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Deliverable A

Transmission-Distribution Coordination Protocols

TDWG Meeting #17

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Purpose & Outline

Purpose: provide an overview of the final Deliverable A report on Transmission-Distribution (T-D) Coordination Protocols

Presentation outline:

- Objectives
- Coordination Challenge
- Pre-Operation Coordination
- Highlighted Requirements
- Coordination Models
- Service Timeframes
- Key Feature of Protocols
- Swim Lane Diagrams

Objectives

- Facilitate DER/A* participation in distribution and wholesale services through coordination among DER/A participants, DSOs*, and the IESO
- Consider the potential for DER/A to 'stack' services at both levels
- Examine the T-DSO*, DP-DSO*, and the MF-DSO* models
- Detail operational actions and information exchanges among parties
- Focus on the coordination of participating, dispatchable DER/A

NOTE: elements of the protocols can be implemented in the near, medium, and long term

DER/A = Distributed Energy Resource (DER) or DER aggregation; DSO = Distribution System Operator;

T-DSO = Total DSO; DP-DSO = Dual Participation DSO; MF-DSO = Market Facilitator DSO

Coordination Challenge

- Ensure DSOs and IESO visibility into real-time and expected DER/A status
- DER/A status is informed by
 - Advance limits on DER/A to maintain distribution system reliability
 - Schedules and activations for DER/A providing distribution services
 - Schedules and dispatch instructions from the wholesale market
 - Outage reporting to communicate unavailability of DER/A
- Enable DER/A to deliver 'stacked' services to both DSOs and IESO
- Telemetry is essential but not addressed in the T-D Coordination Protocols document

Distribution System Operator

- For the purposes of TDWG, DSO is defined as the entity responsible for operation of the distribution system and operational coordination with IESO at the T-D interfaces
- The DSO's capabilities may include advanced operational functions, e.g.:
 - Operational planning to maintain forecasts, constraints, contingency plans
 - Active management of DER/A to ensure distribution system reliability
 - Procurement and activation of DER/As for provision of distribution services

DER Service Cases

- To comprehensively address coordination among parties, four cases were considered

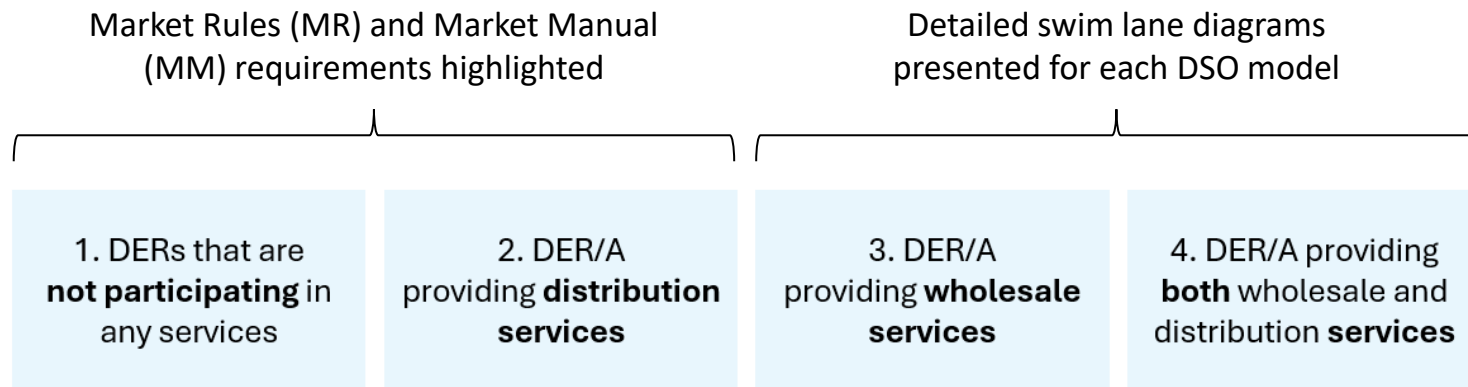
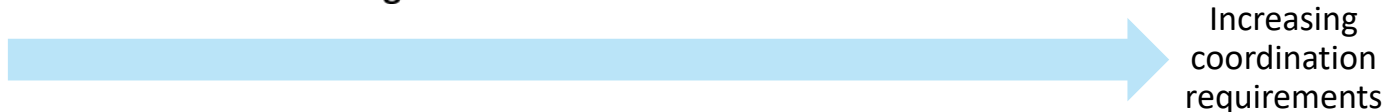


Figure 5: Four DER service cases



Pre-Operation Coordination

- Detailed steady-state, dynamic, and forecasting models are used to assess DER impacts
- DSOs and IESO capture DERs in models, though needs and approaches may differ
- Technology type, capacity, location, ride-through, and ramp rate data feed models
- Model inputs collected in planning, connection assessment, and registration processes
- On-going data (e.g., metering, telemetry, and performance) supports modelling
- NERC is reviewing reliability standards, including aggregated DER modeling, data requirements, and reporting procedures

Highlighted MR/MM Requirements

- MR Ch.5 - Power System Reliability, Section 10.2 Demand Control Initiated by a Market Participant

- “10.2.4 Each distributor or transmitter that intends to initiate a disconnection in load (including, but not limited to, interruptible loads and demand management activities) shall:
- 10.2.4.1 by 10:00 EPT each day, notify the IESO of all such planned disconnections in load and consequent reduction in loads for the following day;
 - 10.2.4.2 immediately notify the IESO of a disconnection in load that is planned after 10:00 EPT for the following day;
 - 10.2.4.3 the proposed date, time, and duration of the disconnection in load by connection point on the IESO-controlled grid, by hour;
 - 10.2.4.4 the proposed reduction, in MWs, of loads by connection point on the IESO-controlled grid, by hour; and
 - 10.2.4.5 details of the actual reduction in loads achieved, in MWs.”

Highlighted MR/MM Requirements

- MR Ch.5 - Power System Reliability

“3.7.1.2 promptly informing the IESO of any change or anticipated change in the capability of its equipment or distribution facilities connected to the IESO-controlled grid that could have a material effect on the reliable operation of the IESO-controlled grid or the operation of the IESO-administered markets;

3.7.1.3 promptly informing the IESO of any event or circumstance in its service territory that could have a material effect on the reliability of the IESO-controlled grid;”

- MM 7.3 - Outage Management

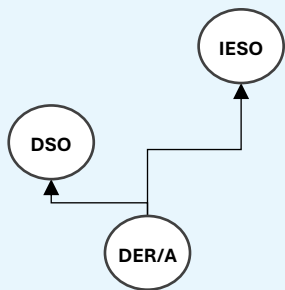
“... the outage reporting obligations under MR Ch.5 s.3.7.1 include distributors with embedded loads or generation that are not registered with the IESO.”

“Result in changes of more than 20 MW in demand or supply in an hour from what is typical for that hour.”

Coordination Models

- TDWG took a neutral approach and explored three coordination models without identifying which model is preferred for the near or long term

Dual Participation DSO
(DP-DSO)



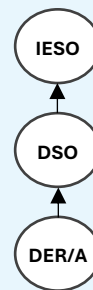
DER/A directly participate in both wholesale markets and distribution services, managing two distinct interfaces.

Market Facilitator DSO
(MF-DSO)



DER/A participates directly in wholesale markets but coordinates operationally through a single DSO interface.

Total DSO
(T-DSO)



DSO is the sole wholesale market participant. All DER/A interact with the market indirectly through the DSO.

Service Timeframe – Wholesale Energy Market [1/2]

- Renewed wholesale market processes, including the day-ahead market (DAM) and real-time market (RTM), are contemplated in the coordination protocols
- Coordination protocols are structured around day-ahead and real-time processes

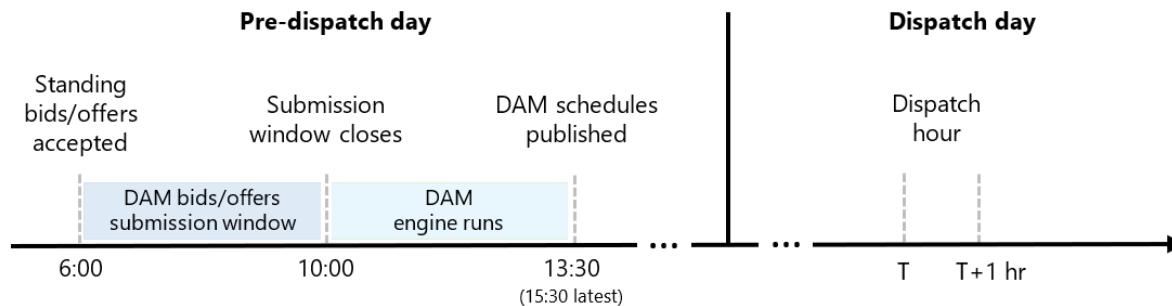


Figure 1: Relevant IESO Day-Ahead Market Timelines

Service Timeframe – Wholesale Energy Market [2/2]

- RTM process determines dispatch instructions and prices for each 5-minute interval
- The rapid pace of this process presents a challenge, as communication latency or execution delays may impact reliability

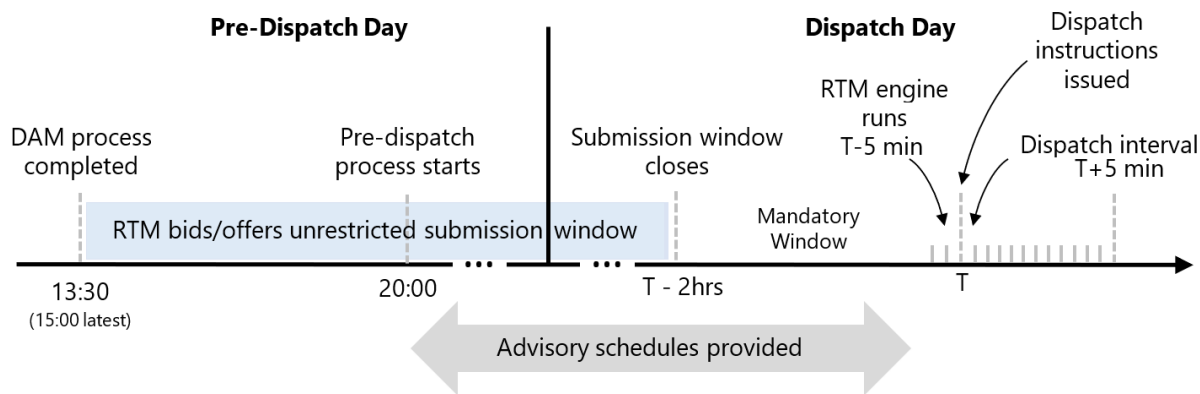


Figure 2: Relevant IESO Real-Time Market Timelines

Service Timeframe – Distribution Service [1/2]

- Operational coordination protocols focus on DER/A providing distribution services
- A minimal set of features for DER/As providing distribution services have been defined, largely related to sequencing and timing considerations

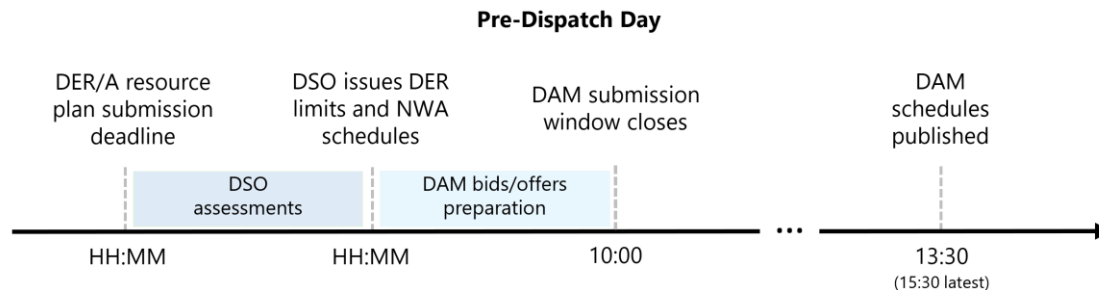


Figure 3: Relevant Day-Ahead DSO and IESO Timelines

Service Timeframe – Distribution Service [2/2]

- A sequential process requires the DSO to strategically perform key DER/A-related tasks before the IESO's DAM and RTM processes
- DSO assessments establish DER/A operating limits and distribution service instructions
- Some timeframes related to distribution services have purposely been left undefined

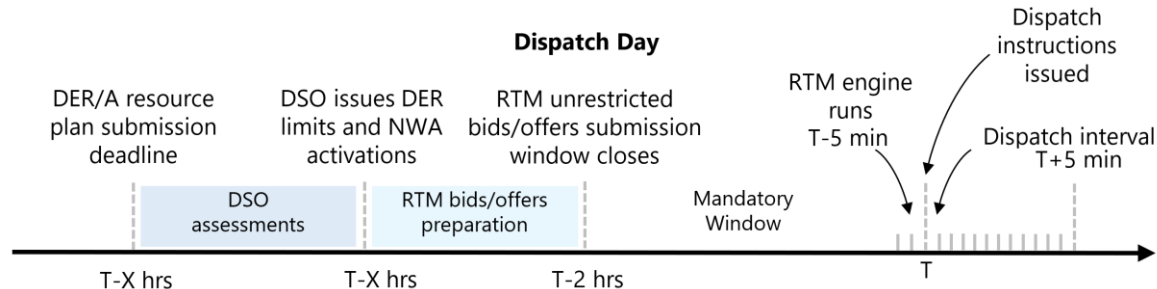


Figure 4: Relevant Real-Time DSO and IESO Timelines

DER/A Resource Plans

- The resource plan is envisioned as a dynamic tool for sharing DER/A data with the DSO, and may include:
 - Availability of DER/A for distribution and/or wholesale services
 - For aggregators, the specific DER contributors planned to operate
 - Pricing information for providing distribution services
 - Wholesale market bids/offers, depending on the DSO model
- Resource plan provides DSOs with data to set DER/A operating limits, issue distribution service instructions, and, if applicable, formulate wholesale market bids/offers
- Data requirements can be targeted/limited initially and expand as DSO needs evolve

Key Features of Operational Coordination

- Four key features form the foundation of the protocols.



Sequential Coordination

DER/A first considered for distribution, then wholesale services.



Ongoing DSO Limits

DSOs set advance operational limits on DER/A to maintain distribution reliability.



Floor Price Offers

DER/As capture distribution service commitments via floor-price wholesale market offers.



DSO Overrides

DSOs can curtail DER/A output to ensure safe, reliable operation of the distribution system.

General T-D Coordination Activities

- Primary action steps, applicable to both day-ahead and real-time processes:

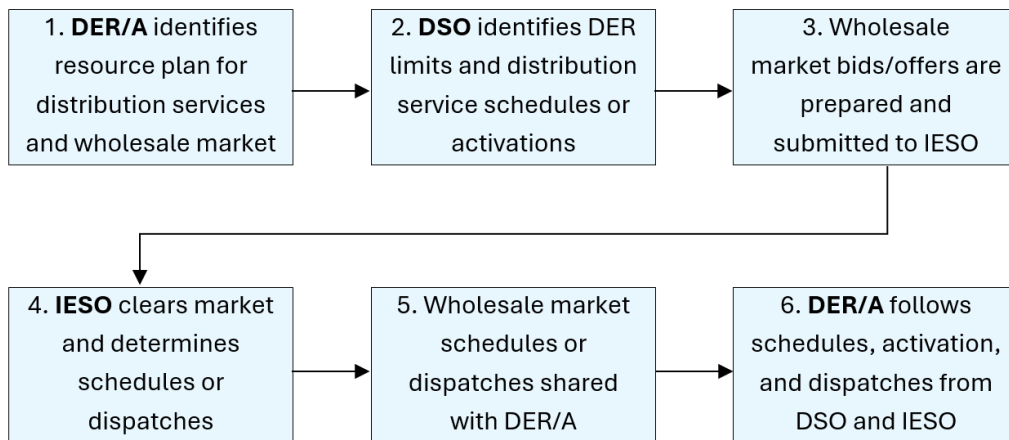


Figure 7: General activities in the protocols for all three DSO models

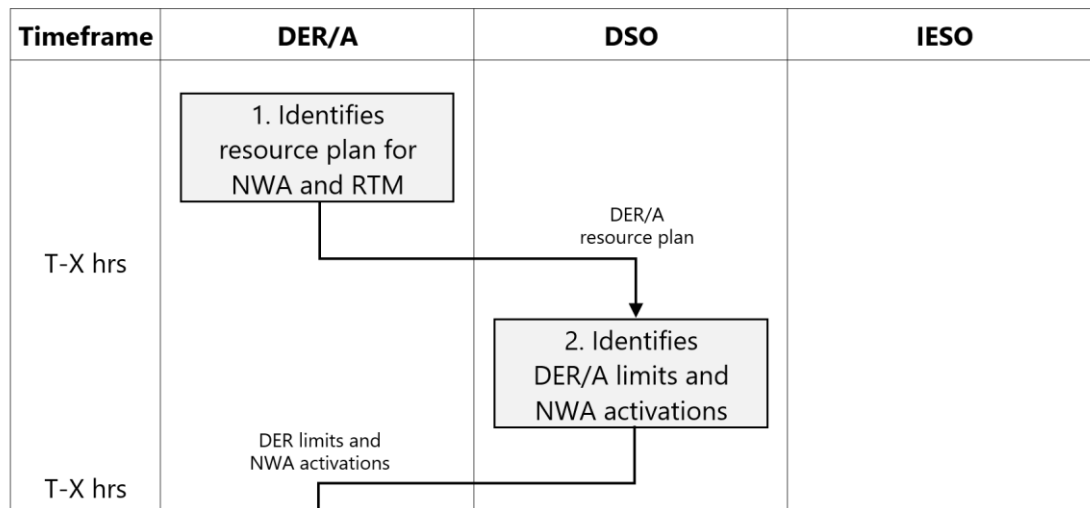
* Does not include actions related to abnormal conditions due to DER/A outages, DSO overrides, or changes to DER/A resource plans

Service Stacking Coordination Protocols

- For each of DP-DSO, T-DSO, and MF-DSO models, the report outlines coordination protocols for five processes:
 - Day-Ahead Process
 - Real-Time Process
 - DER/A Outage Process
 - Distribution Override Process
 - DER/A Resource Plan Change Process

Swim Lane Diagrams

- Swim lane diagrams are used in the report to illustrate coordination among DER/A, DSOs, and the IESO



Conclusion & Future Considerations

- T-D coordination enables DER/A delivering stacked distribution and wholesale services
- Insights from developing protocols for three DSO models will support sector evolution
- Exploring related areas (e.g., settlements, forecasting) can clarify protocol implications
- Real-world demonstrations can validate and refine the operational coordination processes
- Active engagement in industry forums will drive collaboration and continued innovation

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