Dispatchable Reliability Reserve Service (DRRS)

TAC Workshop 2 Presentation

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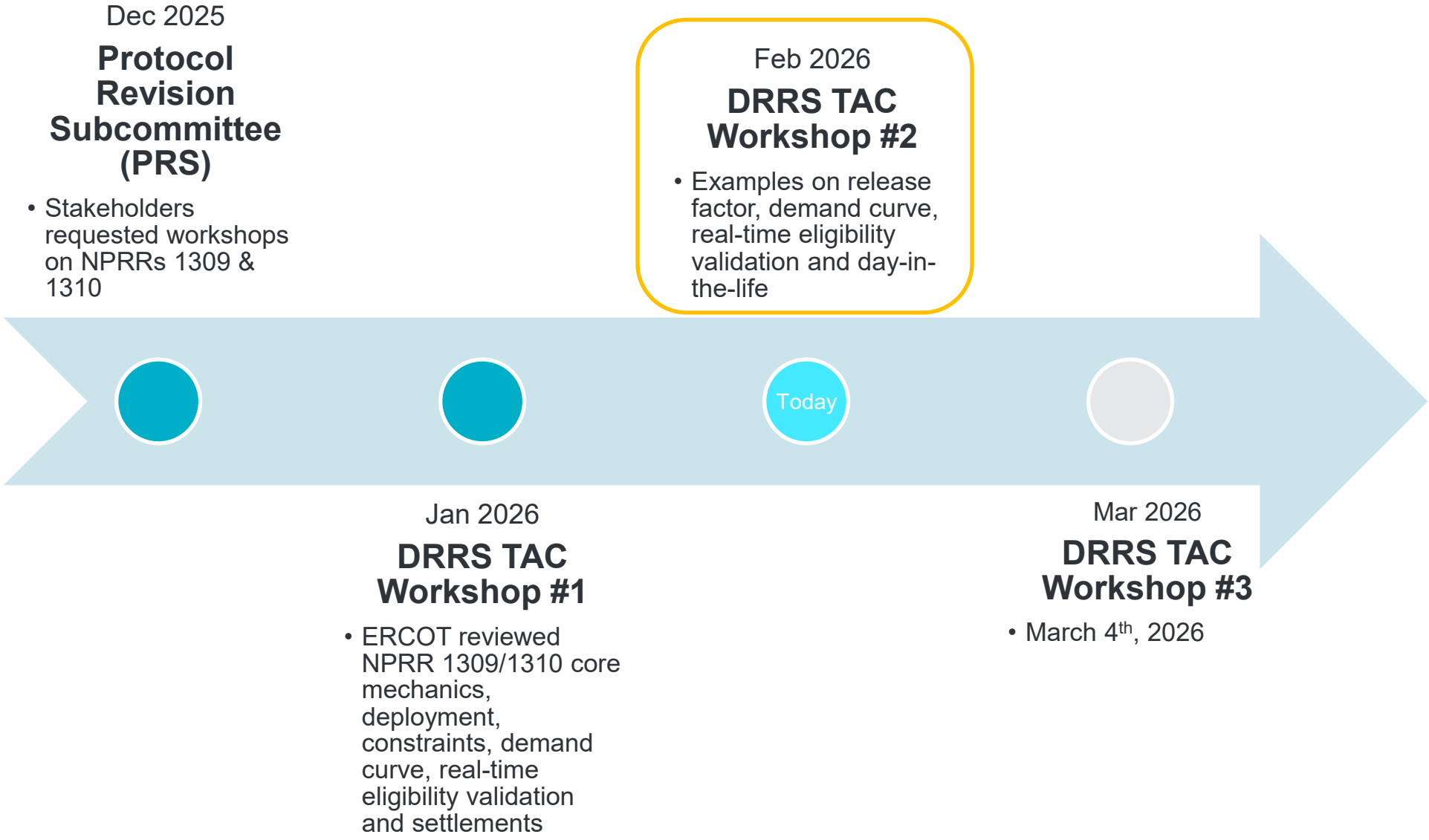
Today's DRRS TAC Workshop #2 Answers Stakeholder Questions on DRRS

- Design details and examples
  - Present examples in response to questions received during the first workshop and via email to help stakeholders to understand the mechanics of core design concepts
- Responses to questions
  - Answers to technical design questions;
  - Clarify which issues are beyond the scope of the NPRR and dependent on future processes
- Discuss next steps

DRRS TAC Workshop #1 Reviewed NPRRs 1309 and 1310



Agenda

- DRRS Release Factor Concept and Calculation Example
- DRRS Constraints and Demand Curve
- Resource Eligibility and DRRS Qualification Amount
- Market Timeline
- DRRS Real-Time Eligibility Validation Examples
- Day-in-the-Life Examples
- Responses to Clarification Questions
- Q&A and Next Steps

DRRS Release Factor, Constraints and Demand Curve

The Release Factor determines how much DRRS can overlap other products

- The Public Utility Commission of Texas (PUCT) provided guidance to ERCOT to build in flexibility in DRRS to support resource adequacy. NPRR 1310 includes a Release Factor that provides this flexibility.
- This Release Factor is a number (which can be set from 0 to 1) which determines the proportion of DRRS-awarded capacity that can overlap with energy and other Ancillary Service (AS) awards.
- The DRRS Release Factor will remain at 0 until the PUCT approves an adjustment.
  - A Release Factor of 0 means no DRRS-awarded capacity can overlap with energy and other Ancillary Service awards, thus the DRRS requirement only addresses operational uncertainty.
- The Release Factor will be an hourly parameter input into the Day-Ahead Market (DAM) and Real-Time Market (RTM) clearing engines.
  - The Release Factor can be adjusted based on season, time of day, etc.

The DRRS Release Factor is calculated from the DRRS requirements

- The DRRS Release Factor is derived from the MW quantities required for DRRS operational reserve (DRRS MW Req OR) and DRRS requirements for supporting resource adequacy (DRRS MW Req RA). DRRS MW Req RA includes DRRS MW Req OR.
- The Release Factor for operating hour (h) would then be calculated as:

$$RF_h = \left(\frac{Max(0, DRRS\ MW\ Req\ RA_h - DRRS\ MW\ Req\ OR_h)}{Max(1, DRRS\ MW\ Req\ RA_h)}\right)$$

- Assume for some hour:
  - DRRS Operational Reserve requirement = DRRS MW Req OR = 1,500 MW
  - DRRS Resource Adequacy requirement = DRRS MW Req RA = 60,000 MW
  - Then:

$$RF_h = \left(\frac{60{,}000 - 1{,}500}{60{,}000}\right) = \frac{58{,}500}{60{,}000} = 0.975$$

Same DRRS Constraints apply in DAM and RTM, modified by Release Factor

- DRRS Resource-level constraints under the NPRR 1310 design:
  - On-Line and Off-Line Resources. For example, for a Generation Resource (r), in hour (h):

$$HSL_{r,h} \geq DRRS\ MW\ award_{r,h}$$

  - On-Line Resource that is DRRS-eligible and has submitted a DRRS Offer. For example, for a Generation Resource (r), in hour (h):

$$Qualified\ DRRS\ MW_{r,h}^{On-Line} \geq DRRS\ MW\ award_{r,h}$$

$$Energy\ MW\ award_{r,h} + RegUpMW\ award_{r,h} + RRS\ MW\ award_{r,h} + ECRS\ MW\ award_{r,h} + NSPIN\ MW\ award_{r,h} + (1 - RF_h)\ DRRS\ MW\ award_{r,h} \leq HSL_{r,h}$$

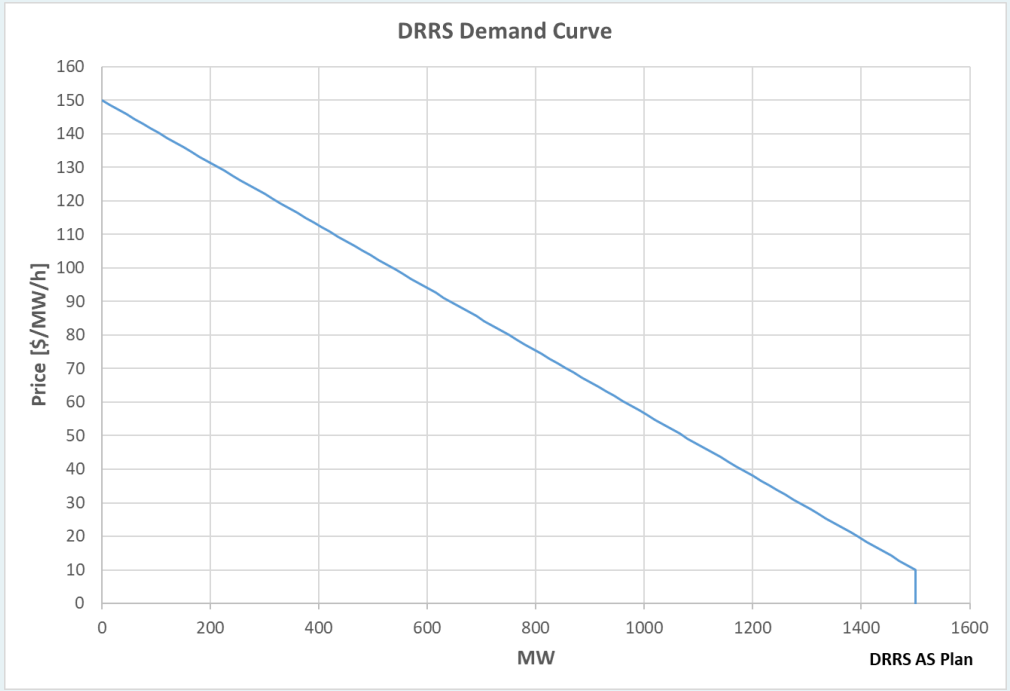
  - Off-Line Resource that is DRRS-eligible and has submitted a DRRS Offer. For example, for a Generation Resource (r), in hour (h):

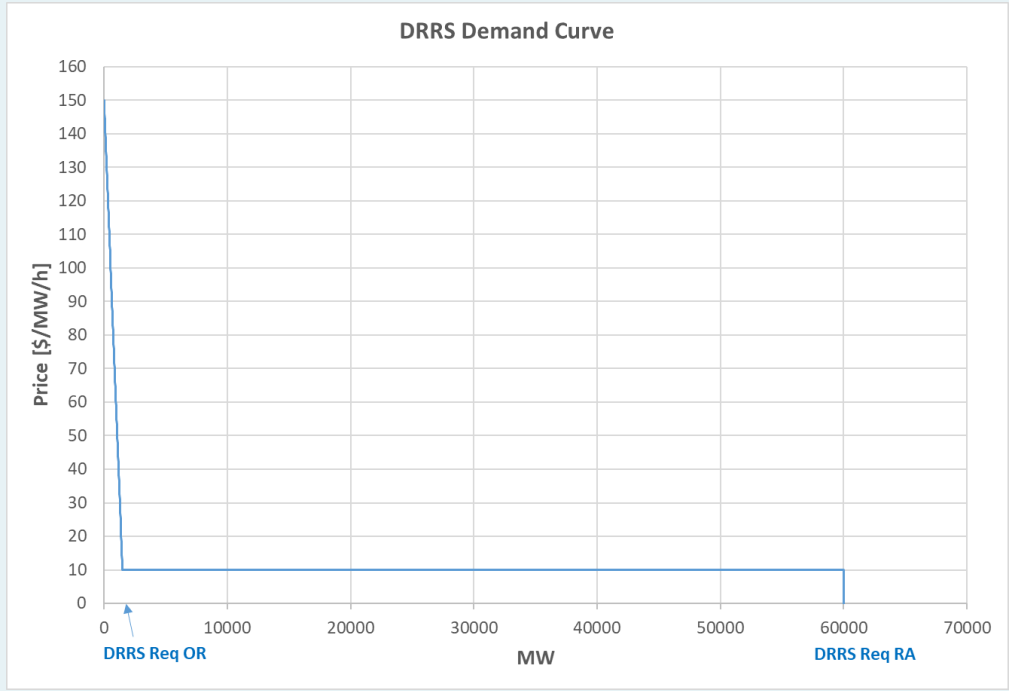
$$Qualified\ DRRS\ MW_{r,h}^{Off-Line} \geq DRRS\ MW\ award_{r,h}$$

$$ECRS\ MW\ award_{r,h} + NSPIN\ MW\ award_{r,h} + (1 - RF_h)\ DRRS\ MW\ award_{r,h} \leq HSL_{r,h}$$

DRRS Demand Curve changes if Resource Adequacy option is activated

NPRR 1309	NPRR 1310
• Assume DRRS Operational Reserve requirement = 1,500 MW.	• Assume DRRS Operational Reserve requirement = 1,500 MW • Assume PUCT approves a non-zero Release Factor, and DRRS Resource Adequacy requirement = 60,000 MW





Values of requirements are for illustrative purpose only

DRRS Requirements Example

DRRS Price depends on Available Supply vs Requirements

- Consider a system with three groups of DRRS-eligible Generation Resources (GRs) as follows:
  - G1: On-Line. Choose to offer energy, other Ancillary Services and DRRS
  - G2: On-Line. Choose to offer energy and DRRS
  - G3: Off-Line. Choose to offer DRRS
- Consider NPRR 1310 design, and assume the Release Factor can be set to a non-zero value
- Assume the capability of Resources to provide energy, other Ancillary Services, and DRRS as follows:

GR group	∑HSL (MW)	∑LSL (MW)	∑Energy (MW)	∑Up AS (MW)	∑DRRS (MW)	∑DRRS OR portion (MW)
G1	40,000	0	30,000	9,000	40,000	1,000
G2	20,000	0	19,500	0	20,000	500
G3	5,000	0	0	0	5,000	5,000
Total	**65,000**	**0**	**49,500**	**9,000**	**65,000**	**6,500**

Values are for illustrative purpose only

DRRS Price depends on Available Supply vs Requirements

- Assume the following requirements for a given hour: DRRS Total = 60,000 MW, DRRS OR = 1,500 MW. Release Factor = 0.975

Scenario	Generation Resource Groups	Quantity available for DRRS	DRRS Awards	DRRS MCPC
1	G1, G2 and G3 are all available	• Total DRRS = 65,000 MW • DRRS OR = 6,500 MW	60,000 MW	Between $0 and $10, based on the cleared offers
2	G1 and G3 are available. G2 is on Outage	• Total DRRS = 45,000 MW • DRRS OR = 6,000 MW	Between 1,500 MW and 60,000 MW	$10, based on the flat portion of the demand curve
3	G1 is available. G2 and G3 are on Outage	• Total DRRS = 40,000 MW • DRRS OR = 1,000 MW	DRRS OR awards < 1,500 MW	Between $150 and $10, based on the sloping portion of the demand curve

Requirements and release factor values are for illustrative purpose only

Resource Eligibility and DRRS Qualification Amount

NPRR 1310 provides the option for Energy Storage Resource eligibility

Core Requirements applicable to both NPRR 1309 and 1310

>= 4 hours
Sustain High Sustained Limit (HSL)

Start <= 2 hours
Off-Line to On-Line

Dispatchable
Follow SCED signals

NPRR 1309

Eligible Resources

On-Line Gen | Off-Line Gen

Energy Storage Resources participation: Not Included

NPRR 1310

Eligible Resources

On-Line Gen | Off-Line Gen | + Energy Storage Resources ★

★ Energy Storage Resources participation: Optional

On-Line DRRS Qualified MW differs between NPRR 1309 and 1310

DRRS Qualified MW	NPRR 1309	NPRR 1310 *
Off-Line Generation Resources	An Off-Line Generation Resource must be capable of starting (cold start) and ramping to its DRRS Ancillary Service award within 2 hours.	Same as NPRR 1309
On-Line Generation Resources	• Two-hour ramp capability submitted in Resource Integration and Ongoing Operations (RIOO) • When awarding further limited by HSL – LSL	• Two-hour ramp capability submitted in Resource Integration and Ongoing Operations (RIOO) • When awarding further limited by min(HSL, LSL + 2 hour ramp capability)
	<u>Combined Cycle (CC):</u> As above but consider ramp rates for the max configuration and apply it to all lower configurations (*consistent with other Ancillary Services*).	<u>Combined Cycle (CC):</u> As above but consider ramp rates for the max configuration and apply it to all lower configurations (*consistent with other Ancillary Services*).

HSL & LSL: For DAM based on COP. For RTM based on telemetered values.

* Assuming Release Factor is non-zero.

Market Timeline: DAM→RUC→RTM

Market Timeline across DAM, RUC and RTM

Applicable to both NPRR 1309 and 1310

Day-Ahead Market (DAM)

1. Procured in DAM (voluntary participation)
2. QSEs may offer energy, other AS, and DRRS
3. Resources **must offer** DRRS to receive awards
4. DRRS DAM awards paid the DAM MCPC

Reliability Unit Commitment (RUC)

1. RUC deploys Off-Line DRRS, but does not procure DRRS
2. RUC will prefer Off-Line Resources with 'DRRS' COP status for commitment ahead of other Off-Line Resources. To achieve this the start-up and minimum energy costs will be scaled by 20%
3. No RUC Make-Whole Payments or RUC Clawback Charges for Off-Line DRRS deployments
4. RUC blocks that are contiguous with a DRRS deployment will not receive startup costs; only minimum energy costs for the RUC hours will be included in the RUC Guarantee

Real-Time Market (RTM)

1. Reprocured in RTM. Same DRRS constraints as DAM apply
2. **RTM eligibility check** in Day-Ahead Reliability Unit Commitment (DRUC) and all Hourly Reliability Unit Commitment (HRUCs) for given operating hour to verify Resource either had a status of 'DRRS' or 'ON' (or 'OFF' if eligible to provide Non-Spin) in their Current Operating Plan (COP).
3. To be awarded DRRS, the Resource **must offer** DRRS
4. AS imbalance settlement applies

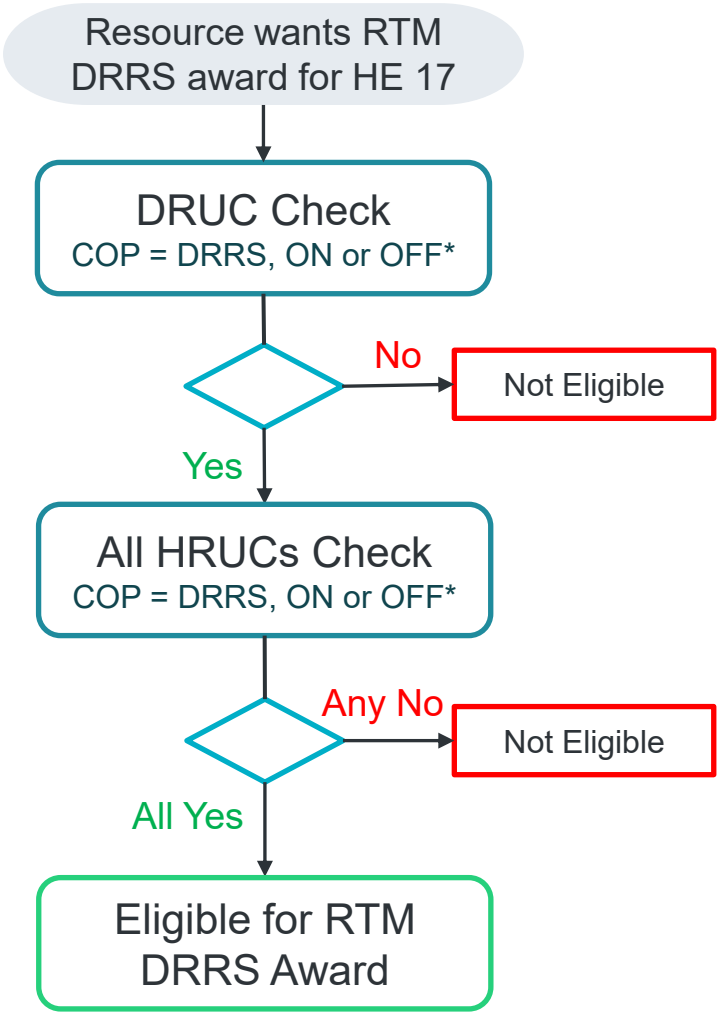
DRRS Real-Time Eligibility Validation Examples

RTM DRRS eligibility requires continuous availability across all RUC runs

To be eligible for DRRS awards in RTM a resource must have stayed available in DRUC and all subsequent HRUC runs for a given Operating Hour (i.e., they were always available for the RUC optimization). The resource must maintain a Current Operating Plan (COP) status of 'DRRS' or 'ON' (or 'OFF' if eligible to provide Non-Spin)

- An Off-Line Resource carrying DRRS may choose to self-commit (show as 'ON' in COP)
- All DRRS-eligible Resources may use the 'DRRS' status and offer into the RTM provided they meet this eligibility check, **regardless of whether they had a DAM DRRS award**

Flow Chart Example



* 'OFF' valid only if resource is Non-Spin eligible

Example 1: Generation Resource maintains eligibility for RTM DRRS award

HRUC	HE	Resource COP Status	RUC Status	Notes
05:15	17	DRRS	OFF	
06:15	17	DRRS	OFF	
07:15	17	DRRS	OFF	
08:15	17	DRRS	OFF	
09:15	17	DRRS	OFF	
10:15	17	DRRS	OFF	
11:15	17	DRRS	OFF	
12:15	17	DRRS	OFF	
13:15	17	DRRS	OFF	
14:15	17	DRRS	OFF	
15:15	17	DRRS	OFF	
16:16	17	DRRS	OFF	

- Resource awarded DRRS in the DAM
- Capacity available for RUC
- No deployment
- Real-Time Telemetered Status: DRRS
- Maintained a COP status of DRRS/ON for DRUC and all subsequent HRUCs for given hour
- Eligible for Real-Time DRRS award

Example 2: Generation Resource maintains eligibility for RTM DRRS award, though it was not awarded DRRS in DAM

HRUC	HE	Resource COP Status	RUC Status	Notes
05:15	17	DRRS	OFF	
06:15	17	DRRS	OFF	
07:15	17	DRRS	OFF	
08:15	17	DRRS	OFF	
09:15	17	DRRS	OFF	
10:15	17	DRRS	OFF	
11:15	17	DRRS	OFF	
12:15	17	DRRS	OFF	
13:15	17	DRRS	OFF	
14:15	17	DRRS	OFF	
15:15	17	DRRS	OFF	
16:16	17	DRRS	OFF	

- Resource not awarded DRRS in the DAM
- Capacity available for RUC
- No deployment
- Real-Time Telemetered Status: DRRS
- Maintained a COP status of DRRS/ON for DRUC and all subsequent HRUCs for given hour
- Still eligible for Real-Time DRRS award, as in Example 1

Example 3: Generation Resource doesn't maintain eligibility for RTM DRRS award

HRUC	HE	Resource COP Status	RUC Status	Notes
05:15	17	DRRS	OFF	
06:15	17	DRRS	OFF	
07:15	17	DRRS	OFF	
08:15	17	DRRS	OFF	
09:15	17	DRRS	OFF	
10:15	17	DRRS	OFF	
11:15	17	DRRS	OFF	
12:15	17	OUT	OUT	Outage for rest of the day
13:15	17	OUT	OUT	
14:15	17	OUT	OUT	
15:15	17	OUT	OUT	
16:16	17	OUT	OUT	

- Resource may or may not be awarded DRRS in the DAM
- No RUC deployment
- Did not maintain a COP status of DRRS/ON for DRUC and all subsequent HRUCs for given hour
- Not eligible for Real-Time DRRS award

X

Example 4: Generation Resource doesn't maintain eligibility for RTM DRRS award, though it comes back from Outage

HRUC	HE	Resource COP Status	RUC Status	Notes
05:15	17	DRRS	OFF	
06:15	17	DRRS	OFF	
07:15	17	DRRS	OFF	
08:15	17	DRRS	OFF	
09:15	17	DRRS	OFF	
10:15	17	DRRS	OFF	
11:15	17	DRRS	OFF	
12:15	17	OUT	OUT	Outage for one HRUC run
13:15	17	DRRS	OFF	
14:15	17	DRRS	OFF	
15:15	17	DRRS	OFF	
16:16	17	DRRS	OFF	

- Resource may or may not be awarded DRRS in the DAM
- No RUC deployment
- Did not maintain a COP status of DRRS/ON for DRUC and all subsequent HRUCs for given hour
- Not eligible for Real-Time DRRS award

X

Day-in-the-Life Examples

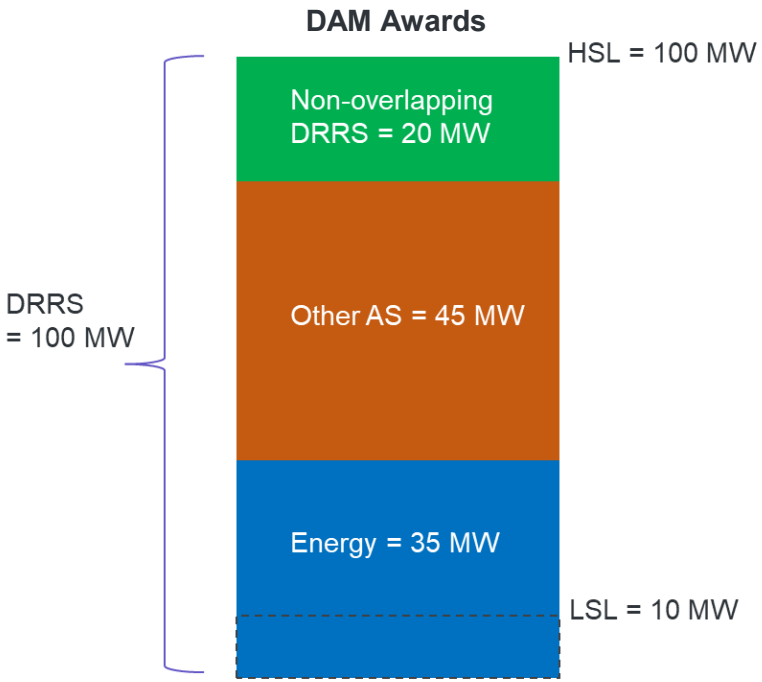
Examples of DRRS Awards and Settlements

- Next, consider examples for a DRRS-eligible Generation Resource for a given hour (HE 17)
- These examples use the NPRR 1310 design and assume the Release Factor can be set to a non-zero value
- **Example 5**: Generation Resource is On-Line in DAM (either through self-commitment or DAM-commitment) and On-Line in RTM; with RTM conditions same as or close to those in DAM
  - DAM: The Generation Resource offers and is awarded DRRS in DAM
  - RUC: The Generation Resource maintains RTM DRRS eligibility through COP status of 'DRRS' or 'ON' in DRUC and all subsequent HRUCs for study period covering the given hour
  - RTM: The Generation Resource offers and is awarded DRRS in RTM
- **Example 6**: The Generation Resource does not offer in DAM, but maintains RTM DRRS eligibility through COP status of 'DRRS' or 'ON' in DRUC and all subsequent HRUCs for study period covering the given hour
  - DAM: The Generation Resource is Off-Line in DAM. It does not offer DRRS in DAM, hence it does not receive a DRRS award*
  - RUC: The Generation Resource maintains RTM DRRS eligibility through COP status of 'DRRS' or 'ON' in DRUC and all subsequent HRUCs for study period covering the given hour
  - RTM: The Generation Resource offers and is awarded DRRS in RTM

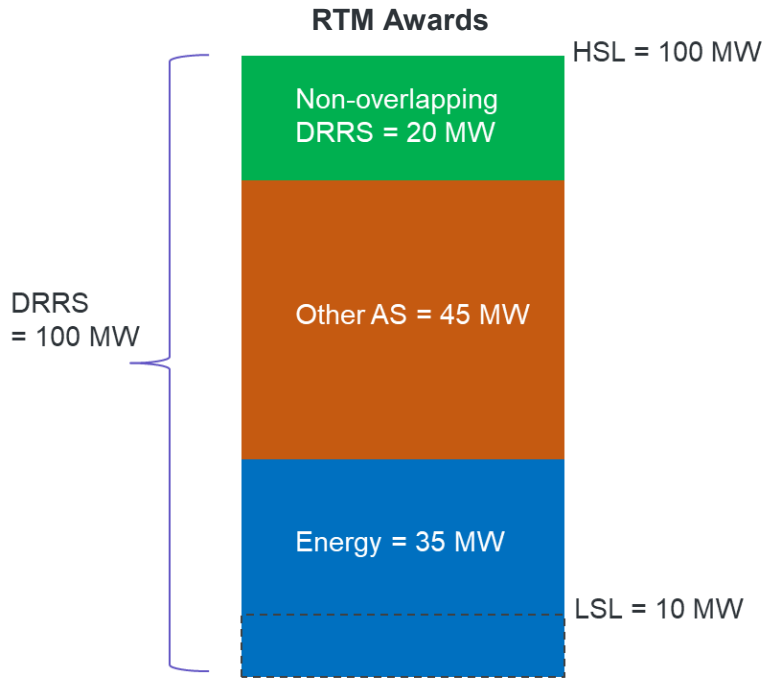
* Note: In general, eligible Off-Line Generation Resources are able to offer and be awarded DRRS in DAM

Example 5: No imbalance charges when DAM and RTM conditions align

- Consider DRRS-eligible Generation Resource with HSL = 100 MW, LSL = 10 MW, and DRRS qualified MW = 100 MW
- Assume Release Factor for HE 17 = 0.8 (i.e., 80%)
- Non-overlapping DRRS = (1 - RF) * DRRS Award= (1-0.8)*100 = 20 MW



RUC
Resource maintained RTM DRRS Eligibility



Total DRRS Revenue
$500

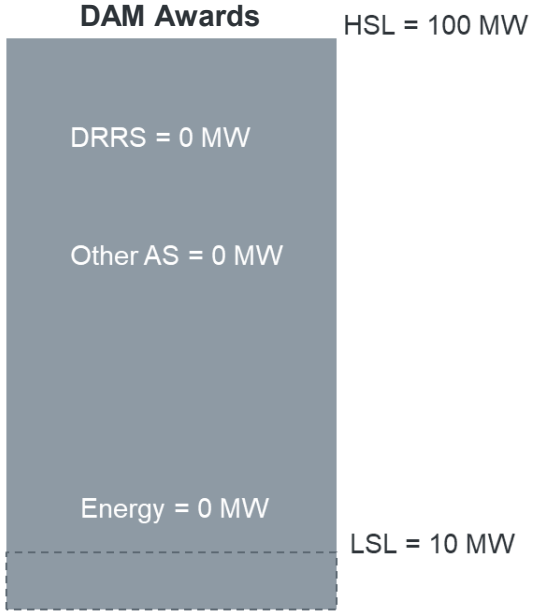
DAM Settlement	
(-1) * DAM DRRS Award * DAM DRRS MCPC	(-1) * 100 MW * $5/MW
Settlement:	-$500

RTM Settlement	
(-1) * (RTM – DAM DRRS Award) * RTM DRRS MCPC	(-1) * 0 MW * $5/MW
Settlement:	$0

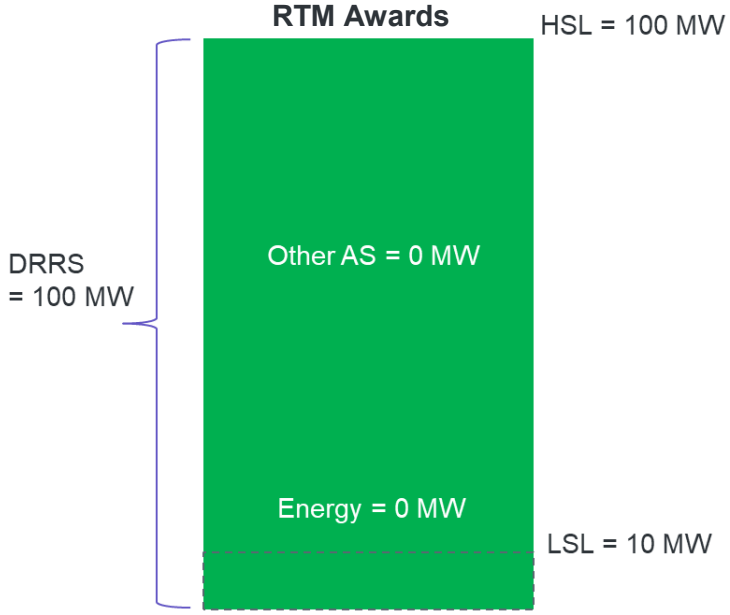
Insight: The non-overlapping DRRS acts as an operational reserve

Example 6: Earns RTM DRRS award and payment, even without DAM award by maintaining RTM DRRS eligibility

- DRRS-eligible Resource was Off-Line in DAM and RTM. It did not offer DRRS in DAM, so it did not receive DRRS award in DAM.
- RUC (DRUC and HRUC) did not deploy DRRS from this Resource. Assume it maintained RTM DRRS eligibility for HE 17, and submitted DRRS offer for its HSL in RTM.



RUC
Resource maintained RTM DRRS Eligibility



Total DRRS Revenue
$500

DAM Settlement	
(-1) * DAM DRRS Award * DAM DRRS MCPC	(-1) * 0 MW * $5/MW
Settlement:	$0

RTM Settlement	
(-1) * (RTM – DAM DRRS Award) * RTM DRRS MCPC	(-1) * (100-0) MW * $5/MW
Settlement:	-$500

Insight: In this example the entire RTM DRRS award of 100 MW counts towards the operating reserve component of DRRS requirement

Responses to Technical Questions from Stakeholders

- Will the DRRS Verbal Dispatch Instruction (VDI) include a MW quantity and what will it correspond to (LSL, Award, Capability)?
  - DRRS is not expected to be deployed through a VDI. Off-Line Generation Resources with ‘DRRS’ COP status can be deployed using the DRUC or HRUC processes. RUC does not procure DRRS. This deployment instruction will be issued by RUC and will be like a RUC instruction to be On-Line for a period of time.
- Will the On-Line DRRS qualification test differ from the Off-Line test?
  - Yes. Like Non-Spin, there will be On-Line DRRS qualification and qualified MW and there will be separate Off-line DRRS qualification and qualified MW.

Some Policy Questions need further discussion

- How are Release Factors established?
  - Setting Release Factor to non-zero, i.e., using DRRS for resource adequacy, would require PUCT approval. The PUCT could initiate use of a non-zero value, or ERCOT or stakeholders could initiate by proposing for the PUCT's consideration
  - The DRRS Release Factor is calculated using the DRRS quantities required for operational reserve and resource adequacy
- What is the methodology ERCOT will use for the DRRS Ancillary Service Plan? Does ERCOT anticipate using a probabilistic model?
  - This may be dependent on outcomes related to the 2026 Reliability Assessment being performed under PUCT Project 58777 and subsequent policy discussion at the PUCT
- What is the expected DRRS requirement for resource adequacy? What is the shape of the procurement by hour?
  - This may be dependent on outcomes related to the 2026 Reliability Assessment and subsequent policy discussion at the PUCT

Next Steps

- Feedback on items discussed today
- Feedback on focus and presentations for next workshop

Appendix

DRRS Statutory Requirements

The impetus for developing DRRS comes from Public Utility Regulatory Act (PURA) § 39.159(d)-(e):

(d) The commission shall require the independent organization certified under Section 39.151 for the ERCOT power region to develop and implement an ancillary services program to procure dispatchable reliability reserve services on a day-ahead and real-time basis to account for market uncertainty. Under the required program, the independent organization shall:

1) determine the quantity of services necessary based on historical variations in generation availability for each season based on a targeted reliability standard or goal, including intermittency of non-dispatchable generation facilities and forced outage rates, for dispatchable generation facilities;

2) develop criteria for resource participation that require a resource to:

   A. be capable of running for at least four hours at the resource's high sustained limit;

   B. be online and dispatchable not more than two hours after being called on for deployment; and

   C. have the dispatchable flexibility to address inter-hour operational challenges; and

3) reduce the amount of reliability unit commitment by the amount of dispatchable reliability reserve services procured under this section.

Glossary

- AS – Ancillary Services
- CC – Combined Cycle
- COP – Current Operating Plan
- DAM – Day-Ahead Market
- DRRS – Dispatchable Reliability Reserve Service
- DRUC – Day-Ahead Reliability Unit Commitment
- ECRS – ERCOT Contingency Reserve Service
- ESR – Energy Storage Resource
- GR – Generation Resource
- HRUC – Hourly Reliability Unit Commitment
- HSL – High Sustained Limit
- LSL – Low Sustained Limit
- MCPC – Market Clearing Price for Capacity
- NPRR – Nodal Protocol Revision Request
- OR – Operational Reserve
- PRS – Protocol Revision Subcommittee
- PUCT – Public Utility Commission of Texas
- PURA – Public Utility Regulatory Act
- QSE – Qualified Scheduling Entity
- RF – Release Factor
- RIOO – Resource Integration and Ongoing Operations
- RRS – Responsive Reserve Service
- RTM – Real-Time Market
- RUC – Reliability Unit Commitment
- TAC – Technical Advisory Committee
- VDI – Verbal Dispatch Instruction