Hybrid Resource Modeling

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DIRS
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Types of Hybrid Projects within PJM

	AC or DC Coupled [Charged From Grid]	**DC Coupled [Charged From On-Site Generation]**
CIRS	CIRS Granted For Each Fuel Type Independently	CIRS Granted for Non-Storage Fuel Types
Gen Deliv Test – Charge vs. Discharge of Storage Component of Hybrid Project	Both Charging and Discharging Modes Tested in GenDeliv Test	Generation Only
Battery Charging	NonFirm	N/A

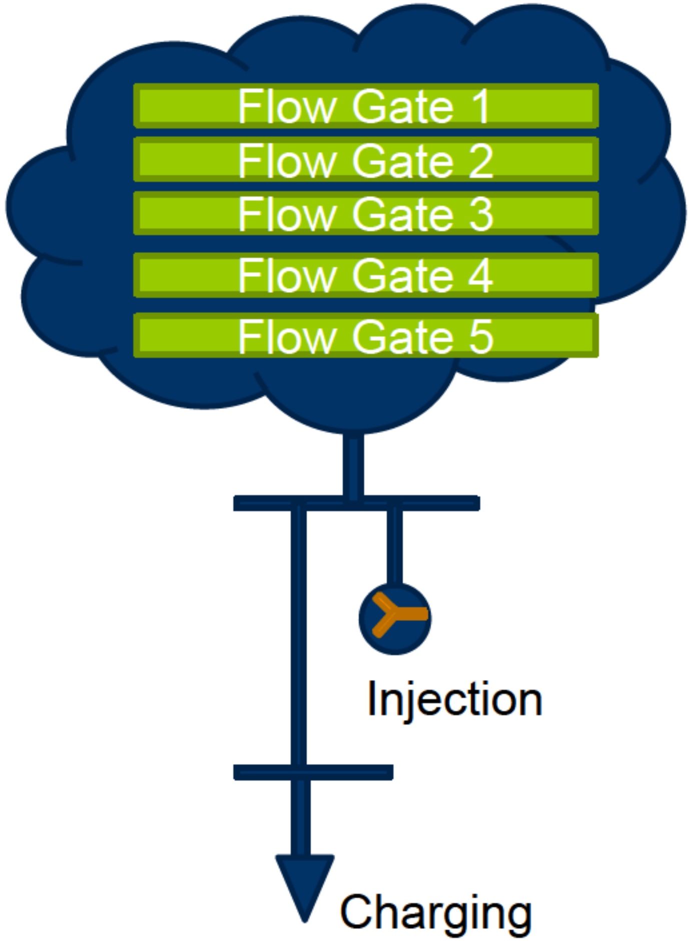
Hybrid Projects with Battery Component

- Batteries may have both a injection and withdrawal (charging) component based on if the battery is DC Coupled or AC Coupled and if it’s charged by the grid or from on-site generation.

- Do we model the battery in the discharging/generation/injection mode or charging/withdrawal mode ?How do we know that we have captured the worst case scenario?

- The best way is to run the both charging and discharging modes and pick the worst case scenario.

Battery Component of a Hybrid Projects



- The goal is to identify worst case loading on the facilitates from either the charging portion of the battery or discharging portion of the battery
- On some facilities charging portion of the battery would increase the loading on the facilities and on other the discharging porting of the battery would increase the loading on the facilities
- We pick the worst case (charging/discharging) portion to be dispatched based on the facility under study. On certain facilities the charging component gets dispatched and on the others the discharging components gets dispatched

Key Ideas

- We start off with both generation and load component offline
- The Generation Component and Load Component have the equal magnitude of distribution factor on a target flowgate but have opposite signs. What does that mean?
- Example 1 : For a target flowgate A, if the distribution factors of a battery project is 5%, that means
  - If there is an injection at the bus of 100 MW, there would be an increase in 5 MW flow on flowgate A
  - If there is a withdrawal at the bus of 100 MW, there would be a decrease in 5 MW flow on flowgate A
  - For the target flowgate A, the worst case scenario is to test the battery project with its injection. So for flowgate A, we ramp up the injection component of the battery

Key Ideas

- Example 2 : For a target flowgate B, if the distribution factors of a battery project is -10%, that means
  - If there is an injection at the bus of 100 MW, there would be an decrease in 10 MW flow on flowgate B
  - If there is a withdrawal at the bus of 100 MW, there would be a increase in 10 MW flow on flowgate B
  - For the target flowgate B, the worst case scenario is to test the battery project with its withdrawal. So for flowgate B, we ramp up the withdrawal component of the battery
- Flowgate A (Injection is the worst case scenario)
- Flowgate B (Withdrawal is the worst case scenario)
- **Injection and Withdrawal component DFAXs of the battery are complementary to one another**
- We loop through all the flowgates in PJM and use a **dynamic dispatch** for the target flowgate based on the worst case scenario (Injection/Withdrawal)
- **In conclusion, we model both charging and discharging components to the battery and let dynamic dispatch evaluate the worst case scenario.**

Example DFax Table

Flowgate A

Queue Project	MW Size	DFax	MW Contributed
AE1-001 BAT	100	-15%	
AE1-001 C	100	15%	15
AE1-002 C	100	14%	14
AE1-003 C	100	13%	13
J500 C	100	12%	12
J501 C	100	11%	11
J502 C	100	10%	10
AE1-007 C	100	9%	9
AE1-008 C	100	4%	
AE1-009 C	100	3%	
AE1-010 C	100	2%	

Flowgate B

Queue Project	MW Size	DFax	MW Contributed
AE1-001 BAT	100	15%	15
AE1-001 C	100	-15%	
AE1-002 C	100	14%	14
AE1-003 C	100	13%	13
J500 C	100	12%	12
J501 C	100	11%	11
J502 C	100	10%	10
AE1-007 C	100	9%	9
AE1-012 C	100	4%	
AE1-015 C	100	3%	
AE1-020 C	100	2%	

On Flowgate A, Injection Component of the Battery is dispatched
On Flowgate B, Charging Component of the Battery is dispatched

Example 1: Hybrid Modeling Injection + Withdrawal

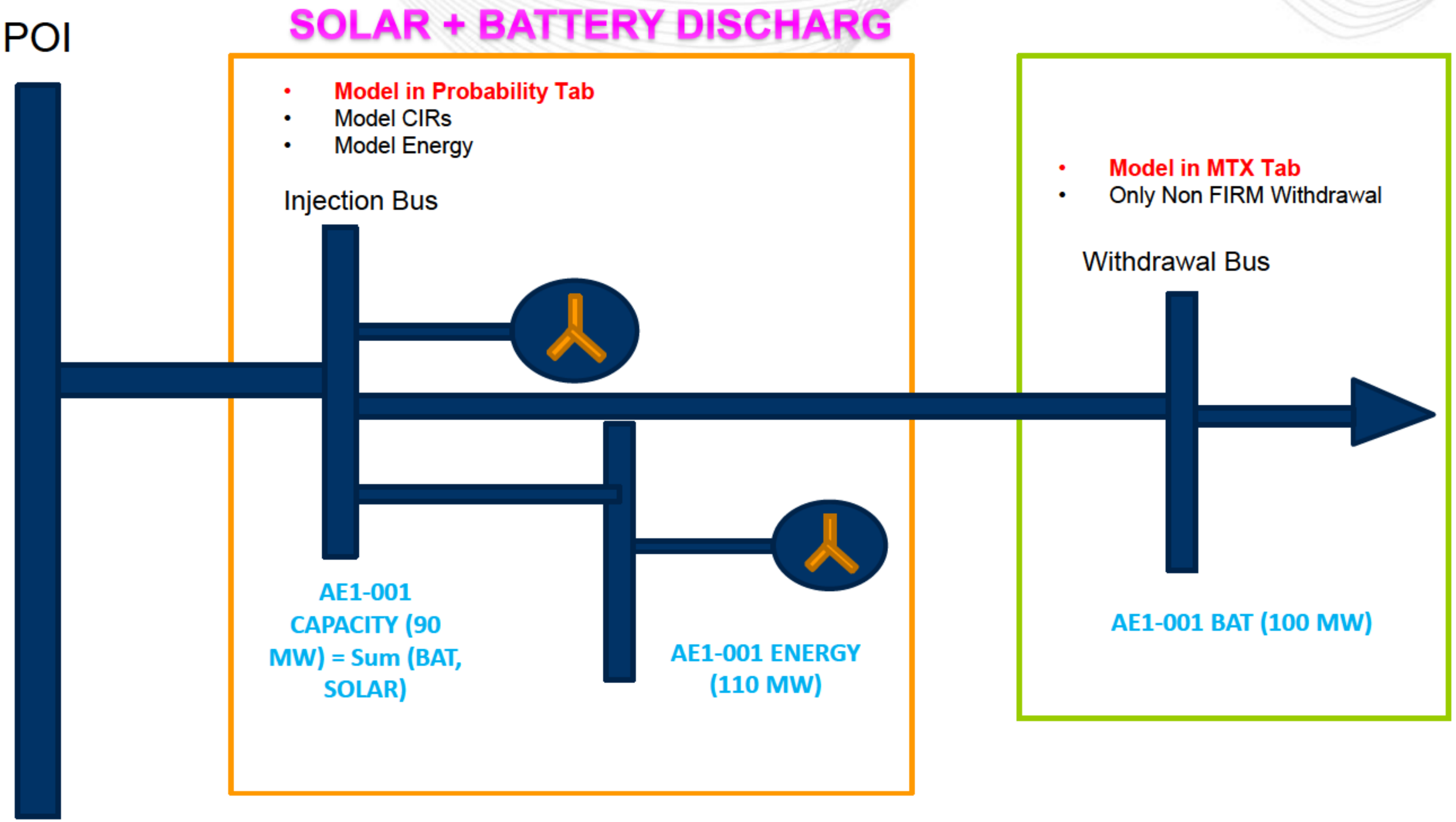
Practical Modeling

Queue : AE1-001

Total : 200 MW
Capacity : 90 MW
Energy : 110 MW

Battery : 100 MW
CHAR : 100 MW
DISCHARG : 100 MW
Capacity : 20 MW
Energy : 80 MW

Solar : 100 MW
Capacity : 70 MW
Energy : 30 MW



*If the project is picked, use the lower of the Solar, Battery EEFORD

Example 2: Hybrid Modeling Injection + Withdrawal (MFO Capped)

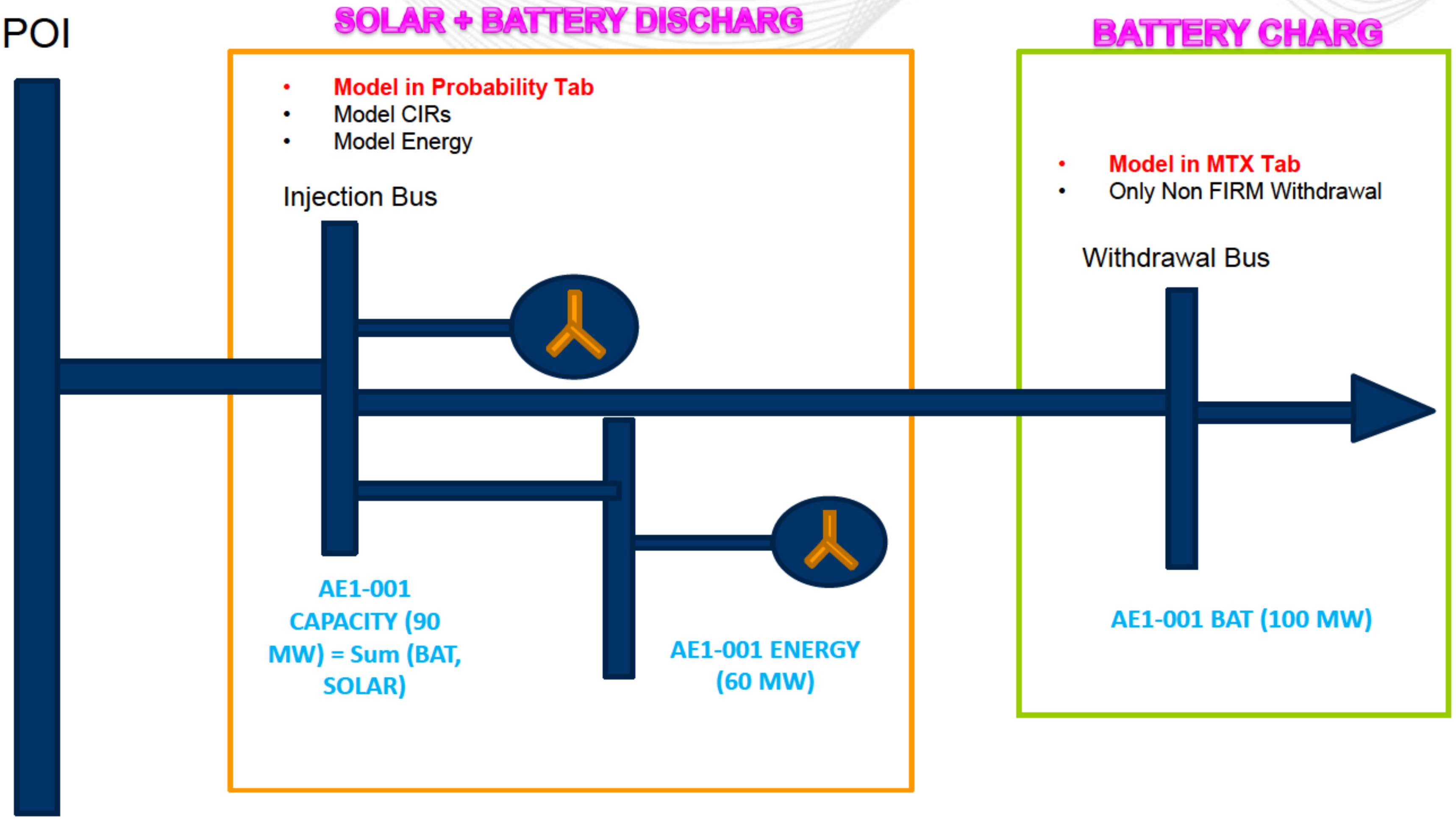
Practical Modeling

Queue : AE1-001

Total : 150 MW
Capacity : 90 MW
Energy : 60 MW

Battery : 100 MW
CHAR : 100 MW
DISCHARG : 100 MW
Capacity : 20 MW
Energy : 80 MW

Solar : 100 MW
Capacity : 70 MW
Energy : 30 MW



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