RESOURCE ASSET REGISTRATION FORM WORKSHOP

Wind Generation Resources

March 24, 2008

ANTITRUST ADMONITION

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AGENDA

RESOURCE REGISTRATION WORKSHOP AGENDA

- **New Form**
- **General Information and Ownership**
- **Generator Unit Information**
- **Reactive Capability Curves**
- **Resource Parameters**
- **Network Model Data**
- **Planning Data**
- **Private Network Information**

General Information

- **Resource Registration public mail list for Registration Communications and Updates**
    - Sign up at http://lists.ercot.com
- **Registration Schedule**
    - Final RARFs to be sent the week of April 7, 2008
    - Official RARFs due May 1, 2008
    - Submittal instructions and guide will be included with the distribution of RARFs
- **Presentation available on ERCOT calendar**
- **Questions? Send email to NodalMarketTransition@ercot.com**

Resource Registration

NEW RARF

- **Tabs are by subject**
  - Generator Unit Information is a separate tab from Reactive Capability Curves

- **Uses hyperlinks to move between tabs**
  - Each worksheet has a link to "Return to Map"

- **Will define which tab is needed for Resource type**

- **Will provide references to the "New RARF" Guide**

- **Each field will be defined in the guide**

- **Watch "ResourceRegistration" emails for details on submittal changes, file postings, schedule updates, etc.**

NEW RARF – MAP AND NAVIGATION

WIND	RARF Guide / Protocol Reference	% Complete	Worksheets included in this form:
Instructions	RARF Guide: Section 3.0		Instructions
Map (this page)	RARF Guide: Section 3.0		Spreadsheet Map (this page)
General Information - ALL	RARF Guide: Section 4.0		General Information
Site Information - GEN CC WIND	RARF Guide: Section 4.0	0%	Site Information
Unit Info - WIND	RARF Guide: Section 5.3	0%	Unit Information
Resource Parameters - WIND	RARF Guide: Section 6.3	0%	Resource Parameters
Operational Resource Parameters - WIND	RARF Guide: Section 7.3 Nodal Protocols 3.7.1	0%	Operational Resource Parameters
Reactive Capability - WIND	RARF Guide: Section 8.3	0%	Reactive Capability
GSU Transformer - ALL	RARF Guide: Section 9.1	0%	GSU Transformer
Ownership - WIND	RARF Guide: Section 10.3		Ownership
Planning - WIND	RARF Guide: Section 12.1	0%	Planning
Protection - WIND	RARF Guide: Section 12.3	0%	Planning
Generation Owned Transmission Assets - ALL	RARF Guide: Section 14.0		Generation Owned Transmission Assets

Resource Registration

NEW RARF – REACTIVE CAPABILITY CURVE SAMPLE

Field Description	Notes	Labels	Unit 1	Unit 2	Unit 3
ERCOT Confidential	**RETURN TO MAP**				
Reactive Capability Curve					
This worksheet tab applies to all non-wind Generation Resources. This information applies to UNITS.					
Please complete this section and select RETURN (Cell C1)					
Unit Code	Pre-populate				
MW1	Lowest MW of curve	MW			
Lagging MVAR limit associated with MW1 output		MVAR			
Leading MVAR limit associated with MW1 output	Enter as positive number	MVAR			
MW2		MW			
Lagging MVAR limit associated with MW2 output		MVAR			
Leading MVAR limit associated with MW2 output	Enter as positive number	MVAR			
MW3		MW			
Lagging MVAR limit associated with MW3 output		MVAR			
Leading MVAR limit associated with MW3 output	Enter as positive number	MVAR			
MW4		MW			
Lagging MVAR limit associated with MW4 output		MVAR			
Leading MVAR limit associated with MW4 output	Enter as positive number	MVAR			
MW5 - Unity Power Factor		MW			
If hydrogen cooled, indicate hydrogen pressure (psi) associated with your Reactive Curve		PSI			
Net Maximum Leading Operating Capability (MVAR)	Independent of MW	MVAR			
Net Maximum Lagging Operating Capability (MVAR)	Independent of MW	MVAR			

Resource Registration

Unit Details	Labels	Unit 1	Unit 2
Unit Name			
Resource Name (Unit Code/Mnemonic)			
PUC Registration Number			
ERCOT Interconnection Project Number			
NERC Number			
Unit Start Date			
Unit End Date			
Physical Unit Type			
Renewable	Y/N		
Renewable/Offset			
Resource Category			
Qualifying facility	Y/N		
Eligible for McCamey Flowgate Rights (MCFRIs)?	Y/N		
Name Plate Rating	MVA		
Real Power Rating	MW		
Reactive Power Rating	MVAR		
Unit Generating Voltage	KV		
Latitude of center of Wind Farm	decimal degrees		
Longitude of center of Wind Farm	decimal degrees		
Average Height above ground of Turbine Hub	meters		
Latitude of Meteorological Tower	decimal degrees		
Longitude of Meteorological Tower	decimal degrees		
Height of Meteorological Tower Instrumentation	meters		

Resource Registration

GENERAL INFORMATION AND OWNERSHIP

Date Form Completed:	
Resource Entity Submitting Form:	
Resource Entity DUNS #:	

- **Submittal Information**
  - Date format shall be MM/DD/YYYY
  - Resource Entity name must match ERCOT's record
  - DUNS number is either a 9 digit or 13 digit number

- **Resource Entity Authorized Representative**
  - As registered with ERCOT
  - Responsible for submission of RARF to ERCOT

- **Primary Contact**
  - Site or facility contact for Generation Resources
  - Resource Entity contact for Load Resources
  - May be Authorized Representative

- **Site info for Generation Resources**
  - Resource Site Name/Code to be determined jointly with ERCOT
  - Site In-Service Date is the date when plant was commissioned
  - Indicate the 2003 CMZ where Resource is located
    - If this is not known, send a request to NodalMarketTransition@ercot.com
  - Indicate if Resource is owned by a NOIE and metered
  - Identify TDSP providing service
  - Confirm metering scheme and quantity
  - Identify if Generation Load splitting

| Resource Site Name: |
| Resource Site Code: |
| Street Address: |
| City: |
| State: |
| County: |
| Site In-Service Date: |
| Site Stop Service Date: |
| Congestion Management Zone for 2003: |
| Resource owned by NOIE? (Y/N): |
| Is Resource behind a NOIE Settlement Meter Point? (Y,N): |
| TDSP Providing Service To Resource: |
| TDSP DUNS Number: |
| ESI-ID (if answer to row 54 above is "No"): |
| ERCOT Read (Y or N): |
| Number of EPS Primary meters: |
| Gen. Load Splitting (Y or N): |

OWNERSHIP

- **Ownership section of the RARF documents who controls the output of the facility (represents the power to ERCOT)**

- **Split Generation Resources**
  - WGRs registered with multiple Resource Entities representing the output of the wind facility
  - The Master Owner of a Split Generation facility is responsible for registration documentation

- **Load Splitting**
  - Applies to facilities with multiple Retail Electric Providers (REPs)

Unit 1 Data		
Sub Generator Data	Owner 1	Owner 2
Market Participant (Resource) Name		
Market Participant (Resource) Duns Number		
Fixed Ownership %		
Master Owner (Y or N)		

Resource Registration

GENERATOR UNIT INFORMATION

GENERATOR UNIT INFORMATION

Unit Name	
Unit Code/Mnemonic	
Unit Start Date	
Unit End Date	
Physical Unit Type	
Primary Fuel Type	
Secondary Fuel Type	
Fuel Transportation Type	
Renewable (Y/N)	
Renewable/Offset	
Resource Category	
Qualifying Facility (Yes or No?)	

- **All Generation Resources will have to fill out a Generator Unit Information Tab**
  - Resource Unit Name & Code to be determined jointly with ERCOT
  - Start Date and End Date should be formatted MM/DD/YY

Resource Registration

GENERATOR UNIT INFORMATION

- **Physical Unit Type** – used for Reporting Purposes

- **CA** = Combined Cycle steam part (includes steam part of integrated coal gasification combined cycle)
- **CC** = Combined Cycle total unit (use only for plants/generators that are in planning stage, for which specific generator details cannot be provided)
- **CE** = Compressed air energy storage
- **CS** = Combined Cycle single shaft (combustion turbine and steam turbine share a single generator)
- **CT** = Combined Cycle combustion turbine part (includes combustion turbine part of integrated coal gasification Combined Cycle)
- **FC** = Fuel Cell
- **GT** = Combustion (gas) turbine (includes jet engine design)

- **HY** = Hydraulic turbine (includes turbines associated with delivery of water by pipeline
- **IC** = Internal combustion (diesel, piston) engine
- **NA** = Unknown at this time (planned units only)
- **OT** = Other
- **PS** = Hydraulic Turbine - Reversible (pumped storage)
- **PV** = Photovoltaic
- **ST** = Steam Turbine including nuclear, geothermal and solar. Does not include combined cycle.
- **WT** = Wind Turbine

- **Resource Category – used for Settlement Purposes**

  – Nuclear

  – Hydro

  – Coal and Lignite

  – Combined-Cycle ≤ 90 MW

  – Combined-Cycle > 90 MW

  – Gas Steam - Supercritical Boiler

  – Gas Steam - Reheat Boiler

  – Gas Steam - Non-reheat or Boiler without air-preheater

  – Simple Cycle ≤ 90 MW

  – Simple Cycle > 90 MW

  – Diesel

  – Renewable (Wind, Solar, Wave, Fuel Cells)

- **A Renewable Energy Credit (REC) or Offset represents one MWH of renewable energy from an existing facility that may be used in place of a REC to meet renewable energy requirement. See Substantive Rule 25.173(c) (10).**

- **See Protocol Section 14.9 to determine if the unit is a certified Renewable Energy Credit (REC) Generator Resource or a certified offset generator.**

- **Qualifying Facility**
  - A qualifying co-generation facility or qualifying renewable small power production facility under regulatory qualification criteria as defined in PURPA, 16 USC §796(18)(B) and §796(17)(C).

GENERATOR UNIT INFORMATION

- **High Reasonability Limit (HRL)**
  - An "Out-of-Bounds" maximum MW value chosen by RE and used by ERCOT to alarm/reject data exceeding this value.

- **Low Reasonability Limit (LRL)**
  - An "Out-of-Bounds" minimum MW value chosen by RE and used by ERCOT to alarm/reject data exceeding this value.

| High Reasonability Limit (Max Net MW level) |
| Low Reasonability Limit (Min Net MW level) |
| High Reasonability Ramp Rate Limit (Max ramp MW/min) |
| Low Reasonability Ramp Rate Limit (Min ramp MW/min) |

- **High Reasonability Ramp Rate Limit (HRRRL)**
  - An "Out-of-Bounds" maximum MW/minute value chosen by RE and used by ERCOT to alarm/reject data exceeding this value.

- **Low Reasonability Ramp Rate Limit (LRRRL)**
  - An "Out-of-Bounds" minimum MW/minute value chosen by RE and used by ERCOT to alarm/reject data exceeding this value.

- **Values that are submitted by QSE outside of the LRL and HRL range will be rejected by ERCOT**

- **Example:**
  - HRL = 150 MW
  - On COP, QSE submitted High Sustainable Limit HSL = 160 MW
  - ERCOT will not accept this value

- **Values that are submitted by QSE outside of the LRRRL and HRRRL range will be rejected by ERCOT**

- **Example:**
  - HRRRL = 15 MW/Min
  - In MMS, QSE enters ramp rate of 20MW/Min
  - ERCOT will not accept this value

GENERATOR UNIT INFORMATION

Seasonal Net Max Sustainable MW Rating- Spring
Seasonal Net Min Sustainable MW Rating- Spring
Seasonal Net Max Emergency MW Rating- Spring
Seasonal Net Min Emergency MW Rating- Spring
Seasonal Net Max Sustainable MW Rating- Summer
Seasonal Net Min Sustainable MW Rating- Summer
Seasonal Net Max Emergency MW Rating- Summer
Seasonal Net Min Emergency MW Rating- Summer
Seasonal Net Max Sustainable MW Rating- Fall
Seasonal Net Min Sustainable MW Rating- Fall
Seasonal Net Max Emergency MW Rating- Fall
Seasonal Net Min Emergency MW Rating- Fall
Seasonal Net Max Sustainable MW Rating- Winter
Seasonal Net Min Sustainable MW Rating- Winter
Seasonal Net Max Emergency MW Rating- Winter
Seasonal Net Min Emergency MW Rating- Winter

- **Seasonal Net Max Sustainable MW Rating:**
  - Maximum sustained net energy production capability of the Resource.
  - There will be 4 values representing MW output in Spring, Summer, Fall, and Winter

- **Seasonal Net Min Sustainable MW Rating:**
  - Minimum sustained net energy production capability of the Resource.
  - There will be 4 values representing MW output in Spring, Summer, Fall, and Winter

Resource Registration

GENERATOR UNIT INFORMATION

- **Seasonal Net Max Emergency MW Rating:**
  - Limit established by the QSE describing the maximum temporary unsustainable energy production capability of the Resource.
  - This limit must be achievable for a time stated by the QSE, but not less than 30 minutes.
  - There will be 4 values representing MW output in Spring, Summer, Fall, and Winter

- **Seasonal Net Min Emergency MW Rating:**
  - Limit established by the QSE describing the minimum temporary unsustainable energy production capability of the Resource.
  - This limit must be achievable for a time stated by the QSE, but not less than 30 minutes.
  - There will be 4 values representing MW output in Spring, Summer, Fall, and Winter

Resource Registration

| Name Plate Rating |
| Name Plate Real Power Rating |
| Name Plate Reactive Power Rating |
| Unit Generating Voltage |

- **Name Plate Rating**
  - Name Plate Rating (MVA) = nameplate MVA Rating of the unit at its rated Power Factor
  - Rating (MW) = MW output of the unit at its rated Power Factor
  - Rating (MVAR) = MVAR output of the unit at its rated Power Factor
  - Turbine Rating (MW) = Rating of the Turbine in MW
  - Unit kV is the name plate terminal voltage in kV (kilovolts). This value is typically from 11 kV to 34.5 kV.

- **Please note the nameplate ratings should correspond to a nameplate power factor. MVA rating will not be lower than either the MW or MVAR rating.**

Resource Registration

GENERATOR UNIT INFORMATION

Latitude of center of Wind Farm	decimal degrees
Longitude of center of Wind Farm	decimal degrees
Average Height above ground of Turbine Hub	meters
Latitude of Meteorological Tower	decimal degrees
Longitude of Meteorological Tower	decimal degrees
Height of Meteorological Tower Instrumentation	meters

- **Latitude/Longitude of center of Wind Farm**
  - Exact GPS coordinates of the geographical center of the wind farm measured in decimal degrees (e.g., 30.3444 ^{0}N, 60.2323 ^{0}W)

- **Average Height above ground of Turbine Hub (meters)**
  - Simple average of the height above ground of all WGR turbine hubs

- **Latitude/Longitude of Meteorological Tower**
  - Exact GPS coordinates of the Meteorological Tower used in the WGR farm, as measured in decimal degrees (e.g., 30.6444 ^{0}N, 60.3323 ^{0}W)

- **Height of Meteorological Tower Instrumentation (meters)**
  - Average height of all instruments mounted on the Meteorological Tower

Resource Registration

- **Group WGRs by Equipment Type. Indicate Manufacturer name, Model number, etc.**

- **If there are units that were from the same manufacturer but have different ratings, these units will be grouped separately (e.g., 1 MW vs. 1.5 MW)**

- **Indicate Name Plate MW Rating for each group**

- **Indicate the quantity of WGR units for each group**

Group 1 - Type of Turbine (Manufacturer/Model)	
Group 1 - MW Rating for this model of Turbine	MW
Group 1 - Number of this type of Turbine	
Group 2 - Type of Turbine (Manufacturer/Model)	
Group 2 - MW Rating for this model of Turbine	MW
Group 2 - Number of this type of Turbine	
Group 3 - Type of Turbine (Manufacturer/Model)	
Group 3 - MW Rating for this model of Turbine	MW
Group 3 - Number of this type of Turbine	
Group 4 - Type of Turbine (Manufacturer/Model)	
Group 4 - MW Rating for this model of Turbine	MW
Group 4 - Number of this type of Turbine	
Group 5 - Type of Turbine (Manufacturer/Model)	
Group 5 - MW Rating for this model of Turbine	MW
Group 5 - Number of this type of Turbine	

Resource Registration

- **What are the seasonal sustainable and emergency ratings?**
  - PMAX
  - Also the data is used 4.4.9.4.1 Mitigated Offer Cap in calculating the capacity factor of the resource.

- **How are these used by Nodal systems?**
  - This information is used in planning studies. In addition, the data is used 4.4.9.4.1 Mitigated Offer Cap in calculating the capacity factor of the resource.

- **What if the Emergency MW and Sustainable MW ratings are the same?**
  - These values can be the same. If this is the case, fill in the same values for corresponding fields.

Resource Registration

- **What are the High/Low Reasonability Limits?**

  – An "Out-of-Bounds" value chosen by RE and used by ERCOT to alarm/reject data exceeding the value per Nodal Protocol 3.7.1. This value is used to validate data submitted to ERCOT (Alarms, ICCP, COP).

  – Any submittals such as a High Sustainable Limit in the COP that exceed the High Reasonability Limit will be rejected by ERCOT systems.
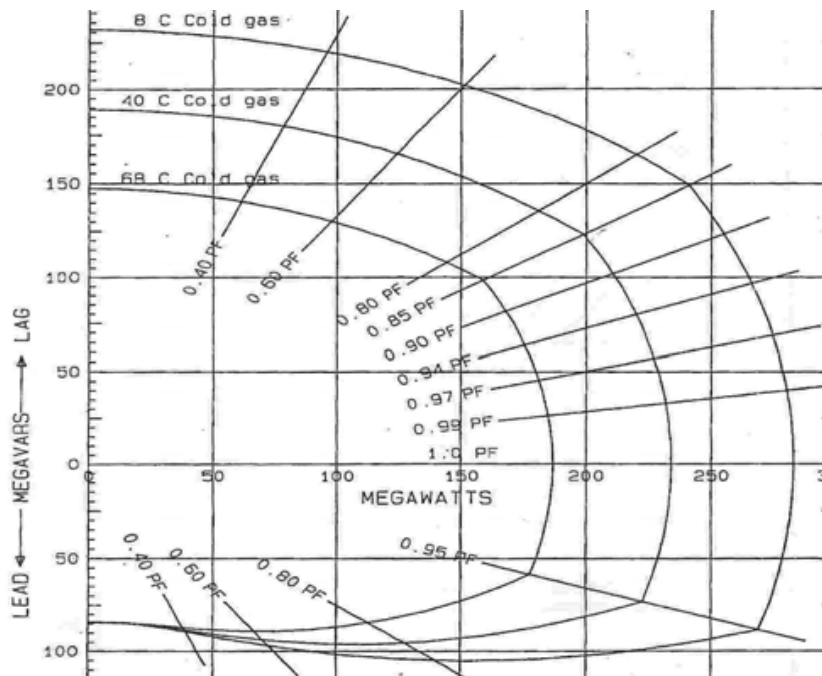
REACTIVE CAPABILITY CURVES

REACTIVE CAPABILITY CURVES

- **Reactive Capability is the ability of a Generator unit to continuously supply/absorb Reactive Power (MVAR) to/from ERCOT grid for a given MW operating value without damaging the unit.**

- **Reactive Power is required to control voltages during normal and emergency situations in order to prevent voltage collapse of the grid.**

- **RE shall conduct reactive capacity qualification tests to verify maximum leading and lagging reactive capability of all Generation Resources required to provide VSS.**

- **Reactive Capability tests are performed on initial qualification and at a minimum of once every two years as required by ERCOT.**

Resource Registration

- Figure on the left shows a typical Reactive Capability Curve or D-Curve of a Generator

- X-axis is MW and Y-axis is MVAR

- Values above the x-axis (positive VARs) are "LAGGING" MVARs

- Values below the x-axis (negative VARs) are "LEADING" MVARs

- Straight lines correspond to different power factor (PF) values

- RE will submit D-Curves of all WGRs to ERCOT

- Form has been modified to allow for D-Curves for each type of turbine in a unit (i.e. each group of turbines)

REACTIVE CAPABILITY CURVES

- **The Reactive Capability Curve, also known as the D-curve, represents the operating limits of the generator**

- **ERCOT is asking for nine points of information in order to build the curve**

- **Use positive (lagging MVAR) and negative numbers (leading MVAR) as shown on the example**

- **Enter 5 increasing MW values of Operating Real Power**
  – MW1 (low operating point) through MW5 (unity)

Field Description	Unit #1
MW1 (lowest MW value of curve – minimum operating MW output)	18
Lagging MVAR limit associated with MW1 output	145
Leading MVAR limit associated with MW1 output	-145
MW2 (midpoint (50%) between MW1 and MW5)	38
Lagging MVAR limit associated with MW2 output	130
Leading MVAR limit associated with MW2 output	-130
MW3 (seventy-fifth percentile (75%) between MW1 and MW5)	48
Lagging MVAR limit associated with MW3 output	115
Leading MVAR limit associated with MW3 output	-115
MW4 (between MW3 and MW 5 - breakpoint of curve)	60
Lagging MVAR limit associated with MW4 output	80
Leading MVAR limit associated with MW4 output	-80
MW5- Unity Power Factor	68
If hydrogen cooled, indicate hydrogen pressure (psi) associated with your Reactive Curve submitted for ERCOT studies	65

Resource Registration

- **Lagging MVAR for MW1**
  - On the D-Curve, draw a vertical line from the x-axis (MW1 value) and extend upward until it intersects the curve. From this intersection, draw a horizontal line extending to the y-axis. This point on the y-axis is the Lagging MVAR for MW1.

- **Leading MVAR for MW1**
  - On the D-Curve, draw a vertical line from the x-axis (MW1 value) and extend downward until it intersects the curve. Then, draw a horizontal line extending to the y-axis. This point on the y-axis is the Leading MVAR for MW1.

Field Description
Unit and Group
MW1 (lowest MW value of curve)
Lagging MVAR limit associated with MW1 output
Leading MVAR limit associated with MW1 output
MW2
Lagging MVAR limit associated with MW2 output
Leading MVAR limit associated with MW2 output
MW3
Lagging MVAR limit associated with MW3 output
Leading MVAR limit associated with MW3 output
MW4
Lagging MVAR limit associated with MW4 output
Leading MVAR limit associated with MW4 output
MW5- Unity Power Factor

- **Lagging MVAR for MW2**
  - On the D-Curve, draw a vertical line from the x-axis (MW2 value) and extend upward until it intersects the curve. From this intersection, draw a horizontal line extending to the y-axis. This point on the y-axis is the Lagging MVAR for MW2.

- **Leading MVAR for MW2**
  - On the D-Curve, draw a vertical line from the x-axis (MW2 value) and extend downward until it intersects the curve. Then, draw a horizontal line extending to the y-axis. This point on the y-axis is the Leading MVAR for MW2.

Field Description
Unit and Group
MW1 (lowest MW value of curve)
Lagging MVAR limit associated with MW1 output
Leading MVAR limit associated with MW1 output
MW2
Lagging MVAR limit associated with MW2 output
Leading MVAR limit associated with MW2 output
MW3
Lagging MVAR limit associated with MW3 output
Leading MVAR limit associated with MW3 output
MW4
Lagging MVAR limit associated with MW4 output
Leading MVAR limit associated with MW4 output
MW5- Unity Power Factor

- **Lagging MVAR for MW3**
  - On the D-Curve, draw a vertical line from the x-axis (MW3 value) and extend upward until it intersects the curve. From this intersection, draw a horizontal line extending to the y-axis. This point on the y-axis is the Lagging MVAR for MW3.

- **Leading MVAR for MW3**
  - On the D-Curve, draw a vertical line from the x-axis (MW3 value) and extend downward until it intersects the curve. Then, draw a horizontal line extending to the y-axis. This point on the y-axis is the Leading MVAR for MW3.

Field Description
Unit and Group
MW1 (lowest MW value of curve)
Lagging MVAR limit associated with MW1 output
Leading MVAR limit associated with MW1 output
MW2
Lagging MVAR limit associated with MW2 output
Leading MVAR limit associated with MW2 output
MW3
Lagging MVAR limit associated with MW3 output
Leading MVAR limit associated with MW3 output
MW4
Lagging MVAR limit associated with MW4 output
Leading MVAR limit associated with MW4 output
MW5- Unity Power Factor

- **Lagging MVAR for MW4**
  - On the D-Curve, draw a vertical line from the x-axis (MW4 value) and extend upward until it intersects the curve. From this intersection, draw a horizontal line extending to the y-axis. This point on the y-axis is the Lagging MVAR for MW4.

- **Leading MVAR for MW4**
  - On the D-Curve, draw a vertical line from the x-axis (MW4 value) and extend downward until it intersects the curve. Then, draw a horizontal line extending to the y-axis. This point on the y-axis is the Leading MVAR for MW4.

Field Description
Unit and Group
MW1 (lowest MW value of curve)
Lagging MVAR limit associated with MW1 output
Leading MVAR limit associated with MW1 output
MW2
Lagging MVAR limit associated with MW2 output
Leading MVAR limit associated with MW2 output
MW3
Lagging MVAR limit associated with MW3 output
Leading MVAR limit associated with MW3 output
MW4
Lagging MVAR limit associated with MW4 output
Leading MVAR limit associated with MW4 output
MW5- Unity Power Factor

REACTIVE CAPABILITY CURVES

- **MW5 – Unity Power Factor**
  - Maximum value of Real Power MW at 1.0 PF. For MW5, Reactive Power (both Lagging & Leading) is zero

- **Net Maximum Leading Operating Capability (MVAR)**
  - Maximum Leading Reactive Power output of the unit independent of Real Power output

- **Net Maximum Lagging Operating Capability (MVAR)**
 - Maximum Lagging Reactive Power output of the unit independent of Real Power output

Net Maximum Leading Operating Capability (MVAR)	MVAR
Net Maximum Lagging Operating Capability (MVAR)	MVAR
Manufacturer's Capability Curve submitted?	Y/N

Resource Registration

- **Sample input data table**

| Field Description	Unit #1
MW1 *(lowest MW value of curve – minimum operating MW output)*	18
Lagging MVAR limit associated with MW1 output	145
Leading MVAR limit associated with MW1 output	-145
MW2 *(midpoint (50%) between MW1 and MW5)*	38
Lagging MVAR limit associated with MW2 output	130
Leading MVAR limit associated with MW2 output	-130
MW3 *(seventy-fifth percentile (75%) between MW1 and MW5)*	48
Lagging MVAR limit associated with MW3 output	115
Leading MVAR limit associated with MW3 output	-115
MW4 *(between MW3 and MW 5 - breakpoint of curve)*	60
Lagging MVAR limit associated with MW4 output	80
Leading MVAR limit associated with MW4 output	-80
MW5- Unity Power Factor	68
If hydrogen cooled, indicate hydrogen pressure (psi) associated with your Reactive Curve submitted for ERCOT studies	65

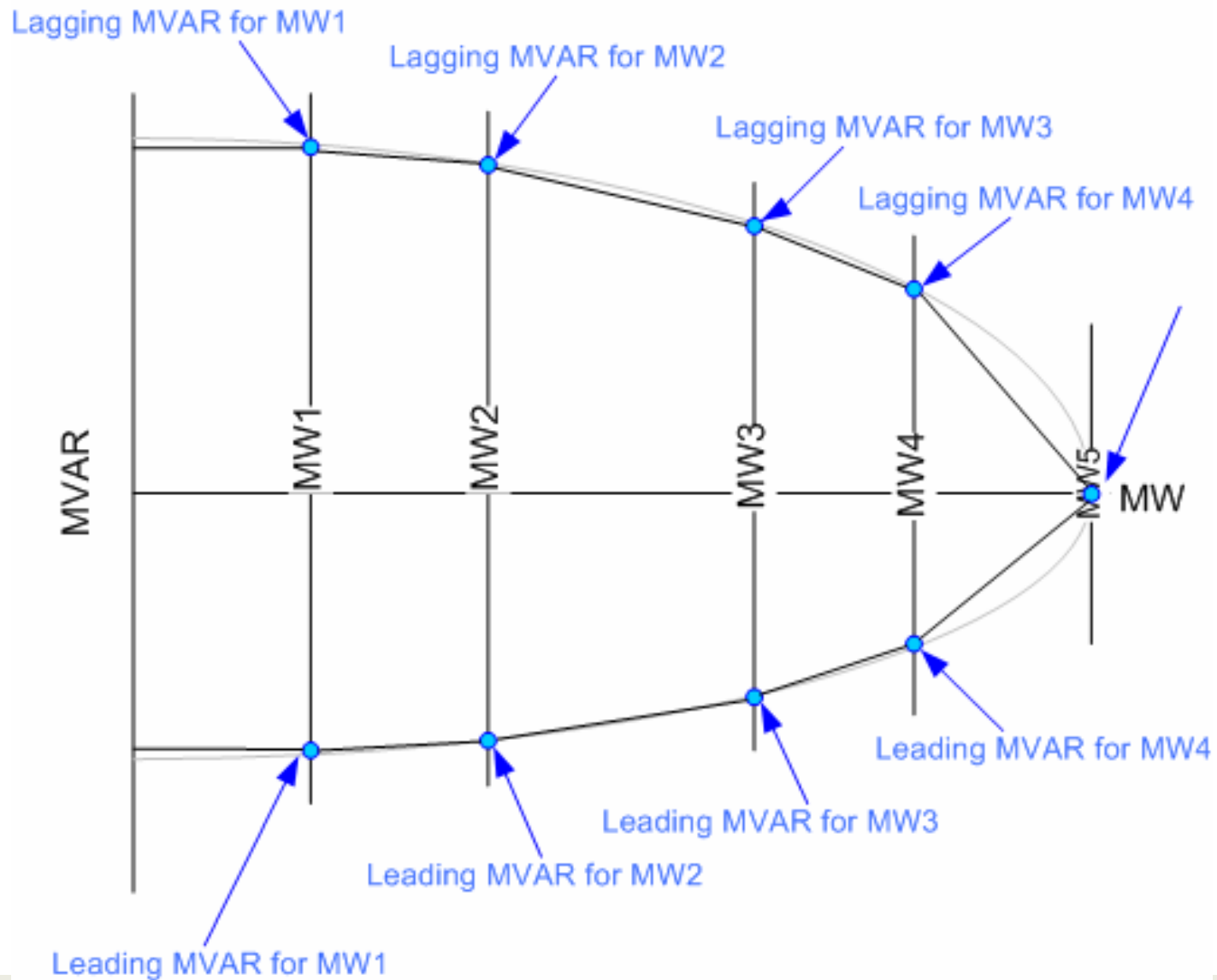- **Sample D-Curve used to create the data used in the table on left**
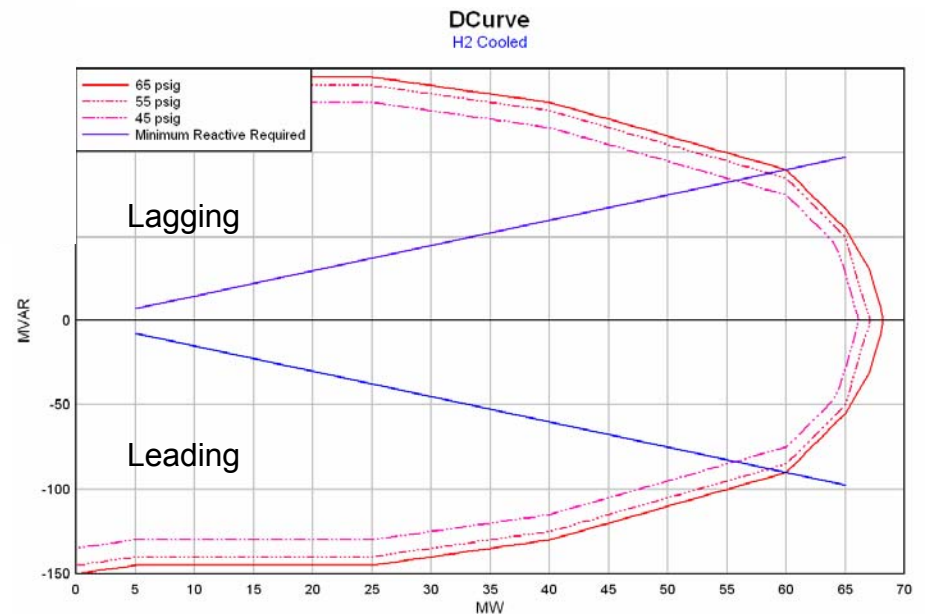
Resource Registration
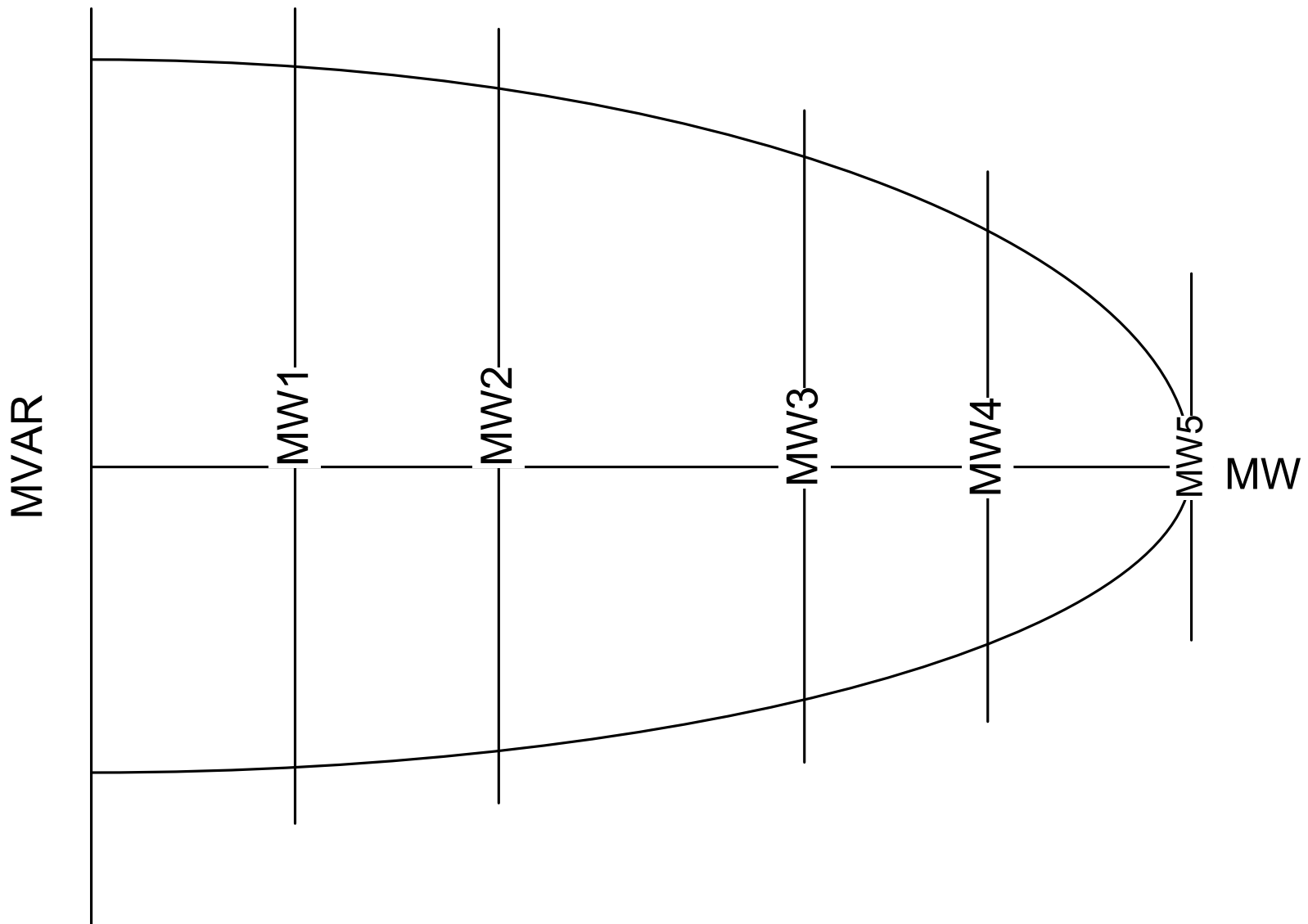
Resource Registration
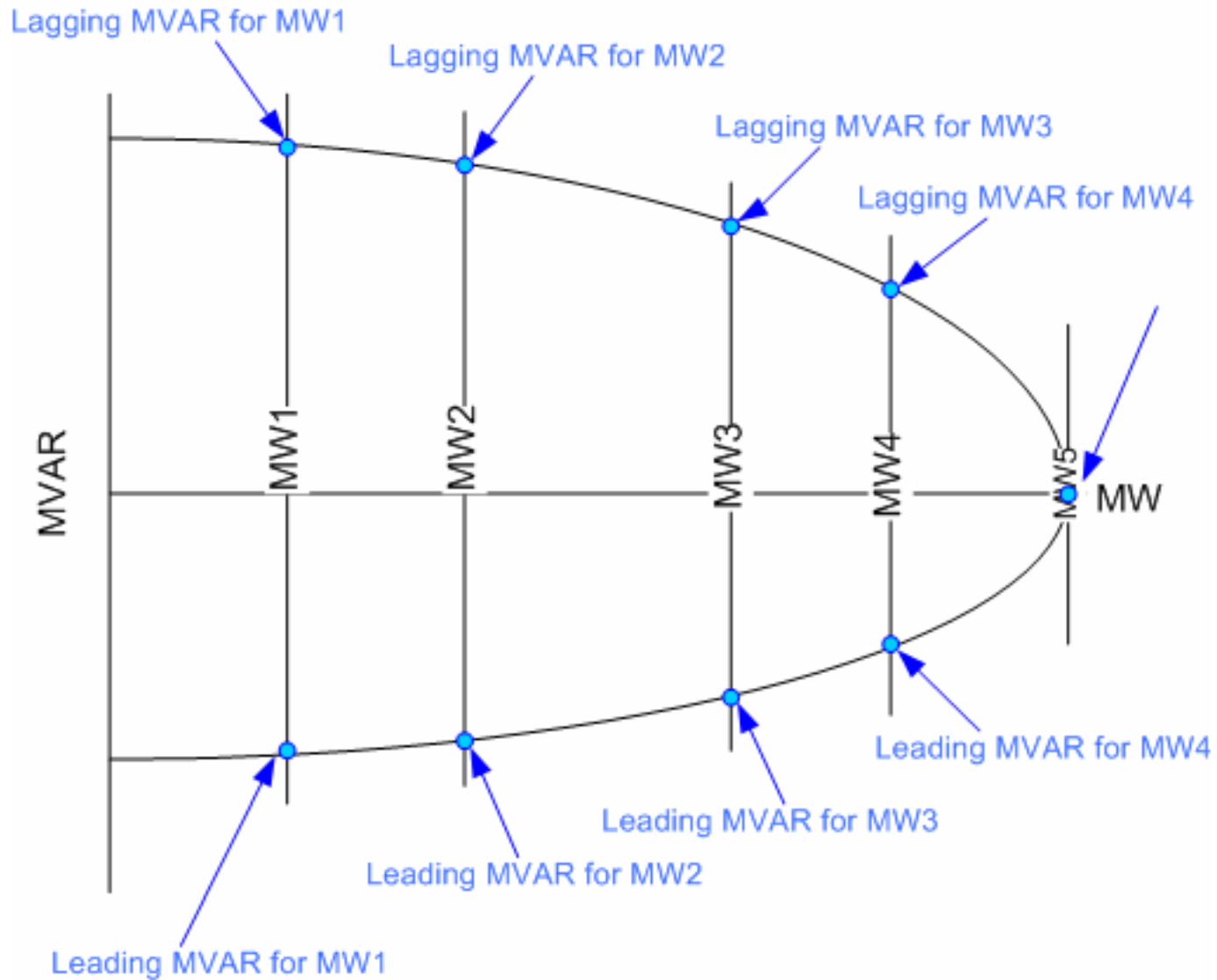
REACTIVE CAPABILITY CURVES – FAQ

- **Does ERCOT want the Manufacturer's Reactive Capability Curve added as a separate tab to this document?**

  – Please include Capability Curve as a separate document.

- **For "Net Maximum Leading Operating Capability (MVAR)" and "Net Maximum Lagging Operating Capability (MVAR)", what is "Net"?**

  – "Net" is defined as Generation less Auxiliary load.

Resource Registration

RESOURCE PARAMETERS

OPERATIONAL RESOURCE PARAMETERS

- **Minimum On-Line Time (Hrs)**
  - Minimum number of consecutive hours a Resource must be On-Line before being shut down. Field was previously called Minimum Up Time on zonal GARF

- **Minimum Off-Line Time (Hrs)**
  - Minimum number of consecutive hours a Resource must be Off-Line before being restarted. Field was previously called Minimum Down Time on zonal GARF.

- **Hot Start Time (Hrs)**
  - Time, in hours, from the ERCOT notice to the Resource breaker-closing, for a Resource in its hot-temperature state.

Field Description
Resource Parameters
Minimum On Line Time
Minimum Off Line Time
Hot Start Time
Intermediate Start Time
Cold Start Time
Max Weekly Starts
Max On Line Time
Max Daily Starts
Max Weekly Energy
Hot-to-Intermediate Time
Intermediate-to-Cold Time

- **Intermediate Start Time (Hrs)**
  - Time interval, in hours, from the ERCOT notice to the Resource breaker-closing, for a Resource in its intermediate temperature state

- **Cold Start Time (Hrs)**
  - Time interval, in hours, from the ERCOT notice to the Resource breaker-closing, for a Resource in its cold-temperature state

- **Max Weekly Starts**
  - The maximum number of times a Resource can be started in seven consecutive days under normal operating conditions

Field Description
Resource Parameters
Minimum On Line Time
Minimum Off Line Time
Hot Start Time
Intermediate Start Time
Cold Start Time
Max Weekly Starts
Max On Line Time
Max Daily Starts
Max Weekly Energy
Hot-to-Intermediate Time
Intermediate-to-Cold Time

OPERATIONAL RESOURCE PARAMETERS

- **Max On Line Time (Hrs)**
  - Maximum number of consecutive hours a Resource can run before it needs to be shut down

- **Max Daily Starts**
  - Maximum number of times a Resource can be started in a 24 hour period under normal operating conditions

- **Max Weekly Energy**
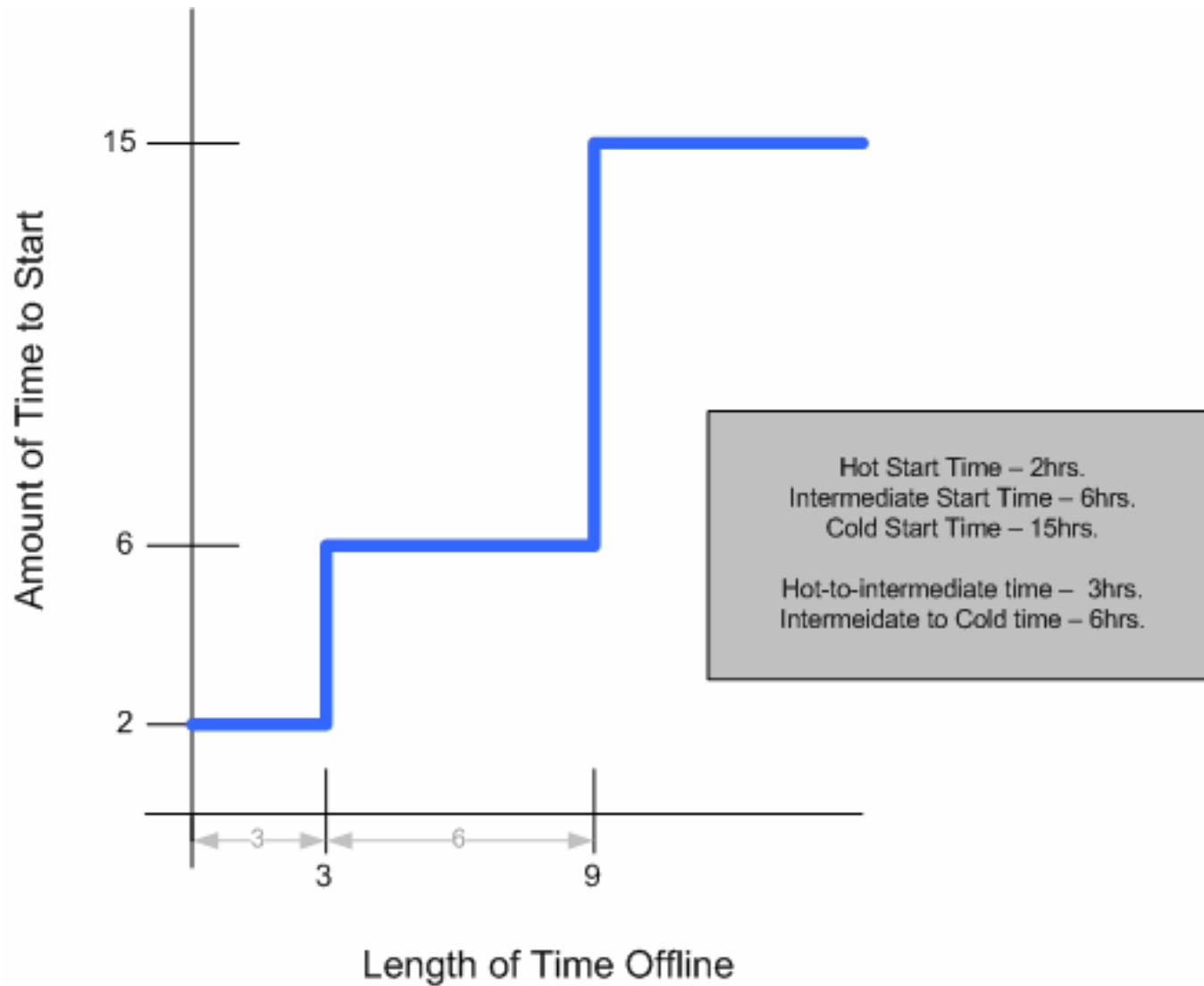 - Maximum amount of energy, in MWh, a Resource can produce in seven consecutive days

Field Description
Resource Parameters
Minimum On Line Time
Minimum Off Line Time
Hot Start Time
Intermediate Start Time
Cold Start Time
Max Weekly Starts
Max On Line Time
Max Daily Starts
Max Weekly Energy
Hot-to-Intermediate Time
Intermediate-to-Cold Time

Resource Registration

- **Hot-to-Intermediate Time (Hrs)**
    - Time, in hours, after shutdown that a hot temperature- state Resource takes to cool down to intermediate-temperature state

- **Intermediate-to-Cold Time (Hrs)**
    - Time, in hours, after shutdown that an intermediate temperature-state Resource takes to cool down to cold-temperature state

Field Description
Resource Parameters
Minimum On Line Time
Minimum Off Line Time
Hot Start Time
Intermediate Start Time
Cold Start Time
Max Weekly Starts
Max On Line Time
Max Daily Starts
Max Weekly Energy
Hot-to-Intermediate Time
Intermediate-to-Cold Time

Resource Registration

Hot Start Time – 2hrs.
Intermediate Start Time – 6hrs.
Cold Start Time – 15hrs.

Hot-to-intermediate time – 3hrs.
Intermeidate to Cold time – 6hrs.

Resource Parameters	Labels	Wind_U1
Minimum On Line Time	hours	0
Minimum Off Line Time	hours	0
Hot Start Time	hours	0
Intermediate Start Time	hours	0
Cold Start Time	hours	0
Max Weekly Starts		168
Max On Line Time	hours	168
Max Daily Starts		24
Max Weekly Energy	MWh	
Hot-to-Intermediate Time	hours	0
Intermediate-to-Cold Time	hours	0

Normal Ramp Rate Curve	Labels	Wind_U1
MW1	MW	LRL
Upward RampRate1	MW/min	LRRRL
Downward RampRate1	MW/min	LRRRL
MW2	MW	HRL
Upward RampRate2	MW/min	HRRRL
Downward RampRate2	MW/min	HRRRL

Resource Registration

OPERATIONAL RESOURCE PARAMETERS

- **Ramp Rate Curve data will be entered for both Normal and Emergency Operations**
  - Ramp rates are initially submitted in the RARF
  - QSEs will be able to update the ramp rates in Market Management System (MMS)

- **Ramp rates will be in the up and down directions**

- **Ramp rate curves are step functions**

- **Ten segments/steps to RR curve NEW!!****

Field Description
Normal Ramp Rate Curve
MW1
Upward RampRate1
Downward RampRate1
MW2
Upward RampRate2
Downward RampRate2
MW3
Upward RampRate3
Downward RampRate3
MW4
Upward RampRate4
Downward RampRate4
MW5
Upward RampRate5
Downward RampRate5

** This document still reflects 5 segments.

Resource Registration

ERCOT

- **All ramp rate values, including downward rates, should be entered in the RARF as positive values**

- **Ramp Rates and curves are critical and must be provided for every unit**

- **In the case of Combined-Cycle facilities, Ramp Rates curves are needed for every configuration**

- **The values in the RARF are used to build the Ramp Rate step curves**

Field Description
Normal Ramp Rate Curve
MW1
Upward RampRate1
Downward RampRate1
MW2
Upward RampRate2
Downward RampRate2
MW3
Upward RampRate3
Downward RampRate3
MW4
Upward RampRate4
Downward RampRate4
MW5
Upward RampRate5
Downward RampRate5

OPERATIONAL RESOURCE PARAMETERS

- **Ramp Rate Curves are not tools to restrain the operating range of the unit**

- **Ramp Rate Curves are extended down to zero and up to infinity.**
  - Realistically, the curves are limited to LRL and HRL.
  - Further operating restrictions are done as part of the COP and telemetry

- **Ramp Rates should not be entered as zero or negative numbers**

Field Description
Normal Ramp Rate Curve
MW1
Upward RampRate1
Downward RampRate1
MW2
Upward RampRate2
Downward RampRate2
MW3
Upward RampRate3
Downward RampRate3
MW4
Upward RampRate4
Downward RampRate4
MW5
Upward RampRate5
Downward RampRate5

Resource Registration

OPERATIONAL RESOURCE PARAMETERS

- **Decimal values are acceptable**
  - At this time, EDS testing is rounding these values. This issue is being resolved

- **If there is only one ramp rate, then only one MW value needs to be filled in**

- **If not all five MW values are used, use only MW1 through MWx as needed**
  - For example, if there are three rates, then use MW1, MW2, and MW3.

Field Description
Normal Ramp Rate Curve
MW1
Upward RampRate1
Downward RampRate1
MW2
Upward RampRate2
Downward RampRate2
MW3
Upward RampRate3
Downward RampRate3
MW4
Upward RampRate4
Downward RampRate4
MW5
Upward RampRate5
Downward RampRate5

Resource Registration

OPERATIONAL RESOURCE PARAMETERS

- The table below further defines the Ramp Rates. It also may help to sketch your curves to ensure the submitted data is accurate.

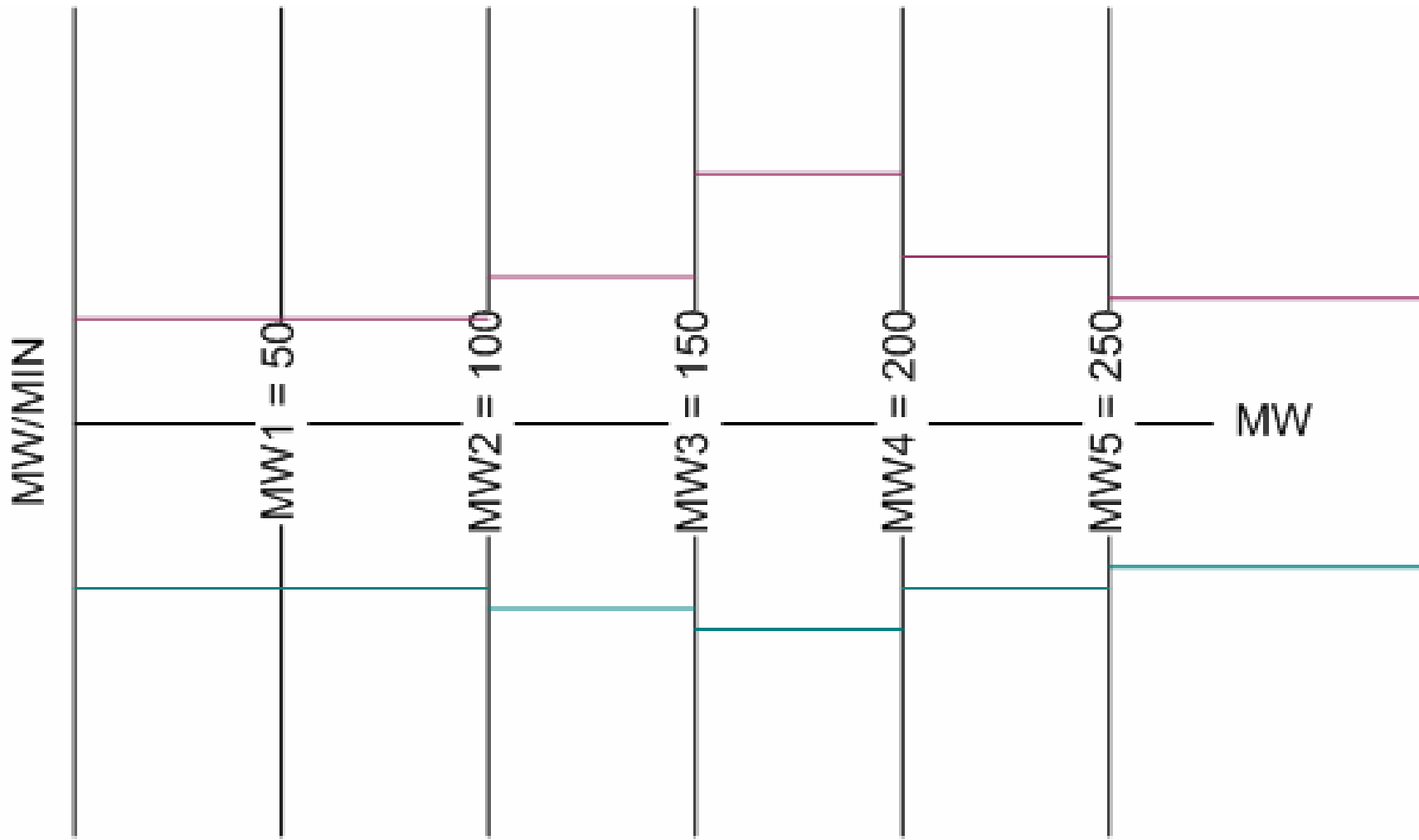| Ramp Rate Curve: The rate of change in MW per minute of a Resource, specified by the QSE to ERCOT by up to 10 segrments, each segment represents a single MW per minute value (across the capacity of the Resource) that describe the available rate of change in output for the given range (between HRL and LRL) of output of a Resource.	
Ramp Rate Curve	
MW1 (MW1/Low to MW5/High end of curve)	*Covers all MW values between LRL and MW2*
Upward RampRate1 (MW/minute)	The upward rate of change in MW/minute for any MW value between LRL to MW2
Downward RampRate1 (MW/minute) positive number	The downward rate of change in MW/minute for any MW value between LRL and MW2
MW2	*Covers all MW values between MW2 and MW3*
Upward RampRate2 (MW/minute)	The upward rate of change in MW/minute for any MW value between MW2 and MW3
Downward RampRate2 (MW/minute)	The downward rate of change in MW/minute for any MW value between MW2 and MW3
MW3	*Covers all MW values between MW3 and MW4*
Upward RampRate3 (MW/minute)	The upward rate of change in MW/minute for any MW value between MW3 and MW4
Downward RampRate3 (MW/minute)	The downward rate of change in MW/minute for any MW value between MW3 and MW4
MW4	*Covers all MW values between MW4 and MW5*
Upward RampRate4 (MW/minute)	The upward rate of change in MW/minute for any MW value between MW4 and MW5
Downward RampRate4 (MW/minute)	The downward rate of change in MW/minute for any MW value between MW4 and MW5
MW5	*Covers all MW values between MW5 and HRL*
Upward RampRate5 (MW/minute)	The upward rate of change in MW/minute for any MW value between MW5 and HRL
Downward RampRate5 (MW/minute)	The downward rate of change in MW/minute for any MW value between MW5 and HRL

Resource Registration
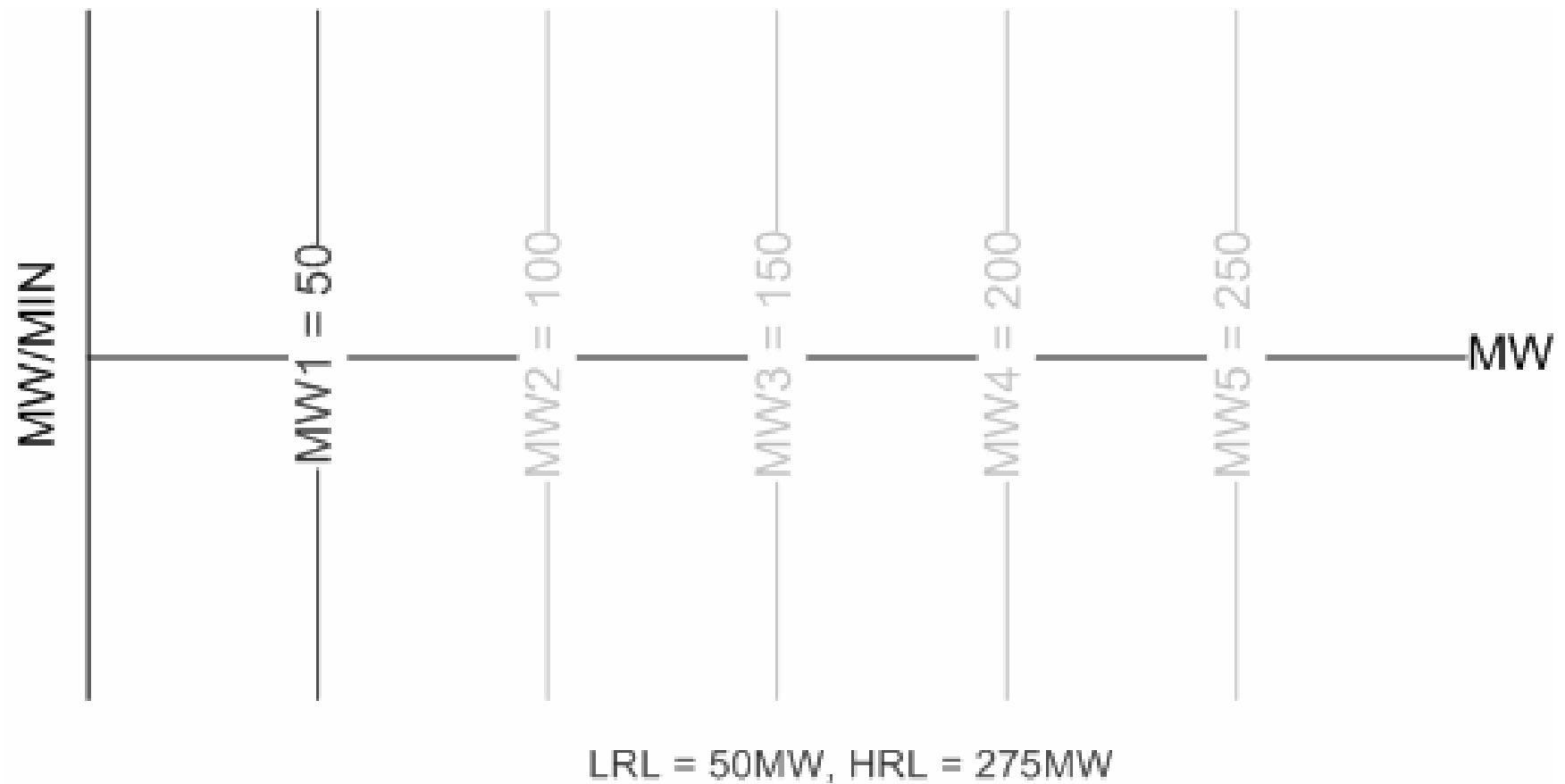
- **SAMPLE RAMP RATE TABLE AND RAMP RATE CURVE**
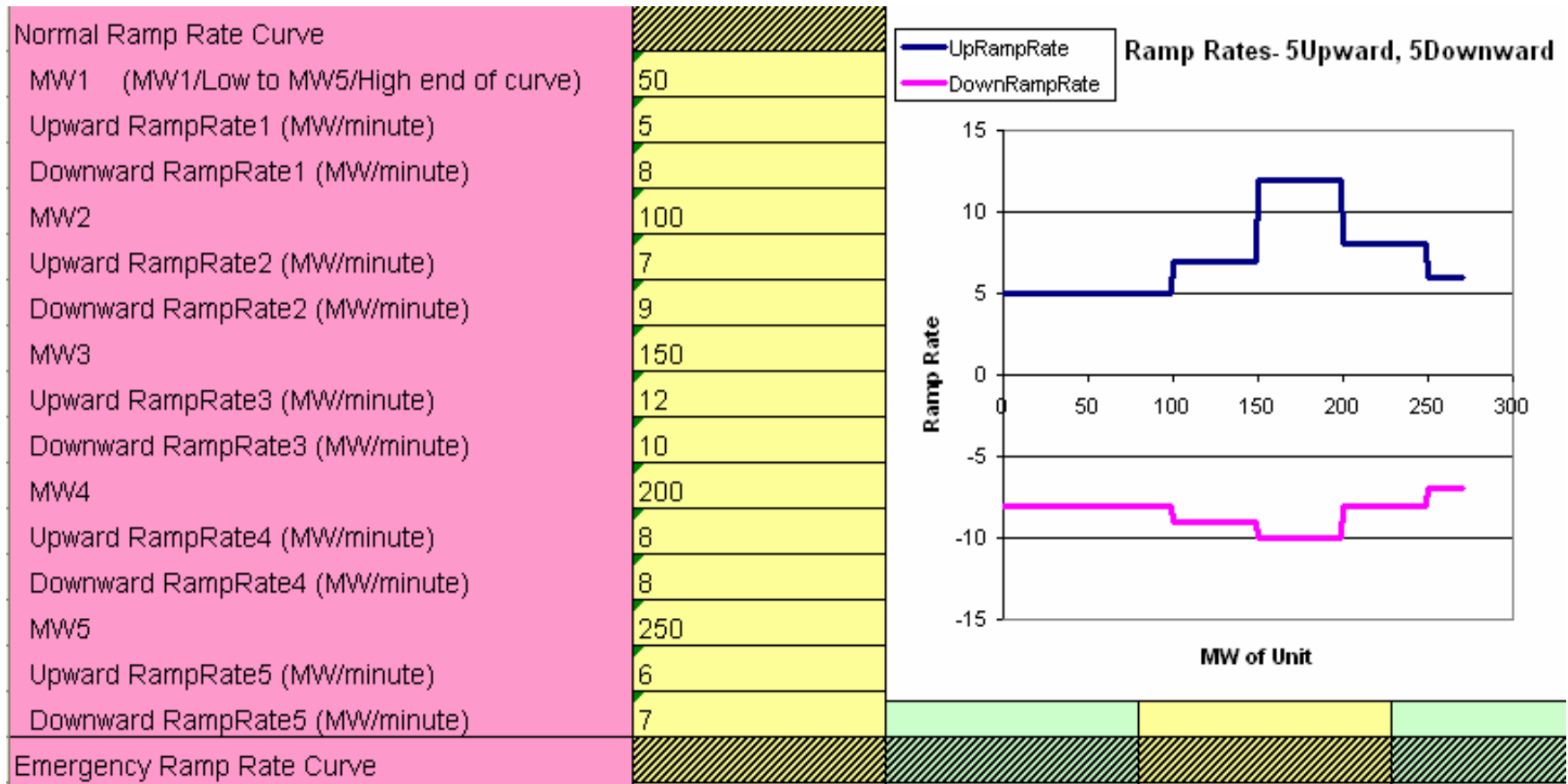
Normal Ramp Rate Curve	
MW1 (MW1/Low to MW5/High end of curve)	50
Upward RampRate1 (MW/minute)	5
Downward RampRate1 (MW/minute)	8
MW2	100
Upward RampRate2 (MW/minute)	7
Downward RampRate2 (MW/minute)	9
MW3	150
Upward RampRate3 (MW/minute)	12
Downward RampRate3 (MW/minute)	10
MW4	200
Upward RampRate4 (MW/minute)	8
Downward RampRate4 (MW/minute)	8
MW5	250
Upward RampRate5 (MW/minute)	6
Downward RampRate5 (MW/minute)	7
Emergency Ramp Rate Curve	

Ramp Rates- 5Upward, 5Downward

LRL = 50MW, HRL = 275MW

Resource Registration

LRL = 50MW, HRL = 275MW

Resource Registration

LRL = 50MW, HRL = 275MW

Resource Registration

LRL = 50MW, HRL = 275MW

Resource Registration

LRL = 50MW, HRL = 275MW

Resource Registration

LRL = 50MW, HRL = 275MW

Resource Registration

MW/MIN

MW1 = 50   MW2 = 100   MW3 = 150   MW4 = 200   MW5 = 250   MW

LRL = 50MW, HRL = 275MW

LRL = 50MW, HRL = 275MW

Resource Registration
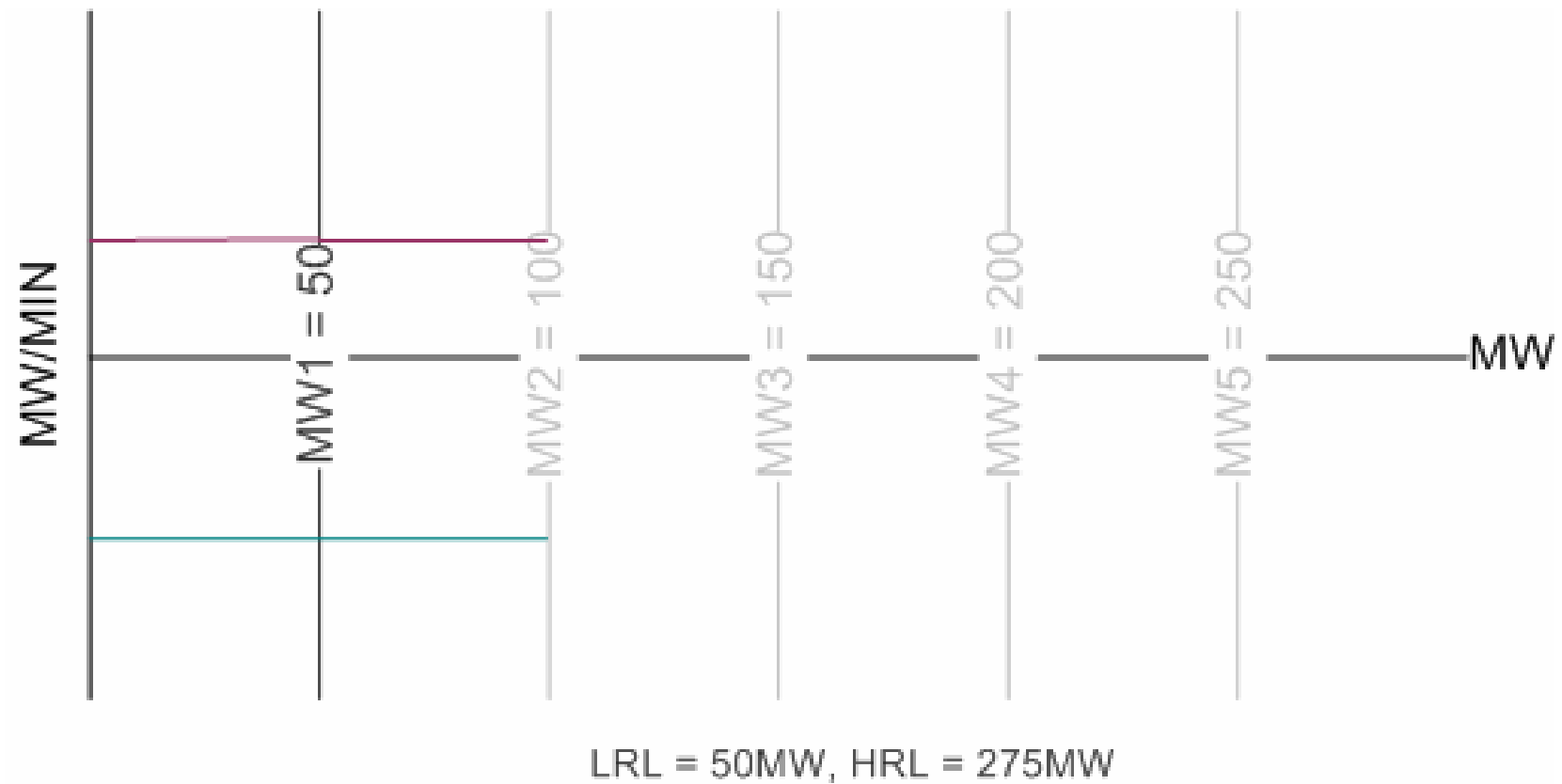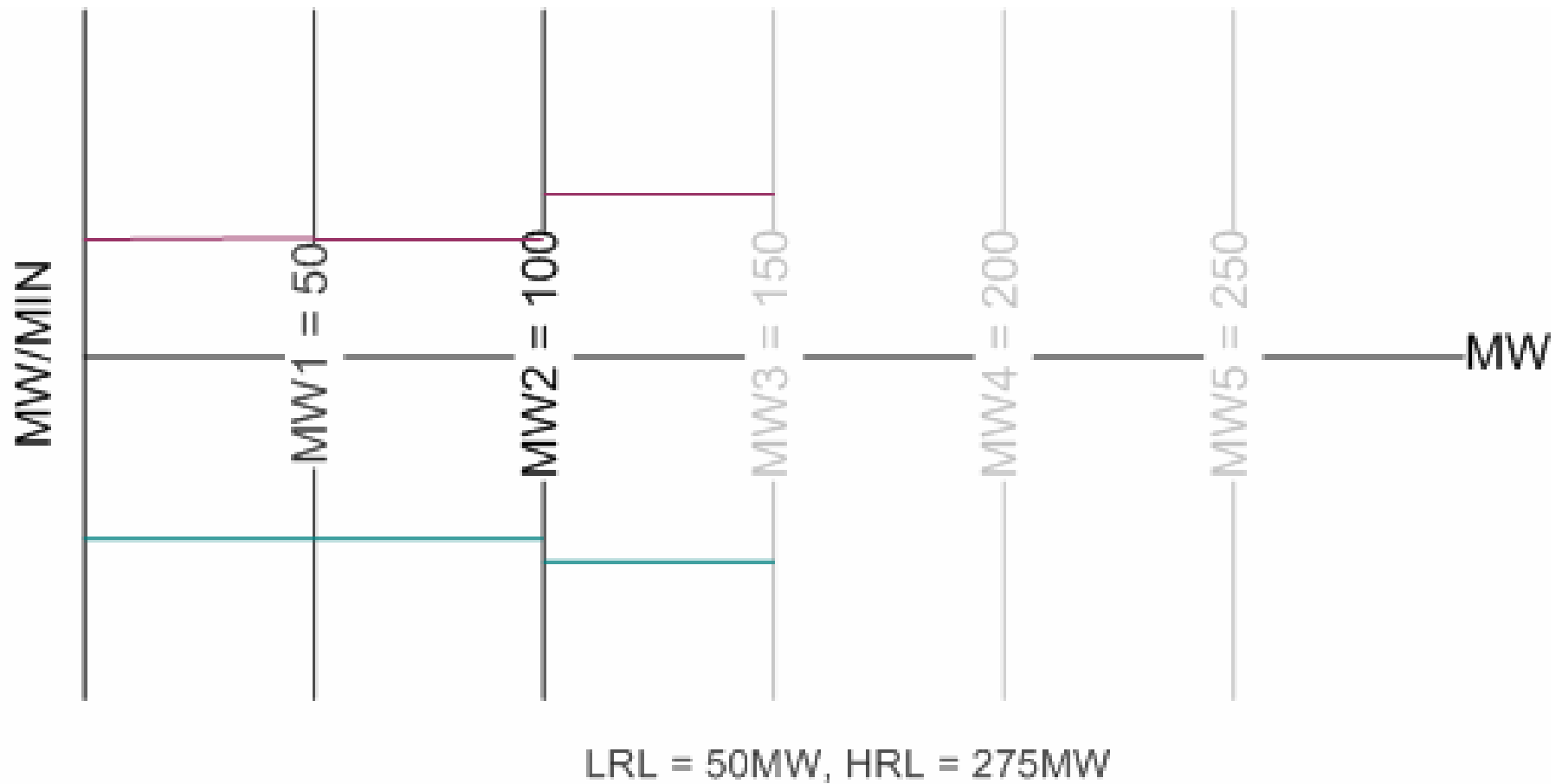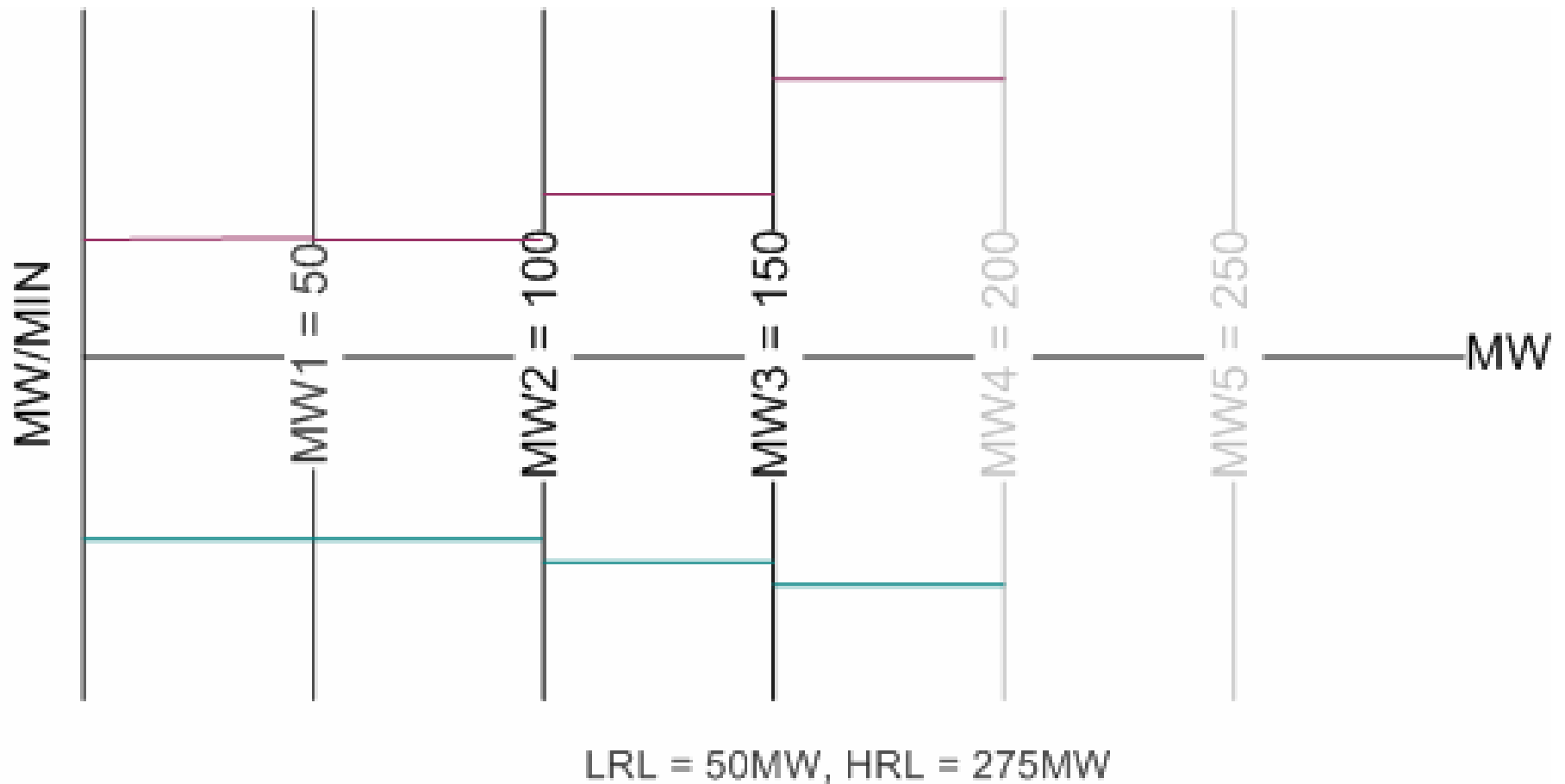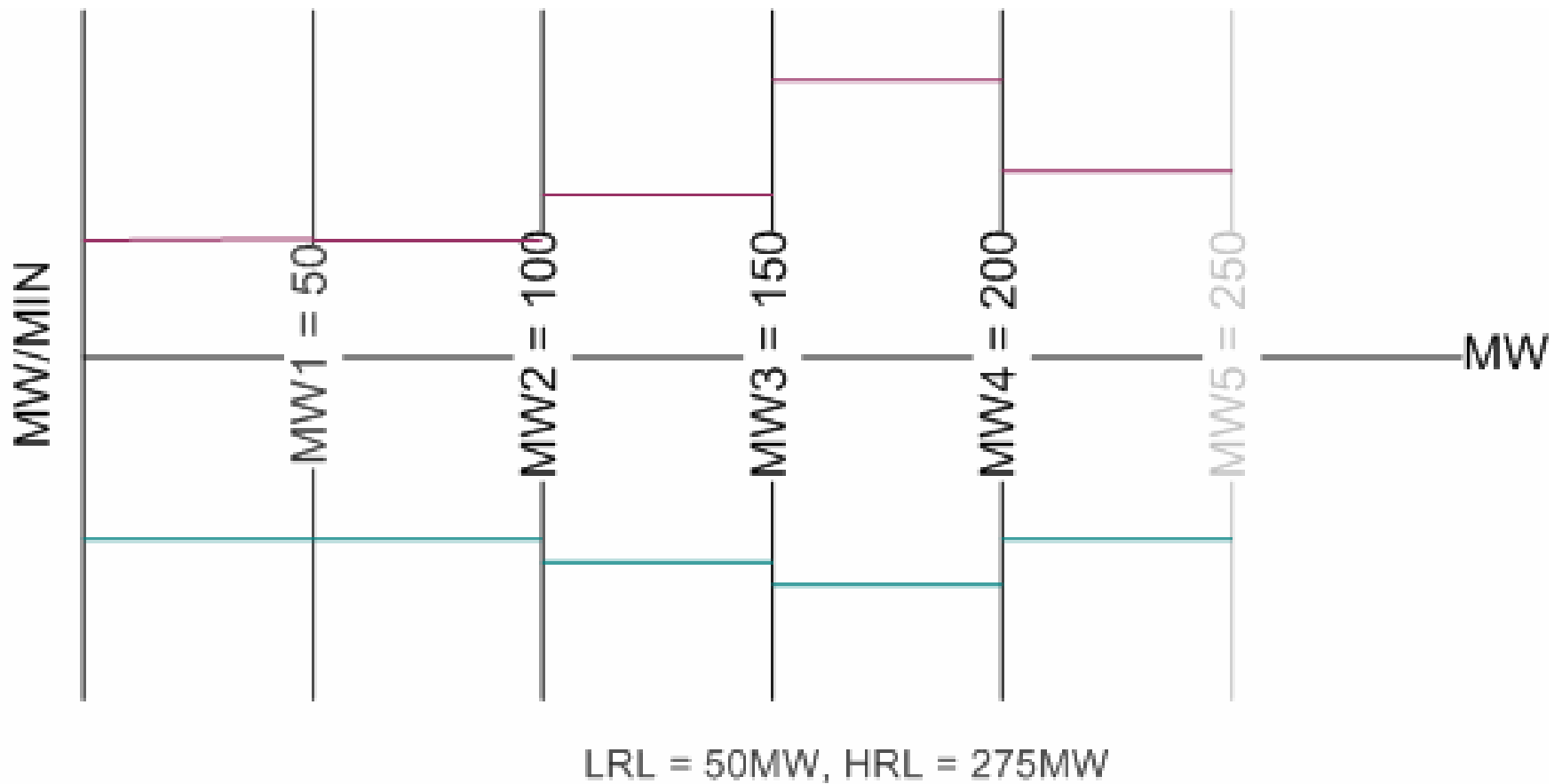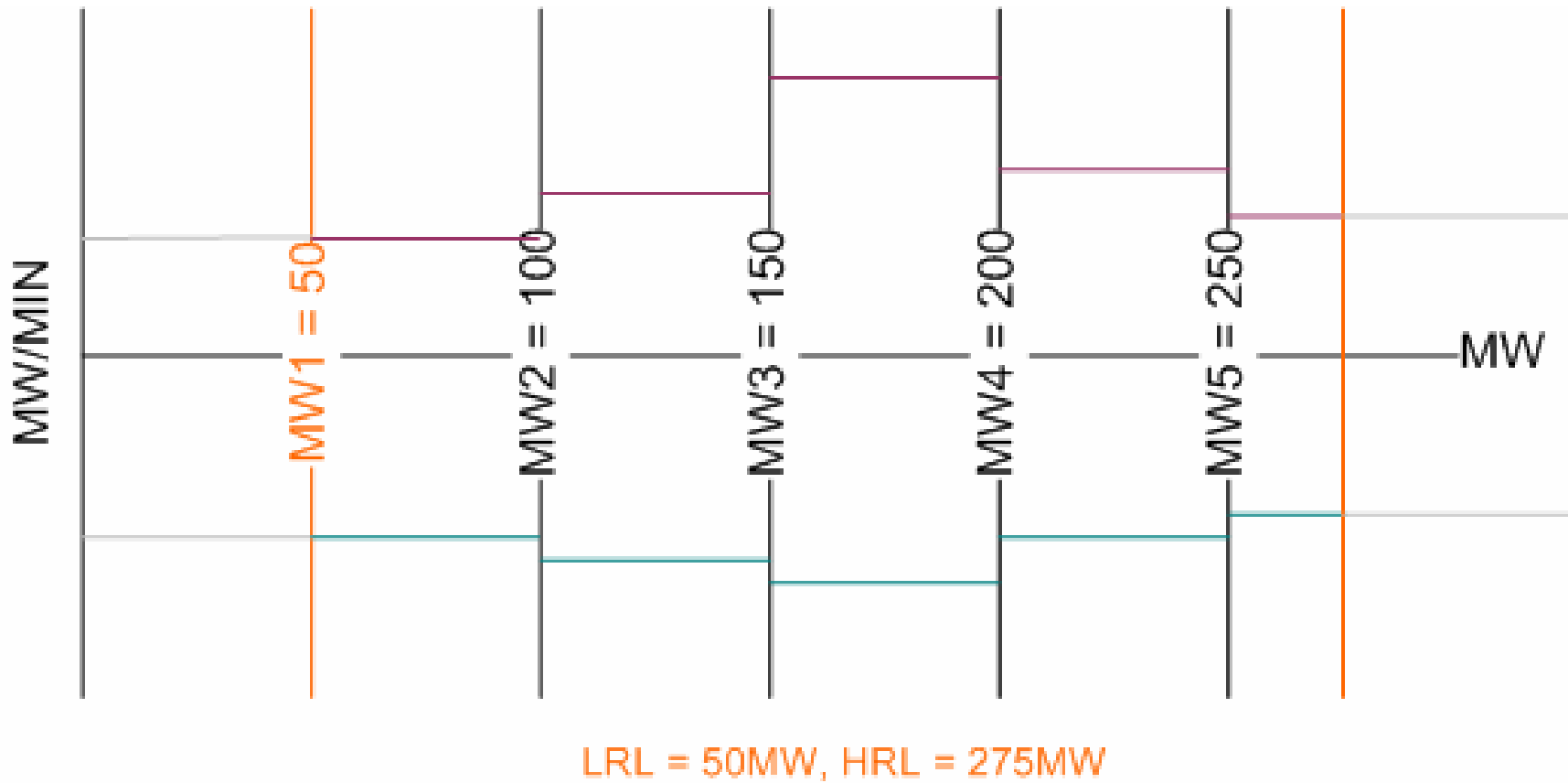
- **Can you input the min interruption and restoration times in minutes or hours? If hours, can you show a fraction of say .25 for 15 min?**
  - RUC Commitment is hourly, so the values should be in whole hours

- **For the Max Weekly Starts, can you show a fraction? i.e. if once every 2 weeks is desired, can you insert a 0.5?**
  - This value, along with the others in this section of the RARF, should only be in whole numbers over a seven day (1-week evaluation period). A fraction or a number representing any period other than the seven day window is not appropriate

- **For Ramp Rate Curves, the ramp rate varies in different operational scenarios, such as winter, summer etc. What does "Normal" mean?**
  - ERCOT desires the ramp rate curve from the Low Sustainable Limit (LSL) to the High Sustainable Limit (HSL) and can be entered in 5-pairs at different MW levels

  - If there are significant changes in operational conditions (derating, unplanned outages, seasonal configuration changes) the ramp rate curves can be updated with the QSE providing a reason code - but this should be only a few times per year

Resource Registration

- **Does ERCOT want per day or per year data for the "Minimum On/Off Line Time (hrs)" and "Max On Line Time (hrs)"?**

  – Minimum online and offline time is defined in the Protocols 3.7.1.1(1). This information should be in whole hours. Min Online time represents the minimum number of consecutive hours the Resource must be On-Line before being shut down. Min Offline time is the minimum number of consecutive hours the Resource must be Off-Line before being restarted

  – When filling out these values for base load units, please make appropriate assumptions. For example, when a unit comes online and needs to be taken offline, what is the minimum time online before it could be taken offline? And once it is offline, what is the minimum time it would have to remain offline before it could be brought back on?

  – For Load Resources, the information is required per Nodal Protocols and detailed in 3.7.1.2.

- **What data does ERCOT look for in "Max Weekly Energy"?**

  – Max Weekly Energy would be the maximum energy a unit can produce during a seven day window, in MWh and would be considered as a constraint by the RUC program in the selection of resources. If you are not aware of special production limits, you may not have any. An example of a limitation could be production limited in order to meet for environmental requirements

- **For 'Maximum Weekly Energy' on the RARF form, do you want this based on a seasonal rating? If so, which season?**

  – This should not be seasonal – but it is a field that the QSE can update in the MMS with supporting information

Network Model Data

- **Transformer information should be provided for transmission-level connections (i.e. over 60kV)**

- **kV Base**
  - Reference value for the Line-to-Line voltage of the transformer expressed in kV (kilovolts)

- **High Voltage Limit (no-load)**
  - Line-to-line voltage, in kV, on the high side (transmission side) of transformer when there is no load (i.e. breaker is open)

- **Low Voltage Limit (no-load)**
  - Line-to-line voltage, in kV, on the low side (generator side) of transformer when there is no load (i.e. breaker is open)

Step-Up Transformer Name (all data in 100MVA base) (if multiple transformers, attach supporting data)
Provide kV Base
High Voltage Limit (no-load)
Low Voltage Limit (no-load)
High Voltage Connection (Delta/Wye)
Low Voltage Connection (Delta/Wye)
Series Resistance
Series Reactance
Shunt Magnetizing Conductance
Shunt Magnetizing Susceptance
Normal Rating MVA
Emergency Rating MVA
Loadshed Rating MVA
Load Tap Changer (Y/N)

Resource Registration

- **High Voltage Connection (Delta/Wye)**

  – Transformer winding connection on the high side of the transformer. Check name plate or OEM manual

- **Low Voltage Connection (Delta/Wye)**

  – Transformer winding connection on the low side transformer. Check name plate or OEM manual

Step-Up Transformer Name (all data in 100MVA base) (if multiple transformers, attach supporting data)
Provide kV Base
High Voltage Limit (no-load)
Low Voltage Limit (no-load)
High Voltage Connection (Delta/Wye)
Low Voltage Connection (Delta/Wye)
Series Resistance
Series Reactance
Shunt Magnetizing Conductance
Shunt Magnetizing Susceptance
Normal Rating MVA
Emergency Rating MVA
Loadshed Rating MVA
Load Tap Changer (Y/N)

Resource Registration

- **Series Resistance (R1)**
  - Determined by "short-circuit test" where low-voltage side is short-circuited and enough voltage is applied on high-voltage terminals to circulate rated current. Check name plate or OEM manual
  - This is the winding resistance per phase (in ohms)

- **Series Reactance (X1)**
  - Determined by "short-circuit test" where low-voltage side is short-circuited and enough voltage is applied on high-voltage terminals to circulate rated current. Check name plate or OEM manual
  - This is the winding reactance per phase (in ohms)

- **Series Impedance, Z1 = R1 + jX1**

Step-Up Transformer Name (all data in 100MVA base) (if multiple transformers, attach supporting data)
Provide kV Base
High Voltage Limit (no-load)
Low Voltage Limit (no-load)
High Voltage Connection (Delta/Wye)
Low Voltage Connection (Delta/Wye)
Series Resistance
Series Reactance
Shunt Magnetizing Conductance
Shunt Magnetizing Susceptance
Normal Rating MVA
Emergency Rating MVA
Loadshed Rating MVA
Load Tap Changer (Y/N)

Resource Registration

- **Shunt Magnetizing Conductance (G_c) in ohms**

  - Calculated using "open-circuit test" where rated voltage is applied to low-voltage terminal, and power input and currents are measured

  - Part of the magnetizing admittance, $Y = G_c – jB_m$ per phase. Check name plate or OEM manual

- **Shunt Magnetizing Susceptance (B_m) in in ohms**

  - Calculated using "open-circuit test" where rated voltage is applied to low-voltage terminal, and power input and currents are measured.

  - Part of the magnetizing admittance, $Y = G_c – jB_m$ per phase. Check name plate or OEM manual

Step-Up Transformer Name (all data in 100MVA base) (if multiple transformers, attach supporting data)
Provide kV Base
High Voltage Limit (no-load)
Low Voltage Limit (no-load)
High Voltage Connection (Delta/Wye)
Low Voltage Connection (Delta/Wye)
Series Resistance
Series Reactance
Shunt Magnetizing Conductance
Shunt Magnetizing Susceptance
Normal Rating MVA
Emergency Rating MVA
Loadshed Rating MVA
Load Tap Changer (Y/N)

Resource Registration

- **Normal Rating MVA**
  - Represents the continuous MVA rating of Transmission Facility (including substation terminal equipment in series with a conductor or transformer) at the applicable ambient temperature
  - Transmission Facility can operate at this rating indefinitely without damage, or violation of National Electrical Safety Code (NESC) clearances

- **Example:**
  - Normal rating MVA of 345 kV line = **400 MVA** @ 80 ^{0}F ambient temp. (Continuous Rating)

Step-Up Transformer Name (all data in 100MVA base) (if multiple transformers, attach supporting data)
Provide kV Base
High Voltage Limit (no-load)
Low Voltage Limit (no-load)
High Voltage Connection (Delta/Wye)
Low Voltage Connection (Delta/Wye)
Series Resistance
Series Reactance
Shunt Magnetizing Conductance
Shunt Magnetizing Susceptance
Normal Rating MVA
Emergency Rating MVA
Loadshed Rating MVA
Load Tap Changer (Y/N)

Resource Registration

- **Emergency Rating MVA**
  - Represents the two (2) hour MVA rating of a Transmission Facility (including substation terminal equipment in series with a conductor or transformer) at the applicable ambient temperature
  - The Transmission Facility can operate at this rating for two (2) hours without violation of NESC clearances or equipment failure

- **Loadshed Rating MVA**
  - The Transmission Facility can operate at this rating for fifteen minutes without violation of NESC clearances or equipment failure

Step-Up Transformer Name (all data in 100MVA base) (if multiple transformers, attach supporting data)
Provide kV Base
High Voltage Limit (no-load)
Low Voltage Limit (no-load)
High Voltage Connection (Delta/Wye)
Low Voltage Connection (Delta/Wye)
Series Resistance
Series Reactance
Shunt Magnetizing Conductance
Shunt Magnetizing Susceptance
Normal Rating MVA
Emergency Rating MVA
Loadshed Rating MVA
Load Tap Changer (Y/N)

Resource Registration

Normal Rating MVA	Per ERCOT Operating Guides, Section 3: Normal Rating or Continuous Rating: Represents the continuous MVA rating of a Transmission Facility (including substation terminal equipment in series with a conductor or transformer) at the applicable ambient temperature. The Transmission Facility can operate at this rating indefinitely without damage, or violation of National Electrical Safety Code (NESC) clearances.
Emergency Rating MVA	Per ERCOT Operating Guides, Section 3: Emergency Rating: Represents the two (2) hour MVA rating of a Transmission Facility (including substation terminal equipment in series with a conductor or transformer) at the applicable ambient temperature. The Transmission Facility can operate at this rating for two (2) hours without violation of NESC clearances or equipment failure.
Loadshed Rating MVA	Per Operating Guides, Section 3:Loadshed Rating or Fifteen Minute Rating: Represents the fifteen (15) minute MVA rating of a Transmission Facility (including substation terminal equipment in series with a conductor or transformer) at the applicable ambient temperature and with a step increase from a prior loading of ninety percent (90%) of the Continuous Rating. The Transmission Facility can operate at this rating for fifteen (15) minutes, assuming its pre-contingency loading was ninety percent (90%) of the Continuous Rating limit at the applicable ambient temperature, without violation of NESC clearances or equipment failure. This rating takes advantage of the time delay associated with heating of a conductor or transformer following a sudden increase in current.

Resource Registration

Low Side Tap Setting	
Nominal Voltage (Kv)	
Total Number of Tap Positions	
Normal Tap Position	
Lowest Tap Position	
Highest Tap Position	
Nominal Tap Position (Neutral Step)	
Step Size in Percent	

High Side Tap Setting	
Nominal Voltage (Kv)	
Total Number of Tap Positions	
Normal Tap Position	
Lowest Tap Position	
Highest Tap Position	
Nominal Tap Position (Neutral Step)	
Step Size in Percent	

- **Complete only section that applies to transformer**
  - Low side is Generator side
  - High side is Transmission side

- **Nominal Voltage is the normal or design voltage in kV (e.g., 13.8 kV Line-to-Line)**

- **Enter tap positions and not voltage (or kV) values**
  - Typically 1 through 5, or -16 to 16, or 1 to 33

- **What do we do if we have more than one step-up transformer per unit?**

  – Attach additional transformer information with the RARF submittal.

  – The "New RARF" will revisit this, allowing transformers to be registered, and then assigned to appropriate units

- **What do we do if we have multiple units for one step-up transformer?**

  – Enter the transformer information once, and put a reference in the "transformer name" row for the other units.

  – This will also be resolved in the "New RARF"

- **Can you give some detail as to what you are looking for when you ask us to "Provide kV Base"?**

  – The KV Base is needed to identify the base voltage used in the per unit calculations associated with the transformer data

  – Electrical systems are often modeled on a per unit basis. In order to make per unit calculations useful to ERCOT, the base for MVA and KV must be disclosed

  – For the step-up transformer, ERCOT has requested that the MVA Base is 100MVA. Even if the MVA Base is given, the resource needs to provide the kV Base in the RARF

  – Use "Line-to-Line Voltage" kV Base for uniformity

- **In the Network Model Transformer Data section, what is needed in the Low Voltage Limit and High Voltage Limit fields?**
  - The High Voltage Limit and the Low Voltage Limits for the transformers should be the no-load ratings
  - On the EDS 4 RARF, these fields are labeled as:
    - High Voltage Limit (no-load tap)
    - Low Voltage Limit (no-load tap)
  - These should read:
    - High Voltage Limit (no-load)
    - Low Voltage Limit (no-load)
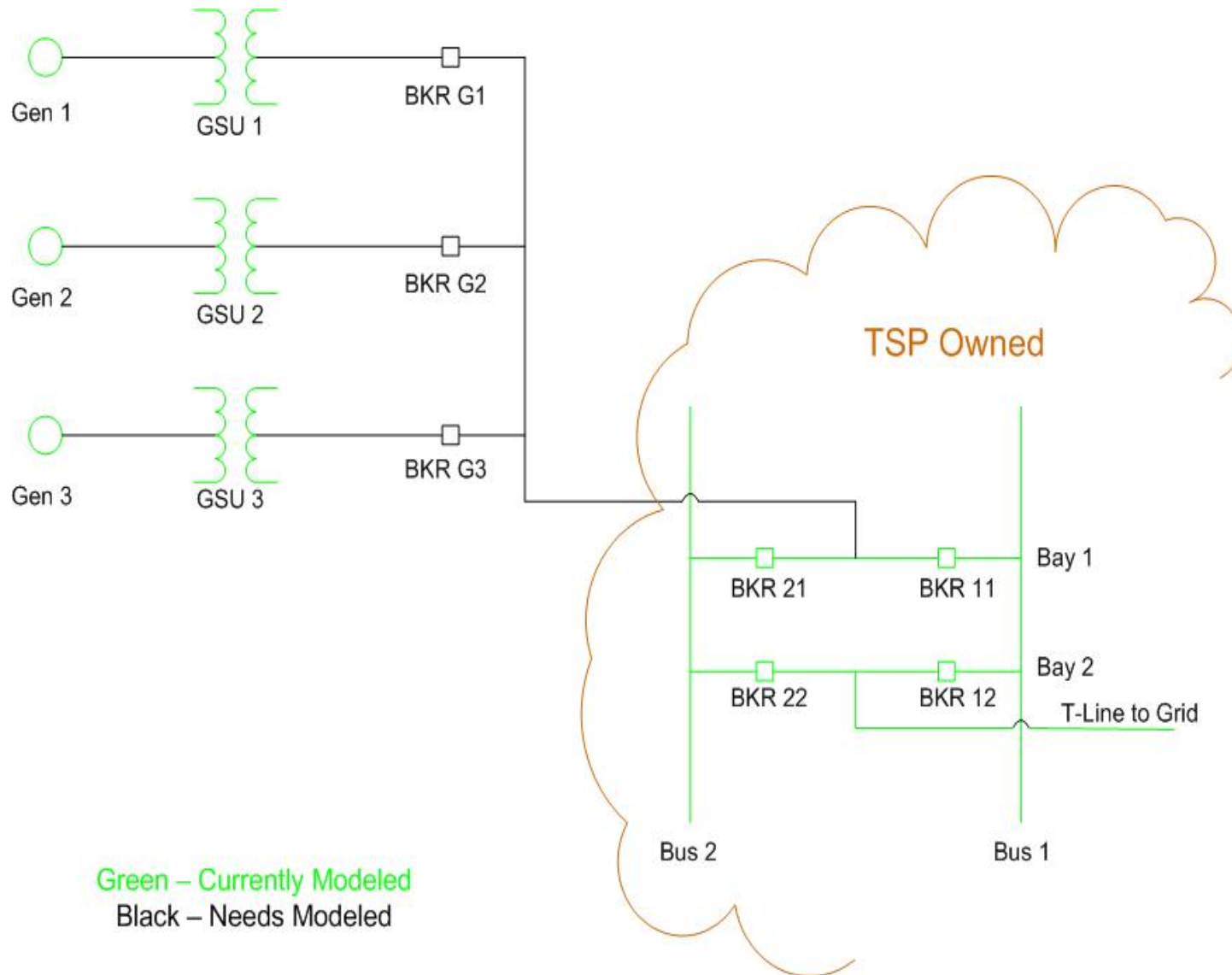 - For example, the per-unit nominal voltage is 1.0, the no-load limits could be 1.1

Resource Registration

- **Where can I find existing transformer information?**
  - Much of the step-up transformer information is available in the ERCOT Branch Data file, which is available from the secure Operations and System Planning Data website, in the Operations Model folder.

- **Where do I find the transformer name?**
  - The Transformer name is in the ERCOT Branch Data file. The information is requested in per-unit. In order to calculate per-unit data, the MVA and KV base must be known. The per-unit data should be calculated with a 100MVA Base, and the (Line-to-Line Voltage) KV Base needs to be submitted. Additional information on the Conductance, Susceptance and MVA ratings can be found in the Glossary (see the Appendix)

NETWORK MODEL DATA – ADDITIONAL ASSETS

- **Applies to ALL generation resources**

- **Used to complete model of transmission system**
  - Capture lines and equipment other than the generator and step-up transformer that are owned and/or operated by the generation resource and not part of the operations of the TSP.
  - This information is needed for the ERCOT system model, and is required per the Nodal Protocols in section 3.10.7.
  - Examples include the transmission line to reach the first TSP-modeled substation or a capacitor bank in service between the generator and the TSP switching device.

- **Another resource for existing PTI model information includes the ERCOT Branch Data zip file found in the Operations and System Planning (OSP) secure website**
  - To login or to register for access for the OSP website, please go to http://oldercot.ercot.com/tmaps/login.cfm
  - Once a user is logged in, select the folder "Operations Model Data" then select the zip file for ERCOT Branch Data.

Resource Registration

LINE (any length)		Notes	Line 1	Line 2
Status (ADD, DEL, CHANGE)		Select ADD, DEL, or CHG where ADD = Addition; DEL = Deletion; CHG = Change		
	If this is a change, is it for a change in Impedance and/or Ratings?	Only answer this question if CHG was selected above. Please select Impedance, Ratings, or Both.		
ERCOT LINE NAME		RE to work with TSP to define a name using the established naming convention. The Line Name is checked for uniqueness by ERCOT.		
Line Voltage Level kV		Enter line voltage value in KV.		
TSP Name		Identify TSP at point of interconnection to ERCOT grid.		
To TSP Owned Station	ERCOT Station Code Mnemonic (TSP owned)	Enter ERCOT Station Code at point of interconnection to ERCOT Grid. RE to verify with TSP		
	Switching Device Name(s)	Enter switching device names at point of interconnection. RE to verify with TSP.		
	Bus Number (PTI Bus Number)	Enter PTI Bus Number at point of interconnection. RE to verify with TSP.		
	Station Weather Zone	Enter Weather Zone for the station at the point of interconnection. RE to verify with TSP.		
From RE Station	ERCOT Station Code Mnemonic (RE owned)	Enter ERCOT Station Code at point of interconnection to ERCOT Grid. RE to verify with TSP		
	Switching Device Name(s)	Enter switching device names (identified below).		
	Bus Number (PTI Bus Number)	Enter PTI Bus Number (identified below).		
	Station Weather Zone	Enter Weather Zone for the station.		
Resistance in p.u.		Enter the resistance for this line in per-unit using a 100MVA base.		
Reactance in p.u.		Enter the reactance for this line in per-unit using a 100MVA base.		
Charging Susceptance in p.u.		Enter the charging susceptance for this line in per-unit using a 100MVA base.		
Continuous Rating (MVA)		Enter the continuous rating in MVA.		
2-hr Emergency Rating (MVA)		Enter the 2 hour emergency rating in MVA.		
15-min Rating (MVA)		Enter the 15 minute emergency rating in MVA.		
Has an ICCP Service Request been submitted?		Verify that an ICCP Service Request been submitted for all related ICCP points.		
Comments		Enter RE comments (if any).		

BREAKER or SWITCH	Notes	Device 1	Device 2
Status (ADD, DEL, CHANGE)	Select ADD, DEL, or CHG where ADD = Addition; DEL = Deletion; CHG = Change		
Switch Name	Enter switch name.		
Device Status	State whether this device is NO (normally open) or NC (normally closed)		
Voltage Level KV	Enter nameplate value in KV.		
PTI Bus Number	Enter PTI Bus Number. Assigned by TSP if not already assigned.		
Will this station will have or has a Voltage reading?	Identify if the voltage reading via SCADA/ICCP exists or will exist.		
If yes, what is the PTI Bus Number where the voltage is read.	If the answer above is Y, Identify the PTI Bus number where the voltage will be read.		
Has an ICCP Service Request been submitted?	Verify that an ICCP Service Request been submitted for all switching device points.		
Comments	Enter RE comments (if any).		
CAPACITOR or REACTOR	**Notes**	**Device 1**	**Device 2**
Status (ADD, DEL, CHANGE)	Select ADD, DEL, or CHG where ADD = Addition; DEL = Deletion; CHG = Change		
Capacitor or Reactor (C/R)	Select CAP or REACT where CAP = Capacitor and REACT = Reactor		
Device Name	Enter the device name. Work with TSP and ERCOT if questions exist on the naming convention.		
Nominal MVAR	Enter nameplate value in MVAR.		
Voltage Level KV	Enter nameplate value in KV.		
PTI Bus Number	Enter PTI bus number. If not already assigned, work with TSP to get number assigned.		
Switching device number(s) that this reactive device is directly connected to	Verify with TSP.		
Has an ICCP Service Request been submitted?	Verify that an ICCP Service Request been submitted for all related ICCP points.		
Comments	Enter RE comments (if any).		

Resource Registration

NETWORK MODEL DATA – ADDITIONAL ASSETS

- **ERCOT Branch Data can assist with filling this out**
  - Found in Operations Model Data folder on secure Operations and System Planning Website
  - http://oldercot.ercot.com/tmaps/login.cfm

- **TSP will be familiar with naming conventions and may be able to provide assistance**

- **Additional questions should be directed to NodalMarketTransition@ercot.com who will redirect to ERCOT Network Modeling**

- **The breaker ownership used to be the TSP and now is part of the generation company. Who should report this information?**
  - The entity that owns/represents the breaker should report it

  - If the TSP previously provided the information to ERCOT, it should be available in the ERCOT Branch Data file

  - The generation entity should validate/verify the information if the current model is the source

PLANNING DATA

- **These parameters are needed for Transient Analysis, Fault Analysis, etc.**

- **Identify the MVA Base where Z, X, & R values were based on**
  - Typically, this is 100 MVA (3-phase) but not always. Check nameplate or OEM manual

- **Identify the kV Base where Z, X, & R values were based on**
  - Typically, this is the Line-to-Line Terminal Voltage

- **All impedances, Z, are provided in per unit (p.u.) of the machine bases (MVA & kV) identified in this section**

What is the MVA base that the following data is based on?
What is the kV base that the following data is based on?
Machine Impedance
Positive Sequence Z
Negative Sequence Z
Zero Sequence Z
Armature Z
Rotor Z
Mutual coupling Armature-Rotor Z

- **Machine Impedance (Z)**
  - Check name plate or OEM manual (in p.u.)

- **Positive Sequence Z_1**
  - Check name plate or OEM manual (in p.u.)
  - $Z_1 = R_1 + jX_1$

- **Negative Sequence Z_2**
  - Check name plate or OEM manual (in p.u.)
  - $Z_2 = R_2 + jX_2$

- **Zero Sequence Z_0**
  - Check name plate or OEM manual (in p.u.)
  - $Z_0 = R_0 + jX_0$

What is the MVA base that the following data is based on?
What is the kV base that the following data is based on?
Machine Impedance
Positive Sequence Z
Negative Sequence Z
Zero Sequence Z
Armature Z
Rotor Z
Mutual coupling Armature-Rotor Z

- **Armature Z**
  - Check name plate or OEM manual (in p.u.)
  - Impedance of the Armature (Resistance and Reactance)

- **Rotor Z**
  - Check name plate or OEM manual (in p.u.)
  - Impedance of the Rotor (Resistance and Reactance)

- **Mutual coupling Armature-Rotor Z**
  - Check name plate or OEM manual (in p.u.)
  - Impedance derived from the mutual inductance between the Armature winding and Rotor's magnetic field. (Resistance and Reactance)

What is the MVA base that the following data is based on?
What is the kV base that the following data is based on?
Machine Impedance
Positive Sequence Z
Negative Sequence Z
Zero Sequence Z
Armature Z
Rotor Z
Mutual coupling Armature-Rotor Z

Resource Registration

Breaker Interruption (after the relay is closed, how many cycles does it take to clear the fault?)
Plant Voltage Protection
Instantaneous Undervoltage Trip (kV)
Time 1 (provide a time in seconds)
Undervoltage 1 (KV)
Time 2 (seconds)
Undervoltage 2 (KV)
Time 3 (seconds)
Undervoltage 3 (KV)
Instantaneous Overvoltage Trip (kV)
Time 1 (seconds)
Overvoltage 1 (KV)
Time 2 (seconds)
Overvoltage 2 (KV)
Time 3 (seconds)
Overvoltage 3 (KV)
Plant Frequency Protection
Instantaneous Underfrequency Trip (Hz)
Time 1 (provide a time in seconds)
Underfrequency 1 (Hz)
Time 2 (seconds)
Underfrequency 2 (Hz)
Time 3 (seconds)
Underfrequency 3 (Hz)
Instaneous Overfrequency Trip (Hz)
Time 1 (seconds)
Overfrequency 1 (Hz)
Time 2 (seconds)
Overfrequency 2 (Hz)
Time 3 (seconds)
Overfrequency 3 (Hz)

- **Identify time for breaker clear fault**

- **Identify generator protection**
  - Voltage
  - Frequency
  - Instantaneous and up to three settings
  - These information can be found in the relay setting data sheets

Field Description
Direct Axis Subtransient reactance, X"di
Direct Axis Transient reactance, X'di

- **Direct Axis Subtransient Reactance, X''_{di}**
  - Can be found on the WGR's name plate or OEM manual (in p.u.)
  - Reactance determined from the ratio of an initial reduced voltage open circuit condition and the currents from the three-phase fault at the machine terminals at the rated frequency.
  - Initial open circuit voltage is adjusted so the rated current is obtained. The impedance is determined from the currents during the first few cycles

- **Direct Axis Transient Reactance, X'_{di}**
  - Can be found on the WGR's name plate or OEM manual (in p.u.)
  - Reactance determined from the ratio of an initial reduced voltage open circuit condition and the currents from the three-phase fault at the machine terminals at the rated frequency
  - Initial open circuit voltage is adjusted so the rated current is obtained. The initial high decrement currents during the first few cycles are neglected

- **$X''_{di} < X'_{di} < X_{di}$**
  - Direct Axis Subtransient Reactance is less than the Transient Reactance

Resource Registration

PLANNING DATA

- **Forms available online**
- **Over/under excitation forms are new**
- **Used for dynamic models**

PSSE MODEL	
PSSE Compatible Wind Generator Models submitted to ERCOT?	Y/N
Do you have a Dynamic Reactive Device?	Y/N
If so, is corresponding Dynamic Reactive Device Form on file with ERCOT?	Y/N

Resource Registration

- **What is Armature Z? What is Rotor Z? What is Mutual coupling Armature-Rotor Z?**

  – The Armature impedance would also be the Stator impedance.

  – These three components (Armature, Rotor, and Mutual Coupling of Armature and Rotor) are used to calculate an equivalent impedance for the unit, Z_{eq}

  – This section came from the Generation Data Forms Detailed Gen Info-by unit tab for Transient Stability Analysis. ERCOT is looking for the machine impedances in R + jX form

- **Is Machine Impedance the same as Positive Sequence?**

  – Usually not. Machine Impedance (Z) row should be the Z_{eq} if available

- **Do we need to be including the alarms and operator's guides for manual trip times in this section or is it OK to omit any information based on the fact that these are not automatic trips?**
  - If there are no automatic trips, please enter N/A and use the comments section to the right to document

- **When filling out the RARF, if we have multiple voltage trip settings, one at a higher voltage as a back-up to another, which one do you want?**
  - The most current version of the RARF has space available to report multiple voltage and frequency trip settings

- **Breaker Interruption Time (RARF) – What breaker is being referred to?**
  - The breaker that protects the WGRs

PLANNING DATA – FAQ

- **Will ERCOT be updating their site with all the new manufactures model sheets? Where can we get copies of the latest model sheets?**
  - PTI Dynamic Models can be found in the Generation Project Interconnection Information folder on the Operations and System Planning secure website at:

    http://www.ercot.com/tmaps/ListMaps.cfm?GroupID=50

  - In addition, some models can be found on ERCOT.com at:

    http://www.ercot.com/gridinfo/generation/index.html

  - ERCOT's standard models are obtained from PSSE manuals
  - Non-standard models, typically new generator designs, will have to be generated and submitted by the resource

Private Network Information

- **Please note that we are asking for gross totals as well as net values for the specific rows. A simple check would be to follow the equation below:**

- **Net Interchange = Gross Capability – Self Serve Load**

Private Network (Y or N)	Enter as Y or N
Average Amount of Self-Serve private load (MW)	Site Total MW Load (also remains on RARF where load is allocated to each unit).
Average Amount of Self-Serve private reactive load (MVAR)	Site Total MVAR Load (also new field on Gen/CC tab to allocate to each unit).
Expected Typical Private Network Net Interchange (MW)	Enter as MW - typical net interchange for the site. Positive values indicate net generator on grid. Negative values indicate net load on grid.
Expected Typical Private Network Net Reactive Interchange (MVAR)	Enter as MVAR - typical net interchange for the site. Positive values indicate net generator on grid. Negative values indicate net load on grid.
Private Network Gross Unit Capability (MW)	Total generation capability of all the private network generators at the site in MW.
Private Network Gross Unit Reactive Capability (MVAR)	Total reactive capability of all the private network generators at the site in MVAR.
Load Characteristics:	
--Large Motor, percent of total MW load	Defined by electrical connection of 4160V and up. Enter as a percentage of total MW Load (Average Amount of Self-Serve private load MW)
-Small Motor, percent of total MW load	Defined as electrically connected at voltage less than 2400/4160V. Enter as a percentage of total MW Load (Average Amount of Self-Serve private load MW)
-Resistive (Heating) Load, percent of total MW load	Enter as a percentage of total MW Load (Average Amount of Self-Serve private load MW)
-Discharge Lighting, percent of total MW load	Enter as a percentage of total MW Load (Average Amount of Self-Serve private load MW)
-Other, percent of total MW load	Enter as a percentage of total MW Load (Average Amount of Self-Serve private load MW). The Large Motor, Small Motor, Resistive, Discharge Lighting, and Other should total 100% of the Total MW Load.
--Large Motor, percent of total MVAR load	Defined by electrical connection of 4160V and up. Enter as a percentage of total MVAR Load (Average Amount of Self-Serve private reactive load MVAR)
-Small Motor, percent of total MVAR load	Defined as electrically connected at voltage less than 2400/4160V. Enter as a percentage of total MVAR Load (Average Amount of Self-Serve private reactive load MVAR)
-Discharge Lighting, percent of total MVAR load	Enter as a percentage of total MVAR Load (Average Amount of Self-Serve private reactive load MVAR)
-Other, percent of total MVAR load	Enter as a percentage of total MVAR Load (Average Amount of Self-Serve private reactive load MVAR). The Large Motor, Small Motor, Discharge Lighting, and Other should total 100% of the Total MVAR Load.

- **Load Characteristics PN load**
  - Definition of large and small motor
    - By voltage
      - Connected 2400/4160V and above are large
      - Connected below 2400/4160V are small

- **Percentages of MW should add up to 100%**

- **Percentages of MVAR should add up to 100%**

- **Load characteristics of generator auxiliary load are not assumed to be the same as the load characteristics of the private networks.**

- **Give most information with a reasonable amount of effort**
  - Guesses and inaccuracies cause model to be inaccurate

- **Gross Gen, Load, Net Interchange**
  - MW and MVAR by *unit*
  - All units should sum to total for site
- **Load trip**
  - Identify if load trips when unit trips
  - Identify percentage of load (as allocated to that unit) that will trip

Average Amount of Self-Serve private load (MW)
Average Amount of Self-Serve private reactive load (MVAR)
Expected Typical Private Network Net Interchange (MW)
Expected Typical Private Network Net Reactive Interchange (MVAR)
Private Network Gross Unit Capability (MW)
Private Network Gross Unit Reactive Capability (MVAR)
If Generation trips, does Load trip?
If yes, approximate percentage of Load that will trip?

PRIVATE-USE NETWORK – FAQ

- **Our units are dual-grid (i.e. outside of ERCOT). Are we a private network?**
  - No, this is not considered a private network. ERCOT will be requesting the information for the tie line into the ERCOT Grid, as well as other components that are not currently modeled in ERCOT, in order to ensure the model is accurate

- **Does "Private Network" exclude auxiliary/house power in generating stations?**
  - Yes. Please include all auxiliary/house power in generating stations separately in the Additional Planning Data section under "Generation Auxiliary Load".

- **For private network, what are the High/Low Reasonability Limits?**
  - The Highest and Lowest amount of power that could be injected into the ERCOT grid from that unit, depending on unit capabilities and swing of the industrial load behind the fence.

Resource Registration