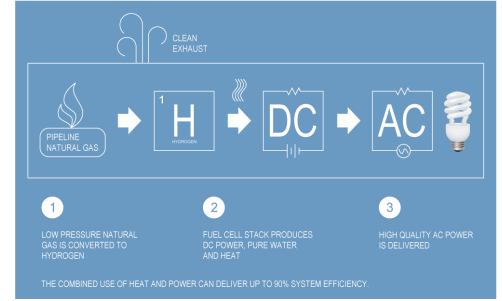


Exhibit C



Distribution Generation Interconnection Impact Study

Dynamic Energy Solutions LLC - Stag Industrial Holdings
40 Pepes Farm Rd, Milford, CT 06460

June 25, 2021

Prepared For:
The United Illuminating Company
180 Marsh Hill Road, Orange, CT 06477

Submitted By:
Hussain Biyawerwala

Investigators:

TABLE OF CONTENTS

THE UNITED ILLUMINATING COMPANY

1. EXECUTIVE SUMMARY	1
2. STUDY MODELS AND ASSUMPTIONS.....	4
3. INTERCONNECTION EVALUATION.....	5
3.1 VOLTAGE CHANGE ANALYSIS	6
3.2 VOLTAGE FLUCTUATION ANALYSIS.....	10
3.3 SYSTEM IMBALANCE IMPACTS	11
3.4 POTENTIAL FOR FERRORESONANCE.....	11
3.5 UNINTENTIONAL ISLANDING.....	12



1. EXECUTIVE SUMMARY

This distribution system impact study evaluates the effect of a proposed Distributed Generation (DG) interconnection, located at 40 Pepes Farm Rd, Milford, on the operation and performance of the electric distribution system. A system model was developed to simulate the DG interconnection under various operating conditions.

The results of the simulations have shown that this proposed DG interconnection of 1500 kW of PV solar generator system would result in minor adverse impacts on the Electric Distribution Company (EDC) distribution system as described below:

Analysis	Criteria	Results	Upgrades	Notes
Voltage	$95\% < V < 105\%$	PASS		Pre-existing under voltage during minimum load condition.
Voltage Change	$\Delta V < 1\%$ at PCC	PASS		
Load Flow	No Violation	PASS		No Reverse Power through substation transformer
System Imbalance	UI Criterion	PASS		
Ferroresonance	Wye-grounded at high side	PASS after upgrade	Utility owned Vista Switch	Developer proposes a secondary SEL 651R relay & 50, 50P relay at high side.
Risk of Islanding	Inverter anti-islanding feature	PASS after upgrade	Utility owned Vista Switch	Developer proposes a secondary SEL 651R relay & 50, 50P relay at high side.
Contingency Analysis	All criteria for voltage, voltage change, load flow and system imbalance	FAIL*		Voltage change at POI > 1.0 % (1.07%)

Table #1: Results Summary

* After further review of the 'Contingency Analysis' UI has determined that there will be minor or no adverse effect to the Distribution System.

INTRODUCTION AND SYSTEM DESCRIPTION

Dynamic Energy Solutions LLC has requested the interconnection of 1500 kW of PV distributed generation named Stag Industrial Holdings at 40 Pepes Farm Rd, Milford. The project has requested approval for the interconnection of 1500 kW of PV generation through one customer proposed transformer (1) 2000 kVA 13.8kV/0.48kV, Wye Grounded/Wye Grounded interconnection transformer with an impedance of 5.75%.

The proposed DG is to be interconnected to The United Illuminating Co. (UI) distribution system through the Woodmont Substation Feeder #3660. Feeder #3660 will be the normal supply while Woodmont Substation Feeder #3650 will be the backup supply to the DG site load during peak and minimum loading conditions.

Figure #1 shows the one-line diagram of the proposed system design and the proposed connection to the interconnecting feeder for the 1500 kW PV generation. Figure #2 shows the overall developed CYMDIST system model for the proposal.

The purpose of this study is to evaluate the proposed DG interconnection and its impact on the UI distribution system. The following items have been identified as the main concerns for the DG interconnection to the UI system:

- a) Voltage Change Analysis - evaluation of the steady-state and change in distribution voltage levels at the substation bus associated with interconnection and separation of the generating facility. This will investigate the voltage change at both peak and minimum substation bus loading periods.
- b) Voltage Fluctuation Analysis - control settings on existing automatic regulation devices will be examined to determine if the proposed generation will adversely impact the regulating equipment controls or the regulating equipment's duty.
- c) System Imbalance Impacts - evaluation of potential for excessive bus imbalance associated with the generating facility when interconnected.
- d) Potential for ferroresonance - the potential for the occurrence of ferroresonance upon switching at the service entrance will be investigated.
- e) Unintentional Islanding – potential for an unintentional islanding condition in which the generator continues to supply power to a location even though electrical grid power from the local Electric Power System (EPS) is no longer present.

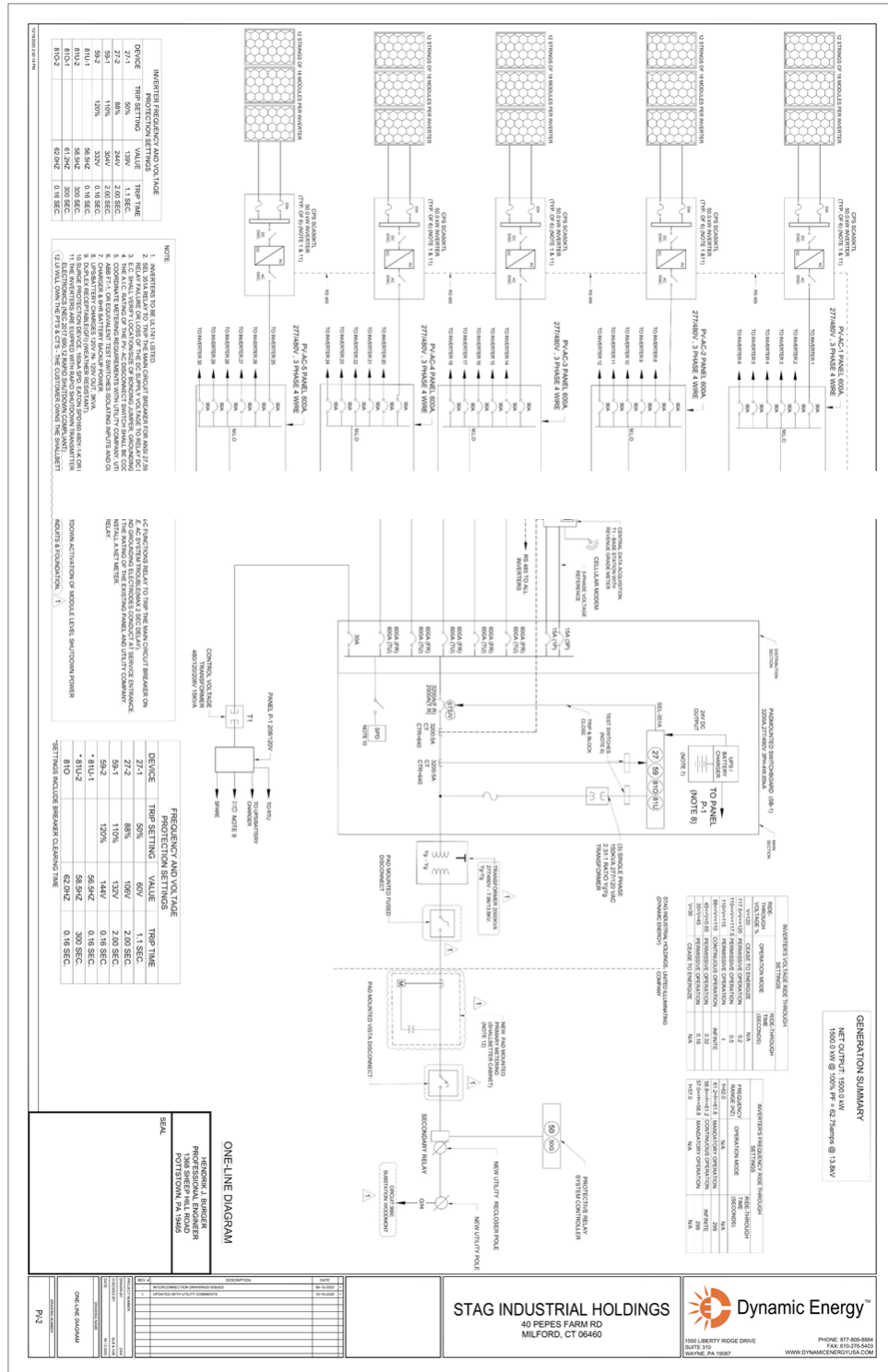


Figure #1. One-line Diagram of Proposed 1500 kW DG Interconnections.



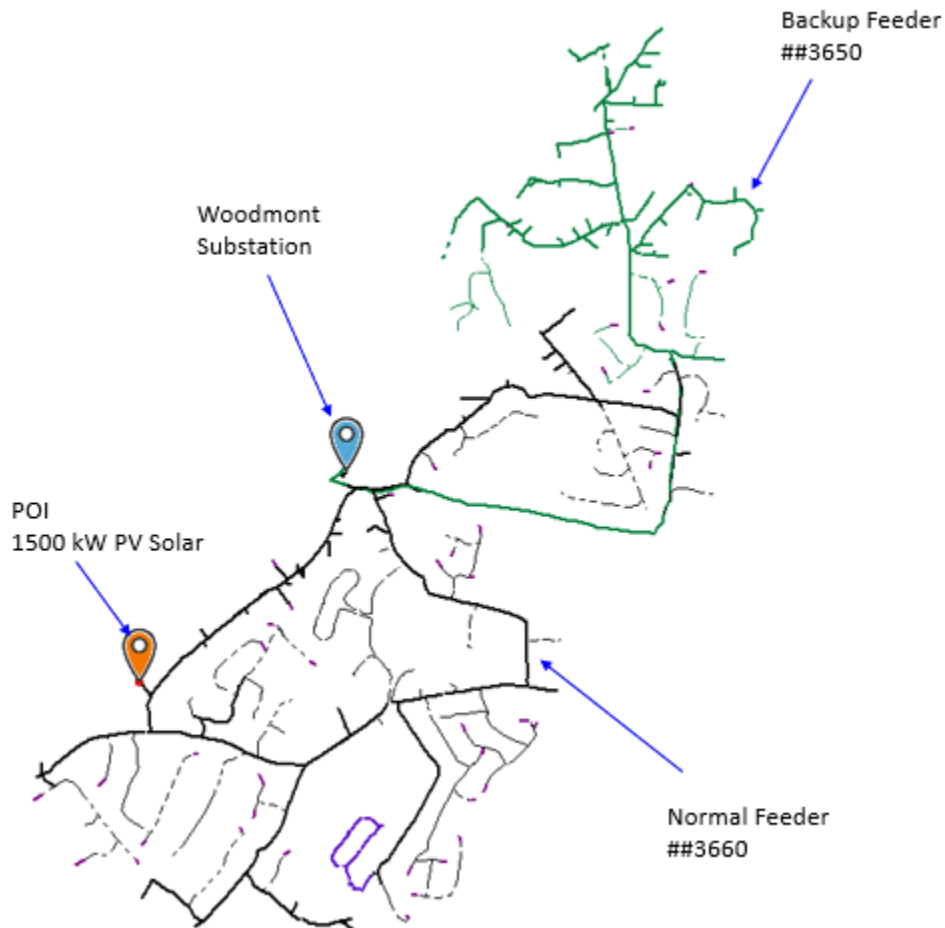


Figure #2: The CYMDIST Model Detail of the Stag Industrial Holdings at 40 Pepes Farm Rd, Milford, Customer's 1500 kW DG

2. STUDY MODELS AND ASSUMPTIONS

As Figure #2 shows, a system model has been developed in the CYMDIST power system simulation software. This model represents the PV generator, the interconnection transformer, and the interconnecting distribution feeder. Below is a list of assumptions made as part of the modeling and analysis:

- The proposed DG Interconnection Request received on 06/16/2020 and as depicted on the drawing by Dynamic Energy for Dynamic Energy Solutions, LLC. The Revised IA Drawings dated 10/16/2020 will be used in the study.

- The system model considered both peak and minimum load conditions on the normal and backup supply feeder, using July 2020 and April 2020 load information respectively, for the area customers and total demand of the feeders.
- All other customers' existing parallel generators and all generation on the feeders proposed prior to Dynamic Energy Solutions LLC (generation in the "queue" before Dynamic Energy Solutions LLC) are assumed to be in service.
- The proposed DG unit will be connected to the UI 13.8 kV distribution system through customer proposed one (1) 2000 kVA 13.8 kV/0.48 kV, Wye Grounded/Wye Grounded interconnection transformer with an impedance of 5.75% and X/R ratio of 2.22. The transformer is assumed to be solidly grounded. The transformer is utility-grade and has a Basic Insulation Level (BIL) of 95 kV.
- There is no emergency generation that will contribute to the site generation when the proposed DG is not interconnected.
- Loads are modeled as constant power type.
- The voltage at the source node of the feeders is operated at 1.03 per unit average (14.2 kV) during peak load periods.
- The voltage at the source node of the feeders is operated at 1.00 per unit average (13.8 kV) during minimum load periods.
- The generating facility will be connected to the UI 13.8 kV distribution system near Pole 6317, 40 Pepes Farm Rd on the feeder #3660, Woodmont Substation.

3. INTERCONNECTION EVALUATION

The system models described above have been used to complete the required analyses and simulations under different operating conditions. The sections below investigate the identified DG interconnection screens per the results of the conducted simulations. As was described in Section 2, the feeder steady-state voltage and voltage change study items that follow were performed considering these individual scenarios:

Scenario A:

1. 1500 kW PV interconnected to the normal supply Feeder #3660 during peak load conditions and all available generation on-line at that time.
2. 1500 kW PV interconnected to the backup supply Feeder #3650, feeding all the normal supply Feeder #3660 during peak load conditions and all available generation on-line at that time.



Scenario B:

1. 1500 kW PV interconnected to the normal supply Feeder #3660 during minimum load conditions and all available generation on-line at that time.
2. 1500 kW PV interconnected to the backup supply Feeder #3650, feeding all the normal supply Feeder #3660 during minimum load conditions and all available generation on-line at that time.

3.1 VOLTAGE CHANGE ANALYSIS

Voltage regulation is often a key issue when interconnecting DG to the utility system. One of the most significant limiting factors is how much the voltage changes when all DG is suddenly disconnected. These voltage changes may impact the safety, power quality, and reliability of supply to other customers which are served by the same feeder that the proposed DG will be interconnected to.

For these reasons it is recommended that for renewable generation such as photovoltaic generation, voltage changes of more than 1% will trigger closer scrutiny. Standard utility voltage regulating equipment, including substation transformer load tap changers (LTC) and pole type voltage regulators may not be able to compensate for larger changes in voltage in a timely manner.

Assuming that the generator will be operated in a constant power factor mode with a power factor of unity, this analysis simulates a sudden disconnection/loss of the 1500 kW PV generation, plus all other same type generation, and calculates the resulting voltage drop at the interconnecting DG PCC location on the feeder. The voltage changes are analyzed at the distribution feeder source, located at Woodmont Substation, at peak and minimum load periods, with maximum available generation.

Steady State Voltage – Peak Load: Figure #3 shows the voltage drop profile of Feeder #3660 under normal operating conditions before and after the proposed 1500 kW (at full output) generator interconnects with the electric system. Table #2 below shows the voltage levels (on a 120.0 Volt base) up to the POI at near Pole 6317 located within the ROW before and after the interconnection of the proposed 1500 kW PV generator. The voltage levels after the interconnection of the proposed 1500 kW PV generator are within acceptable levels.



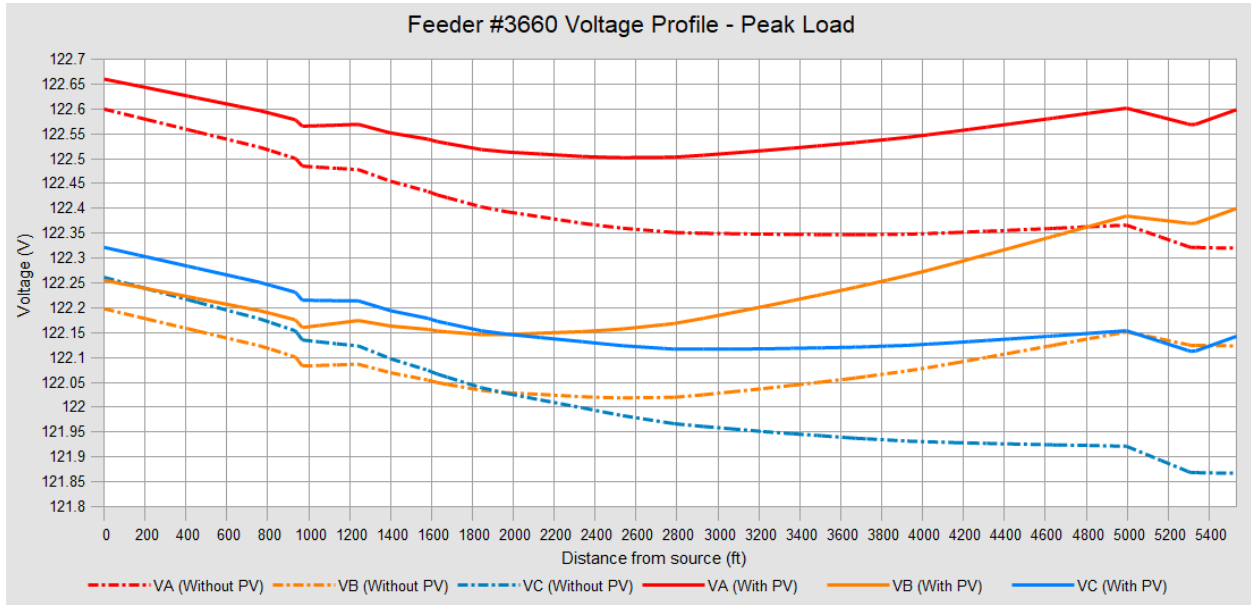


Figure #3: The Voltage Profile of Feeder #3660 from Woodmont Substation to the Customer POI near Pole 6317 at Peak Load Periods Before (dashed line) and After (solid line) with Full 1500 kW Generation (Scenario A) (120.0 Volt Base)

Phase Designation	Before DG (V)	After DG (V)	Delta (V) @ POI
A	122.32	122.60	0.28
B	122.12	122.40	0.28
C	121.87	122.14	0.27

Table #2: The Voltage Levels Before and After on Customer POI Near Pole 6317 at Peak Load Periods Before and After with Full 1500 kW Generation (Scenario A) (120.0 Volt Base)

Steady State Voltage – Minimum Load: Figure #4 shows the voltage drop profile of Feeder #3660 under normal operating conditions before and after the proposed 1500 kW (at full output) generator interconnects with the electric system. Table #3 below shows the voltage levels (on a 120.0 Volt base) up to the POI at Pole 6317 located within the ROW before and after the interconnection of the proposed 1500 kW PV generator. The voltage levels after the interconnection of the proposed 1500 kW PV generator are within acceptable levels.



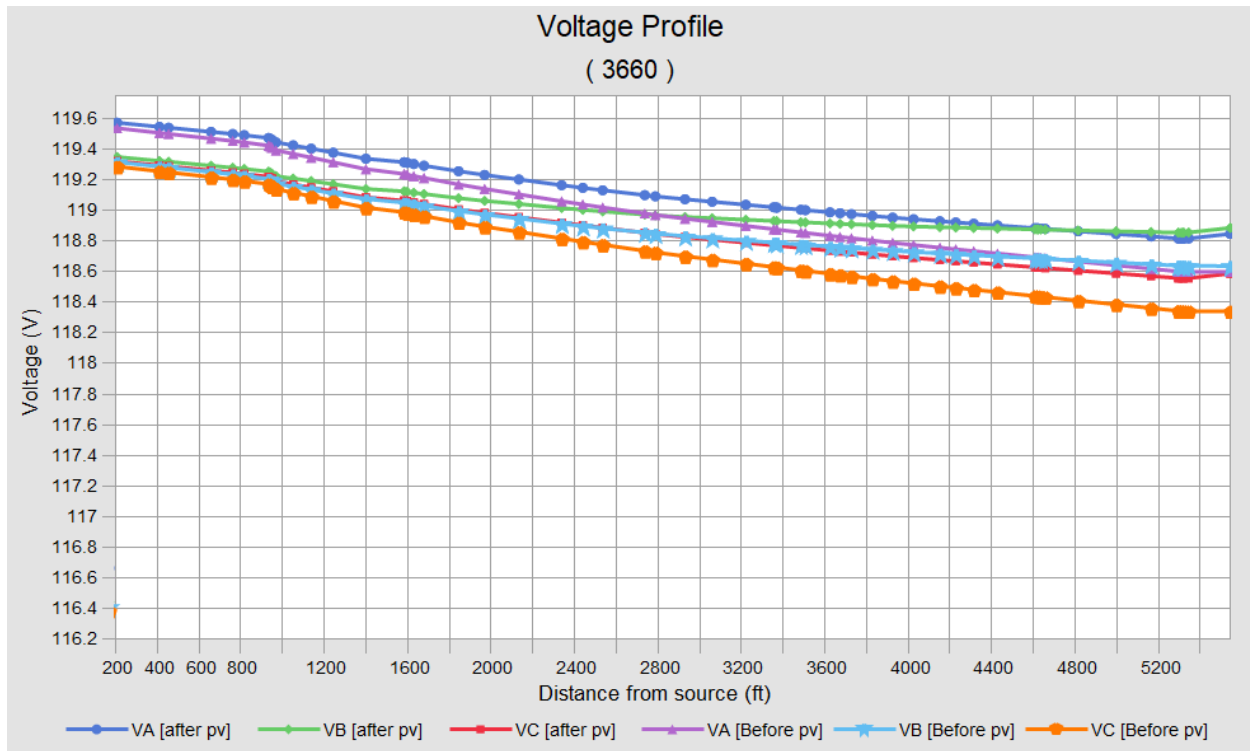


Figure #4: The Voltage Profile of Feeder #3660 from Woodmont Substation to the POI near Pole 6317 at Minimum Load Periods with Before (dashed line) and After (solid line) with Maximum Available Generation (Scenario B) (120 V Base)

Phase Designation	Before DG (V)	After DG (V)	Delta (V) @ POI
A	118.6	118.8	0.2
B	118.7	118.9	0.2
C	118.4	118.6	0.2

Table #3: The Voltage Levels Before and After on Customer POI near Pole 6317 at Minimum Load Period before and after with Full 1500 kW Generation (Scenario B) (120.0 Volt Base)

The worst-case scenario, maximum project output under minimum load conditions, reverse power flow through the Feeder #3660 is not observed.

Voltage Change – Scenario A (1500 kW DG, Peak Load): Table #4 shows the average voltage change measured at the customer’s riser near Pole 6317 (POI) due to the sudden loss of the 1500 kW PV when interconnected to Feeder #3660. The voltage changes are 0.16%, 0.16% and 0.16% on Phase A, B and C, respectively. This voltage change is less than the 1% change threshold value that would be of concern.



		PEAK		
		VA	VB	VC
@ POI (100% drop)	V1	122.60	122.40	122.14
	V2	122.32	122.12	121.87
	Diff.	0.23%	0.23%	0.22%

Table #4: The Voltage Change on the Normal Feeder #3660 at Customer POI near Pole 6317 upon Sudden Loss of the 1500 kW PV Generator at Peak Load Periods (Scenario A) using Static Method of Voltage Change.

There is an insignificant voltage change at Woodmont Substation Bus #2 (Bus having the Normal Feeder #3660) for a sudden loss of the generating facility.

In the event of a contingency on Feeder #3660 at peak load periods the DG site load of the Feeder will be transferred to Woodmont Substation Feeder #3650, which is the backup to this area.

		PEAK		
		VA	VB	VC
@ POI (100% drop)	V1	116.99	116.85	115.61
	V2	115.71	115.64	114.36
	Diff.	1.07%	1.01%	1.04%

Table #5: The Voltage Change on the Backup Feeder #3650 at Customer POI Pole 6317 upon Sudden Loss of the 1500 kW PV Generator at Peak Load Periods (Scenario A) using Static Method of Voltage Change.

Table #5 shows the average voltage change measured at the customer's POI Pole 6317 due to the sudden loss of the 1500 kW PV generator when Feeder #3650 backs up Feeder #3660. The voltage changes are 1.07%, 1.01% and 1.04% on Phase A, B and C, respectively, which is more than the 1% voltage change threshold value that would be of concern. *After further review, the proposed project would have minor or no adverse effect on the Distribution System during the contingency conditions when Feeder #3650 picks up the full load from Feeder #3660. Note, it is unlikely Feeder #3650 would be required to support the entire load from feeder #3660; this load would generally be shared between several circuits if the need arises.*

Voltage Change – Scenario B (1500 kW DG, Minimum Load): Table #6 shows the average voltage change measured at the customer's POI Pole 6317 due to the sudden loss of the 1500 kW PV generator when interconnected to Feeder #3660. The voltage changes are 0.22%, 0.21% and

0.21% on Phase A, B and C, respectively. This voltage change is less than the 1% change threshold value that would be of concern.

		MINIMUM		
		VA	VB	VC
@ POI (100% drop)	V1	118.8	118.9	118.6
	V2	118.6	118.6	118.3
	Diff.	-0.17%	-0.25%	-0.25%

Table #6: The Voltage Change on the Normal Feeder #3660 at Customer POI Pole #3660 upon Sudden Loss of the 1500 kW PV Generator at Minimum Load Periods (Scenario B) using Static Method of Voltage Change.

There is an insignificant voltage change at Woodmont Substation Bus #2 (Bus having the Normal Feeder #3660) for a sudden loss of the PV generator.

3.2 VOLTAGE FLUCTUATION ANALYSIS

The distribution system will experience a change in the primary voltage as a result of the connection or sudden loss of the proposed 1500 kW PV at peak load (Scenario A) or at minimum load (Scenario B). The voltage fluctuation analysis investigated the extent that this voltage change would affect the distribution system voltage regulating equipment, including the voltage change at Woodmont Substation. The control settings of this equipment were examined to determine if the proposed generation will adversely impact the equipment’s settings or its service duty.

For the normal operating case with Feeder #3660 supplying the customer, there is minimal voltage change at the Woodmont Substation Bus for the loss of the 1500 kW PV generation at peak load (Scenario A) or minimum load (Scenario B). Since the voltage change measured at the substation is minimal, it will not affect the load tap changers on the substation transformers because the voltage change is less than the 1 V bandwidth of change needed for the tap changer controls to initiate movement.

The typical maximum number of fluctuations of PV output due to variations in cloud cover based on industry available data is approximately 2.5 fluctuations per minute from maximum to minimum output. The greatest voltage change that can be expected was determined to be 0.23% on POI during peak load. Therefore, the result of the voltage fluctuation analysis is that a voltage flicker of no more than 0.23% may occur no more than three times per minute, and this would be below the industry accepted threshold of irritation.



3.3 *SYSTEM IMBALANCE IMPACTS*

The UI 13.8 kV distribution system is normally imbalanced like nearly all U.S. utility distribution systems. The available load data suggests that the main feeder (Feeder #3660) total demand is fairly balanced with imbalance of approximately 3.63 % at peak and 1.30 % at minimum load conditions. Upon the proposed project interconnection, the imbalance is increased to 4.70 % at peak and decreased to 0.95% at minimum load conditions. The proposed configuration of the 1500 kW PV generator with the existing utility 2000 kVA 13.8 kV/0.48 kV, Wye Grounded/Wye Grounded interconnection transformer need to be able to handle any zero-sequence currents absorbed from this unbalance. The DG will share the system zero sequence load current with the substation transformers. In all cases the imbalance is within the EDC's operating tolerance. The proposed generation configuration operating at unity power factor is not expected to adversely impact any existing customer load imbalance but will slightly worsen it.

3.4 *POTENTIAL FOR FERRORESONANCE*

Ferroresonance refers to a special kind of resonance that involves system capacitance and the iron-core inductance of a transformer. Typically, the system capacitance of concern is the 15kV underground (UG) service entrance cable capacitance since it is most likely to be isolated with the transformer.

Ferroresonance generally occurs during a system imbalance, usually during switching, or when there is an open-phase condition with the conductor supplying the transformer. This unbalanced condition places capacitance in series with transformer magnetizing impedance. This can result in high over-voltages that may lead to failures in transformers, cables, arresters, and customer equipment.

The transformer's primary connection is a critical parameter in the analysis of ferroresonance. Certain transformer winding connections are highly susceptible to ferroresonance and some winding connections are less susceptible to ferroresonance. Transformers that are delta connected on the primary side (13.8 kV) are more susceptible to ferroresonance than those connected grounded wye. Also, there is a greater chance of ferroresonance when the transformer is lightly loaded, which will be the case due to a DG feeding into the distribution system when the customer's load falls below that of the DG's output.

Over-voltages greater than 1.25 p.u. can damage equipment during an open-phase condition. Analysis indicates that a primary UG cable run from the switching device to the transformer that has a high capacitance in combination with a lightly loaded transformer can lead to a ferroresonance susceptible condition.

The utility owned existing one 2000 kVA 13.8 kV/0.48 kV, Wye Grounded/Wye Grounded interconnection transformers will be less susceptible to a ferroresonant condition for any length



of cable due to the grounded primary of the transformer. The developer has secondary SEL 351R relay protection, also a 50, 50G relay at high side to eliminate the concerns. However, it is required to have a Utility owned PCC recloser with SEL 651R.

3.5 UNINTENTIONAL ISLANDING

The generator must adhere to IEEE Standard 1547 that mandates a DG must detect an unintentional islanding condition and cease to energize the Electric Power System (EPS) within two seconds of the occurrence. An islanding condition results whenever the DG continues to power a location even though electrical grid power from the local EPS is no longer present. This would occur if the feeder breaker were opened for any reason other than for a fault on the feeder, or if any other manual switching device in the feeder main line to the DG is opened. It should be noted that there may be interaction with other generators on the feeder.

The issues that arise from islanding depend on the DG system configuration like transformer connections and type of generation. In the case of the Stag Industrial Holdings (40 Pepes Farm Rd, Milford) PV project, the anti-islanding protection schemes in the inverters are expected to halt export of power when the potential for an islanding condition is detected.

