



# **MARS Model Vs. PRISM Model Overview**

April 15, 2008

Reserve Requirement Assumptions  
Working Group  
Agenda Item 5

1. A clear and thorough understanding of PJM Manual 20, which might include performing practical applications of items discussed in the Manual.
2. A familiarity of MARS, and the many aspects of the MARS model. Knowing where to find a current MARS User's manual reference and /or attendance at a MARS workshop.
3. General familiarity and experience in LOLE Study best practices, including interregional studies, involving items such as: current Industry issues, modeling issues, accepted practices, various Industry solution methods, etc.

- Overview of Models
- MARS
- PRISM
- Similarities
- Differences
- Methods employed for modeling consistency

## Multi - Area Reliability Simulation

### MARS – Sold/Supported by GE

- Used by several ISOs in North America
- Multi Area – 70 (as many as you need)
- Transfer pipes – 125(as many as you need)
- Typically uses “Operation like” modeling
- 6 months to 4 yrs ahead

## Probabilistic Reliability Index Study Model

### PRISM – PJM Staff only / RRAWG review

- Probabilistic Load & Generation, deterministic Transmission
- One or Two Area Model
- One transmission pipe between areas
- 3 yrs to 10 yrs ahead – Planning Tool

Many separate tables for modeling values(~50)

- Monte Carlo solution/Standard Error basis
- Probabilistic Capacity model.
- Deterministic Load distribution.
- Probabilistic Transfer pipe values.
- Reporting of LOLE results at EOP margin states
- Modeling specifics of interest include: **LOD-UNCY**, **LOD-MTAR**, **in02 file**, **EOP-DATA**, **INF-TRLM**, **ELU-DIST**, **UNT-DERT**, **UNT-FORS vs UNT-TRNS**.
- Many iterations, say 2500, translates to long run times(~18 hours). Network complexity and binding issues impact run time.

- Three primary input categories-Load, Capacity, Tie Size
- Direct convolution method, Solution tolerance is .001
  - Every possible load and capacity state evaluated.
  - Probabilistic Load model – WKPKFQ => PLOTS
  - Probabilistic Capacity model.
  - Deterministic Transfer pipe - Single value
  - Reporting of LOLE results after invoking load management. (Not disconnecting firm load)
  - Modeling specifics of interest include: **Weekly Std. Normal distribution and EWM, forecast monthly peaks, PLOTS file**, sensitivities to assess emergency procedures and transfer ability, **Capacity model based on Manual 22 statistics**.
  - Solution based on size of Cumulative Probability Table, typically 5-15 minutes.

- In general, the models can be very similar for the Capacity model, making comparing results straight forward for assessing capacity changes in the model.
- The format of reporting the results allows for quick determination of how the LOLE results in MARS compare to the results in PRISM.
- The underlying data needed for the models is nearly identical. This data includes GADS reporting, detailed historic hourly loads, Operations experience, and transfer limits .
- For both models, the interaction of the load and capacity distributions have a direct correlation to the reported LOLE. Reserves in the area are a key factor.
- Most study needs can be satisfied using both models, but using different techniques.

The below items list differences after acknowledging the obvious, MARS can have up to 70 areas while PRISM can have only 2 areas.

The models are primarily different in two aspects: The load model and time period for assessing results.

1. MARS has a deterministic load model while PRISM has a probabilistic load model.
2. MARS allows for hourly data and assessment while PRISM allows for daily peak assessments.
3. Comparing the load modeling techniques in the two models is not intuitive. Combining several model aspects in both models is needed to compare the load model.
4. MARS' ability to model and calculate hourly indices allows for assessing things related to Load Management duration, Wind unit performance characteristics, etc. This is not possible using PRISM.

5. MARS allows for Operation data to be specifically represented.
6. MARS has many tables that allow for specific detailed data representation while PRISM uses fewer specific data entries and more statistical values.
7. MARS can be used for Operations related assessments while PRISM is a planning tool.
8. MARS requires more detailed Transmission limit data, which are not required in PRISM.
9. MARS uses Emergency Operation Procedure values, which are not required in PRISM.

Modeling consistency involves verification that both models have similar data and running check simulations to verify similar results from the same starting set of detailed data.

## Capacity

- A table in MARS can represent the forced outage rate which is the statistic used in PRISM. However, PRISM uses a EEFORd, which incorporates the two state variance representation (FO, MO, PO).
- Once a UNT-FORS table is created MARS usually needs a transition rate set of data. We create this by using a GE supplied tool, which has undocumented abilities to transform the EEFORd values to transition states using the NUM-TRANS table.
- The Capacity model can be manipulated to have almost identical characteristics and solution results.

## Load Model

- All aspects of the load model must be simultaneously considered in both models to arrive at consistent modeling and results. Separately considering individual parts will not accomplish producing consistent models.
- MARS tables involve the hourly load shape (in02 file), the load forecast uncertainty (LOD-UNCY), and the monthly forecast loads (LOD-MTAR).
- The PRISM model involves the PLOTS load model shape (Weekly mean and STD), the forecast error factor, the calculation of the Expected Weekly Maximum (EWM), the standard normal distribution of daily peaks for each week, and the monthly forecast load factors that adjust the PLOTS shape.

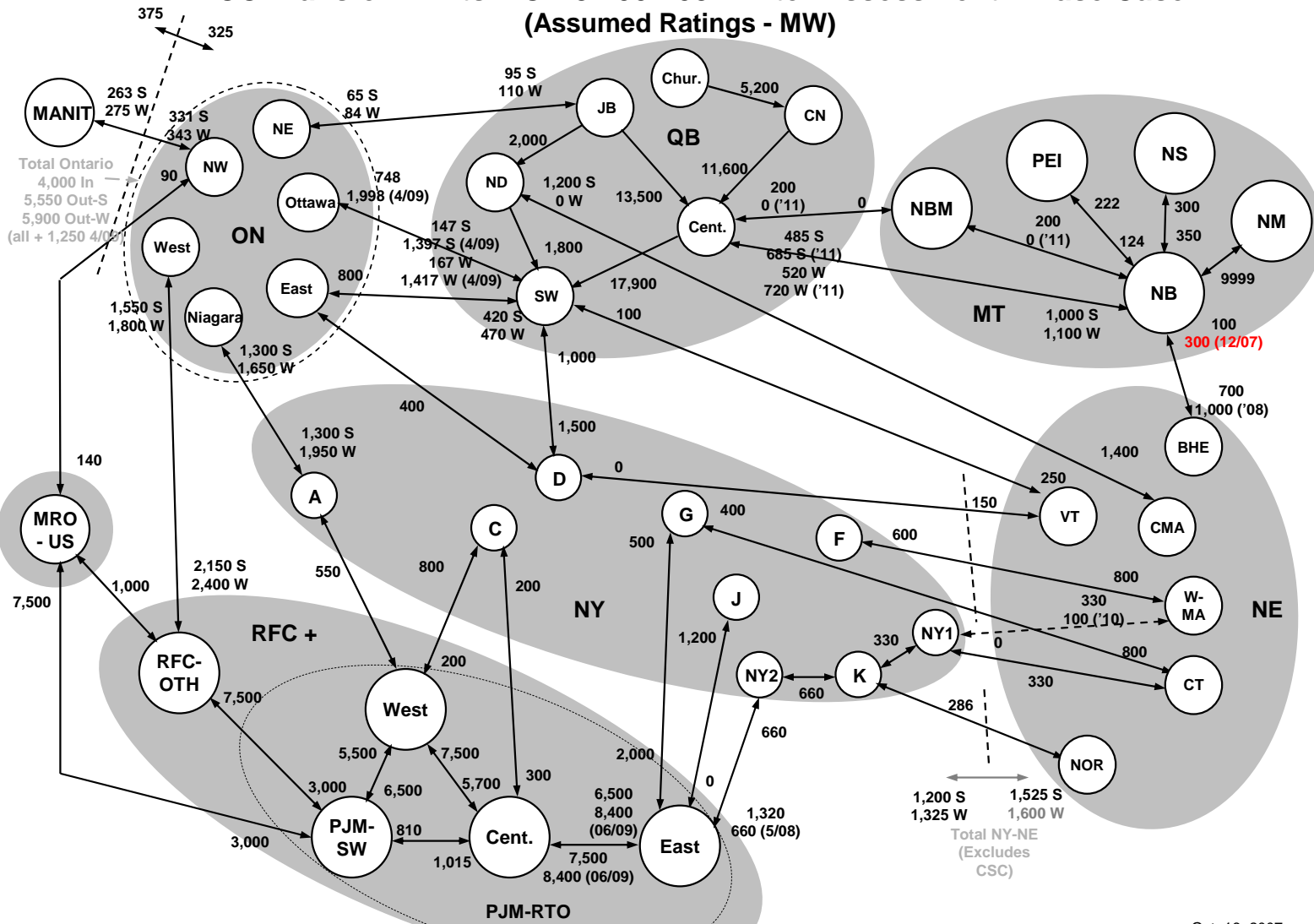
## Load Model

- After making a WKPKFQ run to produce a PLOTS load model for the same period used in the in02 file, calculation of the EWM yields an adjustment factor that is applied to the LOD-UNCY values. This is currently a spreadsheet operation. The LOD-MTAR values match the PJM load forecast report.

# Transmission

- Known Operations limits drove the area definitions in the MARS model. The areas and limits were developed by coordinating with PJM operations and transmission planning staffs.
- In verification simulations, any transfer pipes experiencing limits were assessed with appropriate known transmission upgrades represented to reduce or eliminate the duration of limit.
- The 4 Area PJM MARS model is shown on next slide, which was used in the latest public NPCC CP-8 Study.

## NPCC Transfer Limits – CP-8 2007-08 Winter Assessment – Base Case (Assumed Ratings - MW)



Oct. 16, 2007

# Future Improvements

Future improvements in coordinating the model consistency might involve:

- Automating simulation checks
- Ability to use weekly non-normal distributions
- Ability to adjust the in02 file hourly loads
- Ability to produce unit transition states directly from eGADS.
- Assessment of transfer pipes and EOP values for appropriate areas with known transmission interfaces, such as those used in performing CETO studies.

- If a MARS or a PRISM model exists, typically most all of the data is available for creating the other model.
- The effort to create consistent PRISM and MARS models is not insignificant.
- Verification and performing simulation checks are needed to verify model consistency.
- The details involved in creating the models are very important to produce LOLE study results that are comparable.
- Many of the important comparison details are not fully documented at this time. This documentation might require a significant effort.

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