

Generation Initial Training Program

Real-Time Operational Considerations

PJM State & Member Training Dept.

Students will be able to:

- Identify the various conditions and considerations for operating during real-time
- Describe the process for maintaining voltage schedules and guidelines at PJM
- Identify the reporting guidelines and process for Instantaneous Reserve Check (IRC)

Notifications to PJM during Real-Time Operations

Unit Output Changes

- Generation owners planning to start generation resources are required to call the PJM Control Center at least 20 minutes prior to bringing the unit online.
- Generation owners must also notify PJM when:
 - Taking a unit offline
 - Any change in MW output (assuming the unit is not following SCED)

Unit Hourly Changes

- If a status changes during real-time (for example, the unit limits change), the Operating Company uses the Unit Hourly Updates web page to provide the updated status

Problems with the Unit

- Governor Control
- Blocked Governor
- AVR/PSS Out of Service
- Unable to Maintain Reactive Output

Deviations from Day-Ahead Market for Scheduled Resources

- If a generation resource has been scheduled in the Day-ahead Market and wishes to deviate from that schedule (i.e. not run), the generation owner should contact the PJM Master Coordinator to determine the ramifications of this course of action
- The guideline for notifying PJM of deviations for pool scheduled resources will be the greater of the notification time plus time to start or 45 minutes
- **The generation owner will always be responsible for all imbalance and operating reserve charges**

Deviations from Day-Ahead Market for Scheduled Resources

- If the PJM determines that the generation resource is not needed for reliability purposes for the operating day, the generation owner can decide to not run the resource and no forced outage will be incurred.
- If the PJM determines that the resource is needed for reliability purposes, PJM will inform the generation owner. The generation owner may still elect to not run the resource, but a forced outage for the duration of the scheduled operation of the resource will be generated.

Governor Control

- Mechanism that senses machine speed and adjusts the input to the prime mover to change the mechanical power output of the machine to compensate for changes in load restoring frequency to nominal value
 - **Fossil Unit:** Controls the input of steam to the high pressure stage of the turbine
 - **Hydroelectric Unit:** Controls the flow of water into the hydraulic turbine
 - **Combustion Turbine Unit:** Controls the amount of fuel flow into the combustor
 - **Wind Turbine:** Controls the pitch of the blades

Blocked Governor

- Blocking the governor bypasses the governing feedback mechanisms maintaining the generator at a fixed output level
- Fewer units able to respond via Governor Control can lead to:
 - Longer period of time needed to restore system frequency to normal
 - System stability is impacted due to higher deviations in frequency

Governor Status Changes

- Blocking a governor:
 - Notify PJM’s Generation Dispatcher verbally of the outage
 - Create and submit an eDART ticket to notify PJM of an outage to the governor on the unit
 - Initiate the associated eDART governor ticket by submitting a “Start” time for the equipment outage
 - Update the unit status in Markets Gateway
- Placing a governor in service:
 - Notify PJM’s Generation Dispatcher verbally of the governor being placed into service
 - Close out the associated eDART governor ticket by submitting an “End” time for the equipment outage
 - Update the unit status in Markets Gateway

Generator AVR/PSS Status Reporting

- Per NERC Standard VAR-002-4.1 (excerpts)
 - Each Generator Operator shall notify its associated Transmission Operator within 30 minutes of:
 - R3. Any status change on a generator's AVR, power system stabilizer, or alternative voltage controlling device
 - R4. Becoming aware of a change in reactive capability due to factors other than a status change described in Requirement R3
- Reporting of AVR status and Reactive Capability changes accomplished via eDART generator reporting

Generator AVR/PSS Status Reporting

- PJM Manual 14-D;
 - Whenever a PJM unit's Automatic Voltage Regulation (AVR) status is off (or is planned to be off), the generator's owner/operator must enter a ticket via eDART
 - Excluding the time period when a generator is in the startup or shutdown mode
 - For real-time changes, the generator's owner/operator must also notify the PJM Master Dispatcher (PD) and the respective TO by phone

Generator AVR/PSS Status Reporting

- PJM Manual 14-D:
 - Generation Owners/Operators must coordinate any voltage schedule issues with PJM and the TO
 - Includes issues with stability, automatic voltage regulator, and power system stabilizer outages
 - If automatic voltage regulating devices are out-of-service, the Generator shall provide manual voltage regulation to maintain the prescribed voltage schedule

Generator AVR/PSS Status Reporting

- PJM Manual 14-D:
 - The Generator must notify PJM and the TO with as much lead-time as possible prior to performing all automatic voltage regulator (AVR) and power system stabilizer (PSS) maintenance
 - Notifications of unplanned outages on AVRs and/or PSSs must be communicated to PJM and the TO as soon as possible but no later than within 30 minutes of the occurrence
 - For modeling accuracy the provision of telemetered AVR and PSS status points by Generator Operators to PJM is preferred

What Reactive Reserve Information is Reported?

- Upon the request of PJM, all TOs will provide a Reactive Reserve Check (RRC) report to PJM
 - PJM generally requests a RRC during capacity deficient conditions or when a Heavy Load Voltage Schedule Warning is implemented
 - RRCs are also done periodically for testing/training purposes
- TOs must report MVAR reserve for all units connected to their system
 - MVAR Reserve is the difference between the present operating points, leading or lagging, and the actual lagging MVAR capability

What Reactive Reserve Information is Reported?

- MOCs/GOs must report to the TO any limitation or restriction on their unit which would prevent it from being able to follow its reactive capability curve as recorded in eDART
 - Unless an eDART ticket already exists documenting the condition
- This ensures the TO is submitting accurate information for the RRC

Voltage Limits

- Definition
 - A high and/or low limit placed on voltage to avoid damage to equipment and maintain power system voltage levels at a reliable level
- Affected equipment
 - Motors
 - Transformers
 - Generators
 - Loads
 - Capacitors

Voltage Limits

- Determination of Voltage Limits
 - Maintain system reliability
 - High voltage limits are equipment related
 - Low voltage limit are system related
 - Established by equipment manufacturers
 - ANSI Standards provide basis for voltage schedules
 - 97.5% - 105.0% Normal
 - 95.0% - 105.8% Emergency
 - These limits are for customer voltage

Causes of Low Voltage

- Due to excessive VAR loading
 - Usually seen as voltage drop in an area rather than a single bus
- Due to voltage regulation malfunction
 - Generator voltage regulator may fail
 - Transformer tap changer hang-up
 - Usually seen as voltage decrease at a single bus
 - May result in an imbalance in MVAR flows or circulating MVAR
- Due to Geo-Magnetic Disturbance
 - Increased VAR requirement in system
 - Var absorption by EHV transformers

Causes of High Voltage

- Due to light load
 - Caused by excess line capacitance
 - Voltage rise in area rather than a single bus
- Due to switching in a line with high capacitive charging current
 - Reactive supplied by charging of line
- Also caused by:
 - Voltage regulation malfunction
 - Excess VAR sources on system

Detection of Voltage Problems

- Observe Critical Bus Voltages
 - Where do problems appear first?
- Observe Voltages in an Area
 - Determine if deviation is on a single bus or over an area on the system
- Observe Voltage Alarms
- Monitoring Sources
 - EMS, map board, trends, field reports, customer complaints
 - Monitor voltages, limits, alarms, and MVAR flow



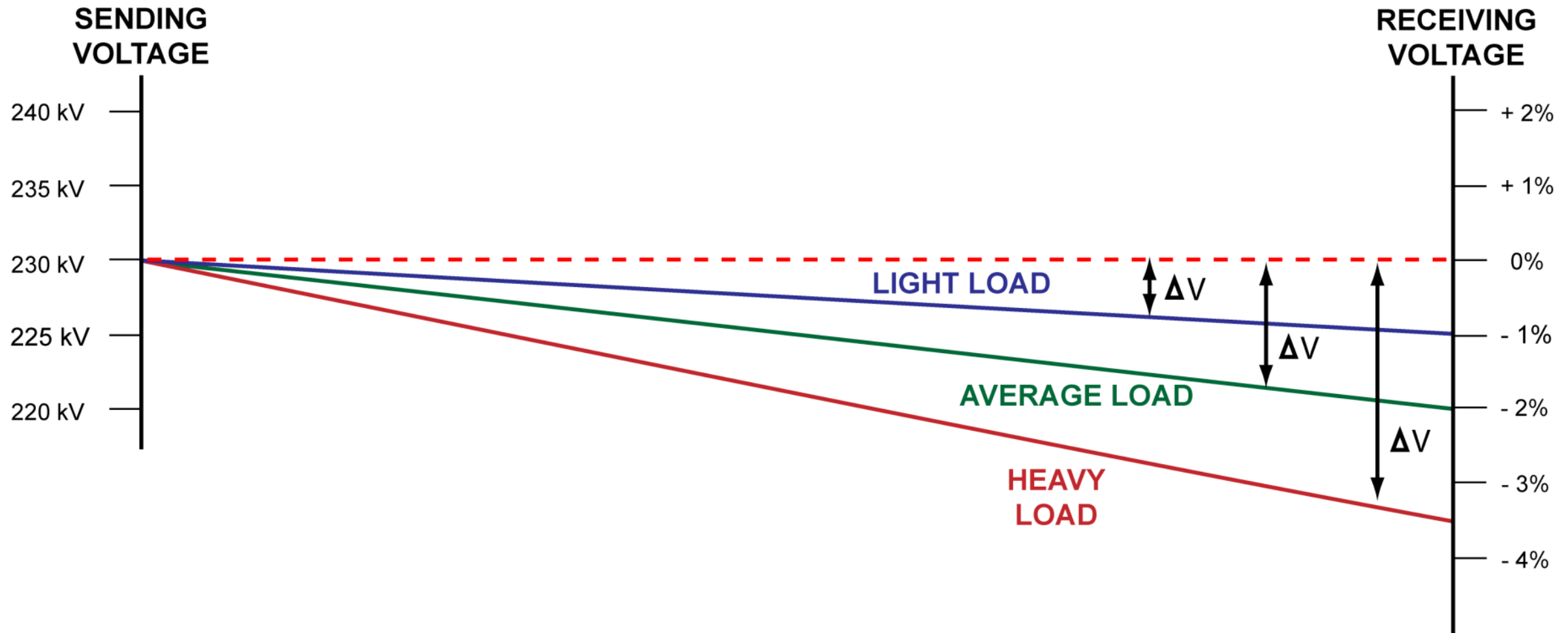
VAR Sources and Sinks

- Voltage Control Means MVAR Control
 - Control of voltage and reactive power are inseparable!
 - MVAR sources support or hold up voltages
 - Capacitors
 - Generators / Synchronous Condensers
 - Static VAR Compensators
 - System Capacitance
 - MVAR sinks pull down voltages
 - Reactors
 - Generators / Synchronous Condensers
 - Loads
 - System Inductance/Mvar Losses
 - Static VAR Compensators



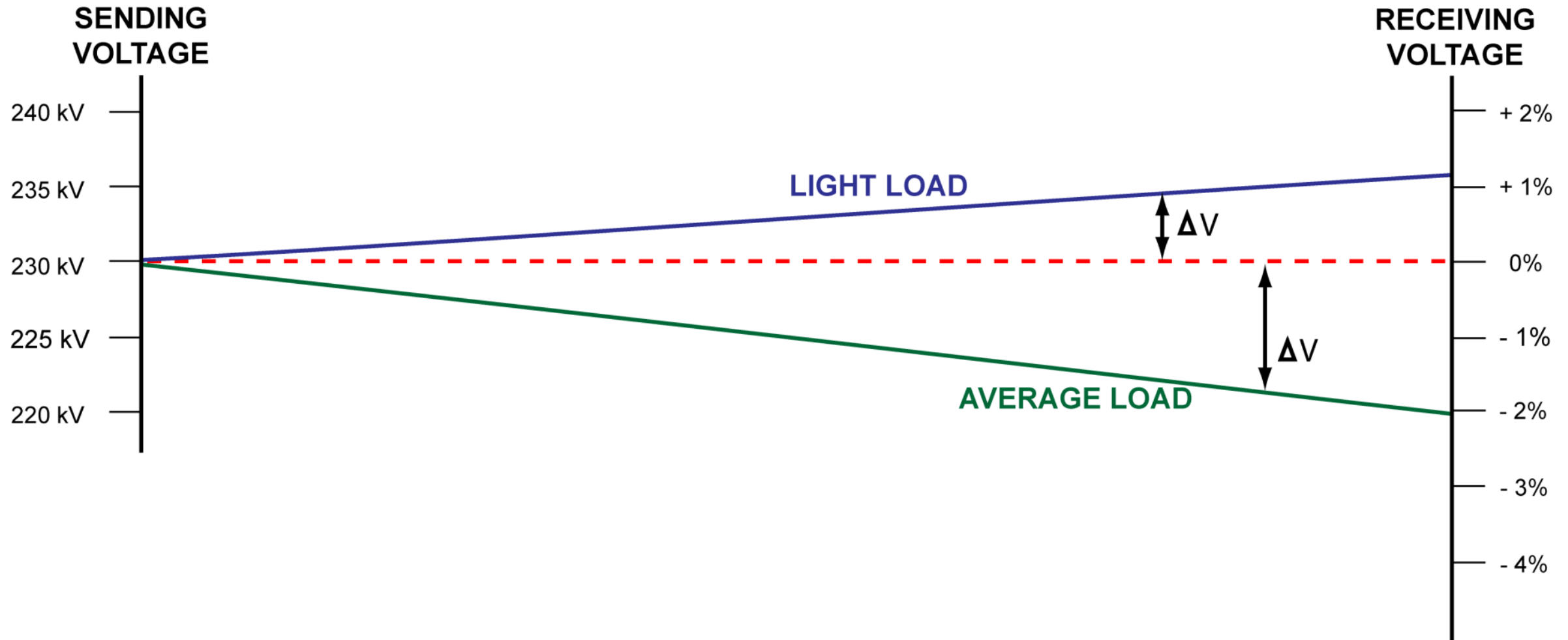
System Voltage Characteristics

- Results - a constantly changing voltage profile



System Voltage Characteristics

- Results - for light loads, voltage can rise due to low losses and line capacitance



Voltage Limits

- Consequences of deviations from voltage limits
 - Low voltage
 - Dim lights
 - Slow heating of heating devices
 - Difficulty starting motors
 - Overheating/damage to motors
 - High voltage
 - Light bulb life decreased
 - Electronic devices life decreased



Voltage Schedules

Voltage Schedules

- NERC Standard VAR-001-5:
 - Each TOP shall:
 - Specify a voltage or reactive power schedule (setpoint and bandwidth)
 - Provide the schedule to the GOP, and direct the GOP to follow the schedule with its AVR in service (automatic)
 - Provide the GOP with the notification requirements for deviations from the schedule
 - Provide the criteria used to develop the schedules
- The TO/TOP Matrix identifies shared or assigned responsibilities

Voltage Schedules

- **PJM:**

- Requires the following subset of generators to follow voltage schedules:
 - Individual generating units > than 20 MVA
 - Generators that aggregate to 75MVA or greater that are connected to a common bus
 - Black start generators
 - Any other Generation Owners/Operators that request a voltage schedule

Voltage Schedules

- **Through the eDART Application:**

- Member TOs submit a specific voltage schedule or a PJM default schedule
- PJM will review voltage schedule, and approve exemption requests
- Member GOs approve voltage schedule

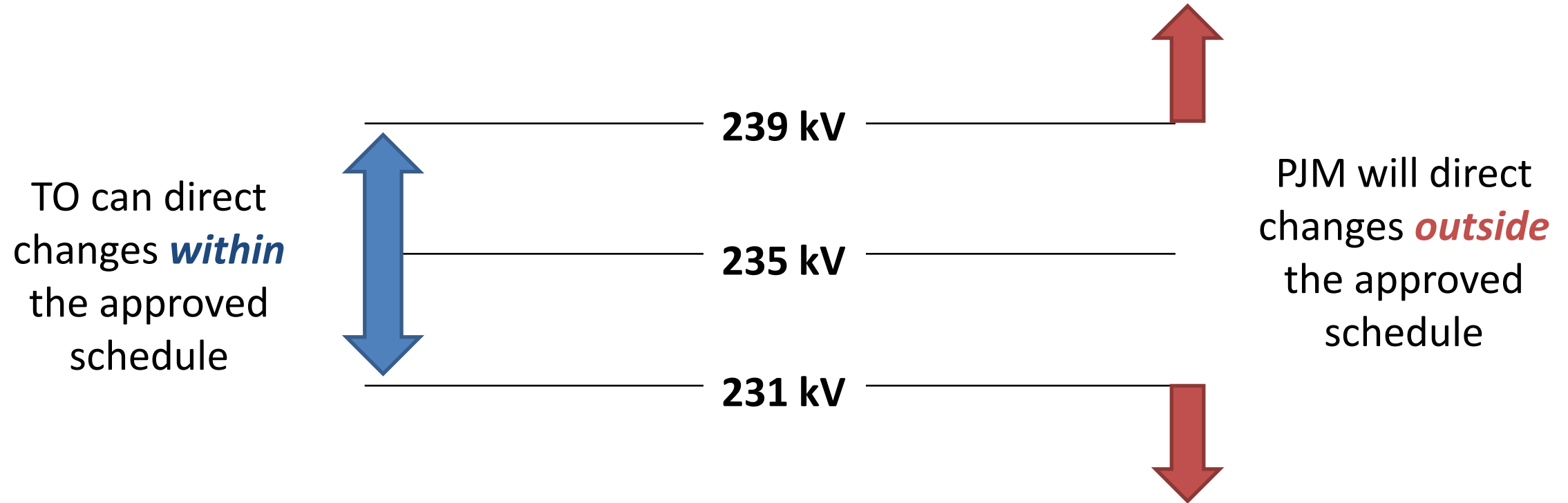
PJM Default Generator Voltage Schedules									
Voltage Level (kV)	765	500	345	230	161	138	115	69	66
Schedule (kV)	760.0	525.0	350.0	235.0	164.0	139.5	117.0	70.0	67.0
Bandwidth (+/- kV)	+/- 10.0	+/- 8.0	+/- 7.0	+/- 4.0	+/- 4.0	+/- 3.5	+/- 3.0	+/- 2.0	+/- 1.5

Voltage Schedules

- **PJM will direct:**
 - Deviations from default voltage schedules based system conditions
 - Generators to adjust voltage schedules if such a direction adversely impacts the units MW output
 - Generator to come online or remain online in the condensing or generating mode to provide voltage support
- **TO (via TO/TOP Matrix) can:**
 - Request generators to adjust MVAR output within the prescribed voltage schedule

Voltage/Schedule Adjustments

230 kV Schedule: 235 kV +/- 4 kV



Voltage Schedules

- Generation Owner/Operator shall:
 - Follow the voltage schedule with the AVR in service
 - If AVR is out of service, must notify PJM and TO
 - Communicate voltage schedule concerns to PJM via the TO for resolution
 - Additional reserves based on D-Curve:
 - Generator is required to notify PJM and the TO that they cannot maintain their assigned voltage schedule and provide updated D-Curve via eDART
 - Operating at full lead/lag MVAR based on submitted D-Curve:
 - Generator is required to notify PJM and the TO that they cannot maintain their assigned voltage schedule
 - PJM will determine if MW reduction is required in order for unit to adjust MVAR output to maintain voltage schedule

Overview

- Generator Voltage Schedules through PJM's eDART application ensures consistent tracking and reporting protocols for communication between PJM, TOs and GOs concerning generator voltage schedules
- Annually, PJM shall initiate a voltage schedule review
 - TOs shall review and update each schedule with the GOs acknowledgement
- Allows TOs to specify, and PJM to approve, Voltage Schedules for all generating units to include:
 - Submitting a new ticket, Editing an existing ticket, handling of exemptions, reporting, processing and seasonal verification

Overview

- Generators that require a Voltage Schedule:
 - Individual generating units > 20 MVA
 - Generators aggregating to 75 MVA or > connected to a common bus
 - Black start generators
 - Any other GOs that request a voltage schedule
- Generators added to eDART that meet the above criteria will have a blank “Needs Schedule” ticket automatically entered requiring a new Voltage Schedule ticket to be submitted by the TO

Overview

- Each Voltage Schedule ticket shall contain:
 - A target voltage schedule
 - Upper and lower bandwidths
 - The regulated transmission bus
- Each schedule can either be PJM’s default voltage schedule, or a schedule as designated by the local Transmission Owner

	PJM Default Generator Voltage Schedules								
Voltage Level (kV)	765	500	345	230	161	138	115	69	66
Schedule (kV)	760.0	525.0	350.0	235.0	164.0	139.5	117.0	70.0	67.0
Bandwidth (+/- kV)	+/-10.0	+/- 8.0	+/- 7.0	+/- 4.0	+/- 4.0	+/- 3.5	+/- 3.0	+/- 2.0	+/- 1.5

Overview

- A voltage schedule can be based on the TO's specifications:
 - Voltage
 - Reactive Power
 - Power Factor
 - Manual (TO Exemption)

AVR Operating Mode	Expected Generator Response
Automatic controlling voltage (voltage schedule)	Reactive output varies based on the grid system needs to maintain the reference voltage within the assigned voltage schedule's bandwidth up to the reactive capabilities of the generator. This is the standard voltage control operating mode for most generators in PJM.
Automatic controlling MVARs (MVAR schedule)	Reactive output remains steady based on scheduled MVARs
Automatic controlling power factor (power factor schedule)	Reactive output varies based on the real power output of the generator to maintain a constant ratio of real power versus apparent power (constant power factor)
Manual	Reactive output varies based on the manual adjustments made by the plant operator

Voltage Schedule Responsibilities

TO

Specify

TO-Specified or PJM Default Voltage Schedule

Specify Voltage Schedule Type: Voltage, Power Factor, or Reactive Power

Provide Target Voltage Schedule & Tolerance Band

Attach Voltage Schedule Letters (Optional)

Submit Exemption Requests

PJM

Review

Maintain List of Applicable Units (M-03 Sect. 3.11)

Review and Acknowledge Voltage Schedules

Coordinate adjacent TO/External Voltage Schedules

Approve Exemption Requests

Initiate **Annual** Voltage Schedule Reviews

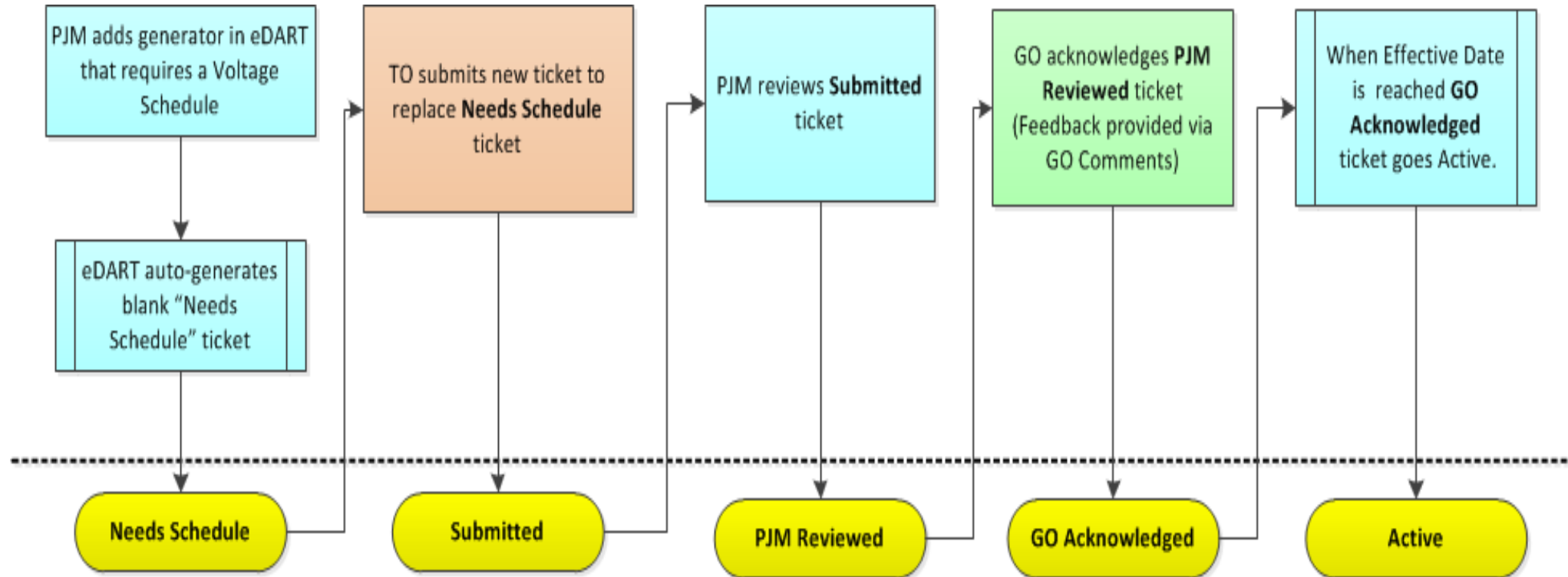
GO

Acknowledge

Acknowledge Voltage Schedules

Provide feedback on Voltage Schedule through GO Comments

Voltage Schedule Ticket Process



Accessing the Voltage Schedules Ticket (GO)

- Feedback
- My eDART
- Upload
- Download
- NEW Upload
- NEW Download
- Gen. Tickets**
- Trans. Tickets
- Network Model
- Black Start
- TERM
- Reactive Reserve
- Instantaneous Reserve Check
- Minimum Gen. Report
- PJM Status Report
- NERC Data
- Facility Data

- After logging into eDART, click on the Generation| Tickets Button to access the Generator Tickets Main Menu.
- The Generator Outage Main Menu is shown on the right.

- Click on the Voltage Schedule button and you will arrive at the Voltage Schedule Page
- Button will be red if there is a required action by the GO

Generator Tickets Main Menu

Summer Peak Period Maintenance Margin Season
Start: 06/10/2019 End: 09/06/2019

Current Maintenance Margin	
Mid Atlantic	N/A
Western Southern	N/A

Create New Ticket Opportunity Window View/Revise Ticket

	MW	Volt. Reg.	MVAR	Governor	MVAR Test	PSS
Submitted Tickets	8	7	33	5	35	4
Revised Tickets	10	0	2	0	1	0
Current Tickets	21	3	5	1	2	1
Approved Tickets	24	0	4	0	0	1
Future Tickets	3	0	0	0	0	0
Approved No Start	21	0	0	0	0	1
Active Beyond End	21	3	5	1	2	1
Recalled Tickets	0					
Forced Tickets						
Tickets History						

Owners Report Maint. Margin Log D-Curve Report

Black Start Test Upload Black Start Test Download Black Start Calculator

GO Survey **Voltage Schedules**

Starting Screen

Voltage Schedule (as of 11/15/2018 03:16)

Needs Schedule (9 / 38)
 Submitted (2 / 0)
 Pending Review (0 / 1)
 TO Review (1 / 0)
 Gen. Owner
 Unit Type

PJM Reviewed (1 / 0)
 GO Acknowledged (0 / 0)
 Saved (0 / 0)
 Active (7 / 1)
 Gen. Owner
 Unit Name

Completed (0 / 0)
 Canceled by TO (0 / 0)
 Canceled by PJM (12 / 1)
 Trans. Zone
 Ticket #

In Effect
 Canceled Prev. Ack. (1 / 0)
 Late (2 / 0)
 GO Comments (0 / 0)
 From Date
 To Date
 Incl. Hist Eff. Date
 TO Date GO Date

Voltage Schedule Tickets

Ticket #	GO Company TO Company	TR Zone	Unit Name Equipment Name Bus Name	Voltage Schedule Type	Normal			Light			Heavy			Effective Date	Status	Comments
					Target	Lower	Upper	Target	Lower	Upper	Target	Lower	Upper			
3006	Baltimore Gas and Electric Company Baltimore Gas and Electric Company	BC	BLUE CREEK 1 WESTPORT 13 KV CT 05 Blue Creek Bus 1	Voltage(KV)	13.0	11.0	15.0	13.0	11.0	15.0				11/30/2018	Active	TO: <input type="text"/> GO: <input type="text"/> PJM: <input type="text"/>
2679	Baltimore Gas and Electric Company Baltimore Gas and Electric Company	BC	BLUE CREEK 3 WESTPORT 13 KV CT 05 bus b	TO Exempt										11/01/2018	Active	TO: <input type="text"/> GO: <input type="text"/> PJM: <input type="text"/>
2642	Baltimore Gas and Electric Company Baltimore Gas and Electric Company	BC	BRANDON SHORES 2 BRANDONS 24 KV GEN 02 Brandon Shores Bus 2	Reactive(MVAR)	110.0	100.0	130.0							11/01/2018	Active	TO: PJM is entering TO comments for Active GO: PJM is entering GO comments for Active PJM: PJM Comments
3007	Baltimore Gas and Electric Company Baltimore Gas and Electric Company	BC	CALVERT CLIFFS 2 CALVERTC 22 KV GEN 02	PowerFactor(PF)	1.00	0.98	0.98							11/06/2018	Active	TO: Test PF Schedule GO: No concerns with this Voltage Schedule PJM: <input type="text"/>

Filter Menu

Command Menu

Voltage Schedule Tickets

Edit Button

Ticket Details

Voltage Schedule Ticket Details (as of 11/15/2018 03:58)

Ticket #	GO Company TO Company	TR Zone	Unit Name Equipment Name Bus Name	Voltage Schedule Type	Normal			Light			Heavy			Effective Date	Status
					Target	Lower	Upper	Target	Lower	Upper	Target	Lower	Upper		
3030	GO Company A TO Company X	XX	Test Unit 1 TEST 500 KV UNIT 1 Test 500 kv Bus A X	Voltage (KV)	525.0	5.0	5.0						11/17/2018	Submitted	

TO Comments: Test ticket

GO Comments:

PJM Comments:

Needs Schedule (9 / 38)
 Submitted (2 / 0)
 Pending Review (0 / 1)
 TO Review (1 / 0)
 PJM Reviewed (1 / 0)
 GO Acknowledged (0 / 0)
 Saved (0 / 0)
 Active (7 / 1)
 Completed (0 / 0)
 Canceled by TO (0 / 0)
 Canceled by PJM (12 / 1)
 In Effect
 Canceled Prev. Ack. (1 / 0)
 Late (2 / 0)
 GO Comments (0 / 0)

Trans. Owner:
 Unit Type:
 Gen. Owner:
 Unit Name:
 Trans. Zone:
 Ticket #:
 From Date: To Date:
 Incl. Hist. Eff. Date TO Date

Unit & Regulated Bus Identification

Voltage Schedule Type Selection

Voltage Schedules Target and Bandwidths

Voltage Schedule Load Conditions

Effective Date

Comment Entry

Ticket Status

Ticket Details

Voltage Schedule Ticket Details (as of 11/15/2018 05:16)

Ticket #	GO Company TO Company	TR Zone	Unit Name Equipment Name Bus Name	Voltage Schedule Type	Normal			Light			Heavy			Effective Date	Status	
					Target	Lower	Upper	Target	Lower	Upper	Target	Lower	Upper			
3115	GO Company A	XX	New Test Unit 1	Voltage	525.0	8.0	8.0							11/21/2018	Submitted	
	TO Company X		TEST 500 KV UNIT 1	(KV)		517.0	533.0									
			TEST 500 KV West Bus													

TO Comments: GO Comments: PJM Comments:

Needs Schedule (9 / 38)
 Submitted (3 / 0)
 Pending Review (0 / 1)
 TO Review (1 / 0)
 PJM Reviewed (1 / 0)
 GO Acknowledged (0 / 0)
 Saved (0 / 0)
 Active (7 / 1)
 Completed (0 / 0)
 Canceled by TO (0 / 0)
 Canceled by PJM (12 / 1)
 In Effect
 Canceled Prev. Ack. (1 / 0)
 Late (2 / 0)
 GO Comments (0 / 0)

Trans. Owner: Unit Type:
 Gen. Owner: Unit Name:
 Trans. Zone: Ticket #: 3115
 From Date: To Date: Incl. Hist. Eff. Date TO Date GO Date

Voltage Schedule Tickets

Ticket #	GO Company TO Company	TR Zone	Unit Name Equipment Name Bus Name	Voltage Schedule Type	Normal			Light			Heavy			Effective Date	Status	Comments
					Target	Lower	Upper	Target	Lower	Upper	Target	Lower	Upper			
3115	GO Company A	XX	New Test Unit 1	Voltage(KV)	525.0	517.0	533.0							11/21/2018	Submitted	TO: <input type="text"/>
	TO Company X		TEST 500 KV UNIT 1													GO: <input type="text"/>
			TEST 500 KV West Bus													PJM: <input type="text"/>

Required Entries

Optional Entries

Ticket Details

- The “Effective Date” is the day the ticket is in effect:
 - Applies to all four types of Voltage Schedules
 - The date cannot be the day the ticket was submitted
 - Earliest “Effective Date” allowed is the next day (submission date + 1 day)
 - No two tickets can start on the same day.
 - Error returned if user submits a future ticket with the same effective date as one that already exists for the unit.



Acknowledging a Reviewed Voltage Schedule Ticket

- A ticket in “GO Acknowledged” status will turn “Active” once the effective date of the ticket has been reached
- Old Active Voltage Schedule tickets are automatically “Completed” once a new GO Approved ticket turns active by reaching its Effective Date.
- Active tickets are highlighted by a mint-green tab on the Voltage Schedule Tickets listing

PJM Instantaneous Reserve Check

- IRC is used to verify PJM's reserve situation
 - **ALL** generators must validate/update their reserve information to PJM when requested
 - A minimum of one request via PJM All-Call before each daily peak
 - Usually 30 to 45 minutes prior to the peak
 - Could be more than 2 requests in a day depending on system conditions
 - Establish benchmarks which can be used to estimate reserves
 - Determine if reserve shortages exist and what if any emergency procedures should be declared

PJM Instantaneous Reserve Check

- Expectations:
 - Receive accurate member information “Instantly”
 - Data accuracy – maintain hourly updates in Markets Gateway

Some Notes!

- Reserve quantities should reflect current regulation assignments
- If a Maximum Generation Alert is issued and Maximum Emergency Generation is called into the capacity, Emergency Maximum should be used in place of Spin Max or Economic Maximum
- TTS = Time to start (Notification Time + Startup)
- Eco Max value used in calculations ONLY when no Spin Max value is provided

Operating Reserves

- Operating Reserves: Offline + Online
 - Offline (the lesser of):
 - Offline Spin Max
 - Spin Ramp Rate X (30 min – TTS)

NOTE: Offline Reserve Units that have a (Notification + TTS) ≤ 30 minutes shows should be included

- Online (the lesser of):
 - Ramp rate x 30 minutes
 - Spin Max – Current MW level

Operating Reserves Example

Gen	Fuel Type	Emerg. Min	Eco Min	Eco Max	Emerg Max	Current MW output	Spin Ramp Rate MW/Min	Notification &TTS
Amus	Hydro	10	15	180	200	80	20	10 Min
Grange	CT	0	0	600	600	0	10	5 Min

- Calculate the Operating Reserves for the Amus and Grange units

- Amus, Online Unit

- (Spin Ramp Rate X 30 Min) = (20 MW X 30 min) = 600 MW; or

- (*Eco Max* – Current Output) = (180 MW – 80MW) = 100 MW

- Grange, Offline Unit

- Eco Max = 600 MW; or

- (Spin Ramp Rate X (30 min – TTS)) = 10 X (30 mins – 5 mins) = 250MW

Synchronized Reserves

- Synchronized Reserve
 - Synch Reserve = lesser of:
 - *Spin Ramp Rate * 10 min*
 - *Spin Max – current MW level*

Synchronized Reserves Example

Gen	Fuel Type	Emerg. Min	Eco Min	Eco Max	Emerg Max	Current MW output	Ramp Rate MW/Min	Notification & TTS
Amus	Hydro	10	15	180	200	80	20	10 Min
Grange	CT	0	0	600	600	0	10	5 Min

- Calculate the Synchronized Reserves for the Amus and Grange units
 - Amus:
 - $(\text{Spin Ramp Rate} \times 10 \text{ Min}) = (20 \text{ MW} \times 10) = 200 \text{ MW}; \text{ or}$
 - $\text{Eco Max} - \text{Current output} = (180 \text{ MW} - 80 \text{ MW}) = 100 \text{ MW}$
 - Grange:
 - 0 MW – Offline Unit

Quick Start Non Synchronized Reserves

- Quick Start NSR
 - Offline Reserve Units that have a (Notification + TTS) \leq 10 minutes should be included
 - Quick Start Reserve = lesser of:
 - *Spin Max*
 - *Spin Ramp rate * (10 min – TTS)*

Quick Start NSR Example

Gen	Fuel Type	Emerg. Min	Eco Min	Eco Max	Emerg Max	Current MW output	Spin Ramp Rate MW/Min	Notification &TTS
Amus	Hydro	10	15	180	200	80	20	10 Min
Grange	CT	0	0	600	600	0	10	5 Min

- Calculate the Quick Start Reserves for the Grange unit
 - Grange:
 - Eco Max = 600 MW
 - Spin Ramp rate * (10 min – TTS)
 - $(10 \text{ MW} \times (10 \text{ min} - 5 \text{ min})) = (10 \text{ MW} \times 5 \text{ Min}) = 50 \text{ MW}$

Secondary Reserves

$$\text{Secondary Reserve} = \text{Operating Reserve} - \text{Primary Reserve}$$

- Supplemental Reserve for Amus & Grange:
 - $((\text{Amus Operating} + \text{Grange Operating}) - (\text{Amus Primary} + \text{Grange Primary}))$
 - $((100 \text{ MW} + 250 \text{ MW}) - (100 \text{ MW} + 50 \text{ MW})) = (360 \text{ MW} - 160 \text{ MW}) = \mathbf{200 \text{ MW}}$

Instantaneous Reserve Check (IRC)

PJM Instantaneous Reserve Check

- Once data is received from Member, PJM determines:
 - PJM Operating Reserve
 - Adjusted Primary Reserve vs. requirement
 - Adjusted Synchronized Reserve vs. requirement
 - Unaccounted for capacity
 - Area Synchronized Reserve levels
- PJM compares values calculated from Member data to reserve requirements to determine deficiencies
- PJM report results to Members via eDART

PJM Instantaneous Reserve Check

- eDART is the tool used to report Reserve information

SBTGO

Training/SandB:

- Feedback
- My eDART
- Upload
- Download
- Gen. Tickets
- Trans. Tickets
- Instantaneous Reserve Check
- Minimum Gen. Report
- PJM Status Report
- Facility Data
- Online Help
- Logout

IRC Company Data

Company: [redacted] Request Timestamp: 05/30/2018 09:34
 Request ID: [redacted] Date Updated: 05/30/2018 09:39
 User Name: [redacted] Posted Timestamp:

Company Totals		PJMCZ	AP	CE_OLD	AEP	DAY	DLCO	CE	ATSI	DEOK	EKPC	DOM	RTO	Total
0m-30m	Reserve	0	0	0	0	0	0	0	0	0	0	0	0	0
0m-10m	PRIMARY Reserve	0	0	0	0	0	0	0	0	0	0	0	0	0
	SYNCHRONIZED Reserve	0	0	0	0	0	0	0	0	0	0	0	0	0
	Non-synchronized Reserve (Quick Start)	0	0	0	0	0	0	0	0	0	0	0	0	0
	-- NSR Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0
	-- NSR Other	0	0	0	0	0	0	0	0	0	0	0	0	0
10m-30m	Secondary Reserve	0	0	0	0	0	0	0	0	0	0	0	0	0
30m-180m	Beyond Secondary	366	0	0	0	0	0	0	0	0	0	0	0	366

Notes to PJM Operator (500 char. max.)

Training

Apply Sort Refresh Recalc/Submit Main Menu Help

Note: Regulation assignments should not be included in the Synchronized Reserves unless the reserve is beyond the regulation bandwidth.
 **Please see the Help button for an explanation.
 All numbers on this form have been rounded for display.

IRC Company Unit Data

If you do not wish to acknowledge any unit, please uncheck the acknowledge check box prior to clicking Recalc/Submit.

Unit Name	ACAP	Unit Type	Zone	Eco Max	Real-Time MW	Regulating	Synchronized Reserves	Quick Start NSR	Secondary	Beyond Secondary	Acknowledge
NUG Unit 1	33	Nug	PN	0	0	0	<input type="text"/>	0	<input type="text"/>	87	<input checked="" type="checkbox"/>
Diesel Unit 1	12	Diesel	PS	0	11	0	<input type="text"/>	0	<input type="text"/>	0	<input checked="" type="checkbox"/>

PJM Instantaneous Reserve Check

Unit Name	ACAP	Unit Type	Control Zone	Eco Max	Real-Time MW	Ramp Rate MW/Min	Notification and TTS (minutes)	Regulating	Synchronized Reserves	Quick Start NSR	Secondary	Beyond Secondary
Columbus	200	Hydro	AEP	225	0	25	5	0				
Lexington	688	Fossil	AEP	700	680	8	360	0				
Bedford	290	CC	AP	300	210	15	20	0				
Elmwood	1200	Nuclear	CE	1200	1200	5	2880	0				
Whitehouse	400	Hydro	DAY	400	0	30	14	0				
Pleasantville	66	CT	DLCO	70	45	4	3	0				
Richmond	585	CT	DOM	600	0	50	7	0				
Corolla	24	CT	DOM	25	0	3	2	0				
Elizabeth	550	Fossil	PJMCZ	590	410	12	720	0				
Lebanon	1147	Fossil	PJMCZ	1150	620	10	1200	0				

IRC Exercise

Given the portfolio:

- Fill out the IRC data in eDART with the following values:
 - Synchronized Reserve
 - Quick Start NSR
 - Secondary
 - Beyond Secondary

PJM Instantaneous Reserve Check

Unit Name	ACAP	Unit Type	Control Zone	Eco Max	Real-Time MW	Ramp Rate MW/Min	Notification and TTS (minutes)	Regulating	Synchronized Reserves	Quick Start NSR	Secondary	Beyond Secondary
Columbus	200	Hydro	AEP	225	0	25	5	0				
Lexington	688	Fossil	AEP	700	680	8	360	0				
Bedford	290	CC	AP	300	210	15	20	0				
Elmwood	1200	Nuclear	CE	1200	1200	5	2880	0				
Whitehouse	400	Hydro	DAY	400	0	30	14	0				
Pleasantville	66	CT	DLCO	70	45	4	3	0				
Richmond	585	CT	DOM	600	0	50	7	0				
Corolla	24	CT	DOM	25	0	3	2	0				
Elizabeth	550	Fossil	PJMCZ	590	410	12	720	0				
Lebanon	1147	Fossil	PJMCZ	1150	620	10	1200	0				

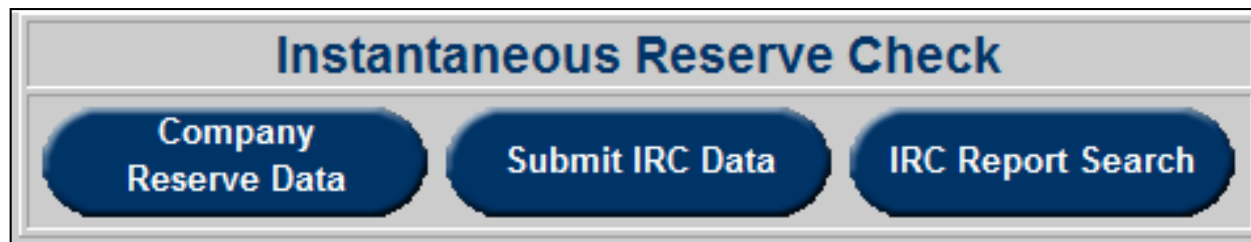
Instantaneous Reserve Check Tool

- The Instantaneous Reserve Check (IRC) is used to verify the PJM reserve situation at a given moment in time
- Unit by Unit Design:
 - Reserve data is pre-populated from PJM Markets and EMS systems on a Unit by Unit basis
 - User option to acknowledge reserve values: all units or per unit
 - User entry fields to submit changes to reserve values
- IRC Self-Check:
 - Display of current reserve data when IRC is not in progress

IRC_help@pjm.com

Instantaneous Reserve Check

- Company Reserve Data:
 - Display of PJM view of company reserve data
 - Updated every 5 minutes
 - Available only when IRC is not in progress
- IRC Submission
 - User can acknowledge reserve values displayed
 - User can submit reserve values and acknowledge submissions



Company Reserve Check

Company Reserve Self-Check													
Company: [REDACTED]										Request Timestamp: 06/05/2018 07:38			
User Name: [REDACTED]										Date Updated: 08/17/2015 14:26			
Company Totals													
Time Range	Reserve Category	PJMCZ	TEST_CZ	AP	AEP	DAY	DLCO	CE	ATSI	DEOK	EKPC	DOM	RTO Total
0m-30m	OPERATING Reserve	3578		27	1915	370	41	966	979	197	438	749	9260
0m-10m	PRIMARY Reserve	1296		23	434	157	40	325	322	145	37	562	3341
	SYNCHRONIZED Reserve	776		17	45	157	40	325	320	145	37	419	2281
	Non-synchronized Reserve (Quick Start)	520		6	389	0	0	0	2	0	0	143	1060
	-- NSR Hydro	223		6	389	0	0	0	0	0	0	143	761
	-- NSR Other	297		0	0	0	0	0	2	0	0	0	299
10m-30m	Secondary Reserve	2282		4	1481	213	1	641	657	52	401	187	5919
30m-180m	Beyond Secondary	1810		29	179	105	15	1695	724	181	0	510	5248

Apply Sort/Filter Refresh Main Menu Help

Note: Regulation assignments should not be included in the Synchronized Reserves unless the reserve is beyond the regulation bandwidth.

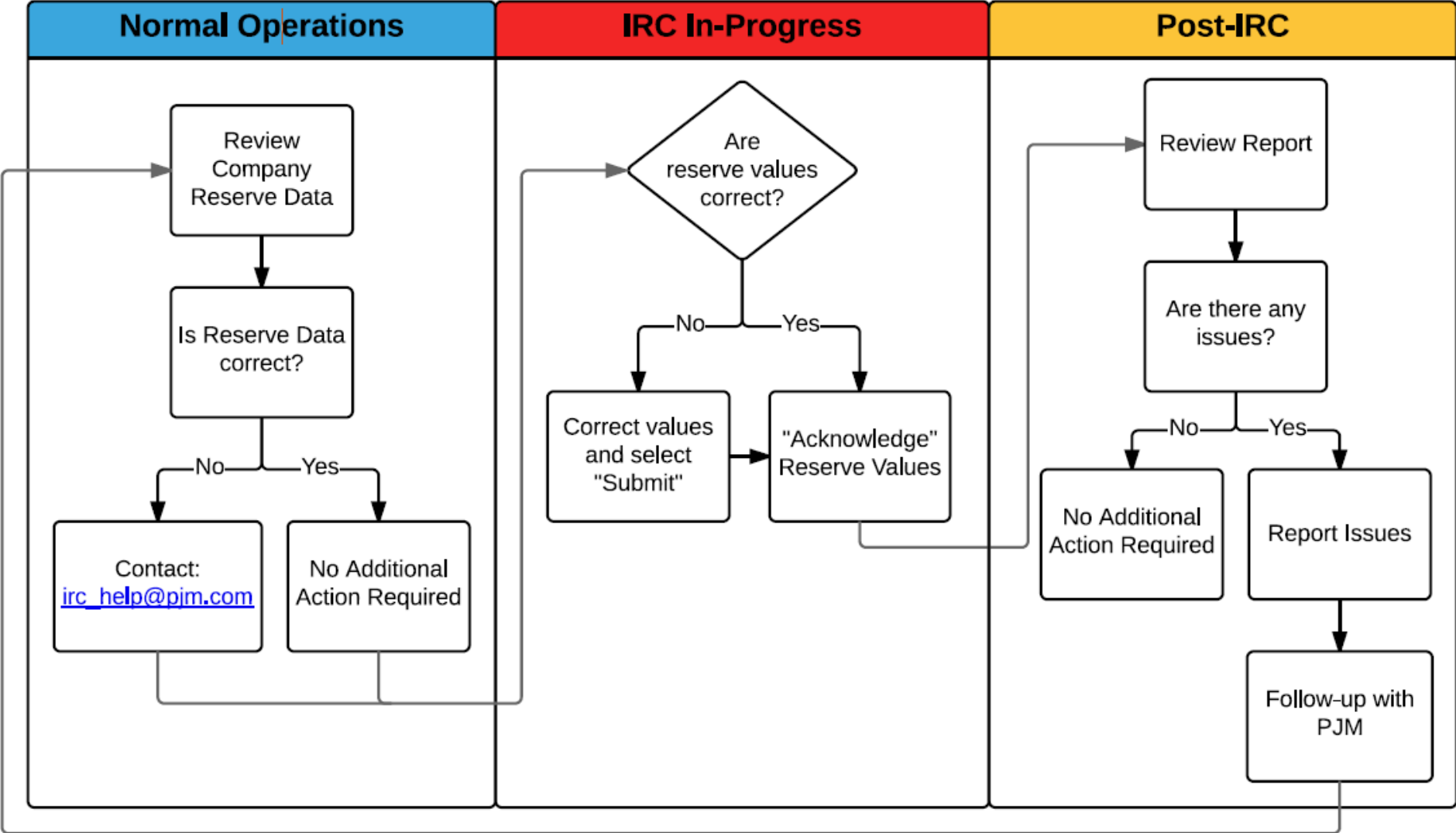
**Please see the Help button for an explanation.

All numbers on this form have been rounded for display.

Unit Data

Unit Name	ACAP	Unit Type	Zone	Eco Max	Real-Time MW	Regulating	Synchronized Reserves	Quick Start NSR	Secondary	Beyond Secondary
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	134	0	0	0	0	0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	0	0	0	0	0	0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	909	0	0	0	0	0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	0	0	0	0	0	0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	220	0	0	0	53	0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	1210	0	0	0	0	0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	1171	0	0	0	0	0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	617	0	5	0	0	0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	633	0	0	0	0	0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	45	0	0	0	0	0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	296	0	4	0	0	0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	335	0	10	0	13	0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	660	0	0	0	0	0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	0	0	0	0	0	0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	1196	0	0	0	0	0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	0	1157	0	0	0	0	0

IRC Process Review



Resources & References



PJM Interconnection. (2019). *PJM Manual 14D: Generation Operational Requirements*. (rev 48). Retrieved from: <https://www.pjm.com/~media/documents/manuals/m14d.ashx>

Questions?

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Website: www.pjm.com



The Member Community is PJM's self-service portal for members to search for answers to their questions or to track and/or open cases with Client Management & Services