



# 2016 Maine Resource Integration Study – Status Update

---

*Planning Advisory Committee*

Al McBride

SYSTEM PLANNING

# Agenda

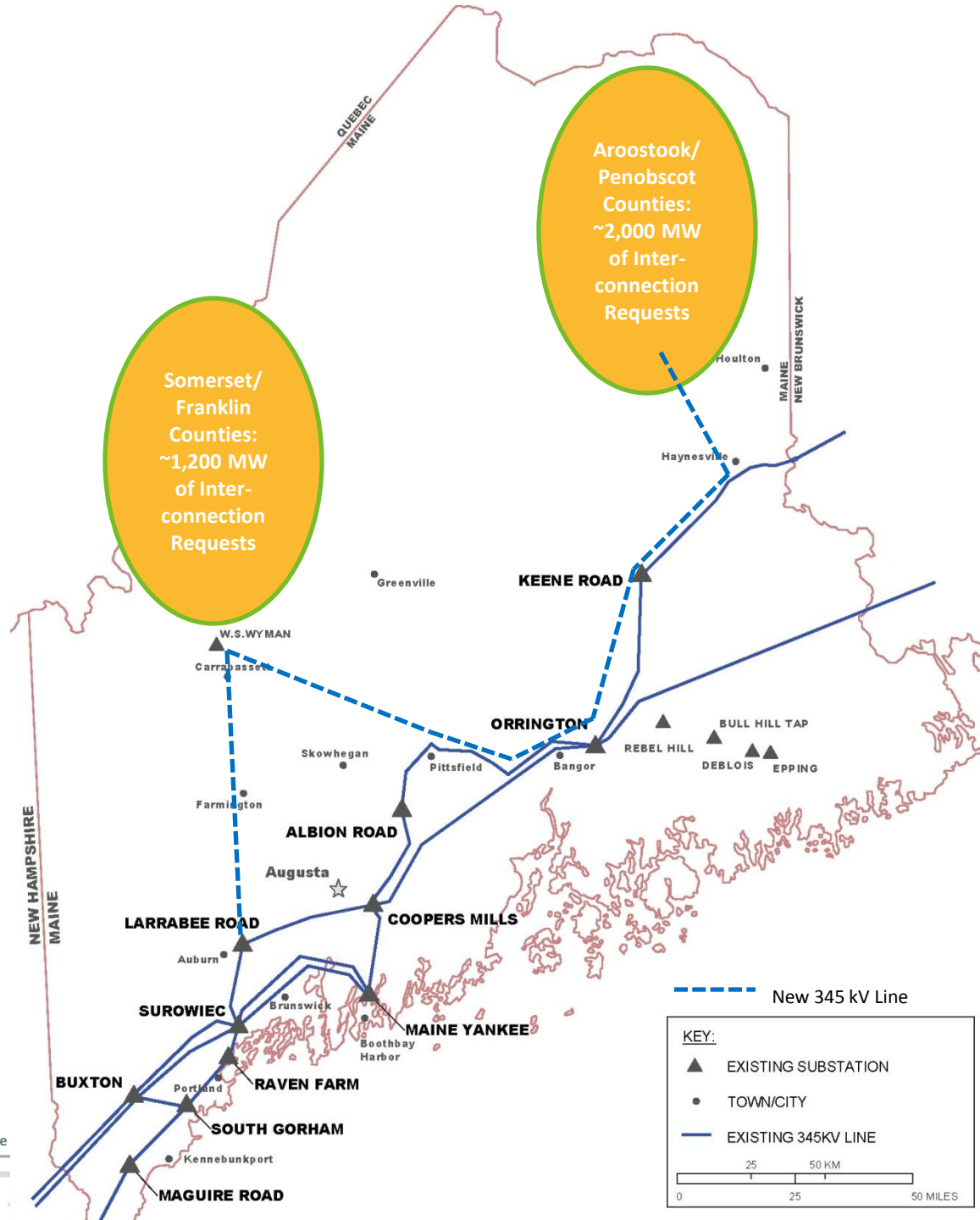
- Briefly review the objectives of the Maine Resource Integration Study
- Present the Interconnection Requests that have been identified as potentially eligible to participate in the cluster
- Present updated results of steady state analysis with application of the Network Capability Interconnection Standard (the Minimum Interconnection Standard)
  - Testing that includes re-dispatch within Maine
- Discuss preliminary stability analysis findings

# Study Objectives

- Identify potential transmission infrastructure that could be used **to interconnect** queued generation in Maine
  - Quantify generation that could interconnect with new transmission
  - See Appendix for discussion regarding the assumptions used in interconnection studies
- The Maine Resource Integration Study is focused on the assessment of new 345 kV AC transmission circuits that could connect to the areas with the largest quantity of requested new generation interconnections
  - [Scope](#) presented to the March 2016 PAC meeting
  - [Initial Steady State Results](#) presented to the September 2016 PAC
  - [Additional Steady State Results](#) presented to the November 2016 PAC
- The study will also attempt to identify whether there is an identifiable point where HVDC becomes an appropriate alternative to continuing to add AC transmission to the existing system

# Conceptual Transmission Upgrades

- Analysis of new 345 kV transmission in parallel with the existing network
- Evaluations include interconnecting with, or bypassing, existing lines and substations



# Link to Interconnection Queue Clustering

- The Tariff changes for the proposed interconnection clustering methodology received the support of the NEPOOL Participants Committee at the February meeting
- The proposed methodology will be triggered when more than one Interconnection Request requires common new transmission line infrastructure to interconnect
- Clustering approach will have two phases
  - Phase 1 will be a Regional Planning Study that is presented to the PAC
    - It is proposed that this Maine Resource Integration Study will be used as the regional study for the first cluster(s)
  - Phase 2 will be a Cluster System Impact Study where more than one project will be studied together and will share the costs for certain upgrades

# CLUSTER ELIGIBLE INTERCONNECTION REQUESTS

# Eligible Interconnection Requests

- The following Interconnection Requests are currently being considered in the Maine Resource Integration Study and have been identified as potentially eligible to participate in a subsequent Cluster System Impact Study (CSIS)
- This does not reflect the final list of Interconnection Requests that will be ultimately identified as eligible to participate in a subsequent CSIS
- The final eligibility to participate in such a subsequent CSIS will be determined by the final clustering rules, as approved by the Commission and the status of each Interconnection Request at the time of the finalization of the Maine Resource Integration Study

# Eligible Interconnection Requests, continued

QP417

QP458

QP459

QP460

QP461

QP462

QP470

QP471

QP571

QP572

QP573

QP574

QP576

QP577

QP578

QP589

QP590

QP591

QP593

QP594

QP621

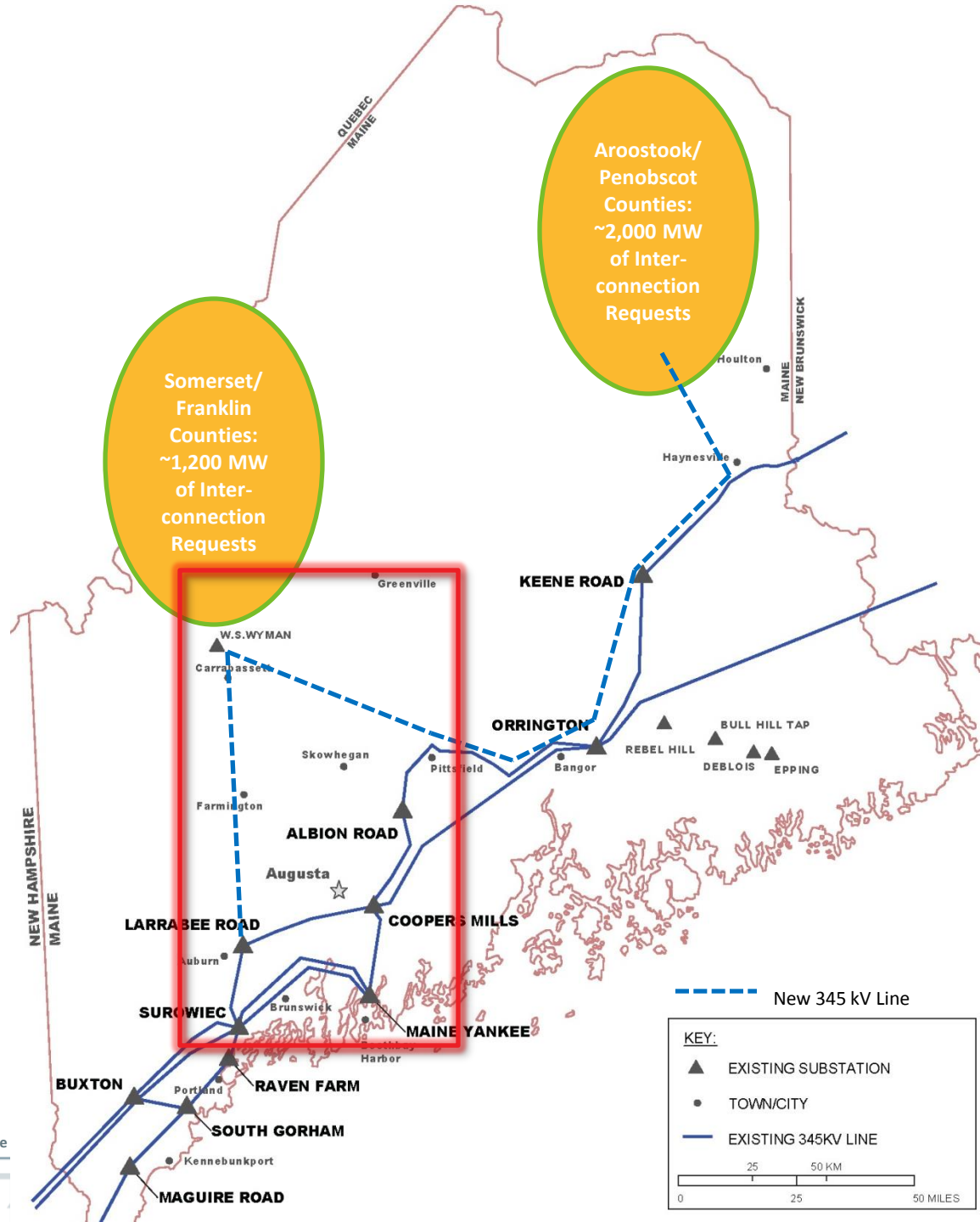
QP626



# REVIEW OF STEADY STATE RESULTS WESTERN MAINE

# Western Infrastructure Concepts

- 345 kV connections between the Wyman area and Pittsfield and/or Larrabee Road
- No connection proposed to the 115 kV at Wyman

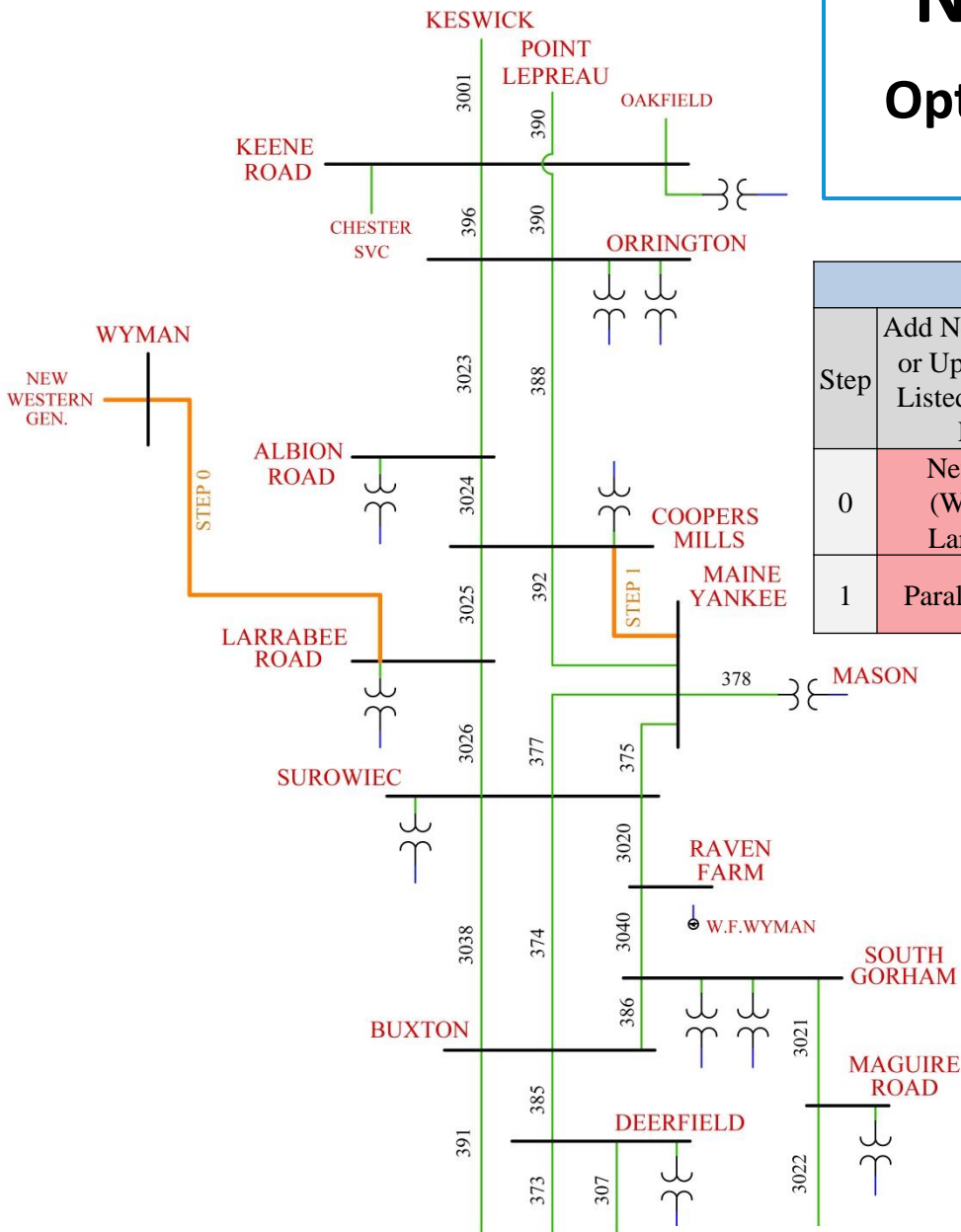


# Western Infrastructure Concepts

- Four alternative configurations were evaluated to interconnect resources in Western Maine
- Western Option 2a was identified to provide the best steady state performance – also compatible with Northern Maine infrastructure concepts

# N-1 New Western Gen.

## Option 2a – Interconnect at Larrabee from Wyman Western Gen.



(Wyman to Larrabee)

Step	Add New Line(s) or Upgrade the Listed Existing Line	Next Most-Limiting Element	Limiting Contingency	Available MW Injection*
0	New Line (Wyman-Larrabee)	S.392 (Coopers-ME Yankee)	S.3026 (Larrabee-Surowiec)	660
1	Parallel S.392	S.374/3038 (Surowiec-Buxton)	S.3040 (S.Gorham-Raven)	1001

\*No re-dispatch north of Maine-New Hampshire was conducted for these results

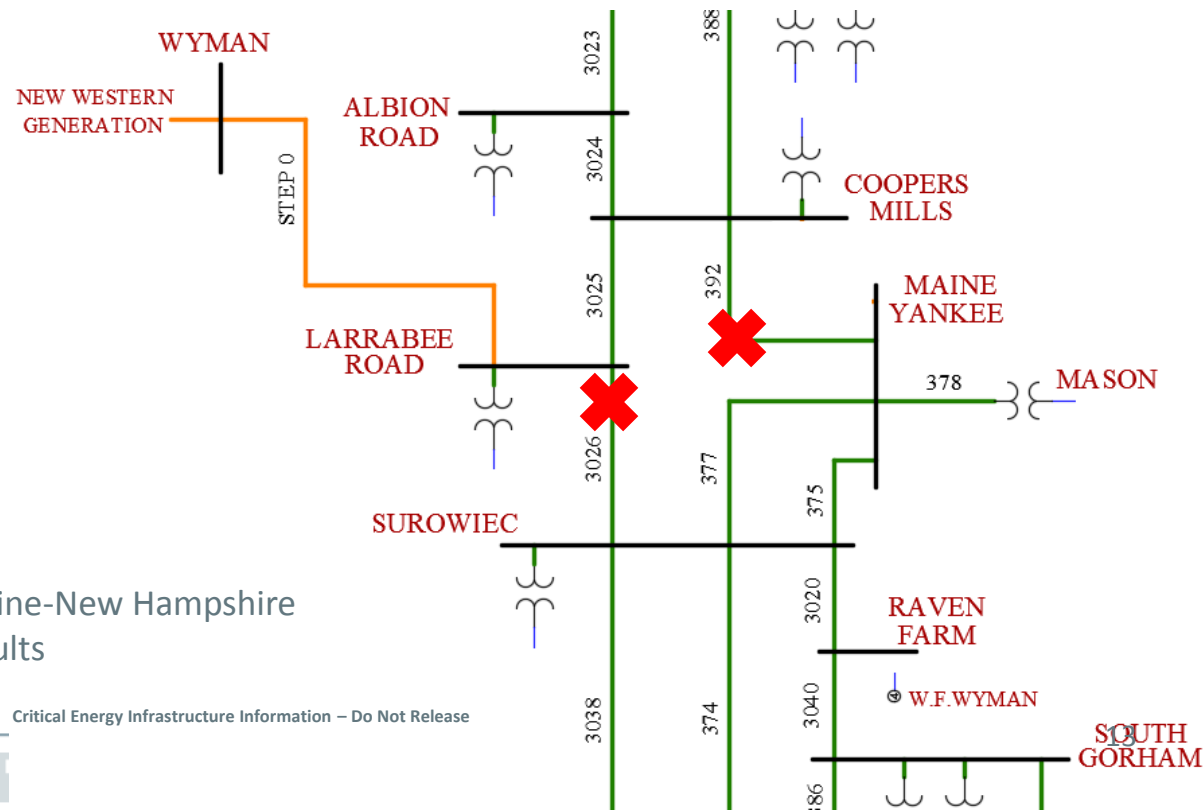
# Western N-1-1 Thermal Results – Option 2a

## (Step 0 Only)

The N-1-1 Limit for Western Option 2a modeling the addition of the new line from Wyman to Larrabee Road only is 460 MW.

In order to increase the amount of generation to greater than 460 MW a parallel S.392 would need to be added.

First Level Outage	Contingency	Monitored Facility	LTE Rating	Option 2a
				Wyman-Larrabee
				Available MW Injection
LN_3026	LN_392	CROWLEYS 115 SUROWIEC 115 1 <i>(Several Elements Overloaded)</i>	226	<b>460</b>



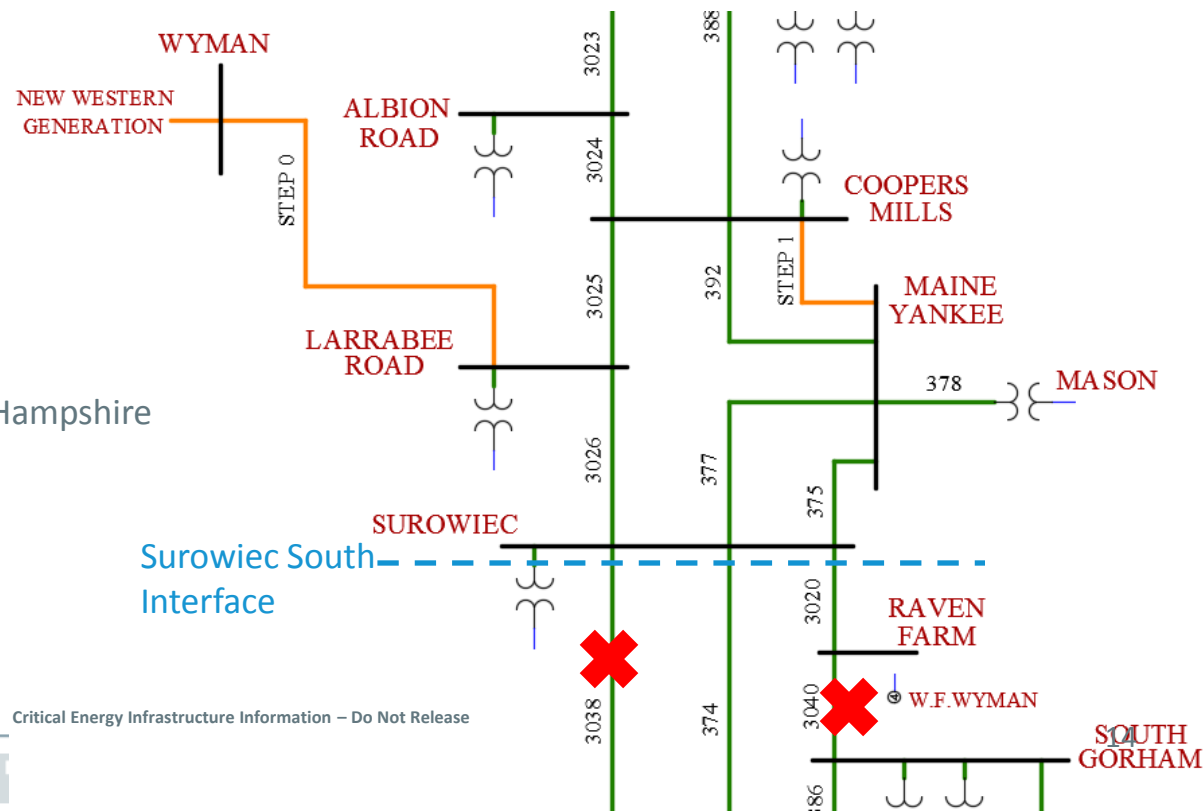
\*No re-dispatch north of Maine-New Hampshire was conducted for these results

# Western N-1-1 Thermal Results – Option 2a

## (Step 0 & Step 1 Upgrades)

The N-1-1 Limit for Western Option 2a, with the inclusion of a parallel S.392, is increased to 785 MW.

First Level Outage	Contingency	Monitored Facility	LTE Rating	Option 2a
				Wyman-Larrabee
				Available MW Injection
S.374/3038 (Surowiec-Buxton)	S.3040 (S.Gorham-Raven)	S.374/3038 (Surowiec-Buxton)	1429	<b>785</b>



\*No re-dispatch north of Maine-New Hampshire was conducted for these results

# Network Capability Interconnection Standard

## Re-dispatch Options – Western Option 2a

- Note that, without re-dispatch, there would be an increase in Surowiec South transfers
  - Surowiec South was at limit before the addition of the new resources
- For the N-1-1 limits found, a candidate resource to dispatch against is Yarmouth 4 (also known as WF Wyman 4)
  - Yarmouth 4 is connected to the 345 kV system
  - However, Yarmouth 4 is connected to the south of Surowiec South

# Investigation of Increasing the Surowiec South Transfer Capability

- Investigating increasing Surowiec South from 1,600 MW to 2,200 MW
  - The increased flow was simulated in the study by (partially) dispatching against Yarmouth 4
  - The remaining re-dispatch was performed by turning down existing Western Maine generation when adding the new proposed Western Maine resources
- Note that this increase in Surowiec South will require a significant amount of stability and voltage testing to confirm achievability
- As described later in this presentation, an increase in Surowiec South transfer capability would be used by both Western and Northern Maine proposed resources



# NCIS Re-dispatch Results – Western Option 2a

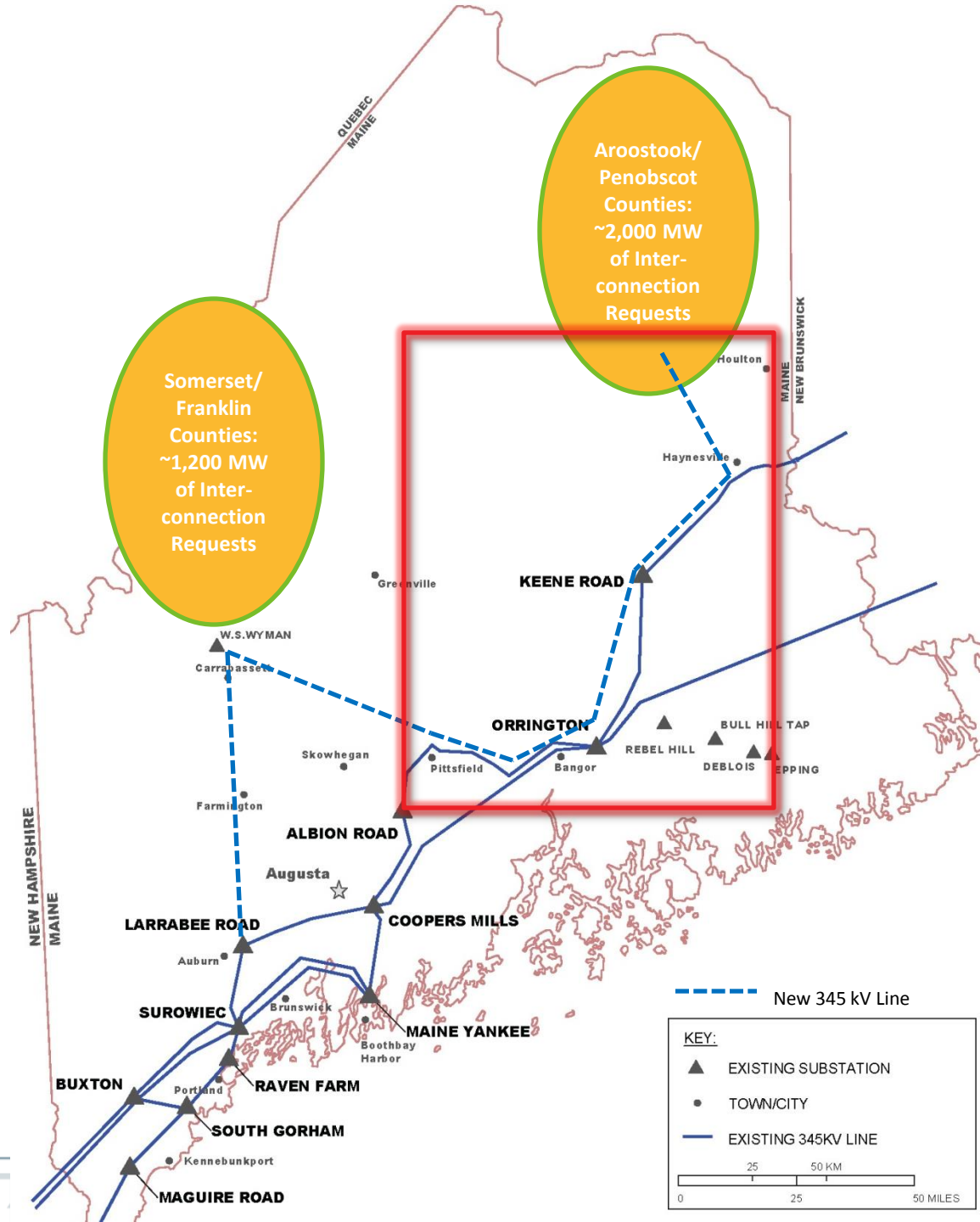
- When dispatching against Yarmouth 4 and existing Western Maine resources – no N-1 or N-1-1 thermal violations were identified for the addition of up-to 1,200 MW of new resources in Western Maine
  - From a thermal perspective, Western Maine option 2a can accommodate up-to 1,200 MW
  - **Note that significant stability and voltage testing is still required to demonstrate achievability**
  - **Preliminary stability and voltage testing is showing that very large reactive upgrades (perhaps more than 1,000 MVAR) are required**
  - **A preliminary review of short circuit strength is showing that significant reinforcement could be required, either in the form of synchronous condensers or additional transmission**

# STEADY STATE RESULTS

## NORTHERN MAINE

# Northern Infrastructure Concepts

- 345 kV connection between the Northern Maine area and Pittsfield



# Northern Infrastructure Concepts

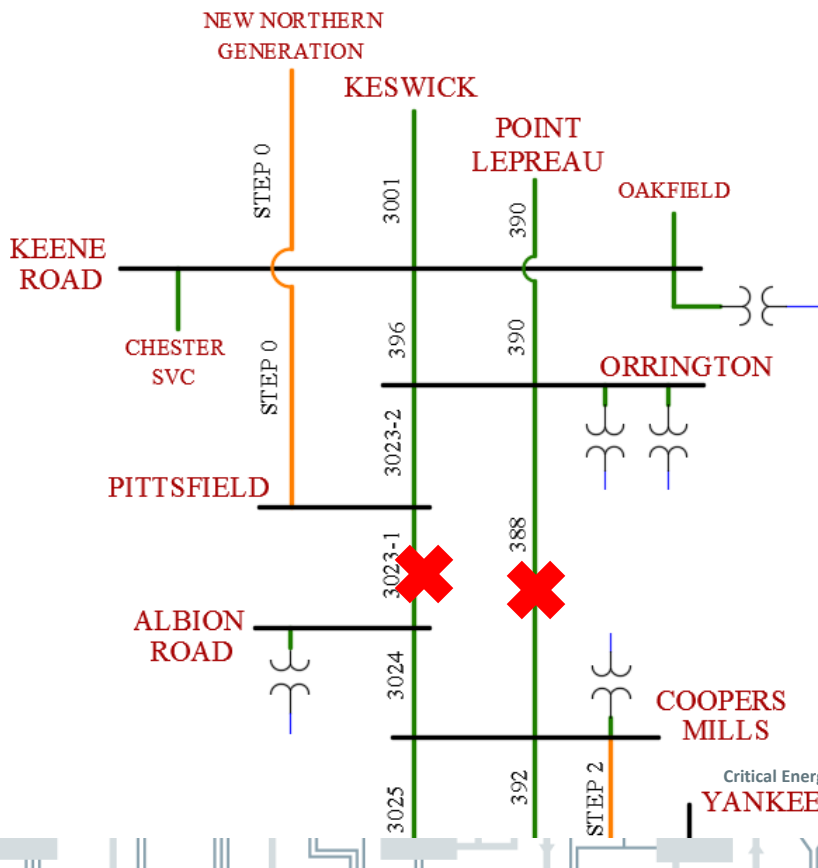
- Four alternative configurations were evaluated to interconnect resources in Northern Maine
- All four options showed the need for additional infrastructure to meet N-1-1 requirements

# Northern N-1-1 Thermal Results

First Level Outage	Contingency	Monitored Facility	LTE Rating	Option 1	Option 2	Option 3	Option 4
				Haynes. & Keene Road Interconnect	Keene Road Bypassed	Haynes. Bypassed	Haynes. & Keene Road Bypassed
				Available MW Injections			
LN_3023-1	Orrington K390/388 <i>(Several Contingencies)</i>	CMP_65_EM 115 BUCKSPORT 115 1	193	<b>345</b>	<b>344</b>	<b>345</b>	<b>346</b>

One line diagram for Option 4

Note that all 4 options were tested

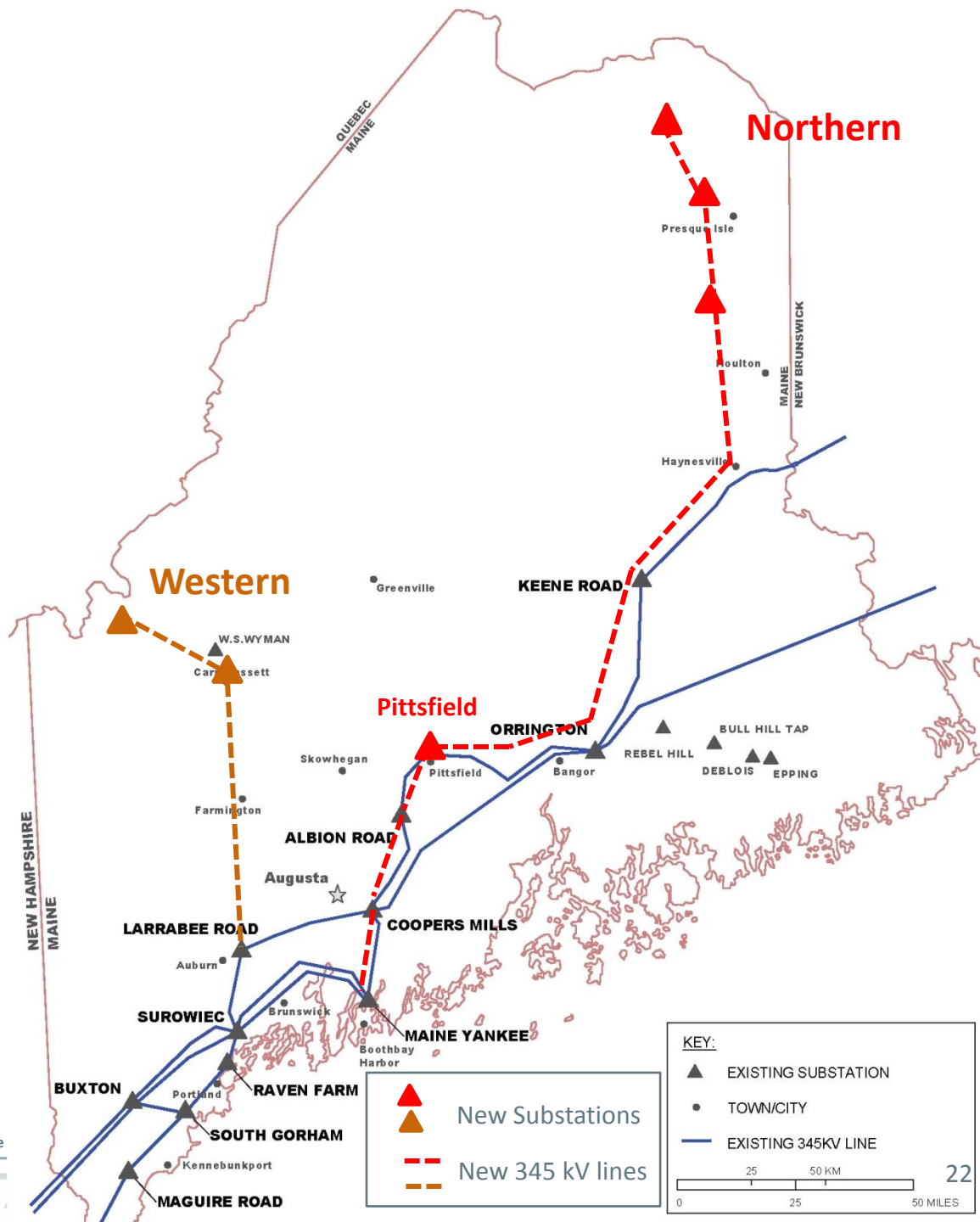


The N-1-1 Limit for all Options is approx 345 MW – additional upgrades defined in the N-1 analysis will not increase this limit. In order to increase this limit another line from Pittsfield or Orrington-South is required.

\*No re-dispatch north of Maine-New Hampshire was conducted for these results

# Conceptual Transmission Upgrades

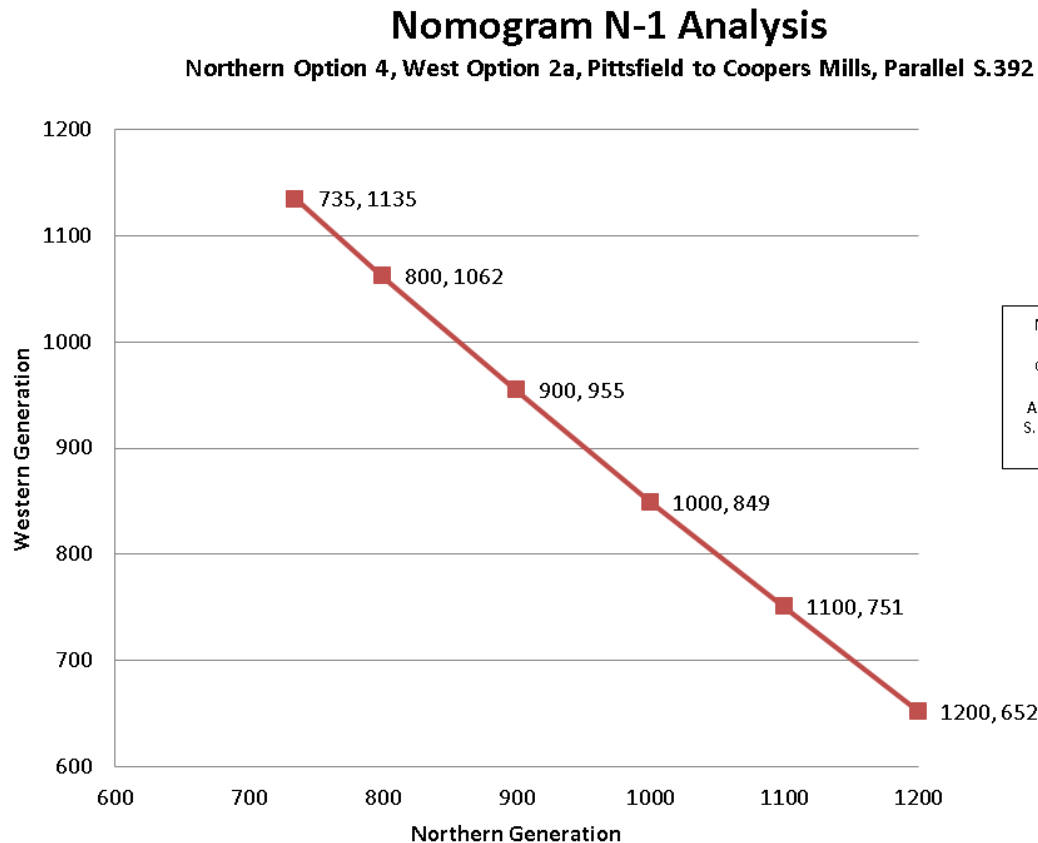
- Analyzed the addition of a parallel Pittsfield-Albion-Coopers Mills 345 kV path
- Also included a parallel 392 line (345 kV from Coopers Mills – Maine Yankee)



# NCIS Re-dispatch Results – Northern Option 4 with Pittsfield-Coopers & Parallel 392

- When dispatching against Yarmouth 4 and existing Western Maine resources – no N-1 or N-1-1 thermal violations were identified for the addition of up-to 1,200 MW of new resources in Northern Maine
  - From a thermal perspective, Northern Maine option 4 with Pittsfield-Coopers & Parallel 392 can accommodate up-to 1,200 MW
  - **Note that significant stability and voltage testing is still required to demonstrate achievability**
  - **Preliminary stability and voltage testing is showing that very large reactive upgrades (perhaps more than 1,000 MVAR) are required**
  - **A preliminary review of short circuit strength is showing that significant reinforcement could be required, either in the form of synchronous condensers or additional transmission**

# North/West Combination – Simultaneous Injection Capability



These combinations were  
Also all acceptable under  
The tested N-1-1  
Conditions

Northern Generation  
Fixed, Western  
Generation Adjusting  
  
All Scenarios Limited By  
S.84 Overload caused by  
the loss of S.259



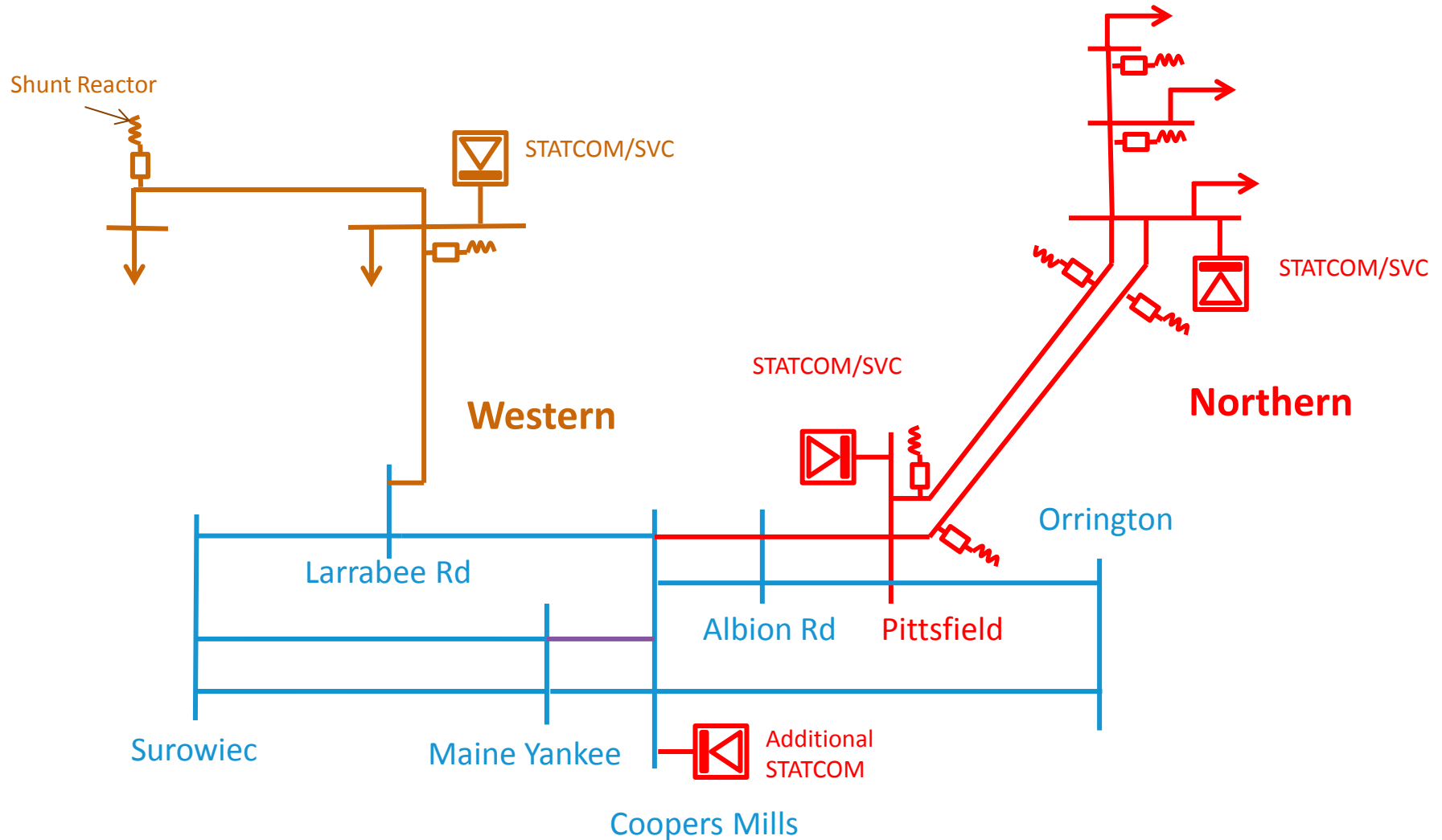
# PRELIMINARY STABILITY AND SHORT CIRCUIT RATIO TESTING

# Stability and Short Circuit Ratio (SCR) Testing

- Preliminary stability and SCR testing is indicating the need for the following upgrades:
  - To accommodate up-to 1,200 MW, the Northern connection from Aroostook County to Pittsfield should be double circuit
  - One Statcom/SVC with the Western projects
  - Two Statcom/SVCs with the Northern projects
  - Expansion of the existing Statcom at Coopers Mills
  - Shunt reactors with each transmission line element
  - Synchronous condensers with the Northern projects (and possibly with the Western projects)
- Comprehensive stability testing, short circuit ratio analysis and some PSCAD testing will be used to size the reactive device upgrade sizes



# Conceptual Transmission Upgrades



# Next Steps

- Complete weak grid evaluations
- Complete stability analysis
- Present final results
  - Q2 2017

# Questions



# APPENDIX

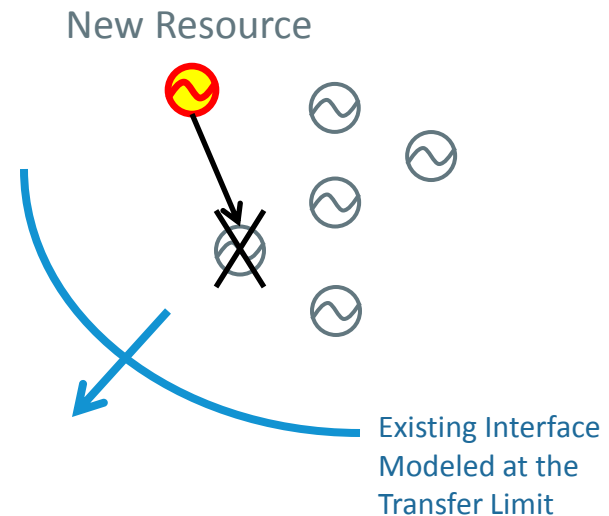
## *Study Approach of the Maine Resource Interconnection Study*

# Network Capability Interconnection Standard (NCIS)

- The conditions used in NCIS System Impact Studies are described in [Planning Procedure 5-6](#)
  - Peak load (mostly for steady state) and light load (mostly for stability) testing
  - Resources are modeled at their nameplate ratings (50 degrees F or 0 degrees F, as appropriate)
  - New Resources may dispatch against existing resources under the Network Capability Interconnection Standard
  - Interfaces modeled at the transfer limit

# System Impact Studies Ensure No Adverse Impact on Transfer Capability

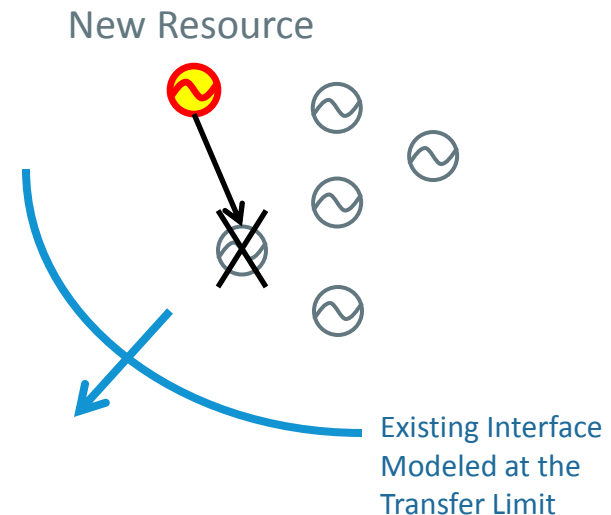
- New resources may dispatch against existing resources
  - Not required to increase transfer capability
  - Not allowed to degrade transfer capability
- What is the outcome?
  - After the addition of the new resource, more resources will now be competing to use the same transfer capability





# Why Ensure No Adverse Impact on Transfer Capability?

- Degrading transfer capability:
  - Would mean a reduction in the level of interconnection transmission service than has been previously provided to the existing resources
  - Would have additional consequences such as the reduction of upstream import capability from other regions
    - Reduction in tie benefits
  - May not be operable (transfer limit would decrease for an increase of one resource's output)

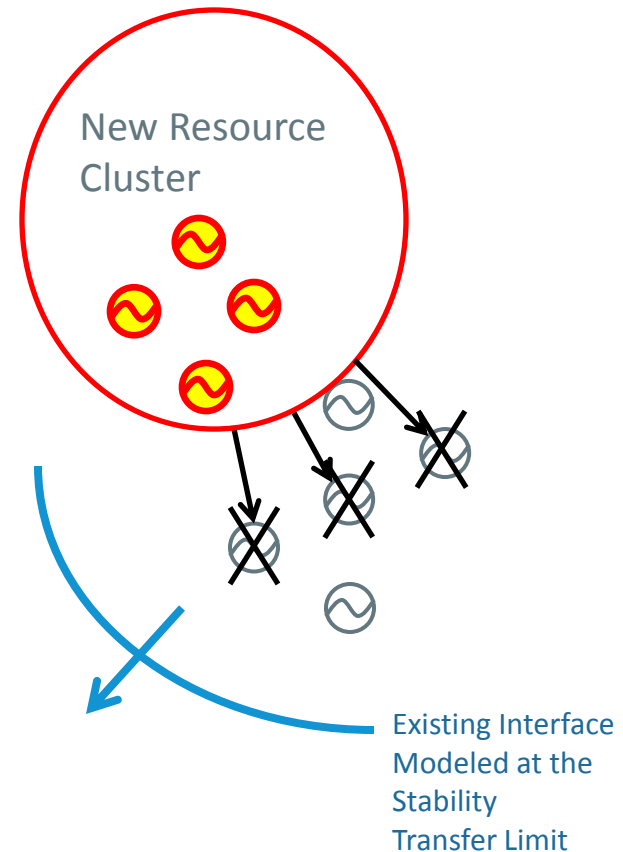


# A System Impact Study is Not an Economic Study

- A System Impact Study does not seek to forecast likely patterns of congestion or likely economic dispatch outcomes because such issues are not considered in the provision of interconnection transmission service
  - Under the interconnection procedures, resources request (and the ISO and Transmission Owner provide) interconnection service in the amount of requested nameplate capability
- Even though intermittent resources (such as wind) may not always be running at the full nameplate level, the interconnection service is still provided for the full amount
  - The full interconnection service is used when the resource runs at full output

# Implications for Cluster Applications of the Network Capability Interconnection Standard

- For the system to be operable, all possible combinations (up to the interface stability transfer limit) must be feasible
  - This will include scenarios where all of the resources in the cluster are running together at the same time



# Steady State

## Summer Peak Load Base Case Conditions

Interface Flows (MW)	Generation Dispatch (MW)	
New Brunswick-New England = 1049	Belldune	480
Orrington South = 1359	Mactaquac	290
Surowiec South = 1494	Bayside	170
Maine-New Hampshire = 1922	Coleson Cove	300
	Pt. Lepreau	705
	Mckay Hydro	33
	Jimmy Owl	26
	Stetson	57
	Dundee	33
	Rollins	27
	Passadumkeag	40
	MIS	310
	Oakfield	148
	Pisgah	9
	Bull Hill	34
	Bucksport	0
	Kibby	132
	QP333 Wind	185
	VERSO Cogen AEC	165
	Rumford Power	277
	Newpage Cogen	110
	Record Hill	51
	Sappi Somerset	97
	Westbrook Energy	539
	Yarmouth 4	623

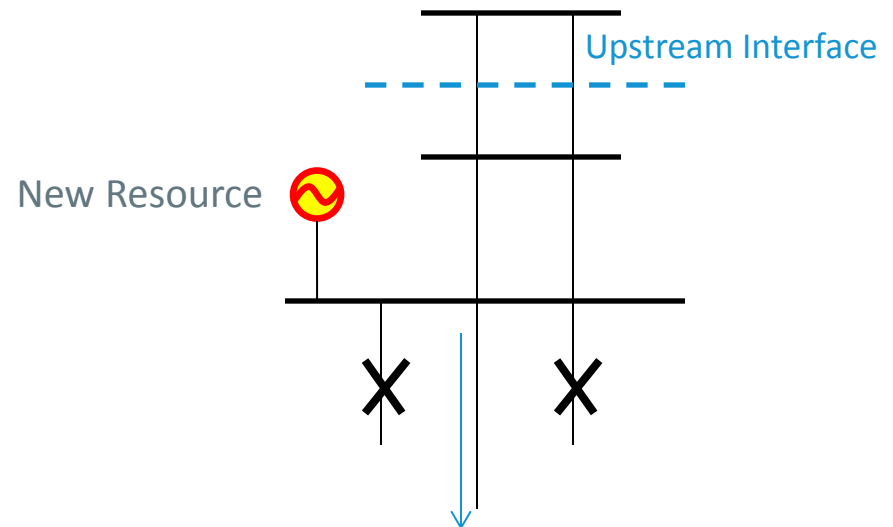
# Steady State N-1 & N-1-1 Thermal Testing

- Thermal transfer analysis for each interconnection area:
  - Northern Maine
    - 4 Potential Configurations (with no Western Injection)
  - Western Maine
    - 4 Potential Configurations (with no Northern Injection)
- Thermal transfer analysis for a combination using a configuration from each area
  - With simultaneous injections in both the North and the West
- All N-1 thermal transfer analyses used Short Time Emergency (15 minute) ratings
- N-1-1 limits respect Long Time Emergency (12 hours – Summer) ratings
  - Line Outages – All Maine 345kV Lines

# Criteria Note

## 1,200 MW Back Down Limit in N-1-1 Testing

- Up to 1,200 MW back down allowed between the first and second contingency:
  - New Brunswick (but upstream interfaces should be at-limit initially)
  - Existing Generation
  - New Generation



What is the back down required  
To ensure this line is within LTE  
Rating after the 2 contingencies?

# Criteria Note

## Limit of 1,200 MW on a Radial Connection

- The quantity of MW that can connect using a radial line is limited to 1,200 MW
  - Loss-of-source limit for Normal Contingencies

