ERCOT Market Education

Wholesale Markets 201
Reliability Unit Commitment
Module Overview

Introduction

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
- Distinguish the timelines of the Day-Ahead RUC and the Hourly RUC
- Summarize the impacts of ERCOT, TSPs and QSEs on this process
- 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
Capacity Considerations

- QSEs have already committed Resource capacity
- Some capacity committed as Ancillary Service
- RUC ensures enough “dispatchable” capacity to meet security constraints
  - Power Balance
  - Transmission Constraints
When does Reliability Unit Commitment (RUC) occur?

- Day-Ahead Reliability Unit Commitment (DRUC)
- Hourly Reliability Unit Commitment (HRUC)
DRUC Timing and Study Period

- Runs once a day
- Studies all hours of the next day
HRUC Timing and Study Period

- Runs every hour
- Studies all hours already studied by DRUC
The Reliability Unit Commitment Process

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

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

Outputs:
- Resource Commitments
- Resource Decommissions

Economics flow:
- Reliability Unit Commitment Process

Other outputs:
- Network Operations Model
- Contingencies
- Load Forecast
The Reliability Unit Commitment Inputs

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

Economics

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

Resource Commitments
Resource Decommitments

Reliability Unit Commitment Process
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, but available for RUC commitment

• **OUT**: Resource is not available
The Reliability Unit Commitment Inputs

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

Economics

Reliability Unit Commitment Process

Transmission Security Analysis (TSA)

Reliability Unit Commitment (RUC)

Resource Commitments

Resource Decommitments
Network Operations Model

- Normal topology
- Equipment Ratings
- Generic Constraints

- Expected topology changes

Reliability Unit Commitment
Generic Transmission Constraints

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

```
Generic Transmission Limit = 900 MW
```

```
300 MW Rating
```

```
400 MW Rating
```

```
300 MW Rating
```

```
Generic Transmission Limit = 900 MW
```

```
Somewhere, Texas
```

```
Somewhere Else, Texas
```
Network Operations Model

- Normal topology
- Equipment Ratings
- Generic Constraints
- Other constraint management plans

Outage Scheduler

- Expected topology changes

Reliability Unit Commitment
**RAS** Remedial Action Scheme

- Automatically activated
- Maintain system security
- Transmission, Load or Resource solution

**AMP** Automatic Mitigation Plan

- Automatically activated
- Manage only localized voltage issues
- Switches series reactors

**RAP** Remedial Action Plan

- Manually activated by ERCOT and TSP
- Maintain system security
- Transmission solution
The Reliability Unit Commitment Inputs

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

Reliability Unit Commitment Process

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

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)
Reliability Unit Commitment (RUC)

Economics

Resource Commitments
Resource Decommitments

Reliability Unit Commitment Process
Load Distribution Factors

- Distribute the Load Forecast to individual buses within a Load Zone
- Allows RUC to model power flows

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

Reliability Unit Commitment Process

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

Economics

Transmission Security Analysis (TSA)

Reliability Unit Commitment (RUC)

Resource Commitments

Resource Decommitments
RUC Engine Optimizes Commitment Costs

Source of these costs depends on circumstances

- Start-Time > 1hr
- Start-Time ≤ 1hr

Costs Considered
Three-Part Supply Offer

RUC uses only:
- Startup Offer
- Minimum Energy Offer

Capped at maximum of Generic or Verifiable Costs
No Three-Part Supply Offer from QSE

Based on:

- Approved Verifiable Costs
- Resource Generic Costs

Scaled up to 150%
Regardless of what QSE submits

Based on:

- Approved Verifiable Costs
- Resource Generic Costs

$\$/Start

$\$/MWh

Scaled down to 20%*
Startup Cost Considered?

• No QSE commitments
• RUC initially commits

RUC will consider Startup Costs
Startup Cost Considered?

- QSE initially commits
- RUC extends commitment

RUC will not consider Startup Costs
The Reliability Unit Commitment Process

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

Economics

Transmission Security Analysis (TSA)

Reliability Unit Commitment (RUC)

Resource Commitments

Resource Decommitments
1. Determine initial unit commitment

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

Produces a dispatch solution for input to Transmission Security Analysis

Transmission Security Analysis (TSA)

Reliability Unit Commitment (RUC)
Proxy Energy Offer Curve

- Allows RUC to calculate a “dispatch solution”
- Derived from Mitigated Offer Cap

\[
\text{Mitigated Offer Curve} \times 0.10\% \quad \text{Proxy Energy Offer}
\]
The Reliability Unit Commitment Process

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
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 Process

Economics

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</td>
<td>Updates COP to confirm change in Resource status</td>
</tr>
<tr>
<td>is required to be at least LSL</td>
<td></td>
</tr>
</tbody>
</table>

### Communication:

- May be electronic
- May be verbal
Energy Offer Curve for a 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 which the Resource is required to be Off-Line, duration, and reason for decommitment</td>
<td>Updates COP to confirm change in Resource status</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 the QSE will recover Startup and Minimum Energy Costs

A few conditions
- Must actually incur the costs
- Startup costs included for starts incurred due to the RUC Commitment
ERCOT compares revenues received to costs incurred

- Real-Time Revenue less Incremental Costs
- Startup Costs
- Minimum Energy Costs

RUC Guaranteed Amount

Revenues Received vs. Costs Incurred
What if revenues are less than costs?

Revenues Received

- Make-Whole Payment
  - Real-Time Revenue less Incremental Costs

Costs Incurred

- Minimum Energy Costs
- Startup Costs
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
Funding for RUC Make Whole Payments

RUC Make-Whole Payments

RUC Capacity-Short Charges
When a QSE does not provide enough capacity to meet its obligations, it may be assessed a Capacity Short Charge.
What is included in a QSEs capacity 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
When does ERCOT make the comparison?

- Execution of RUC
- Close of Adjustment Period

Charge based on largest shortfall

- Capacity required to meet QSE Obligations
- Capacity arranged by QSE
  - QSE Shortfall

RUC (DRUC / HRUC)

Adjustment Period

- Capacity required to meet QSE Obligations
- Capacity arranged by QSE
  - QSE Shortfall
Can a QSE have a capacity shortfall if they have no Load?

**Capacity Required to meet QSE Obligations**

**Capacity arranged by QSE**

QSE Shortfall
Can a QSE reduce their shortfall if they have no Resources?
RUC Capacity-Short Charge

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

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

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

or their cap

\[
2 \times \frac{\text{RUC Capacity Shortfall}}{\text{RUC Make-Whole Total}} \times \frac{}{\text{RUC Capacity Total}}
\]
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
<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>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>QSE 1 Shortfall</strong></td>
<td>40 MW</td>
</tr>
<tr>
<td><strong>QSE 2 Shortfall</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>QSE 1 Shortfall Ratio Share</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>QSE 2 Shortfall Ratio Share</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>QSE 1 Short Charge Cap</strong></td>
<td>$80</td>
</tr>
<tr>
<td><strong>QSE 1 Calculated Short Charge</strong></td>
<td>$100</td>
</tr>
<tr>
<td><strong>QSE 2 Short Charge Cap</strong></td>
<td>$0</td>
</tr>
<tr>
<td><strong>QSE 2 Calculated Short Charge</strong></td>
<td>$0</td>
</tr>
</tbody>
</table>
Capacity-Short Charges may not cover Make-Whole

Difference uplifted to QSEs representing Load
If ERCOT decommits 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 posted 5 days after Operating Day
You have learned about:

• The purpose of the Reliability Unit Commitment (RUC) process

• The timelines of the Day-Ahead RUC and the Hourly RUC

• The impacts of ERCOT, TSPs and QSEs on this process

• The financial impacts of Reliability Unit Commitment