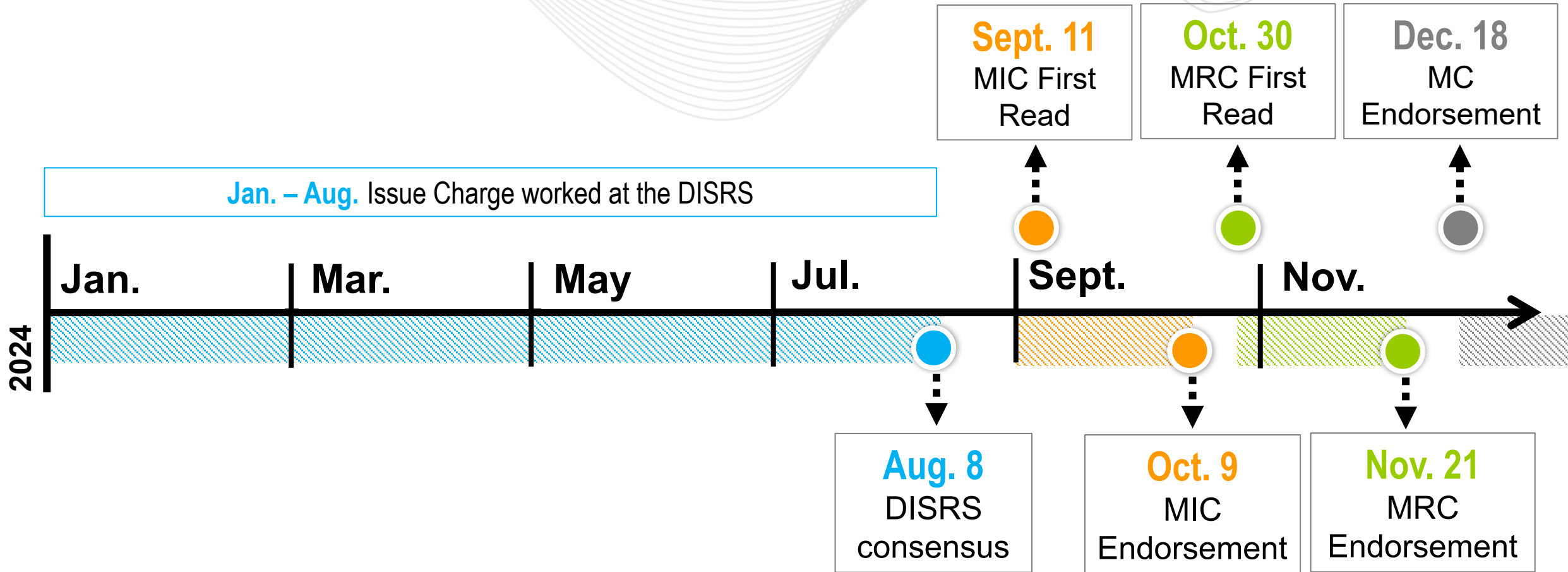


First Read of Hybrids Phase 3: Enhancements to the Hybrid Resources Model

Maria Belenky,
Market Design & Economics

Markets and Reliability Committee
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- Ensure that the rules and requirements for Hybrid Resources in PJM's governing documents are clear and complete.
- Ensure that definitions properly capture hybrid resources' operational characteristics.
- Ensure alignment between Tariff and Manual language regarding all aspects of the Hybrid Resources participation model.
- Expand the existing market participation model for Hybrid Resources to non-inverter hybrids.

- **Issue:** There is a lack of guidance on whether a Mixed Technology Facility (MTF) comprising at least one non-inverter component can participate in PJM's markets as a Hybrid Resource.
- **Proposal:**
 - A MTF with a non-inverter generation component and a battery component (e.g., gas + battery) is eligible to participate in PJM markets as a Hybrid Resource.
 - A MTF with a non-inverter generation component and an intermittent component (e.g., gas + solar) is eligible to participate as separate co-located resources only.

- **Issue:**

- PJM differentiates between an open- and closed-loop Hybrid Resource based on whether the resource can *physically/contractually* charge from the grid.
- This may not be appropriate. Some hybrids *can* physically/contractually charge from the grid, but have chosen to charge from on-site generation only. Current rules force these to be classified as “open-loop” hybrids, inconsistent with their operations.

- **Proposal:**

- The market participant is to determine and indicate to PJM whether or not the unit will operate in the market as an open or closed-loop resource, depending on whether or not it charges the storage component from the grid.
- MTFs that indicate intent to charge a storage component from on-site generation *only* during the interconnection process must participate as closed-loop Hybrid Resources.
- All Hybrid Resources that are capable of charging from the grid must execute a Network Integration Transmission Service (NITS) Agreement.

- **Issue:** Under existing rules, a Hybrid Resource consisting exclusively of components that, in isolation, would be exempt from the RPM must offer requirement, is itself exempt. With the expansion of the Hybrid Resources model to non-inverter hybrids, further specificity may be necessary.
- **Proposal:** A Hybrid Resource with any component that is, in isolation, *not exempt* from the RPM must offer requirement, is itself not exempt.

- **Issue:** PJM's existing Energy & Ancillary services market participation model for Hybrid Resources is limited to those with inverter-based generation and storage components.
- **Proposal:** Hybrid Resources with a non-inverter component and a battery component may participate in the Energy and Ancillary Services markets using a similar approach as the Energy Storage Resource Participation Model.

- **Issue:** Existing energy must offer rules for Hybrid Resources are not sufficiently clear.
- **Proposal:** (*inverter-based Hybrid Resources only*)
 - Hybrid Resources comprised exclusively of inverter-based components meet their must offer requirement by offering Eco Max MW equal to or greater than their hourly forecast.
 - The hourly forecast of hybrids comprised exclusively generation components should equal the sum of the forecasted MW of each generation component, capped at the inverter size.
 - The hourly forecast of battery-backed hybrids must include the anticipated intermittent and battery output. The total offered energy over the course of 24 hours must be equal to or greater than the forecasted energy of the standalone intermittent resource when grossed up for the roundtrip efficiency of the battery.
 - The market participant must provide the hourly forecasted capability of the Hybrid Resource to PJM. The market seller may use PJM's forecast for the intermittent component or develop/procure their own forecast. If the Market Seller develops or procures forecast with different confidence levels, the Market Seller must use the one closest to the median value (e.g. P50).
- Energy market must offer rules for ESR Model Participants and non-inverter Hybrid Resources (which are similar to stand-alone batteries) are not part of this Issue Charge.

- **Issue:** Existing rules should be reviewed and may need to be clarified given the expansion of the Hybrid Resource model to non-inverter hybrids.
- **Proposal:** All existing rules for inverter-based Hybrid Resources continue to apply. I.e., Hybrid Resources can participate in Regulation if they meet performance requirements. Unlike Energy Storage Resources, Hybrids with a battery component cannot provide regulation-only.

- **Issue:** Current Reserves eligibility rules and offer requirements for Hybrid Resources do not distinguish between generation-only (e.g., wind + solar) and generation + battery hybrids and do not contemplate non-inverter Hybrids.
- **Proposal:**
 - Hybrid Resources with a battery component continue to be eligible to provide reserves (and must offer reserves if committed for capacity), with the exception of non-synchronized reserves and offline secondary reserves, per the status quo.
 - Hybrid resources comprised exclusively of generation components are not eligible to provide reserves (and do not have a reserves must offer) unless an exception is requested and approved.
 - Non-inverter hybrids are to follow status quo rules for Hybrid Resources with a battery component.

- **Issue:** Existing rules do not provide sufficient clarity around how charging energy and station power are separated for settlement.
- **Proposal:** Because charging energy and station power are settled differently, the market participant must submit to Power Meter separate values for direct charging energy and station power.

- **Issue:** Existing language around make-whole and LOC payments for ESR Model Participants and Hybrid Resources need minor corrections and clarifications.
- **Proposal:**
 - ESR Model Participants that are instructed to charge more than their LMP-desired quantity are eligible for BOR credits per section 3.2.3(e).
 - ESR Model Participants and Hybrid Resources with a battery component are not eligible for LOC when reducing charging in response to PJM's manual dispatch.
 - Hybrid Resources may seek compensation per section 3.2.3(f-5) if they do not believe that they have been accurately compensated for opportunity costs associated with following PJM manual dispatch instructions due to a transmission constraint or other reliability issue.
 - The energy market uplift rules will be consistently applied to the provision of reactive services.
 - As the SOC field in Markets Gateway is optional, PJM will use SOC telemetry data to calculate uplift.

- **Issue:** The process for selecting and/or changing the market participation model (e.g., co-located or hybrid, closed or open-loop) requires additional detail.
- **Proposal:**
 - New resources must inform PJM of their desired classification least 6 (six) months ahead of their planned in-service date by contacting Member Relations at custsvc@pjm.com.
 - *Capacity resources:* A planned resource must inform PJM of their intent to participate as a hybrid resource in accordance with the NOI deadline for the upcoming BRA/IA by emailing the RPM hotline at rpm_hotline@pjm.com. All changes in classification made by an existing capacity resource must follow the status quo deadline for ELCC class changes and be communicated to PJM in the same manner. All other status quo requirements continue to apply.
 - *Energy market only:* All existing energy-only resources may change their classification (e.g., open to closed-loop, hybrid to co-located, etc.) by contacting Member Relations at custsvc@pjm.com. All other status quo requirements continue to apply.

- **Issue:** Existing operating requirements may need to be clarified given the expansion of the Hybrid Resource model to non-inverter hybrids.
- **Proposal:**
 - Clarify that an Intermittent or Hybrid Resource comprised exclusively of solar, wind, and/or battery components should set its emergency Minimum to 0. A Hybrid Resource with a non-inverter component must set emergency min at or below the economic min of the non-inverter component.
 - Clarify that the operator of a Hybrid Resource with a battery component that is dispatchable must indicate to PJM the hours for which the plant is operating in “generation-only” mode. This is a simple change from “intermittent-only” to be more inclusive of non-inverter hybrids.

- **Issue:** Existing rules may need to be clarified and updated given the expansion of the Hybrid Resource model to non-inverter hybrids.
- **Proposal:** GADS reporting follows the requirements for the underlying resource type. E.g., GADS reporting is required for storage and all non-inverter components of a hybrid resource.

- **Issue:** Existing rules may need to be clarified and updated given the expansion of the Hybrid Resource model to non-inverter hybrids.
- **PJM proposal:** All existing rules for inverter-based Hybrid Resources regarding reactive capability and testing apply to non-inverter hybrids.

- OATT, Definitions C-D/ OA, Definitions C-D:
 - Revised definition of “Closed-Loop Hybrid Resource” to remove reference to physical/contractual inability to charge from the grid
 - Removed reference to “solar-storage” hybrids
- OATT, Definitions L-M-N/ OA, Definitions I-L:
 - Revised definition of LOC Deviation to specify that the separate reference is to wind, solar, hybrids, and ESR “Model Participants”
- OATT, Definitions O-P-Q/ OA, Definitions O-P:
 - Revised definition of “Open-Loop Hybrid Resource” to remove reference to physical/contractual ability to charge from the grid
- OATT, Att K-Appx, Sec 1.4C/ OA, Schedule 1, Section 1.4C:
 - Revised language to reflect new definitions of open- and closed-loop hybrids
 - Removed reference to “inverter-based” hybrids to reflect expanded model
- OATT, Att K-Appx, Sec 1.4D/ OA, Schedule 1, Section 1.4D:
 - Added specificity with respect to the classification change process

- OATT, Att K-Appx, Sec 1.10/ OA, Schedule 1, Section 1.10:
 - Added Hybrid Resources as a resource type that can meet the energy must offer by offering MWs that vary hour to hour from the capacity commitment
- OATT, Att K-Appx, Sec 3.2/ OA, Schedule 1, Section 3.2:
 - Corrected referenced section for uplift payments for Hybrid Resource/ESR Model Participant to Section 3.2.3 (e) and inserted parallel language to the provision of reactive services in 3.2.3B.
 - Added “Hybrid Resource” to Section 3.2.3 (f-5)
 - Clarified language around the uplift rules for the provision of reactive services
- OATT, Att F-2:
 - Revised to reflect that all hybrids capable of charging from the grid must execute a NITSA
- RAA, Article 1 Definitions:
 - Corrected definition of “Hybrid Resource Class” to reflect expansion of model beyond resources with one generation and one storage component
- RAA, Schedule 9.2:
 - Revised language to reflect new definitions of open- and closed-loop hybrids

Facilitator:
Lisa Drauschak,
lisa.drauschak@pjm.com

Secretary:
Dave Anders,
david.anders@pjm.com

SME/Presenter:
Maria Belenky,
maria.belenky@pjm.com

Hybrids Enhancements



Member Hotline

(610) 666 – 8980

(866) 400 – 8980

custsvc@pjm.com

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