Fundamentals of Transmission Operations

Equipment Outages

PJM State & Member Training Dept.

Objectives

At the end of this presentation the Learner will be able to:

- Identify how weather may influence outage planning
- Explain how to communicate a transmission equipment outage request to PJM
- Explain how to modify outage requests with PJM
- Coordinate operations with neighboring systems and PJM
- Explain the notification and coordination requirements, given a real-time outage

Agenda

- Outage planning and Weather
- **Outage Reporting Guidelines**
- eDART
- Communications and Notifications

- Peak Period Outage Scheduling Guidelines
  - Transmission owners should avoid scheduling any outage in excess of 5 days in duration with no restoration time or a restoration time greater than 5 days that may result in increased risk to system reliability during peak summer and winter periods
  - These periods are defined as June 15 – August 31 and January 1 – February 28, respectively
  - These outages include those that may result in:
    - Actual or post-contingency thermal or voltage issues with insufficient generation for control
    - Constraints that are load sensitive with limited controlling actions
    - Stability issues or bottled generation

- Peak Period Outage Scheduling Guidelines (cont.)
  - Transmission owners shall screen for peak period outages prior to submittal in eDART and look to reschedule during shoulder months
    - The transmission owners are encouraged to schedule non-impactful outages during peak seasons
  - PJM shall screen for peak period outages when performing outage analysis
  - PJM may grant exception to ensure RTEP upgrades are installed within specified timeframes or as special circumstances warrant

- Coordinating Outage Requests with Planned Nuclear Generation Outages
  - When a Transmission Owner submits an Outage Request that will open a Nuclear Generating Station‘s Unit Breaker the following guidelines shall be observed:
    - All Nuclear Unit breaker Outage Requests shall be coordinated closely with the Nuclear Station to coincide with a Unit outage
    - In the case that the Outage Request cannot be delayed until the next Unit Outage, the Nuclear station should be given at least six weeks notice. The schedule for opening the Unit Breaker must be closely coordinated with the station. The length of time that the breaker remains open should be minimized
    - PJM will work with the Nuclear Station’s and the Transmission Owner’s outage needs

- Coordinating Outage Requests with Planned Nuclear Generation Outages
  - The Nuclear Generating Stations coordinate the scheduling of a Unit Breaker outage and internal plant equipment outages and testing to minimize station risk
  - Adherence to outage schedule and duration is critical to the plant during these evolutions
  - Any emergent plant or transmission system conditions may require schedule adjustments, which should be minimized
  - Any change to the outage schedule that impacts the Unit Breakers shall be communicated to the nuclear generator operator

Outage Reporting Requirements

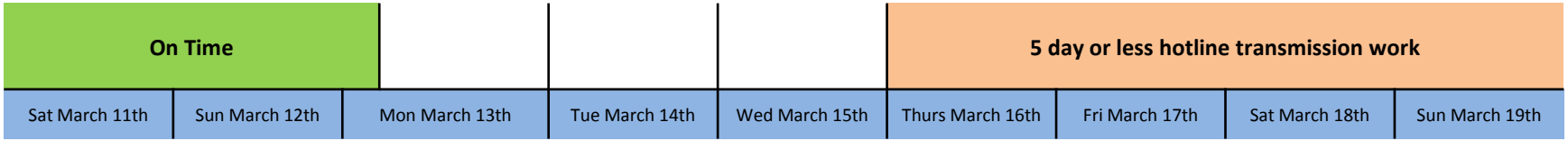
- Transmission Owners:
  - Shall submit tentative dates of all planned transmission outages of reportable transmission facilities as far as in advance as possible
  - Reasonable effort to submit one year in advance
- Transmission Owners are required to provide notice of all transmission outages prior to the first day of the month preceding the month of the outage
- Transmission Owners are also required to report “Hot Line Work” performed on facilities 345 kV and above

Hot Line / In-Service Work

- Why do In-service Work?
  - Reliability
  - Economics
- Type of In-service Work
  - Relay calibrations
  - Relay carrier/transfer trip test
  - Hot line work
  - Restrictions preventing auto-reclosure
- Operator Concerns
  - Increased probability of tripping
  - Awareness of work in area

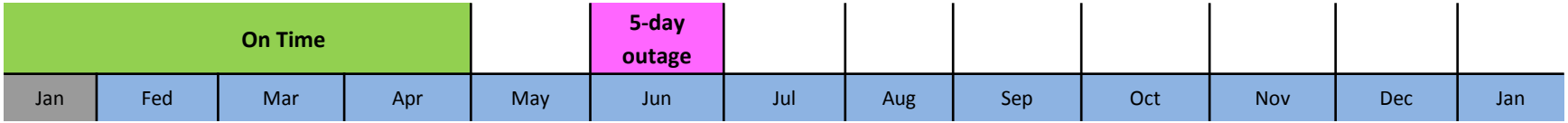
On Time Rules – 4 “Buckets”

- Hotline Ticket Rule (Bucket 1): Transmission Owners are required to provide notice of all hotline transmission work five days or less by 0800 three days prior to the start of the outage (345kV and above)
  - Hotline work starting on March 16, 2017 must be submitted by 07:59 on March 13, 2017 to be on time



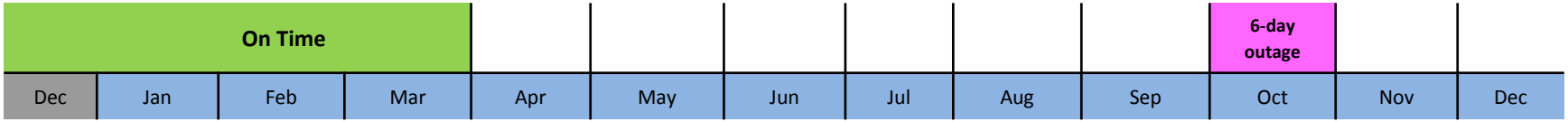
On Time Rules – 4 “Buckets”

- 1-Month Rule (Bucket 2): Transmission Owners are required to provide notice of all transmission outages five days or less prior to the first day of the month preceding the month of the outage
  - A 5-day outage starting in June, 2017 must be submitted by 23:59 on April 30, 2017 to be on time



On Time Rules – 4 “Buckets”

- 6-Month Rule (Bucket 3): The TO is required to submit all outage requests in excess of 5 days in duration prior to the 1st of the month six months in advance of the start of the outage
  - If a 6-day outage begins in October, the outage must be submitted by 23:59 on March 31 to be on time



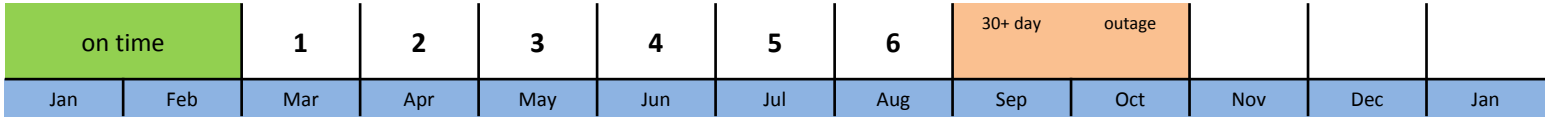
On Time Rules – 4 “Buckets”

- 30-Day Rule (Bucket 4): Outages scheduled for the following Planning year (i.e. June 1 – May 31) exceeding 30 days in duration are to be submitted via eDART prior to February 1 for use in the annual FTR auction unless the 6-month rule is more restrictive

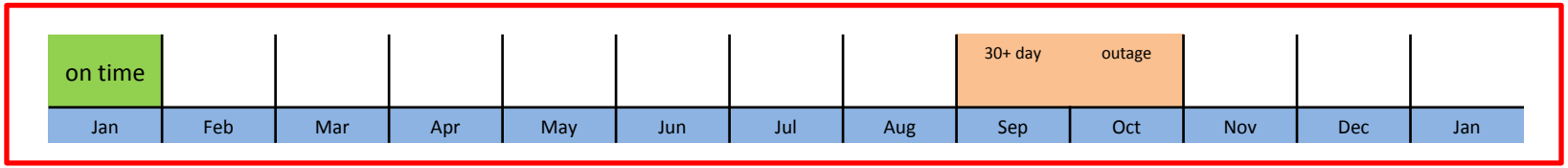
On Time Rules – 4 “Buckets”

Example 1:

- An outage greater than 30 days starts in September 2017. It must be submitted by:
  - 6-month rule: Must be submitted by February 29, 2017 @ 23:59



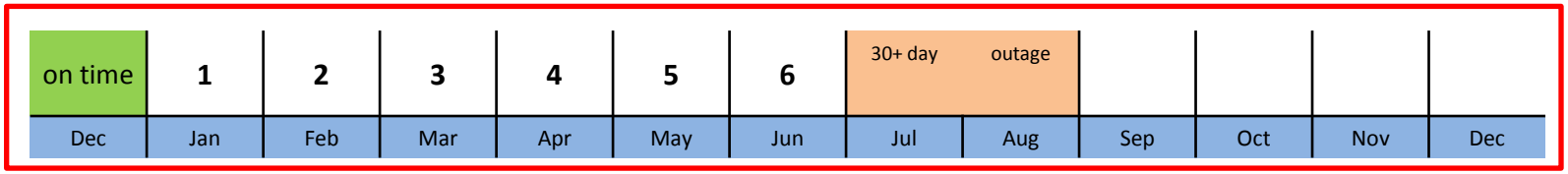
  - 30-day rule: Must be submitted by January 31, 2017 @ 23:59



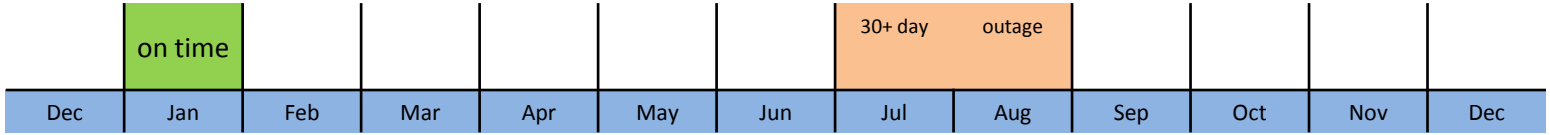
- Since the 30-day rule is more conservative, it applies

Example 2:

- An outage greater than 30 days starts in July 2017. It must be submitted by:
  - 6 month rule: December 31, 2016 @ 2359



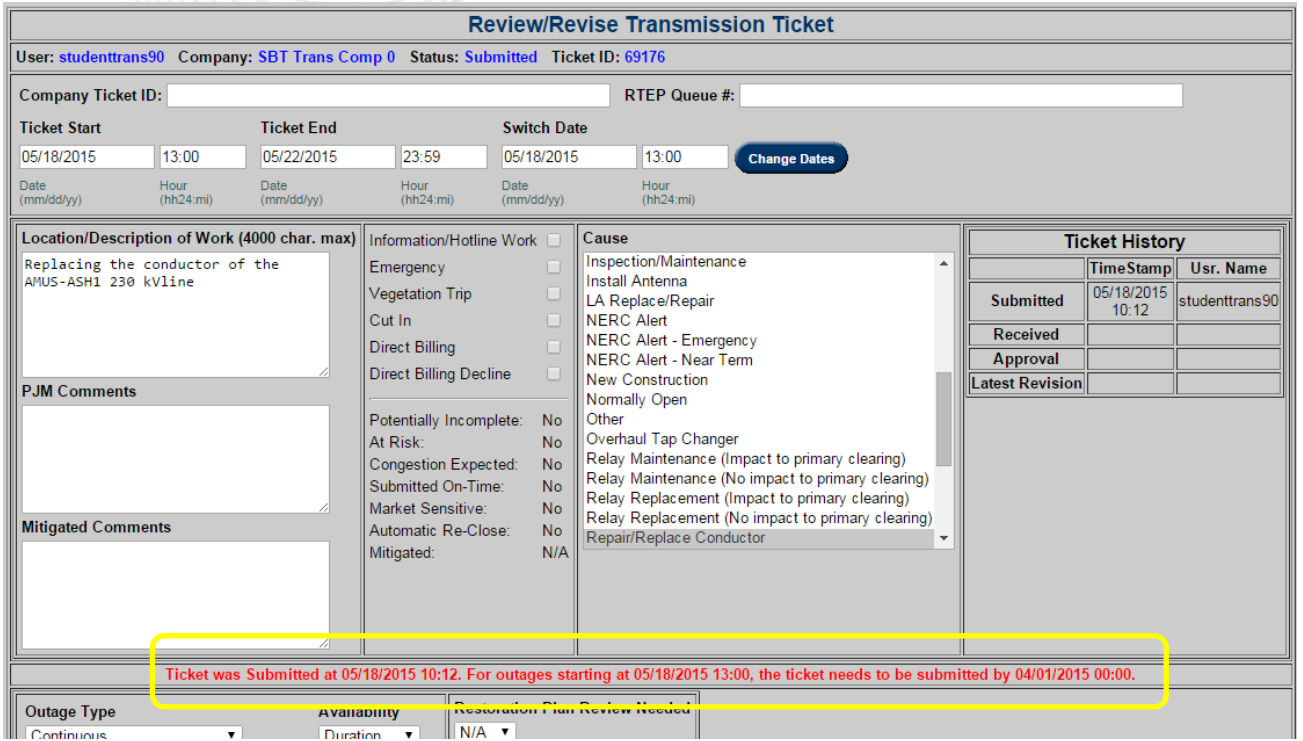
  - 30 day rule: January 31, 2017 @ 2359



- Since the 6 month rule is more conservative, it applies

Late Transmission Tickets

- If a ticket was submitted “late”, reviewing the ticket will show that a comment is now displayed with the date/time the ticket should have been submitted to have been considered on time



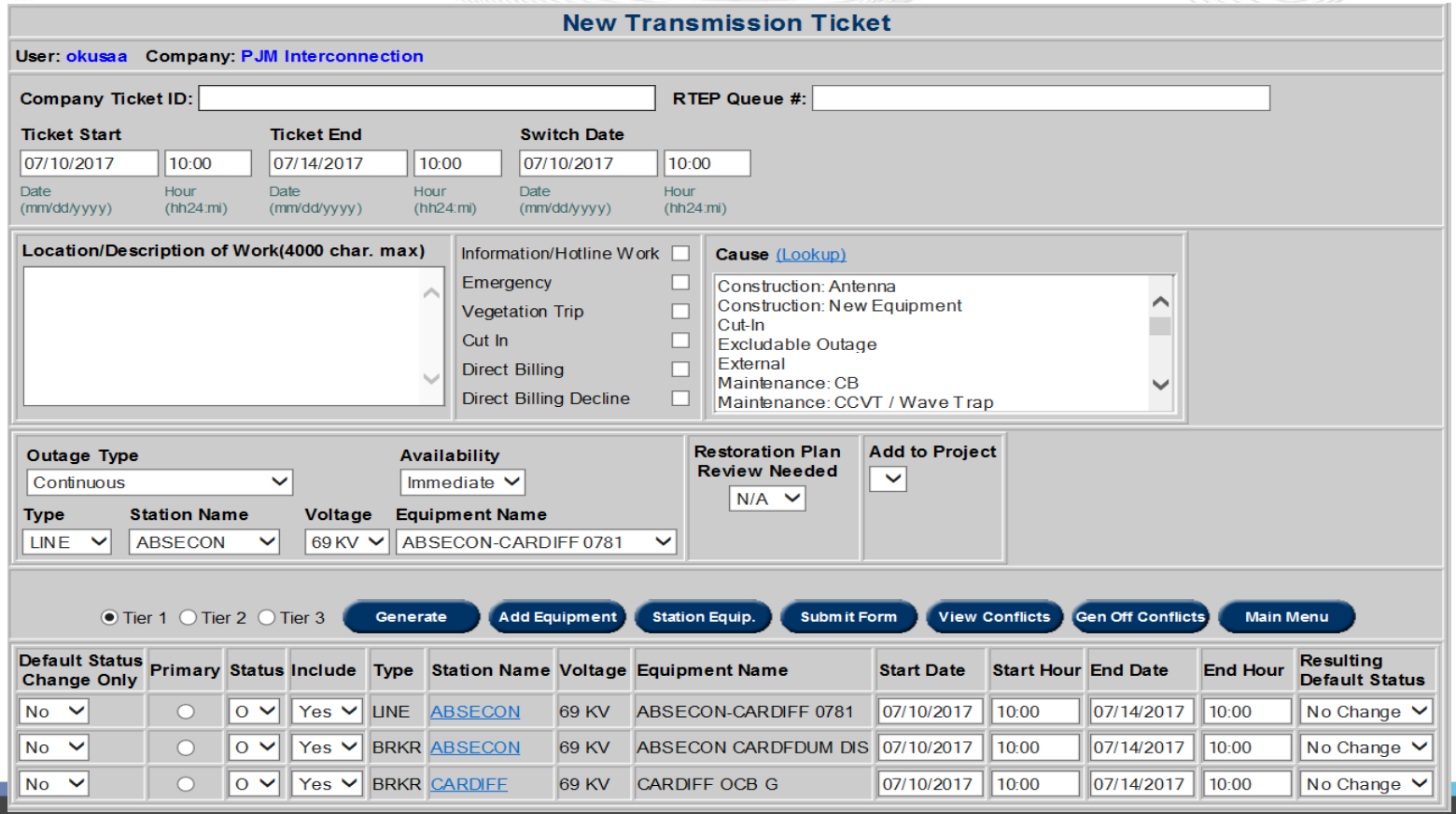
Agenda

- Outage planning and Weather
- Outage Reporting Guidelines
- **eDART**
- Communications and Notifications

- eDART stands for Dispatcher Applications and Reporting Tool
  - eDART is an internet tool for submitting Generation and Transmission operations and planning data to PJM and retrieving operations data from PJM

- Creating a New Transmission Outage Ticket - Business Rules
  - Ticket Start Date/Time must be prior to Ticket End Date/Time
  - Ticket must be submitted a minimum of 3 business days in advance of Ticket Start Date
    - Unless Emergency
  - Equipment Start and End Date/Time must be within Ticket Start and End Date/Time

Creating a Transmission Ticket



Creating a Transmission Ticket

- Location/Description of Work
  - Location of main work
    - i.e. KEENEY 51 TR or TMI-HOSENSACK 5026 line
  - Brief description of work
    - i.e. Overhaul, Relay Work, Repair, Line Work
  - Switching
    - Identify the word “SWITCHING”
    - List CBs or equipment that will be off for switching and approximate duration
      - i.e. Keeney ring CBS 240, 241 open 30 min for switching
    - If switching will last more than 1 hour, it is required to detail the switching instructions in the equipment list

Creating a Transmission Ticket

- Informational/Hotline Work - Work is being performed on selected equipment, however that equipment remains energized
  - Breaker clearances not required
- Emergency - Outage due to equipment problem or tripping and must be taken immediately
  - 3 day notice NOT required for emergency job
- Vegetation Trip – If outage was a tripping caused by tree contact, this checkbox must be checked
  - These are reported to NERC

Creating a Transmission Ticket

- Cut In - Energization of a new facility
- Direct Billing
  - TO will pay for the localized generator controlling actions
- Direct Billing Decline
  - TO will not pay for the localized generator controlling actions, but the late RTEP outage cannot be rescheduled

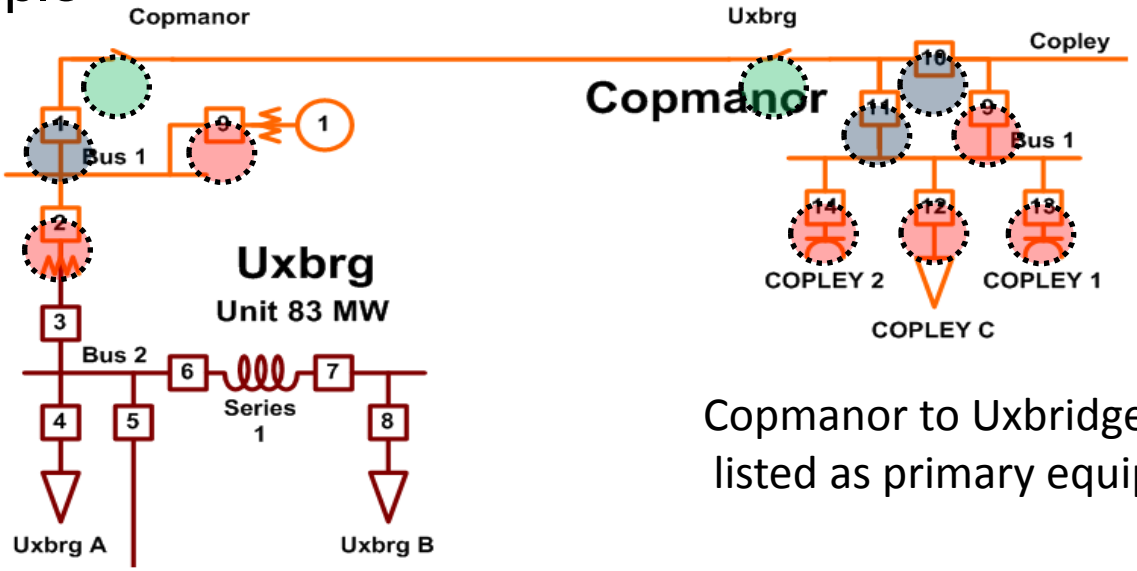
Creating a Transmission Ticket

- Outage Type - Indicates when work will be performed on equipment
  - Selectable from: Daily (including weekends), Daily (no weekends), Daily (weekends only), Continuous
- Availability - Time period from when equipment is requested to go back in service to when it is energized
  - Selectable from: Immediate, 30 min, 1 hr., 2 hr., 4 hr., 8 hr., 24 hr., 48 hr., 72 hr. or Duration

- Circuit Breaker Tiers
  - A Tier is defined as a “level” of CB or disconnect clearance for a piece of equipment
  - All CB or disconnect clearance points for an outage must be defined on the outage ticket
    - Tier selection helps accomplish this
  - Each outage ticket is referenced by a “Primary” piece of equipment
    - Tier CB and disconnects are associated with primary equipment
    - Important: Lines are listed by the first (alphabetical) Station Name

- Circuit Breaker Tiers
  - Used to quickly retrieve clearance points (CBs or Disconnects)
  - Limitations on tiers
    - Available for all equipment EXCEPT Busses
    - Will not get clearance points beyond local substations at each end of line
    - Will not get clearance points at voltage levels other than that of the selected line

Tier Example



Copmanor to Uxbridge line is listed as primary equipment

Tier 1 shaded green

Tier 2 shaded blue (includes tier 1)

Tier 3 shaded red (includes tier 1 and 2)

- Bus Outages
  - No buses modeled explicitly in PJM EMS
  - List breakers that will be open associated with bus
    - Can use tiers to accomplish this quickly
  - Mention BUS outage in Description of Work
  - Only list associated equipment (Lines, transformers) if they are outaged due to bus outage

Creating a Transmission Ticket

- Bus Outages
  - Request outage of Plymouth Meeting #3 bus
  - Lines remain energized from remote end
    - The lines will still be included on the ticket

Revise a Transmission Ticket

- Viewing or Revising an Existing Transmission Outage Ticket
  - Transmission Outage Ticket is “locked” to changes when the Ticket is Approved
    - In order to make changes or to unlock the form you must first notify PJM verbally
    - If the ticket has a status of Submitted, then any field may be changed

Ticket Statuses

- Transmission Ticket Status
  - Submitted
    - Original status of ticket upon submittal by company
  - Received
    - Ticket status changed to Received by PJM upon initial review of ticket by Dispatch
    - Notifications sent to other Transmission Owners through eDART

- Transmission Ticket Status (cont.)
  - Denied
    - Ticket status changed to Denied by PJM if outage request is not approved
    - Notifications sent to other Transmission Owners through eDART
      - Verbal notification given to outage submitter
  - Approved
    - Ticket status changed to Approved by PJM if outage request is approved following detailed analysis by Reliability Engineer
    - Ticket is locked to changes
    - Notifications sent to the Transmission Owner and other Transmission Owners that have requested information for this outage through eDART

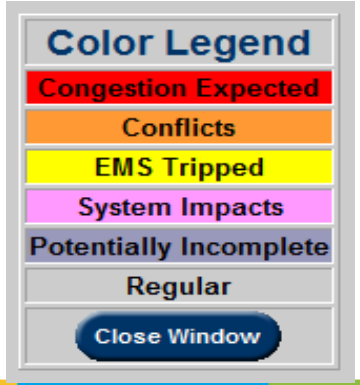
- Transmission Ticket Status (cont.)
  - Cancelled by Company
    - Ticket status changed to Cancelled by Company if company initiates cancellation of ticket
    - Notifications sent to all who had been previously notified through eDART
      - Verbal notification required to PJM if change affects current or next operating day

- Transmission Ticket Status (cont.)
  - PJM Admin Closure
    - Ticket status changed to PJM Admin Closure if PJM initiates cancellation of ticket
    - Notifications sent to all who had been previously notified through eDART
      - PJM gives verbal notification to outage submitter
  - Revised
    - Ticket status changed to Revised if any data on ticket has changed (unless ticket is active)
    - Ticket must be Received and Approved again
      - Notifications resent

- Transmission Ticket Status (cont.)
  - Active
    - Ticket status changed to Active upon input of an actual outage start date
      by PJM
      - Verbal notification required to PJM at actual start of outage ticket
  - Complete
    - Ticket status changed to Complete upon input of an actual end date by PJM
      - Verbal notification required to PJM at actual end of outage ticket

Color-Coding of eDART Tickets

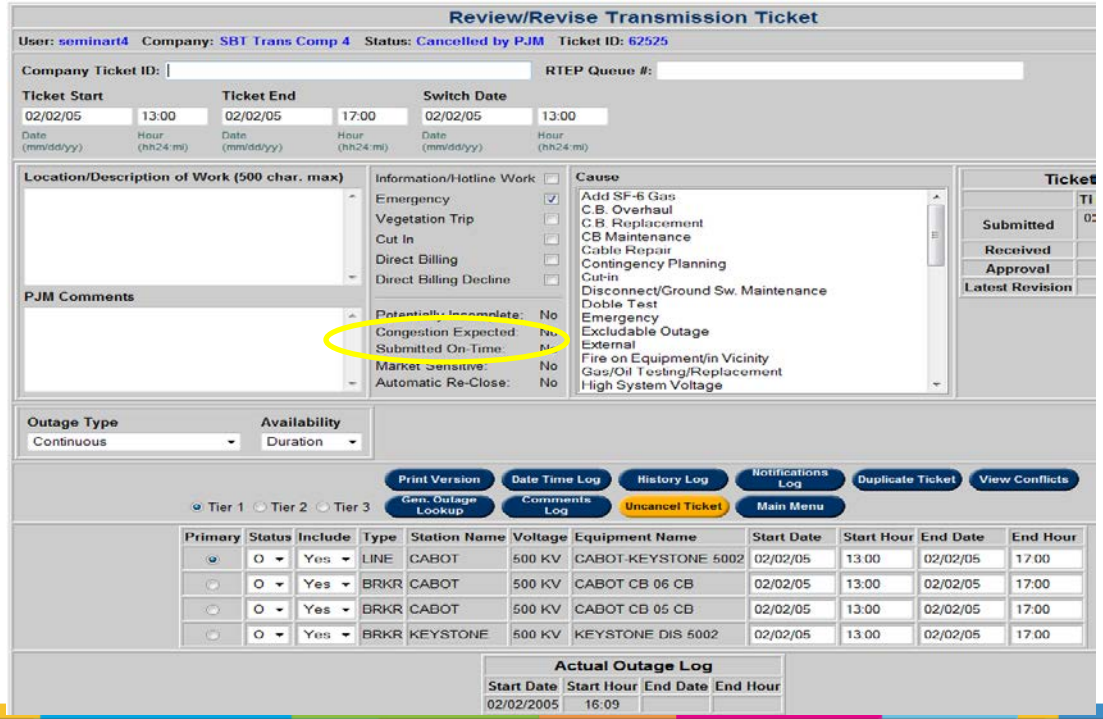
- Certain types of eDART tickets are given special Color-Coding to identify that they may require additional follow-up or attention
- If an eDART has more than one color status, it will take on the status with the highest color on the chart



Color-Coding of eDART Tickets

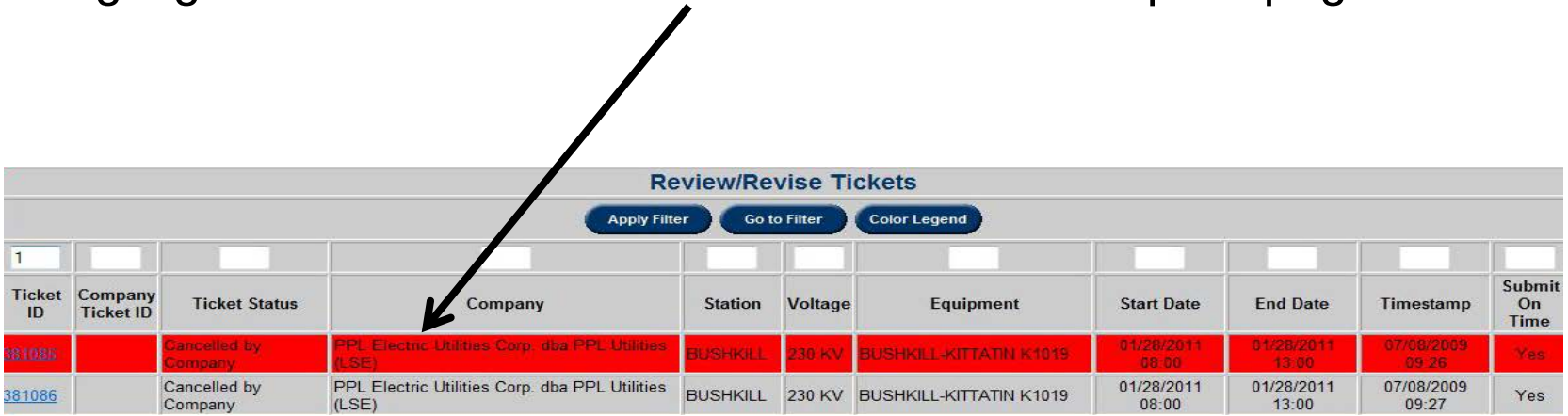
The “Congestion Expected” flag

- PJM will check this flag when a studied outage causes the potential for off-cost operation
- Allows PJM operators to filter these outages out if necessary



Color-Coding of eDART Tickets

- An outage that is suspected to cause congestion will also be highlighted in red when viewed on the “Status Report” page….



Review/Revise Tickets

Apply Filter | Go to Filter | Color Legend

Ticket ID	Company Ticket ID	Ticket Status	Company	Station	Voltage	Equipment	Start Date	End Date	Timestamp	Submit On Time
3810		Cancelled by Company	PPL Electric Utilities Corp. dba PPL Utilities (LSE)	BUSHKILL	230 KV	BUSHKILL-KITTATIN K1019	01/28/2011 08:00	01/28/2011 13:00	07/08/2009 09:26	Yes
381086		Cancelled by Company	PPL Electric Utilities Corp. dba PPL Utilities (LSE)	BUSHKILL	230 KV	BUSHKILL-KITTATIN K1019	01/28/2011 08:00	01/28/2011 13:00	07/08/2009 09:27	Yes

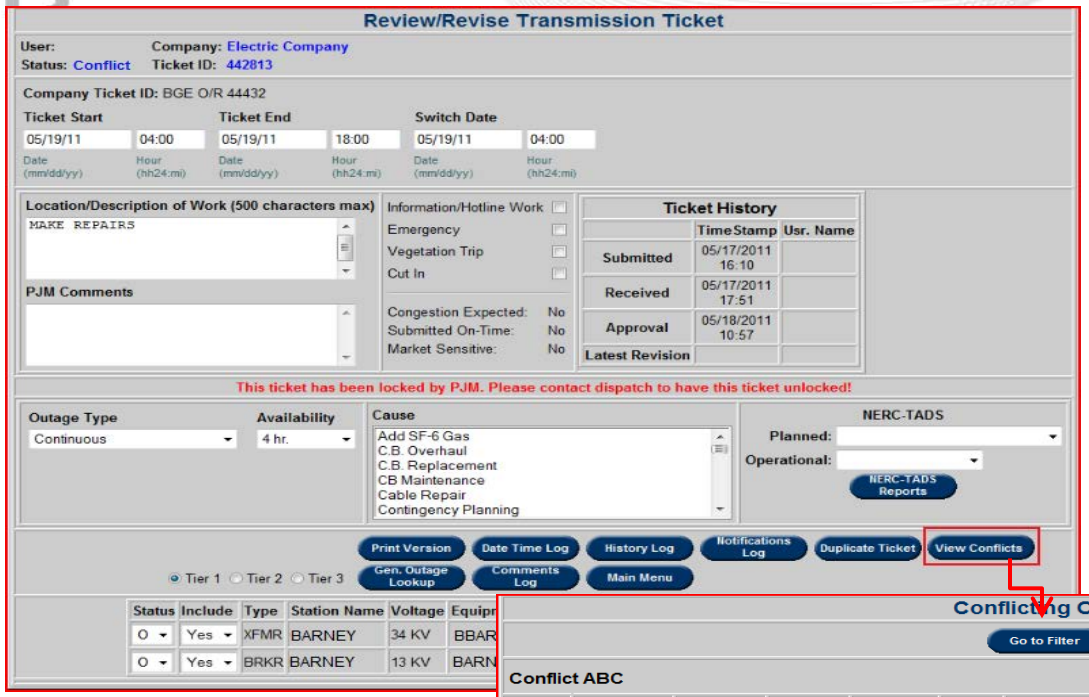
The “Conflict” Flag

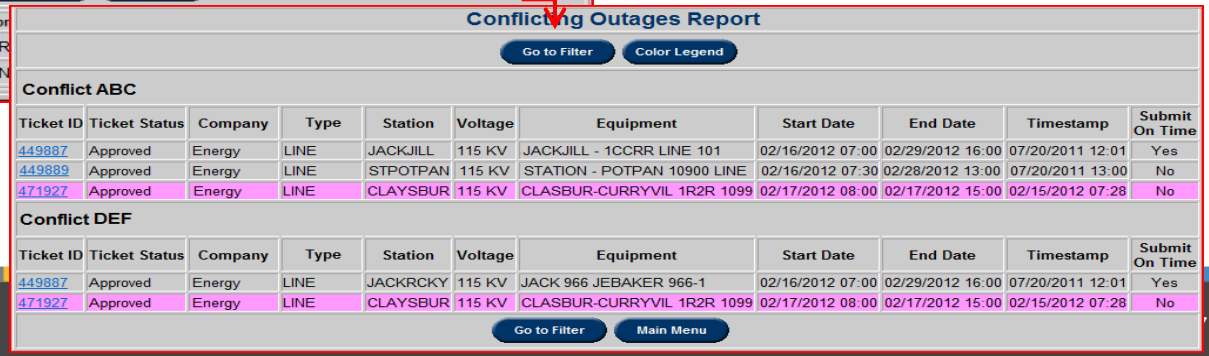
- This functionality looks at eDART tickets to identify outage combinations that should never occur
  - List of scenarios available in eDART
- Some scenarios may be cross-company
- If an outage is submitted violating a scenario, immediate feedback on impacted previously submitted tickets will be provided

Conflicts

Ticket ID	Company Ticket ID	Ticket Status	Company	Station	Voltage	Equipment	Start Date	End Date	Timestamp	Submit On Time
62000		Conflicted	Energy	SANDUNE	230 KV	SANDUNE LINE 11222	05/10/2011 11:00	05/22/2011 12:00	05/01/2011 12:58	No
62225		Cancelled by Company	Energy	SANDUNE	34 KV	SANDUNE-BNY CB	05/19/2011 11:00	05/23/2011 15:00	05/01/2011 11:15	No

Color-Coding of eDART Tickets





- 'View Conflicts' button available on tickets
- Ticket specific conflicts available for users to see by clicking on the 'View Conflicts' button

EMS Tripping Tickets

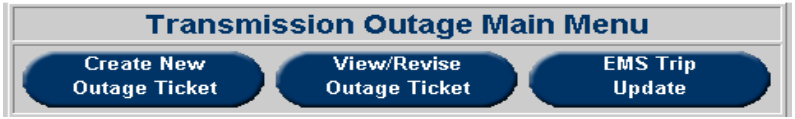
- Tripped equipment (from PJM EMS) automatically creates an eDART outage ticket or activates an existing one for the equipment scheduled for the near future
- All equipment 115kV and above
- Outage type = EMS Tripped
- Ticket has Active status
- Start date/time = time of tripping
- End date/time = Start date/time + 2 hours

Color-Coding of eDART Tickets

- EMS Tripping Tickets created automatically by eDART are given a default cause of “Unknown”
- EMS Trip Update button (on main menu) has the functionality to allow the Transmission Operator to associate cause for the purpose of performance compliance data gathering and to give PJM a better understanding of the reason for the outage
- “Pre-Contingency Switching” checkbox is for the outage being caused by pre-contingency switching

Color-Coding of eDART Tickets

- EMS Trip Update form in Transmission Outage Ticket to allow TO to assign Cause Type to all EMS Trip Tickets marked “Unknown”
- User either selects a Cause Type from drop down or checks “Pre-Contingency Switching”
- Button on Transmission Outage Ticket menu only visible if user’s company has EMS Trip Tickets marked “Unknown”
- Transmission Owner/Operator is expected to update ticket if “EMS Trip Update” Button is shown



Color-Coding of eDART Tickets

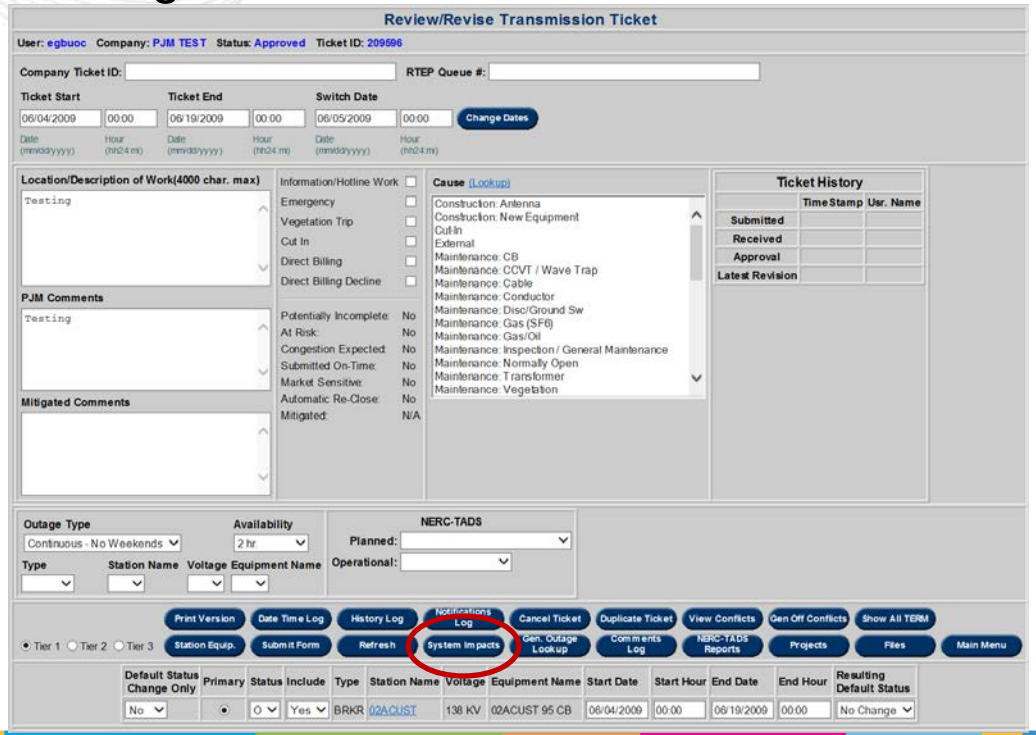
"System Impact" flag

- PJM has the capability to permanently link comments to specific equipment outages in eDART
  - Allows the Reliability Engineers to pre-screen outages based on known impacts to generation, thermal overloads, voltage violations, stability restrictions, etc. before studying the outage
  - Serves a reminder for the PJM folks, could be useful to the TOs as well.
  - Outages that have System Impact notes available will be highlighted in purple on the "Status Report" page

Ticket ID	Company Ticket ID	Ticket Status	Outage Type	Company	Station	Voltage	Equipment	Start Date	End Date	Timestamp	Submit On Time
82169		Approved	Daily - Weekends Only	PJM TEST	BOONEDAM	4 KV	C-T	09/09/2009 00:00	10/10/2009 00:00		Yes
209593		Received	Continuous	PJM TEST	02ACUST	138 KV	95	05/12/2009 00:00	05/14/2009 00:00		No
209596		Approved	Continuous - No Weekends	PJM TEST	02ACUST	138 KV	95	06/04/2009 00:00	06/19/2009 00:00		No
212464	JordanPJMTESTTest	Approved	Continuous	PJM TEST	CROMBY	230 KV	CRO-LIM0	12/04/2011 09:25	12/10/2011 09:30	12/01/2011 09:08	No

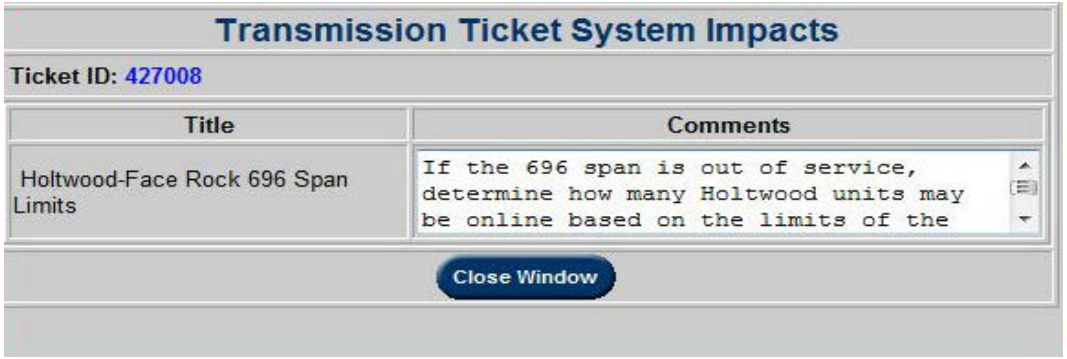
Color-Coding of eDART Tickets

- The eDART ticket for those outages will have an additional button labeled “System Impacts”



Color-Coding of eDART Tickets

- Clicking on the “System Impacts” button will bring up a screen detailing the linked comments



The “Potentially Incomplete” flag

- Added to transmission outage tickets to flag tickets that may need further review by PJM
- Potentially Incomplete is flagged if:
  - All outaged equipment in the ticket are breakers and the ticket is not Information/Hotline Work
  - Location/Description of Work field needs more information
- PJM will determine if non-BRKR facility should be added or more description text is necessary
    - Ex. For Ticket where BRKR on either side submitted w/o submitting LINE, have company add LINE to the ticket

Color-Coding of eDART Tickets

- Potentially incomplete ticket can be Cancelled or Denied but no other status change is allowed until Potentially Incomplete is unchecked
- PJM can remove flag once issue resolved and continue normal status change
- Potentially Incomplete tickets will be highlighted in Lavender

Color-Coding of eDART Tickets

- PJM Comments automatically added when a ticket is flagged as Potentially Incomplete
  - If Location/Description of Work field has less than a pre-determined number of characters:
    - PJM Comments = "Please include additional information in the work description"
  - If all outaged equipment in the ticket are breakers and the ticket is not Information/Hotline Work:
    - PJM Comments = "Please include applicable non-BRKR facilities“
- Both comments are added if both of the conditions above persist

Potentially Incomplete Tickets

- EMS Tripping -vs- Potentially Incomplete:
  - EMS Tripped process overrides Potentially Incomplete logic to activate previously submitted tickets
  - If EMS Tripped process is activating a ticket currently in the Submitted status and Potentially Incomplete is TRUE, it will also set the Potentially Incomplete flag to FALSE

Agenda

- Outage planning and Weather
- Outage Reporting Guidelines
- eDART
- **Communications and Notifications**

- Communications
  - Verbal Notification required to PJM for:
    - Any change to ticket (dates, equipment) which affects the current or next operating day
    - Transmission trippings
      - Also submit an outage ticket
      - If return date is unknown, use end of estimated month at 23:59
    - Switching, when it is ready to begin
      - To allow PJM to perform final reliability studies
    - Actual start and end time of outage tickets
      - PJM will then update the ticket in eDART
    - Problems with entering tickets through eDART

Communications and Notifications

- Communication Guidelines
  - Verbal Notification will be given from PJM for:
    - Denial or cancellation of outage request
    - Questions about submitted outage request
    - Any special requirements for outage
    - 500 kV and above switching messages
      - via All-Call

- Notifications - Receiving
  - Notifications will be made based on updated Reportable Transmission Facilities list
    - Notifications can be found in eDART
  - eDART will allow those who are notified to view Transmission Outage Tickets
  - Notifications must be acknowledged by receiving company through eDART

- Real Time Outage Communication Process
  - PJM Member Company Actions
    - Notifies PJM System Operator verbally 1/2 hour prior to scheduled outage of any Designated Transmission Facility
    - If 500 kV or above outage, notifies PJM again verbally, just prior to switching to verify conditions
    - Notifies PJM verbally when facility is out of service
    - Ensures that outaged facilities are properly represented in real-time system models

- Real Time Outage Communication Process
  - PJM Actions
    - Verifies outage will not adversely impact Control Area reliability
    - If 500 kV or above, notifies other PJM Member Companies of outage via All-Call
    - Notifies other affected Control Areas verbally

Summary

- Overview on navigating eDART in order to create or edit transmission tickets
- Communication and Notifications associated with eDART that will be utilized when necessary