Transmission Planning Assumptions

Probabilistic Methodology/Implementation and Minimum Load Level Update

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Purpose

- To provide updates to the assumptions and methods being used for generator dispatches in base cases
- To provide an update on Minimum Load level to be used
- To provide a tentative schedule for each of the planned Needs Assessments

Background

- ISO has been reviewing the key assumptions used in transmission planning studies and how they should be applied to Needs Assessment studies
- At the December 2015 and January 2016 PAC meetings, the ISO presented a conceptual methodology for base case assumption quantification
- At the February 2016 PAC meeting, the ISO shared with the PAC a summary of current industry efforts related to probabilistic transmission assessments
- At the May 2016, August 2016, and December 2016 PAC meetings, the ISO presented the PAC with detailed updates on the ISO's developing conceptual methodology for base case assumption quantification
- At the March 2017 PAC meeting, the ISO summarized the elements of the base case assumption quantification and described the plan to implement the new assumptions in late spring
- At the September 6, 2017 PAC meeting, two presentations were given:
  - Review of probabilistic method and including an update to the threshold
  - Provide specific details on the creation of Needs Assessment dispatches incorporating the probabilistic method

Background, cont.

- At the September 28, 2017 PAC meeting, the ISO made four presentations associated with study scopes using the new method and assumptions
  - 2027 Needs Assessment Scope of Work Common Assumptions and Study Methodology
  - SWCT 2027 Needs Assessment Scope of Work
  - Eastern Connecticut (ECT) 2027 Needs Assessment Scope of Work, Rev. 1
  - New Hampshire (NH) 2027 Needs Assessment Scope of Work

ISSUES AND RESOLUTION OF CONCERNS WITH STUDY SCOPES

Scope Review

- During the review period, the ISO continued to review the proposed dispatches and study conditions for the studies presented at the September 28, 2017 PAC meeting as well as additional studies that were being prepared to be delivered at future PAC meetings
- Initial impressions were that in some instances, implementation of the new method led to some study conditions that were more severe than anticipated
- Concerns regarding Minimum Load Level also surfaced

Unit Size Discrepancy

- Review of the dispatches showed the potential for a significant number of generators to be simultaneously unavailable
- The most glaring of these was found in the ECT scope presentation
- The ECT data showed that up to 488 MW of generation could be considered unavailable at peak load
  - The largest generator in the ECT study area is Montville 6 (413 MW). There are 13 other generators in ECT which only total 253 MW
  - In cases with Montville 6 in service, the method would suggest that all other units in the area could be shut off simultaneously
  - The presence of a single large generator in an area with a small number of smaller sized generators in the calculation can skew the results
- Solution
  - Recalculate the upper limit of generation outages using the probabilistic method by excluding the large generator(s) for dispatches with the large generator(s) in service
    - In the ECT example, in cases with Montville 6 in service the maximum amount of generation unavailable is limited to 115 MW (previously 488 MW)
  - This methodology will be used across all study areas in instances where there is a unit-size discrepancy within a group of generators for which a probability based MW unavailability is calculated

Load Level

- Comparison of the dispatches for the 90/10 load level versus the 50/50 load level showed much more severe dispatches are permissible
  - While there are limited additional hours of exposure, the calculation allows for significantly higher generator outages. As an example, for CT:
    - 90/10 load level = 1369 MW
    - 50/50 load level = 1901 MW
- Review of the dispatches has shown inconsistency with real time operating experience
- There is concern that the methodology may be oversensitive to changes in load level
- Solution
  - Eliminate 50/50 load level from consideration

Small Groups of Generators at a Bus/Station

- Review of the dispatches showed very pessimistic results on an individual station basis
- As an example, the SWCT scope included a dispatch at the 90/10 load level where three out of nine generators at Devon are simultaneously unavailable
- While the math showed that this dispatch is acceptable, it does not align with historical operating experience
- Review of the real world raw generator availability data shows this to be an overly pessimistic dispatch
- While only preliminary investigation has been done, part of the concern stems from using EFORd on a substation basis for generators with limited run time
- Solution
  - Establish a two unit upper limit on the number of generators that can be assumed unavailable at a bus/station. In other words, no more than two generators will be assumed to be simultaneously unavailable at a bus/station in any dispatch

Minimum Load Level

- Minimum Load Level evaluations currently consider a net New England load of 8,500 MW load level plus the Maine mill loads (originally 364 MW when the decision to use 8,500 was made, currently 320 MW)
  - As described in the technical guide, the handling of the Maine mill loads is different than what was intended
  - Original intent was to include the Maine mill loads in the 8,500 MW Minimum Load Level total
- A review of trends in Minimum Load has shown continued decreases over the past 5 years. Using hourly loads, the annual Minimum Load Levels were:
  - 2013 – 9195 MW
  - 2014 – 9135 MW
  - 2015 – 9046 MW
  - 2016 – 8851 MW
  - 2017 – 8838 MW
- A review of 2017 operating data has confirmed that real time load has already been at or below that being considered in long term reliability studies
- Solution
  - Revise the Minimum Load Level to 8,000 MW
  - Correct the original error on the handling of Maine mill loads in the Minimum Load evaluations – Maine mill loads are to be included in the 8,000 MW value

TENTATIVE NEEDS ASSESSMENT SCHEDULE

Tentative Schedule*

- SWCT, ECT, and NH
  - Post revised scope presentation for additional stakeholder comments in November 2017
  - Post draft scope report in December 2017
  - Post final scope report in Q1, 2018
  - Present study results in Q1, 2018
  - Post draft Needs Assessment in Q2, 2018
  - Post final Needs Assessment in Q2, 2018
- ME
  - Post scope presentation for stakeholder comments in November 2017
  - Post draft scope report in December, 2017
  - Post final scope report in Q1, 2018
  - Present study results in Q1, 2018
  - Post draft Needs Assessment in Q2, 2018
  - Post final Needs Assessment in Q2, 2018

*Assumes that changes in forecasts or FCA12 results do not require study revision.

Tentative Schedule, cont.

- WCMA
  - Post scope presentation for additional stakeholder comments in January 2018
  - Post draft scope report in February, 2018
  - Post final scope report in Q1-Q2, 2018
  - Present study results in Q2, 2018
  - Post draft Needs Assessment in Q2-Q3, 2018
  - Post final Needs Assessment in Q3, 2018
- SEMA/RI
  - Post scope presentation for additional stakeholder comments in December 2017
  - Post draft scope report in January 2018
  - Post final scope report in Q1, 2018
  - Present study results in Q2, 2018
  - Post draft Needs Assessment in Q2, 2018
  - Post final Needs Assessment in Q2, 2018

*Assumes that changes in forecasts or FCA12 results do not require study revision.

UPDATES TO SWCT, ECT, AND NH SCOPE PRESENTATIONS

SWCT, ECT, and NH Scopes

- Updated scopes have been posted for SWCT, ECT and NH
  - Redline (vs 9/28/17 version) and clean versions have been provided in today's materials
  - As noted in the revised scopes, comments on those scopes are due by December 3, 2018
- ECT and SWCT scopes have been modified to address the issues associated with discrepancies in resource sizes
  - No changes were needed in the NH scope to address this issue
- All three scopes have been modified to eliminate the 50/50 load level case(s) and incorporate necessary 90/10 cases
  - Some generator outages were originally considered only in the 50/50 cases
  - New 90/10 cases were added to ensure that this state was considered
- All three scopes have been modified to include the change in Minimum Load Level to 8,000 MW, including the Maine mill loads

SWCT Specific Changes

- Based on feedback received from Avangrid during the Stakeholder comment period, the load distributions submitted by Avangrid assume three behind the meter generators to be online
  - Yale DG1 – 8.7 MW
  - Yale DG2 – 8.7 MW
  - Sikorsky – 9.2 MW
- Since the net load distribution was developed considering that these generators would not be explicitly modeled, these generators are kept offline in all the dispatches
- These three generators were excluded from the maximum probability calculation for the three groups of generators considered for the SWCT study
  - The net impact was a reduction in MW unavailable of 5 MW for each group of generators considered
  - Due to the small size of these generators, the probability based MW unavailable thresholds for other study areas was not adjusted and all other study areas consider these generators to be a part of CT generation

ECT Specific Changes

- 1410 Line
  - Though work has been completed on the CMEEC portion of the 1410 line (RSP 1245), the final ratings have not been provided
  - Until ratings are finalized, the Normal, LTE, and STE ratings will be set to 100 MVA to allow for tracking of the actual flow on the line. This will allow the ISO to easily determine whether the line is overloaded once the final ratings are provided

APPENDIX

Selected slides from updated SWCT, ECT and NH presentations

SWCT

Step 2 – Set Dispatches at 90/10 Peak Load

- The non-renewable generators unavailable per dispatch at 90/10 peak load are shown in the table below
- Dispatches that end in A and B have different levels of NY-NE transfers
  - Dispatches with NY-NE at 0 MW end in A (example Dispatch D1A)
  - Dispatches with NY-NE at 1400 MW end in B (example Dispatch D1B)

D1A and D1B	D2A and D2B	D3A and D3B	D4A and D4B	D5A and D5B	D6A and D6B	D7A and D7B
BRIDGEPORT HARBOR 5	MILFORD POWER 1	TOWANTIC	BRIDGEPORT HARBOR 5	MILFORD POWER 1	MILFORD POWER 1	MILFORD POWER 1
DEVON 11	DEVON 15	MIDDLETOWN 4	COS COB 14	DEVON 15	DEVON 10	DEVON 10
COS COB 14	WHEELABRATOR BRIDGEPORT, L.P.	BERKSHIRE POWER	WATERSIDE POWER 1	WHEELABRATOR BRIDGEPORT, L.P.	DEVON 11	DEVON 11
WATERSIDE POWER 1	COS COB 14		PIERCE STATION	COS COB 14	WHEELABRATOR BRIDGEPORT, L.P.	WHEELABRATOR BRIDGEPORT, L.P.
PIERCE STATION	WATERSIDE POWER 1		KIMB ROCKY RIVER PH2	WATERSIDE POWER 1	COS COB 14	COS COB 14
KIMB ROCKY RIVER PH2	PIERCE STATION		BRANFORD 10	WATERBURY GENERATION FACILITY	WATERSIDE POWER 1	WATERSIDE POWER 1
KLEEN ENERGY	WATERBURY GENERATION FACILITY		FOXWOOD G1	KIMB ROCKY RIVER PH2	PIERCE STATION	WATERBURY GENERATION FACILITY
FOXWOOD G1	KIMB ROCKY RIVER PH2		NEW HAVEN HARBOR	BRANFORD 10	WATERBURY GENERATION FACILITY	KIMB ROCKY RIVER PH2
FOXWOOD G2	KLEEN ENERGY		NEW HAVEN HARBOR UNIT 2	FOXWOOD G1	KIMB ROCKY RIVER PH2	BRANFORD 10
HAMILTON GT	FOXWOOD G1		BERKSHIRE POWER	FOXWOOD G2	KLEEN ENERGY	FOXWOOD G1
WEST SPRINGFIELD 3	FOXWOOD G2			HAMILTON GT	FOXWOOD G1	FOXWOOD G2
	HAMILTON GT			NEW HAVEN HARBOR	FOXWOOD G2	HAMILTON GT
	WEST SPRINGFIELD 3			NEW HAVEN HARBOR UNIT 2	HAMILTON GT	NEW HAVEN HARBOR
				BERKSHIRE POWER	WEST SPRINGFIELD 3	NEW HAVEN HARBOR UNIT 2
						BERKSHIRE POWER

Legend	
	Generators Unavailable in Study Area
	Generators Unavailable in Adjacent Areas
	Generators Unavailable in Receiving End

Summary of Peak Load Dispatches – MWs Unavailable and Transfer Levels

Dispatch	Load Level	Adjacent Area	MW Unavailable in Study Area and Adjacent Area (Maximum MW^)		MW Unavailable in Receiving End (Maximum MW^)	External Interface Targets# (Maximum Transfer Capability in MW)					Additional Interfaces (Maximum Transfer Capability in MW)		
			SWCT 90/10 (666)	SWCT + Rest of CT 90/10 (1364)	Western NE 90/10 (1419)	NY-NE (1400)	NB-NE (700)	Phase II (1400)	Highgate (200)	CSC (0)	East-West (3500)	CT Import (3400)	SWCT Import (2800)
D1A	90/10	Rest of CT	657	1316	1415	0	700	1400	200	0	328	-833	1009
D1B	90/10	Rest of CT	657	1316	1415	1400	700	1400	200	0	-1029	-838	1005
D2A	90/10	Rest of CT	612	1271	1370	0	700	1400	200	0	282	-880	962
D2B	90/10	Rest of CT	612	1271	1370	1400	700	1400	200	0	-1073	-883	959
D3A	90/10	Rest of CT	770	1185	1419	0	700	1400	200	0	326	-969	1113
D3B	90/10	Rest of CT	770	1185	1419	1400	700	1400	200	0	-1033	-974	1110
D4A	90/10	Rest of CT	643	1162	1396	0	700	1400	200	0	308	-987	994
D4B	90/10	Rest of CT	643	1162	1396	1400	700	1400	200	0	-1050	-992	992
D5A	90/10	Rest of CT	554	1088	1322	0	700	1400	200	0	234	-1062	904
D5B	90/10	Rest of CT	554	1088	1322	1400	700	1400	200	0	-1121	-1066	902
D6A	90/10	Rest of CT	608	1267	1366	0	700	1400	200	0	280	-883	959
D6B	90/10	Rest of CT	608	1267	1366	1400	700	1400	200	0	-1076	-886	956
D7A	90/10	Rest of CT	549	1084	1318	0	700	1400	200	0	231	-1065	901
D7B	90/10	Rest of CT	549	1084	1318	1400	700	1400	200	0	-1124	-1069	899

^ Maximum MW is the Maximum unavailable MW of non-renewable generators based on probabilistic methods

Actual interface transfers may vary slightly from the targets due to power flow mismatches

ECT

Step 2 – Set Dispatches

- The non-renewable generators unavailable per dispatch are shown in the table below
  - Dispatches ending with A – East to West stress
  - Dispatches ending with B – West to East stress

90/10					
1A	2B	3A	4B	5A	6B
Montville 6	Plainfield	Montville 5	Lisbon	Lisbon	Montville 6
Plainfield	Norwich Jet	SECREC	UCONN	UCONN	Lisbon
Millstone 2	Montville 11	Millstone 2	Tunnel 10	Tunnel 10	Montville 11
West Springfield 2	Rand Whitney	Waterbury	Montville 10	Montville 10	Franklin/Manchester 9
	RISE	Wallingford 7	Foxwoods 1	Foxwoods 1	Pawtucket Power
	Mystic 7	S Meadow 12	Foxwoods 2	Foxwoods 2	Mystic 7
	Kendall	S Meadow 13	RISE	Rand Whitney	ANP Bellingham 1
	Medway Peaker 1	Devon 11	Mystic 7	Millstone	MBTA
		Devon 18	MBTA	Waterbury	Dartmouth Power A, B
		West Springfield 2	Dartmouth Power A, B	Wallingford 7	Putnam 2
			Waters River Jet 2	S Meadow 12	Medway Peaker 1
			Putnam 2	S Meadow 13	Waters River Jet 2
			Putnam 3	Devon 11	West Medway Jet 1
				Devon 18	
				West Springfield 2	

Legend	
	Generators Unavailable in Study Area
	Generators Unavailable in Adjacent Areas
	Generators Unavailable in Receiving End

A 20 MW threshold for units unavailable in the Receiving End was used

Summary of Peak Load Dispatches - MWs Unavailable and Transfer Levels

Dispatch	Load Level	Adjacent Area	MW Unavailable in Study Area and Adjacent Area (Maximum MW^)			MW Unavailable in Receiving End (Maximum MW^)		External Interfaces Targets# (Maximum Transfer Capability in MW)			Additional Interfaces (Maximum Transfer Capability in MW)	
			ECT (115)	ECT + Rest of CT (1,369)	ECT + RI (645)	Western (1,424)	Eastern (1,554)	NY-NE (1,400)	NB-NE (700)	Phase II (1,400)	E-W (3,500)	W-E (2,200)
1A*	90/10	Rest of CT	456	1,365	N/A	1,407	N/A	0	700	1,400	302	N/A
2B	90/10	RI	74	N/A	638	N/A	1,545	1,400	0	950	N/A	1,943
3A	90/10	Rest of CT	101	1,363	N/A	1,422	N/A	0	700	1,400	324	N/A
4B	90/10	RI	78	N/A	642	N/A	1,546	1,400	0	950	N/A	1,944
5A	90/10	Rest of CT	91	1,353	N/A	1,412	N/A	0	700	1,400	321	N/A
6B*	90/10	RI	429	N/A	643	N/A	1,509	1,400	0	950	N/A	1,904

^ Maximum MW is the Maximum unavailable MW of non-renewable generators based on probabilistic methods

Actual interface transfers may vary slightly from the targets due to power flow mismatches

* The Montville 6 EFORd is included in the MW unavailable threshold calculation for Dispatches 1A and 6B where Montville 6 is OOS

NH

Step 2 – Set Dispatches

- The non-renewable generators unavailable per dispatch at 90/10 peak load are shown in the table below
- Dispatches that end in A and B have different stress directions over the East-West interface
  - Dispatches with an East-West direction end in A (example Dispatch D1A)
  - Dispatches with a West-East direction end in B (example Dispatch D1B)

90/10								
D1A	D1B	D2A	D2B	D3A	D3B	D4B	D5B	D6B
Seabrook	Seabrook	Merrimack #2	Merrimack #2	Schiller #6	Schiller #6	Schiller #6	Schiller #6, Jet	Schiller #6, Jet
Lake Road	Dighton Power	Burgess	Burgess	Granite Ridge	Granite Ridge	Granite Ridge	Merrimack #1, CT #10	Merrimack #1, CT #10
Montville G6	Dartmouth Power	Lake Road	Mystic G7	Lake Road	Mystic G7	Yarmouth #3	Whitelake Jet	Whitelake Jet
Middletown G2		Montville G6	ANP Blackstone G2	Montville G6	Dighton Power	Mystic G7	Bridgewater	Bridgewater
Wallingford G2		Middletown G2	Dighton Power	Middletown G2	SEMASS G2	Dartmouth Power	Hemphill Power	Hemphill Power
		Wallingford G2	Dartmouth Power	Wallingford G2			Alexandria Gen	Alexandria Gen
							Tamworth Gen	Tamworth Gen
							Lost Nation Jet	Lost Nation Jet
							Bethlehem	Bethlehem
							Whitefield	Whitefield
							Mystic #7	Bucksport G3, G5
							ANP Blackstone G2	Verso Cogen #1
							Dighton Power	Verso Jay C
							Dartmouth Power	Yarmouth #1, #2
							SEMASS G1, G2	Casco Bay
								Mystic #7
								Dighton Power
								Dartmouth Power
								SEMASS G1

Legend	
	Generators Unavailable in Study Area
	Generators Unavailable in Adjacent Area
	Generators Unavailable in Receiving End

Summary of Peak Load Dispatches - MWs Unavailable and Transfer Levels

Dispatch	MW Unavailable in Study Area and Adjacent Area (Maximum MW^)		MW Unavailable in Receiving End (Max MW^)		External Interfaces Targets# (Maximum Transfer Capability in MW)			Additional Interfaces (Maximum Transfer Capability in MW)				
	NH 90/10 (740)	ME+NH 90/10 (885)	Eastern NE 90/10 (1,554)	Western NE 90/10 (1,424)	NY-NE (1,400)	NB-NE (700)	Phase II (1,400)	Orrington S (1,325)	ME-NH (1,900)	NNE Scobie+394 (3,450)	East-West (3,500/-2,200)	N-S (2,725)
D1A*	1,299	1,299	N/A	1,420	0	700	1,400	1,252	1,502	1,630	-21	953
D1B	1,299	1,299	1,550	N/A	0	700	950	1,252	1,502	1,637	-1,345	953
D2A*	436	436	N/A	1,420	0	700	1,400	1,252	1,500	2,777	-19	1,848
D2B	436	436	1,537	N/A	0	700	950	1,252	1,500	2,784	-1,275	1,849
D3A*	740	740	N/A	1,420	0	700	1,400	1,252	1,499	2,790	-19	1,520
D3B	740	740	1,529	N/A	0	700	950	1,252	1,499	2,797	-1,294	1,521
D4B	740	857	1,535	N/A	0	0	950	561	731	2100	-1,945	759
D5B	349	349	1,529	N/A	0	700	950	1,252	1,499	2,791	-1,270	1,924
D6B	349	655	1,552	N/A	0	0	950	457	544	1925	-1,936	979

^ Maximum MW is the Maximum unavailable MW of non-renewable generators based on probabilistic methods
# Actual interface transfers may vary slightly from the targets due to power flow mismatches
* The target is E-W stress, actual interface flows are W-E due to surplus generation in Western NE

Questions