

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-001

Date of Response: March 11, 2022
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Request from: Department of Energy

Witness: Hebsch, Jennifer J, Johnson, Russel D, Freeman, Lavelle A, Labrecque, Richard C

Request:

Reference: Eversource's October 1, 2020 Least Cost Integrated Resource Plan ("LCIRP") and the March 31, 2021 Supplement ("Supplement"), including all Attachments (providing various area planning studies, solution selection forms, and project authorization forms.)

- a. Please provide a table that lists each planned project Eversource has identified in its LCIRP (2020) and 2021 Supplement. Please indicate -- in the table-- if the project was the "least cost option." In the table, please list the "alternative options" (to resolve the same issue) and list the costs for the selected solution and each option. Please identify the sections of the 2020 LCIRP and Supplement, by bates numbered page, that reference the project and alternative options.
- b. For each instance where the Company did not choose the least cost option discussed in the area planning studies, solution selection forms, and project authorization forms, please explain in detail why the project was selected. The explanation should be in narrative form, referencing the table.
- c. Please provide supporting documents, including economic analysis and calculations.

Response:

The LCIRP (including the Appendices and the Supplemental filing) identifies projects in the following locations:

Group #1 - Original Filing Appendix K – this is a Grid Needs Assessment that lists numerous line and station projects >\$250K.

Group #2 - Original Filing Appendix L – provides Solution Selection Forms ("SSFs")/Project Authorization Forms ("PAFs")/Initial Funding Requests ("IFRs") for 6 different projects.

Group #3 - March Supplement – Appendix C – this is a listing of Proposed Reliability Projects (distribution line reliability) that have been proposed but have not been funded by the 2021 or previous years capital budgets.

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Group #4 - March Supplement – Appendix D – contains early versions of the IFRs for 20 System Planning projects that are in early development (SSFs have not been created).

Group #5 - March Supplement – Appendix E – contains early SSFs for White Lake, Dover, and Monadnock

Group #6 - March Supplement – Appendix F – contains PAFs for Distribution Line projects in the 2021 Capital Plan.

Response to Parts (a) and (b): Attachment DOE 4-001 provides the requested data for planned projects in Group #2, Group #5, and Group #6, totaling 37 projects.

The projects in Groups #1, #3, and #4 have either not progressed to the planned stage or are duplicates of projects included in Groups #2, #5, or #6.

Response to Part (c): Supporting documentation for these projects (SSFs and PAFs) are included in either the original LCIRP filing or the Supplement. For each project, specific additional supporting documentation is available on request.

Document	Bates #	Project Name	Selected Option	Alternative - #1	Alternative - #2	Alternative - #3	Least Cost (Y/N)	Explanation
Oct 2020 - App. L	391	A20C40 Replace	\$148k This PAF is to provide funding for a survey of the first of four zones identified for the replacement of primary conductor on all four network circuits. The survey is intended to create a pull plan for circuit cable routing as well as identify in advance issues needing to be addressed during construction. Additional PAFs will be submitted for subsequent surveys and cable replacement projects.	Address cable failures one at a time as they occur. This increases the overall cost of replacements due to the need to mobilize to respond to a failure and demobilize after replacing that section, until the next failure occurs. This alternative also depends on outages not cascading, which cannot be guaranteed.			Yes	
March 2021 - App. F	508	Manchester Network Cables	The total project will be to replace approximately 9,000 feet of 13.8 kV 350 mcm PILC mainline network cable circuiting per year for four years. Additionally, replace approximately 750 feet of 1/0 PILC tap cable feeding the thirty-three network transformers (approximately eight per circuit) as required. It should be noted that some taps were already replaced as part of the network transformer work over the past 15 years. It is proposed that four modular, disconnectible H-body splices be installed in MH 32A on Elm St. This would allow for a Nutfield Lane circuit to be de-energized for re-conductoring while the remainder of the circuit remains energized from Brook St. This approach could also be adopted while working on Zone 4 by using these same type of splices.					
March 2021 - App. F	456	A17C30 - Pack Monadnock Rebuild	\$3,900k The scope of this project is to construct a new 5,200 foot of primary single-phase line with covered primary conductor. Thirty new poles will be installed. All of the existing line and equipment up to the summit will be removed. A new service will be run to the MIT building, located approximately halfway up the mountain. Work associated with the summit will be addressed under a separate Project Authorization.	from Preliminary Funding PAF 5/8/17: Replace above-ground conduit with direct-buried cable in conduit. Due to the rugged mountain terrain, this was not considered a viable option. Randy Knepper, PUC Director of Safety & Security, proposes an overhead solution as the current terrain prohibits an underground solution.	from 4/15/20 Revision: Multiple alternatives have been considered including various overhead and underground options. All were reviewed internally and with external stakeholders. The final solution for this upgraded line was the result of three years of negotiations, public forums, site meetings, constructability reviews, and buy-in from our State partners.		No	Explanation is included in Alternative #2 description
March 2021 - App. F	468	A21E09 3191X3 - 3191 Circuit Tie	\$579k Convert a 4.16kV section of the 3112X4 to 34.5kV in order to create a tie between the 3191X3 and the mainline of the 3191. Reconductor 1700 feet of 1/0 Spacer Cable and change 9 overhead transformers from 4.16kV to 34.5kV. This would allow for switching around faults on the 3191X3 and picking up customers while work is being done. Install a new recloser for a new tap off the 3191 mainline and another recloser on Winnicut Rd for sectionalizing. (PAF 7/23/2021)	The alternate consideration would be to convert the 3112X4 all the way back to the tap on Breakfast Hill Rd. This would create a tie for the 1564 customers on the 3191X3 and the 149 customers on the 3112X4. This project would add an additional 3000 feet of 1/0 spacer cable, 25 overhead transformers, 2 pad transformers and 1 single phase step-down transformer. The total cost of this project would be \$912,500.			Yes	
March 2021 - App. F	474	A20C16 Bouchard St Replace Cable and MOST Switchgear	\$544k The current three phase 1/0 underground cable feeding the Bouchard St tap will be replaced by approximately 1,100 feet of three phase 1/0 AAC spacer cable. Six poles will be installed and nine poles will be replaced. Elimination of the M.O.S.T switchgear and a sector cabinet will be accomplished by the construction of three risers. Two live front transformers will be replaced, with another unit relocated to a more optimum spot next to the building it serves. Approximately 1,800 feet of 5" conduit will be needed for the civil portion of the job.	1) Reuse the existing cable system as is. However, a good portion of this cable tested in 2013 yielded marginal results (neutral deterioration of < 50% capacity), and there have been several cable failures over the past years. Therefore, it is advisable to replace the existing cable. Replacement of all direct buried cable on Bouchard St with cable in conduit was considered too expensive (\$654,000 total job cost). So while customers will continue to have underground cable feeds to their pad-mounted transformers, the main line cable on Bouchard is proposed to be replaced with overhead spacer cable.	2) Reuse cost reducing measure would be to remove Gentex Corporation at 645 Harvey Rd from the project. This facility is fed from a separate riser pole and cable. It was included in the original project because the cable is also of 1970's vintage and its transformer is live-front. The estimated cost savings for removing this work from the project is \$95,000.		No	Alternative does not address project objectives.
March 2021 - App. F	480	A21E21 63W1 Reconductor Drake Hill Rd	\$1,062k Install 1.06 miles of 477 Spacer cable along Drake Hill Rd in Strafford. Install 1-167 kVA, 219A, 7.2 kV Regulator and associated equipment at P820/90 on new phase. Install 1-900 kVAR Capacitor bank and associated equipment at P820/109	Convert the circuit to 34.5 kV and install step down transformers for side taps. This alternative was not fully investigated due to the magnitude of cost increase and reliability issues.	Another alternative considered was to install a 12 kV substation in the Rochester AWC to offload East Northwood. This option is far more costly and cannot resolve voltage issues by 2021 summer peak period.		Yes	
March 2021 - App. F	487	A20C24 Pad Step RTE 13	\$754.5k Install one 19.9/34.5 kV to 7.2/12.47 kV, 5 MVA three phase pad-mounted step transformer and remove the six existing 500 KVA steps. Utilize existing load side 12.47 kV DA SCADA device. An easement or land purchase of \$30K to place the new transformer has been included in the cost estimate.	Alternative 1: Reconductor and convert up Route 13 for 3.88 miles just beyond Gorham Pond Road (pole 13/217). Initial assessment by Designer shows having to replace or work on almost half the poles in this section. In addition, current standard is covered wire so the existing #2 ACSR would be replaced with 477 spacer cable. Addresses future loading on 1000 KVA steps for 8 years based on 2% load growth. Step loading (60%,35%,84%). No simple load balancing available. Estimated at \$2,412,000	Alternative 2: Reconductor and convert up Route 13 for 2 miles just beyond Paige Hill Road (pole 13/116). Initial assessment by Designer shows having to replace or work on almost half the poles in this section. In addition, current standard is covered wire so the existing #2 ACSR would be replaced with 477 spacer cable. Addresses future loading on 1000 KVA steps for 3 years based on 2% load growth. Step loading (94%, 94%,68%). All simple load balancing taken into account. Estimated at \$1,382,000		Yes	
March 2021 - App. F	502	A21E22 3191X1A Piscassic Rd Conversion	\$1,057k The conversion will complete the following: -Convert 26 transformers – 2.4kV to 19.9 kV -Install 3-500 kVA 19.9/2.4 kV Step-downs. Remove 3-333 kVA step down transformers -Remove 4-2.4kV/19.9kV Step up transformers. -Reconductor 10 spans of 3-#4 CU conductor with 3-477 SPCA from P2/4 to P2/14 (1214') -Reconductor 16 spans of 1-#2 ACSR conductor with 1-1/0 AL TW from P14/1 to P14/9 (2815')	An alternative considered was to reconductor up to P2/54 to remove additional step up transformers from the system and to convert more of the 2.4 kV circuit. To reduce project costs, it was determined the best solution was to convert only the three phase on Piscassic Rd.	Another alternative considered was to install parallel steps instead of converting Piscassic Rd. The copper conductor on Piscassic Rd would still need to be reconducted due to overload, and the #2 ACSR on Old Lee Rd would need to be converted due to condition and overload.		Yes	
March 2021 - App. F	515	A21E23 Fogg Rd Conversion	\$543k This project will complete the following: -Conversion of the 377X3 from 4.16 kV to 34.5 kV on Fogg Rd -Install parallel 500 kVA steps on N River Rd -Reconductor 1-1/0 ACSR on Coffin Rd from P29/311 to P29/22 with 3-477 Spacer. -Provide capacity to serve new 100 home URD on Fogg Rd, Epping -Create a future circuit tie between the 377X3 and 377X10. -Offload step on the 377X10.	Extend three phases on Coffin Rd (2650', 16 spans), convert Fogg Rd (18 spans to 19.9kV) and N River Rd (30 spans to 19.9kV). -Converting Fogg Rd, 7 OH transformers: \$28,000 -Converting Old Stagecoach Rd, 2 OH transformers: \$8,000 -Converting N River Rd, 9 OH Transformers: \$36,000 -Converting N River Rd, 10 Pad mount transformers: \$60,000 -Install new 250 kVA stepdown on Old Stage Rd: \$20,000 -Install new 500 kVA step on N River Rd: \$20,000 -Cost of 2600' of 477 Spacer Cable: \$424,000 -Total cost: \$599,000 This alternative converts an additional 25 spans further down N River Rd to P30/25A. This allows us to feed the remaining 4.8 kV load with 1-500 kVA step down.			Yes	
March 2021 - App. F	520	A20C46 317 Line Section Rebuild Warner	\$944k 27 poles to be replaced with self-weathering steel 5,000' of conductor to be replaced with 477 MCM spacer cable 5,000' of 127 AWA messenger to be installed which will add a neutral to an existing 3 wire system	Do nothing This alternative was not chosen because it does not address the condition deficiencies associated with this line portion and the impact on system reliability or resiliency.	This will address the concern of individual component reliability but will reuse remaining parts of the structure. Due to the age of these poles (approximately eighty-five years), it is likely that many of these poles will also have to be replaced in the near future. This would result in additional line outages, environmental impact, and repeating the work of removing / installing the crossarm. In addition, replacement of an entire structure is more efficient as the new structure is installed next to the existing, and wires transferred. This reduces the cost of having to temporarily support wires and can result in reduced restoral time. This would also not address the clearance issues. As a result, this alternative was not selected. This option also does not address the lack of a system-neutral or the brittle and annealed #2 copper primary conductor.	Replace Only Deteriorated Components Replace Only Structures with Deteriorated Components	No	Alternative does not address project objectives.
March 2021 - App. F	533	A21E24 Beauty Hill Road Conversion	\$522k Convert forty overhead 7.2kV transformers to 19.9kV transformers along Beauty Hill Rd and Hall Rd. Remove Parallel 500 kVA step-down transformers on Beauty Hill Rd. Install two 500 kVA step-down transformers on Hall Rd and Beauty Hill Rd beyond converted areas and two 167 kVA step-down transformers on Granville Rd and Lakeside Oaks Rd to minimize conversion costs.	\$849k Convert Beauty Hill Road and portion of Hall Road. Convert 25 sections of Beauty Hill Rd and 54 sections of Hall Road in Barrington NH to remove overloaded parallel stepdown transformers on the 392X7 circuit out of the Rochester AWC. This approach eliminates the parallel 500 kVA stepdown transformers and hanging new stepdown transformers further out on the circuit.			Yes	
March 2021 - App. F	539	A20E47 Codfish Corner Rd	\$585k Replace failed direct buried cable on the 3105X1 and put the Portsmouth Trailer Park loop back into service. Install 1,850 feet of underground single phase 1/0 XLP cable in conduit between transformers 146/134T2 and 146/134T7 and between transformers 146/134T2A and 146/134T3 to restore loop. Remove overhead out of service riser from customers backyard. Install a new dead-front transformer and removes 75 kVA live front transformer (146/134T2). It also replaces a second live-front transformer (146/134T3) to help complete loop and allow switching without having to de-energize customers.	The alternate consideration would be to splice the failed direct buried cable and use existing out of service riser. This is not possible as the riser and direct buried cable are on private property with no easement and customer will not allow rebuild as wire spans over their home which is a violation of the NESC in its current state.			Yes	
March 2021 - App. F	547	A21L5 Distribution Line Sensors	\$360k Install approximately 140 line sensors at various locations on the Eversource NH distribution system.	Install reclosers that will provide load information and alerts of an outage on a circuit. Estimated Cost: \$70,000 - \$80,000 each. 46 three phase installations at \$70,000 each would be \$3.2M			Yes	
March 2021 - App. F	555	A20E48 Foundry Place Switchgear	\$290k Install 2400 feet of backbone primary into the existing manhole and duct bank system in order to add another switchgear to the 15W4. The switchgear will cut in between Switchgear #2 and #12 and create a load port loop with Switchgear #12 and add a spare load port to downtown Portsmouth. To do this primary will be run through existing conduits that connect MH16, MH17, MH18 and MH19. It will create a loop for radially fed transformers and incoming customers, as well as adding another switching point for the downtown Portsmouth underground system.	The alternative would be to tie in the new switchgear with switchgear 2. This project would require about 2600 feet of primary in the existing manhole and duct bank system. This project is less favorable because it would require an additional 200 feet of underground primary cable.			Yes	
March 2021 - App. F	563	A21N28 Route 16 Line Relocation NHDOT (needs Revisions)	\$169k Construct in new location approximately 2,500 feet of three phase overhead line in Ossipee, NH. The new line will require new conductors on new poles.	No alternatives were considered, as this work is required by state law.			Yes	
March 2021 - App. F	569	A20N50 Line Relocation Route 106 Loudon	\$366k Construct in new location approximately 6,900 feet of three phase overhead line in Loudon NH. The new line will relocate the existing conductors onto new poles.	No alternatives were considered, as this work is required by state law.			Yes	

March 2021 - App. F	578	A21N46 IRU Fiber IFR	\$35k The project objective is to develop segments of a SONET telecommunication network in the northern region of NH to enable provisioning of teleprotection circuits. This project is seeking initial funding in the amount of \$35,000 to: •Develop the scope \$10,000 •Estimate the project \$5,000 •Complete the constructability reviews \$5,000 •Complete conceptual engineering \$10,000 •Other/misc. \$5,000			N/A	Project scope will be developed following completion of the work defined in the Initial funding request.	
March 2021 - App. F	585	A20W33 - Pack Monadnock Summit Rebuild	\$425k The scope of this project is to remove a large portion of the existing distribution system and replace with a mix of new overhead and underground equipment. First, the 50 kVA pole mounted transformer will be replaced with two 50 kVA pad units. These will have the capability of backing each other up should one fail. Underground in conduit will be run from the first pole at the summit across the roadway to the two padmounts. This will allow the removal of the overhead line in the vista viewing area. A new overhead secondary line will be run south behind the tree line to the Crown Castle facility. The new north transformer will intercept the existing feeds to the State Police building, the Fire Tower, and the nearby cell tower. Eversource will work closely with the contractors and the Park personnel to properly restore the site to acceptable conditions.	Multiple alternatives have been considered including various overhead and underground options. All were reviewed internally and with external stakeholders. The final solution for this upgraded line was the result of three years of negotiations, public forums, site meetings, constructability reviews, and buy-in from our State partners.		No	Explanation is included in Alternative #1 description	
March 2021 - App. F	592	A21S12 Apple Tree Cinema URD Rebuild	\$357k Install 3500 feet of 34.5 kV URD cable in conduit and associated padmounted equipment including three new three-phase, 4-position sector cabinets, and replacement of two live front three-phase transformers with dead front equipment. Remove old cable where possible, abandon if not. Remove old padmounted equipment and fill.	Replace single phase equipment: \$100,000 estimate for concrete pads, cable splicing, and installing 6 new sector cabinets. *Future risk of equipment becoming damaged again in the same way.	Extend primary cable in conduit from existing padmounted transformer, 32/2GS2T2, and rebuild the remaining URD as specified: \$390,875 estimate. This is the same approximate length of cable as the project proposes, however, this is less desirable because a) this would put customers on the end of another feed and would reduce reliability, and b) this would require either a cable crossing a water drainage main or two road crossings.	Extend primary cable in conduit from a new sector cabinet on Winding Pond Rd. and rebuild the remaining URD as specified: \$390,875 estimate. This is the same approximate length of cable as the project proposes, however, it will add splices to the cable along Winding Pond Rd. and put the commercial URD customers on a long cable with more exposure and would thereby decrease reliability.	No	Alternative does not address project objectives.
March 2021 - App. F	598	A21C05 Reconductor Academy Rd	\$895k Install new pole plant and associated equipment including 3-1/0 spacer cable in place of 3- #2 ACSR conductors on approximately 3,650 feet of 15 kv, three phase line along Academy Road in Pembroke. In anticipation of future load driven conversion work, 34 kv spacer will be installed.	This project was originally submitted to reconductor Academy Rd in its entirety. The \$1,813,000 estimate to do this was considered cost prohibitive. Instead, the project was revised to selectively reconductor portions of Academy Rd. based on an analysis of past outages and in consultation with Vegetation Management. In so doing, the cost per customer minute saved improved from \$13.48 to \$6.65.		Yes	This project was cancelled.	
March 2021 - App. F	606	A21S13 Pine Isle Drive URD Rebuild	\$581k Install approximately 2400 feet of single-phase 1/0 URD cable in conduit from riser pole 1/17Y to one new sector cabinet, then loop feed to five pad-mounted transformers. Install approximately 700 feet of secondary cable to hand holes. Remove existing above-ground equipment and abandon cable.	Replace failed equipment as needed.		No	Alternative does not address project objectives.	
March 2021 - App. F	613	A21C19 Meetinghouse Rd Substation Offload	\$747k Reconductor approximately 3,319 feet of single phase 1/0 and neutral with three phase 1/0 covered wire along Joppa Hill Road. Utilize approximately 2,550 feet of existing phase of 1/0 ACSR currently not in use from Carriage Lane up to North Amherst Road. Convert ten overhead single-phase transformers from 7,200 volts to 19,900 volts. Install six new overhead 19.9 to 7.2 kv step transformers for street side taps and North Amherst load. Remove two existing 19.9kv to 7.2 kv step transformers on Joppa Hill Road. Install cutouts for new open point between 3W2 and 322X12 on North Amherst Road. Install new three phase DA device at start of Joppa Hill Road.	1) Shift approximately 785 KVA connected from the 3W2 to the 322X12 circuit via Bedford Center Road. Engineering estimate is \$52k . Only lowers TB32 to 99% of nameplate and does not address 322X12 step transformer on Joppa Hill which is at 97% of nameplate.	2) Run three-phase all the way up Joppa Hill to North Amherst, 3,319 feet plus 2,500 feet for a total distance of 5,819 feet. This solution allows for additional load to be transferred from the tail end of the 3W2 circuit to the 322X12 further reducing the TB32 loading at Meetinghouse Road substation to well below 96% of nameplate. Engineering estimate of \$1,000,000 .	No	Alternative does not address project objectives.	
March 2021 - App. F	618	A21S27 Damren Rd. Conversion	\$214k 2500 feet of single phase conversion from 7.2-19.9 kv. Remove overloaded 500 kVA. Replace with two 500 kVA steps, one feeding down Walnut Hill (to open point with Adams Pond Rd. step as back feed), and one feeding the end of Damren Rd. and a large trailer park.	Offload customers on Walnut Hill to Adams Pond Rd step. This would be costs to set up reconfiguration switching only. However, this would effectively eliminate the option to backfeed the Adams Pond Rd. step from Damren Rd, resulting in reduced reliability.		No	Alternative does not address project objectives.	
March 2021 - App. F	623	A21C20 322X14 Off-load	\$141k Install approximately 400 feet of new 1/0 covered conductor along College Road (pole 52/17) to St Anselm's Drive (pole 86/25). Convert twelve overhead 2.4 kv transformers to 7.2 kv transformers and move them from the 322X14 to the 18W1 via College Road. Install load side fusing protection for the 500 KVA step-down transformer which currently does not exist.	Reconductor 190 ft of #2 ACSR with 477 covered conductors to address the overload primary feeder, however this solution fails to off-load 500 KVA step-down transformer to below 100% of nameplate. In addition, this solution fails to improve system voltage on the 322X14 to acceptable levels and does not allow for low side step-down fusing. Estimated Cost \$20k		No	Alternative does not address project objectives.	
March 2021 - App. F	626	A21W36 Remove Lattice Steel Towers	\$250k This project will remove approximately 11 miles/structures of the W15 circuit in Western Region. There are approximately five miles of line to be addressed and it is planned to seek funding for additional section in future years. Environmental controls and access may impact the number of structures able to be completed each year.	Not applicable.		Yes		
March 2021 - App. F	636	A21C25 360X5 Reconductor New Boston Rd	\$825k Reconductor approximately 4,752 feet of single phase #2 ACSR with three phase 477 spacer cable from the start of the 360X5 circuit to Walsh Rd (pole 25/250). Redistribute load from phase C to two new phases. Replace single phase Spear recloser at start of circuit with Nova (SCADA controlled) recloser. Re-balance load on the 360X5.	Convert the tail end of the 322X10 and transfer load from the 360X5 at a cost of less than \$100k . This alternative, which is currently under construction, is a short-term solution which only helps balance load on the 3194X1. It does not address known load growth associated with new residential home construction in progress on the 360X5 and 360X7 circuits. It does not help address loading on the parallel 500 kVA steps on the 360X7 circuit which reached 96% of nameplate rating during summer 2020, nor does it address high growth rate in this area of New Boston. This solution provides no opportunities to address load imbalance and equipment overloads on the 85W1 circuit. It also does not work towards establishing a circuit tie between the 3194X1 and 322X10 circuits.	360X7 – Multiphase down McCurdy Rd approximately 1,230 feet to off load approximately 20 amps of peak loading at a cost \$220k . This alternative helps address the overloaded parallel 500 kVA steps on the 360X7 circuit and provide a slight improvement with load balancing on the 3194X1. It does not address high loading on the 360X5 single phase radial circuit (2.3MW peak) nor does it address new load under construction on the 360X5 circuit. It also does not work towards establishing a circuit tie between the 3194X1 and 322X10 circuits.	No	Alternative does not address project objectives.	
March 2021 - App. F	645	A21W37 Extend Three Phase Route 202 Rindge	\$338k This project is to extend three-phase 1/0 spacer cable from pole 149/28 on Route 202 near Rand Road to pole 37/92 near Forristall Road. The existing 18 – 40 foot poles will be replaced with 50 foot poles. A 333 kVA, 19.9/7.2 kv step will be installed at the beginning of Forristall Road. The line will be opened where Middle Winchendon Road meeting Route 202. The line heading south on Route 202 will be converted 4,000 feet to pole 37A/23. There is just on overhead transformer to be changed and a couple of insulators to upgrade.	A single-phase upgrade was considered. This would have met short term concerns but would not have met longer term objectives for the area.		No	Alternative does not address project objectives.	
March 2021 - App. F	651	A21C42 Westland Ave Conversion	\$261k Convert 1,725 feet of circuit from 2.4 to 7.2 kv as well as reconductor 1,300 feet of #6 Cu primary with 1/0 ACSR. The step-down transformer will be relocated 450 feet downstream of its present location. The #6 primary normal rating precludes the upgrading of the 333 kva with a 500 kva transformer at its present location.	One alternative considered was to extend primary 650 feet on West Mitchell St so that it could feed the back end of the 333 kva step area on Riverdale Ave. A 250 kva transformer at this location would thereby reduce loading on the 333 kva step to 75% of its rating. The cost of this work is estimated at \$125k . However: 1. The need for licensing the railroad crossing would likely mean the June 1 deadline could not be met. 2. This work would increase total system circuit exposure due to the addition of primary line and poles that presently do not exist. 3. This money could be better spent upgrading existing, older facilities (bringing them up to standards), which otherwise would remain in place.		No	Alternative does not address project objectives.	
March 2021 - App. F	657	CO1PCB 2021 PCB Transformer Removals	\$277k Replacement of transformers containing PCBs. Approval of the PCB Transformer Replacement (CO1PCB) project covers authorization of all area work center PCB transformer replacement work orders. The CO1PCB program encompasses the total NH PCB transformer replacement program budget. Actual charges will accumulate in the individual area work center work orders.	Not applicable.		Yes		
March 2021 - App. F	667	A21E08 319X18-377X2 Circuit tie	\$944k This project will complete the following: •Conversion of the 377X2 from 4.16 kv to 34.5 kv •Conversion of 2 pad mount transformers to 34.5 kv •Conversion of 10 overhead transformers to 19.9 kv •Install new 1-19.9kv/2.4 kv 333 kVA step transformer downline to P5/32 & P5A/2 •Remove hydraulic recloser, replace with TripSaver. •Reconductor 950' of 3-#4 Cu, with 3-477 spacer cable from P5/25 to P5/31 •Reconductor 1350' of 3-#4 Cu with 477 spacer cable from P5/12 on Exeter Rd to P5/7/1 Bennett Way •Install new NOVA normally open circuit tie point on Bennett Rd, Newmarket •Replace Tripsaver on P5/62 on Hersey Lane with DA device. •Replace Tripsaver on P55/14 on Bennett Way with DA device.	None.		Yes		
Oct 2020 - App. L	283	A19S40/T1407A Amherst SS - PLC Automation Upgrade and P&C Upgrades	\$12.7M (\$6.6M Dist, \$6.1M Trans) The project objective is to replace the existing PLC based automated system design at Amherst Substation with a design and materials that facilitate operation/maintenance flexibility and the ability to use up-to-date relays and firmware.	No Cost Estimate One alternative is to perform the recommended substation project scope noted minus the cabinet SEL-2240 Axion I/O devices and associated materials. This was not chosen because the metering and equipment alarm topology would not be changed and remain dependent on relays to pass the digitals to ESCC.		Yes	The latest PAF has further information.	
Oct 2020 - App. L	349	A19X22 - Substation Animal Protection - Program Level	\$2.5M This program is to provide an animal protection system for complete substations. This will include covering systems by Tyco or GreenJacket which are approved as capital assets when installed as a complete system. Another type of animal protection is an electrified fence inside the substation.			N/A	Program level approval; \$500K per yr x 5 years	
Oct 2020 - App. L	366	A19X35 - 34.5kV Capacitor Bank Switch Replacement Program Level	\$5.3M This program is to replace seven (7) 34kV Capacitor Bank Switches. This equipment has been recommended for replacement primarily because of age and condition. Some equipment has failed including cracked vacuum bottles. The Electric System Control Center (ESCC) uses the substation 34.5kV capacitor banks during high load periods to control the system losses and transmission voltage. It is important that these switches be available for energizing the substation capacitor banks on the system.			N/A	Program level approval; \$756K per switch x 7 switches	

Oct 2020 - App. L	376	A19X36 - 34.5KV OCB Breaker and Ancillary Equipment Replacement Program Level	\$29.7M This Program is to replace 34.5KV Oil Circuit Breakers (OCBs). This equipment has been recommended for replacement for various reasons including: - There is a need to remove all circuit breakers from the system which break fault current utilizing an oil insulating medium. - Several are unique and old breakers that no longer have spare parts and are difficult to maintain. - The elimination of Type U-Bushings from the system which have PCB oil and create an environmental risk. - Station Operations has identified specific problems with the breaker that cannot be fixed. The overall program objectives are to replace obsolete equipment to increase system reliability, increase employee safety, and reduce maintenance intervals. This Program is to replace all 34.5KV OCBs on the Eversource NH system. There are currently ninety-one (91) OCBs remaining on the system. Sixty-six (66) will be addressed with this Program. The remaining OCBs are being replaced as part of larger projects at the substations. Cable and conduit that runs to the OCBs will be replaced as detailed in the Major Equipment to be Removed/Added sections of the Project Scope.			N/A	Program level approval; \$450K per unit x 66 units	
Oct 2020 - App. L	387	A20X26 - Spare 345-34.5KV Transformer Initial Funding Request	\$5.59M Procure a spare 140MVA 345-34.5KV transformer and design and install it at Timber Swamp SS. This site was chosen based on selection matrix under the Project Scope. This alternative includes a new foundation, oil containment, and AC power to the transformer. HICO provided a quote of \$3.1M for the transformer. Site work at the existing substation, including oil containment is required to place the spare.	\$15M Rebuild Lawrence Road SS to a 115-34.5KV substation with one (1) 62.5MVA transformer Re-terminate the Y135N line into the Lawrence Road SS This solution will eliminate one (1) 345-34.5KV transformer on the system that can then be designated as a system spare.	\$85M Rebuild Timber Swamp SS to a 115-34.5KV substation with three (3) 62.5MVA transformers Install a 345-115KV autotransformer at Timber Swamp Build a 7.5-mile 115KV line from Ocean Road SS to Timber Swamp SS This solution will eliminate two (2) 345-34.5KV transformers on the system that can then be designated as system spares.	\$106M Rebuild Amherst SS to a 115-34.5KV substation with two (2) 62.5MVA transformers Rebuild South Milford SS with one (1) 62.5MVA transformer Build a 115KV line from Long Hill SS to South Milford SS • 4.6 miles of the 34.5KV 3154 line will be converted to 115KV • 10.7 miles of the line from Broad St. SS to South Milford SS will be built in the 34.5KV 329 line ROW requiring Site Evaluation Committee approval. Build a four (4)-mile 115KV line from South Milford SS to Amherst SS Build a 6.5-mile 115KV line from Amherst SS to Eagle SS in the 345KV 3195 ROW This solution will eliminate two (2) 345-34.5KV transformers on the system that can then be designated as system spares.	Yes	This project is under construction
March 2021 - App. E	432	A18N03/T1419A - White Lake Substation Rebuild	N/A			N/A	Solution has not yet been selected & approved	
March 2021 - App. E	445	A18ED4/A19E47/T1401A - Dover/Cochecho Street S/S Rebuild	N/A			N/A	Solution has not yet been selected & approved	
March 2021 - App. E	449	A18W06/A19W49/T1402A Monadnock Substation Rebuild	\$42.3M (\$24.0M Dist, \$18.3M Trans) Distribution: Rebuild the substation in a shared greenfield T&D yard (IEC 61850 design) with two (2) 62.5 MVA transformers with transformer high side circuit switchers, transformer low side circuit breakers, and 34.5 kV double-bus switchgear with integrated control room. The doublebus switchgear includes the following: normally open bus-tie breakers, spare line breaker cubicles, two (2) mobile connection cubicles, an automatic bus restoration scheme, and two (2) 5.4 MVAR capacitor banks. The 4.8 MVAR capacitor bank located in the existing substation will not be reused for the rebuild of the substation. Transmission: Construct a greenfield T & D yard (IEC 61850 design) on property purchased adjacent to the existing site under work order T1371A09. The transmission yard would be a two (2) bay breaker-and-a-half configuration with five (5) breakers for three (3) line terminals and one (1) future line terminal. In addition, the design would include two (2) mobile connections to the 115KV buses. Construct a new control house to be used by transmission.	\$41.1M (\$21.0M Dist, \$20.1M Trans) Distribution: Rebuild the substation in a shared greenfield T&D yard (IEC 61850 design) with two (2) 62.5 MVA transformers with transformer high side circuit switchers, transformer low side circuit breakers, 34.5KV switchgear with normally open bus-tie breaker (which includes one (1) spare line breaker cubicle and two (2) mobile connection cubicles), an automatic bus restoration scheme, and two (2) 5.4 MVAR capacitor banks. Construct a new control house to be used by both transmission and distribution. Transmission: Construct a greenfield T & D yard (IEC 61850 design) on property purchased adjacent to the existing site. The transmission yard would be a breaker and one-half design consisting of six (6) terminal bays (nine (9) breakers).		No	Partial Funding approved 3/2/22. Alternative did not meet DSPG criteria.	

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-002

Date of Response: March 10, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Hebsch, Jennifer J

Request:

Please provide a copy of the latest distribution standards for Eversource and any studies or memos supporting any recent changes covering the minimum requirement for Class 2 poles, covered wire, pole construction configuration, etc.

Response:

Eversource is providing the following Standards in Attachment DOE 4-002 (1):

- Distribution System Engineering Manual (DSEM)
- Overhead Construction Standards
- Underground Construction Standards

To access the above books, perform the following:

1. Unzip the files to a separate directory
2. Open the file called Standards.pdf
3. This opens the “bookshelf” with the three books in it.
4. Click on the book title which will open the book and allow the user to open the various table of contents and documents.

Additional supporting information is also included:

- Attachment DOE 4-002(2) – Eversource Policy: Use of Steel Poles on Distribution Lines

Note that Eversource is working on a topic-by-topic review to consolidate its standards so that each section identifies enterprise-wide as well as operating company level standards within the section. Some standards apply to certain operating companies while others apply to all operating companies.

Use of Steel Poles on Distribution Lines



This policy applies to Eversource NH installations

Responsibility

All Engineering and Operations personnel are expected to understand and abide by this policy.

Policy

New poles installed in Eversource three phase lines in distribution Rights-of-Way are to be direct embedded self-weathering steel poles, class and height to be determined by the Transmission Line Engineering group.

The use of steel poles in other situations such as for single phase lines, jointly owned facilities, or other special situations is by exception only and requires approval from managers or above in Operations and Engineering.

Steel poles shall not be used for service poles.

See the attached Supervisor Briefing Sheet for additional information.

Revision History

0	Created new policy, <i>effective 10/3/2019</i>	
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Use of Steel Poles on Distribution Lines

Steel Pole FAQ (Sabre weathering steel poles)

1. **Are there Eversource standards for steel poles?** Refer to Section 10 of the Overhead book, 9.1--9.4.
2. **Do we build to 200 kV BIL?** Steel Construction in the Distribution ROW is built to 350BIL - Wood construction is built to 200 kV BIL. Consult OH Standards book for correct material.
3. **What do we use for guy attachments? Our current attachment has teeth.** Consult Standards - on angles and dead ends where a guy will be attached, a Tee Plate is used on steel construction (SC:532221). It is flat and will sit flush to the pole.
4. **Can we equipotentially ground on a steel pole? How to ground?** Equipotentially grounding a line is done in almost the same way as a wood pole. The only difference is that you can use a step rung to attach a ground to in lieu of the cluster bracket; however, a cluster bracket is also an acceptable method.
5. **Should caulk guns be purchased - how much caulking is required?** Caulk or RTV is required to seal the drill holes to keep out moisture after a bolt is inserted.
6. **How do you drill holes or work in the air if steps are only on one side?** The preferred method would be to drill the poles on the ground before they are set. Poles now have step rung brackets on three sides above the neutral to assist with drilling and reaching outside phases. To reach outside phases where only one side has steps, a diving board can be utilized or hot stick methods.
7. **Is there a special type of rubber to be used on these poles?** No, the rubber we use on wood poles provides the same insulating value regardless of the material it is covering. Proper inspection of rubber goods and Insulate/Isolate techniques shall be followed when working on steel poles.
8. **Can we glove out of the bucket on an energized steel pole?** Yes, these poles can be worked energized using proper PPE and insulate/isolate methods.
9. **Can the Skylift lift and set steel poles?** The Skylift is limited by weight - use lifting chart on machine to determine if the machine can handle the load. Listed below are the 5 most common size distribution poles and their weight.

Height/Type	Weight
40' Class I	818 lbs.
45' Class I	946 lbs.
50' Class I	1,078 lbs.
45' H1	993 lbs.
50' H1	1,137 lbs.

10. **Who is responsible for setting and working on the steel ROW poles? Can the AWC's ask for help from the Transmission group?** *The AWC's are responsible for all distribution lines in their*

Use of Steel Poles on Distribution Lines

area both off-road and road side. If there is a need for an off-road machine, call the Supervisor on-call and the determination will be made whether the Transmission group will be able to assist, or a contractor will be called.

- 11. If an off-road machine is needed for assistance, who takes the lead?** In a non-storm event and the Transmission group is called to an event in the ROW, they will generally send one or two guys with the machine to assist the crew currently working.
- 12. Where are the steps? How many are needed? What is the process for installing the step?** Each work center was issued a cage of steps to use if needed. The number of steps is determined by pole size but generally they require 15-20 depending on application. A PowerPoint Presentation is available showing the installation of the steps - contact your supervisor if you were not shown the PPT.
- 13. What belts are required to climb?** Steel Poles can be climbed with either a climbing belt, a Ladder belt or a harness. *100% fall arrest must be maintained at all times.* When climbing - the best method is to loop the climbing belt or lanyard around a step above you and take a few steps up. Next, take a separate belt or lanyard and loop it around a step above you. Repeat process until you get to your desired location.
- 14. Are we going to be trained on how to climb using 100% fall arrest?** A video will be available on how to climb a steel pole.
- 15. Are we going to be trained in the rapid rail system?** Rapid Rail is a fall arrest system used on Transmission structures. This system is not used on the Distribution system.
- 16. Are these poles set with a strap or chain?** There is no difference between setting a wood pole and steel pole as far as work procedures go.
- 17. Is there a cluster bracket we can use to hang equipment to avoid drilling holes?** Currently there is no approved bracket, holes must be drilled to attach equipment.
- 18. Copper ground wire is exposed at the bottom of the pole, will this get stolen?** Most of the D-ROW system is well off road and the likelihood of this wire being stolen is low. The pole is made of steel and will act as a ground in the event the wire is stolen.
- 19. How do we use the mag drill to drill holes?** Consult the owner's manual that came with the drill to become familiar with it. A video is also being made available to show the operation of the unit on a steel pole.
- 20. Where is pole top equipment mounted on the poles?** Refer to OH standards on the equipment that is being installed. There is no change between wood and steel poles - same measurements will be used.
- 21. How do we perform pole top rescue on these poles?** It is the same method we currently use for wood poles.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-003

Date of Response: March 08, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Johnson, Russel D

Request:

Describe the role Eversource's LCIRP and Supplement played in the distribution and distribution substation capital project identification and selection process. Please provide specific examples.

Response:

In Eversource's view, the approaches to planning laid out in the LCIRP, Supplement, Appendix A.1 reflect a prudent balance of traditional investments alongside the application of advanced tools and techniques to integrate and support a more dynamic and distributed electric grid. As an example of advanced tools and techniques, the Company developed an NWA Framework and Screening Tool in the fourth quarter of 2020, and rolled it out across the Company in the first quarter of 2021. The screening tool evaluates the ability of non-traditional solutions to enable safe, secure reliable operation of the Eversource electric system at the lowest reasonable cost to our customers. The tool has been integrated into the distribution planning process, as documented in the Distribution System Planning Guide, such that every major capital project includes an NWA screening as part of its solution scope before it can be granted funding. This tool and many others will be continually adapted to help Eversource meet future challenges.

In light of the new and rapidly evolving demands being placed on modern electric systems, system planning must adapt to keep pace with customer needs and to anticipate changes in technology and customer expectations. Eversource has taken steps, as demonstrated in this LCIRP and the attached Distribution System Planning Guide, to analyze, understand, and plan for these future challenges while providing required system performance. In Eversource's assessment, this submission is consistent with the requirements of the New Hampshire statutes governing the scope and purpose of the LCIRP, as well as Commission directives.

Please refer to Confidential Attachment DOE 4-003.

Material in the attachments is confidential as containing critical energy infrastructure information. Accordingly, consistent with Puc 203.08(d), Eversource states that it has a good faith basis for seeking confidential treatment of the material provided with this response.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-004

Date of Response: March 08, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Labrecque, Richard C, Freeman, Lavelle A

Request:

Reference: Eversource LCIRP Joint Planning Report (Appendix I) and Supplement.

In the 2020 Joint Planning Report (Appendix I, LCIRP), a number of substations connected to NHEC delivery points appear to be significantly overrated, e.g., Ashland Substation, Element 3196, capacity 32.3 MVA, peak load 10.3 MW; Beebe River Substation, Element 342B, capacity 32.3 MVA, peak load 8.1 MW; and others (pp. 4-8 i.e., Appendix I, Bates Page 000256-260). Please explain the rationale for substation capacity ratings. Please identify, by Bates Page, any update in the March 31, 2021 LCIRP Supplement.

Response:

The element ratings of particular concern are 34.5 kV substation feeders. Historically, over the past 10 years, the standard construction for 34.5 kV feeder main lines has been to use 477 ACSR conductor (40 MVA rating) (today's standard is 477 kcmil covered spacer cable). These lines make up the backbone of the bulk distribution power system, therefore, it is necessary to ensure these feeders have additional capacity above base load to accommodate future load growth, load transfers during maintenance activities, and additional load due to N-1 contingency events to ensure continuity of service to customers.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-005

Date of Response: March 07, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Labrecque, Richard C, Freeman, Lavelle A

Request:

Reference: Eversource LCIRP Appendix D, Section 2.8 and Supplement.

Please clarify the meaning of “Low to Medium Load-Density” and “Medium to High Load-Density” areas when deciding if Double Bus Switchgear or Ring Bus design is to be used. Please clarify if the respective designs are considered standard or custom. Please indicate the typical percentage cost difference between the two designs.

Response:

From the Distribution System Planning Guide (DSPG), section 2.6:

- High Load Density areas are those greater than 750MWh/sq-mi;
- Medium Load Density areas are those between 250MWh/sq-mi and 750MWh/sq-mi;
and
- Low Load Density areas are those less than 250MWh/sq-mi

Based on the above definitions, all regions of the New Hampshire service territory currently fall within the “Low to Medium Load Density” threshold.

Double-bus switchgear and the ring bus designs are considered standard designs (DSPG section 2.8).

Each substation project will have a unique scope and will involve various design and construction challenges related to the specific site. Therefore, there is no “typical” cost for these large projects.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-006 (Rev.)

Date of Response: March 14, 2022
Page 1 of 4

Request from: Department of Energy

Witness: David Plante, Johnson, Russel D

Request:

Reference: Eversource 2020 LCIRP, Appendix F-1, Rebuild Pack Monadnock Distribution Line, and Supplement:

- a. Please provide a cost breakdown of what is included in the \$1.76 million outside services charge.
- b. Please provide a cost breakdown for what's included in the \$70K materials charge.
- c. Please provide a cost breakdown for removing the existing, unsafe, outdated line.
- d. Please provide a list of external stakeholders and breakdown of time spent with each.

Response:

- (a) Please see Attachment DOE 4-006(a), which provides the cost breakdown of the \$1.76 million estimate of the outside services costs embedded in the Monadnock Project Authorization Form prepared on April 15, 2020.
- (b) Please see Attachment DOE 4-06(b), which provides the materials breakdown, by type, for what was included in the \$70k estimate of the materials charges embedded in the Monadnock Project Authorization Form prepared on April 15, 2020. This report was run out of the STORMS system at the time of preparing the response to this data request. The unit prices assigned to the materials are updated in the STORMS system based on the most recent unit price cost information. Therefore, the total cost estimate for those materials with current unit prices in STORMS totaled \$59,934. The difference between the \$59,934 and the \$70k estimate was due primarily to (1) unit prices for materials that were no longer available or in stock and, therefore rendered a value of zero, and (2) the changes in unit price cost estimates since April 2020.
- (c) Please see the table below for a cost breakdown of the total removal charges for this project through 12/31/2021.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-006 (Rev.)

Date of Response: March 14, 2022
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Project A17C30: PACK MONADNOCK RBLD SINGLE-PHASE LINE		
Cost of Removal		
Vendor	Description	Amount
JCR CONSTRUCTION CO INC	Access / restoration, structure removal & disposal	\$ 51,732.08
EVERSOURCE INTERNAL LABOR		\$ 48,088.77
NORTHERN TREE SERVICE INC	Tree removal and trimming	\$ 46,218.39
SUPREME INDUSTRIES	Ledge removal, grading, and gravel for access points	\$ 26,648.06
TWIN STATES UTILITY CORP.	Existing conduit removal	\$ 23,547.49
LEIDOS ENGINEERING LLC	General Engineering Services	\$ 17,539.47
VANASSE HANGEN BRUSTLIN INC	Land Surveyor	\$ 8,260.12
RANDSTAD US LLP	Project Management	\$ 4,640.90
OVERHEAD	Indirects / Allocations	\$ 237,763.85
	TOTAL COST OF REMOVAL	\$ 464,439.13

(d) This line rebuild was performed entirely on land owned by the State of New Hampshire, within Miller State Park.

Stakeholders

- NH Dept. of Natural & Cultural Resources (DNCR)
 - State Parks Division
 - Forest & Lands Division
- NH Public Utilities Commission (PUC)
- NH Dept. of Transportation (DOT)
- NH Dept. of Environmental Services (DES)
- Eversource property owners and customers served from the line and at the summit
- Town of Peterborough, NH
- Town of Temple, NH
- Community groups:
 - Pack Monadnock Road Alliance – grass roots public organization associated with this project
 - Friends of Wapack Trail
- Public – customers/clients using Miller State Park facilities
- Utility pole joint owners and third party attachees
 - Consolidated Communications, Inc. (CCI)
 - Comcast

Public Service Company of New Hampshire d/b/a Eversource Energy
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Date of Response: March 14, 2022
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- First Light
- The Nature Conservancy
- NH Audubon

Timeline

The time spent with external stakeholders can be more easily defined by duration of the project (years 2017-2021), rather than time spent with each.

The duration of the project was impacted by the permits required and interaction with the following stakeholders that required permits:

- DOT: driveway and excavation permits
- Private property owners: easement
- PUC: Permit to cross state land
- DNCR: Stone Wall Agreement
- Private property owners: Stone Wall Agreement
- DES: Statutory Permit-by-Notification (SPN) Wetlands Permit
- National Park Service: Land Water Conservation Fund approval
- DNCR: Special Use and Construction Permits

Project Planning and Communication

2017 – The PUC determined current condition of the utility line was not up to code and could present safety issues. The initial plan was presented at the first public information session.

2018 – Eversource continued community and stakeholder outreach and received input regarding design. Route selection analysis was performed.

2019 – Project plan was adjusted to incorporate feedback from working group meetings, discussions with state and municipal officials, and a second public information session was held.

2020 – Eversource submitted permit applications for approval, which reflected community and stakeholder feedback and collaboration.

2021 – All permits were secured to allow construction to be performed in 2021. A final public information session was held in March. Eversource continued communication with stakeholders throughout the pre- and post-construction

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-006 (Rev.)

Date of Response: March 14, 2022
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phases. Sign-off and fulfillment of all permits and agreements was completed on June 10, 2021.

Desc.	Lower ROW Peterborough Rt 101 - 81/7	Lower ROW Temple 81/8-81/13X Refeed MIT Bg	Upper ROW Peterborough 81/24-81/29	Upper ROW Temple MIT Blg - 81/23	Totals
WR	3367138	3367164	3160599	3160624	
Engineering Design Services Leidos			\$ 75,000.00	\$ 75,000.00	\$ 150,000.00
Environmental Contingency	\$ 4,125.00	\$ 2,062.00	\$ 18,750.00	\$ 6,250.00	\$ 31,187.00
Off Road Ledge Drilling & Pole Setting JCR	\$ 215,264.00	\$ 161,448.00	\$ 289,770.00	\$ 173,862.00	\$ 840,334.00
Access Roads Build Out Supreme	\$ 1.00	\$ 1.00	\$ 147,261.00	\$ 1.00	\$ 147,264.00
Park Road Restoration	\$ 49,720.00	\$ 37,290.00	\$ 62,150.00	\$ 37,291.00	\$ 186,451.00
Permits / Legal Fees Contingency	\$ 4,950.00	\$ 1,240.00	\$ 11,250.00	\$ 3,750.00	\$ 21,190.00
Surveying Services VHB			\$ 30,900.00	\$ 30,900.00	\$ 61,800.00
ROW Tree Trimming and Clearing Northern Tree	\$ 51,000.00	\$ 26,500.00	\$ 98,400.00	\$ 30,625.00	\$ 206,525.00
Above Ground Conduit Removal Twin State Utilities			\$ 10,000.00	\$ 10,000.00	\$ 20,000.00
Electrical Contractor MIT Building Contingency		\$ 5,000.00			\$ 5,000.00
Traffic Control Services	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 10,000.00
Temporary Generators Prime			\$ 15,000.00		\$ 15,000.00
Totals By Work Order	\$ 327,560	\$ 236,041.00	\$ 760,981.00	\$ 370,179.00	\$ 1,694,751.00
Total Contractor Estimate, with Contingency Allowance					\$ 1,760,000.00

WR 3160599

CU	CU Description	Acct	Action	Plant Acct	UOP	Qty	Matl Amt
AED1X30TEROCK	ANC ELEC ROCK 1X30 TE	C	I	36431	MS00028	3	\$272.47
AED1X53TEROCK	ANC ELEC ROCK 1X53 TE	C	I	36431	MS00028	3	\$649.47
BKOSCTAN14INCH	BRACKET TANGENT 14 IN SPACA	C	I	36431	MS23164	4	\$485.88
CFLBST25-100A	CUTOUT LBST FUSE 100A 12M 25 KV	C	I	365	DA31024	2	\$233.29
INOPSUS35	INSULATOR SUSP POLY 35 KV	C	I	365	DA19824	2	\$37.84
INOPWISE1INTHRD35	INSULATOR WISE 35 KV 1 IN THRD	C	I	365	DA19823	4	\$69.36
<u>KUVSTL3-RGD</u>	<u>CONDUIT STEEL RIGID 3 IN SVC</u>	<u>M</u>	<u>R</u>	<u>59422</u>	<u>ZZ99999</u>	<u>100</u>	<u>\$0.00</u>
QE052B	CABLE MES 052 AWA FOR SPCR CBL	C	I	365	DA31005	950	\$1,876.16
OP1/0AS175M	CABLE PRI 1/0 AS 175MIL HDP 1P	C	I	365	DA31003	950	\$1,527.03
<u>QS4/0ALTPX</u>	<u>CABLE SEC 4/0 AL XLP TPX</u>	<u>M</u>	<u>I</u>	<u>59306</u>	<u>DA31007</u>	<u>30</u>	<u>\$59.45</u>
PE353FULL	POLE ELEC 35 FT CL 3 FULL	C	R	36431	MS10315	1	\$0.00
PE401SYPPENTAFULL	POLE ELEC 40 FT CL 1 FULL PENTA SYP	C	I	36431	MS10316	4	\$2,471.83
PE451SYPPENTAFULL	POLE ELEC 45 FT CL 1 FULL PENTA SYP	C	I	36431	MS10317	2	\$1,678.19
PNOINS7IN-W/2-3/8SHKBLTTY	PIN INSULATOR 7IN 2-3/8IN SHK	C	I	36431	MS23164	1	\$0.00
<u>SZA6-4/0X6-146V</u>	<u>SPLICE BRANCH 6-4/0X6-14 600V</u>	<u>M</u>	<u>I</u>	<u>59899</u>	<u>ZZ99999</u>	<u>3</u>	<u>\$27.17</u>
<i>TC001410-0-499NFL</i>	<i>CABLE #4 CU XFMR LEAD</i>	<i>M</i>	<i>I</i>	<i>58306</i>	<i>X</i>	<i>20</i>	<i>\$0.00</i>
<i>TC0013240-0-499</i>	<i>CONNECT SINGLE XF 1P3W 240 OH</i>	<i>M</i>	<i>I</i>	<i>58306</i>	<i>X</i>	<i>1</i>	<i>\$0.00</i>
<i>TC0013240-0-499</i>	<i>CONNECT SINGLE XF 1P3W 240 OH</i>	<i>M</i>	<i>R</i>	<i>58306</i>	<i>X</i>	<i>1</i>	<i>\$0.00</i>
<i>TC00410-375TRCU-499NFL</i>	<i>CABLE 4/0-375TR CU XFMR LEAD</i>	<i>M</i>	<i>I</i>	<i>58306</i>	<i>X</i>	<i>15</i>	<i>\$0.00</i>
<u>THOBLT5/8X14</u>	<u>BOLT MCH 5/8 X 14 IN XF HDW</u>	<u>M</u>	<u>I</u>	<u>59509</u>	<u>ZZ99999</u>	<u>2</u>	<u>\$0.00</u>
UPREMPILC<350	UG PRIMARY REM ONLY LESS THAN 350 F	C	R	36772	DA31009	1000	\$0.00
Totals							\$9,388.14

WR 3160624

CU	CU Description	Acct	Action	Plant Acct	UOP	Qty	Matl Amt
AED1X30TEROCK	ANC ELEC ROCK 1X30 TE	C	I	36431	MS00028	3	\$270.52
AED1X53TEROCK	ANC ELEC ROCK 1X53 TE	C	I	36431	MS00028	7	\$1,118.73
AEDROD	ROD ANC ELEC	C	R	36431	MS00028	1	\$0.00
AFMOV3DIST	ARRESTER DISTRIBUTION 3 KV MOV	C	R	365	DA31001	2	\$0.00
BK0SCTAN14INCH	BRACKET TANGENT 14 IN SPACE	C	I	36431	MS23164	7	\$971.76
BLOMCH5/8X14	BOLT MCH 5/8X14	C	R	36431	MS00028	4	\$0.00
CFLBST25-100A	CUTOUT LBST FUSE 100A 12M 25 KV	C	R	365	DA31024	2	\$0.00
INOPSUS35	INSULATOR SUSP POLY 35 KV	C	I	365	DA19824	3	\$0.00
INOPSUS35	INSULATOR SUSP POLY 35 KV	C	R	365	DA19824	1	\$0.00
INOPVISE11INTHRD35	INSULATOR VISE 35 KV 1 IN THRD	C	I	365	DA19823	7	\$83.01
INOPVISE11INTHRD35	INSULATOR VISE 35 KV 1 IN THRD	C	R	365	DA19823	4	\$0.00
<u>KUVSTL3-RGD</u>	<u>CONDUIT STEEL RIGID 3 IN SVC</u>	<u>M</u>	<u>R</u>	<u>59422</u>	<u>ZZ999999</u>	<u>110</u>	<u>\$0.00</u>
OE052B	CABLE MES 052 AWA FOR SPCR CBL	C	I	365	DA31005	1935	\$3,118.27
ONREBALL	OH NEUTRAL REMOVAL ONLY ALL SIZES	C	R	365	DA31003	855	\$0.00
OP1/QAS175M	CABLE PRI 1/0 AS 175MIL HDP 1P	C	I	365	DA31003	1935	\$2,660.12
OPREM<1/0	OH PRIMARY REMOVAL ONLY LESS THAN	C	R	365	DA31002	855	\$0.00
PE353SYPPENTAFULL	POLE ELEC 35 FT CL 3 FULL SYP PENTA	C	R	36431	MS10315	5	\$0.00
PE401SYPPENTAFULL	POLE ELEC 40 FT CL 1 FULL PENTA SYP	C	I	36431	MS10316	7	\$4,325.69
PE451SYPPENTAFULL	POLE ELEC 45 FT CL 1 FULL PENTA SYP	C	I	36431	MS10317	3	\$2,517.28
PNOINS7IN-W/2-3/8SHKBLTTY	PIN INSULATOR 7IN 2-3/8IN SHK	C	I	36431	MS23164	2	\$0.00
PNOPTS24INCH	PIN POLE TOP 24IN	C	R	36431	MS23164	4	\$0.00
UPREMPILC<350	UG PRIMARY REM ONLY LESS THAN 350 F	C	R	36772	DA31009	1100	\$0.00
Totals							\$15,065.39

WR 3367138

CU	CU Description	Acct	Action	Plant Acct	UOP	Qty	Matl Amt
AED1X30TEROCK	ANC ELEC ROCK 1X30 TE	C	I	36431	MS00028	2	\$137.20
AED1X53TEROCK	ANC ELEC ROCK 1X53 TE	C	I	36431	MS00028	5	\$977.17
AFMOV3DIST	ARRESTER DISTRIBUTION 3 KV MOV	C	I	365	DA31001	2	\$150.54
BKOSCINSPL	INSULATOR PLATE SPQA	C	I	36431	MS23164	1	\$349.86
BKOSCSTAN14INCH	BRACKET TANGENT 14 IN SPACA	C	I	36431	MS23164	4	\$576.26
<u>BLDEL5/8X14</u>	<u>BOLT EYELET LONG GS 5/8X14</u>	<u>M</u>	<u>I</u>	<u>59306</u>	<u>MS00028</u>	<u>1</u>	<u>\$0.00</u>
<u>BLDEL5/8X14</u>	<u>BOLT EYELET LONG GS 5/8X14</u>	<u>M</u>	<u>R</u>	<u>59306</u>	<u>MS00028</u>	<u>1</u>	<u>\$0.00</u>
<u>BLOMCH5/8X12W/CVWSH</u>	<u>BOLT MCH 5/8X12 W/CV WSH</u>	<u>M</u>	<u>I</u>	<u>59306</u>	<u>MS00028</u>	<u>2</u>	<u>\$0.00</u>
<u>BLOMCH5/8X12W/CVWSH</u>	<u>BOLT MCH 5/8X12 W/CV WSH</u>	<u>M</u>	<u>R</u>	<u>59306</u>	<u>MS00028</u>	<u>2</u>	<u>\$0.00</u>
BLOMCH5/8X14	BOLT MCH 5/8X14	C	R	36431	MS00028	9	\$0.00
CFLBST25-100A	CUTOUT LBST FUSE 100A 12M 25 KV	C	I	365	DA31024	1	\$100.54
CFLBST25-100A	CUTOUT LBST FUSE 100A 12M 25 KV	C	R	365	DA31024	1	\$0.00
CFLBST25-300A	CUTOUT LBST S BLD 300A 12M 25 KV	C	I	365	DA31024	1	\$131.86
<u>ENOSSE3/4BLT</u>	<u>EYENUT SNGL STRAND EYE 3/4 BLT</u>	<u>M</u>	<u>I</u>	<u>59306</u>	<u>MS00028</u>	<u>1</u>	<u>\$0.00</u>
INOPSUS35	INSULATOR SUSP POLY 35 KV	C	I	365	DA19824	4	\$22.49
INOPSUS35	INSULATOR SUSP POLY 35 KV	C	R	365	DA19824	1	\$0.00
INOPVISE1INTHRD35	INSULATOR VISE 35 KV 1 IN THRD	C	I	365	DA19823	4	\$100.62
INOPVISE1INTHRD35	INSULATOR VISE 35 KV 1 IN THRD	C	R	365	DA19823	9	\$0.00
LKQSTIRRUPSPCCBL	LINK STIRRUP FOR SPACER CBL	C	I	36431	MS23164	2	\$29.64
OE052B	CABLE MES 052 AWA FOR SPCR CBL	C	I	365	DA31005	1315	\$2,356.92
ONREBALL	OH NEUTRAL REMOVAL ONLY ALL SIZES	C	R	365	DA31003	1320	\$0.00
OP1/0AS175M	CABLE PRI 1/0 AS 175MIL HDP 1P	C	I	365	DA31003	1440	\$2,119.48
OPREM1/0-336	OH PRIMARY REMOVAL ONLY 1/0 - 336	C	R	365	DA31003	1445	\$0.00
PE30FULLREMOVAL	POLE ELEC 30 FT FULL REMOVAL ONLY	C	R	36431	MS10314	6	\$0.00
PE35FULLREMOVAL	POLE ELEC 35 FT FULL REMOVAL ONLY	C	R	36431	MS10315	1	\$0.00
PE401STLFULL	POLE ELEC STEEL 40 FT CL 1 FULL	C	I	36431	MS23178	1	\$3,631.80
PE401SYPPENTAFULL	POLE ELEC 40 FT CL 1 FULL PENTA SYP	C	I	36431	MS10316	4	\$2,471.83
PE40FULLREMOVAL	POLE ELEC 40 FT FULL REMOVAL ONLY	C	R	36431	MS10316	1	\$0.00
PE45H1STLFULL	POLE ELEC 45 FT CL H1 FULL STEEL	C	I	36431	MS23178	1	\$3,776.91
PE55FULLREMOVAL	POLE ELEC 55 FT FULL REMOVAL ONLY	C	R	36431	MS10319	1	\$0.00
PE55H1STLFULL	POLE ELEC 55 FT CL H1 STEEL FULL	C	I	36431	MS23179	1	\$4,707.94
PEHANDDIG	POLE HAND DIG	C	I	36431	X	42	\$0.00
PNOPTS24INCH	PIN POLETOP 24IN	C	R	36431	MS23164	9	\$0.00
Totals							\$21,641.06

WR 3367164

CU	CU Description	Acct	Action	Plant Acct	UOP	Qty	Matl Amt
AE01X30TEROCK	ANC ELEC ROCK 1X30 TE	C	I	36431	MS00028	1	\$346.21
AE01X53TEROCK	ANC ELEC ROCK 1X53 TE	C	I	36431	MS00028	3	\$629.01
AE01X72TEROCK	ANC ELEC ROCK 1X72 TE	C	I	36431	MS00028	1	\$61.03
AEOROD	ROD ANC ELEC	C	R	36431	MS00028	4	\$0.00
AFMOV3DIST	ARRESTER DISTRIBUTION 3 KV MOV	C	I	365	DA31001	1	\$70.81
BKOSCINSPL	INSULATOR PLATE SPCA	C	I	36431	MS23164	1	\$178.57
BKOSCSTAN14INCH	BRACKET TANGENT 14 IN SPACA	C	I	36431	MS23164	3	\$500.70
BLOMCH5/8X14	BOLT MCH 5/8X14	C	R	36431	MS00028	3	\$0.00
CFLBST25-100A	CUTOUT LBST FUSE 100A 12M 25 KV	C	I	365	DA31024	2	\$213.43
INOPSUS35	INSULATOR SUSP POLY 35 KV	C	I	365	DA19824	3	\$27.55
INOPVISE1INTHRD35	INSULATOR VISE 35 KV 1 IN THRD	C	I	365	DA19823	4	\$95.24
INOPVISE1INTHRD35	INSULATOR VISE 35 KV 1 IN THRD	C	R	365	DA19823	5	\$0.00
OE052B	CABLE MES 052AWA FOR SPCR CBL	C	I	365	DA31005	910	\$1,921.01
ONREBALL	OH NEUTRAL REMOVAL ONLY ALL SIZES	C	R	365	DA31003	855	\$0.00
OP1/0AS175M	CABLE PRI 1/0 AS 175MIL HDP 1P	C	I	365	DA31003	1005	\$1,654.37
OPREM1/0-336	OH PRIMARY REMOVAL ONLY 1/0 - 336	C	R	365	DA31003	855	\$0.00
OS4/0ALTPX	CABLE SEC 4/0 AL XLP TPX	C	I	365	DA31007	150	\$305.68
OSREBALL	OH SECONDARY REMOVAL ONLY ALL SIZE	C	R	365	DA31007	100	\$0.00
PE30FULLREMOVAL	POLE ELEC 30 FT FULL REMOVAL ONLY	C	R	36431	MS10314	4	\$0.00
PE353FULL	POLE ELEC 35 FT CL 3 FULL	C	R	36431	MS10315	1	\$0.00
PE35FULLREMOVAL	POLE ELEC 35 FT FULL REMOVAL ONLY	C	R	36431	MS10315	2	\$0.00
PE401STLFULL	POLE ELEC STEEL 40 FT CL 1 FULL	C	I	36431	MS23178	1	\$3,631.80
PE401SYPPENTAFULL	POLE ELEC 40 FT CL 1 FULL PENTA SYP	C	I	36431	MS10316	4	\$2,471.83
PE451SYPPENTAFULL	POLE ELEC 45 FT CL 1 FULL PENTA SYP	C	I	36431	MS10317	2	\$1,678.19
PECUTKICK	POLE CUT AND KICK	C	I	36431	X	6	\$0.00
PEHANDDIG	POLE HAND DIG	C	I	36431	X	24	\$0.00
PNOINS7IN-W/2-3/8SHKBLTTY	PIN INSULATOR 7IN 2-3/8IN SHK	C	I	36431	MS23164	1	\$0.00
PNOPTS24INCH	PIN POLETOP 24IN	C	R	36431	MS23164	6	\$0.00
<u>RSD3PVCSHIELD</u>	<u>SHIELD POLE RISER PVC 3 IN X 10 FT SCH</u>	<u>M</u>	<u>I</u>	<u>59407</u>	<u>ZZ99999</u>	<u>2</u>	<u>\$0.00</u>
<u>SZAS6-4/0X6-146V</u>	<u>SPLICE BRANCH 6-4/0X6-14 600V</u>	<u>M</u>	<u>I</u>	<u>59899</u>	<u>ZZ99999</u>	<u>6</u>	<u>\$54.35</u>
<i>TC0014CU16-499NF</i>	<i>CABLE #4 CU NFMR LEAD</i>	<i>M</i>	<i>R</i>	<i>58306</i>	<i>N</i>	<i>30</i>	<i>\$0.00</i>
<i>TC0013240-0-499</i>	<i>CONNECT SINGLE NF 1F3M 240 OH</i>	<i>M</i>	<i>I</i>	<i>58306</i>	<i>N</i>	<i>1</i>	<i>\$0.00</i>
<i>TC0013240-0-499</i>	<i>CONNECT SINGLE NF 1F3M 240 OH</i>	<i>M</i>	<i>R</i>	<i>58306</i>	<i>N</i>	<i>1</i>	<i>\$0.00</i>
<i>TC00410-375TRCU16-499NF</i>	<i>CABLE 4/0-375TR CU NFMR LEAD</i>	<i>M</i>	<i>R</i>	<i>58306</i>	<i>N</i>	<i>15</i>	<i>\$0.00</i>
<u>IHOBLT5/8X14</u>	<u>BOLT MCH 5/8 X 14 IN XF HDW</u>	<u>M</u>	<u>R</u>	<u>59509</u>	<u>ZZ99999</u>	<u>2</u>	<u>\$0.00</u>
Totals							\$13,839.77

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-007

Date of Response: March 07, 2022
Page 1 of 4

Request from: Department of Energy

Witness: Brown, Thelma J

Request:

Reference: Eversource 2020 LCIRP and Supplement.

Please provide the Company's plans for upgrading distribution substations. Please provide the timeline, priority, etc.), and updates to any prior filing.

Response:

The following projects or programs are currently in progress or under development. These projects are budgeted and therefore considered the same priority. Additional projects will be identified as justified by System Planning or Asset Strategy when the need is identified.

PLC Automation Scheme Replacement

The program for the PLC Automation Scheme Replacement is an annual program established in 2016. The PLC designed automation schemes are outdated and have become a problem to update and maintain. There are six (6) substations on the Company's system that required replacement in 2016. Three of the PLC automation schemes have been replaced at Chester, Pine Hill and Bedford substations. The construction for the replacement of the PLC automation scheme at Amherst substation is in progress with planned completion in December of 2022. Two remaining PLC automation schemes at Ashland and Great Bay substations remain. The design for the Ashland substation is in progress with construction budgeted for completion in 2023. Great Bay substation is budgeted to be complete in 2024.

Electromechanical Relay Replacement

This program is to replace electromechanical relays in distribution substations with new microprocessor-based relays. These new relays are required in order to improve coordination between transformer protective devices and feeder protective devices and with downstream devices on the feeders originating at these substations. There are 52 feeder relays and 75 transformer relays required to be replaced. The majority of feeder relays will be replaced as a part of Grid Modernization projects. Design and construction for the transformer relays are budgeted to start in 2023 on this multi-year program.

**Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161**

**Date Request Received: February 18, 2022
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**Date of Response: March 07, 2022
Page 2 of 4**

Replace ABB TPU-2000R Differential Relays

This program is to replace four (4) ABB TPU-2000R differential relays in distribution substations with Schweitzer SEL-387E numerical relays. The existing ABB relays are obsolete and no longer supported by the manufacturer. Design and construction for the transformer relays are budgeted to start in 2022 and be complete in 2023.

Substation Animal Protection

Outages caused by animals in substations can affect the reliability to thousands of customers for a single event. A capital program was established in 2019 to provide animal protection systems as a system to protect substations from animal outages. This \$2.5M multi-year program has spent \$603K to date. Seven (7) substations are complete and four (4) substations are in-progress.

34.5kV Capacitor Bank Switch Replacement

The plan for a 34.5kV Capacitor Bank Switch Replacement Program was identified in 2008. There were 21 vacuum switches identified as needing replacement at that time and prioritized based on age, condition, operating problems, and uniqueness. Twelve (12) capacitor switches were removed and/or replaced from 2008 to 2019. In 2019 a multi-year program to replace seven (7) remaining capacitor switches was established. This \$5.3M multi-year program has spent \$1.2M to date. One (1) substation is complete, one (1) substation is scheduled for construction in 2022, and five (5) substations remain. Two (2) additional capacitor switches scheduled for replacement are part of larger projects at the substations to be completed by 2025.

34.5kV OCB Breaker and Ancillary Equipment Replacement Program

The plan for a 34.5kV Oil Circuit Breaker (“OCB”) Replacement Program was identified in 2007. There were 169 OCB identified as needing replacement at that time and prioritized based on age, condition, operating problems, and uniqueness. Seventy-eight (78) circuit breakers were removed and/or replaced from 2007 to 2019. In 2019 a multi-year program to replace the ninety-one (91) remaining OCBs was established. This \$29.7M ten-year program has spent \$3.1M to date. Thirteen (13) OCB replacements are complete, four (4) OCB are scheduled for construction in 2022, and seventy-four (74) OCB remain.

Millyard Substation Rebuild

Millyard Substation is a 34.5kV-4.16-kV substation, located in the Millyard area of Nashua, NH. Eversource completed a Distribution System Study for the 4.16-kV system in downtown Nashua in March 2016. This study supported the rebuild of the Millyard Substation with two 34.5-4.16-kV 10MVA transformers and six feeder circuits on property adjacent to the existing substation. This project is currently in construction with plans to be in-service in 2022.

Public Service Company of New Hampshire d/b/a Eversource Energy
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Date Request Received: February 18, 2022
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Date of Response: March 07, 2022
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Monadnock Substation Rebuild

Monadnock Substation, a 115-34.5kV shared transmission and distribution substation located in Troy, NH, is planned to be fully rebuilt to address Distribution System Planning Guide (“DSPG”) Criteria, asset condition of transformer TB40, and the substandard design of the existing substation where there are no transformer breakers nor high-side circuit switchers. This project is currently in the design phase with plans to start construction in late 2022 with a planned in-service date of 2023.

White Lake Substation Rebuild

White Lake Substation is a 115-34.5 kV shared transmission and distribution substation with two 28 MVA transformers and four distribution feeders located in Tamworth, NH. The distribution portion of the system is planned to be fully rebuilt to address violations of the DSPG Criteria and to address asset condition issues at the substation including the existing OCBs, the two station transformers and the electromechanical relays. This project is currently in the conceptual design phase with plans to start engineering in 2022, construction in 2023, and be in-service in 2024.

Dover Substation Rebuild

Dover Substation, a 115-34.5 kV shared transmission and distribution substation located in Dover, NH, is planned to be fully rebuilt to address DSPG criteria, and to address asset condition issues at the substation including an existing OCB and electromechanical relays. This project is currently in the conceptual design phase with plans to start engineering in 2022, construction in 2023, and be in-service in 2024.

Saco Valley Substation Replace Obsolete Equipment

Saco Valley Substation is a 115-34.5 kV shared transmission and distribution substation located in Conway, NH. The distribution portion of the system is planned to be fully rebuilt to address asset condition issues at the substation including the existing OCBs, the 24VDC control system and the electromechanical relays. This project is currently in the conceptual design phase with plans to start engineering in 2022, construction in 2023, and be in-service in 2024.

Brook Street Substation Transformer and Switchgear Replacement

Brook Street Substation in Manchester, NH is 34.5-13.8kV substation feeding an underground 120/208 Volt network system with two (2) transformers and two (2) metalclad switchgear. Additionally, the 34.5kV G&W switchgear in Brook Street Substation is underrated. This project is to replace the switchgear and transformers which are aging (60+ years old) and obsolete. This project is currently in the conceptual design phase with plans to start engineering in 2022, construction in 2023, and be in-service in 2024.

**Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161**

**Date Request Received: February 18, 2022
Data Request No. DOE 4-007**

**Date of Response: March 07, 2022
Page 4 of 4**

Swanzy Substation Circuit Switcher Replacement

Swanzy Substation is a 115-12.47kV distribution substation in Swanzy, NH. The existing 115kV circuit switcher J2S on the high side of the 115-12.47kV transformer TB2S has a history of sulfur hexafluoride (SF₆) leaks and repair. SF₆ is a greenhouse gas and emissions are damaging to the environment. This project is to replace the SF₆ circuit switcher with an air insulated circuit breaker. This project is currently in the conceptual design phase with plans for engineering and construction in 2022.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-008

Date of Response: March 07, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Johnson, Russel D

Request:

Reference: Eversource 2020 LCIRP and Supplement.

Please list and describe the Company's distribution voltage classes, with miles of each, installed.

Response:

Please see the table below.

Voltage Class	Overhead (Miles)	Underground (Miles)	Total (Miles)
4kV	2,733.29	215.43	2,948.72
8.32kV	352.38	36.05	388.43
12.47kV	5,486.63	570.45	6,057.08
13.8kV	8.69	8.36	17.05
34.5kV	3,599.82	1,191.23	4,791.05
Total	12,180.81	2,021.52	14,202.33

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-009

Date of Response: March 07, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Johnson, Russel D

Request:

Reference: Eversource 2020 LCIRP and Supplement.

Please provide an overall power system diagram and one-line diagrams (including identification of all substations).

Response:

Please see the following confidential documents attached:

- Attachment DOE 4-009(a) – Distribution One-Line diagrams under the controllership of the Electric System Control Center
- Attachment DOE 4-009(b) – Distribution One-Line diagrams under the controllership of the System Operations Center
- Attachment DOE 4-009(c) – Geographic map of the Eversource NH distribution facilities including all distribution substations and main 34.5kV circuit backbones.

Material in the attachments is confidential as containing confidential energy infrastructure information. Accordingly, consistent with Puc 203.08(d), Eversource states that it has a good faith basis for confidential treatment of the material provided with this response. The Company will submit a motion for confidential treatment prior to hearings in this proceeding.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-010

Date of Response: March 07, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Johnson, Russel D

Request:

Reference: Eversource 2020 LCIRP and Supplement.

Please provide a list and description of the Company's customer classes, voltage level, and percentage of total load demand by class.

Response:

Please see Attachment DOE 4-010.

Rate	Total kWh Sales 2020	% Total kWh Sales 2020	Billed Demand June 2021	% Total Billed Demand June 2021	Service Type
Residential	3,371,832,160	43.9%	-	0.0%	Single-phase, 60 hertz, alternating current, normally three-wire at a nominal voltage of 120/240 volts.
Rate G	1,591,763,294	20.7%	345,545	34.9%	Either (a) single-phase, normally three-wire at a nominal voltage of 120/240 volts, or (b) three-phase, normally at a nominal voltage of 120/208 or 277/480 volts. Three-phase, three-wire service at a nominal voltage of 240, 480 or 600 volts is available only to those Customers at existing locations who were receiving such service on February 1, 1986, and who have continuously received such service since that date. In underground secondary network areas, Delivery Service will be supplied only at a nominal voltage of 120/208 volts
Rate G Time of Day	737,281	0.0%	1,243	0.1%	Either (a) single-phase, normally three-wire at a nominal voltage of 120/240 volts, or (b) three-phase, normally at a nominal voltage of 120/208 or 277/480 volts. Three-phase, three-wire service at a nominal voltage of 240, 480 or 600 volts is available only to those Customers at existing locations who were receiving such service on February 1, 1986, and who have continuously received such service since that date. In underground secondary network areas, Delivery Service will be supplied only at a nominal voltage of 120/208 volts
Rate GV	1,538,222,341	20.0%	359,291	36.3%	Three-phase, 60 hertz, alternating current, at a nominal voltage determined by the Company, generally 2,400/4,160, 4,800/8,320, 7,200/12,470, or 19,920/34,500 volts.
Rate GV Backup	2,553,940	0.0%	3,721	0.4%	Three-phase, 60 hertz, alternating current, at a nominal voltage determined by the Company, generally 2,400/4,160, 4,800/8,320, 7,200/12,470, or 19,920/34,500 volts.
Rate LG	1,085,899,818	14.1%	222,016	22.4%	Three-phase, 60 hertz, alternating current, at a nominal delivery voltage determined by the Company, generally 34,500 volts or higher.
Rate LG Backup	64,961,130	0.8%	58,765	5.9%	Three-phase, 60 hertz, alternating current, at a nominal delivery voltage determined by the Company, generally 34,500 volts or higher.
Rate OL	16,649,257	0.2%	-	0.0%	N/A
Rate EOL	11,080,317	0.1%	-	0.0%	N/A
TOTAL	7,683,699,538	100.0%	990,581	100.0%	

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-011

Date of Response: March 07, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Labrecque, Richard C, Freeman, Lavelle A

Request:

Reference: Eversource 2020 LCIRP and Supplement.

Please provide the Company's system planning standards/guidelines.

Response:

The Company's system planning standards are provided in Appendix D of the Least Cost Integrated Resource Plan (LCIRP).

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-012

Date of Response: March 08, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Johnson, Russel D

Request:

Reference: Eversource 2020 LCIRP and Supplement.

Please provide the Company's distribution system protection standards/guidelines.

Response:

PSNH uses protection standards and guideline documents that have been developed internally by the Company's Protection and Controls Engineering department. These documents describe the protection philosophy based upon the equipment that is being protected (*e.g.*, line, transformer, capacitor), the type of protection (*e.g.*, fuses, reclosers, electromechanical/microprocessor relaying), and applicable industry standards. These documents are reviewed and revised periodically as the evolving technology of protective devices over the years has allowed the company to adopt improved protection philosophies.

Attached are examples of distribution protection philosophy documents for substation feeders and distribution power transformers.

Attachment DOE 4-012 A contains the Substation Feeder Protective Device Application Methodology document. Attachment DOE 4-012 B contains the Bulk and Non-Bulk Distribution Supply Transformer Overcurrent Settings document.

The 10/24/16 update of this document is primarily a cleanup of references as re-filed in 2016, plus the addition of an introduction to the relay-relay coordination module within OneLiner. Changes are in blue.

STANDARD PROCESS SUMMARY

The following is a summary of the items generally requiring review as part of a coordination study. While coordinating a single circuit might be accomplished on a more casual basis, using a standard sequence such as is provided here minimizes the chance of overlooking an issue. History has shown that when a complex area reconfiguration must be reviewed, a standardized sequence and a condensed margin requirement reference document are valuable.

GENERAL DESCRIPTION

SENSITIVITY

- Margins in General

- Base Case

- Contingencies

- Remote Bus Faults

- Remote Line End Faults

CT RATIO SELECTION

- CT Ratio Availability

- CT Burden If New CT Ratio or Increased Source

- CT Ratio Selection Using Electromechanical Relaying

- CT Ratio Selection Using Numerical Relaying

LOADING: PHASE OVERCURRENT PICKUP, MHO CIRCLES, LOAD ENCROACHMENT

- Relay Pickup Settings With Load Sensitive Overcurrent Relaying

- Loading Using MHO Circles

- Loading Using Load Encroachment

LOAD SIDE DISTRIBUTION COORDINATION

- Instantaneous Overcurrent Trip Usage

- Time Overcurrent Coordination

- Voltage Sensing Switch Applications

RELAY TO RELAY COORDINATION – RADIAL FEED

- Instantaneous Overcurrent Trip Usage

- Time Overcurrent Coordination

RELAY TO RELAY COORDINATION – LOOP FEED

REFERENCES

The following is intended to provide a brief discussion of the Standard Process Summary shown above, and to then use same as a basis to document the overall overcurrent coordination process. The main voltage level under consideration is 34.5KV, but much of what follows can be applied at other voltages as well.

General Description

Add just enough details to outline the basic configuration, and try to identify items that come to mind requiring particular attention.

Sensitivity

Margins in General

The nominal sensitivity requirements of 2/1 Isc/Ipu for phase-phase faults, and 3/1 Isc/Ipu for single L-G faults under contingency operating conditions, should generally be considered the minimum desirable. There are definitely locations, particularly at voltages below 34.5 KV, where the minimum fault sensitivity is the best setting possible based on coordination and loading requirements. Where choices are available, however, working upward from smaller to larger overcurrent relay pickup levels, based on loading and load side coordination needs, should generally result in improved sensitivity margins. This is as compared to setting the overcurrent relay pickups right up to the level that meets minimum sensitivity requirements. If there are no other compelling reasons for selecting a value (see the sections below on phase pickup versus load, and on load side coordination) contingent phase Isc/Ipu levels of 4.0 or more are desirable. Similarly, if there are no other compelling reasons for selecting a value, contingent L-G fault Isc/Ipu values of 5.0 or more are desirable.

Base Case Sensitivity

Sensitivity during base case operation should be reviewed initially, to begin the relay setting determination process. In Bedford S/S, 6 new breakers were set for what were base case radial feed conditions. The average phase-phase, remote line-end fault sensitivity was 5.26/1 on base case, while for L-G the average was 7.31/1. These should give a sense of where the pickup selection process is headed, although “the higher the ratio, the better” tends to come into play until other factors force lower ratios. The minimum base case phase-phase sensitivity of the 7 breakers was 4.35/1, while the maximum was 6.46/1. Line-ground fault sensitivity ranged from 5.44/1 to 9.62/1. The difference was established primarily by load side device coordination requirements and contingent sensitivity requirements.

Contingent Sensitivity

Proposed line configuration contingencies are not all that should be reviewed, however, but also those that are easily switched into but not necessarily officially proposed and documented. This requires judgment, because not every likely contingency will be part of the load flow package received from System [Planning and Strategy](#). What is received is a series of proposed solutions to resolve contingency operating problems on peak. Off peak there often many plausible, easy, and logically configured solutions. As an example, some lines are potentially tied together through a switch right outside of the substation. Taking a breaker out, or failing a breaker, could allow load to be retained or restored by use of the tie switch, or in many instances by closing in to feed from the remote line end. Only one solution would generally be provided in the load flow, but either would be possible from an operating perspective. This also requires judgment because some areas have multiple tie switches, many of which are not operated as part of the standard load flow package, and which could potentially increase the protection analysis dramatically. It is not the intention of this document to suggest reviewing all possibilities. A brief talk with experienced [operating personnel](#) is likely the best way to judge the probability of a configuration being used, and therefore the necessity of a protection review. For those contingencies not confirmed by System [Planning and Strategy](#) as part of the basic load flow package, an analysis of sensitivity only will generally suffice, rather than also reviewing overcurrent coordination.

In general, most contingencies are straight forward. Loss of any single element (breaker, line, transformer), where backing up such an event is plausible, must be reviewed for fault sensitivity.

For radial feed situations with IPP or utility owned generation, remote faults should be analyzed both with and without generation on line. Remote multi phase faults will always show less fault current at the source breaker with generation infeed along the radial line. L-G faults, however, are less predictable, and the zero sequence fault quantities at the source breaker are affected by both the generator size and its GSU configuration. Please note that sequential operation is occasionally required (though it is a second choice) to meet the desired sensitivity. That is, a mid line generator might have to trip before the source side protective device overcurrent increases to meet the desired sensitivity margins. As discussed later in this document, an effort is made to have the source meet margins with the initial fault, but as a minimum the source should be timing while waiting for the generator to trip.

For loop feed situations, remote faults must be reviewed, both on the remote bus, but also at the remote line end with and without the remote breaker open.

Remote Bus Faults

Though a difficult application at times, remote bus faults must meet minimum sensitivity requirements, and in some locations this includes analyzing parallel lines feeding a remote bus fault with weak feed source side conditions. This assumes that the remote bus has no bus differential relaying. With bus differential protection available on the remote bus, a base case condition can be assumed at the source. With or without remote bus differential relaying, generation on line between the source and the remote bus might be required to trip (sequential tripping) before minimum sensitivity requirements are fulfilled for remote bus faults. This is a last choice (it would be preferable to meet requirements with or without the generation on line), but could conceivably be inevitable, particularly for a bus with multiple parallel sources. In a similar fashion, for faults on remote busses with delta-grounded wye transformers on the faulted bus, the transformer or transformers might have to trip before the remote source side line breaker has sufficient current to meet ground fault sensitivity margins. Note that, when a remote bus is fed from two or more parallel lines from only one source side bus, sequential tripping is always required for faults near the source end of one of the looped lines.

Note also, that care is required if two or more lines are fed from a transformer (or transformers), to a faulted remote bus which has no bus differential protection. The transformer(s) would see the total current delivered to the fault, but the line contributions would be divided into two or more values, and due to the routes of the individual lines, one line might see significantly less current than the others. As a result, a simple one on one check of the transformer overcurrent curves to the line overcurrent curves might not point out the potential source transformer overtrip for the remote bus fault.

Remote Line End Faults

As mentioned, for remote, line end faults in loop fed configurations, sensitivity must be reviewed with and without the remote line breaker open. Where possible (obviously not for the single source situation), it is desirable that minimum sensitivity margins be met for the initial fault. If there are multiple parallel paths to the remote bus, this is not always possible. If it is not possible, it is usually feasible that the overcurrent relay remote from the faulted end of the line at least initially be above pickup. If none of these is possible, care must be taken to assure that minimum sensitivity margins ultimately be met for single element failure conditions, though a sequential clearing operation would be required.

CT RATIO SELECTION

CT Ratio Availability

Always check for the available CTs as well as the subject breaker's rating. There are 1200A breakers on the system with 600/5 maximum CTs available, and there are 1200A breakers with 2000/5 CTs. Remember also that not all of the CT ratio choices that are available at 1200/5 are necessarily available on standard ratio

2000/5 CT's. Finally, also note that there are some CT's on the system (4 lead versus 5 lead) which would be considered "non-standard" today. The available CT ratios actually available must be checked carefully.
CT Burden if New CT Ratio or Increase Source

The recent standard for new, individual 34.5KV breaker additions using numerical relays is **generally** to use 1200/5 CTs, and to assume on that basis that the C400 or better CTs now specified need no detailed burden review. On older circuits where relay changes are made, or where system changes result in increased fault current, a burden study should be performed. The required voltage developed by the CT, at the maximum L-G fault current through the CT circuit in question, should fall on or below the 45 degree line on the knee of the CT saturation curve being considered.

CT Ratio Selection Using Electromechanical Relaying

There are several considerations in CT ratio selection for existing control positions which use electromechanical relaying, and existing electromechanical panel metering. Keeping analog panel instrumentation in a reasonable range of resolution is one objective in CT ratio selection. Another is to minimize the requirement of multiple CT ratio changes over the life of the line position. To these ends, it has become common practice to consider a CT capability which at least matches the capability of the conductor used for the first sections of the line. One exception could be for those few instances, such as the takeoffs for several Huse Road lines, where large wire (795 ACSR in the case of Huse Road) is used as a get away on non-standard towers, with no intention of ever loading the line to the capability of the large conductor. Where feasible, the CT ratio is typically suggested to be sized from 100% to 120% of the line winter rating (ignoring any special take off structures). If contingent loading is anticipated to load the line to its winter rating within a year or two, the CT capability can be shaded toward the 120% figure. Lightly loaded lines, built with larger wire on speculation, can be shaded toward the 100% figure, improving analog instrumentation resolution while still limiting the need for multiple CT ratio changes over time.

This approach of basing the CT ratio on the entire line capability occasionally poses a problem, particularly with the older electromechanical relays. If the relays available do not have a low enough nominal tap range, it is not always feasible to meet overcurrent fault sensitivity requirements with a high CT ratio. Obtaining replacement, low range electromechanical relays is a high cost, sometimes impossible effort. If the required electromechanical relays are not in stock, it is usually necessary to base the CT ratio selection on expected loading (plus whatever margin can in fact be attained with available equipment), planning to then suggest a relay change to numerical protection as the load increases. The discrete overcurrent pickup steps of common electromechanical relays are typically a minimum of 0.5A, but are often 1.0A or 2.0A increments. These step increments are often problematic in locations requiring large CT ratios, but relatively low pickup requirements to meet fault sensitivity margins. Numerical protection typically has no more than 0.1A increments of overcurrent pickup setting capability. In general, due to modeling concerns in ASPEN 1-Liner, off-nominal tap pickups are not to be used in electromechanical relays.

CT Ratio Selection Using Numerical Relaying

For existing installations, with updated numerical relaying but where analog instrumentation is involved, the CT ratio selected should be as described above for electromechanical relaying.

For totally new installations, panel instrumentation is digitally displayed. As a result, resolution is not an issue. On new installations with 1200A or larger breakers, it has become common practice to use a 1200/5 CT ratio. This ratio can carry 120% of 477 26/7 ACSR conductor, which is presently the largest standard takeoff wire in use. As a result, that makes the CT ratio a low, or no probability of being a limiting thermal element. This is even more so given that modern CT's are typically purchased with a 1.5X or higher thermal rating factor.

The following section on phase overcurrent pickup selection, mho circle and load encroachment settings also have a bearing on CT ratio selection.

Loading: Phase Pickup, MHO Circle, Load Encroachment

Relay Pickup Settings With Load Sensitive Overcurrent Relaying

As just mentioned, if fault sensitivity allows, phase overcurrent protection should be configured to carry the full, thermal load capability of the line leaving the corresponding breaker. That reduces the need for multiple reviews of settings based solely on load growth. With unsupervised overcurrent relaying, however, pickup is more likely to be set as a multiple of anticipated loading. A goal of 1.5-2.0X anticipated peak (summer or winter) load should usually be adequate to cover cold load pickup loading after an extended outage. Unless absolutely necessary, use of less than 1.25X anticipated peak load should only be used with the reasonable expectation that there will occasionally be instance where load restoration requires line sectionalizing. Use of less than 1.15X anticipated peak load opens up the possibility of tripping due to simple load unbalance on a per phase basis. Whatever quantity is selected must be reviewed based on required sensitivity as discussed above.

Loading Using Mho Circles

P&CE has accepted a simple to apply (though difficult to describe) criteria to determine the loadability of a circuit which has overcurrent relays supervised by mho elements. Though the calculations are easy, the answer provided only provides a reasonable assurance, supported by history, that the subject mho element will not pick up under load, and consequently will not enable the supervised overcurrent relay to operate on load. The procedure consists first of determining the number of primary ohms represented by a loadability level of approximately 125% of the CT ratio. An 800/5 CT ratio then, would target a loadability of 1000A, or $19,920V/1000A=19.92$ ohms primary at 34.5KV. That number of ohms primary is converted to secondary ohms, then assumed to be a point on the mho circle at half of the mho relay's maximum torque angle, or stated differently, the maximum "R" point on the R-X diagram's mho circle. A 75 degree maximum torque angle relay would then have one point specified as 19.92 ohms (but converted to secondary ohms) at 37.5 degrees. This is then used to determine the diameter of the circle at the maximum torque angle. In the example given, the proposed circle diameter at 75 degrees maximum torque angle is (secondary ohms at 37.5 degrees)/(cosine 37.5 degrees). The resulting mho circle is then checked against the longest required reach of the circuit involved, including operation on contingencies. The circle diameter should be at least 150% of the relay's apparent impedance to its most difficult required fault location and system condition. Use the largest circle to meet the loadability criteria, do not reduce the circle to the 150% level. This maximizes the probability of the mho circle responding to a multi-phase fault with impedance.

Loading Using Load Encroachment

P&CE also has a standard approach to applying load encroachment settings using SEL or GE relays which have that feature. The load encroachment settings are used to supervise phase overcurrent settings of the same relay to prevent operation under heavy load conditions. For specific details, see the latest version of "Load Encroachment Methodology Using SEL Relaying"¹

Load Side Distribution Coordination

Instantaneous Overcurrent Trip Usage

There are two ways that instantaneous overcurrent trip elements can be applied on radial feeds. One is to set the instantaneous trip element to under reach the first coordinating device tapped off of the line. Overcurrent levels required to under reach a given device were given for the 115kV or higher transmission system in Setting Coordination Methods and Procedures\115 kv ground fault protection criteria - specific.doc, and were summarized as follows.

1. Induction cup or induction cylinder elements (e.g. IRP, JBCG) - 1.15X the maximum current value.
2. Hinged armature and plunger elements (e.g. CRP, IBCG) - 1.35X the maximum current value.
3. SEL or GE numerical relays - 1.15X the maximum current value.

4. REL 512 numerical relays - 1.20X the maximum current value.

At the subtransmission level (34.5kV) or lower, these applications are rare. Based on more recent discussions, the values above should be considered minimum values. A universal 1.20X is proposed as a general multiplier for under-reaching instantaneous trips for line applications using numerical relays, and 1.25X if an overtrip would be particularly problematic.

The second way that an instantaneous overcurrent trip can be applied is to set it to overtrip most if not all tapped devices, and then block the instantaneous trip operation after the first operation in order to allow time overcurrent coordination with tapped overcurrent devices. This is most often attempted where “fuse saving” is a desirable goal. The application of this approach is more fully discussed in the Cooper Power Systems book “Electrical Distribution System Protection”. More details will not be added here due to the growing rarity of this approach to overcurrent protective device application as mentioned in the following paragraph.

The use of instantaneous trip elements in any distribution protection application is diminishing rapidly due to quality of service considerations. There is rarely enough electrical “distance” to the first tapped device to allow the application of an under reaching instantaneous element. And the use of an instantaneous element which over reaches, trips and is then cut out of service, often results in customer “blinking circuit” complaints.

Time Overcurrent Coordination

Load side distribution overcurrent curve coordination with substation feeder relaying starts with a review of existing equipment tapped off of the load side of the breaker in question, followed by questioning of the circuit owners involved regarding any special distribution protection needs which have been recognized, such as constricted maximum fusing or recloser settings. These needs, combined with sensitivity and loading requirements as described above, set the stage for a detailed review of each type of equipment tapped off of the load side of the subject breaker.

For non-reclosing load side devices such as fuses or switchgear, coordination with the substation feeder relaying consists of applying standard curve shifts and margins, comparing the source side device response curve to the load side device total clear curves, using ASPEN 1-Liner. The standard curve shifts and margins have been summarized in the latest version of “Protective Device Application Shifts, Margins”².

If the source side relay (or recloser, where applied) uses a non-ratcheting operating mode, the coordination with all load side devices is a similar, simple comparison of response and total clear curves using 1-Liner and standard curve shifts and margins as described above.

If the source side device is an electromechanical relay, and the load side device has an automatic reclose cycle, the EXCEL spreadsheet RATCHET must be applied to account for the ratchet effect on disk reset of the source side device. The margins and curve shifts used are as defined in the latest version of “Protective Device Application Shifts, Margins”².

One other margin required in RATCHET that needs clarification is that of the estimated or tested disk reset times. A 1.1X multiplier is always applied to a source side electromechanical disk reset time (tested or estimated). This adds to the required coordination separation, and also accounts for the less than exact reset time predictability of electromechanical relays. If numerical source side relays using electromechanical emulation are applied, a 1.05X multiplier applied to calculated reset time is suggested. While in this case the reset time is highly predictable, this margin adds a modest margin to the required curve separation, as in the electromechanical case.

There is another factor to consider regarding ratcheting. If the source side device is a ratcheting, straight overcurrent relay (as opposed to a zone two supervised overcurrent timer, or any non ratcheting electronic device), then the estimated reset time must be determined based on loading after the load side, tapped device operates. Load through an overcurrent relay slows disk reset, and this must be accounted for when a distribution device operates in a manner that causes ratcheting of the source side protective device. Reset times based on several load levels are available under tabs within the RATCHET spreadsheets.

All of the above discussion assumes that the most difficult coordination points have been reviewed. This is often at the maximum fault current available, but is not necessarily so. In today's world of electronically generated curves, pickup coordination (source side pickup higher than load side device pickup, as generally desired) does not necessarily mean smooth, parallel, diverging curves at lower fault values. It may be, and often times is, necessary to check ratcheting coordination at lower fault values as taken from the 1-Liner curve plots. There are a myriad of possible fault impedances, including lengths of non consistent wire sizes, between the source and a prospective fault, and these all can serve to reduce fault values at the devices to be coordinated. Rather than run a large number of differing fault impedance values or fault locations beyond a load side device, a simple comparison of the device times (ratcheted if necessary) at varying fault values, taken directly from the zero impedance fault plots for close-in load side faults in 1-Liner, has given good results to date.

Voltage Sensing Switch Applications

The application of voltage sensing switches deserves its own defining document. The latest version of this document is called "Voltage Sensing Switch Setting Methodology.doc"³. The process, in summary, consists of determining the margins required between automatic reclosing of the source side device and the voltage timers which will ultimately open the voltage sensing switch. It is typically expected that a radial circuit will be "tried" once, with an automatic reclose of the source breaker, before the voltage sensing switch is opened. It is necessary, therefore, to determine the latest that a first reclose might occur, from the initiation of a multi-phase fault, to a closed breaker, including tolerances. The voltage sensing timer, with its tolerances and margin, must be set longer than that time.

It must then be determined, based on the proposed setting of the voltage sensing timer, what the earliest second automatic reclose of the source breaker could be, including all tolerances and margin, to be sure that in fact that the voltage sensing switch is open before the second reclose occurs. Stated differently, the latest open time of the voltage sensing switch must be determined.

The easiest way to accomplish the settings for an actual application is through the use of the defining document whose address is shown above.

Please note, that there is also a draft version of an EXCEL spreadsheet which helps analyze the required recloser or breaker timing versus the voltage sensing switch timing. It is based on the Word document listed above, called "Voltage Sensing Switch Timing Calculator DRAFT 10_24_16"⁴. This document has had limited use, but has the potential to significantly reduce the required analysis time. It is on the list of items to be updated and expanded.

Relay To Relay Coordination – Radial Feed

Instantaneous Overcurrent Trip Usage

The use of instantaneous overcurrent trip elements in a relay to relay coordinating scheme does occasionally allow the use of an under reaching instantaneous trip element on a sub-transmission line which has no taps off of it. Lawrence Road to Hudson, and Oak Hill to Penacook are two such examples at this time. Margins required to under reach a particular piece of equipment beyond the device being set are as described above under "Load Side Distribution Coordination". As mentioned in that section, the use of an over reaching instantaneous trip element is diminishing rapidly, and that is particularly so on the 34.5KV system where relay – relay coordination is still required on a large scale.

Time Overcurrent Coordination

If any change is made to a device, due to load side coordination requirements discovered through the previously outlined procedures, all devices on the source side which could supply fault current to the changed device must be checked for coordination. The changed device, which in the foregoing discussion was referred to as the source side device, now becomes the load side device. Coordination should be

achieved for faults close-in to this device versus any source device, on a base case as well as any single contingency basis. A ratcheting review will typically be required.

In the case of bulk distribution transformers feeding the source bus, the P&CE document "Bulk and Non-Bulk Distribution Supply Transformer Overcurrent Settings.doc"⁵ provides guidance. Older sites, where electromechanical overcurrent relays are applied to transformer protection, will require the use of RATCHET. As mentioned in a previous section, if the source side (bank overcurrent device in this case) is a ratcheting, straight overcurrent relay (as opposed to a non ratcheting electronic device), then the estimated reset time must be determined based on loading after the load side device operates. Load through an overcurrent relay slows disk reset, and this must be accounted for when any device operates in a manner that causes ratcheting of the source side protective device. Reset times based on several load levels are available under tabs within the RATCHET spreadsheets.

In the case of multiple lines feeding a bus, the required final coordination margin between coordinating relay pairs, on worst case contingency conditions, for no reclosing or very long reclosing of the faulted feeder, is a fixed quantity based on relay manufacturer. The minimum coordinating margin, relay – relay, if no ratcheting is involved, is 0.35 seconds for Westinghouse electromechanical overcurrent relays, and 0.40 seconds for GE electromechanical relays. 0.35 seconds relay - relay is the required margin for numerical, non ratcheting applications. Details on how these times were developed are part of the P&CE ground overcurrent coordination document "PSNH 115 kV Line Non-pilot Ground Protection Basis and Background of "Specific Setting Criteria"⁶. No current or time multipliers are involved when doing relay – relay coordination.

In the case of multiple lines feeding a bus, the required final coordination margin between coordinating relay pairs where reclosing is involved, on worst case contingency conditions, is 0.20 seconds, "after clear, after coast, after ratcheting" of the relay pairs. This typically requires the use of the RATCHET spreadsheet if the source devices are either electromechanical relays or numerical relays using electromechanical disk emulation. Again, no current or time multipliers are involved when doing relay – relay coordination. Note that when applying RATCHET, the load side (faulted device) estimated or tested disk reset time is reduced by applying a 0.90X multiplier (0.95 for numerical relays), while the source side relay disk reset time is increased by applying either a 1.10X (electromechanical relays) or 1.05X (numerical relays) multiplier. This combination of multipliers gives the "worst case" ratcheting results. That is to say, the faulted device, by shortening its disk reset time, results in a slower second or third operation. Likewise, lengthening the disk reset time of the source side relay shortens its prospective second or third attempt to operate.

There are also other data decisions to make for the use of RATCHET. Absent specific information, 0.10 seconds has typically been used for breaker clearing time. Disk overtravel (coast) time has been standardized as 0.10 seconds for GE electromechanical overcurrent relays, and 0.03 seconds for Westinghouse electromechanical overcurrent relays. 1 cycle coast (rounded to 0.02 seconds) should be used for SEL relays or their equivalent.

As described earlier, care must be taken to use disk reset times based on estimated load conditions where applicable.

Nominal response times are as taken from 1-Liner curve displays for the fault and system configuration in question.

Relay To Relay Coordination – Loop Feed

Many of the steps required to perform a coordination, or a re-coordination, of breakers which are part of a multi-line loop between buses, are the same as for the radial feed cases, including the rare but occasional use of under reaching instantaneous overcurrent elements. In fact, the biggest problem is keeping the overall process organized, while applying a series of steps identical to the radial feed process. The process is iterative, by necessity.

The first step in reviewing a given breaker's settings is to step through the very same steps listed above for non-loop situations. Sensitivity, CT ratio, phase overcurrent issues, and load side distribution coordination

are all required elements (at 34.5 KV or lower) regardless of whether the breaker in question is part of a loop or not. Virtually all looped PSNH lines will at some point be operated radially on contingency, and it must be determined whether setting the breaker for full radial coordination with load side distribution equipment will result in acceptable loop coordination when tied through, end to end. Note that it is not always feasible to have full radial coordination from both ends of a line, but eases operating issues if it is feasible. As a general rule, it is usually possible to offer base case (looped), full coordination with distribution taps (no overtrip by either substation breaker), plus full radial coordination from one end of the line or the other. Full radial coordination from both ends is often problematic, and the effort to meet that standard should generally not be allowed to force major system re-coordination or longer than desirable clearing times. In general, base case clearing of less than 1 second is very desirable. For a circuit with no copper wire, remote, base case fault, total clearing times in the 1-1.3 second range are not unusual. Total clearing times above 1.3 seconds should be checked carefully, particularly since contingent, weak feed situations can extend that time measurably.

With the availability of 1-Liner, many of the coordination steps can be displayed graphically, and reasonably concisely as well. The operate curve for a close-in fault near a feeder breaker can be displayed showing its timing versus every source device with which it must coordinate. Up to 15 overcurrent curves can be displayed simultaneously on a one-line curve plot. In addition, once all of the curves are displayed, base case, line or transformer out, initial and "with end open" fault cases can be easily displayed through use of the fault dialog box. These 1-Liner features greatly expedite the process of observing, analyzing, and documenting the operation of a faulted line's protection versus the overcurrent protection characteristics of all sources to that fault.

The following might seem like a minor note, but it has proven to be an important one in complex area reviews which require coordination between multiple overcurrent devices. It has to do with keeping organized visually, and thereby mentally throughout the analytical process. In reviewing the operation of a particular faulted breaker, organize the curve setup in a consistent pattern from day to day, case to case. For reasons which have become apparent through trial and error, it is recommended that the faulted feeder's phase and ground curves' dialog boxes be displayed in the lower left corner. With this approach, as multiple faults are run, there will be no searching for the faulted element's curve data, since it's always in the lower left corner. Also with this approach, when comparing operate times, there should be no time on the curve set which is faster than the times displayed in the lower left corner, the faulted device. Keep all other phase and ground curves paired on the plot for each breaker, because it is often the case that both are involved in L-G faults, and it is rare that only multi-phase faults are being reviewed. And finally, as the faulted device is changed in a review, keep the responding elements in generally the same layout, except move the now faulted element to the lower left. This simple methodology is a great help in developing a mental picture of where the difficult issues are, how the system is responding, and helps lead to corrective resets in an orderly fashion. Some sources for example, are such weak sources, with consequently such long operate times that their response requires no detailed review at all. If this holds true as contingent cases are run, the required mental picture of the system and its potential coordination problems is simpler to grasp.

With the basic circuit analysis completed as shown above as the first step, it should be possible to do a trial setting of the subject breaker and to attempt a detailed loop fault and coordination study. If full radial coordination and the desired load carrying capability do not result in a gross change of settings, begin running area faults to see what affect the tentative changes would have on system operation. If the settings required to meet all desired distribution coordination possibilities result in potentially changed settings which seem impractical, discuss compromises with the circuit owner involved. The ultimate test, however, is to test loop coordination on a step by step basis, described briefly as follows.

In these and all the cases that follow, care must be taken as described earlier, to use disk reset times based on estimated load conditions where applicable.

The new, tentative settings must be reviewed from two perspectives: how do the new settings respond to faults on lines or transformers attached to the remote bus at the far end of the line being reset (the new settings must wait for these faults, on base case and contingencies), and how do the new settings respond

versus sources “behind” it for close in line faults (the new settings must beat all actual and potential sources for three phase and L-G faults close-in to the S/S feeder breaker).

Since the typical trend is to create slower clearing times for the breakers being reset (for improved coordination with larger distribution taps, for example), coordination with faults beyond remote busses is often eased. As a result, it usually makes sense to first start running faults close in to the reset (often slower) breaker in order to measure the impact on other relay settings which monitor sources of fault current to the reset breaker. In a looped system, this means running close in, 3 phase and L-G faults, as looped and then with the remote end open. All relays monitoring sources to this fault can typically be shown on the 1-Liner plot, shifted to “Align curves with total fault current” (this feature alone should put Sherman Chan in the P&CE Hall of Fame). Since a simple contingency would be to operate the system radially, a ratcheting analysis should be performed using just the shifted curves with remote open initially, as a stand alone question. Subsequently, however, ratcheting versus all source relays must also be performed starting with close in faults under initial (looped) conditions, followed by radial close in faults assuming the remote end has tripped and remains open prior to the automatic reclose of the local breaker.

Reclosing permissives are critical to the assumed sequence of operations. In rare instances, only synch-check reclosing is employed on the local breaker, in which case no ratcheting review is required, since the breaker should only reclose into an energized (therefore presumed unfaulted) line. In the more common instances where dead line and/or synch-check permissives are employed, a typical, ratcheted sequence must be analyzed. This analysis includes a review of the reclosing permissives used on the remote end of the line.

If the remote permissive is synch-check only, the local breaker can always be assumed to trip once looped, then reclose onto a radial line. If the remote breaker uses dead line and/or synch check, it is often difficult to predict an exact sequence, since the first clearing time is different for each end of the line, and this starts the reclose cycle. In addition, the older style reclosing relays often started a motor or electronically timed equivalent to control reclosing, which makes it difficult or impossible to predict the exact line conditions onto which the local breaker will reclose. Consequently, based on reasonable results of actual system operations to date, a sequence is suggested of one looped clearing time followed by as many radial clearing times as the local reclose cycle allows. This assumed sequence has rarely been shown to lead to incorrect coordination. That is probably because the radial feed situation is typically a more difficult ratcheting problem than the looped case. In addition, however, the fact that a ratcheting review is then done for all single contingency events, probably reduces the probability of error to a negligible value for any unanalyzed reclose sequence.

After the base case conditions are analyzed, it is then necessary to repeat the ratcheting/coordination process for any reasonable single contingency events. This can begin to potentially require serious changes to the source relay settings, and the probability of that particular contingency must be determined. At times, it becomes necessary to accept a compromise rather than to step into an exhaustive reset of multiple area relays. A typical compromise on contingency, for example, might be to accept a reduced (or zero), ratcheted coordinating margin if an overtrip of the source side breaker would not result in a permanent loss of load.

Once the tentative new settings for the relays in question have been established through the process just described, it is necessary to review their coordination with faulted lines beyond remote busses, and/or with relays on lines “around the corner” to the looped, parallel, adjacent line feeding the remote bus, which are fed from the relays just analyzed. The process is similar, but hopefully less onerous.

This lays out the basic start of the reset process, but usually this is just the first phase. For every relay that must be changed to coordinate with the relay changed initially, a similar review is required. At times those “remote” resets are easy (if there is a two transformer source to the remote bus, for example, relays remote from that bus often have an easy coordination requirement due to the transformer fault current infeed). The process, however, is iterative, and must be iterative. All of the changes proposed potentially affect many coordinating devices. There is no way around the process except to possibly limit the number of change requests that are honored. It is often possible, after a cursory review of a requested change, to demonstrate the magnitude of the resulting changes that would be required. Compromises can then be worked out with

the circuit owner, which still allow enough, but perhaps not all, of the desired gains in distribution equipment application options.

There is another tool available in One Liner that can occasionally help the review of proposed settings, at least on an initial, non-reclosing or non-ratcheting basis. It is described here for use on the transmission system, but with care can be an aid on the looped subtransmission. It can test more contingencies than can realistically be done manually. The use of OneLiner to analyze ratcheted settings has not been reviewed as yet.

ASPEN OneLiner “Check Primary/Backup Coordination”

Once an area coordination review is complete and the proposed overcurrent settings have been modeled in a OneLiner case, OneLiner has an excellent tool to allow a review of the anticipated relay-relay coordination. From the Main Window Commands at the top of the system diagram in OneLiner (or right click the chosen relay group) select “Check” then Primary/Backup Coordination” from the drop down menu. This opens a dialog box from which to select the coordination to be checked, and the parameters to be used in checking any coordinating pairs of relays. The “Help” screen walks through the process of setting up coordinating pairs and executing a check. Once the relay data is loaded, and the pairs are properly tied to one another by right clicking a relay group to “form coordinating pair”, the coordination check can be executed in a matter of seconds. Rather than re-write the “Help” section, the following observations are offered based on past experience with the module.

1) Carefully create all associated coordinating pairs. The program has no way of knowing which relays are expected to coordinate except by the creation of coordinating pairs. It is easy to get a “no problems found” report that misses potential problems if this first step isn’t carefully executed. It is also easy to get a meaningless report if a pair is selected which has no relay data in it to work with. The process is simple, but attention to detail is a must.

2) While there are multiple choices under “Coordination Types Checked”, the “OC Backup/OC Primary (Multi-Point)” selection has proved to be very helpful for time delay time overcurrent coordination checking. This selection will place faults along a given line at selectable percentage interval levels, such as every 5% or 10% of the line length. 5% gives a reasonable level of detail, and takes (virtually) no longer than larger intervals. It would be extremely cumbersome to manually check coordination for as many faults as the program checks and summarizes in seconds. This is particularly true when single or double contingencies can be run by a simple check box.

3) The coordinating time interval, CTI, is selectable. At times it is informative to set the interval above the desired level to see how close the coordination is. For example, if a 0.35 seconds margin is desired, run a case at 0.5 seconds to see where the potential problems might lie. Then drop down to the desired level, and if the coordination meets margins for all contingencies and no problems are reported, you still have a better picture than if just the final desired margin is run initially.

4) Remember that this check does not include ratcheting if in fact ratcheted relays are involved, but it can be useful as a first check of the coordination situation. For long open times or with numerical relays not using electromechanical relay emulation, it can be extremely helpful as a double check of the final solution.

References

Specific References:

1) K:\RESTRICTED - ED\System Projects\Protection & Controls\P&CE Technical White Papers and References\White Papers\Load Encroachment Methodology Using Numerical Relays.doc

2) K:\RESTRICTED - ED\System Projects\Protection & Controls\P&CE Technical White Papers and References\Reference Articles and Coordination Tools\Protective Device Application Shifts, Margins.doc

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- 6) K:\RESTRICTED - ED\System Projects\Protection & Controls\P&CE Technical White Papers and References\White Papers\115 kv ground fault protection criteria - basis and background.doc

General References:

- K:\RESTRICTED - ED\System Projects\Protection & Controls\P&CE Technical White Papers and References\White Papers\Distribution Line Capacitor Fusing Methodology 7_6_09.doc
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The following are the suggested settings (including temporary settings for initial energization) and their basis for bulk and non bulk distribution supply transformers. As in the past, these transformers are defined as delta connected on the high voltage side, and grounded wye on the low voltage side, with low side voltages up to and including 19.9/34.5 KV. The previous (2009) revision included two major changes. One was the addition of guidance for smaller distribution supply transformers, typically fed from the 34.5KV system rather than just the 115 KV and 345 KV discussed in previous issues, and the other was the addition of comments on 65⁰ C base rated transformers. The references to 55⁰ C base rated transformers have been retained due to the large installed base currently on the system, but also since many of the newly purchased transformers are still base rated at 55⁰ C. The 2016 revision makes the 2009 proposals permanent, and is a general update with clarifying discussion but few proposed setting changes. The summary pages at the end have been condensed further. The 2016 changes are marked with this color type.

The settings involved are for the typical high side phase and ground overcurrent, and low side neutral overcurrent relay functions. It is assumed that solid state or numerical overcurrent relays are being applied. Existing electromechanical relays need not be reset routinely, but the basis for settings as described here can easily be adapted for that purpose where necessary as described in the final section of this document.

In broad terms, the objective of this setting process is to balance through fault protection and sensitivity against loading concerns and sneak trips.

High Side Overcurrent Relays

High Side Phase Overcurrent Relay(s)

Most of the company's larger transformers have a 55⁰ C base rating, with a 65⁰ C rise maximum capability with oil and fans. Some of the newer transformers are only rated at 65⁰ C. This ultimately has little effect on the settings as shown in the following.

- For a 115 KV source and a 55⁰ C base rated transformer, if the station has differential protection on the low side bus, set the phase time overcurrent pickup at approximately 2X the maximum 55⁰ C rating. Check that the selected value results in an I_{sc}/pickup value of at least 2/1 for the worst case low side multi-phase fault. Worst case I_{sc}/pickup of 2/1 or higher is a requirement. Also check that the pickup is equal to or greater than any of the feeder phase overcurrent settings. If, however, there are more than two transformers normally feeding a bus, check for pickup coordination with the feeder settings by the use of a computerized fault study program. This setting may or may not result in full fault sensitivity backup, by the transformer phase overcurrent relay(s), for remote feeder faults combined with a feeder breaker failure.

For a 65⁰ C base rated transformer, it has been determined and confirmed by the System Planning and Strategy Department that on a general planning basis up to 1.5X the transformer's top rating can be carried through the transformer for 15 minutes in an emergency. As a result, the high side phase overcurrent relay could be set at approximately 1.8X the transformer's top rating if the station has bus differential protection on the low side, which results in a 20% margin above the desired short time loadability.

For existing transformers with a 55⁰ C base rating and a 65⁰ C top rating, or the 65⁰ C rated transformers, the proposed pickup will be essentially the same. Specifically, 2X40MVA = 80MVA and 1.8X44.8MVA = 80.6MVA. These values are often much higher than the anticipated load, and as a result the proposed pickup should be treated as a guide. Sensitivity should not be risked in order to use "standard" values; sensitivity to low side faults must be achieved as described above.

- For a 115 KV source, if the station has no differential protection on the low side bus, set the time overcurrent pickup at approximately twice the anticipated peak load, but not more than twice the maximum 55⁰ C rating for 55⁰ C base rated transformers, or 1.8X the maximum 65⁰ C rating for 65⁰ C base rated transformers. Check that the selected value results in an I_{sc}/pickup value of at least 2/1 for the worst case low side multi-phase fault. Worst case I_{sc}/pickup of 2/1 or higher is a requirement.

Also check that the pickup is equal to or greater than any of the feeder phase overcurrent settings. If, however, there are more than two transformers normally feeding a bus, check for pickup coordination with the feeder settings by the use of a computerized fault study program for the worst case single contingency. This setting may or may not result in full fault sensitivity backup, by the transformer phase overcurrent relay(s), for remote feeder faults combined with a feeder breaker failure.

- For a 345 KV source, set the overcurrent pickup using the same requirements as the 115 KV cases discussed in the previous paragraphs, but with one exception. Use an upper pickup target of 15% above the winter TFRAT capability rather than twice the maximum 55⁰ C rating for 55⁰ C base rated transformers, or 1.8X the top 65⁰ C rating for 65⁰ C base rated transformers. Note, however, that with the high impedance transformers used at 345 KV, sensitivity to low side bus faults may preclude much loadability above the winter TFRAT rating.
- For a 34.5 KV or lower source side voltage, use the same general approach shown above for 115KV sources. With low side bus differential protection available, use either twice the top 55⁰ C rating (for 55⁰ C base rated transformers), or 1.8X the top 65⁰ C rating (for 65⁰ C base rated transformers), but confirm sensitivity to low side multi phase faults. Without low side bus differential, or equally as important if the application only uses a high side fuse, or a high side recloser with no low side bank neutral overcurrent relay, revert to a multiple of expected load approach (preferably 2X expected load, but at least 1.5X if possible) in order to maximize sensitivity to low side bus faults, particularly L-G faults.

In the case of stations with low side bus differential protection, these values are rather arbitrarily based on 1) the long standing PSNH minimum sensitivity for multi-phase faults, and 2) the often expressed opinion of operating personnel that any of our transformers may well be asked to carry “twice nameplate for 30 minutes” (see system configuration comments below), or for the more recently adopted 1.8X the top 65⁰ C rating for 65⁰ C base rated transformers. To date, a setting of twice the maximum 65⁰ rating has not been requested for 55⁰ C base rated transformers. Any overcurrent setting above the minimum required for sensitivity is deemed to be arbitrary because P&CE does not purport to protect transformers from overload, but does require a given level of protection for faults.

In the case of stations with no low side bus differential protection, the high side overcurrents are the low side bus protection for multi-phase faults. It is appropriate, therefore, to maximize sensitivity of the phase overcurrent relays while comfortably carrying the expected transformer load. This is also true for L-G fault sensitivity in any application that does not have either a low transformer neutral overcurrent relay or bus differential protection, requiring the high side protection to provide low side bus protection.

In either case, care must be exercised when analyzing sensitivity during phase-phase faults. If there are only two high side phase overcurrent relays it is not appropriate to take credit for the one phase which is always carrying twice the current of the adjacent two phases because the phase with high current could be the one with no phase overcurrent relay.

System configuration has historically been a factor in accepting phase pickup values up to twice the maximum 55⁰ C rating at 115 KV. At this voltage it was and is typical that either multiple transformers are paralleled to feed an area (such as in the Nashua area), or two transformers may be paralleled with no bus tie breaker to supply an otherwise isolated bus (such as Whitelake). With this configuration, it is very possible to lose a transformer and immediately put a heavy contingent load on the remaining unit or units. Setting trip levels as proposed is intended to allow up to 30 minutes for operators to off load the system rather than go into a cascading loss of transformation.

At 345 KV, the only difference from the 115 KV settings is in the phase pickup value. At this voltage, the 34.5 KV system is presently operated radially except during short time switching events, and no two transformers are paralleled on a single bus. On that basis, it would be necessary to switch into a heavy loading scenario, so the need for a 30 minute extreme load capability is minimized.

All of the following criteria apply to bulk or other distribution transformers supplied at any high side voltage.

- Set the phase overcurrent time to 1) lie under the transformer through fault characteristic defined by ANSI/IEEE C57.109 at all currents above the pickup value described previously, and 2) coordinate with the slowest low side feeder breaker during the most difficult coordination contingency. A **nominal relay-relay (no tolerances or breaker times added)** time margin of 0.5 seconds or more (assuming a non-ratcheting application) is suggested between feeder relay and this relay's operate time, although 0.4 seconds is acceptable if required.

Please note that "or more" margin often makes sense. One objective is to minimize future bank overcurrent settings if possible. If the feeder breakers all operate in 0.5 seconds for a close in fault, and the bank overcurrent relay is set for 1.0 seconds, the next requested feeder setting change would also likely require a bank overcurrent reset. The bank through fault curve typically allows solid through faults for 2 seconds or more. Setting the bank overcurrent relay times in the 1.2-1.5 second range for the example given would reduce the number of future bank resets, yet still be well under the through fault curve. This expanded coordination margin is most adamantly true for installations with full transformer and bus differential protection (since the overcurrent relays are providing backup only), but can be applied with discretion for other applications.

If the low side breakers have breaker failure relaying, it is not necessary to have a full coordination time margin on top of the feeder line relays plus breaker failure time. A concurrent operation of the transformer overcurrents with a breaker failure operation is acceptable, but timing should always assure operation of the breaker failure lockout for a legitimate breaker failure event. As an example, a breaker failure timer setting of 0.25 seconds with a bank overcurrent coordination margin of 0.5 seconds would assure breaker failure operation when necessary, and would allow a chance for (but not assure) complete bank overcurrent coordination versus a failed low side breaker. This would be an acceptable condition.

The need to stay under the transformer through fault characteristic is fundamental to the protection of the transformer. (Note, however, that these pickup and time values may leave the low current end of the transformer through fault characteristic unprotected. Where this is required for heavy contingent loading it is acceptable). The margins are based on both history and manufacturer's recommendations. The nominal electromechanical relay-electromechanical relay time has historically been 0.4 seconds at PSNH. GE now publishes a recommended minimum of 0.27 seconds plus breaker time for IAC53 relays, or 0.37 seconds relay-relay including 0.1 seconds for breaker time. Since this also includes 0.1 seconds for coast, the bare minimum if solid state relays are used on the high side could be reduced to 0.27 seconds. The 0.5 seconds suggested margin, and 0.4 seconds minimum margin, arbitrarily adds 0.13 seconds to these values due to the implications of an overtrip in this application. (These basic margins are consistent with the PSNH ratcheting program in which 0.2 seconds margin is accepted after clear and coast, or nominally 0.4 seconds relay-relay assuming a 0.1 second breaker time and a GE relay).

- Set the phase instantaneous overcurrent pickup to a value as close as practical to 15X the transformer base rating for either 55⁰ C or 65⁰ base rated transformers.

Note: In locations where two transformer differential relays are used, the typical 50P function might or might not be applied based on the tripping path of the associated lockout relay. Operational clarity is the objective; this application should be decided upon based on the specifics of the final control diagram.

15X base rating is a revision instituted for the 3/12/03 version of this document (18X was used previously). 15X represents an attempt to get further reach of the instantaneous into the transformer to minimize the chance of locking out a source line for a transformer fault with failed (or no) differential protection.

Limited information from transformer manufacturers, and earlier discussions with Jim Borowitz, have been somewhat inconclusive regarding the degree of inrush of 65 degree transformers versus 55 degree transformers. Monitoring the "calculated inrush" figures, which are part of the standard PSNH test requirements, should be part of the final setting process. As more 65 degree units are purchased, the comfort level with the suggested inrush level should improve.

This instantaneous setting provides a 25% margin over the often referenced inrush quantity of 12X for 0.1 seconds. A second inrush quantity of 35X for 0.01 seconds is often referenced also (A.B. Chance Bulletin 10-8901 for example). Drawing a straight line between these two inrush points on TCC curve paper gives an

approximate target curve to which a typical solid state instantaneous element can be compared if set as proposed here (see attached curve "B"). This comparison shows that although there is not perfect coordination at these levels, there is theoretically a low risk of false operation. In addition, PSNH has many relays set below 15X pickup and even the lower levels have posed no actual problems. This is likely because the theoretical problem ignores the effect of system impedance and assumes worst case inrush. This worst case inrush has never been witnessed in the time that PSNH has been monitoring the energization of large transformers.

In addition to inrush, the 15X setting still comfortably under reaches bolted low side faults, even assuming an infinite bus and an impedance of 8.325% (a nominal 9% less 7.5% of 9%) per ANSI standards. Lower bank impedances such as is typical at voltages below 115KV (see ANSI C57.12.10-1997 Table 10) must be reviewed carefully. Modern numerical or solid state relay instantaneous elements require at least a 15% margin (**preferably a 20% margin if possible**) versus the most demanding low side fault to which the relay responds, and clapper type electromechanical instantaneous elements require a 35% margin. Ref: "Substation Feeder Protective Device Application Methodology".

High Side Residual Overcurrent Relay

Note: In locations where two transformer differential relays are used, the typical 50/51N function might or might not be applied based on the tripping path of the associated lockout relay. Operational clarity is the objective, and this application should be decided upon based on the specifics of the final control diagram.

- Set the high side residual time overcurrent pickup for 55⁰ C base rated transformers as close as practical to 30% of twice the maximum 55⁰ C rating suggested above for a possible phase pickup. This then amounts to (.3)(2X the maximum 55⁰ C rating), or 0.6X the maximum 55⁰ C rating.

Set the high side residual time overcurrent pickup for 65⁰ C base rated transformers as close as practical to 30% of 1.8X the 65⁰ C maximum rating suggested above for a possible phase pickup. This then amounts to (.3)(1.8X the maximum 65⁰ C rating), or 0.54X the maximum 65⁰ C rating.

This is based on a worst case +/-10% CT error, or 20% for the worst case in 2 CT's, along with a 150% safety factor. Although this relay could legitimately be based on the maximum phase setting actually applied, the use of the maximum phase setting envisioned going forward should preclude the need for review of 51NH with each phase overcurrent increase. The setting as proposed still has ample sensitivity given the very limited protective zone which it covers.

- Set the high side residual overcurrent time and percent of pickup the same as the phase overcurrent time element (the same time dial if identical curves are in use).

This is based on the fact that for a low side fault, the high side phase overcurrent relay is designed for full coordination. The high side ground overcurrent pickup is a percentage of the phase setting which accounts for maximum CT error. The neutral time setting as suggested will assure high side neutral overcurrent coordination for low side faults with maximum high side CT error.

- Set the high side residual instantaneous element pickup as close as practical to 4.5X the transformer base rating for either 55⁰ C⁰ or 65⁰ C base rated transformers.

Although a case could be made for setting this element as low as 20% of the phase instantaneous setting to account for worst case CT error, a 50% safety margin has been included, or $(0.5)(0.20)+0.20=0.30X$. The result then is $(.30)(15X \text{ the transformer base rating})$, or 4.5X the transformer base rating.

Low Side Solid State or Numerical Neutral Overcurrent Relay

- Set the low side neutral time overcurrent pickup for a value equal to or greater than any of the feeder neutral overcurrent settings. If, however, there are more than two transformers normally feeding a bus, check for pickup coordination by the use of a computerized fault study program for the worst case single contingency.

This is based on having desirable pickup coordination on worst case contingencies. It may or may not result in full fault sensitivity backup for remote feeder faults combined with a feeder breaker failure.

- Set the low side neutral overcurrent time to 1) lie under the transformer through fault characteristic defined by ANSI/IEEE C57.109 at all currents above the pickup value described previously, and 2) coordinate with the slowest low side feeder breaker during the most difficult coordination contingency. A **nominal relay-relay (no tolerances or breaker times added)** time margin of 0.5 seconds or more (assuming a non-ratcheting application) is suggested between feeder relay and this relay's operate time, although 0.4 seconds is acceptable if required. The general discussion of time margins, as discussed in the section on phase overcurrent timing, also applies here. This includes the discussion of low side breaker failure in the same section.

Electromechanical Relays

The pickup settings and general comments described above can be applied to electromechanical relays. The only differences should be the time settings, which are driven by the need to check ratcheting during worst case coordination contingencies. Two ratcheting issues should be kept in mind during the setting process. 1) The transformer phase overcurrents will generally be carrying load from unfaulted feeders while also responding to a faulted feeder. This slows down the reset time as shown in the PSNH ratcheting data. 2) A minimum of 0.4 seconds is suggested after ratcheting, per the PSNH ratcheting program, using worst case reclose and disk reset times. This margin, as discussed above, is arbitrarily larger than standard due to the implications of an overtrip in this application.

Setting Summary

For convenience, the preceding document is summarized on the following pages. Clarifying comments and operating history have been removed in order to create a more concise setting methodology document.

Summary: Solid State or Numerical High Side Overcurrent Relay Settings

High Side Phase Overcurrent Relay(s)

- For a 115 KV source and a 55⁰ C base rated transformer, if the station has differential protection on the low side bus, set the phase time overcurrent pickup at approximately 2X the maximum 55⁰ C rating. Check that the selected value results in an Isc/pickup value of at least 2/1 for the worst case low side multi-phase fault. Worst case Isc/pickup of 2/1 or higher is a requirement. **Also check pickup against low side feeder pickups as described in the main document.**

For a 65⁰ C base rated transformer set the high side phase overcurrent relay at approximately 1.8X the transformer's top rating if the station has bus differential protection on the low side, which results in a 20% margin above the desired short time loadability. Check sensitivity and pickup coordination as described in the main document.

- For a 115 KV source, if the station has no differential protection on the low side bus, set the phase time overcurrent pickup at approximately twice the anticipated peak load, but not more than twice the maximum 55⁰ C rating for 55⁰ C base rated transformers, or 1.8X the maximum 65⁰ C rating for 65⁰ C base rated transformers. Check that the selected value results in an Isc/pickup value of at least 2/1 for the worst case low side multi-phase fault. Worst case Isc/pickup of 2/1 or higher is a requirement. **Also check pickup against low side feeder pickups as described in the main document.**
- For a 345 KV source, set the overcurrent pickup using the same requirements as the 115 KV cases discussed in the previous paragraphs, but with one exception. Use an upper pickup target of 15% above the winter TFRAT capability rather than twice the maximum 55⁰ C rating for 55⁰ C base rated transformers, or 1.8X the top 65⁰ C rating for 65⁰ C base rated transformers. Note, however, that with the high impedance transformers used at 345 KV, sensitivity to low side bus faults may preclude much loadability above the winter TFRAT rating.
- For a 34.5 KV or lower voltage source, use the same general approach shown above for 115KV sources. With low side bus differential protection available, use either twice the top 55⁰ C rating (for 55⁰ C base rated transformers), or 1.8X the top 65⁰ C rating (for 65⁰ C base rated transformers), but confirm sensitivity to low side multi phase faults. Without low side bus differential, or if the application only uses fuses or a high side recloser with no low side bank neutral overcurrent relay, revert to a multiple of expected load approach (preferably 2X expected load, but at least 1.5X if possible) in order to maximize sensitivity to low side faults, particularly L-G faults.

All of the following criteria apply to bulk or other distribution transformers supplied at any high side voltage.

- Set the phase overcurrent time to 1) lie under the transformer through fault characteristic defined by ANSI/IEEE C57.109 at all currents above the pickup value described previously, and 2) coordinate with the slowest low side feeder breaker during the most difficult coordination contingency. A **nominal relay-relay (no tolerances or breaker times added)** time margin of 0.5 seconds or more is suggested between feeder relay and this relay's operate time, although 0.4 seconds is acceptable if required. Please note that "or more" margin often makes sense.

If the low side breakers have breaker failure relaying, it is not necessary to have a full coordination time margin on top of the feeder line relays plus breaker failure time.

- Set the phase instantaneous overcurrent pickup to a value as close as practical to 15X the transformer base rating for either 55⁰ C or 65⁰ base rated transformers.

High Side Residual Overcurrent Relay

- Set the high side residual time overcurrent pickup for 55⁰ C base rated transformers as close as practical to 30% of twice the maximum 55⁰ C rating suggested above for a possible phase pickup. This then amounts to (.3)(2X the maximum 55⁰ C rating), or 0.6X the maximum 55⁰ C rating.

Set the high side residual time overcurrent pickup for 65⁰ C base rated transformers as close as practical to 30% of 1.8X the 65⁰ C maximum rating suggested above for a phase pickup. This then amounts to (.3)(1.8X the maximum 65⁰ C rating), or 0.54X the maximum 65⁰ C rating.

- Set the high side residual overcurrent time and percent of pickup the same as the phase overcurrent time element (the same time dial if identical curves are in use).
- Set the high side residual instantaneous element pickup as close as practical to 4.5X the transformer base rating for either 55⁰ C⁰ or 65⁰ C base rated transformers.

Summary: Solid State or Numerical Low Side Neutral Overcurrent Relay Settings

Low Side Neutral Overcurrent Relay

- Set the low side neutral time overcurrent pickup for a value equal to or greater than any of the feeder neutral overcurrent settings. If, however, there are more than two transformers normally feeding a bus, check for pickup coordination by the use of a computerized fault study program for the worst case single contingency.
- Set the low side neutral overcurrent time to 1) lie under the transformer through fault characteristic defined by ANSI/IEEE C57.109 at all currents above the pickup value described previously, and 2) coordinate with the slowest low side feeder breaker during the most difficult coordination contingency. For a non-ratcheting application, a **nominal relay-relay (no tolerances or breaker times added)** time margin of 0.5 seconds or more is suggested between feeder relay and this relay's operate time, although 0.4 seconds is acceptable if required.

If the low side breakers have breaker failure relaying, it is not necessary to have a full coordination time margin on top of the feeder line relays plus breaker failure time.

Summary: Electromechanical Relays

See the main document.

Temporary Settings For Initial Energization

See the next page.

Temporary Settings For Initial Energization

Temporary overcurrent settings are typically applied for the initial energization of the transformer, in order to provide additional protection against through faults, and to minimize damage for internal faults. Note: During the initial energization process, the permanent transformer differential relays are either turned to "Off", or left "On" with the tripping functions disabled. This is done to avoid confusion should the relays operate due to wiring errors or malfunctions in the differential systems rather than for a legitimate transformer fault. After the initial energization but prior to load checks, the differential relays may be turned on during "soaking" periods.

The following energization settings may be applied regardless of whether the transformer base rating is at 55⁰ C or 65⁰ C.

High Side Phase Overcurrent Relay(s)

- Use the final instantaneous setting, as described above. This setting is based on riding through inrush, and cannot be made more sensitive without reducing accepted margins.
- Set the high side phase time overcurrent relay pickup to 1 X the base rating of the transformer. This guarantees that the relay curve will fall below the transformer damage curve at all points.
- Set the high side phase time overcurrent relay time dial to provide a set point of 0.40s at 12 X the base rating of the transformer. This provides a 0.30s margin vs. the worst possible transformer inrush.

High Side Residual Overcurrent Relay

- Use the final settings as described above. High side residual settings are already quite sensitive and fast, and provide no protection for through faults. Changing these settings for energization will not significantly improve protection.

Low Side Neutral Overcurrent Relay

- Set the low side neutral relay pickup to 0.5 X the base rating of the transformer.
- Set the low side neutral relay time dial to provide a set point of 0.10s for a bolted low side L-G fault.

These settings are somewhat arbitrary. The intent here is to provide a setting which will be low and fast, and can be calculated based only on the base rating of the transformer. The set point of 0.10s for a bolted L-G fault could be made faster and more sensitive, but doing so would tend to increase the possibility of spurious noise-induced trips from the protection equipment with little legitimate increase in overall protection levels.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-013

Date of Response: March 07, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Labrecque, Richard C

Request:

Please describe and provide any regulatory mandates directly impacting system planning, including but not limited to updates to LCIRP Appendix A Bates Pages 00051-56.

Response:

Eversource must prepare a Least Cost Integrated Resource Plan ("LCIRP") consistent with the requirements of RSA 378:38 and Order Nos. 26,362 (June 3, 2020) and 26,371 (June 22, 2020) issued in Docket No. DE 19-139. Puc 300 also outlines rules for electric service that have an impact on system planning.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-014

Date of Response: March 10, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Hebsch, Jennifer J

Request:

Please provide a 10-year (2011 to present) detailed history of the Company's reliability performance statistics, including "Qualified Storms" and impact on reliability statistics.

Response:

Please see Attachment DOE 4-014 for the requested information.

IEEE 1366 Criteria - Excludes MEDs, Power Supplier Outages and Customer Equipment caused outages

Year	# Parent Events	CI	CMI	Cust Served	SAIDI	CAIDI	SAIFI	CIII
2011	8,968	624,920	77,932,762	498,215	156	125	1.254	70
2012	9,323	609,069	70,958,452	500,070	142	117	1.218	65
2013	8,614	581,827	69,062,920	501,490	138	119	1.160	68
2014	9,599	623,637	61,912,845	504,039	123	99	1.237	65
2015	8,295	538,776	54,177,931	510,645	106	101	1.055	65
2016	9,862	720,704	72,391,329	522,081	139	100	1.380	73
2017	11,789	578,995	62,146,242	525,227	118	107	1.102	49
2018	10,361	565,301	63,373,060	528,668	120	112	1.069	55
2019	8,875	393,465	43,907,584	531,399	83	112	0.740	44
2020	8,866	431,001	51,239,298	535,095	96	119	0.805	49
2021	6,892	321,961	35,531,699	538,684	66	110	0.598	47

All Permanent Events - Storm and Non Storm - No Exclusions

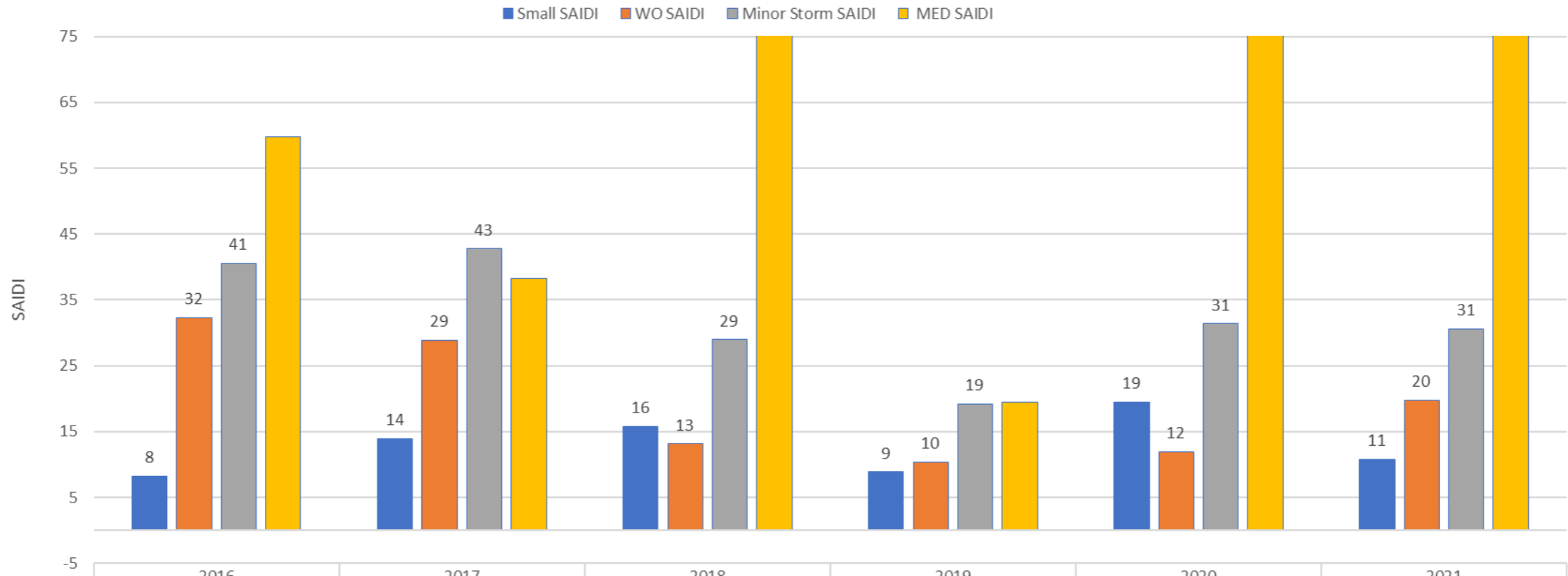
Year	# Parent Events	CI	CMI	Cust Served	SAIDI	CAIDI	SAIFI	CIII
2011	14,025	1,420,678	1,121,114,669	498,215	2,250	789	2.852	101
2012	11,363	875,435	298,949,392	500,070	598	341	1.751	77
2013	10,067	774,073	106,693,930	501,490	213	138	1.544	77
2014	11,713	939,411	440,781,256	504,039	874	469	1.864	80
2015	8,548	573,772	60,883,395	510,645	119	106	1.124	67
2016	11,012	826,837	105,678,322	522,081	202	128	1.584	75
2017	16,808	1,018,158	509,073,382	525,227	969	500	1.939	61
2018	15,196	1,014,800	207,455,653	528,668	392	204	1.920	67
2019	12,013	639,783	122,747,595	531,399	231	192	1.204	53
2020	13,761	808,823	249,991,929	535,095	467	309	1.512	59
2021	8,883	451,936	82,054,948	538,684	152	182	0.839	51

IEEE MED Storm Event Reliability Statistics

Year	# Parent Events	CI	CMI	Cust Served	SAIDI	CAIDI	SAIFI	CIII
2011	5,057	795,758	1,043,181,907	498,215	2,094	1,311	1.597	157
2012	2,040	266,366	227,990,940	500,070	456	856	0.533	131
2013	1,453	192,246	37,631,010	501,490	75	196	0.383	132
2014	2,114	315,774	378,868,411	504,039	752	1,200	0.626	149
2015	253	34,996	6,705,464	510,645	13	192	0.069	138
2016	1,150	106,133	33,286,993	522,081	64	314	0.203	92
2017	5,019	439,163	446,927,140	525,227	851	1,018	0.836	88
2018	4,835	449,499	144,082,593	528,668	273	321	0.850	93
2019	3,138	246,318	78,840,011	531,399	148	320	0.464	78
2020	4,895	377,822	198,752,631	535,095	371	526	0.706	77
2021	1,991	129,975	46,523,249	538,684	86	358	0.241	65

Minor Storms		Major Storm
Small	WO	MED
92nd Percentile	By State	IEEE MED

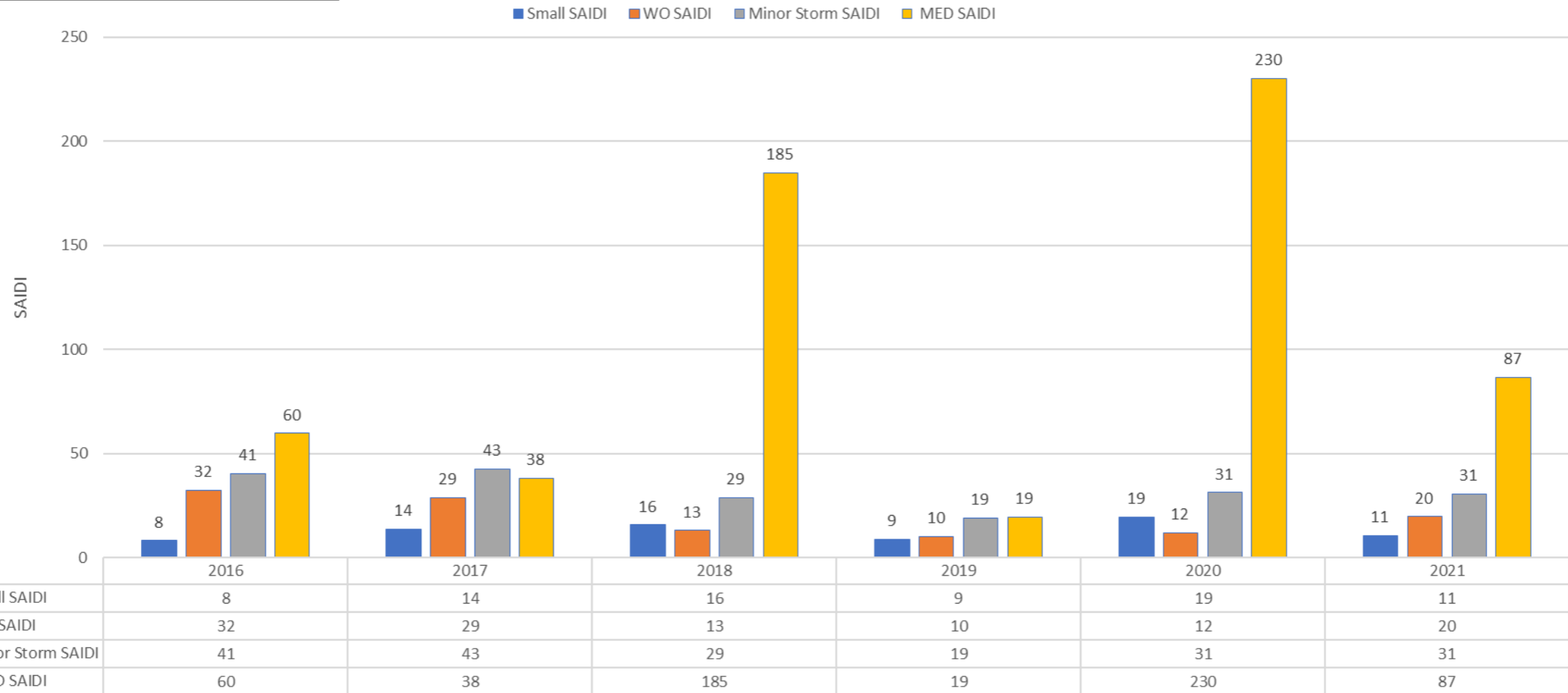
NH Storms Reliability Impact 2016 - 2021 YTD September



	2016	2017	2018	2019	2020	2021
Small SAIDI	8	14	16	9	19	11
WO SAIDI	32	29	13	10	12	20
Minor Storm SAIDI	41	43	29	19	31	31
MED SAIDI	60	38	185	19	230	87

NH Storms Reliability Impact
 2016 - 2021 YTD September - Scaled to fit MED SAIDI

Minor Storms		Major Storm
Small	WO	MED
92nd Percentile	By State	IEEE MED



Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-015

Date of Response: March 10, 2022
Page 1 of 2

Request from: Department of Energy

Witness: Hebsch, Jennifer J

Request:

Please provide a 5-year (2016 to present) detailed history of the Company's worst-performing circuits (prioritized) on the distribution system, selection criteria, improvement plans, implementation schedules, priorities, rationale for priorities, and adherence to implementation schedules.

Response:

Please refer to Attachment DOE 4-015, which provides five years of annual worst performing circuits.

The criteria used to establish the worst performing circuit list is the Contribution to Company System Average Interruption Duration Index (“COSAIDI”) in any given calendar year. Distribution Engineering analyzes the list each year to determine whether any improvement projects warrant consideration. Lower cost improvements are completed under the reliability annual project. Projects estimated at over \$100,000 are reviewed and evaluated for inclusion in the following or future year’s capital plan. Generally, the cost per saved customer minute is the main consideration; however other variables are considered such as the number of customers impacted, frequency of interruptions, exposure to lengthy outages due to access issues, and impact on critical customers.

COSAIDI tends to weight large radial circuits with large customer counts more heavily, therefore, some circuits are consistently on the worst performing circuit list even after improvements projects with reasonable cost per saved customer minute have been completed. Other circuits may appear for one year due to a single, low probability, long duration event and not warrant improvement projects. The Company evaluates each circuit and determines where reasonable, cost-effective solutions can be applied and those projects are proposed and considered along with all other capital needs. The Company does not develop a schedule since the proposed improvements must compete with other system needs during each budget cycle. In addition, the worst performing circuit list is based on a single year’s performance resulting in new circuits to be reviewed and potentially more cost-effective projects proposed to improve reliability each year.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-015

Date of Response: March 10, 2022
Page 2 of 2

The Company also reviews reports identifying multiple operations of devices and significant events which may or may not correlate with the “Worst Performing Circuit” List.

Typical projects include the addition of supervisory control and data acquisition (“SCADA”) controlled pole top devices, Enhanced Tree Trimming, additional protective devices, installation of covered conductors, and construction of circuit-ties.

As noted above, cost per saved customer minute is a leading consideration for reliability improvement projects. However, the application of SCADA controlled pole top devices in order to break customer blocks into 500 customers or less is a very cost-effective proactive program which may improve a worst performing circuit and also may prevent a circuit from making the list. The number of customers affected is another significant consideration and the Company may accept a project with a higher cost per saved customer minute if the project will benefit a large number of customers. This is often considered when evaluating circuit ties that require significant investment.

Table with columns for ID, Date, and various numerical values. The table lists numerous entries, each with a unique identifier and associated data points. The entries are organized in a grid format, with some cells containing text labels like 'TILTON AWC' or 'NASHUA AWC'.

435 29H1_11	0.01	66	31.95	9	9	80	5,273	213	2.2	37	4	24.76	0.38	-	-	4	9 NH CENTRAL	HOOKSETT AWC
436 41H2_61	0.01	107	328.06	7	7	49	5,232	1,340	5.4	9	1	3.91	0.04	-	-	-	1 NH EASTERN	ROCHESTER AWC
437 24H2_11	0.01	78	34.81	67	1	67	5,226	194	1.5	45	1	26.89	0.34	-	-	-	9 NH CENTRAL	HOOKSETT AWC
438 3177X_21	0.01	87	297.30	10	6	60	5,208	1,487	16.4	4	0	3.50	0.04	-	-	-	1 NH SOUTHERN	NASHUA AWC
439 314X24_22	0.01	110	27.32	47	1	47	5,170	107	2.2	21	0	48.32	0.44	-	-	-	17 NH SOUTHERN	NASHUA AWC
440 314X3_22	0.01	110	85.91	7	7	47	5,152	337	8.9	5	1	15.31	0.14	-	-	-	5 NH SOUTHERN	NASHUA AWC
441 8W1_23	0.01	164	225.06	10	3	31	5,081	581	4.0	8	1	8.74	0.05	-	-	-	3 NH SOUTHERN	DERRY AWC
442 362X1_61	0.01	94	86.94	14	4	54	5,073	391	14.3	4	0	12.97	0.14	-	-	-	5 NH EASTERN	ROCHESTER AWC
443 376X6_76	0.01	68	50.78	15	5	74	5,023	313	10.2	7	0	16.04	0.24	-	-	-	6 NH NORTHERN	LANCASTER AWC
444 21H1_77	0.01	58	156.79	42	2	84	4,884	1,098	7.0	12	0	4.45	0.08	-	-	-	2 NH NORTHERN	BERLIN AWC
445 21H5_77	0.01	61	211.06	80	1	80	4,880	1,407	11.0	7	0	3.47	0.06	-	-	-	1 NH NORTHERN	BERLIN AWC
446 325X7_11	0.01	100	245.50	6	7	44	4,418	900	10.4	4	1	4.91	0.05	-	-	-	2 NH CENTRAL	HOOKSETT AWC
447 37H2_42	0.01	201	420.41	11	2	22	4,414	771	11.0	2	0	5.73	0.03	-	-	-	2 NH NORTHERN	TILTON AWC
448 3102X1_63	0.01	190	13.57	23	1	23	4,370	26	1.1	21	1	168.08	0.88	-	-	-	59 NH EASTERN	PORTSMOUTH AWC
449 334X17_11	0.01	208	361.57	3	7	21	4,366	633	3.2	6	2	6.90	0.03	6	6	-	5 NH CENTRAL	HOOKSETT AWC
450 3105X4_63	0.01	216	12.00	20	1	20	4,320	20	0.5	41	2	216.00	1.00	-	-	-	76 NH EASTERN	PORTSMOUTH AWC
451 30H2_22	0.01	99	90.88	5	8	43	4,247	326	12.6	3	1	13.04	0.13	-	-	6	5 NH SOUTHERN	NASHUA AWC
452 328X8_12	0.01	77	24.61	54	1	54	4,158	111	1.4	40	1	37.54	0.49	-	-	-	13 NH CENTRAL	BEDFORD AWC
453 353X5_21	0.01	75	82.25	18	3	55	4,119	377	4.8	11	1	10.93	0.15	-	-	-	4 NH SOUTHERN	NASHUA AWC
454 34W3_61	0.01	43	187.83	15	6	89	3,805	1,393	5.2	17	1	2.73	0.06	-	-	-	1 NH EASTERN	ROCHESTER AWC
455 353X3_21	0.01	234	254.63	5	3	16	3,750	340	3.5	5	1	11.05	0.05	-	-	15	6 NH SOUTHERN	NASHUA AWC
456 338X3_41	0.01	204	25.33	18	1	18	3,672	38	2.4	8	0	96.63	0.47	-	-	-	34 NH NORTHERN	TILTON AWC
457 23W4_11	0.01	107	431.35	6	6	34	3,651	1,222	5.2	7	1	2.99	0.03	-	-	7	2 NH CENTRAL	HOOKSETT AWC
458 393X3_11	0.01	48	12.32	76	1	76	3,648	78	1.7	44	1	46.77	0.97	-	-	-	16 NH CENTRAL	HOOKSETT AWC
459 3174X3_61	0.01	165	30.55	22	1	22	3,630	56	1.4	16	1	64.82	0.39	-	-	-	23 NH EASTERN	ROCHESTER AWC
460 54H1_61	0.01	92	151.54	13	3	39	3,598	493	5.4	7	1	7.31	0.08	-	-	-	3 NH EASTERN	ROCHESTER AWC
461 3115X14_65	0.01	58	75.10	20	3	61	3,559	382	6.2	10	0	9.32	0.16	-	-	-	3 NH EASTERN	EPPING AWC
462 3548X11_42	0.01	95	103.58	9	4	36	3,422	311	10.0	4	0	11.01	0.12	-	-	-	4 NH NORTHERN	TILTON AWC
463 371X30_62	0.01	214	260.88	8	2	16	3,420	348	6.8	2	0	9.83	0.05	-	-	-	3 NH EASTERN	ROCHESTER AWC
464 3137X2_64	0.01	195	126.06	6	3	17	3,316	179	8.7	7	0	18.57	0.10	-	-	8	8 NH NORTHERN	TILTON AWC
465 3191X7_65	0.01	28	6.31	58	2	116	3,242	61	2.3	51	1	53.15	1.90	-	-	-	19 NH EASTERN	EPPING AWC
466 325_11	0.01	66	138.41	12	4	49	3,217	565	7.2	7	1	5.69	0.09	-	-	1	2 NH CENTRAL	HOOKSETT AWC
467 360X10_12	0.01	153	13.57	21	1	21	3,213	24	1.1	19	1	135.28	0.88	-	-	-	47 NH CENTRAL	BEDFORD AWC
468 345X5_41	0.01	119	414.52	2	11	27	3,206	933	28.7	1	0	3.44	0.03	-	-	-	1 NH NORTHERN	TILTON AWC
469 3157X2_61	0.01	97	12.00	33	1	33	3,201	33	1.6	21	1	97.00	1.00	-	-	-	34 NH EASTERN	ROCHESTER AWC
470 15W4_63	0.01	59	186.10	13	4	52	3,054	806	6.4	6	1	3.79	0.06	-	-	-	1 NH EASTERN	PORTSMOUTH AWC
471 3798X4_42	0.01	106	80.26	5	6	27	2,872	181	8.9	3	1	15.90	0.15	-	-	-	6 NH NORTHERN	TILTON AWC
472 45W1_43	0.01	67	56.38	21	2	42	2,817	197	11.0	4	0	14.28	0.21	-	-	-	5 NH NORTHERN	LANCASTER AWC
473 367X2_63	0.01	128	467.10	4	5	21	2,683	817	9.4	2	1	3.28	0.03	-	-	-	1 NH EASTERN	PORTSMOUTH AWC
474 389X8_21	0.00	60	12.00	22	2	44	2,659	44	1.6	28	1	60.43	1.00	-	-	-	21 NH SOUTHERN	NASHUA AWC
475 346X2_45	0.00	24	0.23	105	1	105	2,520	2	2.2	48	0	1,260.00	52.50	-	-	-	441 NH NORTHERN	CHOCORUA AWC
476 3241_21	0.00	496	71.60	5	1	5	2,480	30	5.3	1	0	83.13	0.17	-	-	5	30 NH SOUTHERN	NASHUA AWC
477 3525X6_77	0.00	103	93.00	12	2	24	2,478	186	2.5	10	1	13.32	0.13	-	-	-	5 NH NORTHERN	BERLIN AWC
478 26H2_36	0.00	78	63.97	8	4	31	2,415	165	13.8	2	0	14.61	0.19	-	-	2	5 NH WESTERN	KEENE AWC
479 42H1_61	0.00	85	406.32	6	5	28	2,381	948	12.0	2	0	2.51	0.03	-	-	-	1 NH EASTERN	ROCHESTER AWC
480 312X_12	0.00	76	15.60	30	1	30	2,280	39	1.7	18	1	58.46	0.77	-	-	-	20 NH CENTRAL	BEDFORD AWC
481 322X54_12	0.00	185	34.00	12	1	12	2,220	34	0.8	14	1	65.29	0.35	-	-	-	23 NH CENTRAL	BEDFORD AWC
482 399X18_61	0.00	71	320.20	4	8	30	2,140	801	14.9	2	1	2.67	0.04	-	-	-	1 NH EASTERN	ROCHESTER AWC
483 15H4_21	0.00	96	364.23	11	2	22	2,105	668	2.9	8	1	3.15	0.03	-	-	-	1 NH SOUTHERN	NASHUA AWC
484 370X_11	0.00	102	714.00	3	6	20	2,041	1,190	8.1	2	1	1.72	0.02	-	-	-	1 NH CENTRAL	HOOKSETT AWC
485 3H2_21	0.00	51	280.30	13	3	40	2,034	934	4.4	9	1	2.18	0.04	-	-	-	1 NH SOUTHERN	NASHUA AWC
486 14X109_11	0.00	69	105.10	15	2	29	2,000	254	3.8	8	1	7.87	0.11	-	-	-	3 NH CENTRAL	HOOKSETT AWC
487 377X11_65	0.00	212	180.00	5	2	9	1,907	135	5.5	2	0	14.13	0.07	-	-	7	6 NH EASTERN	EPPING AWC
488 16H3_21	0.00	202	1,653.22	9	1	9	1,818	1,240	6.7	1	0	1.47	0.01	-	-	-	1 NH SOUTHERN	NASHUA AWC
489 328X18_12	0.00	82	73.27	11	2	22	1,793	134	1.9	12	1	13.35	0.16	-	-	-	5 NH CENTRAL	BEDFORD AWC
490 355X7_76	0.00	85	41.14	7	3	21	1,783	72	5.2	4	1	24.76	0.29	-	-	-	9 NH NORTHERN	LANCASTER AWC
491 380X1_65	0.00	162	652.64	3	4	11	1,779	598	11.5	1	0	2.97	0.02	-	-	3	1 NH EASTERN	EPPING AWC
492 3115X9_65	0.00	47	66.68	37	1	37	1,739	206	7.0	5	0	8.46	0.18	-	-	-	3 NH EASTERN	EPPING AWC
493 6H2_63	0.00	65	328.42	8	3	24	1,568	657	14.1	2	0	2.39	0.04	-	-	-	1 NH EASTERN	PORTSMOUTH AWC
494 3102X5_63	0.00	58	242.88	5	5	25	1,442	506	8.3	3	1	2.85	0.05	-	-	-	1 NH EASTERN	PORTSMOUTH AWC
495 3521_77	0.00	72	165.00	5	4	20	1,440	275	8.1	2	0	5.24	0.07	-	-	-	2 NH NORTHERN	BERLIN AWC
496 3175X5_21	0.00	102	179.00	5	3	14	1,432	209	2.0	7	2	6.86	0.07	-	-	1	3 NH SOUTHERN	NASHUA AWC
497 313X4_36	0.00	54	83.92	7	4	26	1,401	182	12.0	2	0	7.70	0.14	-	-	-	3 NH WESTERN	KEENE AWC
498 377X19_65	0.00	197	533.43	4	2	7	1,377	311	4.3	2	0	4.43	0.02	-	-	1	2 NH EASTERN	EPPING AWC
499 90H2_64	0.00	79	591.00	2	7	17	1,348	837	21.0	1	0	1.61	0.02	-	-	1	1 NH NORTHERN	TILTON AWC
500 328X2_12	0.00	155	249.63	3	3	8	1,238	166	2.6	3	1	7.44	0.05	-	-	2	3 NH CENTRAL	BEDFORD AWC
501 47H8_41	0.00	29	60.79	7	6	42	1,232	213	2.1	20	3	5.79	0.20	-	-	-	2 NH NORTHERN	TILTON AWC
502 339X1_63	0.00	39	15.43	28	1	28	1,105	36	1.0	29	1	30.69	0.78	-	-	-	11 NH EASTERN	PORTSMOUTH AWC
503 334X14_12	0.00	105	465.50	5	2	10	1,050	388	8.6	1	0	2.71	0.03	-	-	-	1 NH CENTRAL	BEDFORD AWC
504 43H1_61	0.00	65	379.17	5	3	16	1,041	506	4.4	1	0	2.06	0.03	-	-	-	1 NH EASTERN	ROCHESTER AWC
505 3223_21	0.00	24	103.84	22	2	43	1,033	372	4.4	10	0	2.78	0.12	-	-	-	1 NH SOUTHERN	NASHUA AWC
506 355X15_76	0.00	63	437.13	5	3	16	1,010	583	6.6	2	0	1.73	0.03	-	-	-	1 NH NORTHERN	LANCASTER AWC
507 71W1_63	0.00	122	1,017.50	4	2	8	976	678	6.2	1	0	1.44	0.01	-	-	-	1 NH EASTERN	PORTSMOUTH AWC
508 3115X11_65	0.00	130	667.86	2	3	7	907	392	6.2	1	0	2.31	0.02	-	-	-	1 NH EASTERN	EPPING AWC
509 3164X2_12	0.00	277	1,204.00	3	1	3	831	301	6.4	0	0	2.76	0.01	-	-	3	1 NH CENTRAL	BEDFORD AWC
510 3148X1_62	0.00	270	1,561.50	2	2	3	810	390	6.4	0	0	2.07	0.01	-	-	1	1 NH EASTERN	ROCHESTER AWC
511 380X3_65	0.00	34	86.8															

581	3165X8_63	0.00	37	1,489.00	1	1	1	37	124	3.8	0	0	0.30	0.01	-	-	0 NH EASTERN	PORTSMOUTH AWC
582	345X2_42	0.00	10	94.67	3	1	3	30	24	0.7	4	1	1.27	0.13	-	-	0 NH NORTHERN	TILTON AWC
583	42H2_61	0.00	19	1,956.00	1	1	1	19	163	2.9	0	0	0.12	0.01	-	-	0 NH EASTERN	ROCHESTER AWC

2019 Circuit Hit List - Ranked By COSAIDI - IEEE Criteria																			
Rank	Circuit	COSAIDI	CAIDI	Circuit MBI	CIII	# Outages	Customers Interrupted (C)	Customer Minutes (CM)	Customers Served By Circuit	Circuit Miles	Cust Int Per Mile	Outages Per Mile	Circuit SAIDI	Circuit SAIFI	# Cust_3 Or Mores	#Cust >4Hr Outage	Customer Weighting	AWC	Region
1	3139X_31	2.13	109	3	41	254	10,416	1,133,650	2,636	150.88	69.03	1.68	430.01	3.95	74	670	265.8	KEENE	WESTERN
2	3525X_77	1.78	204	2	141	33	4,645	946,788	845	60.01	77.41	0.55	1,120.68	5.50	1,050	2,284	944.8	BERLIN	N
3	316X1_32	1.70	130	6	77	91	6,983	904,695	3,444	157.77	44.26	0.58	262.68	2.03	415	582	262.2	NEWPORT	WESTERN
4	3525X_77	1.64	161	1	449	12	5,385	869,631	403	21.12	255.00	0.57	2,157.45	13.36		1,582	992.4	BERLIN	N
5	355X10_76	1.28	104	4	72	91	6,554	678,397	2,320	122.21	53.63	0.74	292.47	2.83	60	299	159.2	LANCASTER	N
6	76W7_31	1.08	118	8	23	213	4,827	571,267	3,399	179.96	26.82	1.18	168.06	1.42	290	516	194.2	KEENE	WESTERN
7	348_76	1.02	86	0	6,319	1	6,319	543,434	12	16.07	393.10	0.06	45,286.17	526.58		-	15,850.2	LANCASTER	N
8	3128X_23	1.01	110	16	56	87	4,884	535,247	6,432	149.25	32.72	0.58	83.22	0.76		128	48.3	DERRY	N
9	3133X_23	1.00	120	13	67	66	4,410	529,267	4,773	125.96	35.01	0.52	110.89	0.92		266	78.7	DERRY	N
10	23X5_22	0.99	83	9	48	131	6,348	524,810	4,696	162.57	39.05	0.81	111.76	1.35	81	671	156.0	BEDFORD	CENTRAL
11	3217X_22	0.89	84	8	97	58	5,653	473,141	3,544	84.50	66.90	0.69	133.50	1.59	302	118	124.8	BEDFORD	CENTRAL
12	392X7_62	0.87	115	8	79	51	4,049	464,468	2,607	97.92	41.35	0.52	178.14	1.55	2,377	127	556.8	ROCHESTER	EASTERN
13	11W1_41	0.87	260	12	43	41	1,776	462,169	1,714	35.34	50.25	1.16	269.62	1.04		905	395.2	TILTON	N
14	3410_32	0.85	110	11	53	78	4,118	453,128	3,853	178.27	23.10	0.44	117.59	1.07		411	102.8	NEWPORT	WESTERN
15	63W1_65	0.82	101	6	90	48	4,320	436,203	2,273	85.94	50.27	0.56	191.94	1.90	597	54	194.7	EPHING	EASTERN
16	347_45	0.80	130	12	49	67	3,251	423,582	3,266	98.71	32.94	0.68	129.68	1.00		205	76.1	CHOCORUA	N
17	3818_23	0.78	128	17	55	59	3,251	415,678	4,511	90.44	35.95	0.65	92.16	0.72		613	124.2	DERRY	N
18	3141X_23	0.76	79	11	75	68	5,109	401,975	4,841	115.03	44.41	0.59	83.03	1.06		30	33.6	DERRY	N
19	3148X_62	0.74	96	8	295	14	4,123	395,678	2,804	16.46	250.42	0.85	141.10	1.47		39	55.2	ROCHESTER	EASTERN
20	42X3_32	0.73	157	10	77	32	2,473	388,893	2,125	76.79	32.21	0.42	183.01	1.16		10	65.6	NEWPORT	WESTERN
21	3218_45	0.73	80	2	101	48	4,865	388,713	976	52.55	92.58	0.91	398.44	4.99	3,705	26	884.4	CHOCORUA	N
22	3191X18_65	0.73	105	4	217	17	3,687	388,433	1,176	11.18	329.68	1.52	330.32	3.14	2,767	40	675.0	EPHING	EASTERN
23	3211X_21	0.73	310	25	42	30	1,252	387,742	2,628	51.19	24.46	0.59	147.57	0.48		568	136.8	NASHUA	N
24	27X1_41	0.72	83	4	158	29	4,573	379,973	1,490	48.43	94.42	0.60	255.04	3.07	198	41	135.0	TILTON	N
25	19W2_45	0.70	107	9	52	66	3,457	370,488	2,543	101.72	33.98	0.65	145.67	1.36	9	115	70.0	CHOCORUA	N
26	348X3_76	0.67	133	8	61	44	2,689	357,206	1,892	107.95	24.91	0.41	188.81	1.42		20	69.1	LANCASTER	N
27	3154_21	0.65	122		2,842	1	2,842	346,724		9.32	304.85	0.11				-		NASHUA	N
28	348X1_76	0.65	166	9	19	107	2,079	346,072	1,554	104.93	19.81	1.02	222.66	1.34	372	325	201.1	LANCASTER	N
29	14W7_11	0.64	211	6	147	11	1,619	341,960	750	26.35	61.45	0.42	456.25	2.16		763	274.1	HOOKSETT	CENTRAL
30	43W1_43	0.64	176	5	96	20	1,927	339,428	838	61.39	31.39	0.33	405.21	2.30		859	270.7	TILTON	N
31	3155X_62	0.63	127	10	64	41	2,618	332,820	2,170	86.17	30.38	0.48	153.34	1.21	42	2	62.4	BEDFORD	CENTRAL
32	37X2_25	0.62	144	7	91	25	2,268	327,470	1,374	25.08	90.44	1.00	238.26	1.65	77	954	241.9	EPHING	EASTERN
33	3178_31	0.60	172	10	20	93	1,854	318,168	1,587	46.13	40.19	2.02	200.53	1.17		416	132.6	KEENE	WESTERN
34	4W2_31	0.59	132	9	66	36	2,376	313,301	1,830	55.54	42.78	0.65	171.18	1.30		340	110.9	KEENE	WESTERN
35	348X2_76	0.58	147	4	41	51	2,106	310,436	701	77.00	27.35	0.66	442.85	3.00	117	77	189.9	LANCASTER	N
36	3103X1_65	0.55	115	11	72	35	2,531	292,172	2,349	65.83	38.45	0.53	124.39	1.08		89	56.9	EPHING	EASTERN
37	3108_12	0.55	86	6	106	32	3,390	291,164	1,793	61.38	55.23	0.52	162.40	1.89	324	5	122.4	BEDFORD	CENTRAL
38	3615X1_11	0.54	125	13	43	53	2,270	284,844	2,456	95.73	23.71	0.55	115.97	0.92		402	100.9	HOOKSETT	CENTRAL
39	37W1_12	0.52	126	8	67	33	2,195	276,188	1,404	58.73	37.37	0.56	196.77	1.56		3	69.3	BEDFORD	CENTRAL
40	371X4_61	0.50	187	7	129	11	1,418	265,294	796	15.87	89.35	0.69	333.11	1.78		129	135.9	ROCHESTER	EASTERN
41	38W2_62	0.50	101	5	97	27	2,612	263,774	1,183	41.56	62.84	0.65	222.94	2.21	31	7	85.3	ROCHESTER	EASTERN
42	4W1_31	0.49	144	10	38	48	1,825	262,902	1,563	70.86	25.76	0.68	168.24	1.17	134	316	133.1	KEENE	WESTERN
43	4411_32	0.49	131		1,989	1	1,989	259,860		0.48	4,182.09	2.10				-		NEWPORT	WESTERN
44	3105_63	0.47	217	0	1,155	1	1,155	250,635	5	3.99	289.29	0.25	50,127.00	231.00		-	17,544.5	PORTSMOUTH	EASTERN
45	3115X_23	0.46	74	10	64	52	3,351	246,822	2,738	89.98	37.24	0.58	90.16	1.22	87	31	53.6	DERRY	N
46	75W2_32	0.46	224	19	26	43	1,097	246,181	1,773	52.83	20.77	0.81	138.82	0.62		341	99.7	NEWPORT	WESTERN
47	32W5_23	0.46	110	15	63	35	2,208	243,395	2,739	45.38	48.65	0.77	88.87	0.81		3	31.6	DERRY	N
48	19W1_45	0.46	116	7	116	18	2,094	241,973	1,261	47.77	43.84	0.38	191.93	1.66		6	68.1	CHOCORUA	N
49	3116X1_45	0.45	129	8	27	67	1,842	237,293	1,288	86.15	21.38	0.78	184.31	1.43	564	231	212.0	CHOCORUA	N
50	73W1_61	0.43	178	11	48	27	1,288	228,625	1,223	40.51	31.80	0.67	186.89	1.05	123	352	142.8	ROCHESTER	EASTERN
51	55W2_32	0.42	179	18	34	36	1,241	222,537	1,858	26.05	47.64	1.38	119.75	0.67	112	372	120.1	NEWPORT	WESTERN
52	311X5_12	0.42	104	8	142	15	2,124	221,590	1,385	41.25	51.50	0.36	160.02	1.53	51	194	95.3	BEDFORD	CENTRAL
53	38W1_62	0.41	131	10	110	15	1,647	215,366	1,398	17.51	94.05	0.86	154.07	1.18	188	24	95.1	ROCHESTER	EASTERN
54	3178X4_31	0.41	65	7	50	66	3,322	215,361	1,842	76.37	43.50	0.86	116.95	1.80		130	60.4	KEENE	WESTERN
55	3120_31	0.40	159	13	27	49	1,323	210,394	1,440	66.84	19.79	0.73	146.06	0.92	226	98	111.0	KEENE	WESTERN
56	3155X7_22	0.39	169	7	95	13	1,234	208,697	753	36.47	33.83	0.36	277.09	1.64		502	172.3	BEDFORD	CENTRAL
57	3184X_23	0.39	63	10	73	27	3,334	208,485	2,882	55.38	60.21	0.49	72.33	1.16		11	27.0	DERRY	N
58	3212X_22	0.39	134	15	28	20	1,550	208,094	1,985	39.82	38.92	0.50	104.85	0.78		6	37.6	BEDFORD	CENTRAL
59	362X2_61	0.38	167	19	42	29	1,221	203,486	1,968	64.70	18.87	0.45	103.40	0.62		4	36.8	ROCHESTER	EASTERN
60	314X4_22	0.38	110	10	31	59	1,821	201,011	1,534	98.39	18.51	0.60	131.06	1.19	268	123	117.9	BEDFORD	CENTRAL
61	398X2_41	0.38	106	6	111	17	1,894	200,234	1,002	31.95	59.28	0.53	199.77	1.89		-	69.9	TILTON	N
62	316_32	0.38	94	19	29	73	2,117	199,877	3,278	171.92	12.31	0.42	60.98	0.65	193	277	101.5	NEWPORT	WESTERN
63	3116X_45	0.37	99	9	50	40	2,000	197,552	1,440	36.04	55.49	1.11	137.15	1.39	18	101	66.8	CHOCORUA	N
64	W175_31	0.36	380	53	26	19	498	189,150	2,210	28.91	17.22	0.66	85.60	0.23		178	56.7	KEENE	WESTERN
65	3172X1_63	0.35	76	6	71	34	2,428	184,208	1,218	32.92	73.75	1.03	151.27	1.99		177	79.5	PORTSMOUTH	EASTERN
66	336X1_45	0.34	99	2	109	17	1,849	182,293	339	30.28	61.06	0.56	538.13	5.46	798	5	348.7	CHOCORUA	N
67	346X1_45	0.33	123	16	29	50	1,451	177,948	1,984	55.58	26.10	0.90	89.69	0.73		99	46.2	CHOCORUA	N
68	47W1_32																		

144	3154X2_21	0.12	85	46	34	22	746	63,584	2,830	45.72	16.32	0.48	22.47	0.26	-	22	11.2	NASHUA	N
145	310X3_41	0.12	100	20	39	16	617	61,635	1,047	20.97	29.43	0.76	58.89	0.59	-	-	20.6	TILTON	N
146	33H1_12	0.12	174	31	15	23	353	61,258	899	50.64	6.97	0.45	68.17	0.39	98	69	53.8	BEDFORD	CENTRAL
147	3168X_21	0.11	68	64	31	28	872	59,301	4,625	25.67	33.98	1.09	12.82	0.19	-	6	5.4	NASHUA	N
148	399X19_61	0.11	107	11	33	16	524	56,279	482	3.95	132.64	4.05	116.88	1.09	-	3	41.4	ROCHESTER	EASTERN
149	2H2_63	0.10	104	13	9	57	527	54,758	550	0.00	195,185.19	21,111.11	99.54	0.96	-	44	41.4	PORTSMOUTH	EASTERN
150	48W1_32	0.10	114	27	25	19	480	54,741	1,080	37.18	12.91	0.51	50.70	0.44	-	18	20.4	NEWPORT	WESTERN
151	3105X1_63	0.10	99	44	46	12	549	54,517	1,998	17.27	31.80	0.70	27.29	0.27	-	1	9.7	PORTSMOUTH	EASTERN
152	3615_11	0.10	71	24	69	11	764	54,320	1,514	21.77	35.10	0.51	35.88	0.50	-	3	13.0	HOOKSETT	CENTRAL
153	79W4_12	0.10	133	6	80	5	399	53,115	194	12.31	32.40	0.41	273.20	2.05	-	55	103.9	BEDFORD	CENTRAL
154	25W1_77	0.10	217	36	17	14	244	52,908	728	42.38	5.76	0.33	72.68	0.34	-	16	27.8	BERLIN	N
155	360X5_12	0.10	78	9	75	9	675	52,613	515	20.59	32.79	0.44	102.10	1.31	-	32	40.5	BEDFORD	CENTRAL
156	350X3_77	0.10	148	7	32	11	354	52,267	209	15.90	22.26	0.69	250.08	1.69	79	18	106.0	BERLIN	N
157	40W1_21	0.10	47	10	102	11	1,117	52,121	904	12.22	91.38	0.90	57.63	1.24	-	37	25.7	NASHUA	N
158	49W1_65	0.10	100	5	47	11	518	52,033	227	16.35	31.69	0.67	228.88	2.28	-	3	80.6	EPHING	EASTERN
159	3159X_21	0.10	97	54	17	31	532	51,840	2,383	65.57	8.11	0.47	21.75	0.22	-	4	8.2	NASHUA	N
160	392X5_61	0.10	129	28	40	10	401	51,749	934	11.87	33.79	0.84	55.40	0.43	-	-	19.4	ROCHESTER	EASTERN
161	5H2_76	0.10	112	20	36	13	463	51,632	753	17.36	26.67	0.75	68.54	0.61	-	2	24.3	LANCASTER	N
162	377X20_65	0.10	93	19	92	6	554	51,485	899	26.27	21.09	0.23	57.30	0.62	-	-	20.1	EPHING	EASTERN
163	335X3_12	0.10	67	30	110	7	767	51,402	1,889	10.80	71.00	0.65	27.21	0.41	-	-	9.5	BEDFORD	CENTRAL
164	3010X_21	0.10	49	27	65	16	1,042	51,085	2,321	40.69	25.61	0.39	22.01	0.45	-	7	8.8	NASHUA	N
165	24W1_21	0.10	94	19	19	29	543	51,059	862	39.10	13.89	0.74	59.24	0.63	-	13	22.7	NASHUA	N
166	380X2_65	0.10	153	14	55	6	331	50,601	379	4.69	70.60	1.28	133.69	0.87	-	52	54.6	EPHING	EASTERN
167	3525X4_77	0.09	112	11	21	21	448	50,272	395	29.60	15.13	0.71	127.41	1.14	-	8	45.8	BERLIN	N
168	392X2_61	0.09	192	21	37	7	261	50,025	464	12.40	21.04	0.56	107.91	0.56	-	4	38.4	ROCHESTER	EASTERN
169	3191X2_65	0.09	79	17	157	4	627	49,477	906	9.78	64.09	0.41	54.60	0.69	-	12	20.9	EPHING	EASTERN
170	15H6_21	0.09	121	32	58	7	408	49,464	1,099	5.04	80.88	1.39	45.02	0.37	-	23	19.2	NASHUA	N
171	335X2_12	0.09	66	28	150	5	749	49,147	1,775	27.45	27.29	0.18	27.69	0.42	-	1	9.8	BEDFORD	CENTRAL
172	2W2_41	0.09	84	42	18	33	586	49,069	2,057	50.94	11.50	0.65	23.85	0.28	-	17	10.9	TILTON	N
173	1W1_76	0.09	114	10	27	16	428	48,867	354	21.30	20.09	0.75	138.17	1.21	-	2	48.7	LANCASTER	N
174	3164X2_12	0.09	228	17	107	2	214	48,736	301	6.37	33.59	0.31	161.91	0.71	-	59	65.5	BEDFORD	CENTRAL
175	22W2_11	0.09	91	47	31	17	529	48,257	2,070	8.10	65.30	2.10	23.31	0.26	-	64	17.8	HOOKSETT	CENTRAL
176	3271X1_12	0.09	77	22	18	34	623	48,186	1,132	61.88	10.07	0.55	42.57	0.55	268	2	68.8	BEDFORD	CENTRAL
177	3162X1_65	0.09	121	8	10	39	388	47,123	249	9.09	42.70	4.29	189.50	1.56	15	113	86.3	EPHING	EASTERN
178	393X20_11	0.09	108	44	40	11	435	47,025	1,608	18.18	23.92	0.60	29.25	0.27	-	1	10.4	HOOKSETT	CENTRAL
179	3850X7_63	0.09	87	6	8	64	540	47,005	257	-	-	-	183.26	2.11	-	-	64.1	PORTSMOUTH	EASTERN
180	23X6_22	0.09	80	37	13	43	570	45,532	1,734	40.96	13.92	1.05	26.26	0.33	-	17	11.7	BEDFORD	CENTRAL
181	3155X_22	0.08	97	15	66	7	463	45,008	581	29.65	15.62	0.24	77.47	0.80	-	4	27.7	BEDFORD	CENTRAL
182	3175X_21	0.08	76	22	48	12	579	44,096	1,042	14.92	38.82	0.80	42.32	0.56	-	16	17.2	NASHUA	N
183	371X1_61	0.08	21	16	96	21	2,021	42,341	2,690	43.14	46.85	0.49	15.74	0.75	-	1	5.7	ROCHESTER	EASTERN
184	348X19_43	0.08	166	11	63	4	250	41,562	222	3.57	70.00	1.12	187.43	1.13	-	-	65.6	TILTON	N
185	43H1_61	0.08	75	20	10	56	544	40,796	916	4.45	122.30	12.59	44.55	0.59	-	1	15.7	ROCHESTER	EASTERN
186	39W1_61	0.07	118	35	8	40	329	38,745	951	14.51	22.68	2.76	40.73	0.35	-	69	24.6	ROCHESTER	EASTERN
187	30H2_22	0.07	152	17	127	2	254	38,542	370	12.62	20.12	0.16	104.17	0.69	-	-	36.5	BEDFORD	CENTRAL
188	328X1_12	0.07	131	44	17	17	295	38,521	1,077	18.09	16.31	0.94	35.78	0.27	-	-	12.5	BEDFORD	CENTRAL
189	398X3_41	0.07	47	33	31	26	815	38,054	2,230	45.79	17.80	0.57	17.06	0.37	-	17	8.5	TILTON	N
190	3191X1A_65	0.07	165	34	21	11	230	37,916	658	19.90	11.56	0.55	57.62	0.35	-	63	29.6	EPHING	EASTERN
191	383X3_21	0.07	144	40	44	6	262	37,713	871	8.45	31.00	0.71	43.32	0.30	-	-	15.2	NASHUA	N
192	57W1_61	0.07	127	25	6	51	291	37,033	604	23.49	12.39	2.17	61.27	0.48	75	33	41.4	ROCHESTER	EASTERN
193	3162_65	0.07	79	0	118	4	471	36,996	8	4.16	113.20	0.96	4,624.50	58.88	18	-	1,622.2	EPHING	EASTERN
194	16W1_11	0.07	38	13	69	14	961	36,735	1,049	9.11	105.48	1.54	35.02	0.92	-	-	12.3	HOOKSETT	CENTRAL
195	3020X_21	0.07	107	75	19	17	328	34,994	2,062	30.73	10.67	0.55	16.97	0.16	-	27	10.0	NASHUA	N
196	32X3_62	0.06	67	32	25	20	494	33,091	1,310	32.22	15.33	0.62	25.25	0.38	-	11	10.5	ROCHESTER	EASTERN
197	371X9_62	0.06	64	11	130	4	518	33,084	465	6.90	75.11	0.58	71.16	1.11	-	-	24.9	ROCHESTER	EASTERN
198	3750_21	0.06	94	42	17	21	351	33,029	1,232	30.91	11.35	0.68	26.81	0.28	-	1	9.5	NASHUA	N
199	3137X8_65	0.06	55	7	201	3	602	32,909	350	6.78	88.76	0.44	93.91	1.72	-	-	33.0	EPHING	EASTERN
200	34W4_61	0.06	80	49	10	43	410	32,781	1,677	19.92	20.59	2.16	19.55	0.24	-	5	7.6	ROCHESTER	EASTERN
201	32W4_23	0.06	15	11	141	15	2,120	32,142	1,947	23.87	88.82	0.63	16.51	1.09	-	-	5.8	DERRY	N
202	7W1_11	0.06	30	12	135	8	1,078	32,045	1,041	9.52	113.26	0.84	30.79	1.04	-	-	10.8	HOOKSETT	CENTRAL
203	17H3_21	0.06	308	12	52	2	103	31,700	103	0.71	144.66	2.81	307.77	1.00	-	79	119.6	NASHUA	N
204	23W3_11	0.06	88	90	23	15	352	31,078	2,642	8.25	42.64	1.82	11.76	0.13	-	-	4.1	HOOKSETT	CENTRAL
205	18W3_12	0.06	67	55	66	7	463	31,019	2,118	8.99	51.51	0.78	14.64	0.22	-	-	5.1	BEDFORD	CENTRAL
206	3111X1_63	0.06	90	15	26	13	341	30,775	432	6.48	52.61	2.01	71.18	0.79	-	6	25.8	PORTSMOUTH	EASTERN
207	362X1_61	0.06	64	10	31	15	465	29,927	389	14.26	32.60	1.05	76.88	1.19	-	-	26.9	ROCHESTER	EASTERN
208	3155X3_22	0.06	89	12	31	11	336	29,853	344	12.01	27.99	0.92	86.91	0.98	-	-	30.4	BEDFORD	CENTRAL
209	74W1_32	0.06	125	38	20	12	237	29,511	744	19.22	12.33	0.62	39.65	0.32	-	33	18.8	NEWPORT	WESTERN
210	360X7_12	0.06	58	12	25	20	507	29,275	523	25.34	20.01	0.79	56.02	0.97	-	1	19.8	BEDFORD	CENTRAL
211	399X12_62	0.05	126	12	46	5	231	29,127	224	2.65	87.06	1.88	130.27	1.03	-	11	47.2	ROCHESTER	EASTERN
212	3151X7_76	0.05	135	5	22	10	215	29,091	91	8.16	26.36	1.23	318.81	2.36	-	91	125.2	LANCASTER	N
213	314X54_22	0.05	116	29	42	6	251	29,027	599	13.22	18.98	0.45	48.47	0.42	-	-	17.0	BEDFORD	CENTRAL
214	3615X2_11	0.05	44	24	60	11	663	28,891	1,334	41.34	16.0								

291	377X1_65	0.02	71	12	30	6	178	12,611	176	6.95	25.62	0.86	71.86	1.01	3	-	25.8	EPPING	EASTERN
292	350X1_77	0.02	235	121	11	5	53	12,473	533	4.16	12.76	1.20	23.40	0.10	-	16	10.6	BERLIN	N
293	32X6_61	0.02	485	189	13	2	25	12,126	393	5.51	4.54	0.36	30.84	0.06	-	23	14.2	ROCHESTER	EASTERN
294	3137X80_65	0.02	60	11	50	4	200	12,027	181	8.84	22.62	0.45	66.48	1.11	-	-	23.3	EPPING	EASTERN
295	23X2_12	0.02	97	24	16	8	124	12,001	248	16.28	7.62	0.49	48.34	0.50	-	1	17.1	BEDFORD	CENTRAL
296	350X_77	0.02	47	3	129	2	258	12,000	74	6.31	40.92	0.32	162.16	3.49	-	-	56.8	BERLIN	N
297	3162X4_65	0.02	98	8	9	14	120	11,796	76	4.29	27.95	3.26	155.21	1.58	-	1	54.5	EPPING	EASTERN
298	41H2_61	0.02	78	102	10	15	152	11,788	1,286	5.37	28.29	2.79	9.16	0.12	-	-	3.2	ROCHESTER	EASTERN
299	3148X_62	0.02	56	32	30	7	212	11,772	557	12.28	17.27	0.57	21.13	0.38	-	-	7.4	ROCHESTER	EASTERN
300	72W1_21	0.02	95	129	17	7	122	11,560	1,314	11.02	11.07	0.64	8.80	0.09	-	-	3.1	NASHUA	N
301	5W2_12	0.02	65	67	16	11	176	11,471	980	24.47	7.19	0.45	11.70	0.18	-	-	4.1	BEDFORD	CENTRAL
302	33W1_12	0.02	47	59	17	14	243	11,439	1,186	29.10	8.35	0.48	9.64	0.20	-	-	3.4	BEDFORD	CENTRAL
303	393X3_11	0.02	132	11	28	3	85	11,202	78	1.73	49.17	1.74	143.62	1.09	-	-	50.3	HOOKSETT	CENTRAL
304	W185_31	0.02	63	75	8	22	177	11,144	1,110	22.34	7.92	0.98	10.04	0.16	-	-	3.5	KEENE	WESTERN
305	3615X3_11	0.02	53	111	17	12	205	10,790	1,894	18.02	11.38	0.67	5.70	0.11	-	-	2.0	HOOKSETT	CENTRAL
306	355X6_76	0.02	83	12	43	3	128	10,666	130	9.84	13.01	0.30	82.26	0.99	-	-	28.8	LANCASTER	N
307	311X1_12	0.02	89	76	8	14	116	10,368	735	37.25	3.11	0.38	14.11	0.16	-	-	4.9	BEDFORD	CENTRAL
308	311X3_12	0.02	114	8	13	7	91	10,344	64	9.39	9.69	0.75	162.26	1.43	-	-	56.8	BEDFORD	CENTRAL
309	54H1_61	0.02	77	44	11	12	134	10,265	491	5.38	24.90	2.23	20.92	0.27	-	-	7.3	ROCHESTER	EASTERN
310	64W1_63	0.02	51	53	50	4	200	10,265	886	5.34	37.48	0.75	11.58	0.23	-	-	4.1	PORTSMOUTH	EASTERN
311	360X1_12	0.02	168	55	12	5	61	10,230	280	9.97	6.12	0.50	36.50	0.22	-	11	14.4	BEDFORD	CENTRAL
312	36W1_76	0.02	50	11	67	3	201	10,103	179	5.77	34.86	0.52	56.55	1.13	-	-	19.8	LANCASTER	N
313	3178X5_31	0.02	105	31	13	7	94	9,856	239	10.25	9.17	0.68	41.24	0.39	-	12	16.2	KEENE	WESTERN
314	339X4_63	0.02	149	64	13	5	65	9,696	349	2.44	26.61	2.05	27.82	0.19	-	-	9.7	PORTSMOUTH	EASTERN
315	355X3_76	0.02	41	13	34	7	238	9,681	259	16.67	14.28	0.42	37.43	0.92	-	1	13.2	LANCASTER	N
316	71W1_61	0.02	87	71	18	6	109	9,527	642	6.17	17.67	0.97	14.85	0.17	-	-	5.2	PORTSMOUTH	EASTERN
317	340X1_63	0.02	113	66	9	9	84	9,512	461	6.29	13.35	1.43	20.61	0.18	-	10	8.7	ROCHESTER	EASTERN
318	67W1_63	0.02	70	78	14	10	135	9,480	880	20.53	6.58	0.49	10.78	0.15	-	-	3.8	PORTSMOUTH	EASTERN
319	310X5_41	0.02	118	22	27	3	80	9,424	144	4.18	19.13	0.72	65.63	0.56	-	8	24.2	TILTON	N
320	21H5_77	0.02	134	242	14	5	70	9,400	1,411	11.01	6.36	0.45	6.66	0.05	-	6	3.2	BERLIN	N
321	54W1_32	0.02	62	78	18	8	147	9,178	954	10.50	14.00	0.76	9.63	0.15	-	1	3.5	NEWPORT	WESTERN
322	314X23_22	0.02	118	58	8	10	76	8,932	369	24.80	3.06	0.40	24.18	0.21	-	-	8.5	BEDFORD	CENTRAL
323	3112X4_63	0.02	26	12	343	1	343	8,918	342	7.71	44.48	0.13	26.10	1.00	-	-	9.1	PORTSMOUTH	EASTERN
324	16H3_21	0.02	118	198	8	9	75	8,842	1,238	6.70	11.20	1.34	7.14	0.06	-	-	2.5	NASHUA	N
325	314X26_22	0.02	145	105	30	2	60	8,700	525	6.08	9.87	0.33	16.56	0.11	-	1	5.9	BEDFORD	CENTRAL
326	3151X10_12	0.02	69	81	10	13	125	8,574	845	7.47	16.74	1.74	10.15	0.15	-	-	3.6	BEDFORD	CENTRAL
327	32X24_62	0.02	109	130	26	3	78	8,471	847	3.88	20.12	0.77	10.00	0.09	-	-	3.5	ROCHESTER	EASTERN
328	355X15_76	0.02	68	57	25	5	124	8,440	585	6.64	18.69	0.75	14.43	0.21	-	-	5.1	LANCASTER	N
329	42H1_61	0.02	82	106	26	4	103	8,428	914	12.04	8.56	0.33	9.23	0.11	-	-	3.2	ROCHESTER	EASTERN
330	24H1_11	0.02	27	16	63	5	314	8,361	412	1.99	158.19	2.52	20.31	0.76	-	-	7.1	HOOKSETT	CENTRAL
331	377X10_65	0.02	68	36	40	3	121	8,275	367	3.82	31.64	0.78	22.58	0.33	-	-	7.9	EPPING	EASTERN
332	317X1_12	0.02	116	31	18	4	71	8,257	184	15.54	4.57	0.26	44.96	0.39	-	-	15.7	BEDFORD	CENTRAL
333	322X3_12	0.02	57	26	48	3	145	8,223	308	2.43	59.71	1.24	26.67	0.47	-	-	9.3	BEDFORD	CENTRAL
334	48H1_63	0.02	94	111	10	9	86	8,047	799	9.53	9.03	0.94	10.08	0.11	-	20	6.5	PORTSMOUTH	EASTERN
335	393X8_11	0.01	126	65	16	4	63	7,963	341	3.93	16.02	1.02	23.36	0.18	-	-	8.2	HOOKSETT	CENTRAL
336	3144X1_21	0.01	75	91	7	15	106	7,927	800	21.21	5.00	0.71	9.91	0.13	-	4	4.1	NASHUA	N
337	376X1_76	0.01	69	46	23	5	114	7,830	440	12.96	8.80	0.39	17.79	0.26	-	-	6.2	LANCASTER	N
338	377X19_65	0.01	77	36	51	2	101	7,756	305	4.29	23.52	0.47	25.47	0.33	-	39	8.9	EPPING	EASTERN
339	3103_65	0.01	158	207	8	6	48	7,601	828	36.73	1.31	0.16	9.18	0.06	-	1	3.4	EPPING	EASTERN
340	3137X10_65	0.01	90	69	8	10	84	7,553	480	17.68	4.75	0.57	15.74	0.18	-	3	6.0	EPPING	EASTERN
341	14H4_11	0.01	171	152	11	4	44	7,545	556	3.42	12.86	1.17	13.57	0.08	-	13	6.7	HOOKSETT	CENTRAL
342	399X13_62	0.01	144	101	5	9	49	7,048	413	12.77	3.84	0.70	17.05	0.12	-	2	6.3	ROCHESTER	EASTERN
343	3154X1_21	0.01	71	321	12	8	99	7,042	2,644	33.44	2.96	0.24	2.66	0.04	-	-	0.9	NASHUA	N
344	348X9_76	0.01	194	78	5	7	35	6,798	229	16.98	2.06	0.41	29.74	0.15	-	3	10.9	LANCASTER	N
345	14W2_11	0.01	44	115	26	6	153	6,772	1,463	7.77	19.70	0.77	4.63	0.10	-	-	1.6	HOOKSETT	CENTRAL
346	23W7_22	0.01	82	129	41	2	82	6,714	879	9.37	8.75	0.21	7.64	0.09	-	-	2.7	BEDFORD	CENTRAL
347	3102X6_63	0.01	39	17	85	2	170	6,600	240	2.72	62.58	0.74	27.50	0.71	-	-	9.6	PORTSMOUTH	EASTERN
348	16W3_11	0.01	72	160	7	13	90	6,495	1,202	24.79	3.63	0.52	5.40	0.07	-	-	1.9	HOOKSETT	CENTRAL
349	399X4_61	0.01	117	19	9	6	54	6,328	87	0.62	87.05	9.67	72.60	0.62	-	-	25.4	ROCHESTER	EASTERN
350	14X126A_11	0.01	203	232	8	4	31	6,292	599	9.61	3.22	0.42	10.50	0.05	-	20	6.7	HOOKSETT	CENTRAL
351	6H2_63	0.01	32	41	49	4	194	6,260	657	14.12	13.74	0.28	9.54	0.30	-	-	3.3	PORTSMOUTH	EASTERN
352	351X4_77	0.01	223	178	6	5	28	6,244	415	20.37	1.37	0.25	15.04	0.07	-	6	6.2	BERLIN	N
353	324X8_11	0.01	80	46	20	4	78	6,208	301	17.01	4.59	0.24	20.66	0.26	-	-	7.2	HOOKSETT	CENTRAL
354	328X3_12	0.01	115	11	26	2	52	6,002	47	1.00	51.76	1.99	128.84	1.12	-	-	45.1	BEDFORD	CENTRAL
355	56H2_61	0.01	65	168	5	17	92	5,964	1,288	7.75	11.86	2.19	4.63	0.07	-	1	1.8	ROCHESTER	EASTERN
356	380X1_65	0.01	37	48	30	5	151	5,564	599	11.47	13.16	0.44	9.29	0.25	-	-	3.3	EPPING	EASTERN
357	325X7_11	0.01	51	104	10	10	104	5,335	899	10.42	9.99	0.96	5.94	0.12	-	-	9.9	HOOKSETT	CENTRAL
358	321X11_11	0.01	137	98	6	6	38	5,220	311	8.41	4.52	0.71	16.81	0.12	-	-	5.9	HOOKSETT	CENTRAL
359	346X6_45	0.01	237	166	22	1	22	5,214	305	2.60	8.45	0.38	17.11	0.07	-	-	6.0	CHOCORUA	N
360	324X12_11	0.01	136	42	12	3	35	4,771	122	4.01	8.73	0.75	39.11	0.29	-	-	13.7	HOOKSETT	CENTRAL
361	399X11_62	0.01	113	19	14	3	42	4,746	65	3.06	13.73	0.98	73.11	0.65	-	-	25.6	ROCHESTER	EASTERN
362	348X4_76	0.01	122	36	8	5	39	4,741	116	9.98	3.91	0.50	40.84	0.34	-	2	14.6	LANCASTER	N
363	324X10_11	0.01	69	213	10	7	68	4,718	1,206	1									

438 38506B_63	0.00	100	45	2	4	9	900	33			26.95	0.27	-	-	-	9.4	PORTSMOUTH	EASTERN
439 6H1_63	0.00	58	250	3	5	15	871	313	3.64	4.13	1.38	2.78	0.05	-	-	1.0	PORTSMOUTH	EASTERN
440 8W1_23	0.00	48	387	6	3	18	862	581	3.97	4.54	0.76	1.48	0.03	-	-	0.5	DERRY	N
441 3174X1_61	0.00	86	129	10	1	10	860	108	4.13	2.42	0.24	7.98	0.09	-	-	2.8	ROCHESTER	EASTERN
442 360X9_12	0.00	93	115	2	4	9	836	86	5.39	1.67	0.74	9.73	0.10	-	-	3.4	BEDFORD	CENTRAL
443 W1_31	0.00	69	135	12	1	12	828	135	2.55	4.71	0.39	6.13	0.09	-	-	2.1	KEENE	WESTERN
444 3112X1_63	0.00	164	336	1	5	5	822	140	9.48	0.53	0.53	5.87	0.04	-	-	2.2	PORTSMOUTH	EASTERN
445 339X8_63	0.00	32	152	5	5	25	803	317	3.49	7.17	1.43	2.53	0.08	-	-	0.9	PORTSMOUTH	EASTERN
446 12W2_12	0.00	28	360	10	3	29	799	870	4.35	6.66	0.69	0.92	0.03	-	-	0.3	BEDFORD	CENTRAL
447 345X4_41	0.00	86	68	3	3	9	772	51	0.98	9.18	3.06	15.09	0.18	-	-	5.3	TILTON	N
448 3613_11	0.00	53	1,162	14	1	14	742	1,356	23.20	0.60	0.04	0.55	0.01	-	-	0.2	HOOKSETT	CENTRAL
449 3115X11_65	0.00	82	519	3	3	9	741	389	6.21	1.45	0.48	1.90	0.02	-	-	0.7	EPPING	EASTERN
450 3521_77	0.00	14	63	26	2	52	711	275	8.12	6.41	0.25	2.59	0.19	-	-	0.9	BERLIN	N
451 338X3_41	0.00	58	38	6	2	12	699	38	2.38	5.04	0.84	18.39	0.32	-	-	6.4	TILTON	N
452 328X10_12	0.00	95	506	7	1	7	665	295	2.29	3.05	0.44	2.25	0.02	-	-	0.8	BEDFORD	CENTRAL
453 399_62	0.00	104	303	6	1	6	624	152	9.81	0.61	0.10	4.12	0.04	-	-	1.4	ROCHESTER	EASTERN
454 58W1_63	0.00	156	734	2	2	4	624	245	3.34	1.20	0.60	2.55	0.02	-	-	0.9	PORTSMOUTH	EASTERN
455 21W1_12	0.00	48	1,159	13	1	13	624	1,255	5.13	2.54	0.20	0.50	0.01	-	-	0.2	BEDFORD	CENTRAL
456 351X8_77	0.00	102	770	6	1	6	612	385	7.28	0.82	0.14	1.59	0.02	-	-	0.6	BERLIN	N
457 16H2_21	0.00	149	1,590	4	1	4	596	530	2.56	1.56	0.39	1.12	0.01	-	-	0.4	NASHUA	N
458 21H4_77	0.00	84	1,313	4	2	7	585	766	6.30	1.11	0.32	0.76	0.01	-	-	0.3	BERLIN	N
459 3108X1_12	0.00	143	830	1	4	4	570	277	11.64	0.34	0.34	2.06	0.01	-	-	0.9	BEDFORD	CENTRAL
460 17H1_45	0.00	141	308	4	1	4	564	103	6.33	0.63	0.16	5.49	0.04	-	-	1.9	CHOCORUA	N
461 328_12	0.00	540	81	1	1	1	540	7	5.03	0.20	0.20	80.00	0.15	-	-	28.2	BEDFORD	CENTRAL
462 13H2_65	0.00	107	1,741	2	3	5	533	725	8.91	0.56	0.34	0.73	0.01	-	-	0.3	EPPING	EASTERN
463 3241_21	0.00	115	72	4	1	4	460	24	5.34	0.75	0.19	19.30	0.17	-	-	6.8	NASHUA	N
464 12W3_12	0.00	14	660	32	1	32	448	1,760	4.77	6.70	0.21	0.25	0.02	-	-	0.1	BEDFORD	CENTRAL
465 3174X2_61	0.00	62	565	7	1	7	434	330	6.12	1.14	0.16	1.32	0.02	-	-	0.5	ROCHESTER	EASTERN
466 380_65	0.00	85	12	5	1	5	425	5	2.62	1.91	0.38	85.00	1.00	-	-	29.8	EPPING	EASTERN
467 23X4_12	0.00	202	648	2	1	2	404	108	6.68	0.30	0.15	3.74	0.02	-	-	1.3	BEDFORD	CENTRAL
468 54H2_61	0.00	40	293	3	4	10	403	244	7.81	1.28	0.51	1.65	0.04	-	-	0.6	ROCHESTER	EASTERN
469 328X18_12	0.00	396	1,620	1	1	1	396	135	1.89	0.53	0.53	2.93	0.01	-	-	1.2	BEDFORD	CENTRAL
470 311X2_12	0.00	47	121	8	1	8	376	80	6.79	1.18	0.15	4.68	0.10	-	-	1.6	BEDFORD	CENTRAL
471 339X3_63	0.00	75	919	5	1	5	375	383	1.09	4.61	0.92	0.98	0.01	-	-	0.3	PORTSMOUTH	EASTERN
472 377X6_65	0.00	120	1,281	2	2	3	359	320	10.05	0.30	0.20	1.12	0.01	-	-	0.4	EPPING	EASTERN
473 14X178_11	0.00	62	341	5	1	5	310	142	1.93	2.59	0.52	2.18	0.04	-	-	0.8	HOOKSETT	CENTRAL
474 41H1_61	0.00	62	560	3	2	5	309	233	2.38	2.10	0.84	1.32	0.02	-	-	0.5	ROCHESTER	EASTERN
475 115_62	0.00	142	60	1	2	2	284	10	3.90	0.51	0.51	28.40	0.20	-	-	9.9	ROCHESTER	EASTERN
476 360X10_12	0.00	69	72	4	1	4	276	24	1.10	3.64	0.91	11.54	0.17	-	-	4.0	BEDFORD	CENTRAL
477 395X1_45	0.00	125	612	1	2	2	250	102	2.52	0.80	0.80	2.45	0.02	-	-	0.9	CHOCORUA	N
478 360X13_12	0.00	121	12	2	1	2	242	2	0.62	3.24	1.62	121.00	1.00	-	-	42.4	BEDFORD	CENTRAL
479 3102X5_63	0.00	121	3,036	1	2	2	242	506	8.32	0.24	0.24	0.48	0.00	-	-	0.2	PORTSMOUTH	EASTERN
480 3172X2_63	0.00	80	1,065	3	1	3	240	266	7.59	0.40	0.13	0.90	0.01	-	-	0.3	PORTSMOUTH	EASTERN
481 314X24_22	0.00	77	425	2	2	3	231	106	2.19	1.37	0.91	2.18	0.03	-	-	0.8	BEDFORD	CENTRAL
482 399X6_61	0.00	224	24	1	1	1	224	2	0.51	1.94	1.94	112.00	0.50	-	-	39.2	ROCHESTER	EASTERN
483 46W1_32	0.00	106	266	1	2	2	211	44	5.16	0.39	0.39	4.76	0.05	-	-	1.7	NEWPORT	WESTERN
484 21W4_63	0.00	102	3,411	1	2	2	203	569	10.83	0.18	0.18	0.36	0.00	-	-	0.1	PORTSMOUTH	EASTERN
485 15H1_21	0.00	25	463	3	3	8	201	309	1.38	5.81	2.18	0.65	0.03	-	-	0.2	NASHUA	N
486 389X3_21	0.00	189	1,873	1	1	1	189	156	6.93	0.14	0.14	1.21	0.01	-	-	0.4	NASHUA	N
487 19X6_11	0.00	181	2,970	1	1	1	181	248	3.47	0.29	0.29	0.73	0.00	-	-	0.3	HOOKSETT	CENTRAL
488 314_22	0.00	174	547	1	1	1	174	46	9.95	0.10	0.10	3.82	0.02	-	-	1.3	BEDFORD	CENTRAL
489 351X2_76	0.00	12	83	14	1	14	168	97	4.36	3.21	0.23	1.73	0.14	-	-	0.6	LANCASTER	N
490 14X38_11	0.00	76	168	2	1	2	152	28	0.37	5.42	2.71	5.43	0.07	-	-	1.9	HOOKSETT	CENTRAL
491 340X4_61	0.00	135	358	1	1	1	135	30	0.60	1.68	1.68	4.53	0.03	-	-	1.6	ROCHESTER	EASTERN
492 371X8_62	0.00	127	4,500	1	1	1	127	375	5.25	0.19	0.19	0.34	0.00	-	-	0.1	ROCHESTER	EASTERN
493 21H2_77	0.00	60	4,929	2	1	2	120	821	6.57	0.30	0.15	0.15	0.00	-	-	0.1	BERLIN	N
494 351X1_76	0.00	38	192	3	1	3	114	48	4.68	0.64	0.21	2.37	0.06	-	-	0.8	LANCASTER	N
495 387_12	0.00	112	9,333	1	1	1	112	778	6.65	0.15	0.15	0.14	0.00	-	-	0.1	BEDFORD	CENTRAL
496 15H3_21	0.00	97	4,296	1	1	1	97	358	1.92	0.52	0.52	0.27	0.00	-	-	0.1	NASHUA	N
497 14X136_11	0.00	83	2,316	1	1	1	83	193	0.73	1.36	1.36	0.43	0.01	-	-	0.2	HOOKSETT	CENTRAL
498 377X18_65	0.00	12	12	6	1	6	72	6	0.63	9.52	1.59	12.00	1.00	-	-	4.2	EPPING	EASTERN
499 24H2_11	0.00	35	1,154	2	1	2	70	192	1.48	1.35	0.68	0.36	0.01	-	-	0.1	HOOKSETT	CENTRAL
500 3162X3_65	0.00	65	444	1	1	1	65	37				1.76	0.03	-	-	0.6	EPPING	EASTERN
501 328X2_12	0.00	60	1,985	1	1	1	60	165	2.57	0.39	0.39	0.36	0.01	-	-	0.1	BEDFORD	CENTRAL
502 3174X3_61	0.00	59	672	1	1	1	59	56	1.40	0.71	0.71	1.05	0.02	-	-	0.4	ROCHESTER	EASTERN
503 324X4_11	0.00	51	672	1	1	1	51	56	1.60	0.63	0.63	0.91	0.02	-	-	0.3	HOOKSETT	CENTRAL
504 3142_12	0.00	25	108	2	1	2	50	18	3.41	0.59	0.29	2.78	0.11	-	-	1.0	BEDFORD	CENTRAL
505 322X14_12	0.00	49	2,700	1	1	1	49	225	2.21	0.45	0.45	0.22	0.00	-	-	0.1	BEDFORD	CENTRAL
506 355X7_76	0.00	46	855	1	1	1	46	71	5.20	0.19	0.19	0.65	0.01	-	-	0.2	LANCASTER	N
507 328X7_12	0.00	42	453	1	1	1	42	38	0.67	1.50	1.50	1.11	0.03	-	-	0.4	BEDFORD	CENTRAL
508 360X4_12	0.00	40	767	1	1	1	40	64	3.01	0.33	0.33	0.63	0.02	-	-	0.2	BEDFORD	CENTRAL
509 325_11	0.00	33	6,798	1	1	1	33	567	7.15	0.14	0.14	0.06	0.00	-	-	0.0	HOOKSETT	CENTRAL
510 3111_63	0.00	7	189	1	1	1	7	16	4.81	0.21	0.21	0.44	0.06	-	-	0.2	PORTSMOUTH	EASTERN

2018 Circuit Hit List - Ranked By COSAIDI - IEEE Criteria

Rank	Circuit	COSAIDI	CAIDI	Circuit MBI	CIII	# Outages	Customers Interrupted (C)	Customer Minutes (CM)	Customers Served By Circuit	Circuit Miles	Cust Int Per Mile	Outages Per Mile	Circuit SAIDI	Circuit SAIFI	# Cust_3 Or Mores	#Cust >4Hr Outage	Customer Weighting	AWC
289	10W1_41	0.06	73	29.87	50	9	452	32,881	1,125	11.36	40	1	29.23	0.40	-	4	10.83	TILTON
489	115_62	0.00	175	9.23	13	1	13	2,275	10	3.90	3	0	227.50	1.30	-	-	79.63	ROCHESTER
139	11W1_41	0.21	158	29.12	22	32	705	111,296	1,711	35.33	20	1	65.06	0.41	-	79	34.62	TILTON
354	11W2_41	0.03	47	39.64	59	6	351	16,495	1,159	11.35	31	1	14.23	0.30	-	-	4.98	TILTON
126	12W1_43	0.24	123	15.04	29	36	1,040	127,574	1,303	74.60	14	0	97.90	0.80	-	39	40.12	LANCASTER
214	12W2_12	0.12	185	31.31	85	4	338	62,400	882	4.35	78	1	70.76	0.38	-	-	24.77	BEDFORD
331	12W3_12	0.04	77	75.58	40	7	279	21,408	1,757	4.77	58	1	12.18	0.16	-	-	4.26	BEDFORD
401	13H2_65	0.02	50	43.16	11	18	201	9,955	723	8.91	23	2	13.77	0.28	-	-	4.82	EPHING
78	13W1_12	0.42	99	9.64	171	13	2,217	219,425	1,780	7.57	293	2	123.26	1.25	-	1	43.29	BEDFORD
34	13W1_43	0.85	331	7.32	34	40	1,359	450,344	830	61.20	22	1	542.91	1.64	21	872	325.02	LANCASTER
365	14H4_11	0.03	8	3.25	682	3	2,047	15,440	555	3.42	599	1	27.83	3.69	-	-	9.89	HOOKSETT
135	14H7_11	0.22	77	6.26	499	3	1,497	115,958	781	2.70	555	1	148.57	1.92	-	-	52.00	HOOKSETT
198	14H8_11	0.14	83	6.81	219	4	874	72,216	496	2.88	303	1	145.67	1.76	-	-	50.99	HOOKSETT
336	14W1_11	0.04	24	14.96	163	5	815	19,834	1,016	7.53	108	1	19.52	0.80	-	50	14.33	HOOKSETT
371	14W2_11	0.03	13	15.82	166	7	1,165	15,082	1,535	7.76	150	1	9.82	0.76	-	-	3.44	HOOKSETT
108	14W7_11	0.32	161	8.61	104	10	1,037	166,872	744	26.35	39	0	224.26	1.39	-	-	78.49	HOOKSETT
397	14X109_11	0.02	40	11.54	53	5	264	10,529	254	3.80	70	1	41.47	1.04	-	-	14.51	HOOKSETT
272	14X118_11	0.07	222	38.80	58	3	174	38,562	563	1.74	100	2	68.53	0.31	-	100	38.99	HOOKSETT
269	14X126A_11	0.07	90	23.09	110	4	438	39,317	843	9.53	46	0	46.66	0.52	-	-	16.33	HOOKSETT
293	14X128A_11	0.06	289	10.36	110	1	110	31,786	95	0.27	415	4	334.59	1.16	-	103	132.56	HOOKSETT
451	14X130_11	0.01	302	129.42	19	1	19	5,738	205	0.34	56	3	28.00	0.09	-	-	9.80	HOOKSETT
573	14X135_11	0.00	65	945.71	7	1	7	455	552	3.62	2	0	0.82	0.01	-	-	0.29	HOOKSETT
485	14X136_11	0.00	105	96.46	24	1	24	2,520	193	0.73	33	1	13.06	0.12	-	-	4.57	HOOKSETT
280	14X188_11	0.07	93	27.30	22	18	395	36,559	899	13.61	29	1	40.69	0.44	-	42	20.54	HOOKSETT
577	14X38_11	0.00	65	56.00	2	3	6	390	28	0.37	16	8	13.93	0.21	-	-	4.88	HOOKSETT
381	15H1_21	0.02	412	123.09	11	3	32	13,187	328	1.39	23	2	40.17	0.10	-	30	18.56	NASHUA
592	15H3_21	0.00	54	1,551.67	2	2	3	162	388	1.87	2	1	0.42	0.01	-	-	0.15	NASHUA
380	15H4_21	0.02	194	117.53	17	4	68	13,193	666	2.81	24	1	19.81	0.10	-	28	11.13	NASHUA
350	15H6_21	0.03	132	89.20	22	6	130	17,097	966	5.03	26	1	17.69	0.13	-	36	11.59	NASHUA
594	15W4_63	0.00	70	4,671.50	1	2	2	140	779	6.11	0	0	0.18	0.00	-	-	0.06	PORTSMOUTH
247	16H2_21	0.08	85	11.98	265	2	529	44,926	528	2.56	206	1	85.03	1.00	-	-	29.76	NASHUA
152	16H3_21	0.19	70	10.06	113	13	1,471	102,411	1,234	6.67	221	2	83.01	1.19	-	16	31.45	NASHUA
110	16W1_11	0.31	117	8.87	109	13	1,419	165,829	1,049	9.11	156	1	158.11	1.35	-	-	55.34	HOOKSETT
312	16W3_11	0.05	61	32.45	28	16	442	26,746	1,195	24.81	18	1	22.37	0.37	-	-	7.83	HOOKSETT
538	16W4_63	0.00	501	246.50	1	2	2	1,001	41	4.69	0	0	24.37	0.05	-	1	8.68	PORTSMOUTH
547	17H1_21	0.00	169	348.00	3	2	5	845	145	0.99	5	2	5.83	0.03	-	1	2.19	NASHUA
503	17H2_21	0.00	61	372.00	16	2	31	1,884	961	2.90	11	1	1.96	0.03	-	-	0.69	NASHUA
39	17W1_43	0.75	245	4.82	54	30	1,610	394,813	647	43.27	37	1	609.91	2.49	-	764	328.07	NEWPORT
229	18H1_21	0.11	72	21.96	60	13	780	55,830	1,427	6.35	123	2	39.12	0.55	-	-	13.69	NASHUA
442	18H2_21	0.01	173	12.00	37	1	37	6,401	37	1.00	37	1	173.00	1.00	-	-	60.55	NASHUA
352	18W1_12	0.03	91	114.41	18	10	182	16,552	1,735	8.99	20	1	9.54	0.10	-	-	3.34	BEDFORD
223	18W3_12	0.11	26	15.88	226	10	2,259	59,494	2,989	8.87	255	1	19.91	0.76	-	-	6.97	BEDFORD
41	19W1_45	0.72	94	3.68	194	21	4,074	381,874	1,251	47.71	85	0	305.32	3.26	-	190	135.36	CHOCORUA
27	19W2_45	1.02	99	5.59	90	60	5,419	539,046	2,524	101.61	53	1	213.60	2.15	783	44	237.96	CHOCORUA
556	19X5_11	0.00	55	407.46	13	1	13	715	441	3.72	3	0	1.62	0.03	-	-	0.57	HOOKSETT
287	19X6_11	0.06	517	43.48	66	1	66	34,092	239	3.32	20	0	142.54	0.28	-	66	59.79	HOOKSETT
261	1W1_76	0.08	170	17.33	14	17	243	41,430	351	21.27	11	1	118.03	0.69	118	31	69.56	LANCASTER
82	1W2_76	0.41	132	6.88	26	63	1,621	214,298	929	56.01	29	1	230.68	1.74	252	152	153.94	LANCASTER
85	1X4_42	0.40	123	6.46	74	23	1,695	209,309	913	35.95	47	1	229.23	1.86	938	124	286.43	TILTON
46	20W1_42	0.66	78	6.43	108	41	4,448	347,026	2,384	62.56	71	1	145.56	1.87	2,236	18	500.85	TILTON
64	20W2_42	0.50	204	15.59	33	39	1,298	264,793	1,686	48.34	27	1	157.02	0.77	15	490	131.46	TILTON
211	21H1_77	0.12	171	35.84	52	7	367	62,881	1,096	6.97	53	1	57.36	0.33	-	9	21.43	BERLIN
425	21H2_77	0.02	89	101.09	16	6	97	8,626	817	6.57	15	1	10.56	0.12	-	-	3.69	BERLIN
508	21H4_77	0.00	337	1,841.80	5	1	5	1,685	767	6.30	1	0	2.20	0.01	-	5	1.52	BERLIN
361	21H5_77	0.03	134	143.18	39	3	118	15,806	1,408	10.98	11	0	11.23	0.08	-	-	3.93	BERLIN
564	21W1_12	0.00	50	1,255.08	12	1	12	600	1,255	5.07	2	0	0.48	0.01	-	-	0.17	BEDFORD
467	22W1_11	0.01	70	248.07	10	6	57	4,000	1,178	4.85	12	1	3.39	0.05	-	-	1.19	HOOKSETT
328	22W2_11	0.04	41	47.07	35	15	528	21,863	2,071	8.08	65	2	10.56	0.25	-	-	3.70	HOOKSETT
589	23H3_22	0.00	206	5,768.00	1	1	1	206	481	3.20	0	0	0.43	0.00	-	-	0.15	NASHUA
346	23W1_11	0.04	47	69.81	30	13	395	18,725	2,298	5.55	71	2	8.15	0.17	-	-	2.85	HOOKSETT
242	23W3_11	0.10	100	61.74	36	14	503	50,330	2,588	8.20	61	2	19.45	0.19	-	-	6.81	HOOKSETT
493	23W4_11	0.00	47	325.91	9	5	45	2,134	1,222	5.10	9	1	1.75	0.04	-	-	0.61	HOOKSETT
455	23W7_22	0.01	58	111.66	19	5	94	5,446	875	9.37	10	1	6.23	0.11	-	-	2.18	NASHUA
539	23X2_12	0.00	162	503.33	2	3	6	972	252	16.28	0	0	3.86	0.02	-	-	1.35	BEDFORD
334	23X4_12	0.04	101	6.34	102	2	203	20,495	107	6.66	30	0	191.10	1.89	-	-	66.88	BEDFORD
19	23X5_22	1.22	91	7.96	57	124	7,073	645,408	4,694	165.21	43	1	137.49	1.51	283	28	108.93	BEDFORD
315	23X6_22	0.05	86	79.62	12	25	300	25,802	1,991	40.78	7	1	12.96	0.15	-	5	5.29	NASHUA
586	24H1_11	0.00	55	1,225.25	4	1	4	220	408	2.06	2	0	0.54	0.01	-	-	0.19	HOOKSETT
591	24H2_11	0.00	84	1,163.50	2	1	2	168	194	1.48	1	1	0.87	0.01	-	-	0.30	HOOKSETT
237	24W1_21	0.10	134	25.38	14	29	402	53,790	850	38.45	10	1	63.26	0.47	-	-	22.14	NASHUA
12	24X1_36	1.61	218	6.05	40	98	3,898	849,414	1,965	122.46	32	1	432.18	1.98	719	1,542	526.37	KEENE
52	25W1_77	0.58	131	3.72	68	34	2,327	304,995	721	42.26	55	1	423.31	3.23	-	285	190.91	BERLIN
572	26H1_36	0.00	65	525.71	4	2	7	457	307	3.32	2	1	1.49	0.02	-	-	0.52	KEENE
370	26H2_36	0.03	61	7.92	25	10	249	15,203	164	13.83	18	1	92.5					

188	3137X3_65	0.15	96	6.80	58	14	818	78,450	463	10.22	80	1	169.29	1.77		50	66.75	EPHING
147	3137X5_65	0.20	110	5.51	69	14	970	106,759	446	15.60	62	1	239.64	2.18	45	21	96.02	EPHING
186	3137X6_65	0.15	90	6.85	98	9	883	79,522	504	11.75	75	1	157.70	1.75			55.20	EPHING
532	3137X7_65	0.00	97	140.83	12	1	12	1,164	141	6.06	2	0	8.27	0.09			2.89	EPHING
405	3137X8_65	0.02	73	31.90	26	5	132	9,699	351	6.78	19	1	27.64	0.38			9.67	EPHING
95	3137X80_65	0.36	335	3.76	48	12	572	191,638	179	8.73	66	1	1,069.11	3.19	68	359	441.64	EPHING
316	3138X_12	0.05	75	75.73	18	19	344	25,729	2,171	17.37	20	1	11.85	0.16			4.15	BEDFORD
9	3139X_31	1.77	72	2.41	91	143	13,067	934,640	2,619	150.45	87	1	356.81	4.99	587	319	290.14	KEENE
2	313X1_36	3.07	167	2.91	135	72	9,699	1,624,137	2,352	118.17	82	1	690.53	4.12	2,611	2,380	1,120.89	KEENE
367	313X2_36	0.03	65	23.02	26	9	235	15,301	451	25.50	9	0	33.95	0.52		39	17.73	KEENE
428	313X3_36	0.02	52	15.60	22	7	157	8,148	204	10.18	15	1	39.92	0.77			14.12	KEENE
535	313X4_36	0.00	67	136.75	8	2	16	1,064	182	11.97	1	0	5.84	0.09			2.04	KEENE
158	313X7_36	0.19	114	10.51	32	27	877	100,176	768	29.03	30	1	130.45	1.14	605	51	174.31	KEENE
463	313X8_36	0.01	108	25.05	21	2	42	4,519	88	3.72	11	1	51.55	0.48			18.04	KEENE
597	314_22	0.00	65	157.50	2	1	2	130	26	8.44	0	0	4.95	0.08			1.73	NASHUA
45	3140_36	0.66	151	5.92	39	59	2,310	347,715	1,140	58.98	39	1	305.08	2.03	525	402	272.08	KEENE
70	3140X1_36	0.45	208	8.50	28	41	1,150	239,121	814	38.37	30	1	293.67	1.41	267	233	191.14	KEENE
10	3140X2_36	1.68	148	3.23	62	97	6,009	889,384	1,620	94.76	63	1	549.03	3.71	978	670	488.26	KEENE
183	3140X3_36	0.16	84	3.31	75	13	971	82,042	268	14.48	67	1	306.41	3.63			107.24	KEENE
8	3141X_23	1.82	77	4.63	99	126	12,483	959,889	4,817	114.22	109	1	199.29	2.59	226	84	127.56	DERRY
558	3142_12	0.00	344	108.00	2	1	2	688	18	3.38	1	0	38.22	0.11		2	13.68	HOOKSETT
412	3143X_22	0.02	123	34.22	13	6	77	9,497	220	7.54	10	1	43.25	0.35			15.14	NASHUA
219	3144_21	0.11	71	13.68	122	7	856	60,624	976	19.94	43	0	62.11	0.88		2	22.04	NASHUA
234	3144X1_21	0.10	125	21.56	25	18	443	55,188	796	21.14	21	1	69.35	0.56		115	41.52	NASHUA
475	3144X3_21	0.01	140	405.50	4	6	24	3,354	811	17.78	1	0	4.14	0.03		1	1.60	NASHUA
510	3148X_62	0.00	135	553.00	4	3	12	1,625	553	12.18	1	0	2.94	0.02			1.03	ROCHESTER
26	3148X2_62	1.04	79	4.80	277	25	6,919	550,013	2,770	16.07	430	2	198.53	2.50		212	101.29	ROCHESTER
182	3148X3_62	0.16	85	9.92	138	7	968	82,380	800	18.45	52	0	102.95	1.21			36.03	ROCHESTER
474	3148X4_62	0.01	136	234.84	4	7	25	3,395	489	5.07	5	1	6.94	0.05		3	2.88	ROCHESTER
116	314X12_22	0.30	150	11.06	59	18	1,062	159,367	979	20.93	51	1	162.76	1.08		206	87.87	NASHUA
273	314X14_22	0.07	183	12.77	35	6	209	38,249	222	9.02	23	1	171.97	1.94		5	60.94	NASHUA
207	314X15_22	0.12	132	8.64	20	25	497	65,511	358	18.29	27	1	182.99	1.39	84	106	96.75	NASHUA
259	314X23_22	0.08	99	10.30	24	18	427	42,083	367	24.71	17	1	114.80	1.16	8	16	44.18	NASHUA
373	314X24_22	0.03	313	25.91	24	2	47	14,725	102	2.19	21	1	145.07	0.46		46	57.68	NASHUA
468	314X26_22	0.01	61	97.59	16	4	64	3,902	521	5.80	11	1	7.50	0.12			2.62	NASHUA
262	314X3_22	0.08	155	15.19	19	14	264	40,948	334	8.90	30	2	122.54	0.79		5	43.64	NASHUA
511	314X35_22	0.00	50	6.00	16	2	32	1,600	16	1.22	26	2	100.00	2.00			35.00	NASHUA
38	314X4_22	0.76	145	6.62	42	66	2,768	400,820	1,526	98.27	28	1	262.63	1.81	244	836	266.12	NASHUA
402	314X46_22	0.02	237	13.71	21	2	42	9,952	48	3.00	14	1	207.33	0.88		38	78.27	NASHUA
239	314X54_22	0.10	307	42.15	28	6	170	52,166	597	13.22	13	0	87.36	0.28		79	42.42	NASHUA
215	3151X10_12	0.12	71	11.58	292	3	875	62,204	844	7.45	117	0	73.67	1.04		19	28.64	BEDFORD
335	3151X49_12	0.04	94	5.89	54	4	216	20,405	106	1.87	115	2	192.35	2.04			67.32	BEDFORD
323	3151X52_12	0.05	94	20.97	51	5	253	23,835	442	4.66	54	1	53.91	0.57			18.87	BEDFORD
569	3151X9_12	0.00	61	173.38	3	3	8	491	116	3.85	2	1	4.25	0.07			1.49	BEDFORD
291	3152X_65	0.06	119	63.58	15	18	269	31,921	1,425	18.41	15	1	22.40	0.19			7.84	EPHING
348	3152X1_65	0.03	67	25.31	31	9	275	18,490	580	15.59	18	1	31.88	0.47	249	7	62.01	EPHING
580	3153X_63	0.00	158	87.50	2	1	2	316	15	4.35	0	0	21.67	0.14			7.58	PORTSMOUTH
528	3153X1_63	0.00	135	81.67	5	2	9	1,214	61	14.50	1	0	19.82	0.15		1	7.09	PORTSMOUTH
313	3154X1_21	0.05	81	100.01	19	17	321	26,104	2,675	33.53	10	1	9.76	0.12		21	6.57	NASHUA
236	3154X2_21	0.10	89	54.99	25	24	609	53,939	2,791	44.23	14	1	19.33	0.22		24	10.37	NASHUA
155	3155X_22	0.19	166	11.03	56	11	611	101,589	562	29.54	21	0	180.84	1.09			63.30	NASHUA
16	3155X2_22	1.33	175	6.45	69	58	4,013	700,577	2,157	86.03	47	1	324.83	1.86	84	153	153.44	NASHUA
233	3155X3_22	0.10	245	18.19	28	8	226	55,427	343	11.82	19	1	161.83	0.66		142	77.94	NASHUA
20	3155X4_36	1.19	207	8.26	74	41	3,022	626,825	2,080	89.51	34	0	301.31	1.45		2,007	406.51	KEENE
142	3155X6_36	0.21	464	11.91	78	3	234	108,676	232	9.90	24	0	467.93	1.01		231	198.42	KEENE
265	3155X7_22	0.08	164	37.03	12	20	243	39,953	750	36.36	7	1	53.28	0.32			18.65	NASHUA
333	3155X8_22	0.04	55	7.91	22	17	376	20,649	248	18.92	20	1	83.30	1.52	77		44.55	NASHUA
304	3155X9_22	0.05	49	16.22	31	19	581	28,471	785	50.44	12	0	36.26	0.74		4	13.29	NASHUA
81	3157X1_61	0.41	73	8.94	74	40	2,946	214,820	2,195	69.27	43	1	97.88	1.34		68	44.46	ROCHESTER
490	3157X3_61	0.00	119	833.56	5	4	19	2,263	1,320	0.06	315	66	1.71	0.01			0.60	ROCHESTER
60	3159X_21	0.51	92	9.75	84	35	2,939	270,877	2,389	65.69	45	1	113.39	1.23		42	45.99	NASHUA
73	316_32	0.44	112	18.91	18	118	2,078	232,245	3,275	172.07	12	1	70.91	0.63	555	102	151.12	NEWPORT
472	3162_65	0.01	204	5.65	6	3	17	3,475	8	4.61	4	1	434.38	2.13			152.03	EPHING
190	3162X1_65	0.14	138	5.49	79	7	553	76,171	253	9.75	57	1	301.07	2.19			105.38	EPHING
297	3162X2_65	0.06	164	4.10	26	7	183	30,068	63	5.60	33	1	480.45	2.92	111		190.36	EPHING
418	3162X3_65	0.02	235	11.38	39	1	39	9,165	37	1.37	28	1	247.70	1.05			86.70	EPHING
349	3162X4_65	0.03	235	11.54	78	1	78	18,330	75	4.42	18	0	244.40	1.04			85.54	EPHING
399	3164X1_12	0.02	478	12.00	21	1	21	10,038	21	0.17	124	6	478.00	1.00		21	170.45	BEDFORD
531	3164X2_12	0.00	148	451.00	3	3	8	1,182	301	6.37	1	0	3.93	0.03			1.38	BEDFORD
303	3164X3_12	0.05	112	60.13	13	19	255	28,566	1,278	24.12	11	1	22.36	0.20			7.82	NASHUA
441	3164X8_12	0.01	88	51.64	10	7	73	6,456	314	3.72	20	2	20.55	0.23			7.19	BEDFORD
565	3165X8_63	0.00	28	71.52	21	1	21	588	125	3.80	6	0	4.70	0.17			1.64	PORTSMOUTH
94	3168X_21	0.36	65	18.34	140	21	2,937	192,242	4,488	25.66	114	1	42.84	0.65		195	44.24	NASHUA
1	316X1_32	3.30	115	2.72	101	150	15,204	1,745,689	3,440	157.53	97	1	507.47	4.42	6,648	1,044	1,663.82	NEWPORT
101	316X2_32	0.34	177	11.33	21	49	1,008	178,402	952	44.93	22	1	187.48					

307	70W1_41	0.05	78	58.80	5	70	352	27,622	1,725	17.46	20	4	16.02	0.20	52	-	16.01	TILTON
483	71W1_63	0.01	108	305.92	4	6	25	2,690	637	5.83	4	1	4.22	0.04	-	3	1.93	PORTSMOUTH
257	71W3_63	0.08	75	35.16	112	5	562	42,210	1,647	9.11	62	1	25.63	0.34	-	-	8.97	PORTSMOUTH
332	71W4_63	0.04	83	85.81	42	6	253	20,963	1,809	6.36	40	1	11.59	0.14	-	-	4.06	PORTSMOUTH
353	72W1_21	0.03	66	62.99	63	4	250	16,528	1,312	11.02	23	0	12.60	0.19	-	21	7.56	NASHUA
86	73W1_61	0.39	90	6.35	60	38	2,296	206,617	1,216	40.01	57	1	169.93	1.89	-	47	66.53	ROCHESTER
23	73W2_61	1.11	128	6.11	96	48	4,584	584,789	2,336	69.16	66	1	250.36	1.96	110	923	248.08	ROCHESTER
245	74W1_32	0.09	140	27.03	16	21	330	46,236	743	19.14	17	1	62.19	0.44	-	31	26.42	NEWPORT
92	75W2_32	0.37	123	13.49	26	62	1,607	198,013	1,806	51.83	31	1	109.62	0.89	264	285	133.92	NEWPORT
256	76W1_31	0.08	40	34.91	97	11	1,065	43,042	3,098	25.94	41	0	13.89	0.34	-	-	4.86	KEENE
96	76W5_31	0.36	149	12.64	39	33	1,272	189,422	1,340	39.11	33	1	141.39	0.95	-	160	73.49	KEENE
28	76W7_31	1.00	87	6.71	40	150	6,065	526,099	3,391	179.55	34	1	155.14	1.79	382	482	203.00	KEENE
400	79W4_12	0.02	120	27.82	12	7	83	9,994	192	12.31	7	1	51.94	0.43	-	6	19.08	BEDFORD
325	7W1_11	0.04	82	44.43	23	12	281	23,136	1,040	9.52	30	1	22.24	0.27	-	-	7.78	HOOKSETT
169	85W1_12	0.17	86	16.85	20	51	1,036	89,120	1,455	70.05	15	1	61.25	0.71	-	3	21.89	BEDFORD
479	8W1_23	0.01	44	101.00	7	10	69	3,036	581	3.97	17	3	5.23	0.12	-	-	1.83	DERRY
376	90H1_64	0.03	94	52.76	15	10	149	14,017	655	10.98	14	1	21.40	0.23	-	1	7.64	TILTON
368	90H2_64	0.03	65	42.86	13	18	236	15,271	843	20.89	11	1	18.12	0.28	-	15	8.59	TILTON
515	9H2_21	0.00	76	642.15	10	2	20	1,516	1,070	3.80	5	1	1.42	0.02	-	-	0.50	NASHUA
338	9W1_41	0.04	65	47.03	30	10	299	19,471	1,172	15.66	19	1	16.62	0.26	-	22	9.12	TILTON
277	W110_31	0.07	73	29.93	22	23	501	36,775	1,250	44.59	11	1	29.43	0.40	45	2	19.60	KEENE
67	W15_31	0.47	114	9.62	28	79	2,177	248,958	1,746	78.94	28	1	142.60	1.25	472	49	151.66	KEENE
53	W175_31	0.57	96	8.46	109	29	3,160	303,323	2,228	30.74	103	1	136.13	1.42	114	141	91.60	KEENE
77	W185_31	0.42	110	6.48	34	58	1,994	220,051	1,077	21.70	92	3	204.26	1.85	-	4	72.09	KEENE
154	W2_31	0.19	103	10.43	71	14	988	102,145	859	18.51	53	1	118.97	1.15	-	26	45.54	KEENE
153	W9_31	0.19	44	6.68	192	12	2,302	102,357	1,281	12.31	187	1	79.92	1.80	-	44	34.57	KEENE

586 389_21	0.00	97	54.0	2	1	2	194	9	6.3	0	0.2	0.2	0.222	-	-	0 NASHUA AWC	NH SOUTHERN
587 19X5_11	0.00	10	366.3	19	1	19	190	580	4.9	4	0.2	0.0	0.033	-	-	0 HOOKSETT AWC	NH CENTRAL
588 360X9_12	0.00	58	338.2	2	2	3	174	85	5.4	1	0.4	0.0	0.035	-	-	0 BEDFORD AWC	NH CENTRAL
589 393X44_11	0.00	55	85.2	3	1	3	165	21	0.3	10	3.4	0.1	0.141	-	-	0 HOOKSETT AWC	NH CENTRAL
590 353_21	0.00	54	108.0	3	1	3	162	27	6.0	1	0.2	0.1	0.111	-	-	0 NASHUA AWC	NH SOUTHERN
591 3850X6A_63	0.00	80	161.1	1	2	2	160	27	1.7	1	1.2	0.1	0.074	-	-	0 PORTSMOUTH AWC	NH EASTERN
592 32_62	0.00	148	1,441.8	1	1	1	148	120	12.6	0	0.1	0.0	0.008	-	-	0 ROCHESTER AWC	NH EASTERN
593 340X5_61	0.00	73	1,948.2	1	2	2	146	325	7.4	0	0.3	0.0	0.006	-	-	0 ROCHESTER AWC	NH EASTERN
594 9H2_21	0.00	36	3,216.7	2	2	4	142	1,072	3.8	1	0.5	0.0	0.004	-	-	0 NASHUA AWC	NH SOUTHERN
595 3850X5_63	0.00	138	189.2	1	1	1	138	16	4.3	0	0.2	0.1	0.063	-	-	0 PORTSMOUTH AWC	NH EASTERN
596 46W1_32	0.00	63	280.2	1	2	2	125	47	4.4	0	0.5	0.0	0.043	-	-	0 NEWPORT AWC	NH WESTERN
597 3191X5_65	0.00	124	3,717.2	1	1	1	124	310	2.1	0	0.5	0.0	0.003	-	-	0 EPPING AWC	NH EASTERN
598 3102X7_63	0.00	8	35.8	15	1	15	120	45	1.6	9	0.6	0.3	0.335	-	-	0 PORTSMOUTH AWC	NH EASTERN
599 3241_21	0.00	119	228.0	1	1	1	119	19	2.7	0	0.4	0.1	0.053	-	-	0 NASHUA AWC	NH SOUTHERN
600 329_22	0.00	56	11.1	2	1	2	112	2	11.6	0	0.1	1.1	1.083	-	-	0 BEDFORD AWC	NH CENTRAL
601 70H2_63	0.00	110	5,235.0	1	1	1	110	436	4.7	0	0.2	0.0	0.002	-	-	0 PORTSMOUTH AWC	NH EASTERN
602 27H2_22	0.00	107	3,534.5	1	1	1	107	295	3.1	0	0.3	0.0	0.003	-	-	0 BEDFORD AWC	NH CENTRAL
603 327X8_12	0.00	51	652.6	2	1	2	102	109	5.0	0	0.2	0.0	0.018	-	-	0 BEDFORD AWC	NH CENTRAL
604 360X10_12	0.00	100	276.0	1	1	1	100	23	1.1	1	0.9	0.0	0.043	-	-	0 BEDFORD AWC	NH CENTRAL
605 351X3_77	0.00	99	958.2	1	1	1	99	80	3.2	0	0.3	0.0	0.013	-	-	0 BERLIN AWC	NH NORTHERN
606 348_76	0.00	18	28.8	5	1	5	90	12	16.1	0	0.1	0.4	0.417	-	-	0 LANCASTER AWC	NH NORTHERN
607 3175X3_21	0.00	8	216.0	11	1	11	88	198	1.7	6	0.6	0.1	0.056	-	-	0 NASHUA AWC	NH SOUTHERN
608 347X6_45	0.00	85	696.0	1	1	1	85	58	2.6	0	0.4	0.0	0.017	-	-	0 CHOCORUA AWC	NH NORTHERN
609 393X36T_11	0.00	80	12.0	1	1	1	80	1	0.0	35	35.0	1.0	1.000	-	-	0 HOOKSETT AWC	NH CENTRAL
610 3164X1_12	0.00	11	35.2	7	1	7	77	21	0.2	41	5.8	0.3	0.341	-	-	0 BEDFORD AWC	NH CENTRAL
611 34H2_61	0.00	33	3,336.0	2	1	2	66	556	2.7	1	0.4	0.0	0.004	-	-	0 ROCHESTER AWC	NH EASTERN
612 3153X2_63	0.00	8	221.9	8	1	8	64	148	6.3	1	0.2	0.1	0.054	-	-	0 PORTSMOUTH AWC	NH EASTERN
613 399X14_62	0.00	27	948.0	2	1	2	54	158	1.9	1	0.5	0.0	0.013	-	-	0 ROCHESTER AWC	NH EASTERN
614 3271X3_12	0.00	53	1,020.0	1	1	1	53	85	3.3	0	0.3	0.0	0.012	-	-	0 BEDFORD AWC	NH CENTRAL
616 3115X9_65	0.00	48	2,395.4	1	1	1	48	200	7.1	0	0.1	0.0	0.005	-	-	0 EPPING AWC	NH EASTERN
615 371X7_61	0.00	48	12.0	1	1	1	48	1	0.3	3	3.3	1.0	1.000	-	-	0 ROCHESTER AWC	NH EASTERN
617 15H1_21	0.00	13	1,313.8	3	1	3	39	328	1.4	2	0.7	0.0	0.009	-	-	0 NASHUA AWC	NH SOUTHERN
618 353X4_21	0.00	35	3,946.2	1	1	1	35	329	4.8	0	0.2	0.0	0.003	-	-	0 NASHUA AWC	NH SOUTHERN
619 340X2_61	0.00	22	80.3	1	1	1	22	7	0.5	2	2.0	0.1	0.149	-	-	0 ROCHESTER AWC	NH EASTERN

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-016

Date of Response: March 08, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Johnson, Russel D

Request:

Please provide the Planning Group's updated 2021 Company Strategic Plan and the associated potential capital spending over the upcoming 5-year period.

Response:

Please see Confidential Attachment DOE 4-016 for the 2021 five year strategic plan.

Material in the attachments is confidential as containing confidential energy infrastructure information. Accordingly, consistent with Puc 203.08(d), Eversource states that it has a good faith basis for confidential treatment of the material provided with this response. The Company will file a motion for confidential treatment prior to the hearings in this proceeding.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-017

Date of Response: March 08, 2022
Page 1 of 2

Request from: Department of Energy

Witness: WALKER, GERHARD, Ludwig, Daniel J

Request:

References: LCIRP 2020 at Bates Pages 000019-21 and Appendix D, Distribution System Planning Guide, Bates Pages 000093-99, and Supplement.

Please provide a detailed description of the Company's electrical forecasting methods and process.

Response:

The Company has two levels of load forecasting: (a) a system level peak demand forecast, which is conducted over the Company's planning horizon (10 years) and is responsible for initiating capital projects with sufficient time to allow for a successful project completion.; and (b) a Long-Range Electric Demand Assessment that is conducted to ensure that stations constructed due to capacity limitations identified within the 10-year planning horizon are designed in a manner that allows the continued electrification of mobility, heating, and other sectors in accordance with each state's policy directives.

- a) The Company's system-level peak demand is forecasted using an econometric model that evaluates historical peak demand as a function of peak-day weather conditions and the economy. The econometric model utilizes a three-day weighted temperature humidity index weather variable to forecast summer peak demand. The forecast assumes normal weather conditions based on the most recent ten-year period. Moody's Analytics, an international economic consulting company, provides the economic history and forecast. The resulting forecast is referred to as the trend forecast and does not include incremental adjustments for energy efficiency ("EE"), solar, electric vehicles ("EV"), and large customer projects, which are accounted for separately.

After a trend forecast is produced, the net forecast is derived by adjusting for EE, solar PV, EV, and large customer projects. Company-sponsored EE projections are based on the most readily available plan, while solar projections are developed consistent with historical trends. The Company's forecast projects a higher penetration of electric light duty passenger vehicles. Specific, identified large development projects that the econometric forecasts could not otherwise predict are added to the Company's forecast.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-017

Date of Response: March 08, 2022
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Each substation's peak load forecast is a function of the substation's historical peaks and the relevant operating company's peak load history and forecast. Manual adjustments are made to individual substation forecasts for: (1) specific, identified large development projects and expected changes in system operations that could not otherwise be predicted by the operating company's econometric forecasts or the individual substations' share of those forecasts; (2) substation peak load forecasts are reduced for Company sponsored EE and behind-the-meter solar installations; and (3) substation peak load forecasts are increased for EV additions.

- b) The Long-Range Electrical Demand Assessment looks at local, state, and federal policy objectives which are allocated across the system based on a variety of factors, including bottom up, customer by customer, adoption rate propensity models. The Company is building models for to address the following prominent drivers:
- a. Electric Vehicles:
 - i. Adoption rate models that are based on socio-economic parameters of each customer to determine when and where how many customers will adopt the technology given a certain scenario; and
 - ii. Mobility Analysis models that use GPS tracking data to analyze movement of vehicles and build arrival patterns in regions which, in combination with the distance drive, can be used to create accurate charging patterns.
 - b. Heat Pump:
 - i. Adoption rate models that are based on socio-economic parameters of each customer to determine when and where how many customers will adopt the technology given a certain scenario; and
 - ii. Weather utilization models that look at a 90/10 winter weather utilization of heat pumps to create a loading pattern.
 - c. Solar:
 - i. Behind the meter adoption rate models that look at socio-economic parameters as well as total available roof space (where data is available) of each customer to determine when and where how many customers will adopt the technology given a certain scenario; and
 - ii. Utility Scale Solar adoption rate models that are based on system wide parcel analytics looking at technically developable land and any limitations on that land.

The Company is building these capabilities as part of an Advanced Forecasting and Modelling effort across its entire service territory.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-018

Date of Response: March 08, 2022
Page 1 of 2

Request from: Department of Energy

Witness: West, Ryan C

Request:

Please describe Eversource's Grid Modernization Program and funding plan for New Hampshire. Describe any other New Hampshire-related work assigned to Eversource's Grid Modernization Group.

Response:

There is currently no funded Grid Modernization Program in New Hampshire. The Company is expecting to work with the NH DOE to define investments that are considered "grid modernization" and the process for gathering stakeholder input, creating proposals, and seeking approval for a specific program.

Although the term "grid modernization" has not yet been formally defined in NH, the Company supports the implementation of targeted initiatives to deploy technologies that: (1) increase system efficiency and reduce demand; (2) advance the penetration of automation and control out to the grid edge; and (3) facilitate the integration of clean energy solutions on to the distribution system. A targeted Grid Modernization Program would accelerate benefits to customers at the lowest possible cost. In some cases, the Company expects a Grid Modernization Program would enable deployment of new technologies that are not currently part of the Company's distribution capital funding plan. For example, Volt-Var Optimization is a project that will enable the efficient use of energy on the distribution system, lowering costs to customers and reducing demand and carbon emissions. In the future, Volt-Var optimization functionality will utilize field and substation equipment and advanced logic to achieve multiple objectives including increased operational efficiency, cost reduction and DER enablement. Another objective is advanced forecasting of solar, electric vehicles and other distributed energy resources to develop future scenarios.

In other cases, a targeted Grid Modernization Program could accelerate the deployment of technologies that increase visibility and control of the distribution system. One example is the installation of modern microprocessor relays. The technology exists today at a subset of substations in NH and on the current path would take years to install at the remaining locations. With a Grid Modernization Program in place, the Company could accelerate this plan and it would allow for more automated control and advanced protection schemes that in the end enhance the

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ability to provide safe and reliable service while enabling the adoption of more distributed energy resources.

The Company's Grid Modernization organization is currently engaged in delivering software solutions for both operations and engineering. The Grid Modernization organization is currently engaged on the following list of projects in NH:

- Synergi implementation;
- Distribution Management System implementation;
- Geographic Information System Consolidation; and
- Outage Management System Upgrade.

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Date Request Received: February 18, 2022
Data Request No. DOE 4-019

Date of Response: March 08, 2022
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Request from: Department of Energy

Witness: Freeman, Lavelle A

Request:

Reference: LCIRP 2020 at 00030 and Appendix D, Distribution Planning Guide, Section 4.8.3 Bates 000106-109 (NWS Screening tool description).

Please provide example output from the Non-Wires Alternative (NWA) Tool (Excel based) that illustrates how all solutions are considered, and how the output clearly presents least-cost, long-term, most cost-effective solutions.

Please update the August 2020 list of NWA candidates, including but not limited to projects with a 1-2 year lead time, with capacity (not reliability) focus. Please identify which potential projects are candidates under both the new and old non-bulk planning criteria.

Response:

The Company has provided the results from the NWA Tool in report format as part of its supplemental filing in this proceeding submitted on March 31, 2021 as Supplemental Appendix A-2.

An update is not available to the August 2020 list, however all design violations identified in the 2020-2029 Load Flow Study Report are considered prospective candidates for NWA until detailed study of the violation(s) at each location can be performed. At the time the detailed local area study is performed, both traditional and NWA solutions are analyzed (using the NWA tool). All violations identified in the 2020-2029 Load Flow Study Report are based on the Distribution System Planning Guide (DSPG 2020) criteria.

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Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-020

Date of Response: March 08, 2022
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Request from: Department of Energy

Witness: WALKER, GERHARD, Freeman, Lavelle A

Request:

Please provide 2020-2021 NWA solution options for New Hampshire categorized as either accepted or rejected along with the corresponding reasons why (accepted or rejected).

Response:

The Company has conducted the full and detailed analysis on the following stations:

- Loudon Station

For Loudon Station, the Company has provided the results of the analysis in report format as part the Company's supplemental filing in this proceeding submitted on March 31, 2021 as Supplemental Appendix A-2.

One project that is in conceptual engineering and another that is in design engineering were both rejected for NWA.

- Monadnock Substation, presently in the design phase, has an asset condition issue with transformer TB40 and substandard station design (no transformer breakers nor high-side circuit switchers) in addition to N-1 contingent capacity limitations. Based on Eversource NWA suitability criteria, asset condition related projects are not typically considered for NWA solutions.
- Dover Substation, presently in the conceptual phase, has asset condition issues at the substation including an oil circuit breaker and electromechanical relays in addition to N-1 contingent capacity limitations of approximately 28.8 MW. A full NWA analysis was not performed since that magnitude of peak load was considered unachievable in the present NWA regulatory environment. In addition, based on Eversource NWA suitability criteria, asset condition related projects are not typically considered for NWA solutions.

All other design violations identified in the 2020-2029 Load Flow Study Report have yet to be studied within local area studies where a detailed NWA screening analysis will be performed to assess the feasibility of the solutions.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-021

Date of Response: March 07, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Johnson, Russel D

Request:

Please provide the criteria used to prioritize "conversion of old 4-kV systems to higher voltages" projects in the capital plan for reliability improvement.

Response:

Conversions of 4 kV systems to a higher voltage are generally the outcome of some other initiating event. The following are examples.

The construction of a circuit tie at either 34.5 or 12.47 kV through an existing 4 kV area where conversion, rather than overbuilding, is appropriate. Such a project would be prioritized based on cost per saved customer minute and customers affected.

If asset condition is driving the retirement of 4 kV equipment in a substation, the substation may be converted to 12 kV in order to maintain the substation source, provide circuit ties and backup capacity for other 12 kV substations. The urgency of the asset condition would dictate the priority.

Likewise, the projected overload of a 4 kV substation transformer may drive the replacement and conversion to 12 kV for the same benefits. If there is no benefit to converting to a 12 kV substation (an islanded substation for example), the station may be retired and the load served at 4 kV via overhead step transformers or a pad-mounted step. The priority would be based on when, and to the extent, the substation transformer is forecasted to be overloaded.

In practice, there tends to be reliability, asset condition, and capacity considerations regardless of the initiating driver of the project that may influence the prioritization.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-022

Date of Response: March 08, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Johnson, Russel D

Request:

Please provide a summary of the benchmarking activities Distribution Engineering has participated in over the past 5 years. Provide samples of the most recent comparisons.

Response:

Distribution Engineering participates in the following benchmarking activities:

- IEEE Distribution Reliability Working Group Benchmark Study
 - Eversource participates annually
 - The 2021 study is provided as Attachment DOE 4-022.
 - PSNH performance is identified as company U159.
- PSE&G Benchmarking Study
 - Eversource participates annually
 - The Company is unable to provide the results of the study due to a non-disclosure agreement between Eversource and the study's sponsor.
- TRC's Eversource New Hampshire Distribution System Assessment, dated 5/28/2021
 - This assessment was performed earlier this year as part of the PSNH Distribution Rate Case in Docket No. DE 19-057 and the Least Cost Integrated Resource Plan filed in this docket. The document is located at: https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-161/LETTERS-MEMOS-TARIFFS/20-161_2021-05-28_EVERSOURCE_SYSTEM_ASSESSMENT.PDF
 - As noted in their executive summary, TRC "surveyed industry research to identify common practices across peer utilities."

IEEE Benchmark Year 2021 Results for 2020 Data

2021 Distribution Reliability Working Group
Virtual Meeting

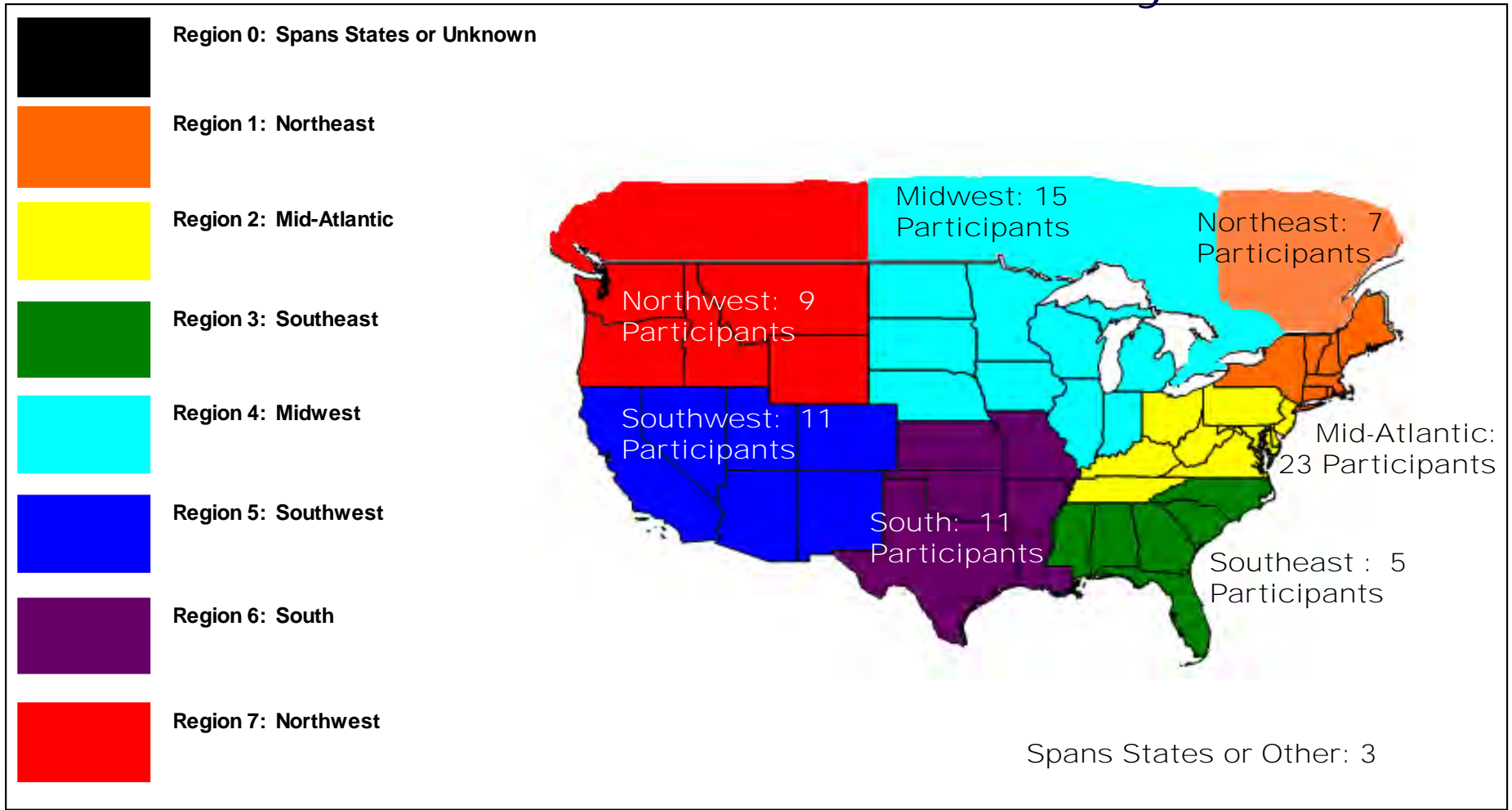
Background to IEEE DRWG Benchmark Study

- 1. Initiated in 2003, conducted annually*
- 2. Participants are anonymous with key identifier to retain anonymity*
- 3. Participation list is not revealed to anyone*
- 4. Each participant can choose to share their results*
- 5. No inference is made about good or bad reliability*
- 6. Intended to provide information for users to assess their performance relative to peers*
- 7. Called the 2021 Study (for 2020 Results)*

Benchmarking

- Using annual key metrics (SAIDI, SAIFI and CAIDI) to assess performance of a system may be useful, however, needs to be tempered
- DRWG Study attempts to identify various aspects that could cause a difference in reported metrics
- Data may not be directly comparable, since
 - Data collection & system differences exist
 - Certain exclusion differences can occur, although we strive to have the differences minimized
- IEEE 1366-2003/2012
 - addresses data issues by clearly defining the rules (i.e. what data should be excluded)
 - It **DOES NOT** address the data collection issues
 - Companies may not report all forms of outages, due to data collection issues or other reasons

Regions represented by the participants 2021 Benchmark Study



Respondents

- About 260 companies have responded at some time
- 2021 Survey: 84 entries responded

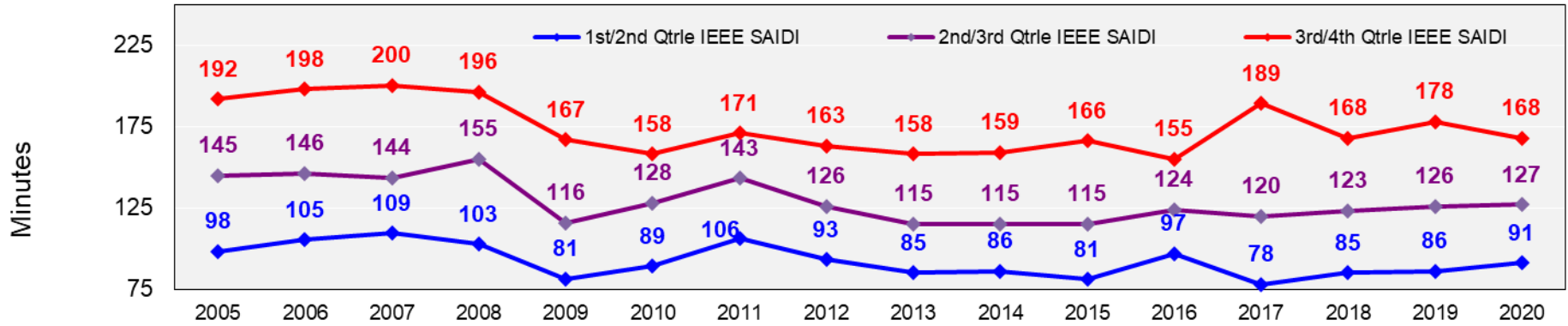
	SAIDI ALL	SAIDI IEEE	SAIDI WOF	SAIDI	SAIFI ALL	SAIFI IEEE	SAIFI WOF	SAIFI WOP	CAIDI ALL	CAIDI
MIN	30	27	24	23	0.43	0.40	0.29	0.28	28	24
Q1	151	91	87	83	1.03	0.85	0.75	0.68	136	98
MEDIAN	321	127	112	104	1.42	1.06	0.90	0.85	206	118
Q3	525	168	152	144	1.86	1.33	1.10	1.02	333	135
MAX	8701	440	417	384	6.31	5.60	5.45	5.53	2711	230

Respondents by Utility Size

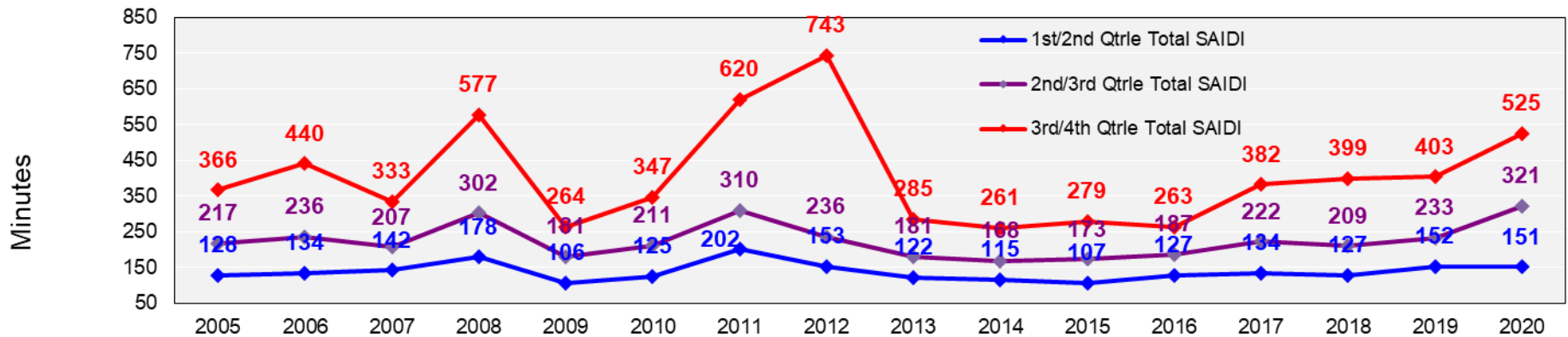
Quartile Small	4	SAIDI ALL	SAIDI IEEE	SAIDI WOF	SAIDI WOP	SAIFI ALL	SAIFI IEEE	SAIFI WOF	SAIFI WOP	CAIDI ALL	CAIDI IEEE
0	MIN	150	107	108	86	1.06	1.06	0.82	0.63	107	77
1	Q1	155	144	120	98	1.32	1.14	0.89	0.66	117	88
2	MEDIAN	296	187	136	104	1.68	1.42	0.96	0.81	134	119
3	Q3	438	224	151	114	2.39	1.96	1.04	0.97	166	146
4	MAX	444	244	158	139	3.68	2.82	1.14	1.00	222	148
Medium	49	SAIDI ALL	SAIDI IEEE	SAIDI WOF	SAIDI WOP	SAIFI ALL	SAIFI IEEE	SAIFI WOF	SAIFI WOP	CAIDI ALL	CAIDI IEEE
0	MIN	30	27	24	23	0.43	0.40	0.29	0.28	28	24
1	Q1	152	99	89	86	0.99	0.87	0.72	0.68	141	100
2	MEDIAN	312	128	117	108	1.36	0.98	0.89	0.83	205	123
3	Q3	567	164	149	137	1.94	1.37	1.23	1.14	385	136
4	MAX	8701	407	391	363	6.31	5.60	5.45	5.53	2711	198
Quartile Large	31	SAIDI ALL	SAIDI IEEE	SAIDI WOF	SAIDI WOP	SAIFI ALL	SAIFI IEEE	SAIFI WOF	SAIFI WOP	CAIDI ALL	CAIDI IEEE
0	MIN	84	40	40	32	0.83	0.55	0.55	0.47	98	73
1	Q1	147	84	82	80	1.04	0.82	0.80	0.69	145	98
2	MEDIAN	339	103	95	91	1.45	1.06	0.91	0.86	215	108
3	Q3	484	169	154	146	1.73	1.21	1.07	1.00	301	131
4	MAX	3117	440	417	384	3.29	2.85	2.20	2.03	1550	230

Historic SAIDI-IEEE & Total

2021 IEEE Benchmark: 2005 - 2020 IEEE SAIDI Quartiles

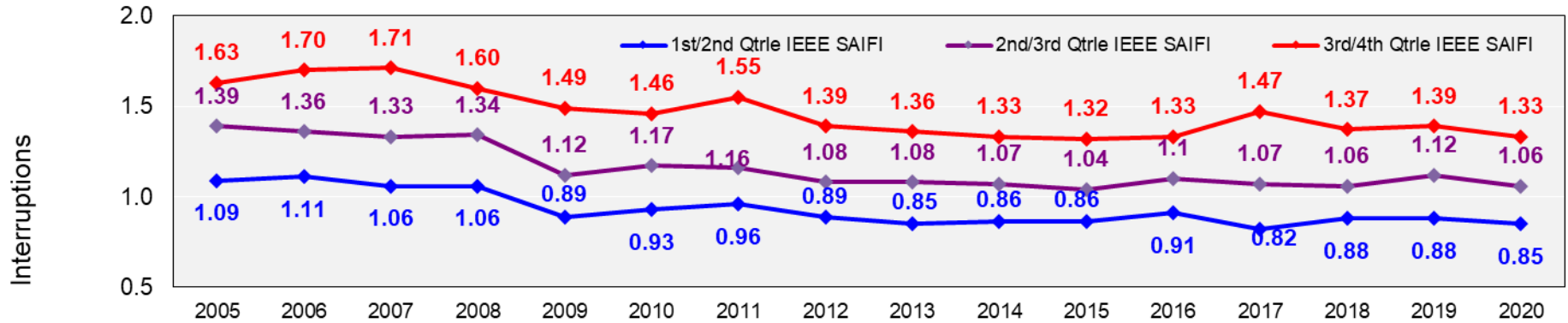


2021 IEEE Benchmark: 2005 - 2020 Total SAIDI Quartiles

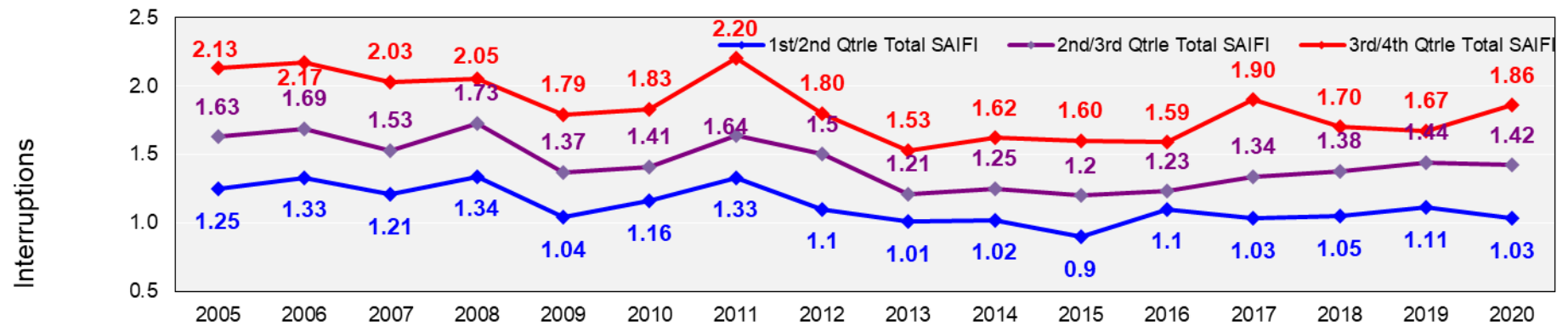


Historic SAIFI-IEEE & Total

2021 IEEE Benchmark: 2005 to 2020 IEEE SAIFI Quartiles

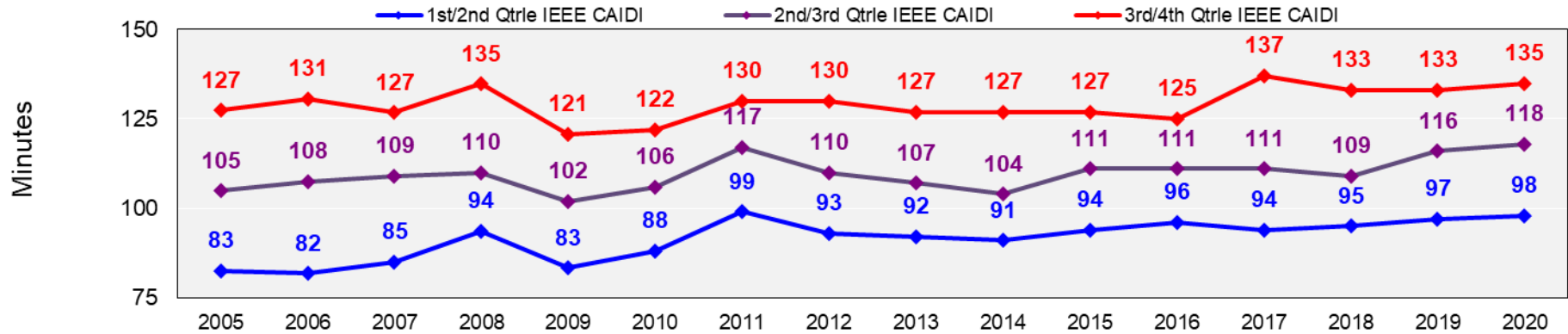


2021 IEEE Benchmark: 2005 to 2020 Total SAIFI Quartiles

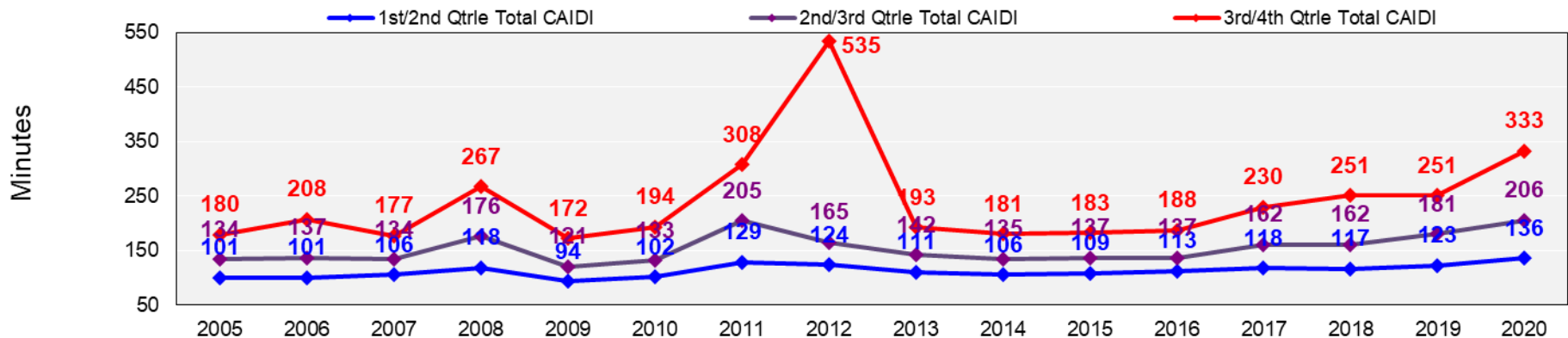


Historic CAIDI-IEEE & Total

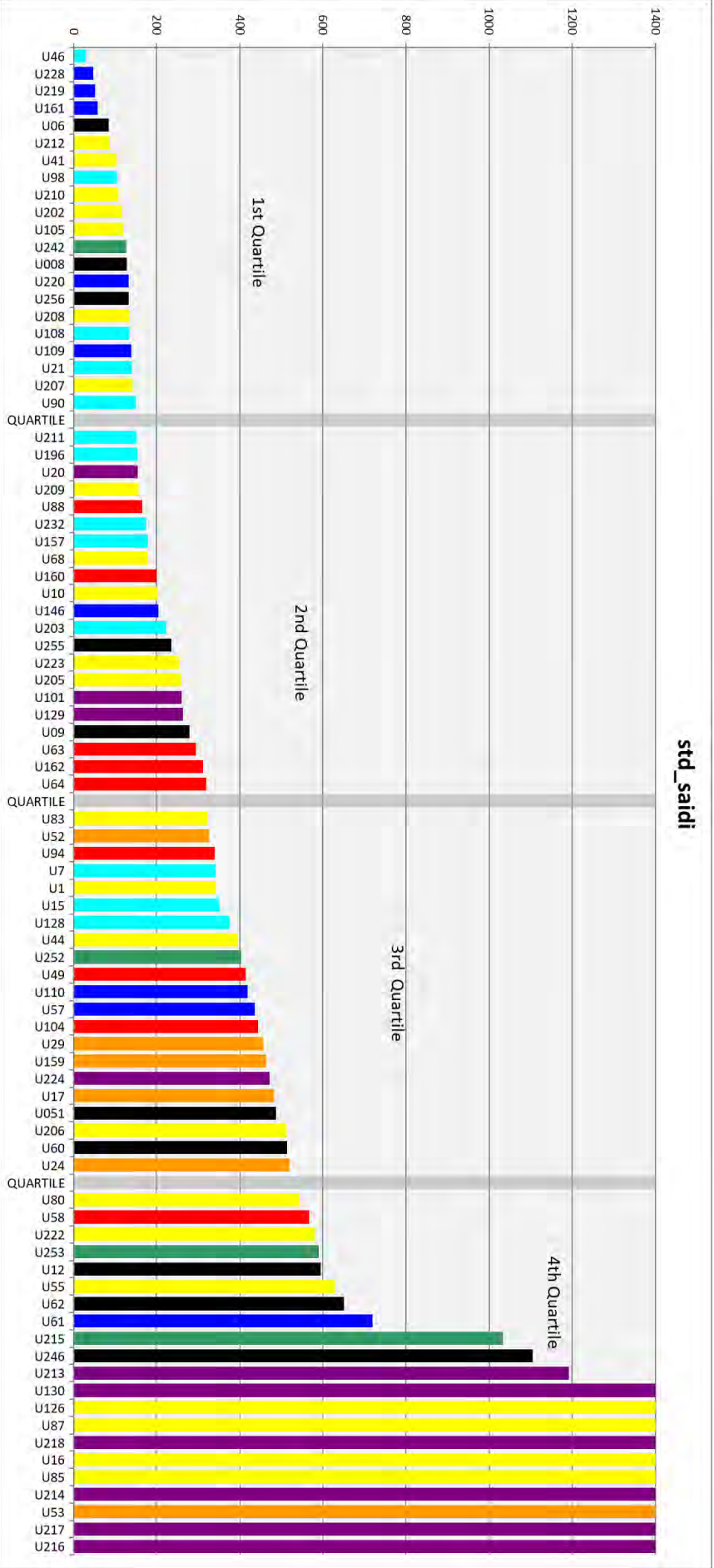
2021 IEEE Benchmark: 2005 to 2020 IEEE CAIDI Quartiles



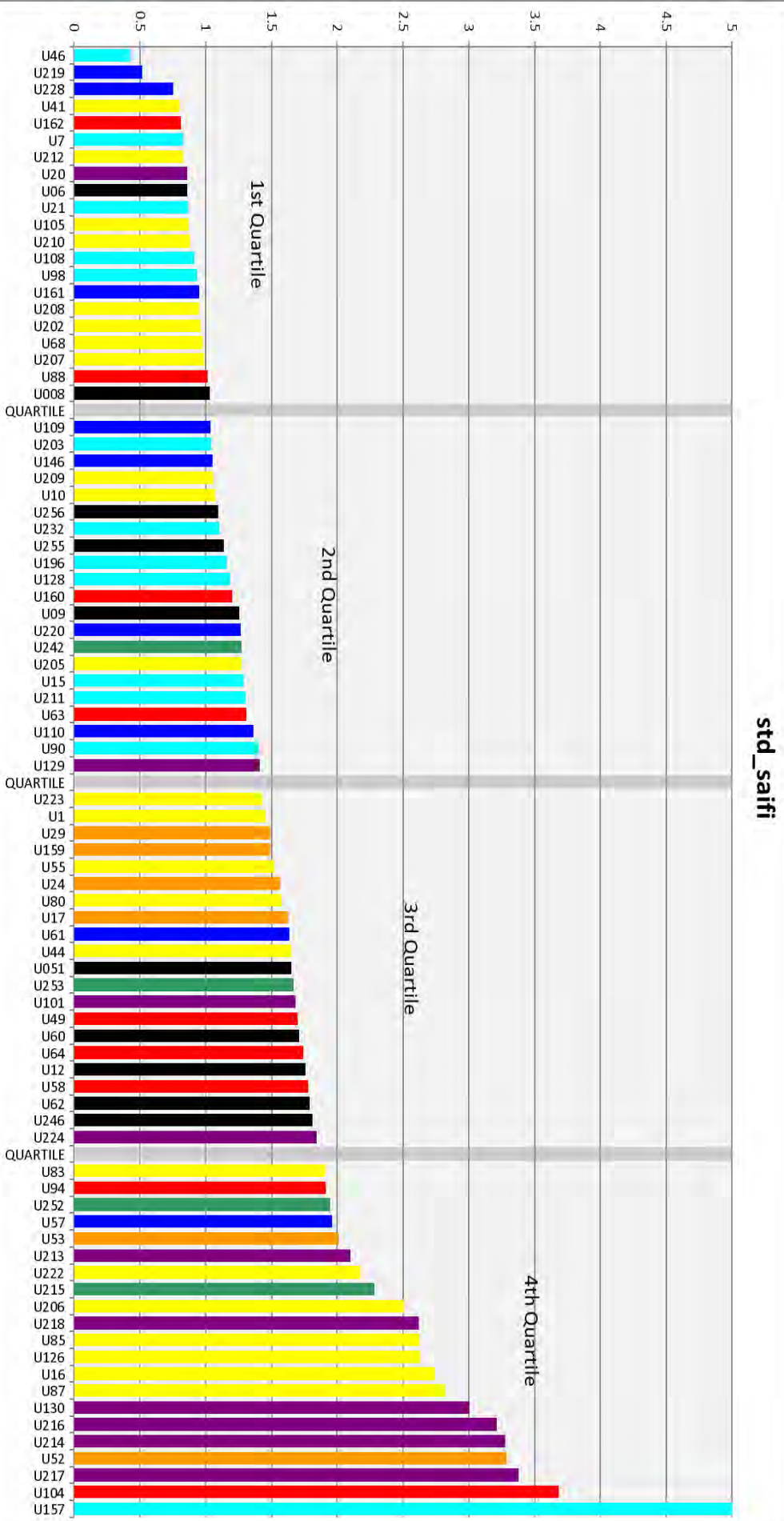
2021 IEEE Benchmark: 2005 to 2020 Total CAIDI Quartiles



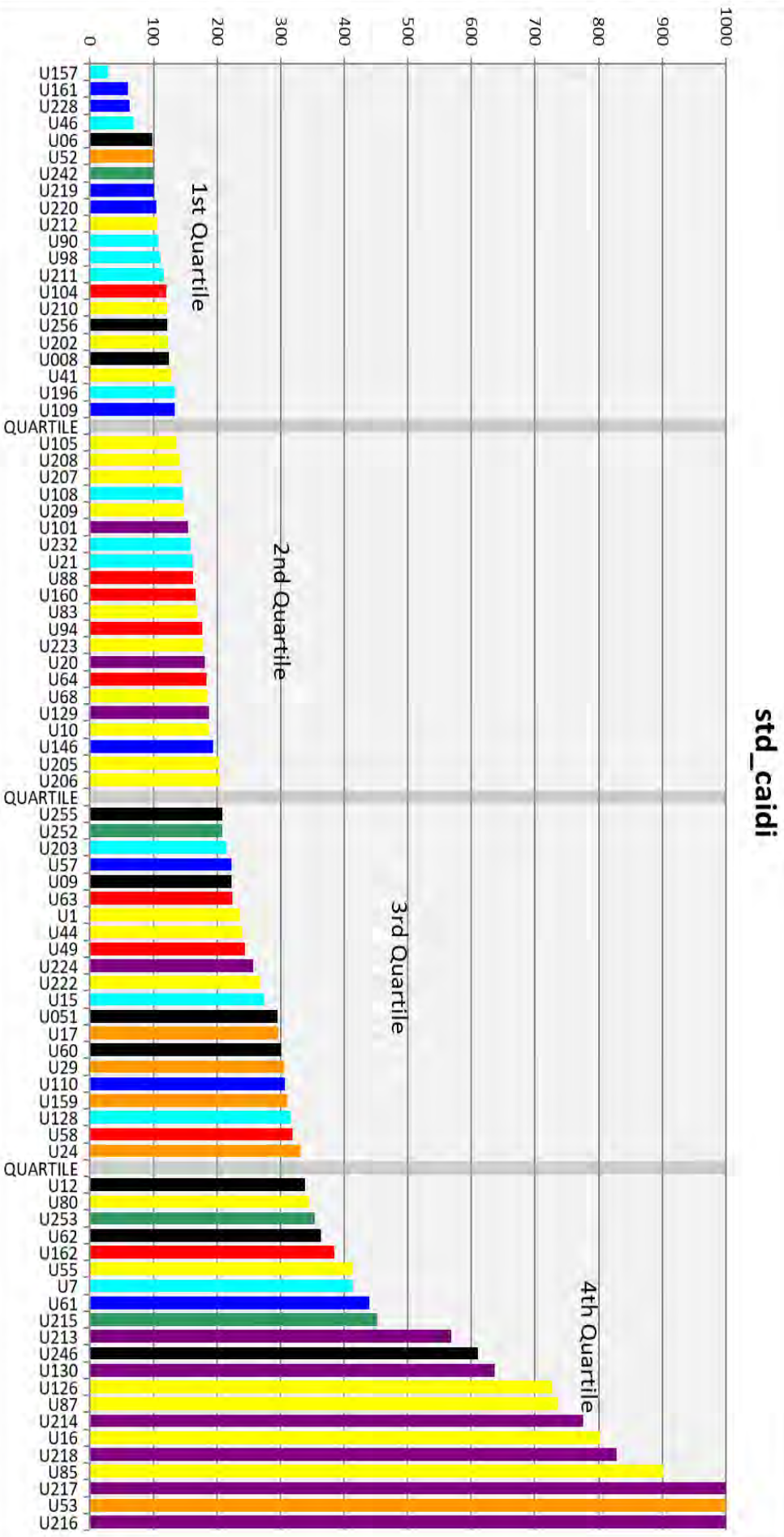
Total (STD) SAIDI 2021



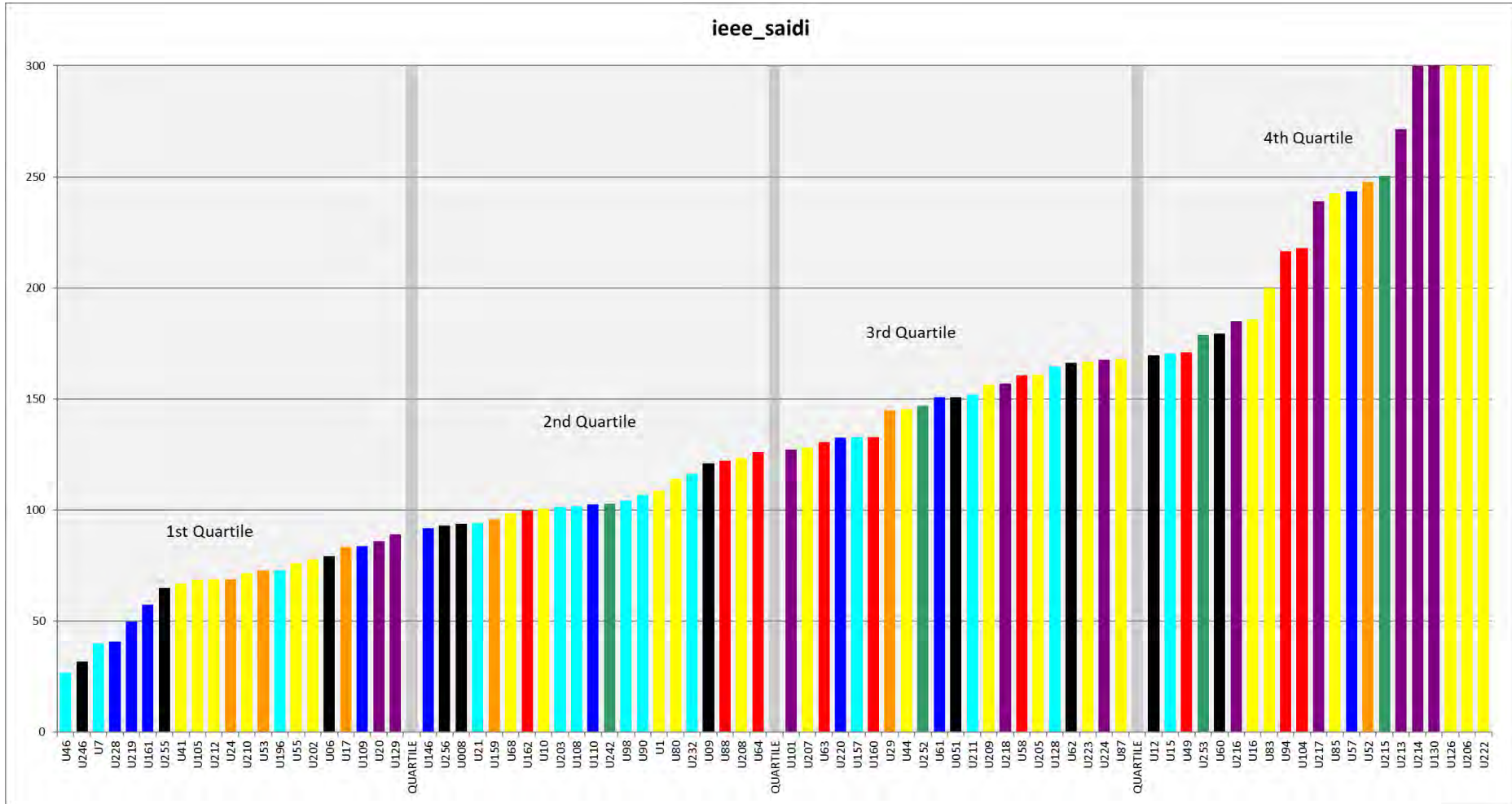
Total (STD) SAIFI 2021



Total (STD) CAIDI 2021

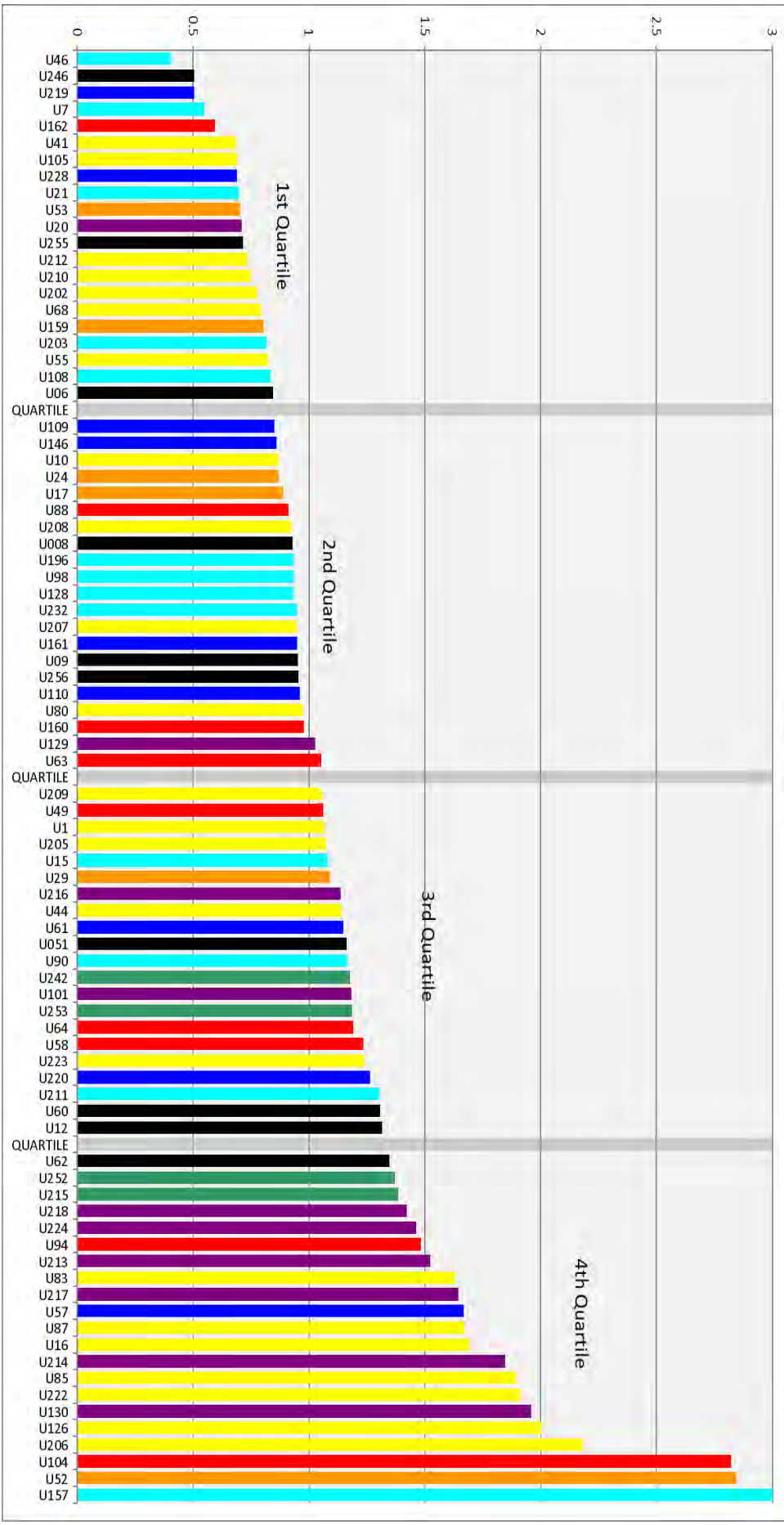


Major Event Excluded (IEEE SAIDI 2021)



Major Event Excluded (IEEE SAIFI 2021)

ieee_saifi



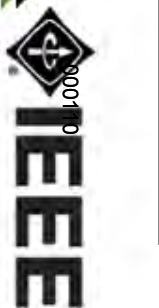
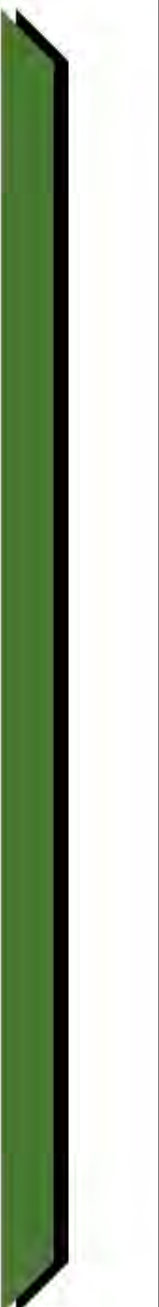
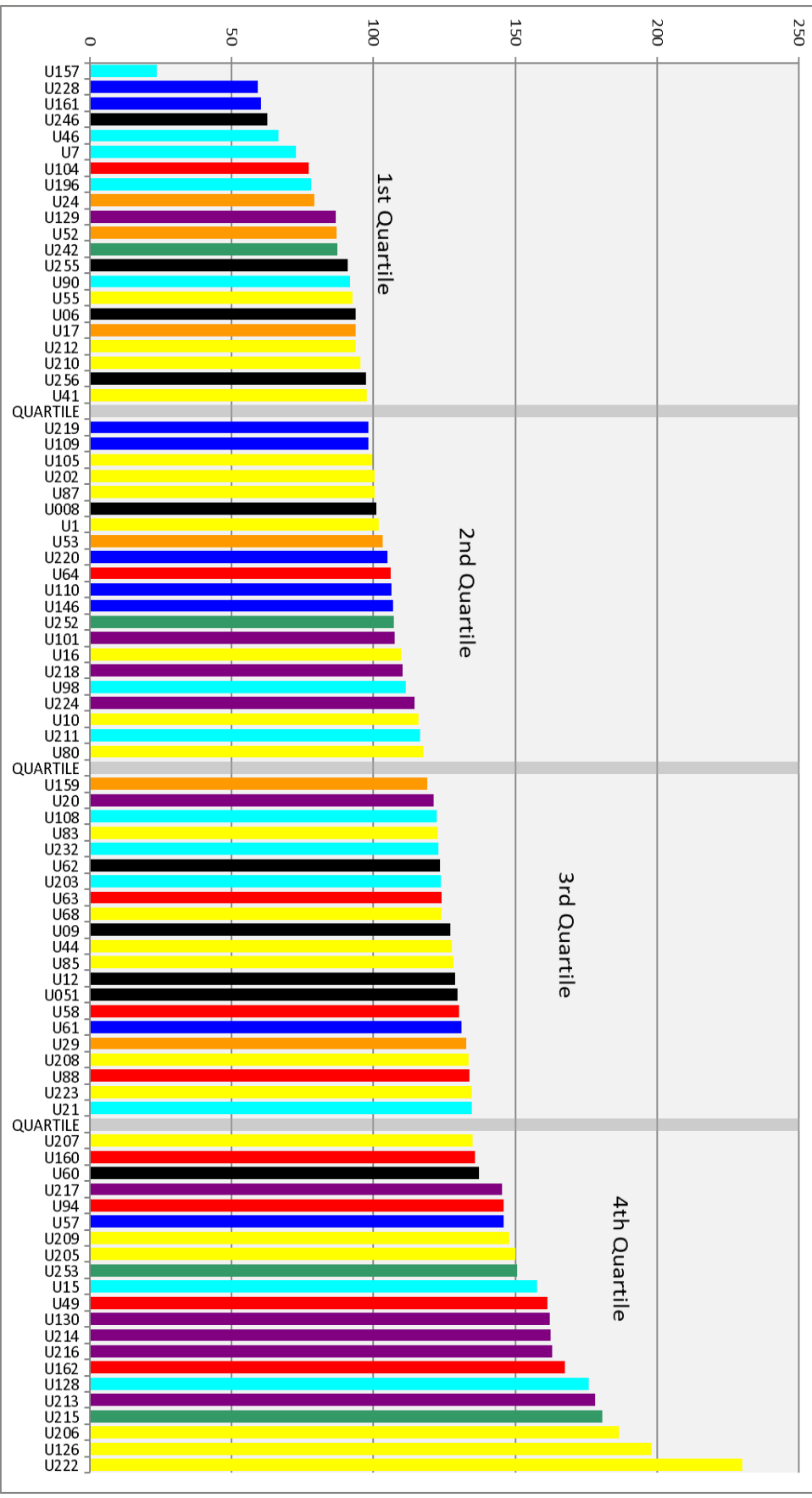
Power & Energy Society



800119

Major Event Excluded (IEEE CAIDI 2021)

ieee_caidi



Questions



Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-023

Date of Response: March 07, 2022
Page 1 of 2

Request from: Department of Energy

Witness: Labrecque, Richard C, Freeman, Lavelle A

Request:

Please provide a summary of the changes made to the distribution planning criteria in 2020 that were included in the Supplement.

Response:

Base Case changes from prior planning criteria to the 2020 Distribution System Planning Guide (“DSPG”) were identified in the initial filing in Section 5.6, Distribution System Planning Criteria Revisions (p.22-24). Additional reliability criteria to ensure continuity of service to customers during substation contingency events and transmission events were also added to the DSPG. These criteria are noted in Section 2.7 Reliability Criteria of the DSPG and included in the summary below.

In summary, the changes are as follows:

Criteria	Pre-2020 DSPG	2020 DSPG	DSPG Section
Base Case			
Bulk Transformer Loading	75% Nameplate	95% Nameplate	2.3 Substation Transformer
Non-Bulk Transformer Loading	100% LTE	100% Nameplate	2.3 Substation Transformer
First Contingency (N-1) (Bulk Substations Only)			
Single Contingency Event (N-1)	<i>N-1 Definition: Loss of one transformer per event.</i> 0 MW sustained loss of load after initial restoration that is limited to three Distribution Transfer Switching steps.	<i>N-1 Definition: Loss of one bus section, bus tie breaker, or transformer per event.</i> 0 MW sustained loss of load after initial restoration that is limited to three	2.7.1 Reliability / Bulk Distribution Substations

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
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		Distribution Transfer Switching steps.	
Transmission System Consideration	Substation with one transmission line supply must use distribution feeders as the secondary supply.	A single Transmission contingency event shall not cause a condition greater than a single Distribution contingency event.	2.7.1 Reliability / Bulk Distribution Substations

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-024

Date of Response: March 10, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Hebsch, Jennifer J

Request:

See generally, LCIRP Bates pages 00051, 00120-21, Appendix D and Supplement.

Please explain how the DSEM is to be used and by whom, including but not limited to what is meant by “circuits.”

Response:

In general terms, the Distribution System Engineering Manual (“DSEM”) is used by all the Company’s employees and its contractors in the performance of engineering and/or design functions. The Company notes that the DSEM addresses most design situations conforming to utility industry standards, but it does not encompass all possible situations. For those situations not covered, the Company relies on the experience and expertise of its engineering management personnel.

The DSEM does not contain a definition of “circuit.” The Company generally defines a circuit as a primary voltage three phase line beginning at a substation or at a point where a 34.5 kV line in ROW is tapped with a protective device.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-025

Date of Response: March 08, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Johnson, Russel D

Request:

Please provide a narrative and documented process that describes how a capital project focused on improving the NH distribution system resiliency is triggered, what engineering specifications constitute an acceptable solution, what committee reviews the resiliency need and recommended solution, and what level of managerial/executive approval is required for a project to proceed to construction.

Response:

Eversource historically has not distinguished between reliability and resiliency projects. Recent improvements in standard materials and design have inherently improved the resiliency of the distribution system.

The Company does not have a documented process that describes how a capital project focused on improving the NH distribution system resiliency is triggered and what engineering specifications constitute an acceptable solution, however, the following is a brief narrative.

A capital project focused on improving NH system resiliency may be triggered by (1) system performance and historical trends that point to specific areas or opportunities for improvement, or (2) new technologies or system improvements that have been identified for system resiliency improvements.

Based on Eversource and industry best practices for resiliency, as well as approved resiliency or storm hardening standards, Eversource Engineering (in a collaborated effort between Standards Engineering, Distribution Engineering and Resiliency & Reliability Engineering) identifies potential Resiliency improvement options and work towards the best solution.

In accordance with existing procedures, a resiliency project is handled similar to any other project from a project approval process.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-026

Date of Response: March 07, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Labrecque, Richard C, Freeman, Lavelle A

Request:

Please compare the role of mobile transformers in support of bulk and non-bulk substations, including typical MVA and voltage ratings for each. If there are other applications for mobile units, please explain these applications as well.

Response:

Mobile transformers on the New Hampshire system are utilized during equipment outages that are either planned for maintenance, capital projects or in response to an emergency, unplanned event.

For maintenance or capital project related outages, the mobile fleet is utilized either to carry base load where capacity is reduced due to the outage or is utilized to mitigate single-contingency loss of load (“SCLL”) during the abnormal system configuration while the outage takes place.

In emergency response at non-bulk substations, where oftentimes the supplied distribution system is a relatively small radially fed load (no alternative source) at 4.16 kV, 12.47 kV, or 13.8 kV, the mobile transformer is installed to restore all customer load.

Distribution System Planning criteria sets a bulk-system design that ensures all customer load during an N-1 contingency can be restored with remaining capacity. This capacity is either within the substation where the event occurred, or by way of load transfers to alternate sources. If it is determined that a mobile is necessary for a bulk system contingency event, its installation allows for the distribution system to return to its normal or a near-normal configuration for the remainder of the outage.

Mobile transformer voltages and sizes are shown in the table below:

Quantity	Nameplate Data		
	Primary Voltage (kV)	Secondary Voltage (kV)	MVA
3	115	34.5	35
1	115	12.47	30
1	46 or 34.5	13.09	14
2	34.4	4.36 or 13.09	10
1	34.4	4.36 or 13.08	7

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-027

Date of Response: March 07, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Labrecque, Richard C, Freeman, Lavelle A

Request:

Please provide the maximum loading capacity (amps) for the 477 MCM spacer-cable and for the 477 MCM covered wire that is the NH standard "main-line" replacement conductor size.

Response:

Eversource uses 477 AAC for both its spacer cable and open-wire, covered-wire configuration. The 90 degree rated conductor is what is presently used for new construction and reconductoring.

Size	Conductor Rating Degrees C	Summer Normal	Summer Emergency	Winter Normal	Winter Emergency
477 AAC 170 mil 15 kV	75	585	750	790	905
477 AAC 150 mil 15 kV	90	700	810	875	955
477 AAC 320 mil 35 kV	75	550	705	750	855
477 AAC 320 mil 35 kV	90	650	755	815	890

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022
Data Request No. DOE 4-028

Date of Response: March 07, 2022
Page 1 of 1

Request from: Department of Energy

Witness: Labrecque, Richard C, Freeman, Lavelle A

Request:

Please complete (see yellow highlights) and/or correct /update the entire referenced Excel spreadsheet, attached hereto as DOE 4-28.1 (Attachment).

Response:

The attached spreadsheet has been revised (Attachment DOE 4-028.xlsx). Eversource corrections and updates are in red-colored text.

Document:	ED-3002	SYSPLAN-010	DSPG 2020
Jurisdiction:	NH	CT-MA-NH	CT-MA-NH
Primary Criteria Document:	1/10/2008-8/1/2018	8/1/2018-9/22/2020	9/22/2020-Present
Bulk Transformers (115kV and above)			
(N-0) Normal Operation (Base Case) - Violations Criteria			
	NH-ED3002 <small>(Source 1 below)</small>	SYSPLAN-010	Distribution System Planning Guide 2020 <small>(Source 2 below)</small>
Bulk Transformer Loading	115% - 150% top nameplate rating (TFRAT)	> 75% top nameplate rating	CT-MA: > 75% top nameplate rating NH: > 95% top nameplate rating
Voltage, Unregulated Load	< 97.5%	n/a	n/a
Voltage, Regulated Load	< 95%	n/a	n/a
Voltage, Service	n/a	< 95%	< 95%
Load Block Transfer Limit	n/a	n/a	n/a
Remaining Isolated Load	n/a	n/a	n/a
(N-1) Contingency - Violations Criteria			
	NH-ED3002 <small>(Source 1 below)</small>	SYSPLAN-010	Distribution System Planning Guide 2020 <small>(Source 2 below)</small>
Bulk Transformer Loading	115% - 150% top nameplate rating (TFRAT)	> 100% LTE	> 100% LTE
Bulk Substation Loading	n/a	> 100% STE _{N-1}	> 100% STE _{N-1}
Voltage, Unregulated Load	< 95%	n/a	n/a
Voltage, Regulated Load	< 92.5%	n/a	n/a
Voltage, Service	n/a	< 95%	< 92%
Load Block Transfer Limit	3	3	3
Remaining Isolated Load	30MW load out for up to 24 hrs	> 0 MW (no loss of load)	> 0 MW (no loss of load)
Transmission Supply N-1	30MW load out for up to 24 hrs	> 0 MW (no loss of load)	Single Transmission N-1 shall not cause greater than a single Distribution N-1 condition.
Non-Bulk Transformers (below 115kV)			
(N-0) Normal Operation (Base Case) - Violations Criteria			
	NH-ED3002 <small>(Source 1 below)</small>	SYSPLAN-010	Distribution System Planning Guide 2020 <small>(Source 2 below)</small>
Non-Bulk Transformer Loading	115% - 150% top nameplate rating (TFRAT)	115% - 150% top nameplate rating (LTE)	> 100% top nameplate rating
(N-1) Contingency - Violations Criteria			
	NH-ED3002 <small>(Source 1 below)</small>	SYSPLAN-010	Distribution System Planning Guide 2020 <small>(Source 2 below)</small>
Non-Bulk Transformer Loading	> LTE rating for 1 load cycle; mobile transformer to be installed within 24 hrs if circuit ties not available	> LTE rating for 1 load cycle; mobile transformer to be installed within 24 hrs if circuit ties not available	> LTE rating for 1 load cycle; mobile transformer to be installed within 24 hrs if circuit ties not available
Distribution Lines			
(N-0) Normal Operation (Base Case) - Violations Criteria			
	NH-ED3002 <small>(Source 1 below)</small>	SYSPLAN-010	Distribution System Planning Guide 2020 <small>(Source 2 below)</small>
Line Loading	> 100% normal	n/a	n/a
Line Loading, Overhead	n/a	> 100% normal	> 100% normal
Line Loading, Underground	n/a	> 100% normal	> 100% normal
(N-1) Contingency - Violations Criteria			
	NH-ED3002 <small>(Source 1 below)</small>	SYSPLAN-010	Distribution System Planning Guide 2020 <small>(Source 2 below)</small>
Line Loading	> 100% emergency	n/a	n/a
Line Loading, Overhead	n/a	> 100% emergency	CT-MA: > 100% normal NH: > 100% emergency
Line Loading, Underground	n/a	> 100% normal	> 100% normal

Notes:

Voltage limits in ED-3002 were set for when using PSS/E loadflows, which only model the circuit backbones. Was utilized after DSPG 2020 release until Synergi was rolled out in NH in 2021. Voltage limits in ED-3002 were set for when using PSS/E loadflows, which only model the circuit backbones. Was utilized after DSPG 2020 release until Synergi was rolled out in NH in 2021. Voltage limits when using Synergi, which models the distribution circuit down to the high side of poletop distribution transformers.

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Source 1: NH-ED3002
Source 2: LCIRP, 10/1/20, Appendix D - Distribution System Planning Guide (DSPG 2020), approved September 20, 2020
Source 3: LCIRP, Appendix D - Generally, System Planning Design Criteria and Violations

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Request from: Department of Energy

Witness: Labrecque, Richard C, Freeman, Lavelle A

Request:

Please define the following for the 3 sets of planning criteria provided in the above Excel spreadsheet, i.e., DOE 4-28.1 Attachment 1:

- a. When each was/is used, including first use.
- b. How each is used and by whom.
- c. How each will be used going forward and by whom, including which is the Company's first choice.
- d. What has been done and planned by the Company to help Staff better understand the need for three sets of criteria, and the potential consequences if the preferred set is not accepted/approved by Staff.

Response:

Of the three criteria being compared in DOE 4-28.1 Attachment 1, only two are documents that set System Planning criteria: ED-3002 and the Distribution System Planning Guide (DSPG 2020). The third document being referenced is a system study report that references the criteria in the Distribution System Planning Guide. The following responses compare the use of ED-3002 and the Distribution System Planning Guide.

- a. Of the different documents guiding New Hampshire System Planning design criteria, the first is ED-3002, which was originally issued January 10, 2003. This document was the primary guidance for NH System Planning until SYSPLAN-010 was revised.

SYSPLAN-010 was a criteria document created in 2014. In 2018, the first effort to bring all planning criteria of the different operating companies into one document occurred. The revised SYSPLAN-010 document was adopted by all three states on August 1, 2018 and supersedes ED-3002. However, some specific planning criteria not addressed by SYSPLAN-010 are still applicable from ED-3002.

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The Distribution System Planning Guide, adopted September 22, 2020, is today's primary document for system planning criteria, rating, and planning methodology. The DSPG 2020 supersedes SYSPLAN-10 and ED-3002, by extension. However, some specific items not addressed by the DSPG 2020 are still applicable in SYSPLAN-010 and ED-3002.

- b. All documents are used by New Hampshire Distribution System Planning for criteria on how to study the distribution system and ensure system capacity needs are fulfilled, and system voltage remains within limits for base case and contingency scenarios.

ED-3002: Portions not superseded by DSPG 2020 and SYSPLAN-010, used by New Hampshire

SYSPLAN-010: Portions not superseded by DSPG 2020, used by Connecticut, Massachusetts, and New Hampshire

DSPG 2020: Used by Connecticut, Massachusetts, and New Hampshire

- c. The Company's primary distribution system planning criteria document is the Distribution System Planning Guide, released in 2020. Any items not addressed by the DSPG 2020, are supplemented, first by SYSPLAN-010 and then by ED-3002. Based on changing roles and responsibilities, some items are still referenced in SYSPLAN-010 by Transmission Planning and in ED-3002 by Distribution Engineering, until replacement guides/policies can be written.
- d. The new Distribution System Planning Guide was included in the Company's initial filing in this docket. Eversource's initial filing highlighted the implementation of the new DSPG and changes to the criteria were described. Subsequent to the initial filing of the LCIRP, Eversource and Staff discussed the new planning criteria at a technical session. The Eversource response to data request DOE 4-028 provides additional details. Eversource is committed to these new criteria as a means to ensure system reliability under various single contingency events. Customers will be exposed to the risk of prolonged outages if the system is not planned and designed to these criteria.