

Background on Recent Changes to Connecticut Import Limits

Reliability Committee Meeting



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Purpose

- To explain the Connecticut (CT) Import interface definition
- To provide background on the changes made to the CT Import transfer limit that were presented the June 3, 2013 PSPC meeting



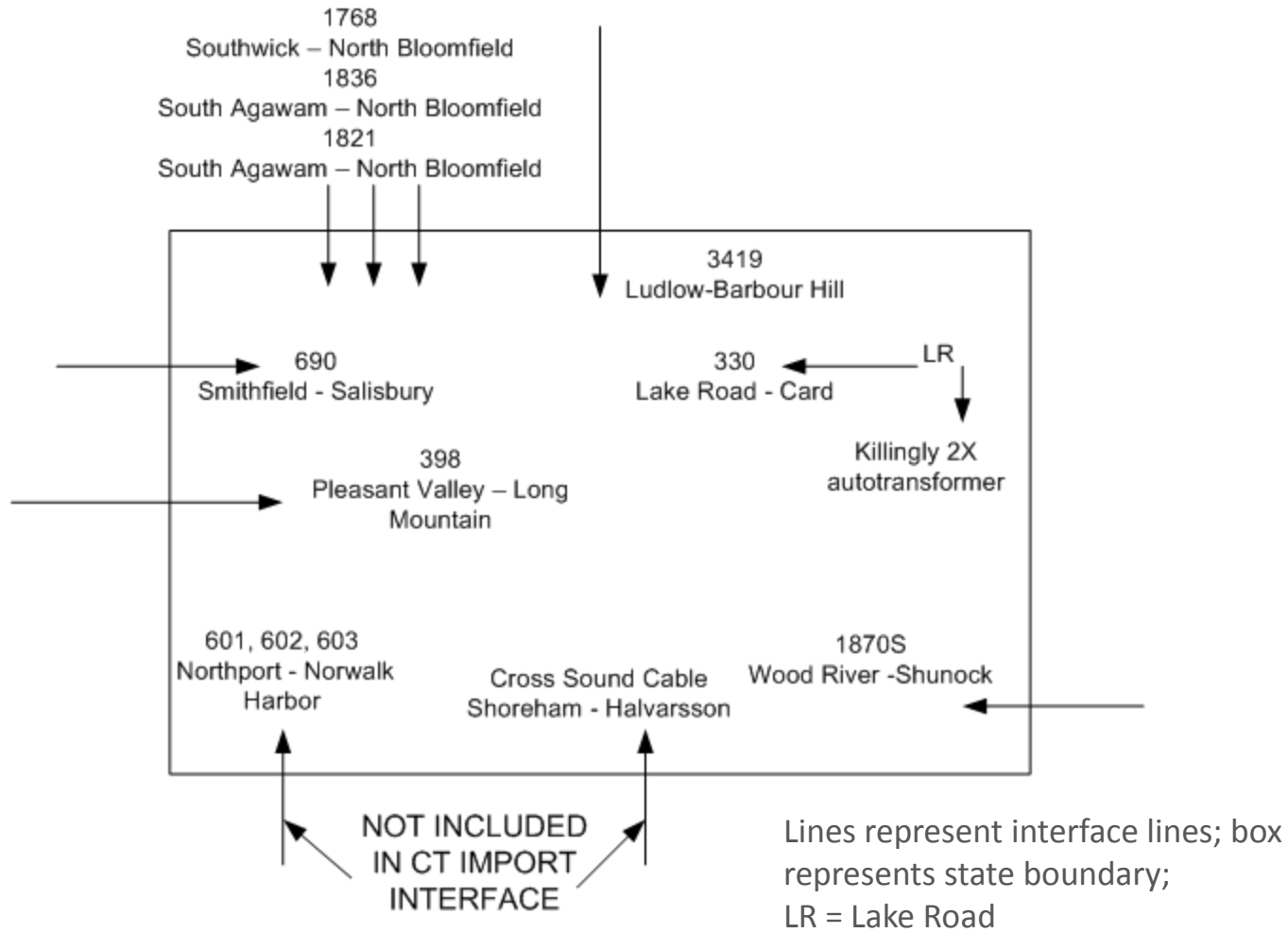
CT IMPORT INTERFACE BACKGROUND

CT Import Interface Background

- Pre-Greater Springfield Reliability Project (GSRP) Interface Definition
 - 330 (Lake Road – Card 345 kV)
 - 398 (Pleasant Valley – Long Mountain 345 kV)
 - 690 (Smithfield – Salisbury 69 kV)
 - 1870S (Wood River – Shunock 115 kV)
 - Killingly 2X (345/115 autotransformer)
 - 3419 (Ludlow – Barbour Hill 345 kV)
 - 1768 (Southwick – North Bloomfield 115 kV)
 - 1836 (South Agawam – North Bloomfield 115 kV)
 - 1821 (South Agawam – North Bloomfield 115 kV)
- Does not include:
 - 601, 602, 603 (Northport, LI – Norwalk Harbor, CT 138) - NNC
 - 481 (Cross Sound Cable, Shoreham, NY – Halvarsson, CT HVDC)



CT Import Interface Background (pre-GSRP system shown)



Why aren't the NNC or CSC included in the CT Import interface?

- An interface is a tool to assist engineers/operators in assessing the system
 - Captures important information about the system
 - May be “closed” or “open”
 - Closed – interface includes all lines into (importing) or out of (exporting) a part of the system
 - Open – interface includes only some of the lines into or out of an area
 - CT Import is an open interface (doesn't include NNC, or CSC)
- CT Import interface is defined to understand the stress that is on the system
 - Does not measure the total amount of power flowing in to CT or out of CT
 - More meaningful than a total power measurement
 - To get the total power - must sum the CT Import, NNC and CSC

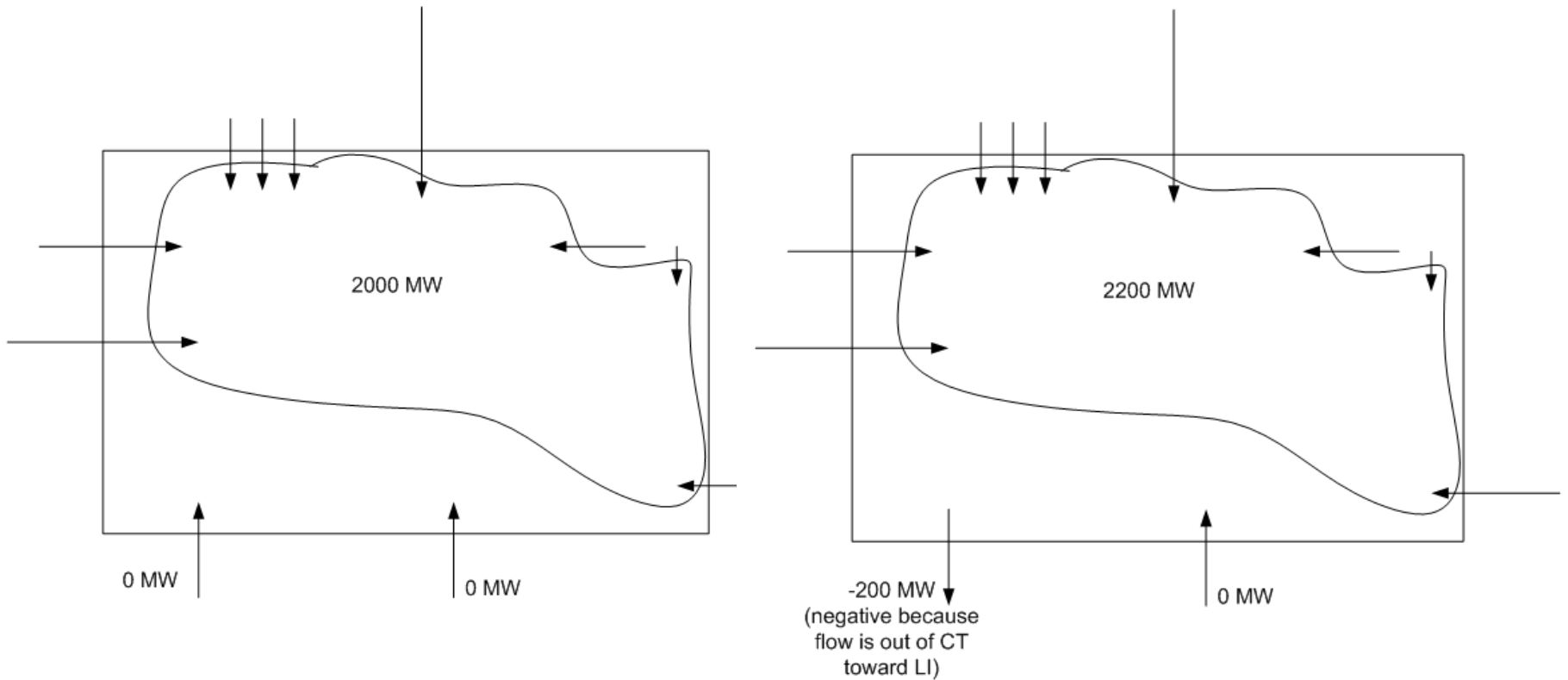


Why aren't the NNC or CSC included in the CT Import interface? Numerical example

- Assume 2000 MW coming across the interface. Assume 0 MW on CSC and 0 MW NNC. This is a system that has heavy loading coming from NY (non-Long Island), MA, and RI into CT
- Make no changes to the generation or load in CT, and increase transfers across NNC to from CT to LI to 200 MW
 - Causes the flow across the CT Import to reach 2200 MW, and flow on the NNC to be -200 MW (it would be negative since it is leaving CT). If the CT Import interface included the flow on the NNC, the total would be equal to $2200 - 200 = 2000$ MW. While there is 200 MW greater flowing from into the non-Long Island ties to CT, if the NNC is included, there is absolutely no change in flow shown, even while the non-Long Island ties to CT are much more heavily stressed
 - By not including the NNC, the flow on the CT Import interface changes from 2000 MW, to 2200 MW showing the increase in stress
 - Similar examples can be created for the Cross Sound Cable



Numerical Example



Lines represent interface lines; box represents state boundary;
LR = Lake Road

CHANGES IN CT INTERFACE DEFINITION

Changes in CT Import Interface Definition Over Time

- Various parts of the New England East-West Solution (NEEWS) either add or remove lines which cross into CT or modify the electrical characteristics of the system such that the interface definition needs to be moved

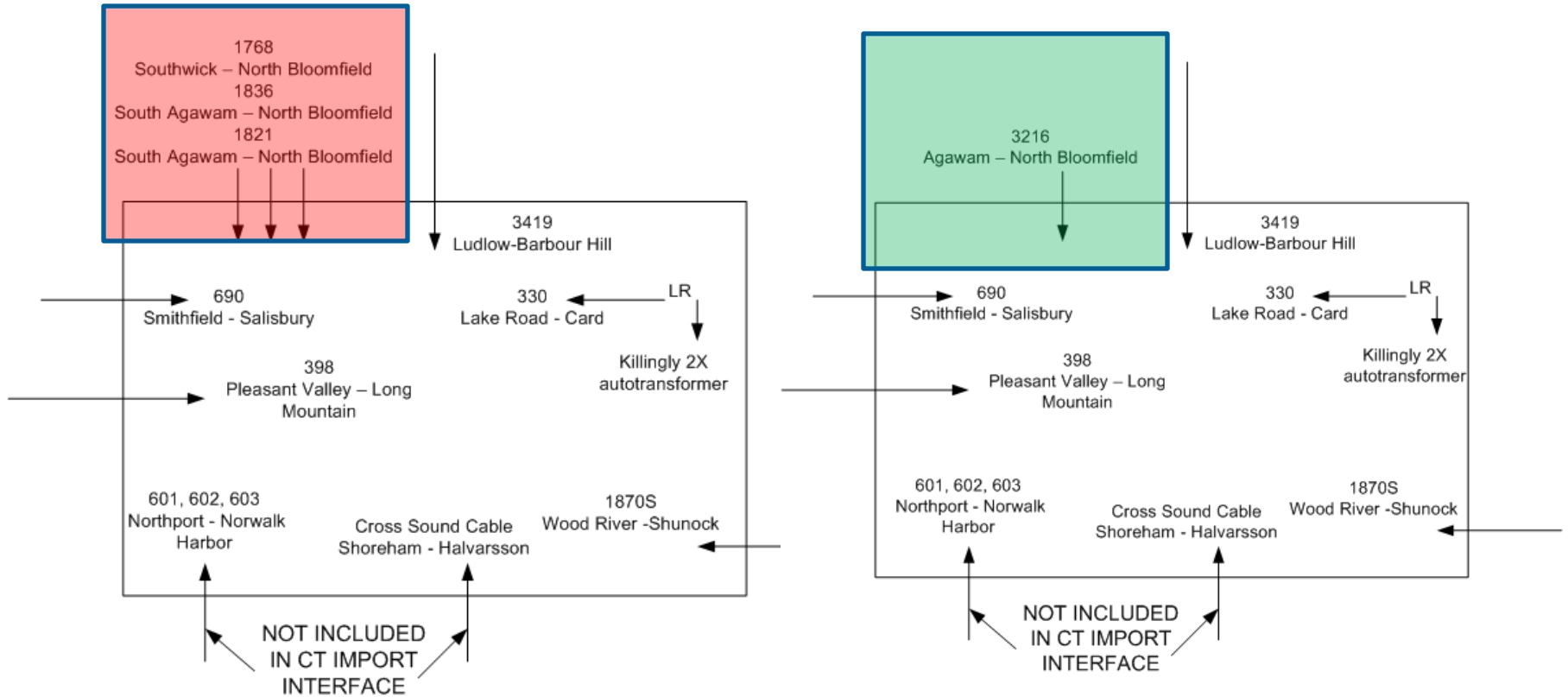


CT Import Interface – Definition Changes over Time

- Pre-Greater Springfield Reliability Project Interface
 - 330 (Lake Road – Card 345 kV)
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 - 1836 (South Agawam – North Bloomfield 115 kV)
 - 1821 (South Agawam – North Bloomfield 115 kV)
- Post-Greater Springfield Reliability Project
 - 330 (Lake Road – Card 345 kV)
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 - 3216 (Agawam – North Bloomfield 345 kV)



Pre-GSRP to Post-GSRP



Lines represent interface lines; box represents state boundary; LR = Lake Road

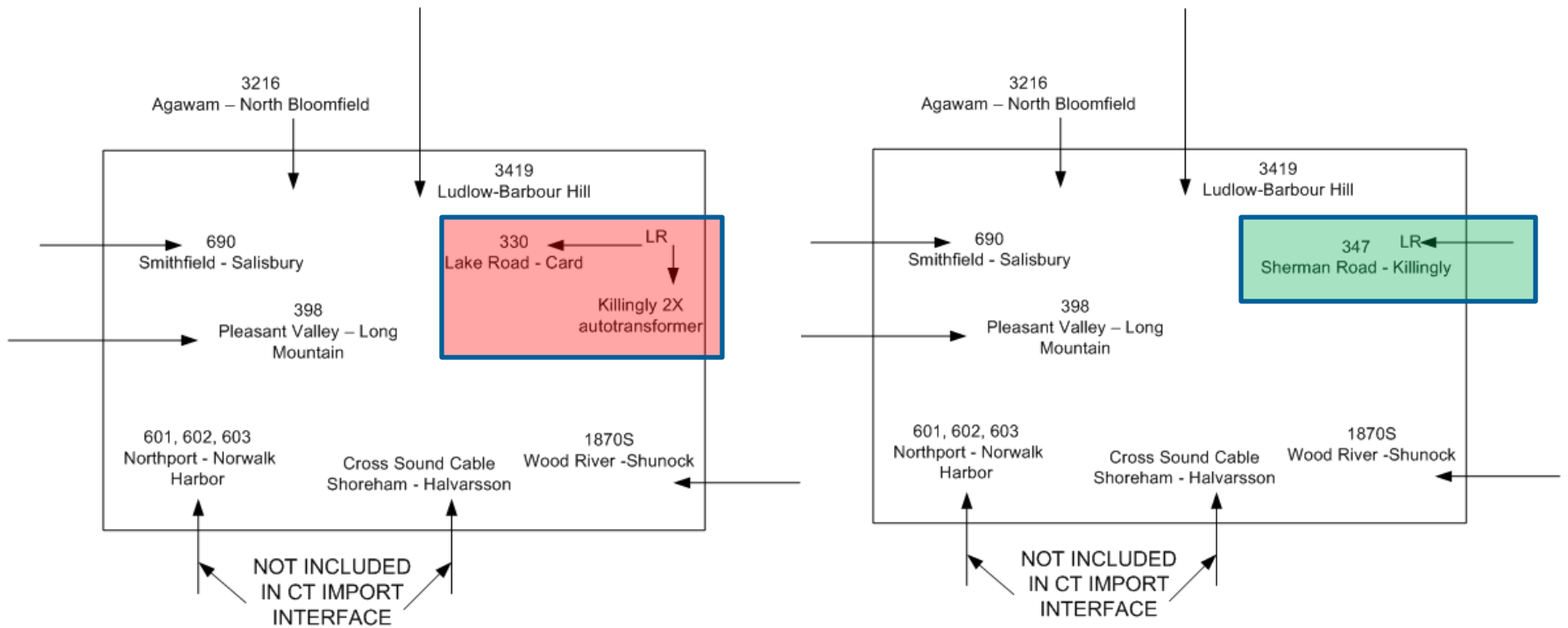


CT Import Interface – Definition Changes over Time

- Post-Greater Springfield Reliability Project (repeated from previous slide)
 - 330 (Lake Road – Card 345 kV)
 - 398 (Pleasant Valley – Long Mountain 345 kV)
 - 690 (Smithfield – Salisbury 69 kV)
 - 1870S (Wood River – Shunock 115 kV)
 - Killingly 2X (345/115 autotransformer)
 - 3419 (Ludlow – Barbour Hill 345 kV)
 - 3216 (Agawam – North Bloomfield 345 kV)
- Post-Card-Lake Road portion of the NEEWS Interstate Reliability Project (IRP) (Card – Lake Road is the only portion of the IRP that has been certified in FCM)
 - 398 (Pleasant Valley – Long Mountain 345 kV)
 - 690 (Smithfield – Salisbury 69 kV)
 - 1870S (Wood River – Shunock 115 kV)
 - 3419 (Ludlow – Barbour Hill 345 kV)
 - 3216 (Agawam – North Bloomfield 345 kV)
 - 347 (Sherman Road – Killingly 345 kV)



Post-GSRP to Post Card-Lake Road



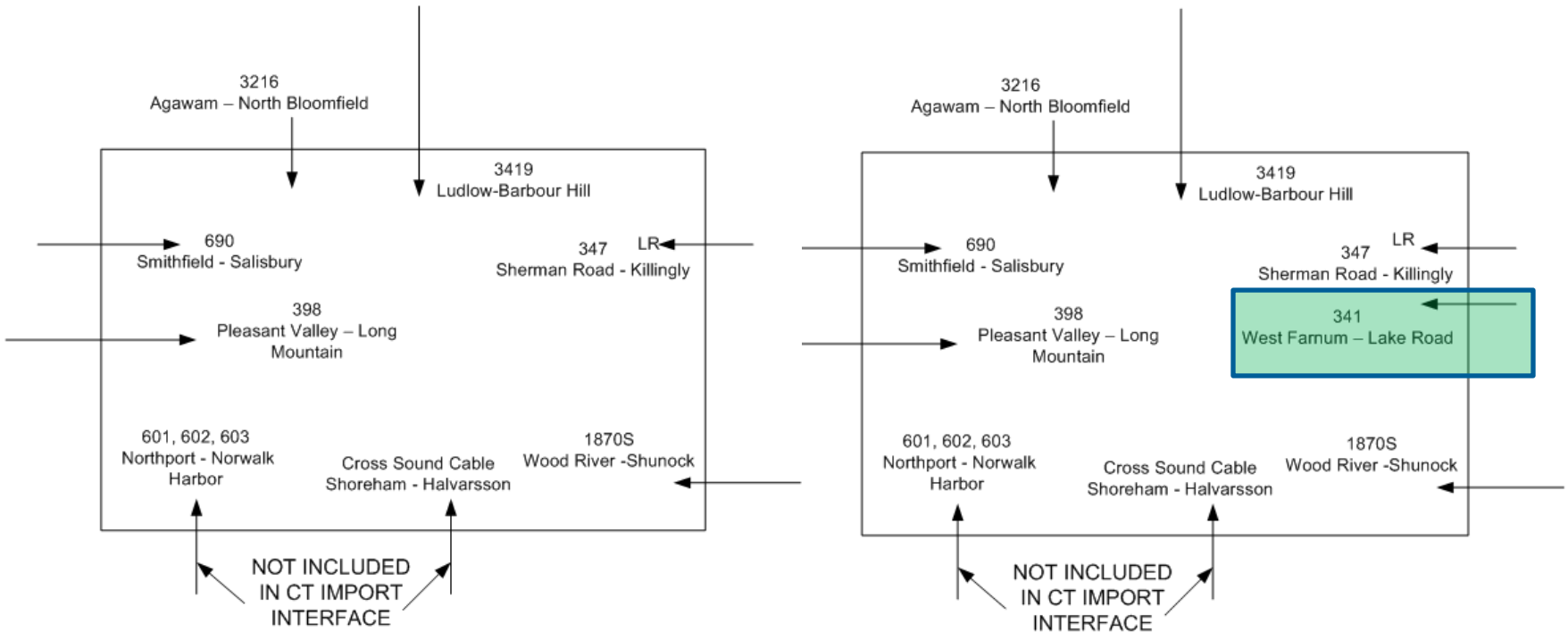
Lines represent interface lines; box represents state boundary; LR = Lake Road

CT Import Interface – Definition Changes over Time

- Post-Card-Lake Road portion of the NEEWS (repeated from previous slide)
 - 398 (Pleasant Valley – Long Mountain 345 kV)
 - 690 (Smithfield – Salisbury 69 kV)
 - 1870S (Wood River – Shunock 115 kV)
 - 3419 (Ludlow – Barbour Hill 345 kV)
 - 3216 (Agawam – North Bloomfield 345 kV)
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- Post-Interstate Reliability Project
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 - 1870S (Wood River – Shunock 115 kV)
 - 3419 (Ludlow – Barbour Hill 345 kV)
 - 3216 (Agawam – North Bloomfield 345 kV)
 - 347 (Sherman Road – Killingly 345 kV)
 - 341 (West Farnum – Lake Road 345 kV)



Post-Card-Lake Road to Post-IRP



Lines represent interface lines; box represents state boundary; LR = Lake Road

TRANSFER LIMITS VERSUS PROXY LIMITS

Transfer Limit Background

- System must be operated so that operating criteria are met within 30 minutes after the occurrence of an unanticipated system event (contingency)
- The first contingency limit establishes the amount of power that can be moved into an area for the first contingency. In other words, this is the amount of power that can be moved into an area with all elements in service such that the first contingency can be withstood. Often referred to as the N-1 limit
- The second contingency limit (N-1-1) established the amount of power that can be moved into an area for the second contingency. This is the amount of power that can be moved into an area with an element out of service such that the second contingency can be withstood



Transfer Limit versus Proxy Limits

- In some instances, operators may not be able to operate to the N-1 limit. Often operators will operate to a “proxy limit”, which is based on the N-1-1 limit plus 30-minute actions
- Numerical example
 - An area has an N-1 limit of 2000 MW and an N-1-1 limit of 1400 MW
 - An area has 200 MW of fast start resources (after derating by 20 percent) that are assumed to be available
 - Assume no other 30-minute actions are available
 - If the operators are operating at the N-1 limit of 2000 MW and then experience a first contingency, they must get to the N-1-1 limit of 1400 MW in 30 minutes to be ready for the second contingency. The only action they can take is to start the fast start resources, which provide 200 MW of relief ($2000 \text{ MW} - 200 \text{ MW} = 1800 \text{ MW}$ import)
 - In this scenario, the operators will fail to meet criteria in 30 minutes because the N-1-1 limit will be over by 400 MW ($1800 \text{ MW} - 1400 \text{ MW N-1-1 Limit} = 400 \text{ MW}$)
 - Instead, the proxy limit is set to 1600 MW ($1400 \text{ MW N-1-1 Limit} + 200 \text{ MW fast start relief} = 1600 \text{ MW}$). If the operators are operating at 1600 MW and then experience a first contingency, they must get to 1400 MW in 30 minutes. The fast start resources are started and the N-1-1 limit of 1400 MW in can be achieved in 30 minutes
- This is why areas with limited 30-minute actions may not operate near at their N-1 limit



CHANGES IN TRANSFER LIMITS OVER TIME

Pre-GSRP and Post-GRSP CT Import Limits

- Pre-GSRP CT Import Limit
 - N-1 = 2500 MW
 - N-1-1 = 1300 MW
- Post-GSRP CT Import Limits – initially established limits
 - Based on evaluations performed a number of years ago
 - N-1 = 2600 MW
 - N-1-1 = 1400 MW
 - Presented at the April 18, 2013 Power Supply Planning Committee (PSPC) meeting
 - In response to stakeholder questions ISO revisited the transfer limits

Post-GRSP CT Import Limits

- Review of previous testing
 - Limiting conditions were established based on system concerns within CT and distant from CT
 - Sink was established in SWCT to test Central Connecticut Reliability Project (CCRP – the fourth piece of NEEWS) and CT Import limits simultaneously
 - Identified issues moving power through central CT on the way to SWCT
 - Identified issues moving power out of Millbury
 - Old testing did not adequately handle the change in interface definition with the IRP in place
- Revised testing
 - Sink was established using all generation across CT – no longer concentrated in SWCT
 - System limits identified as distant from CT were ignored



Revised Post-GSRP CT Import Limits

- Initial post-GSRP CT Import Limits (repeated from previous slide)
 - N-1 = 2600 MW
 - N-1-1 = 1400 MW
- Revised post-GSRP CT Import Limits – provided at the June 3, 2013 PSPC meeting
 - N-1 = 3050 MW (increase of 450 MW over initial posting)
 - N-1-1 = 1850 MW (increase of 450 MW over initial posting)



Revised IRP CT Import Limits

- Initially IRP CT Import Limits
 - N-1 = 3400 MW
 - N-1-1 = 2500 MW
- Revised post-IRP CT Import Limits – provided at the June 3, 2013 PSPC meeting
 - N-1 = 2950 MW (“decrease” of 450 MW over initial posting)
 - N-1-1 = 1750 MW (“decrease” of 750 MW over initial posting)
 - Both values are less than they were for the post-GSRP system
 - The “decrease” is associated with a relocation of the interface, as explained later in presentation

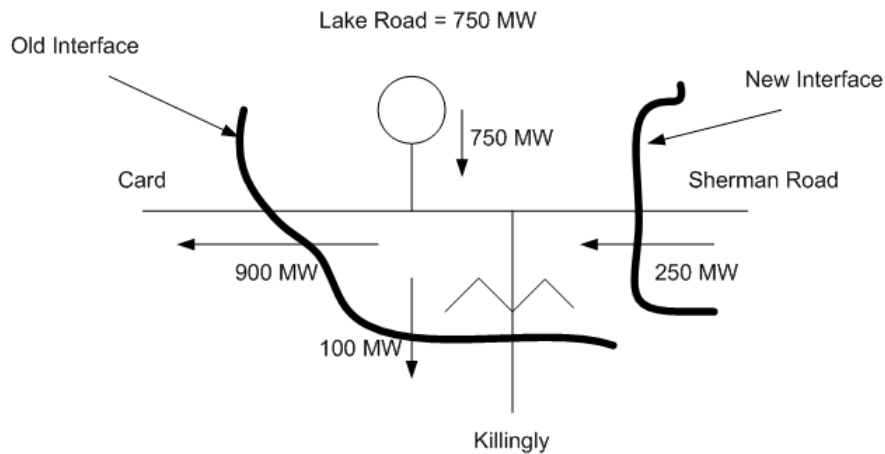


Does the IRP have Adverse Impact on the System?

- The IRP does NOT have an adverse impact on the system
- The CT Import limit decrease due to the change in location of the interface
- System capabilities are not decreased
- Numerical example to follow



Numerical Example – Moving the Interface



- To compare old transfer limits to new transfer limits, the impact of moving the interface must be understood
- Assume no changes to the system, simply move the interface to see how the math works
- Old interface
 - Lake Road – Card = 900
 - Killingly auto = 100
 - Total import = 900 + 100
 - Total import = 1000 MW
- New interface
 - Sherman to Killingly = 250 MW
- No changes have been made to the system, but by moving from the old interface to the new interface, flow is reduced by the amount of Lake Road (750 MW)

True Comparison to Previous Limits

- The addition of the IRP redefines where the CT Import interface is defined
- Similar to the example on the previous slide, redefining the interface moves Lake Road inside the interface and Lake Road output must be added to the interface limit for a true comparison
- Previous post-IRP CT Import Limits
 - N-1 = 3400 MW
 - N-1-1 = 2500 MW
- Revised post-IRP CT Import Limits – (presented at the June 3, 2013 PSPC meeting) + 750 MW due to Lake Road
 - N-1 = 3700 MW (increase of 300 MW over initial posting)
 - N-1-1 = 2500 MW (identical to initial posting)
 - The limits above are for comparison purposes only. Published limits remain:
 - N-1 = 2950 MW
 - N-1-1 = 1750 MW

Post-Card-Lake Road (Additional System Condition Needs to be Considered)

- Limits have been calculated for the condition where only Card-Lake Road is in service – the only portion of IRP that has been certified for FCA#8
- Limits as provided to PSPC on June 3, 2013
 - N-1 = 2800 MW
 - N-1-1 = 1600 MW
- “Limits” with 750 MW from Lake Road added in
 - N-1 = 3550 MW
 - N-1-1 = 2350 MW
 - The limits above are for comparison purposes only. Published limits remain:
 - N-1 = 2800 MW
 - N-1-1 = 1600 MW



Questions

