Module Overview

Fundamentals of the Nodal Market

Enter

Day-Ahead Market

Reliability Unit Commitment

Exit
Upon completion of this module, you will be able to:

- Describe the purpose of the Reliability Unit Commitment (RUC) process
- Identify the impacts of ERCOT, TSPs and QSEs on this Process
- Identify the timelines of both Day-Ahead and Hourly Reliability Unit Commitment
- Identify the financial impacts of Reliability Unit Commitment
It ensures:

- Enough capacity is committed to serve the forecasted load
- Committed capacity is in the right locations
Considerations

• Reviews Resource commitments and security constraints

• Some Capacity committed as Ancillary Service

• Must ensure enough “dispatchable” capacity to serve the load.
DRUC occurs after the Day-Ahead Market and before the Adjustment Period.
DRUC

- Occurs once a day
- Ensures enough capacity committed for next Operating Day

DRUC studies all hours of Day 2
Hourly Reliability Unit Commitment (HRUC)

Hourly Reliability Unit Commitment works like DRUC, but within a different timeframe.

HRUC fine-tunes DRUC commitments for the remaining hours.
HRUC fine tunes DRUC commitments

- Reviews all hours already studied by DRUC
- Occurs hourly
The Reliability Unit Commitment Process

- Current Operating Plans
- Network Operations Model
- Contingencies
- Load Forecast
- Transmission Security Analysis (TSA)
- Reliability Unit Commitment (RUC)
- Offers
- Resource Commitments
- Resource Decommitments

Reliability Unit Commitment
The Reliability Unit Commitment Inputs

- Current Operating Plans
- Network Operations Model
- Contingencies
- Load Forecast

Transmission Security Analysis (TSA)

Reliability Unit Commitment (RUC)

Offers

Reliability Unit Commitment

Resource Commitments

Resource Decommissions
COP statuses through the eyes of RUC

**Current Operating Plan**

- **ON** (any variety): Resource capacity is committed
- **OFF**: Resource is offline but available for RUC commitment
- **ONRR**: Resource is online acting as a synchronous condenser and available for RUC commitment
- **OUT**: Resource is not available
The Reliability Unit Commitment Inputs

- Current Operating Plans
- Network Operations Model
- Contingencies
- Load Forecast

Offers

Transmission Security Analysis (TSA)

Reliability Unit Commitment (RUC)

Resource Commitments

Resource Decommitments
Network Operations Model

- Normal topology
- Equipment Ratings
- Generic Constraints
- Remedial Action Schemes and Plans
- Automatic Mitigation Plans

Outage Scheduler

Reliability Unit Commitment

- Updates model with known or expected changes
Generic Transmission Constraints

- Represent stability and voltage limits between areas
- More constraining than thermal limits

Network Operations Model

Generic Transmission Limit = 900 MW

Somewhere, Texas

300 MW Rating

400 MW Rating

300 MW Rating

Somewhere Else, Texas

Generic Transmission Limit = 900 MW
Network Operations Model

**Remedial Action Scheme (RAS)**
- Automatically activated
- Maintain system security
- Transmission, Load or Resource solution

**Automatic Mitigation Plan (AMP)**
- Automatically activated
- Manage only localized voltage issues
- Switches series reactors

**Remedial Action Plan (RAP)**
- Manually activated by ERCOT and TSP
- Maintain system security
- Transmission solution

RASs and AMPs replace Special Protection Systems (SPSs)
The Reliability Unit Commitment Inputs

- Current Operating Plans
- Network Operations Model
- Contingencies
- Load Forecast
- Offers

Resources

- Transmission Security Analysis (TSA)
- Reliability Unit Commitment (RUC)

Resource Commitments

Resource Decommitments
The Three C’s of Transmission Security

Contingency:
Constraint:
Congestion:

Security Violation is always a Contingency/Constraint pair
The Reliability Unit Commitment Inputs

- Current Operating Plans
- Network Operations Model
- Contingencies
- Load Forecast

Transmission Security Analysis (TSA)

- Offers

Reliability Unit Commitment (RUC)

- Resource Commitments
- Resource Decommitments
- Undeliverable Ancillary Service

Reliability Unit Commitment
Load Distribution Factors

• Distribute the Load Forecast to individual buses within a Load Zone
• Based on historical power flows

Load Distribution Factors are published based on “cold,” “mild,” or “hot” proxy days.
The Reliability Unit Commitment Inputs

- Current Operating Plans
- Network Operations Model
- Contingencies
- Load Forecast

Transmission Security Analysis (TSA)

Reliability Unit Commitment (RUC)

Offers

Resource Commitments

Resource Decommissions

Reliability Unit Commitment
The QSE’s Three-Part Supply Offers provides cost information for a specific Resource.
RUC Participation with a Three-Part Supply Offer

In evaluating a Resource for commitment, RUC utilizes:

- Startup Offer (if needed)
- Minimum Energy Offer

The Energy Offer Curve is not used by RUC
Startup Cost Considered?

- No QSE commitments
- RUC initially commits
- QSE extends commitment

RUC will consider Startup Costs
Startup Cost Considered?

• QSE initially commits
• RUC extends commitment

RUC will not consider Startup Costs
DRUC uses Three-Part Supply Offers submitted, but not awarded in the DAM
HRUC uses Three-Part Supply Offers submitted by the end of the Adjustment Period.
RUC Participation **Without** Three-Part Supply Offer

Use 150% Approved Verifiable Costs

**or**

Use 150% Resource Generic Costs

### Startup
- Cost up to LSL
  - ($/Start)

### Minimum Energy
- Cost per hour at LSL
  - ($/MWh)
Transmission Security Analysis (TSA)

Reliability Unit Commitment (RUC)
1. **Determine initial unit commitment**

- Includes Resources previously committed
- May add commitments to meet Load Forecast
- Does not recognize Transmission Constraints
1. Determine initial unit commitment

Produces a dispatch solution for input to Transmission Security Analysis
Proxy Energy Offer Curve

- Allows RUC to calculate a “dispatch solution”
- Projects congestion patterns for TSA
- Derived from Mitigated Offer Caps
2. Check to see if dispatch solution is secure

- Tests base case and contingency cases
- Determines Transmission Constraints

Any contingency that triggers a RAP, AMP or RAS is ignored
2. Check to see if dispatch solution is secure

Produces a set of Security Violations to be solved by RUC
3. Determine revised unit commitment

- Enforces Transmission Constraints
- Revise Resource Commitments as needed to resolve Security Violations
4. Repeat process until solutions converge
The Reliability Unit Commitment Results

Current Operating Plans
Network Operations Model
Contingencies
Load Forecast

Transmission Security Analysis (TSA)
Reliability Unit Commitment (RUC)

Reliability Unit Commitment

I approve

Resource Commitments
Resource Decommitments
**RUC Commitment of a Resource**

**Commitment Responsibilities:**

<table>
<thead>
<tr>
<th>ERCOT:</th>
<th>QSE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicates the start interval and duration for which the Resource is required to be at least LSL</td>
<td>• Updates COP to confirm RUC status</td>
</tr>
<tr>
<td></td>
<td>• Updates Energy Offer Curve for RUC status</td>
</tr>
</tbody>
</table>

**Communication:**

- May be electronic
- May be verbal
RUC Results and Responsibilities

Energy Offer Curve for RUC-Committed Resource

- All energy above LSL subject to offer floor
- QSE may update by end of Adjustment Period
- ERCOT will adjust if QSE does not

Applies only to hours in the RUC-commitment Period
RUC Results and Responsibilities

RUC Decommitment of a Resource

Decommitments:

RUC may decommit a Resource for a transmission security violation that is otherwise unresolvable.

Decommitment Responsibilities:

<table>
<thead>
<tr>
<th>ERCOT:</th>
<th>QSE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicates the interval in</td>
<td>Updates COP to communicate to ERCOT</td>
</tr>
<tr>
<td>which the Resource is required</td>
<td>receipt of Notice</td>
</tr>
<tr>
<td>to be Off-Line, duration, and</td>
<td></td>
</tr>
<tr>
<td>reason for decommitment</td>
<td></td>
</tr>
</tbody>
</table>
MIS Postings upon completion of RUC

All active and binding transmission constraints used in the commitment process

All Resources committed or decommitted by RUC
For each input below, discuss:

- How is it used in the overall RUC process?
- What are the impacts?

- Current Operating Plan
- Equipment Ratings
- RAPs and RASs
- Contingencies
- Load Forecast
- Three Part Supply Offer
Reliability Unit Commitment: Financial Impacts
If ERCOT commits a Resource through RUC

- ERCOT guarantees that QSE will recover Start-up and Minimum Energy Costs

A few conditions

- Must actually incur the costs
- Startup costs included for starts incurred due to the RUC instruction
What if revenues are less than costs?

- **RUC Make-Whole Payment**
- Real-Time Revenue less Incremental Costs
- **RUC Guaranteed Amount**
  - Minimum Energy Costs
  - Startup Costs

<table>
<thead>
<tr>
<th>Revenues Received</th>
<th>Costs Incurred</th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
<td>$</td>
</tr>
</tbody>
</table>

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What if revenues are less than costs?

- Make-Whole Payment
- Real-Time Revenue less Incremental Costs
- Minimum Energy Costs
- Startup Costs

Revenues Received vs. Costs Incurred
Make-Whole Payments and Caps

- Look to Three-Part Supply Offer for cost data
- Capped at Verifiable Costs if available
- Otherwise, capped at Generic Costs

<table>
<thead>
<tr>
<th>Startup Offer</th>
<th>Minimum Energy Offer</th>
</tr>
</thead>
<tbody>
<tr>
<td>$/Start</td>
<td>$/MWh</td>
</tr>
</tbody>
</table>
Funding for RUC Make Whole Payments

RUC Make Whole Payments

RUC Capacity Short Charges
RUC Capacity Short Charge

When a QSE does not provide enough capacity to meet its obligations, it may be assessed a Capacity Short Charge.
What is included in the total QSE obligation?

- Adjusted Metered Load
- Capacity Trades where the QSE is a seller
- Energy Trades where the QSE is a seller
- Cleared DAM Energy Offers
How can a QSE arrange to meet these obligations?

- Show capacity from its Resources in its COP
- Capacity Trades where the QSE is a buyer
- Energy Trades where the QSE is a buyer
- Cleared DAM Energy bids
Can a QSE have a Capacity Shortfall even if they have no Resources or Load?
When does ERCOT make the comparison?

- Execution of RUC
- Close of Adjustment Period

**Charge based on largest shortfall**
RUC Capacity Short Charge

All QSEs who were capacity short in each RUC will pay a portion of the RUC Make Whole Payments for that particular RUC:

\[
\text{RUC Capacity Short Charge} = \frac{\text{RUC Capacity Shortfall Ratio Share}}{\text{(RUC Make Whole Total)}} \times \text{(by 15-Minute Settlement Interval)}
\]
Short Charge Cap

The charge to each QSE is capped at

\[
2 \times \text{RUC Capacity Shortfall} \times \frac{\text{RUC Make Whole Total}}{\text{RUC Capacity Total}}
\]
A QSE with a capacity shortfall will pay the lesser of

\[
\text{RUC Capacity Shortfall Ratio Share} \times \left( \frac{\text{RUC Make Whole Total}}{\text{RUC Capacity Total}} \right)
\]

or their cap

\[
2 \times \text{RUC Capacity Shortfall} \times \frac{\text{RUC Make Whole Total}}{\text{RUC Capacity Total}}
\]
Class Activity

Split into groups:

- Maximum of 5 people per group
- Minimum of 3

Read & Respond:

- ERCOT Commits capacity through RUC
- ERCOT pays $100 in RUC Make-Whole Payments during the cases shown in the following table
- Complete the table
- Determine how much each QSE will pay in each case
## RUC Capacity Short Charge Activity

<table>
<thead>
<tr>
<th>RUC Procurement</th>
<th>RUC Capacity Total = 100 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUC Payment</td>
<td>RUC Make Whole Total = $100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>QSE 1 Shortfall</th>
<th>40 MW</th>
<th>60 MW</th>
<th>20 MW</th>
<th>40 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>QSE 2 Shortfall</td>
<td>0</td>
<td>0</td>
<td>20 MW</td>
<td>20 MW</td>
</tr>
</tbody>
</table>

| QSE 1 Shortfall Ratio Share | 1 | 1 | .50 | .67 |
| QSE 2 Shortfall Ratio Share | 0 | 0 | .50 | .33 |

| QSE 1 Short Charge Cap |  |
| QSE 1 Calculated Short Charge |  |
| QSE 2 Short Charge Cap |  |
| QSE 2 Calculated Short Charge |  |
RUC Make-Whole Uplift Charges

• When RUC Capacity-Short Charges are not enough to cover RUC Make-Whole Payments

• The balance of the funds needed are collected from QSEs based on load ratio share as Make-Whole Uplift Charges
Revenues may not be enough for make-Whole Payments

Difference uplifted to QSEs representing Load
If ERCOT de-commits a Resource through RUC

- ERCOT may pay QSE the cost to restart

A few conditions

- Resource was QSE-Committed
- Resource not scheduled to shut down within the Operating Day
Payments and Charges for RUC Committed Hours

- Appear on Real-Time Statements
- Initial Statements issued 5 days after Operating Day
You have learned about:

• The Reliability Unit Commitment (RUC) process

• The impact of ERCOT, TSPs, and QSEs on these processes

• The timelines of Day-Ahead and Hourly RUC

• The financial impacts of RUC
Module Conclusion