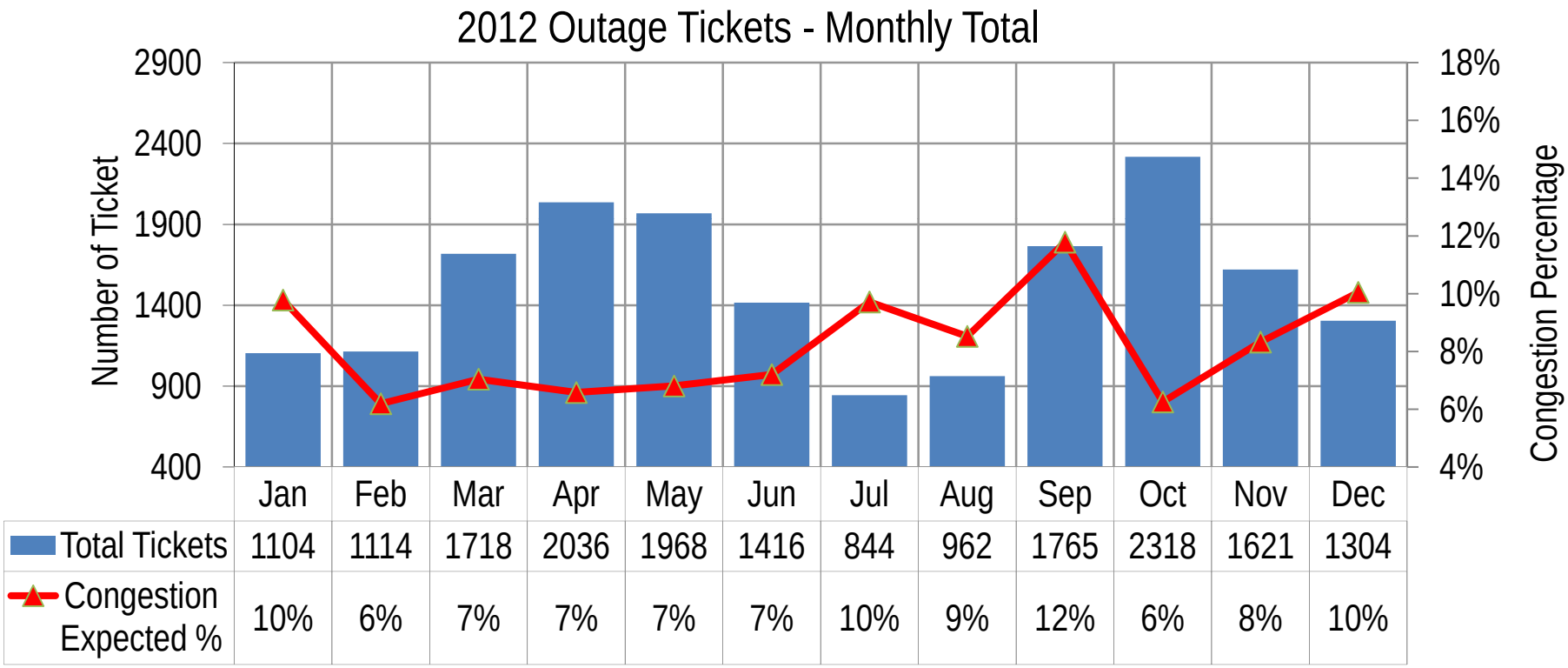
21% of U.S. GDP produced in PJM

As of 6/1/2013

Requirement

Outage Duration	Request Submitted
Outage>30 Calendar Days	Before February 1 (for the following planning cycle June 1 – May 31)OR by the 1st of the month six months prior to the starting month of the outage (whichever is more restrictive)
5 Calendar days < Outage <= 30 Calendar Days	Before the 1st of the month six months prior to the starting month of the outage
Outage <= 5 Calendar Days	Before the 1st of the month prior to the starting month of the outage

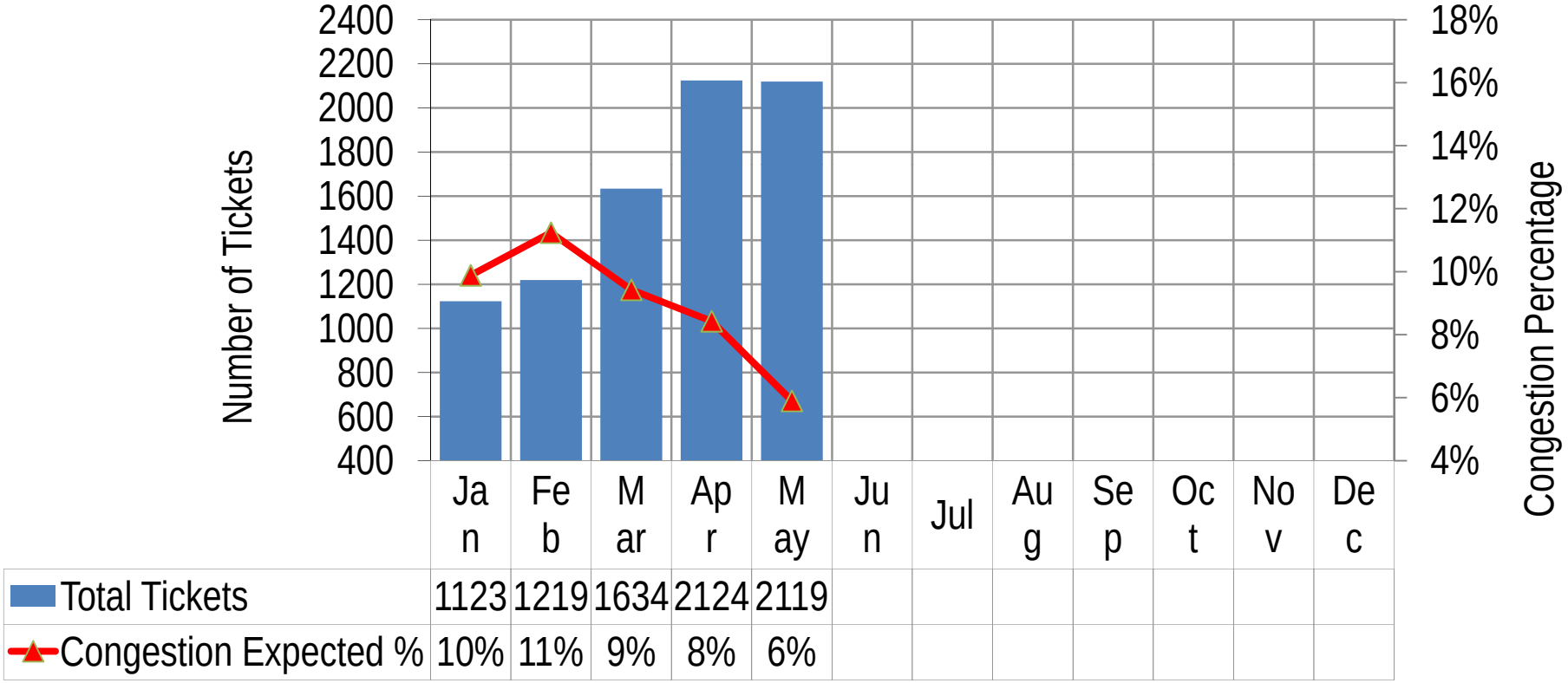
Total Number of Outage Tickets



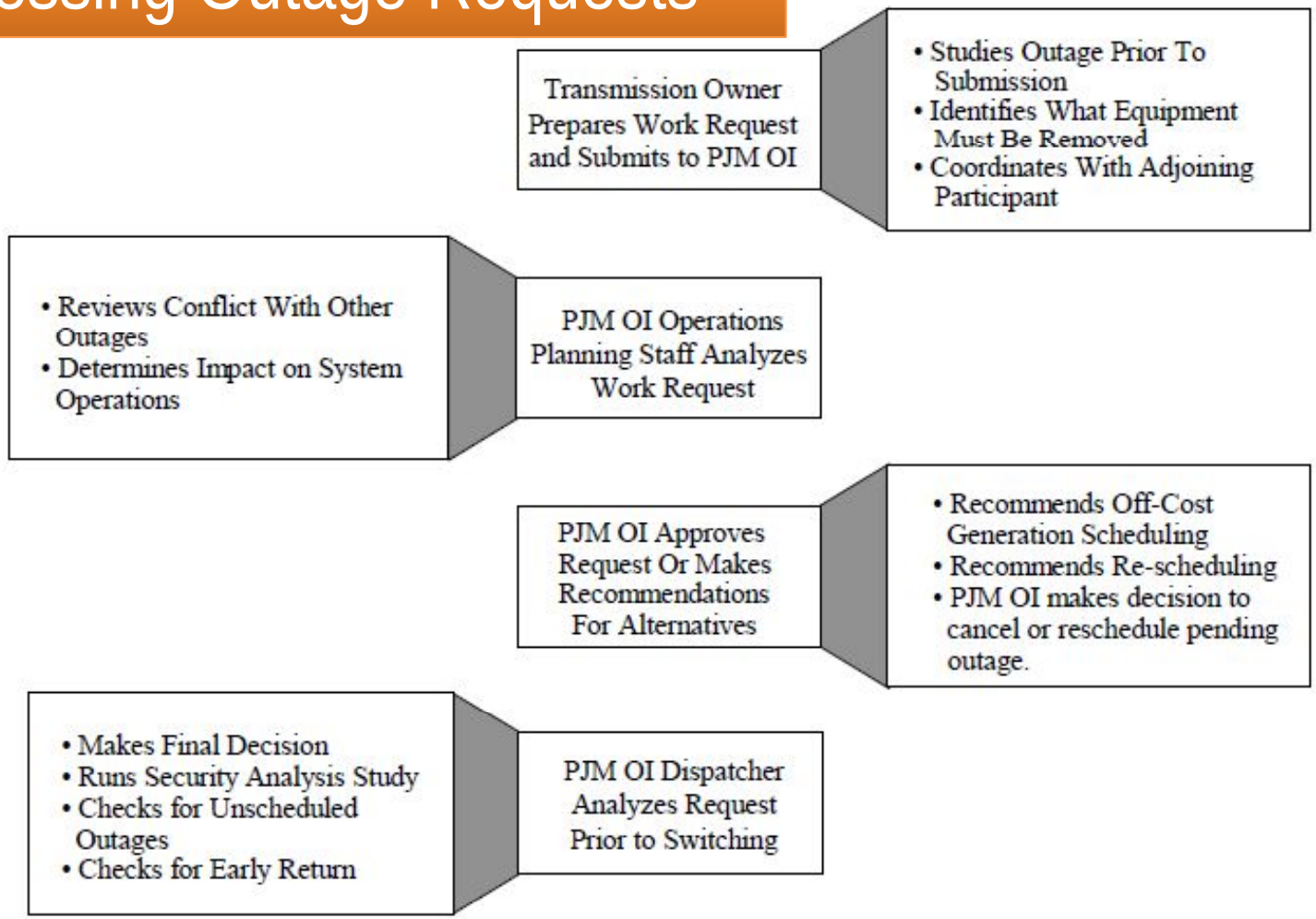
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Tickets	1104	1114	1718	2036	1968	1416	844	962	1765	2318	1621	1304
Congestion Expected %	10%	6%	7%	7%	7%	7%	10%	9%	12%	6%	8%	10%

18,170 tickets in 2012

For 2013, the outage ticket volume is expected a total increase of 3-6% in 2013.



Processing Outage Requests



Processing Outage Requests

Short-term Study

- 2-pass study
- Day-ahead study
- 2-days out study
- 3-days out study

Long-term Study

- 1-month out study
- 6-month out study

Ad-hoc Study

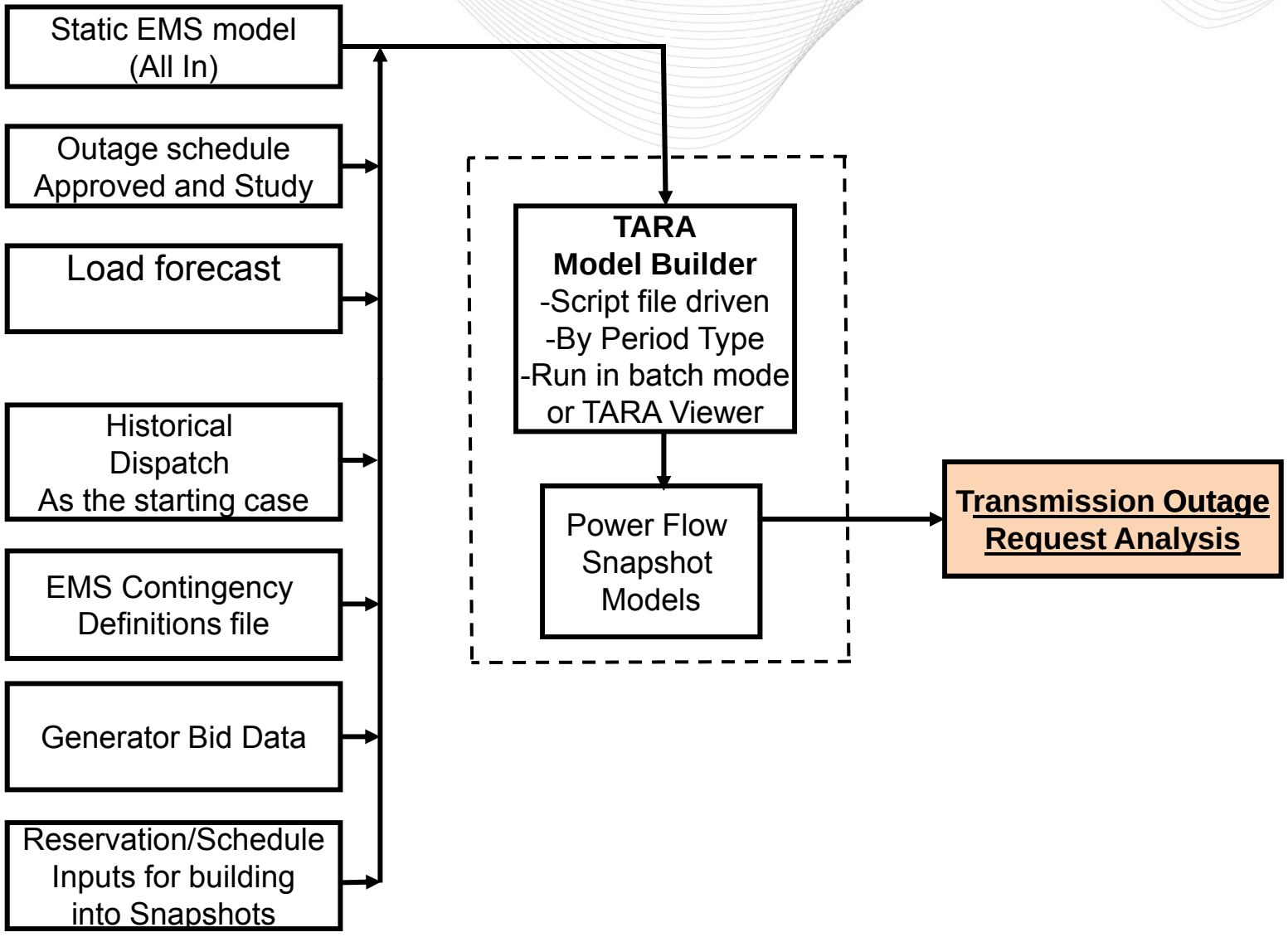
Issues in current outage study process

- Incomplete system condition snapshot
  - Peak vs. Valley
- The gaps
  - Longer time outage
  - Late outage
- Tedious & Time consuming process
  - Base case set up
  - Apply outages into EMS
- Manual process and lack of resource

PJM TARA/ORA Project

- Started in 2010 and PowerGEM TARA (Transmission Adequacy and Reliability Assessment) tool chosen
- Key Modules involved in PJM outage study process:
  - Automated Model Builder (AMB)
  - Contingency Analysis (CA)
  - Security Constrained Economic Dispatch (SCED)
  - Outage Reliability Analyzer (ORA)

PJM TARA/ORA Project



Designed and customized the tool to closely replicate the PJM's outage study process in EMS

- Nodal cased EMS breaker-breaker models
- Saved case in PowerWorld AUX format
- Instead of block dispatch, Use real-time market economic info in SCED
- Developed ORA
- Developed Outage Opportunity Window function to optimize outage timeframe
- Multi-core mode

Automate the outage study process

- Automatically dump the system topology info from EMS and create the projected system snapshot based on the study type
- Automatically apply and study the outages and re-evaluate to optimize outage timeframe when needed

Enhance the Current Outage Process with TARA/ORA

- Automated 7-days out outage study
  - Process Kicked off @ 12:00am
  - On-going rolling basis
  - 5 system snapshots per day: 00:00, 04:00, 08:00, 12:00, 18:00
  - Close the study gaps
- Automated 1-month and 6-month outage study
  - 1 peak snap shot for each day and different cases for weekday and weekend
  - Screening tool now; replace the manual process completely in the future
  - Big time saving and engineer can focus more on the coordination with TOs and GOs

Enhance the Current Outage Process with TARA/ORA

- Optimize the outage schedule
  - In the process of developing the procedure and user friendly report
  - Resolve conflicts, with suggested time schedule to TOs
- Add in additional study process
  - 1-year out outage study

Future Tasks & Considerations

- Fine-tune our process to further close the study gaps and improve the efficiency
- Build complete in-production environment
- Create two-way communication between TARA and EMS
- Build UI within existing widely used tools in PJM; for example, outage scheduling tool (eDART)
- Quantify the outage impact to market; for example, calculate the cost for controlling the constraints
- Automatic TARA analysis feedback to the Transmission Owner after a transmission outage request is submitted.

Questions