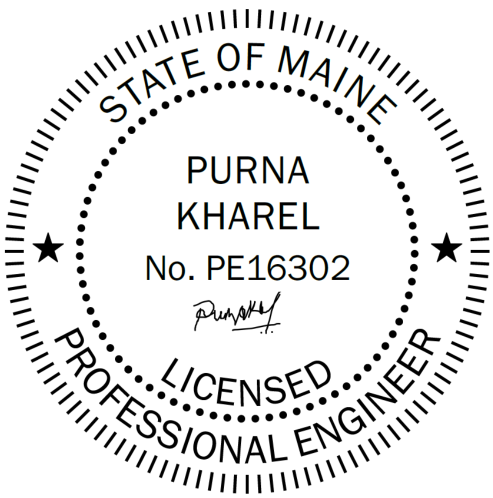
PRJ 391
Maine DOT Environmental Office (Augusta)
Final Report

Distribution Interconnection Impact Study

-- POI: Pole 511, 73 Whitten Rd, Augusta, ME 04330 --



June 10th, 2020

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1. <u>Introduction</u>

The purpose of this study is to identify any potential adverse impacts to the Distribution System that would result from the interconnection of **0.50 MW** of photovoltaic (PV) generation applied by **Maine DOT Environmental Office** to **Circuit 215D2 (12.47 kV)** out of **Capitol Street Substation**. The proposed Point of Interconnection (POI) will be at **pole #511** on **73 Whitten Rd, Augusta, ME 04330.**

The study was conducted in accordance with Central Maine Power Company (CMP) reliability and design standards, study guidelines, procedures and practices and Chapter 324 Rules governing distributed generation interconnection as approved by the Maine Public Utilities Commission (MPUC).

It is assumed that the customer (**Maine DOT Environmental Office**) will conduct further studies of their facilities as they deem necessary to assure adequacy of any customer-owned equipment in conjunction with the addition of the proposed generation equipment.

The following studies were done to evaluate the impact to distribution equipment and performance of the circuit and the substation:

- Load-Flow
- Steady State Voltage Analysis
- Voltage Change Analysis
- Short-Circuit
- Transformer Inrush
- Circuit Protection and Coordination
- Intertie Relay Review
- Effective Grounding
- Harmonics Evaluation

In addition, the study will provide a brief description and non-binding cost estimate of upgrades required to interconnect the project to the distribution system.

2. <u>Project Description</u>

The **0.50 MW** of photovoltaic (PV) generation (the project) will be connected to the existing overhead distribution lines at pole #511 on 73 Whitten Rd, Augusta, ME 04330 as shown in Figure 1. The connection will be made to the primary voltage of 12.47 kV via Circuit **215D2,** which is served from the **Capitol Street Substation**.

Figure 1. Site plan proposed by the project.

The distance from POI to the nearest three phase line is **0 miles** and approximately **1.92 miles** to the substation.

The total project AC kW output is limited to **0.50 MW** with four (4) 125 kW inverters. One (1) 500 kVA wye grounded-wye grounded pad mounted GSU transformer, along with one (1) 15 kVA, wye grounded-delta, grounding transformer is proposed as part of the customer one-line configuration for the project to connect to CMP's 12.47 kV grounded-wye distribution system. Appendix F summarizes useful data from the customer application report.

Customer Information:

Maine DOT Environmental Office – c/o David Gardner
24 Child Street
Augusta, ME, 04333
Phone: 1-207-592-2471

3. Study Method

Both off-peak and peak loads recorded from the past 24 months were reviewed to determine the necessary base case(s). The PV generation was studied to analyze its operation in conjunction with, without negatively affecting, the distribution system. The study used worst case scenarios and aids to determine possible mitigation techniques for observed adverse impacts. Various studies were done on the base case to identify existing issues, and any that were found, prior to interconnection, were considered pre-existing conditions. For study purposes, these conditions were addressed by modification of the base case as appropriate to preclude their impact on the generation studies.

4. Study Assumptions

The **Capitol Street Substation** transformer (10 / 14 MVA) with Load Tap Changer (LTC) regulates the 12.47 kV circuit voltage. To maintain satisfactory service and normal load flow to customers connected to Circuit **215D2**, and provide for operational flexibility, the circuit voltage must be maintained within the normal Company Planning criteria of 123 volts minimum and a maximum of 126 volts at the substation, on a 120-volt basis.

The base voltage and LTC settings are:

Base Voltage: 124.0 V
Bandwidth: 3.0 V
Time Delay: 30 s

To the extent permissible, the project generation is assumed to operate in unity power factor mode by the Customer. It is also assumed that ISO New England will review the proposed project separately and may require the generator to operate in voltage control mode. In that case, their requirements may determine the operating mode and power factor.

Customer equipment and facilities were modeled to the extent necessary to evaluate the impact of Company facilities equipment ratings, service voltage, circuit reliability, protection, and system operation. It is the customer's responsibility to ensure that their facilities are adequate for the proposed project.

It is assumed that the Customer may, at their discretion, utilize transformer taps, if available, on each GSU to adjust the secondary voltage to levels they deem acceptable for their inverters, etc. This should have no direct impact on the utility side voltage of the GSU transformers.

There is a 420 kW generation site present on Circuit **215D2** which is considered pre-existing throughout the study to follow.

The CMP **Capitol Street Substation** Transformer is rated for 10 / 14 MVA and it serves two (2) 12.47 kV circuits**, 215D2** and **215D3**. Since the project will off-set normal circuit loading, the worst-case scenario to be analyzed, for steady state study purposes, is minimum load and maximum project output.

5. Historical Loads

Historical load from the past 24 months for circuits **215D2, 215D3** and **233D1** (contingency circuit) was used as the basis for the load modeling in the base and generation cases. The following Tables, 1 & 2, give an overview of the historical load for peak and off-peak conditions on the circuits **215D2, 215D3** and **233D1**. Refer to Appendix E for the Capitol Street Substation one-line diagram.

Table 1. Peak Load at Circuits 215D2, 215D3 and 233D1.

Device	Amps Phase A	Amps Phase B	Amps Phase C	PF (%)
215D2	128.39	129.69	142.59	96.80
215D3	190.55	207.15	217.85	93.70
233D1	138.20	133.50	134.75	97.60

Table 2. Off-Peak Load at Circuits 215D2, 215D3 and 233D1.

Device	Amps Phase A	Amps Phase B	Amps Phase C	PF (%)
215D2	19.26	19.45	21.39	96.80
215D3	28.58	31.07	32.68	93.70
233D1	20.73	20.03	20.21	97.60

6. <u>Load Flow Analysis</u>

6.1 Equipment Loading

Several Load Flow studies were conducted to determine the project's impact on the distribution equipment thermal loading. Utilizing peak and off-peak loading conditions with maximum generation, Circuit **215D2** was analyzed to identify overloads and equipment incompatibility with reverse power flow, if present. Figures 2 and 3 show the load flow under peak and off-peak conditions, without and with the proposed project interconnection and with Solar Generation connected in all scenarios.

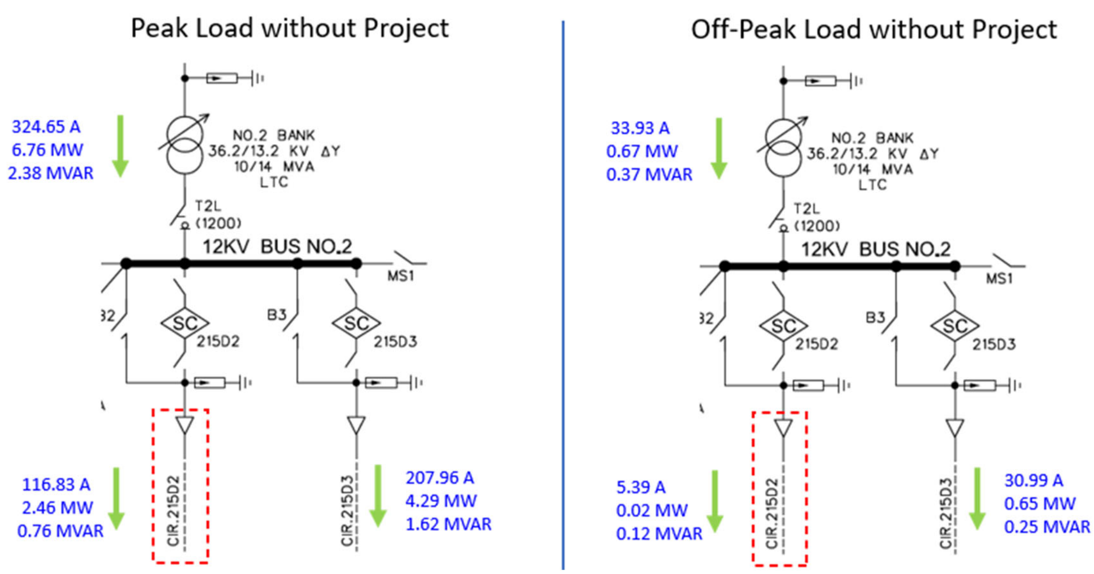

Figure 2. Substation Bank Loading under peak and off-peak conditions without Proposed Project.

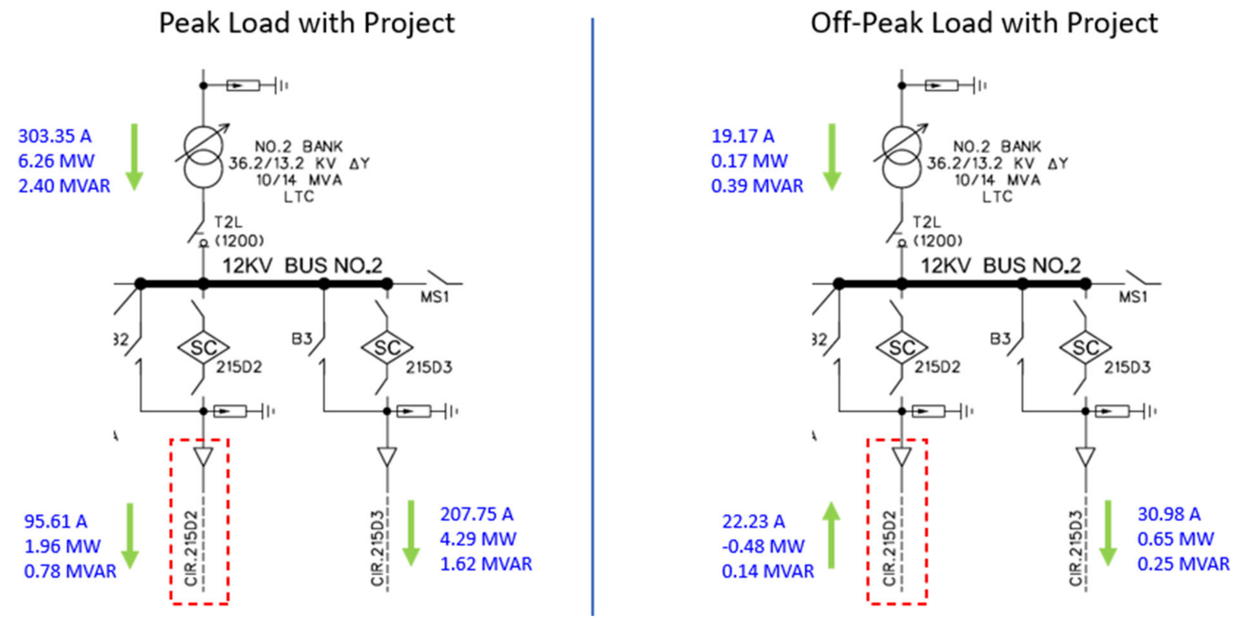

Figure 3. Substation Bank Loading under peak and off-peak conditions with proposed project.

The worst-case scenario, maximum project output under off peak load conditions, does not cause the substation transformer rating to be exceeded. Reverse power flow through is observed through the circuit but not the substation transformer, with the project interconnected.

7. <u>Voltage Impact</u>

7.1 Steady State Voltage Analysis

A Steady State Voltage Analysis was conducted to determine the project's impact on the distribution circuit voltage. To ensure adequate service voltage to customers, 114 to 126 volts, the circuit voltage must remain within the range of 117 to 126 volts (120 volt base) during normal operation. In general, the circuit voltage at the substation must remain in the range of 123 to 126 volts to maintain an adequate voltage on **Circuit 215D2** under all anticipated load conditions, regardless of project operation. Table 3 shows the simulation results for voltage impact on **215D2**.

Table 3. Simulation Results for Voltage Impact on Circuit 215D2 under Peak and Off-peak loads due to proposed project interconnection.

Circuit 215D2 Load	0.50 MW PV (ON/OFF)	Substation Voltage (V)	POI Voltage (V)	V-max (V)	V-min (V)	Threshold (V)
Peak (1.033 pu)	OFF	122.61	121.64	122.81	121.34	117 - 126
Peak (1.033 pu)	ON	122.72	122.00	122.92	121.70	
Off-peak (1.045 pu)	OFF	124.84	124.72	124.94	124.65	
Off-peak (1.045 pu)	ON	124.89	125.01	125.08	124.82	

Voltages are within limits upon interconnection of the proposed project.

7.2 Voltage Change Analysis

A Voltage Change Analysis was performed to determine the instantaneous change in voltage (voltage change/flicker) that would occur in the distribution system upon sudden loss of the **0.50 MW** project. The voltage flicker at the POI given a 100% loss of the project must be "< / = 3%". Similarly, the voltage change at the substation LTC must be less than or equal to half the bandwidth "< / =1.5 V".

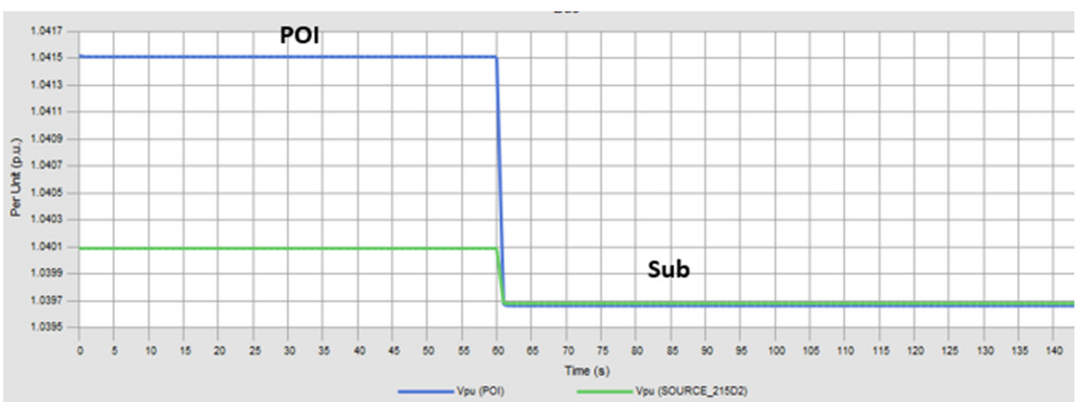

Figure 4. Circuit 215D2 POI and Substation Voltage Change at peak Loads Due to Sudden 100% Loss of the 0.50 MW PV Project.

Peak Load with 100% sudden loss of the proposed project, results:

$$\Delta V = 1.0415 - 1.0397 = 0.0018\, p.u. \Rightarrow 0.18\,\% < 3\% \text{ @ POI}$$
$$\Delta V = 1.0401 - 1.0397 = 0.0004\, p.u. \Rightarrow 0.05\, V < 1.5\, V \text{ @ Substation LTC}$$

The voltage flicker is below the allowable 3% limit at the POI and the voltage change at the substation LTC is less than half its bandwidth. Therefore, the project passes this section of study.

7.3 Contingency Circuit Analysis

Circuit **233D1,** served from the Manchester substation (12 kV), is the contingency circuit for circuit **215D2**. The contingency circuit contains a pre-existing project PRJ 95 which is considered as being online.

Simulation results show no over-voltage and voltage flicker violations, Vmax of 123.92 V and voltage flicker less than 3% at POIs for both the proposed project and the existing project PRJ 95, when Circuit **233D1** picks up the load from Circuit **215D2**.

Therefore, the proposed project can operate during the contingency conditions.

8. Short Circuit Analysis

A short circuit analysis was performed to determine the fault duty at various points and identify if any circuit reclosers exceeded their interrupting capability as a result of the project interconnection.

Below is a summary of the maximum fault levels on the 12.47 kV Distribution System Circuit **215D2**. The difference in percentage before and after the interconnection at the substation is shown in Table 4 and the point-of-interconnection (POI) in Table 5.

Table 4. Summary of Short Circuit Analysis at Substation.

DER Status	LLL (A)	LLG (A)	LL (A)	LG (A)
OFF	4447	4911	3841	4912
ON	4474	4934	3852	4928
Difference	**0.61%**	**0.47%**	**0.29%**	**0.33%**

Table 5. Summary of Short Circuit Analysis at POI.

DER Status	LLL (A)	LLG (A)	LL (A)	LG (A)
OFF	2472	2318	2135	2072
ON	2498	2338	2146	2094
Difference	**1.05%**	**0.86%**	**0.52%**	**1.06%**

The short circuit study detected no violations for LLL/LLG/LL/LG faults as a result of the addition and operation of the proposed generation.

Additionally, the DER project does not cause any protective devices on Circuit **215D2** to exceed 87.5% of their short circuit interrupting capability. The substation recloser and customer proposed recloser can interrupt the increased short circuit current. Protection coordination will be evaluated in the following section.

9. Circuit Protection Review

The project is located at about **1.92 miles** from Capitol Street Substation. The distance from POI to the nearest three phase line is **0 miles**.

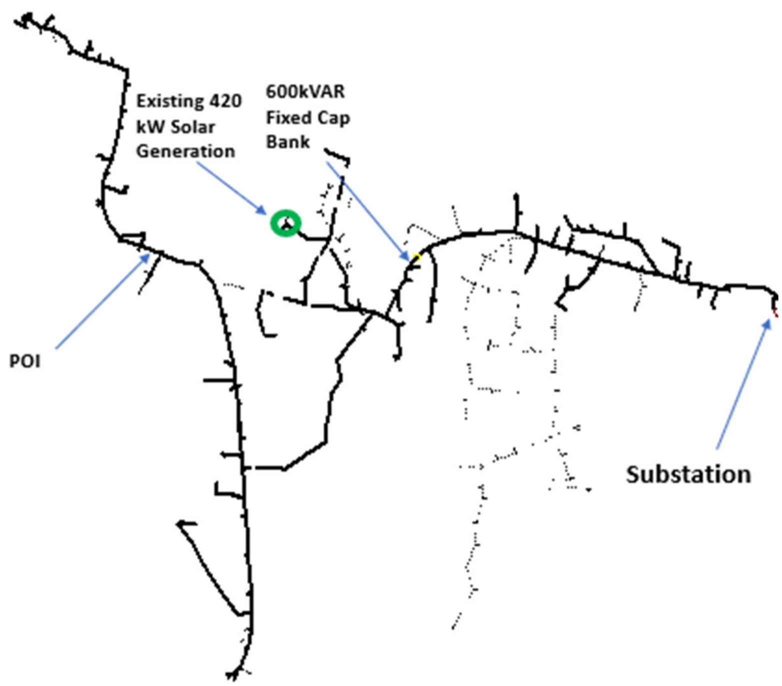

Figure 5. Distribution Circuit 215D2.

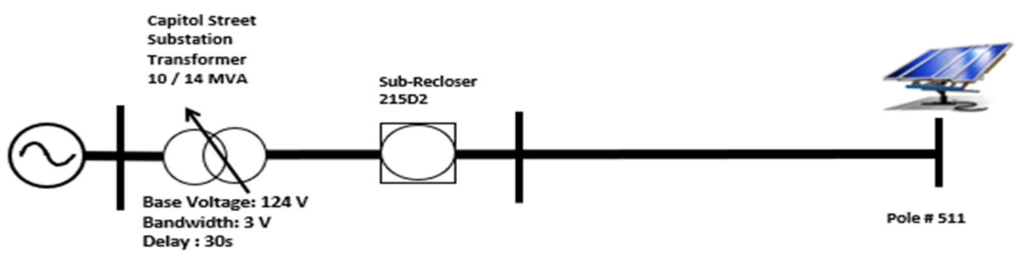

Figure 6. Protection Review from POI to Substation of Circuit 215D2.

No overloads observed between the POI and the substation.

9.1 Transformer Inrush

The transformer inrush current is highly non-linear, it peaks at 1/2 cycle (0.008 sec) after the transformer is energized. The current then drops to normal after about 6 cycles (0.1 sec). The magnitude of the inrush current depends on the following:

- Time that you throw the switch.
- Length and size of the conductors feeding the transformer.
- Stiffness (available fault current) of the system feeding the transformer.
- The size of the transformer.
- The type of transformer.

The worst case of the transformer inrush is when the one (1) 500 kVA generating step-up (GSU) transformers are energized. The inrush current is determined as:

$$10 \times FLA = 10 \times 23.15\ A = 231.5\ A$$

Review of the TCC settings for substation recloser **215D2** with SEL351R control shows that the inrush will not trip its settings within 6 cycles. Therefore, Circuit **215D2** is adequately protected from inrush current due to the project GSU transformer energization. See TCC curve located in Appendix D, for more details.

9.2 Intertie Relay

<u>Protection Review for the PV GENERATION</u>

Maine DOT Environmental Office (73 Whitten Rd) has proposed to use a recloser as shown below with a SEL-651R as the intertie relay. The site intertie relay will need to be able to detect ground bank transformer faults and remove the project generation from service for all project system current, frequency, or voltage abnormalities. The SEL-651R overcurrent protection for Maine DOT Environmental Office (73 Whitten Rd) will need to coordinate with the substation recloser at the CMP Capitol Street Substation.

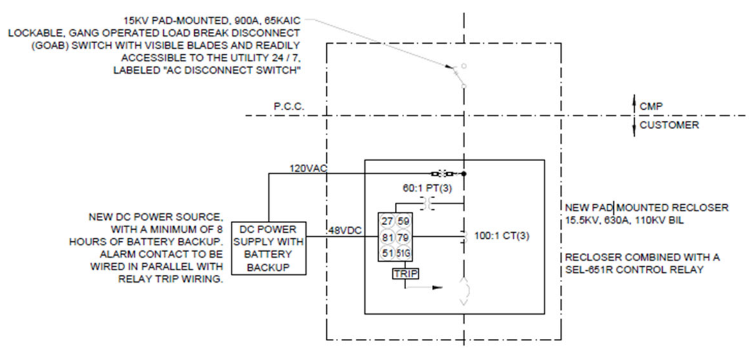

Figure 7. New Pole-mount recloser provided by the customer.

Table 6. Relay Settings.

PROPOSED PROTECTION RELAY SETTINGS							
DEVICE	PICKUP			Time Delay		Total Clearing Time	
	Primary		Secondary				
27-1	50%	(3599.8 V)	(54 V)	63 CYC	1.05 SEC	66 CYC	1.1 SEC
27-2	88%	(6335.6 V)	(95.04 V)	117 CYC	1.95 SEC	120 CYC	2 SEC
59-1	110%	(7919.5 V)	(118.8 V)	117 CYC	1.95 SEC	120 CYC	2 SEC
59-2	120%	(8639.5 V)	(129.6 V)	6.6 CYC	0.11 SEC	9.6 CYC	0.16 SEC
81U-1	58.5 HZ			17997 CYC	299.95 SEC	18000 CYC	300 SEC
81U-2	56.5 HZ			6.6 CYC	0.11 SEC	9.6 CYC	0.16 SEC
81O-1	61.2 HZ			17997 CYC	299.95 SEC	18000 CYC	300 SEC
81O-2	62 HZ			6.6 CYC	0.11 SEC	9.6 CYC	0.16 SEC
51		29 A	0.29 A	SET PER UTILITY STANDARDS			
51G		10 A	0.1 A	SET PER UTILITY STANDARDS			
79	0.95 PU - 1.05 PU 59 HZ - 60.5 HZ			17997 CYC	299.95 SEC	18000 CYC	300 SEC

SETTINGS ASSUME 3 CYCLE ESTIMATED DEVICE TRIP OPENING TIME
SETTINGS ARE BASED ON IEEE 1547-2018 TABLE 1 (VOLT) AND 2 (FREQ).
SETTINGS ARE BASED ON A 108V SECONDARY PT BASE.

9.3 Single Phasing

The behavior of three-phase transformers, when one of the phases is lost, is commonly called "single phasing." Upon a single phasing condition voltages and currents, on both the HV side and LV side, depend greatly on the transformer winding connection (delta, wye, wye-grounded, etc.) as well as the transformer's core construction. A single phasing condition is very difficult to detect by relays where the CTs are monitoring current on the LV side of the transformer.

On the customer side, with the presence of long underground cables (high capacitance); the most important factor affected by this is the Ferranti effect. It is more pronounced in cables than in lines. This induces several limitations. Also, with increased capacitance, the charging current drawn is also increased. Underground cables have 20 to 75 times the line charging current compared to overhead lines. Due to these two conditions, it is suggested that the recloser have the ability of monitoring zero-sequence voltage to eliminate the single-phasing concerns.

10. Effective Grounding

Utilities in the Northeastern part of the United States currently use the conventional effective grounding concept prescribed in IEEE 142. The standard says, "The grounding scheme of the DR interconnection shall not cause overvoltage that exceeds the rating of the equipment connected to the Area EPS and shall not disrupt the coordination of the ground fault protection on the Area EPS." The grounding impedance (X_0) is calculated based on the positive sequence impedance (X_1) provided by the inverter manufacturer and X_0 /X_1 <3, R_0/X_1<1 are generally used. Refer to Appendix G for the customer proposed one-line diagram of the project.

Table 7. Effective Grounding Values at POI.

Status	R_0/X_1	X_0/X_1	Threshold
w/o project	0.522	1.576	**$R_0/X_1 < 1$**
w/ project	0.517	1.563	**$X_0/X_1 < 3$**

The proposed one (1) 500 kVA Wye-grounded to Wye-grounded, pad mounted GSU transformer, with one (1) 15 kVA Grounded-Wye / Delta grounding transformer is effectively grounded and will not worsen the grounding conditions, hence, not creating adverse impacts to distribution Circuit **215D2**.

11. Harmonics Evaluation

According to the small generating facility characteristic data that is provided for inverter-based machines, **harmonics characteristics is (THD) <3 %**. In IEEE 519, the accepted THD is 5%. Therefore, harmonics will not be a concern or a problem for the project. Project passes this section of the study.

12. Conclusions

1. Load Flow Analysis
   - No adverse impact was detected with the interconnection of proposed project at Circuit **215D2**.

2. Equipment Loading
   - No overloads detected between the POI and the substation.

3. Voltage Impact
   - No over-voltages were detected due to the project interconnection.
   - The voltage flicker at the POI and the voltage change at the substation are within the allowable limit during a 100% loss of the proposed project.

4. Contingency Analysis
   - The proposed project can operate under the contingency condition.

5. Short circuit Analysis
   - Protective devices can interrupt the available short circuit with PV Generation project interconnection.

6. Circuit Protection Coordinate/Protection Review
   - Circuit is adequately protected.

7. Effective grounding
   - No adverse impacts were found in the effective grounding study due to the interconnection of the project.

8. Harmonics
   - No adverse impacts were found in the harmonics study.

The project passes all sections of the Impact Study and is therefore able to interconnect, Contingency Circuit Analysis section pertains only to the ability of the project to operate during contingencies. The interconnection is contingent upon upgrades and mitigation methods applied (if any) throughout the study in order to maintain the distribution system's reliability and integrity.

13. <u>Suggested Solutions and cost estimation (total $35,835)</u>

Note:

- This estimate is in accordance with the guidance provided under the Maine Public Utilities Commission Chapter 324 Rule. Under §12.N, the rule states the Utility "should endeavor to estimate within +/- 25%." While the intent of this estimate is to refine costs to upgrade to a figure within that tolerance, the total amount to upgrade is an estimate of costs and may not reflect all known costs at the time of the estimate. Should a project desire more refinement or a detailed breakdown of an estimate, please refer to the last paragraph of Section N where it states, "The detailed system modifications and more accurate costs of the modifications necessary to interconnect the ICGF shall be identified in the Facilities Study." If the project desires a Facilities Study, please advise the Interconnection Services Group.

- Estimate is based on Distribution Planning Estimating Guide Version 1.3 Appendix A.

- Estimate assumes a 25% overall contingency.

- Estimate Includes Project Engineering, Project Manager, Administrative Support, Miscellaneous Overheads, and Allocations.

- TBD costs are not included in the total dollar amount and are a separate cost "high level" associated with the project interconnection.

Interconnection Cost

- The project will require a **bi-directional pole mounted primary metering package** located off the existing 12.47 kV overhead CMP distribution circuit. The facility includes one solid state meter, three 12.47 kV CT and three 12.47 kV VT, the detailed price is listed in Appendix B**.------ $14,522 (total installed cost)/$225.4 (per month maintenance and translation)**
- Install (1) new pole for primary metering equipment and connect the overhead line to pole #511 73 Whitten Rd, Augusta, ME 04330.
- Install a GOAB switch.
- Install (1) new pole for GOAB switch.

Customer Responsibilities

- Everything on the load side or customer side of the Gang Operated Air Break Switch (GOAB) representing the Point of Common Coupling (PCC) will be the responsibility of the customer or developer. This includes any protective reclosers, breakers, the telephone line to the Revenue Meter and all associated equipment.
- All facilities that have a generating capacity of 1,000 kW or greater must be equipped with SCADA equipment.

Appendix

A. Planning Cost Estimate

Project Name:	Maine DOT Environmental Office	Project #:	PRJ 391
Location:	73 Whitten Rd, Augusta, ME 04330	Org Date:	19-May-20
Section		Rev Date:	
By:	Distribution Planning Department	Rev by:	
Project Stage:	Concept	*This is a Planning Grade Estimate with tolerance of -50% to +200%*	
		Contingency value =	25%

Item	Quantity to:			Average Unit Cost			Estimated SubTotal Cost			Contingency	Estimated Total Cost		
	Install	Remove	Shift	CAP	COR	O&M	CAP	COR	O&M		CAP	COR	O&M
Poles - Electric Owned and Maintained													
15kV - Reinsulate Single Phase	0	0	0	$ -	$ 50	$ 100	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Reinsulate Three Phase	0	0	0	$ -	$ 50	$ 300	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - New Single Phase	0	0	0	$ 1,500	$ -	$ -	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - New Three Phase	2	0	0	$ 3,000	$ -	$ -	$ 6,000	$ -	$ -	25%	$ 7,500	$ -	$ -
15kV - Replace Single Phase	0	0	0	$ 2,000	$ 400	$ 200	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Replace Three Phase	0	0	0	$ 3,000	$ 600	$ 300	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Dress for aerial cable	0	0	0	$ 700	$ -	$ 70	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Pole Set Assist	0	0	0	$ 1,000	$ -	$ 100	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - H-Frame, Two Pole Structure	0	0	0	$ 15,000	$ 4,500	$ -	$ -	$ -	$ -	25%	$ -	$ -	$ -
Poles - Telco Owned and maintained													
15kV - New Single Phase	0	0	0	$ 500	$ -	$ -	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - New Three Phase	0	0	0	$ 2,500	$ -	$ -	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Replace Single Phase	0	0	0	$ 1,000	$ 200	$ 100	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Replace Three Phase	0	0	0	$ 2,500	$ 500	$ 250	$ -	$ -	$ -	25%	$ -	$ -	$ -
OH Conductor (per section - 150ft)													
15kV - Single Phase	0	0	0	$ 125	$ 25	$ 13	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Three Phase Tap	0	0	0	$ 250	$ 50	$ 25	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Three Phase Mainline	0	0	0	$ 450	$ 90	$ 45	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Three Phase Mainline - Spacer	0	0	0	$ 800	$ 160	$ 80	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Replace Secondary/Service Conductor	0	0	0	$ 150	$ 30	$ 15	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Aerial Cable - Express	0	0	0	$ 4,000	$ 800	$ 400	$ -	$ -	$ -	25%	$ -	$ -	$ -
UPZ Vegatation Management	0	0	0	$ 2,000	$ 400	$ 200	$ -	$ -	$ -	25%	$ -	$ -	$ -
Major OH Equipment													
15kV - Cutout - Single	0	0	0	$ 200	$ 40	$ 20	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Cutout - Three	0	0	0	$ 600	$ 120	$ 60	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Bells - 1ø	0	0	0	$ 150	$ 30	$ 15	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Bells - 3ø	0	0	0	$ 400	$ 80	$ 40	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Disc Switch - InLine	0	0	0	$ 1,000	$ 200	$ 100	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Disc Switch - UnderArm	0	0	0	$ 1,800	$ 360	$ 180	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Load Break Switch	1	0	0	$ 5,000	$ 1,000	$ 500	$ 5,000	$ -	$ -	25%	$ 6,250	$ -	$ -
15kV - OH Recloser	0	0	0	$ 30,000	$ 6,000	$ 3,000	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - OH Cap Bank	0	0	0	$ 17,000	$ 3,400	$ 1,700	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - OH Arrestors	0	0	0	$ 500	$ 100	$ 50	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - SCADA Controlled Recloser - 3Ø	0	0	0	$ 31,000	$ 6,200	$ 2,500	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - SCADA Switch - 3Ø	0	0	0	$ 26,000	$ 6,200	$ 2,500	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - SCADA Single Phase Reclosers	0	0	0	$ 21,000	$ 4,200	$ 2,000	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - TripSavers - 1Ø	0	0	0	$ 4,500	$ 850	$ 250	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - FuseSavers - 1Ø	0	0	0	$ 2,500	$ 450	$ 250	$ -	$ -	$ -	25%	$ -	$ -	$ -
Transformer - includes the Txf													
15kV - Single Phase OH Txf's	0	0	0	$ 1,200	$ 240	$ 120	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Three Phase OH Txf's	0	0	0	$ 3,700	$ 740	$ 370	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Single Phase SDB OH Txf's	0	0	0	$ 3,400	$ 680	$ 340	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Three Phase SDB OH Txf's	0	0	0	$ 20,000	$ 4,000	$ 2,000	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Three Phase SDB Txf's 2 pole structure	0	0	0	$ 32,000	$ 6,400	$ 3,200	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Single Phase URD Pad Txf's	0	0	0	$ 5,000	$ 1,000	$ 500	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Three Phase URD Pad Txf's	0	0	0	$ 12,000	$ 2,400	$ 1,200	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Single Phase Submrs	0	0	0	$ 6,000	$ 1,200	$ 600	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - 3 Single Phase Submrs	0	0	0	$ 18,000	$ 3,600	$ 1,800	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Three Phase Submrs	0	0	0	$ 35,000	$ 7,000	$ 3,500	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Polemounted Regulators - 1Ø	0	0	0	$ 15,000	$ 3,500	$ 1,500	$ -	$ -	$ -	25%	$ -	$ -	$ -
15kV - Platform Mounted Regulators - 1Ø	0	0	0	$ 28,000	$ 5,000	$ 2,000	$ -	$ -	$ -	25%	$ -	$ -	$ -
Misc Labor not accounted for in listed Activities													
Overhead Department Labor in Hours	0	0	0	$ 140	$ 140	$ 140	$ -	$ -	$ -	25%	$ -	$ -	$ -
Underground Department Labor in Hours	0	0	0	$ 140	$ 140	$ 140	$ -	$ -	$ -	25%	$ -	$ -	$ -
Trans/Station Department Labor in Hours	0	0	0	$ 140	$ 140	$ 140	$ -	$ -	$ -	25%	$ -	$ -	$ -
Test Department Labor in Hours	0	0	0	$ 140	$ 140	$ 140	$ -	$ -	$ -	25%	$ -	$ -	$ -
Subtotal							$ 11,000	$ -	$ -		$ 13,750	$ -	$ -
Project Engineering	Evaluation, Design and Support						$ 1,100	$ -	$ -	10%	$ 1,375	$ -	$ -
Project/Construction Manager	Support during all phases of the project						$ 550	$ -	$ -	5%	$ 688	$ -	$ -
Administrative Support	Support during all phases of the project						$ 550	$ -	$ -	5%	$ 688	$ -	$ -
Misc Overheads	Overheads during all phases of the project						$ 3,300	$ -	$ -	30%	$ 4,125	$ -	$ -
Allocations	Allocations assigned to the project as percentage						$ 550	$ -	$ -	5%	$ 688	$ -	$ -
Total							**$ 17,050**	**$ -**	**$ -**		**$ 21,313**	**$ -**	**$ -**
							CAP	**COR**	**O&M**		**CAP**	**COR**	**O&M**

Table 8. Planning Cost Estimate.

B. Metering Equipment Cost Estimates

12/19/2019

METERING EQUIPMENT COST ESTIMATE

SJD

Maine DOT Environmental Office (73 Whitten Road)

Monthly O&M Charge for Metering Equipment

Item	Type	Serial Numbers	Qty	Equipment Cost	Installation Cost	Installed Cost
Solid State Meter	EMR		1	5000.00	1200.00	6,200.00
12KV Current Transformer	CT		3	1,500.00	1,500.00	3,000.00
12kV Voltage Transformer	VT		3	3,000.00	1,500.00	4,500.00

Sub-Total Installed Equipment Cost	$13,700.00
General Expense @ 6%	822.00
Total Installed Cost	$14,522.00
Monthly Maintenance Charge @ 1.38% of Total Installed Cost	$200.40
Monthly Translation	$25.00
Total Monthly Meter Charges	$225.40

Note: The Interconnection Customer is responsible for providing a phone line for the metering equipment and is responsible for owning, maintaining, and paying all associated monthly costs for the metering phone line.

C. Circuits Map

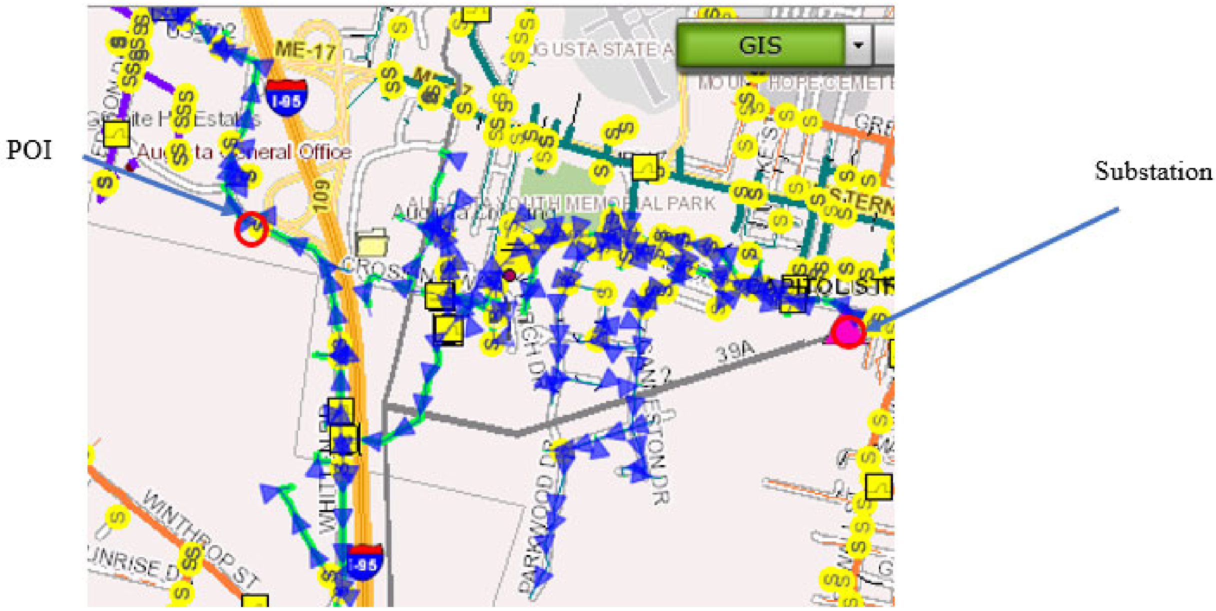

Figure 8. Circuit 215D2 in Smart-Map.

D. TCC Settings

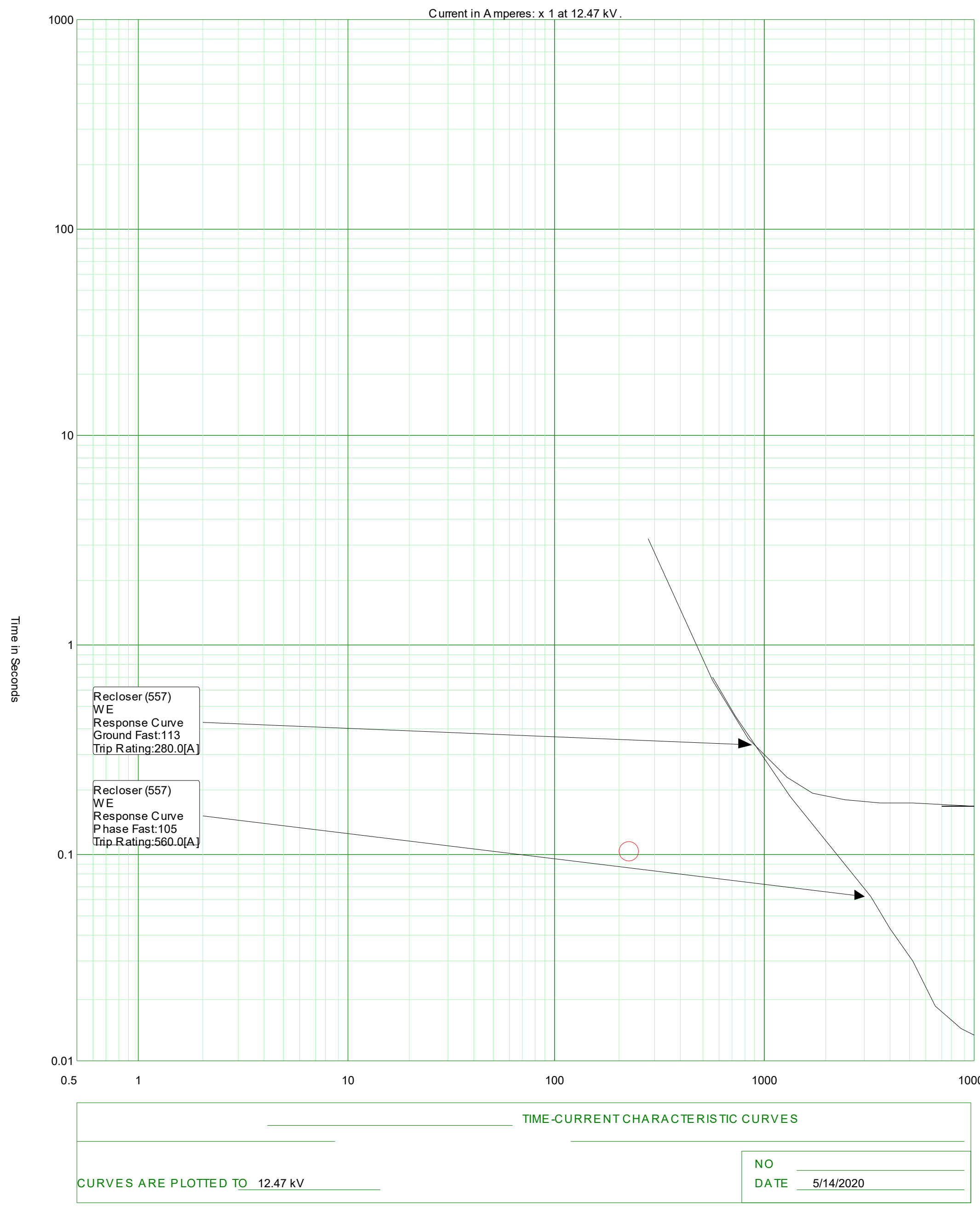

Figure 9. TCC for Substation Recloser.

E. Capitol Street One-Line Diagram

System Diagram e-Book Issue June 27, 2019

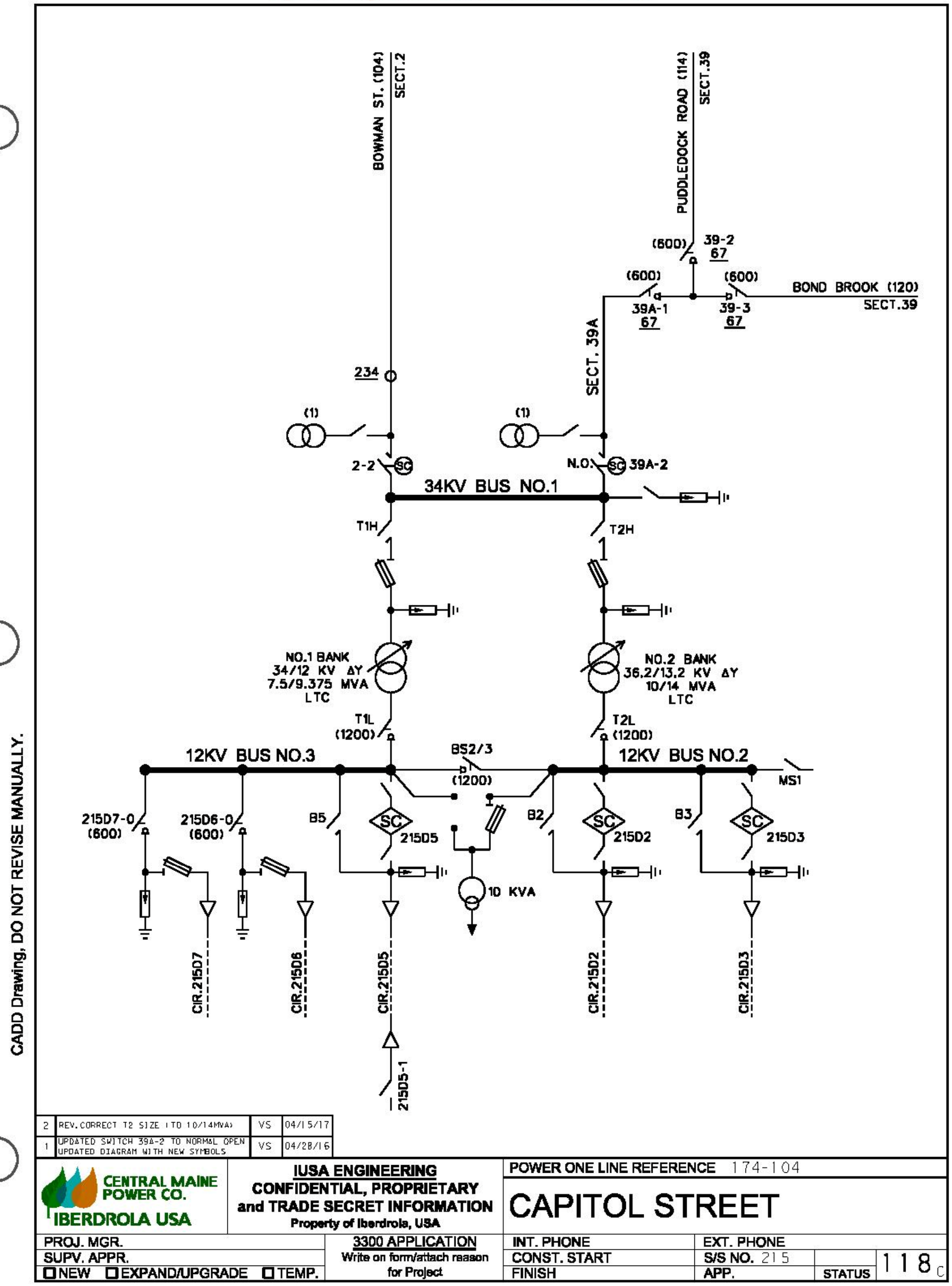

Figure 10. One Line Diagram of Capitol Street Substation.

F. Application

Forms and Agreements 4: Level 2, Level 3 and Level 4 Interconnection Application

A Customer-Generator applicant ("Applicant") hereby makes application to CMP (Utility or T & D Utility) to install and operate a generating facility interconnected with the CMP utility system. This application will be considered as an application for interconnection of generators under Expedited interconnection review provided the generator is not greater than 2 MW but shall serve as an Application for Standard interconnection review if greater than 2 MW or if Expedited review does not qualify the generator for interconnection.

Written applications should be submitted by mail, e-mail or fax to Central Maine Power Company (CMPCO), as follows:

[Utility]: Central Maine Power Company (CMPCO)
[Utility's address]: 83 Edison Drive, Augusta, ME 04336
Telephone Number: 207.621.4732
E-Mail Address: nathan.pelletier@cmpco.com.
[Utility] Contact Name: C/O Nick Pelletier
[*Utility*] Contact Title: ______

An application is a Complete Application when it provides all applicable information required below. (Additional information to evaluate a request for interconnection may be required and will be so requested from the Interconnection Applicant by Utility after the application is deemed complete).

Section 1. Applicant Information

Legal Name of Interconnecting Applicant (or, if an Individual, Individual's Name)
Name: MaineDOT Environmental Office– c/o David Gardner
Mailing Address: 24 Child Street
City: Augusta State: ME Zip Code: 04333

Facility Location (if different from above): 73 Whitten Rd Augusta Me. 04330

Telephone (Daytime): 1-207-592-2471
Telephone (Evening): 1-207-592-2471
Fax Number:
E-Mail Address: david.gardner@maine.gov

Not Applicable______ (Utility)	3001-2167-166 (Existing Account Number, if generator to be interconnected on the Customer side of a utility revenue meter)

Type of Interconnect Service Applied for ________ Network Resource, __________
(choose one)

Energy Only, X   Load Response (no export) ________   Net metering

Section 2. Generator Qualifications

Data apply only to the Small Generating Facility, not the Interconnection Facilities.
Energy Source: X Solar ___ Wind ___ Hydro ___ Hydro Type (e.g. Run-of-River):_____

Diesel ___ Natural Gas ___ Fuel Oil ___ Other (state type)__________________

Prime Mover: Fuel Cell ___   Recip. Engine ___   Gas Turb. ___   Steam Turb. ___
Microturbine ___   PV X   Other ___________

Type of Generator: Synchronous ____   Induction ____   Inverter X

Generator Nameplate Rating: 166 kW (30 Units)
Generator Nameplate kVA: 166 kVA (30 Units)

Interconnection Customer or Customer-Site Load: NONE kW (if none, so state)

Typical Reactive Load (if known): N/A
Maximum Physical Export Capability Requested 500 kW

List components of the Small Generating Facility Equipment Package that are currently certified:

	Equipment Type	Certifying Entity
1.	Solectria XGI 1500-125/125	UL 1741 SA
2.	Candian Solar Ku Max 395W	UL 1703
3.		
4.		
5.		

Is the prime mover compatible with the certified protective relay package?
Yes X   No ____

Generator (or solar collector):

Manufacturer, Model Name & Number: Solectria XGI 1500-125/125

Version Number: TBD
Nameplate Output Power Rating in kW:

G. Project Proposed One-Line Diagram

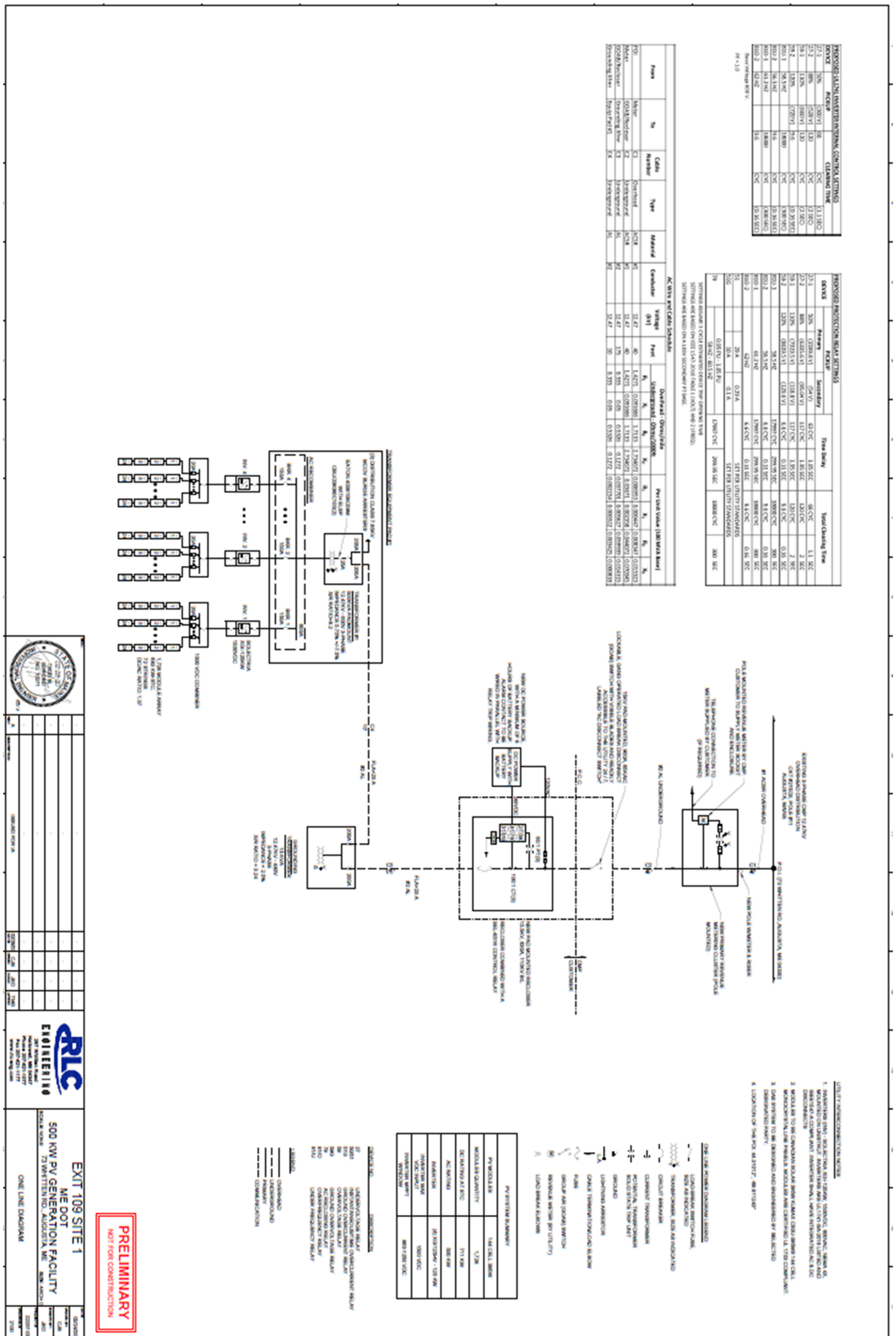

Figure 11. Proposed project One Line Diagram.