OWEN Electric

A Touchstone Energy® Cooperative

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OCT 5 2015

PUBLIC SERVICE COMMISSION

October 1, 2015

Mr. Jeffrey Derouen
Executive Director
Kentucky Public Service Commission
211 Sower Boulevard
P.O. Box 615
Frankfort, Kentucky 40602-0615

Re: Case No. 2015-00213

Dear Mr. Derouen:

Please find enclosed for filing with the Commission in the above-referenced case, and original and ten copies of the update to response 3 of Owen Electric Cooperative, Inc. ("Owen Electric") to the Attorney General's Supplemental Request for Information, dated August 19, 2015.

Very truly yours,

Ann F Wood

Ann F. Wood
Senior Vice President of Corporate Services

Enclosures

CC: Hon. Jennifer Hans
Hon. Mike Kurtz

OWEN ELECTRIC COOPERATIVE, INC.

PSC CASE NO. 2015-00213

CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY

RESPONSE TO INFORMATION REQUEST

ATTORNEY GENERAL'S SUPPLEMENTAL REQUEST FOR INFORMATION TO OWEN ELECTRIC COOPERATIVE, INC. DATED 8/19/2015

REQUEST 3

RESPONSIBLE PARTY: Mark A. Stallons

Request 3: Please reference the Company's response to AG 1-7. Provide a copy of the system impact study and the coordination study when completed.

Response 3: The system impact study was filed with the Commission on September 10, 2015. The coordination study (System Protection Study) is provided on pages 2 through 11 of this updated response.

Owen Electric Cooperative

System Protection Study for Bromley DG

September 2015

Prepared by:

Distribution System Solutions, Inc.

Walton, Kentucky

System Protection Study for Bromley DG Project

Introduction

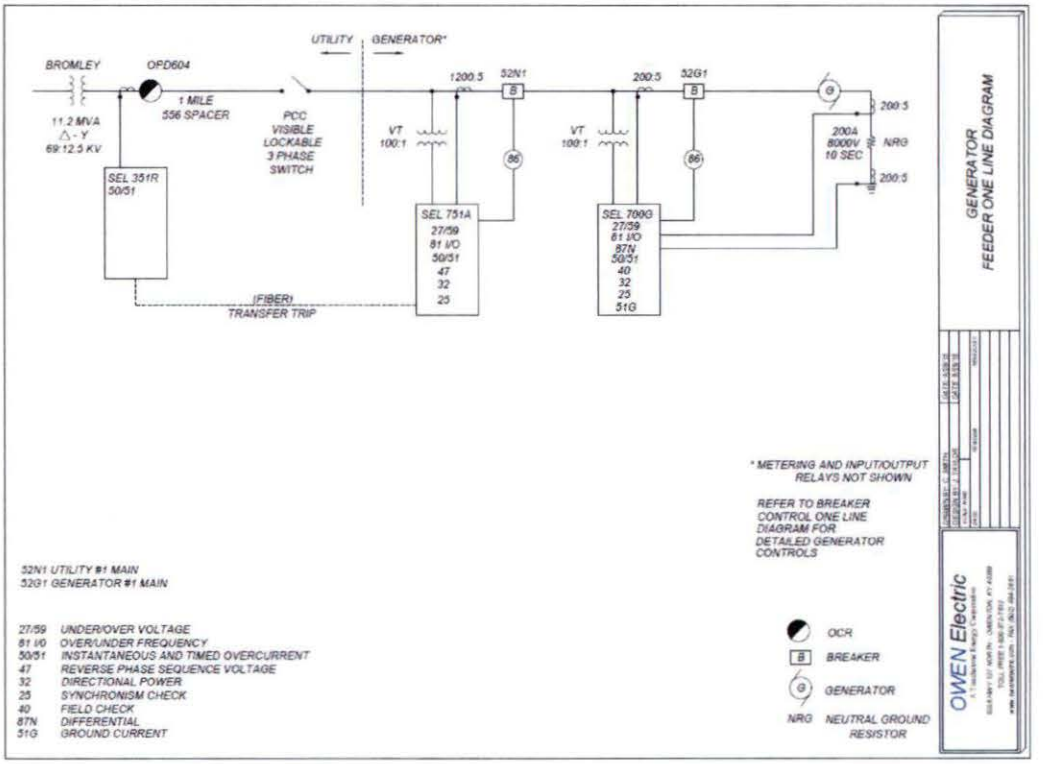
In 2016, Owen Electric Cooperative, Inc. (OEC) will interconnect a 1,988 kW natural gas-fired, synchronous generator set (distributed generator DG) with a newly-constructed, 12.47/7.2 kV distribution feeder (604). This three-phase feeder will originate at the East Kentucky Power Cooperative (EKPC) Bromley Distribution Substation (See Exhibit 1). The feeder will be a dedicated express (Direct Substation Interconnection), one mile long and will be comprised of three 556.5 MCM aerial cables (See Exhibit 2). While the dedicated feeder, with only one mile of exposure, will greatly reduce the incidence of temporary and permanent faults, this interconnected system must be designed and constructed to safely respond to any possible fault situation.

Analyses

1. **Protective Device Coordination-** Overcurrent Protective Device (OPD604) will be located at the distribution bus of the Bromley Substation. The new express feeder will be served through this device. OP604 must clear short-circuit fault current to protect the system on both its source and load sides. The device must operate to clear a fault before the Bromley 69 kV substation protection fuse begins to melt. The time-current curves for the 69 kV substation protection fuse and OPD604 and the fuse minimum melting calculation table are shown in Exhibit 3. It must also clear before the fault current on the distribution feeder can cause a safety hazard or equipment damage. The coordination of these devices is critical to a safe, reliable DG interconnection with the 12.5/7.2 kV distribution system.

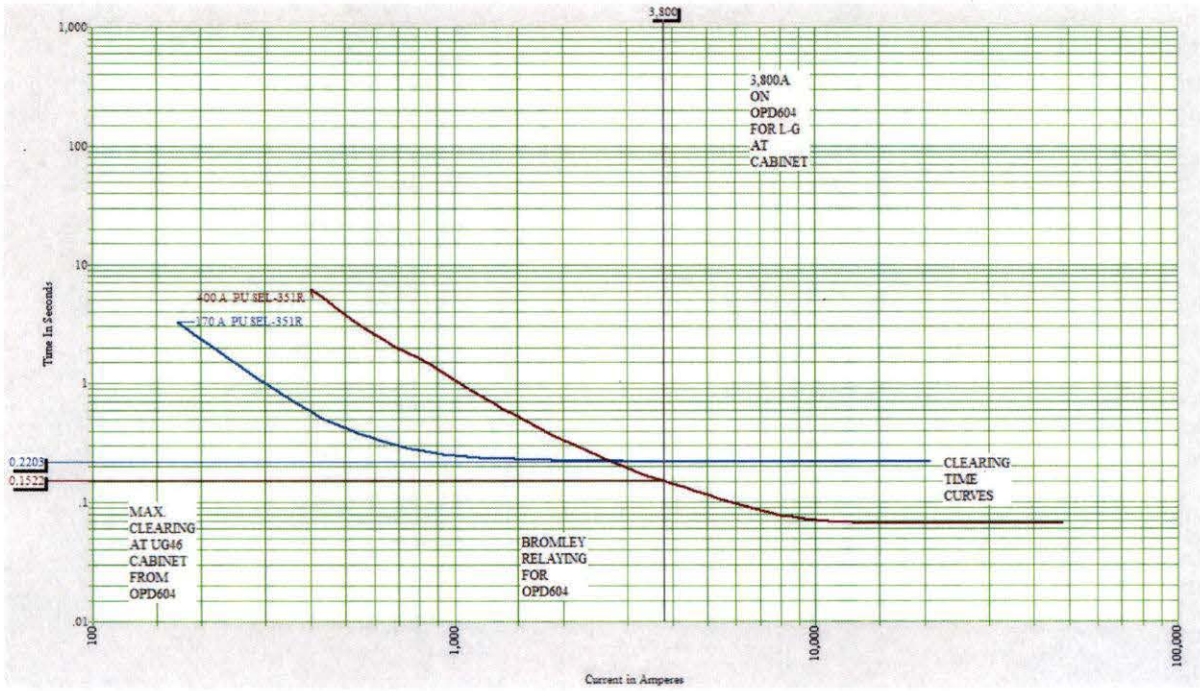
2. **Fault Current Impact-** A short-circuit analysis was performed to determine the additional fault current contribution from the DG. Under a fault condition, the impact on the adjacent feeders from increased fault current produced by the DG, is negligible. The system was modeled, and fault currents calculated in Windmil© by Milsoft. The maximum increase to fault current from the DG on the substation bus is an additional 550A on a three phase fault and an additional 935A on a L-G fault. The maximum L-G fault current at the substation transformer secondary is 6,764A. The maximum anticipated fault current on the dedicated DG feeder will be 6,614A on a L-G fault at the feeder recloser before the generator is taken offline (See Exhibits 4.1 & 4.2). The maximum available fault current from the DG contribution falls well below the fault interrupting ratings of all applicable distribution overcurrent protection equipment. The DG breakers are Eaton VCP-W with a 25 kA fault rating and a 1,200 A load rating.

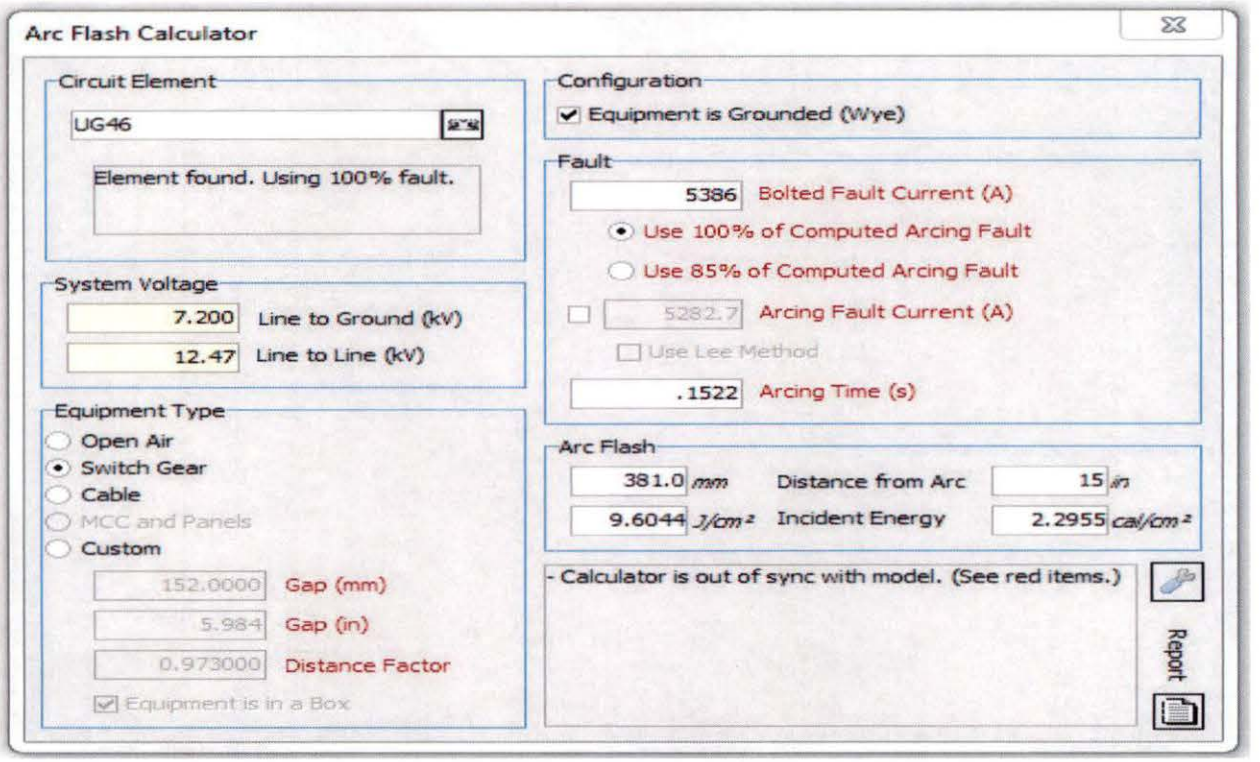
3. **Protective Relaying and Transfer Trip-** The IEEE Standard 1547 requires that a DG with rated output over 30 kW be equipped with several adjustable features that will eliminate the possibility of it operating while the electrical distribution system is deenergized (islanding). This ensures that the DG will not be online to independently serve load. The DG's protection system must drop offline within 2 seconds during an islanding situation. The protection relays will permit the system to operate within IEEE 1547 and will comply with EKPC's *Technical and Functional Requirements for Interconnecting Distributed Generation with the EKPC Electrical Distribution System.* Voltage; Frequency; Harmonic Distortion; Power Factor; Load Flow and several other critical values will be constantly monitored. The DG will cease to operate if any required parameters are not met. While the numerous protection relays listed in the lower left corner of the Generator Feeder One Line Diagram will protect the DG from distribution system disturbances and internal disturbances, a Transfer Trip System will also be installed. The EKPC SEL 351R, which controls OPD604, is located in the substation and will communicate directly with the DG's SEL 751A. An existing fiber optic link will provide the communication path. This transfer trip, along with the various relaying options at the DG, will provide a highly reliable means of protecting Bromley Substation, the distribution feeder and the generator itself, from damages due to any of the reasonably anticipated system disturbance scenarios. Much like OPD604, the EKPC transmission system is protected by instantaneous and time delay reclosing. The DG shall disconnect from the utility prior to reclosure of any utility breaker.



The entire system will be monitored and critical functions controlled from the OEC Control Center. OEC's Supervisory Control and Data Acquisition (SCADA) system presently communicates with Bromley Substation and will be equipped to monitor and control the DG.

4. **Arc Flash Impact-** Rule 410A3 of the 2012 National Electrical Safety Code requires that an assessment be performed to determine potential exposure to an electrical arc for employees who work on or near energized lines, parts or equipment. Such an assessment has been performed at OEC. The electrical supply workers are equipped with clothing that has an effective arc rating not less than the anticipated level of arc energy. However, with the addition of the DG as a second source, fault current levels will have changed. An arc hazard analysis for the impacted area of the interconnected distribution system has shown that the increased level of fault currents do not raise arc flash levels past those encountered at other areas of the OEC distribution system. The present clothing systems will provide the required protection levels. Relay clearing curves and the arc flash calculation for a switch cabinet UG46 are shown below. The incident energy for this event is less than 2.3 cal/cm^2.





5. **Operating Sequence-** OEC will install and maintain a lockable, visible-break isolation device near the termination point of the dedicated feeder. This switch will provide a convenient isolation point near the DG. A detailed operating sequence will be developed for use by the OEC system operators as well as OEC and EKPC field personnel.

   At start-up, the DG will attain its operating speed. The DG controls will synchronize with the utility system and the DG will switch to parallel operation with the distribution system. If the DG goes offline due to a system fault, maintenance, or for any other cause, the system will not be restarted until the fault has been cleared or until maintenance is completed. OEC operations personnel are only permitted to work between two visible, grounded open points. This will be possible on every segment of the paralleled system.
   Restarts will commence no sooner than 5 minutes after the utility steady-state voltage and frequency has been restored.

6. **Commissioning Test-** Prior to the DG interconnecting and beginning operation, OEC and EKPC will perform functional tests of all applicable protective equipment. Once the testing confirms that all protection settings have been correctly applied, the DG will interconnect and operate in parallel with the OEC distribution system.

Conclusion

The recommendations and procedures listed in this report will allow the proposed DG unit to safely and effectively interconnect and operate in parallel with the OEC distribution system.

Bromley
69KV/12.5KV

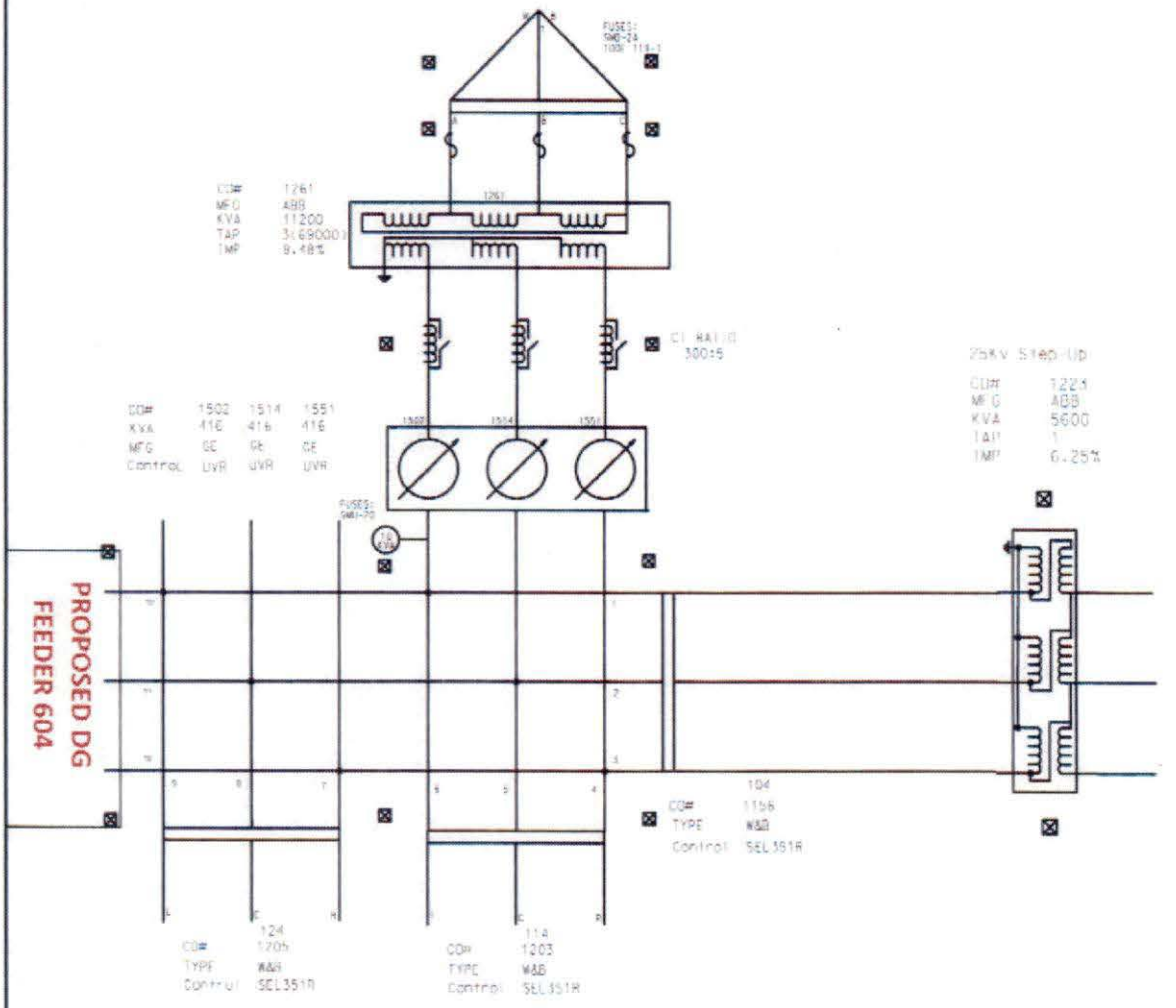


Exhibit 1

LATEST REVISION	
DATE	REV'D BY
7/27/2006	CB

MEMBER SYSTEM	EAST KENTUCKY POWER COOPERATIVE	DRAWN	4/6/2006
OWEN CO.	WINCHESTER, KENTUCKY 40392	CHECKED	
		APPROVED	
		DRAWING NO.	55- N45

PROPOSED DG FEEDER TO BROMLEY SUBSTATION

Existing 25kV 3PH OH Circuit

Feeder 06-01

Termination of Proposed OH Circuit 0604

Stewart Ln

Stewart Ridge Rd

Feeder

KU

US Hwy 127

Proposed 3PH 12.5kV OH 556.5 MCM Aerial Cable Feeder 0604 (Approx. 5680' Along Existing Structures)

EAST KY

Bromley Substation (EKPC N-45)

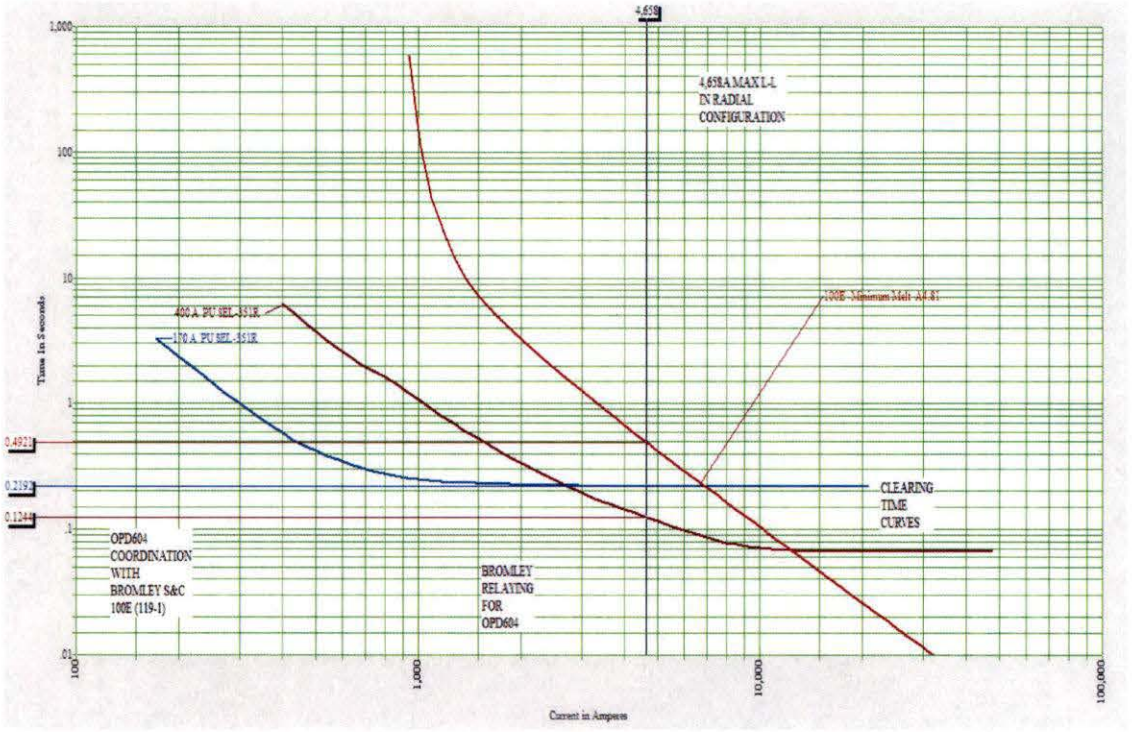
BROMLEY

Feeder 06-02

Feeder 06-03

KU

EXHIBIT 2



High Side S&C SMD 1A or SMD 2B Fuse/Substation Feeder Recloser Coordination Worksheet

Owen Electric

Bromley

OPD604	100% Load		1F1D 2OTL			
SMD	1A		Max -LL	4558		
Speed	119		MM Time	0.49		
Amps	100E					
Pre-Load	P	0.26	Reclose			
1st Cool	C1	0.68	3		Tlock 1	0.17
2nd Cool	C2	0.00	N/A		Tlock 2	0.25
3rd Cool	C3	0.00	N/A		Tlock 3	0.00
1st Clear	TR1	0.12			Tlock 4	0.00
2nd Clear	TR2	0.12				
3rd Clear	TR3	0.00				
4th Clear	TR4	0.00				

Tlock 2 < MM Time
.25 sec .49 sec
Coordination is achieved.

Exhibit 3

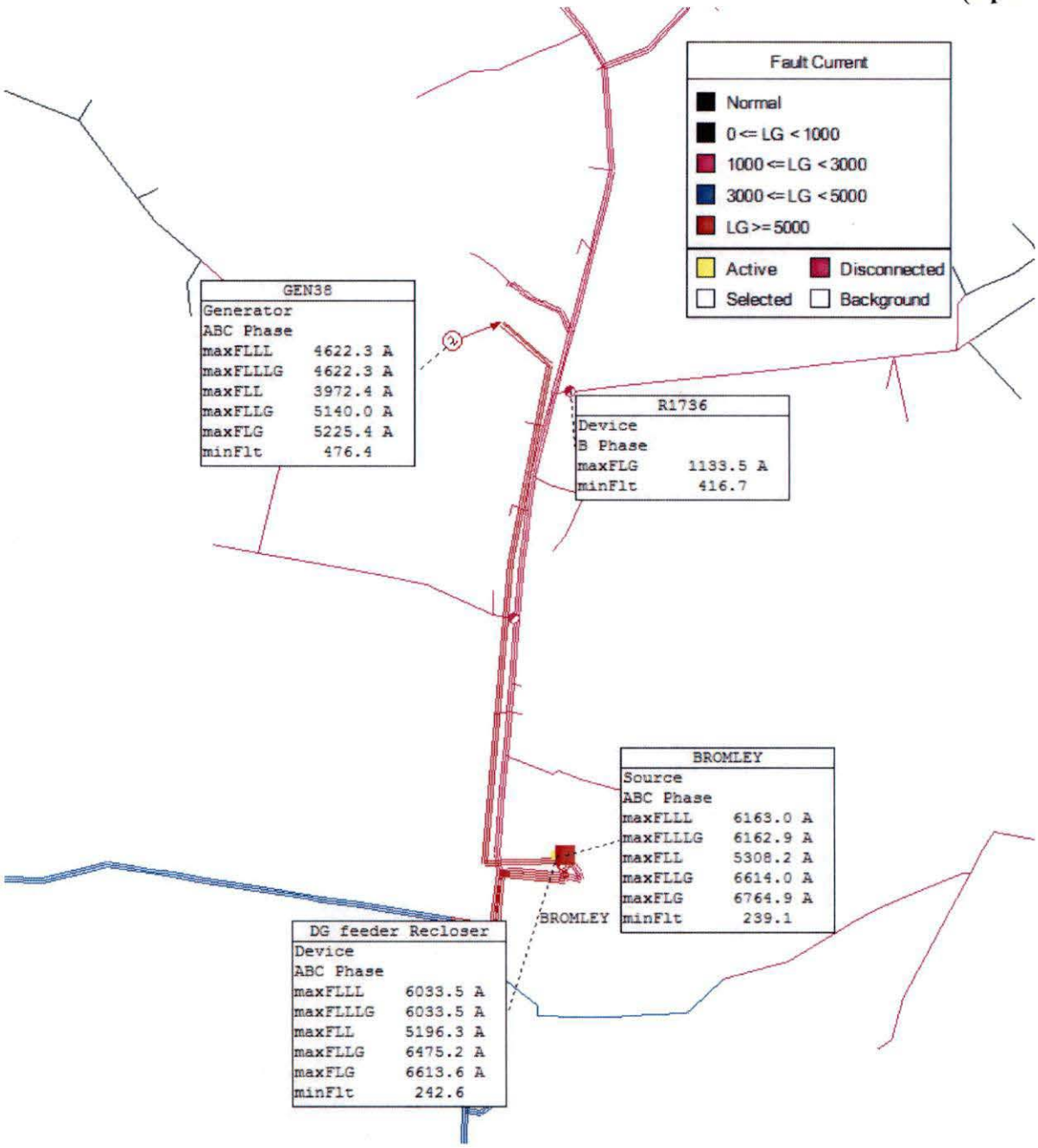

Fault Current
Normal
0 <= LG < 1000
1000 <= LG < 3000
3000 <= LG < 5000
LG >= 5000
Active
Disconnected
Selected
Background
GEN38
Generator
ABC Phase
maxFLLL 4622.3 A
maxFLLLG 4622.3 A
maxFLL 3972.4 A
maxFLLG 5140.0 A
maxFLG 5225.4 A
minFlt 476.4
R1736
Device
B Phase
maxFLG 1133.5 A
minFlt 416.7
BROMLEY
Source
ABC Phase
maxFLLL 6163.0 A
maxFLLLG 6162.9 A
maxFLL 5308.2 A
maxFLLG 6614.0 A
maxFLG 6764.9 A
minFlt 239.1
BROMLEY
DG feeder Recloser
Device
ABC Phase
maxFLLL 6033.5 A
maxFLLLG 6033.5 A
maxFLL 5196.3 A
maxFLLG 6475.2 A
maxFLG 6613.6 A
minFlt 242.6

Exhibit 4.1

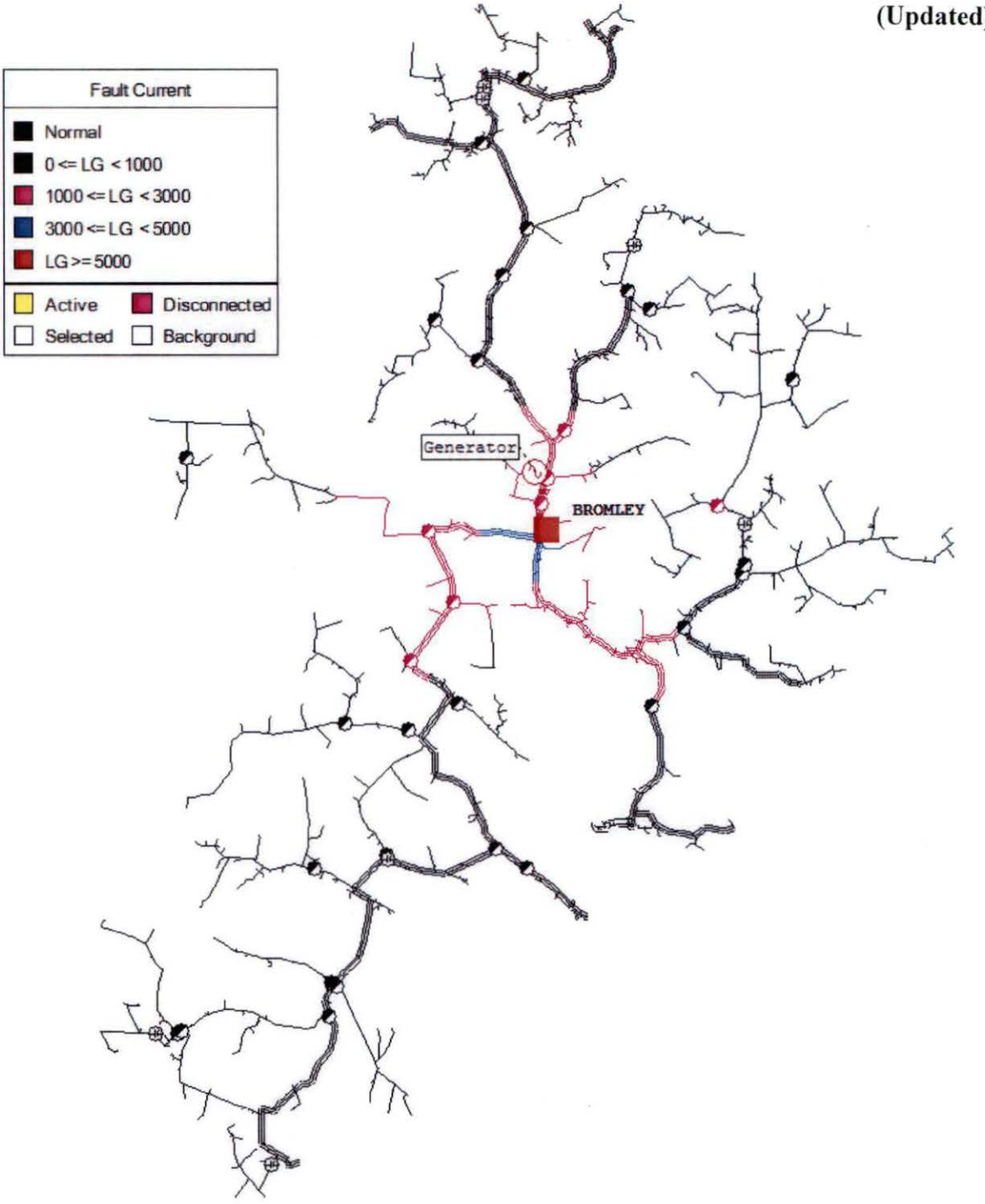

Fault Current
Normal
0 <= LG < 1000
1000 <= LG < 3000
3000 <= LG < 5000
LG >= 5000
Active
Disconnected
Selected
Background
Generator
BROMLEY

Exhibit 4.2