INTERCONNECTION AGREEMENT

This Interconnection Agreement ("Agreement") is made and entered into this 2nd day of May, 2003, by **The Union Light, Heat and Power Company ("ULH&P or Company")**, a corporation organized and existing under the laws of the Commonwealth of Kentucky, herein referred to as "Company", and Fidelity Corporate Real Estate, Inc., a Massachusetts corporation, herein referred to as "Customer," (together "the Parties").

WITNESSETH:

WHEREAS, Customer is installing or has installed generation equipment, controls, and protective relays and equipment ("Generation Facilities") used to interconnect and operate in parallel with the Company's system described as follows and in Exhibit A:

Location: 100 Crosby Parkway, Covington Kentucky 41015

Generator Size and Type: 2250 kW, 12,470V 3-phase diesel-driven synchronous generator

NOW, THEREFORE, in consideration thereof, Customer and Company agree as follows:

1. **Application.** It is understood and agreed that this Agreement applies only to the operation of Customer's Generation Facilities described above and on Exhibit A.

2. **Interconnection.** In consideration of Ten Dollars ($10.00) and other good and valuable consideration the receipt of which is hereby acknowledged, company agrees to allow Customer to interconnect and operate in parallel with the Company's system the Generation Facilities described in Exhibit A in accordance with any operating procedures or other conditions specified in Exhibit A. By this agreement, or by inspection, if any, or non-rejection, or approval, or in any other way, the Company does not give any warranty, express or implied, as to the adequacy, safety, compliance with applicable codes or requirements, or other characteristics of the Generation Facilities. The facilities installed by Customer shall comply with the National Electrical Code, the National Electrical Safety Code, the Company's applicable rules and regulations for electric service in effect from time to time, the rules and regulations of the Commission, and all other applicable local, state, and federal codes and laws, and Customer warrants such compliance.

Customer shall install, operate, and maintain in good order, at its sole cost and expense, such Generation Facilities for safe, efficient and reliable operation of the Generation Facilities in parallel with Company's electric system. Customer shall bear full responsibility for the installation and safe operation of this equipment.

Customer agrees that no changes shall be made to the configuration of facilities described in Exhibit A, and that no relay or other control or protection settings specified in Exhibit A shall be set, reset, adjusted or tampered without written permission from the Company, except to verify that such equipment complies with Company approved settings.

3. **Operation by Customer.** Customer shall operate its facilities in such a manner as not to cause undue fluctuations in voltage, intermittent load characteristics or otherwise interfere with the operation of Company's electric system. At all times when the Generation Facilities are being operated in parallel with Company's electric system, Customer shall so operate the Generation Facilities in such a manner that no disturbance will be produced thereby to the service rendered by Company to any of its other customers.

Customer's Control Equipment shall immediately, completely, and automatically disconnect and isolate the Customer's Generating Facilities from Company's electric system in the event of a fault on Company's electric system, a fault on Customer's electric system, or loss of source on Company's electric system. This automatic disconnecting device shall not be capable of reclosing until after service is restored on Company's electric system. Additionally, if the fault is on Customer's electric system, the automatic disconnecting device shall not be reclosed until after the fault is isolated from the Customer's electric system.

4. Access by Company. Upon reasonable written or electronic advance notice to Customer, Company shall have reasonable access to Customer's Generation Facilities at any time whether before, during or after the time the Generating Facilities first produce energy in order to verify that the installation and operation of Customer's Generation Facilities complies with the requirements of this Agreement. Company shall also have at all times immediate access to breakers or any other equipment that will isolate Customer's Generating Facilities from Company's electric system. Company shall have the right and authority to isolate said Generating Facilities at Company's sole discretion if Company reasonably believes that (a) continued parallel operation creates or contributes to an emergency on either Company's or Customer's electric system, (b) Customer's Generating Facilities present a hazardous condition or (c) Customer's Generating Facilities interfere with the operation of Company's electric system. In non-emergency situations, Company shall give Customer reasonable written or electronic notice prior to isolating Customer's Generating Facilities. Company should notify Customer as soon as reasonably possible after isolating Customer generating facilities in an emergency.

5. Rates and Other Charges. This Interconnection Agreement does not constitute an Agreement by the Company to purchase or wheel power produced by the Generating Facilities nor does it address charges for excess facilities that may be installed by the Company in connection with interconnection of the Generating Facilities. It is understood that if Customer desires an agreement whereby Company wheels power or purchases energy and/or capacity from Customer's Generation Facilities, Company and Customer may enter into another separate agreement detailing the charges, terms and conditions of such purchase or wheeling. It is also understood that if excess facilities are required, including any additional metering equipment, as determined by Company, in order for Customer's Generation Facilities to interconnect with and operate in parallel with Company's system, then a separate Excess Facilities Agreement which details the charges and terms of such excess facilities, shall be entered into by Customer and Company.

6. Insurance. Customer shall procure and keep in force during all periods of parallel operation with Company's electric system, the adequate bodily injury and property damage insurance, with insurance carriers acceptable to Company, with Company as a Named Insured as Company's interests may appear in this Agreement.

Customer shall deliver a CERTIFICATE OF INSURANCE verifying the required coverage to:

ULH&P
Attention: Rhonda Whitaker
107 Brent Spence Square
Covington Kentucky 41014

at least fifteen (15) days prior to any interconnection with Company's electric system by Customer.

7. Release and Indemnification. Each Party shall release, indemnify and hold harmless the other Party from and against all claims, liability, damages and expenses, including attorney's fees, based on any injury to any person, including loss of life, or damage to any property,

including loss of use thereof, arising out of, resulting from or connected with, or that may be alleged to have arisen out of, resulted from or connected with, an act or omission by such other Party, its employees, agents, representatives, successors or assigns in the installation, construction, ownership, operation or maintenance of such Party's facilities used in connection with this Agreement except to the extent such claim, liability, damage or expense arises out of the gross negligence or intentional misconduct of the applicable Party or its employees, agents, representatives, successors, and assigns. Upon written request of the Party seeking relief under this Section 7, the other Party shall defend any suit asserting a claim covered by this Section 7. If a Party is required to bring an action to enforce its rights under this Section 7, either as a separate action or in connection with another action, and said rights are upheld, the Party from whom the relief was sought shall reimburse the Party seeking such relief for all expenses, including attorneys' fees, incurred in connection with such action.

Notwithstanding anything herein to the contrary, neither party shall be liable to the other for, and each party hereby releases the other from, any and all indirect, special or consequential damages which may result from any act or omission of either party in connection with, or related to, the subject matter of this Agreement or from any breach of any covenant under this Agreement by either party hereto.

8. Effective Term and Termination Rights. This Agreement becomes effective when executed and delivered by both Parties and shall continue in effect until terminated as hereafter provided. The agreement may be terminated for the following reasons: (a) Customer may terminate this Agreement at any time, by giving the Company sixty days' written notice; (b) Company may terminate upon failure by the Customer to generate energy from the Generating Facilities in parallel with the Company's system within twelve months after completion of the interconnection; (c) either Party may terminate by giving the other Party at least sixty days prior written notice that the other Party is in default of any of the material terms and conditions of the Agreement, so long as the notice specifies the basis for termination and there is reasonable opportunity to cure the default; (d) Company may terminate by giving Customer at least sixty days notice in the event that there is a material change in an applicable rule or statute which solely as a result of such change, makes this agreement materially disadvantageous to Company.

9. Termination of Any Applicable Existing Agreement. From and after the date when service commences under this Agreement, this Agreement shall supersede any oral and/or written agreement between Company and Customer concerning the service covered by this Agreement and any such agreement shall be deemed to be terminated as of the date service commences under this Agreement.

10. Force Majeure. "Force Majeure" means any cause or event not reasonably within the control of the Party claiming Force Majeure, including, but not limited to, the following: acts of God, strikes, lockouts, or other industrial disturbances; acts of public enemies; orders or permits or the absence of the necessary orders or permits of any kind which have been properly applied for from the government of the United States, the Commonwealth of Kentucky, any political subdivision or municipal subdivision or any of their departments, agencies or officials, or any civil or military authority; unavailability of a fuel or resource used in connection with the generation of electricity; extraordinary delay in transportation; unforeseen soil conditions; equipment, material, supplies, labor or machinery shortages; epidemics; landslides; lightning; earthquakes; fires; hurricanes; tornadoes; storms; floods; washouts; drought; arrest; war; civil disturbances; explosions; breakage or accident to machinery, transmission lines, pipes or canals; partial or entire failure of utilities; breach of contract by any supplier, contractor, subcontractor, laborer or materialman; sabotage; injunction; blight; famine; blockade; or quarantine.

If either Party is rendered wholly or partly unable to perform its obligations because of Force Majeure, both Parties shall be excused from whatever obligations are affected by the Force Majeure (other than the obligation to pay money) and shall not be liable or responsible for any

delay in the performance of, or the inability to perform, any such obligations for so long as the Force Majeure continues. The Party suffering an occurrence of Force Majeure shall, as soon as is reasonably possible after such occurrence, give the other Party written notice describing the particulars of the occurrence and shall use its best efforts to remedy its inability to perform, provided, however, that the settlement of any strike, walkout, lockout or other labor dispute shall be entirely within the discretion of the Party involved in such labor dispute.

11. Commission jurisdiction. Company is subject to the jurisdiction of the Kentucky Public Service Commission ("Commission"). To the extent that Commission approval of this Agreement may be required now or in the future, this Agreement and Company's commitments hereunder are subject to such approval.

IN WITNESS WHEREOF, the Parties have executed this Agreement, effective as of the date first above written.

ULH&P
"Company"

By:_____

(Title) Vice-President & COO, Regulated Businesses

Fidelity Corporate Real Estate, Inc.
"Customer"

By:_____

(Title)_____

PUBLIC SERVICE COMMISSION
OF KENTUCKY
EFFECTIVE

JUN 30 2003

PURSUANT TO 807 KAR 5:011
SECTION 9 (1)

BY_____
EXECUTIVE DIRECTOR

EXHIBIT A

Interconnection Agreement - Fidelity Corporate Real Estate, Inc.

Exhibit A includes this page and the following attachments:

Attachment #1: Single Line Diagram (one sheet) – RUSSELECTRIC INC. Drawing Number 29125-P-1, Rev 1, Sheet 6 of 6

Attachment #2: Relay Settings and Curves (7pages)

Attachment #3: System Description (14 pages)

Description of Generator and Interconnection Facilities:

The generator consists of one 2250kW, 12,470V 3-phase diesel-driven synchronous generator set and is located at 100 Crosby Pky, Covington Kentucky 41015 (Print/Mail Building), which is one of several buildings on the Customer's campus located in Covington Kentucky. The primary purpose of the generator is for emergency power to this building during loss of normal utility power. Paralleling capability is included to allow for closed transition of load to and from the generator. The generator neutral is solidly grounded and the windings are in a wye configuration, generating directly at 12,470V. There are no transformer connections between the generator and the Company's system.

Conditions of Parallel Operation:

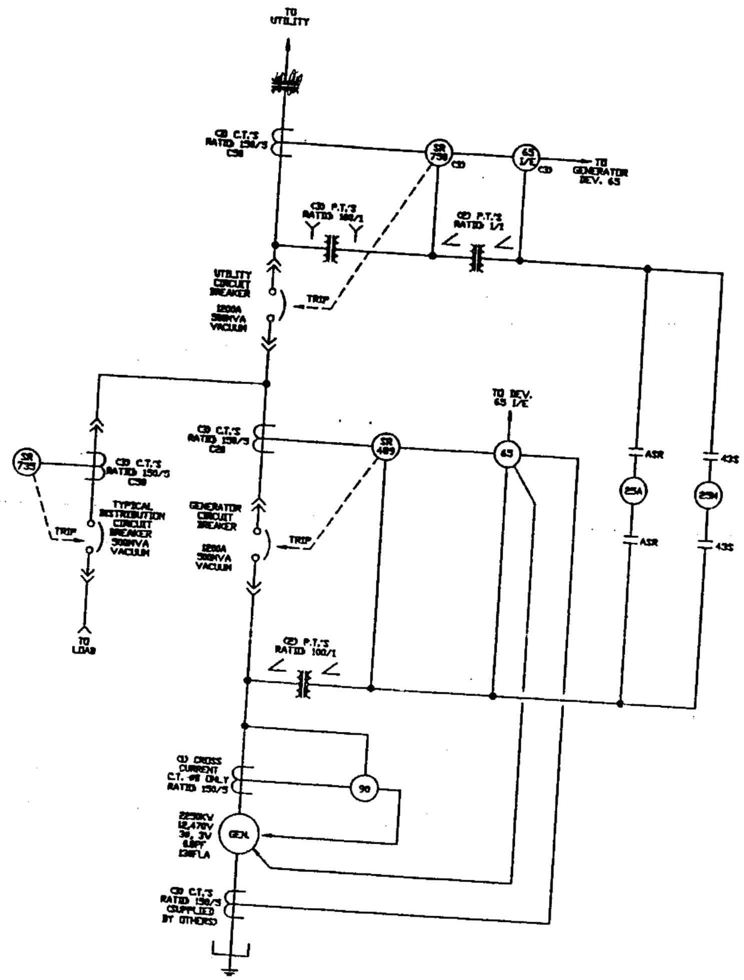
The generator may operate in parallel with the Company's system only under the following conditions:

1. The generator and interconnection system configuration is as shown on Attachment #1, Single Line Diagram.

2. The utility protective relays are set as specified in Attachment #2, Relay Settings and Curves.

3. The system is operated as described in Attachment #3, System Description. Normal parallel operation is for brief periods for purposes of closed transition of load to and from the generator.

4. At no time during parallel operation will the generator power output cause power to flow through the utility circuit breaker (as shown on Attachment #1, Single Line Diagram) to the utility.



DEVICE NO.	DESCRIPTION	FUNCTION
25H	CROMPTON 256-PLLU-PQBX	SYNC. CHECK DEVICE TO PREVENT OUT OF SYNC. CLOSURES BETWEEN DIFFERENT SOURCES.
25A	WOODWARD SPM-A	SYNCHRONIZER TO PROVIDE AUTOMATIC SYNCHRONIZING SIGNAL WHEN CLOSING GENERATOR TO SYNCHRONIZING BUS OR SYNCHRONIZING BUS TO UTILITY.
SR489	MULTILIN	REVERSE POWER RELAY USED TO SENSE REVERSE POWER FLOW INTO THE GENERATOR. (FUNCTION 32) LOSS OF FIELD PROTECTION TO BE DETECTED AS REVERSE VARS TO PROTECT THE GENERATOR FROM VOLTAGE REGULATOR MALFUNCTION WHILE OPERATING IN PARALLEL WITH THE UTILITY. (FUNCTION 40) CURRENT IMBALANCE DETECTION FOR GENERATOR PROTECTION. (FUNCTION 46) SOLID STATE OVERCURRENT TRIP DEVICE WITH LONG, SHORT, INSTANTANEOUS AND GROUND FAULT (FUNCTIONS 50/51, 51G) GENERATOR DIFFERENTIAL RELAY TO DETECT A DIFFERENTIAL FAULT IN THE GENERATOR AND TRIP AND LOCKOUT THE GENERATOR BREAKER.
SR735	MULTILIN	OVERCURRENT TRIP DEVICE WITH LONG, SHORT, INSTANTANEOUS AND GROUND FAULT FUNTIONS. (FUNCTIONS 50/51, 51G)
SR750	MULTILIN	UNDERVOLTAGE NEGATIVE PHASE SEQUENCE RELAY TO MONITOR VOLTAGE LEVEL AND PHASE SEQUENCE OF THE UTILITY SOURCE. 1 - 6 SEC DELAY. FREQUENCY RELAY TO SENSE ABNORMAL BUS FREQUENCY AND TRIP THE UTILITY MAIN CIRCUIT BREAKER IF UNDER FREQUENCY OCCURS WHILE OPERATING IN PARALLEL WITH UTILITY. REVERSE POWER RELAY USED TO SENSE POWER FLOW INTO THE UTILITY SYSTEM, AND TRIP THE UTILITY MAIN BREAKER. OVER CURRENT TRIP DEVICE, WITH LONG SHORT, INSTANTANEOUS, GROUND FAULT FUNCTIONS. (FUNCTIONS 50/51, 51G) UNDER/OVER VOLTAGE RELAY USED FOR ENGINE START, AND TRIPPING THE UTILITY BREAKER IF AN ABNORMAL CONDITION IS DETECTED WHILE PARALLELED WITH THE UTILITY SOURCE.
65	WOODWARD	GOVERNOR FOR CONTROLLING THE PRIME MOVER, LOAD SHARING TYPE.
65 I/E	G.E. FANUC 90-30	PROCESS CONTROLLER USED AS AN IMPORT/EXPORT DEVICE FOR RAMPING LOAD ON TO AND OFF OF ENGINE GENERATORS.
90	BASLER DECS	DIGITAL EXCITATION CONTROL SYSTEM WITH OPTIONAL VAR/POWER FACTOR REGULATION.

PUBLIC SERVICE COMMISSION
EFFECTIVE
JUN 3 0 2003

NOTE: THE CALIBRATION AND SETTINGS OF ALL PROTECTIVE DEVICES MUST BE DETERMINED BY A SHORT CIRCUIT AND COORDINATION STUDY PROVIDED BY OTHERS.

INSTALLATION
FIDELITY INVESTMENTS
COVINGTON, KENTUCKY

Cubicle: ALL
Switchboard: PSWB01

DFTP.	DDD	02/06/02
CHKD.		
APPD.		

TITLE BY EXECUTIVE DIRECTOR

PROTECTIVE RELAY
SINGLE LINE DIAGRAM

...ELECTRIC INC.
SOUTH SHORE PARK HINGHAM, MA 02043

DWG. NO. 29125-P-1 | REV. 1

SHEET NO. 6 of 6

Fidelity
100 Crosby Addition Generator
Hixson Job No. 5734.29
5/5/02

Utility Relay

Equivalent Device No.	Function	Setting
27	under voltage	Trip at 85% after 2 seconds, 50% after 1 second
59	over voltage	Trip at 110% after 3 seconds, 120% after .2 seconds
81u	Underfrequency	Trip at 59.8Hz after .1 second
81o	Overfrequency ***	Trip at 60.2Hz after .1 second
67-1,2,3	AC directional overcurrent Phase Time OC2	1) OC Pickup: .26 (39A) 2) Curve Shape: IEC Curve C, multiplier .03 3) Instantaneous OC Pickup: .05 (7.5A), time delay 100 seconds
67G	AC neutral directional overcurrent	1) OC Pickup: .05 (7.5A) 2) Curve Shape: IAC Extreme Inverse, 6.2 phase-time overcurrent shift, time multiplier 1 3) Instantaneous OC Pickup: .26 (39A)
50/51	Instantaneous / Time overcurrent Phase Time OC1	1) OC Pickup: 1.25 (187.5A) 2) Curve Shape: IAC Extreme Inverse, 1.25 phase-time overcurrent shift, time multiplier 3 3) Instantaneous OC Pickup: 11 (1650A), Delay: .03 sec.
51G	Time overcurrent	1) OC Pickup: .18 (27A) 2) Curve Shape: Extreme inverse, 2.32 phase-time overcurrent shift, time multiplier 1 3) Instantaneous OC Pickup: 8.38 (1257A)

*** Overfrequency is available as a monitoring point with the SR750 relay, and will be used to trip the relay by actuating a monitoring output signal connected to an input trip signal.
Also note that under and over frequency are backed up by the generator relay.

Notes: 1) Relay should be locked out under normal conditions (utility power, no generator), to allow the upstream fuse to provide protection and prevent nuisance tripping.

May 06, 2002 13:39:01
Project Name: 5734skm112601
TCC Name: SR750G.tcc
Reference Voltage: 12470 V
Current Scale: X 10^0

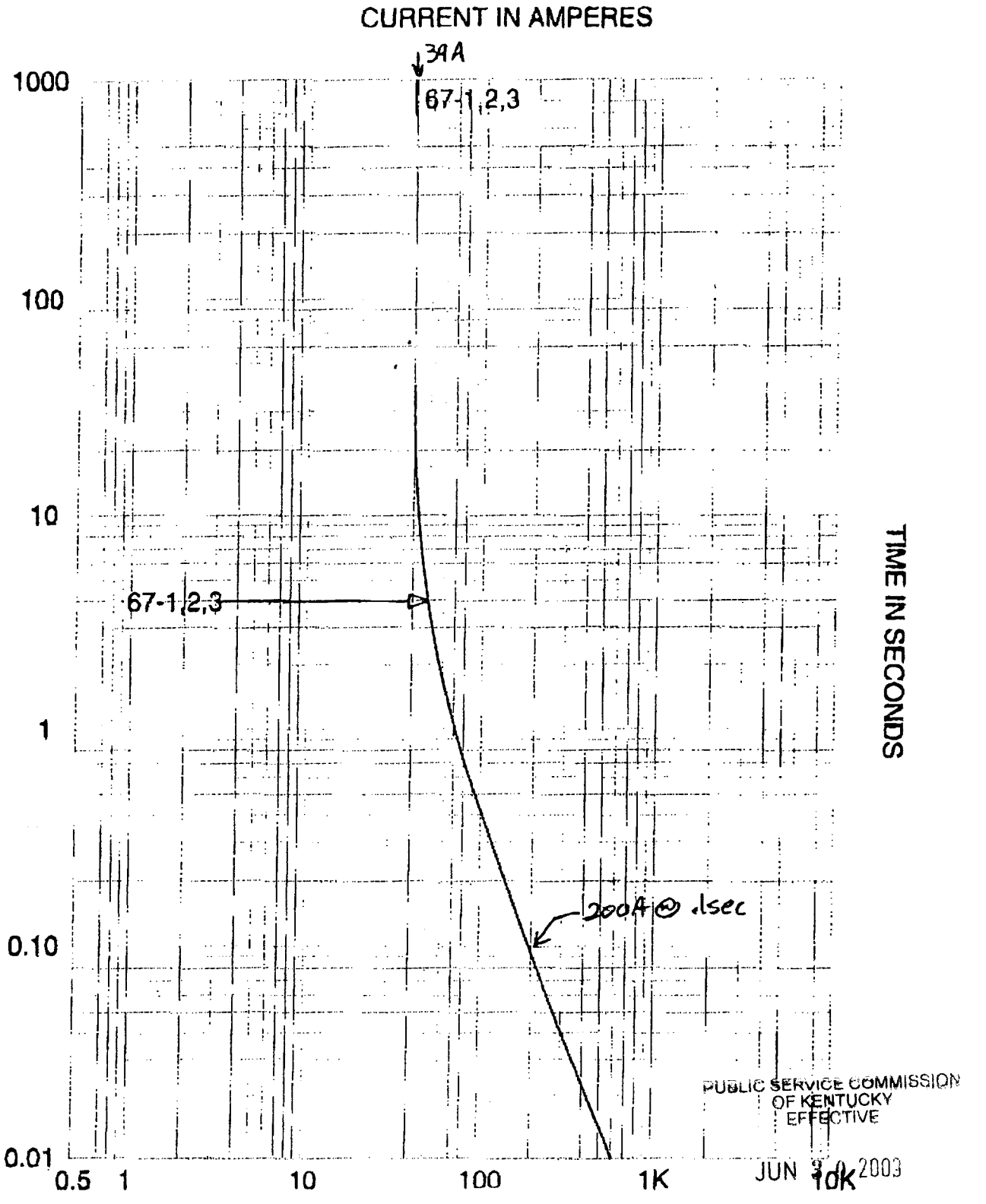
ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL, INTERPRETATION,
AND APPLICATION BY A REGISTERED ENGINEER ONLY.
CAPTOR (Computer Aided Plotting for Time Overcurrent Reporting)

Device Name:	UTILITY-SR750G			TCC Name:	SR750G.tcc
Bus Name:	KPPSG001			Bus Voltage:	12470.0V
Function Name:	Ground				
Manufacture:	MULTILIN			Description:	5A CT Sec
Sub Type:	SR750/760 Feeder Relay			Class Description:	SR760
AIC Rating:	N/A			Fault Duty:	3541.6A
Current Rating:	150A / 5.00A			Curve Multiplier:	1.00000
Setting: 1) OC Pickup		0.18	(27A)	Test Points:	@2.0X, 4.047s
2) Ext Inverse		2.32	1		@5.0X, 0.574s
3) Inst OC Pickup		8.38	(1257A)		@10.0X, 0.228s

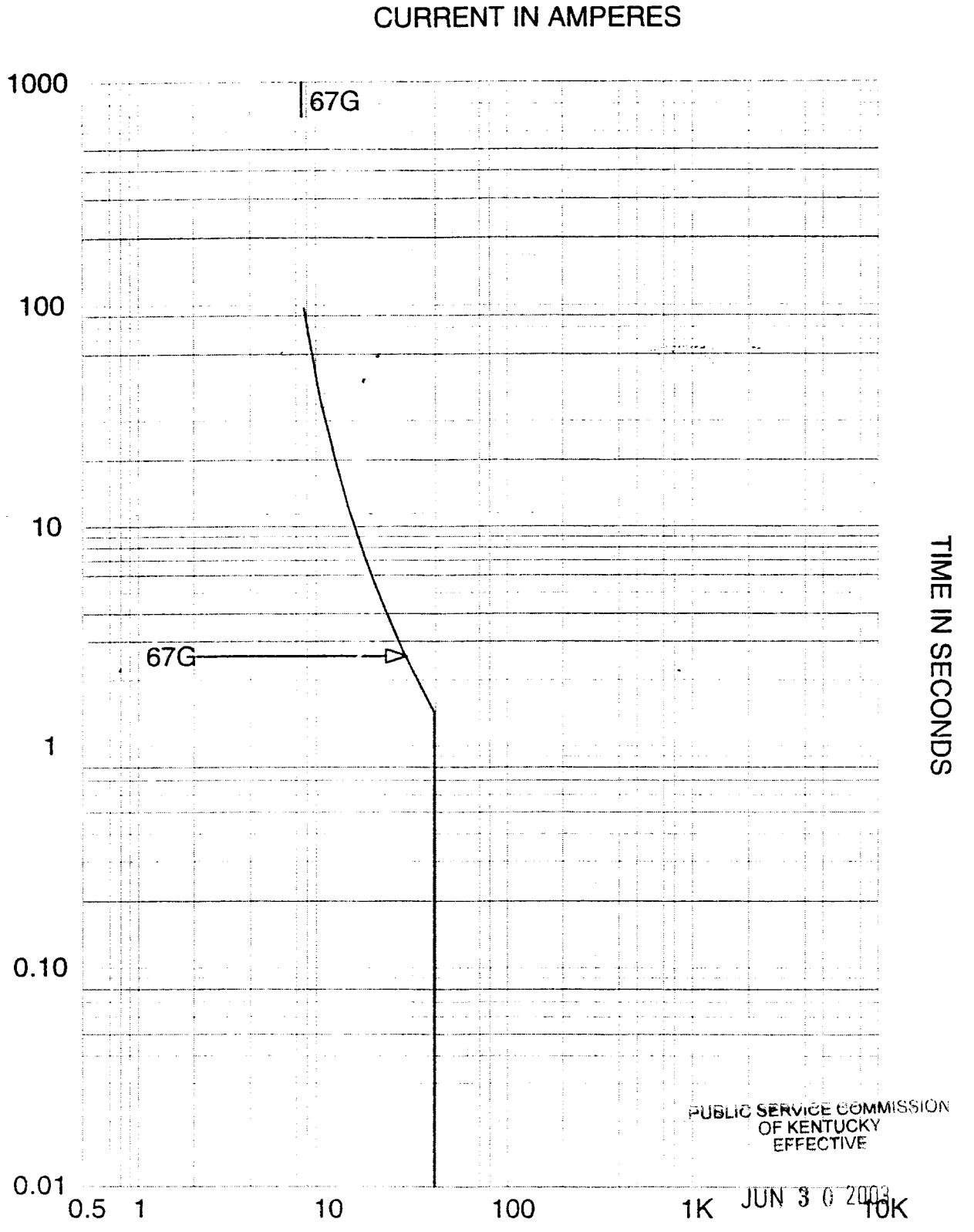
May 06, 2002 11:05:49
Project Name: 5734skm112601
TCC Name: Utility SR750.tcc
Reference Voltage: 12470 V
Current Scale: X 10^0

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL, INTERPRETATION,
AND APPLICATION BY A REGISTERED ENGINEER ONLY.
CAPTOR (Computer Aided Plotting for Time Overcurrent Reporting)

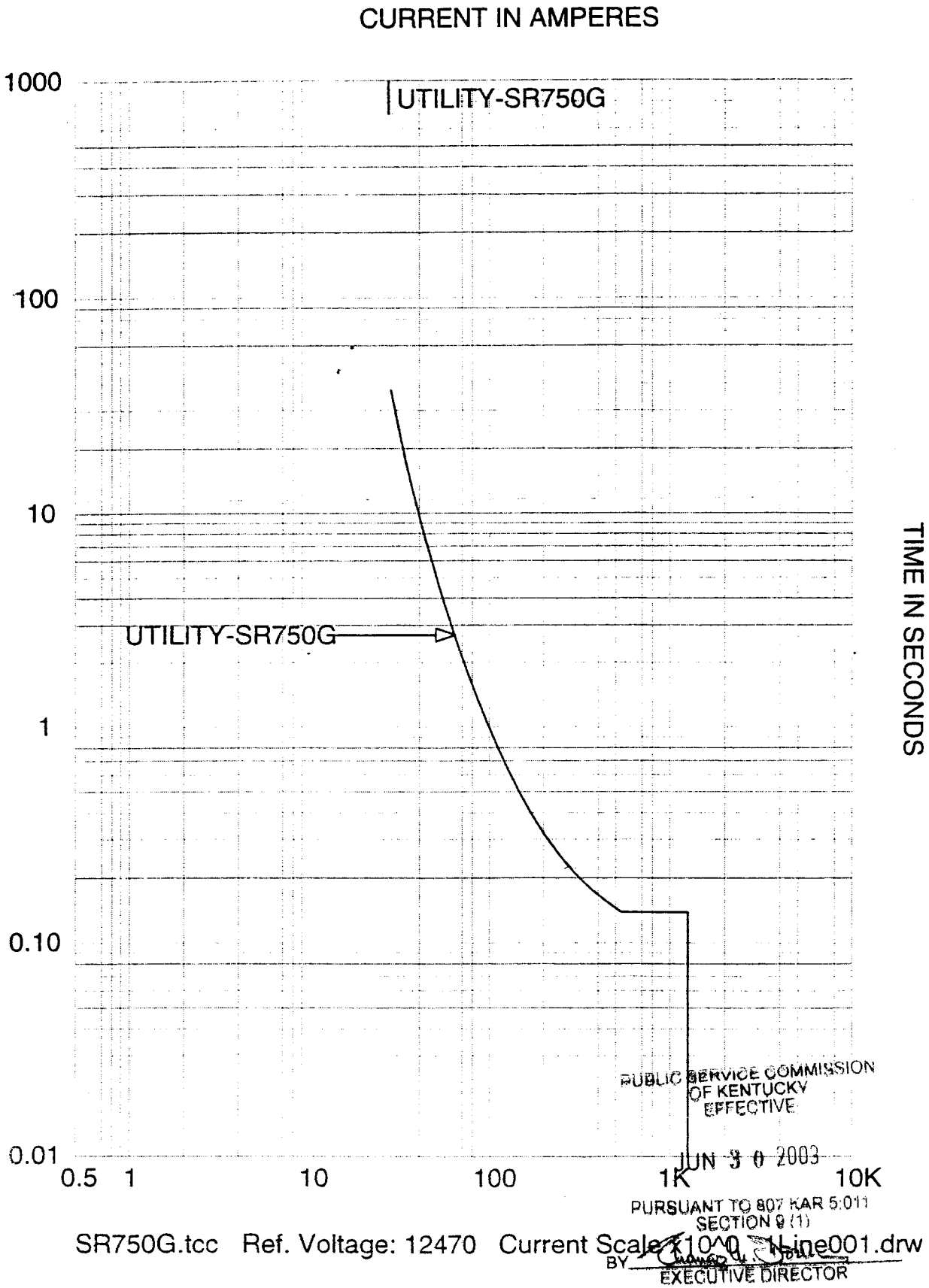
Device Name:	UTILITY-SR750			TCC Name:	Utility SR750.tcc
Bus Name:	KPPSG001			Bus Voltage:	12470.0V
Function Name:	Phase				
Manufacture:	MULTILIN			Description:	5A CT Sec
Sub Type:	SR750/760 Feeder Relay			Class Description:	SR750
AIC Rating:	N/A			Fault Duty:	3541.6A
Current Rating:	150A / 5.00A			Curve Multiplier:	1.00000
Setting: 1) Inst OC Pickup		1.25	(187.5A)	Test Points:	@2.0X, 1.873s
2) IAC Ext Inv		1.25	1		@5.0X, 0.307s
					@10.0X, 0.116s



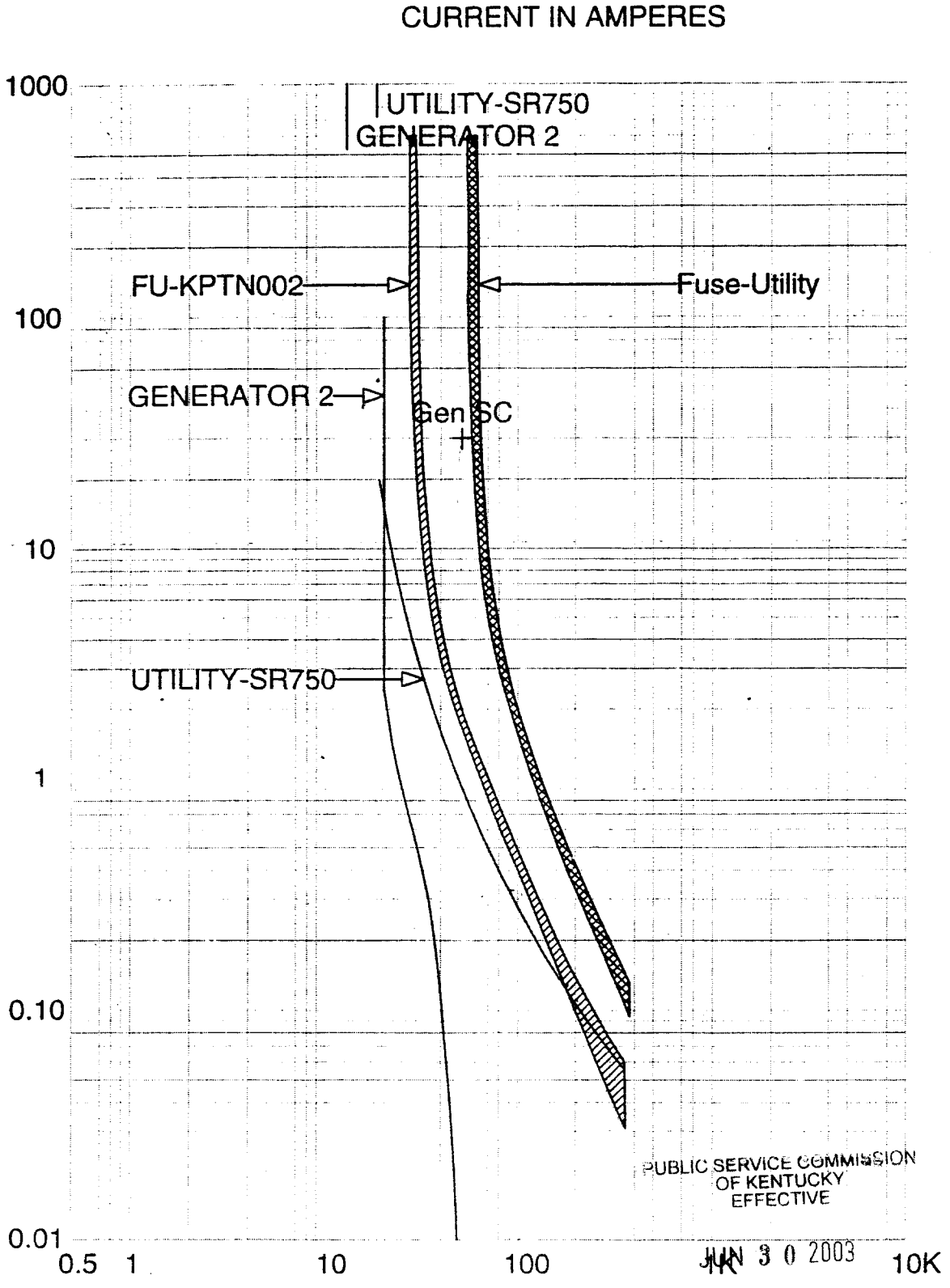
67.tcc Ref. Voltage: 12470 Current Scale x10^0 Relays



67G.tcc Ref. Voltage: 12470 Current Scale x10^0 Relays



SR750G.tcc Ref. Voltage: 12470 Current Scale: X10^0 Line001.drw



Utility.tcc Ref. Voltage: 12470 Current Scale x10^1 Line001.drw

1 System Description

1.0 Overview

1.0 Introduction

This section describes Russelectric Low & Medium Voltage, Emergency Generator Control Switchgear for the Fidelity Investments in Covington, Kentucky.

1.1 Description

The emergency generator control and distribution switchgear is designed to automatically control and supply emergency generator power to the building loads. A programmable logic controller (PLC) will control the system. In the unlikely event of a PLC failure, automatic operation will be carried out by a redundant Controls. The emergency power is derived from One 2250KW, 12,470V, 0.8 power factor, 3-phase, 3-wire, 60Hz, diesel-driven generator sets.

Protective Devices are provided to monitor the system, to detect and isolate problems, and ensure continuity of service with minimum damage to equipment and personnel. The calibration and settings of all protective devices must be determined by a short circuit and coordination study by others.

The following description will outline this equipment.

- Generator Parallel Control Switchgear Drawing #29125-P-2 including:
- One (1) Generator/Master Control Cubicle (CC)

- Generator, Utility & Distribution Circuit Breaker Switchgear Drawing #29125-P-1 including:
- One (1) Generator Circuit Breaker Cubicle (D1)
- One (1) Utility Circuit Breaker Cubicle (D2)
- One (1) Distribution Circuit Breaker Cubicle, Containing Two Circuit Breakers (D3)

1.1 Automatic Operation

When the **ENGINE SELECTOR** switche and the **MASTER CONTROL** switch are in their ***Auto*** positions the emergency generating system is placed on standby. The generator circuit breaker is normally open and the emergency distribution breakers are normally closed.

Upon receipt of an engine start signal, the engine-generator will start and after reaching 90% of rated voltage and 58Hz frequency is connected to the emergency bus through its generator circuit breaker. At this time a trip signal is sent to the utility main circuit breaker, and lower priority distribution circuit breakers. After the utility main circuit breaker is open, a close signal is sent to the generator circuit breaker.

At this time, the priority one loads are fed through normally closed distribution circuit breaker. The priority two distribution circuit breaker will close after an adjustable time delay. (The priorities, and time delays of these distribution breakers are adjustable through the Touch Screen).

The generator control switchgear is equipped with an alarm system that automatically shuts down the engine and initiates load shedding if an engine failure occurs or an underfrequency condition exists. Refer to Section 1.5 for more information on load controls.

When the normal supply voltage returns, the system transfers all building loads back to the normal source after an adjustable time delay. A trip signal is sent to the generator circuit breaker, and a close signal is sent to the utility circuit breaker. The engines continue to operate unloaded for a 5-40 minute adjustable period of time through controls provided in the switchboard. All controls are now automatically reset and in readiness for the next operation.

1.2 Manual Operation

Complete manual operation is allowed if the **MASTER SELECTOR** switch is in the ***Manual*** position. Engines may be manually started using their **ENGINE SELECTOR** switches.

The Generator/Master control cubicle door (CC) has a bus voltmeter, synchroscope, sync lights, and a frequency meter. The generator is provided with a **FREQUENCY METER** switch position to operate the frequency meter and provide a comparison between the bus and the oncoming generator frequency.

The generator also includes a **SYNCHROSCOPE** switch position that energizes the synchroscope, sync lights and the manual sync check relay. This relay prevents breaker closure unless the two sources are within acceptable limits of synchronism. An interlock ensures that these breakers have their associated synchroscope circuitry enabled before closure is allowed. Manual closure of the circuit breaker is accomplished via the circuit breaker control switch in the equipment.

The Utility Circuit Breaker is provided with a **FREQUENCY METER** switch position to operate the frequency meter and provide a comparison between the bus and the Utility Source.

The Utility also includes a **SYNCHROSCOPE** switch position that energizes the synchroscope, sync lights and the manual sync check relay. This relay prevents breaker closure unless the two sources are within acceptable limits of synchronism. An interlock ensures that these breakers have their associated synchroscope circuitry enabled before closure is allowed. Manual closing of the circuit breaker is accomplished via the circuit breaker control switch in the equipment.

In the ***Manual*** position, the automatic synchronizer is locked out of the system. Receipt of an engine start signal starts the standby engine-generator, but synchronizing and paralleling procedures must be performed manually.

☑ ***NOTE : Whenever the* MASTER SELECTOR *switch is in the* Manual *position, all automatic functions are disabled and must be performed manually, including transfers of non-priority one loads to the emergency system.***

1.3 Industrial Operator Interface Computer Features

An automatic engine starting control and failure system is provided to control the starting, stopping, and monitoring of the engine-generator. The Industrial Operator Interface Computer is supplied with a number of screens that allow the operator to perform control functions in real time.

- **A password is required to view and change any settings.**. The password is installed via the Touch Screen using a screen depicting a standard keyboard. Once an operator enters the system using his password, a password timer runs. If no action is taken using the touch screen for an adjustable time delay the password lock is reinstated automatically.

- The main menu is a pictorial screen depicting a One-Line of the equipment supplied. An operator wishing to view information on an engine touches the engine depicted on this screen. Touching areas of the screen accesses information contained in the switchgear.

A series of software keys are provided on each screen. These keys allow the operator to toggle between screens.

Areas available for viewing are as follows:

1.3.1 Engine Screen
1.3.2 Generator Metering Screen
1.3.3 Generator Control Screen
1.3.4 System Metering Screen
1.3.5 System Control Screen
1.3.6 Annunicator Status Screen
1.3.7 Generator Settings Screen
1.3.8 Report Screens

1.3.1 Engine Screen

Various engine parameters are available for viewing. Examples include:

COOLANT TEMPERATURE	OIL PRESSURE ALARM	OIL PRESSURE SHUT DOWN
HIGH OIL TEMP. ALARM	HIGH OIL TEMP. SHUTDOWN	LOW COOLANT TEMP. ALARM
HIGH COOLANT TEMP. ALARM	HIGH COOLANT TEMP. SHUTDOWN	
D.C. VOLTAGE PRE-ALARM	EMERGENCY STOP	ENGINE RUNNING
ENGINE IN STANDBY	ENGINE LOCKED-OUT	ENGINE HOURS

1.3.2 Generator Metering Screen

The following areas are accessible to an operator through the **Generator Metering Screen.**

1. A **VOLTMETER** and **VOLTMETER SELECTOR** switch is shown for the generator. The voltmeter reflects the voltage that the generator is supplying. The **VOLTMETER SELECTOR** switch can be operated via the Touch Screen to select the desired phase to monitor.
2. A **VOLTAGE ADJUST SELECTOR** switch is shown for the generator. This switch can be operated via the Touch Screen to adjust the generator voltage.
3. A **SPEED ADJUST SELECTOR** switch is shown for the generator. This switch can be operated via the Touch Screen to adjust the generator frequency.
4. A kilowatt meter is shown for the generator. This meter reflects the real power that the generator is supplying to the load.
5. A power factor meter is shown for the generator. This meter reflects the power factor of the generator.
6. An **AMMETER** and **AMMETER SELECTOR** switch is shown for the generator. The ammeter reflects the generator current that the generator is supplying. The **AMMETER SELECTOR** switch can be operated via the Touch Screen to select the desired phase to monitor.

1.3.3 Generator Control Screen

The following areas are accessible to an operator through the generator control Screen.

1. Setting and changing various time delay timers, examples include: ***"Failure to sync."***
2. An **ENGINE SELECTOR** switch is shown, which is identical to the **ENGINE SELECTOR** switch mounted on the equipment.

3. A **SYNCHROSCOPE** switch, and **CIRCUIT BREAKER CLOSE** switch is shown.
4. A **VOLTMETER** and **VOLTMETER SELECTOR** switch is shown for the generator, and generator bus. The generator bus voltmeter reflects the voltage that the generators are supplying. The **VOLTMETER SELECTOR** switch can be operated via the Touch Screen to select the desired phase to monitor.
5. A frequency meter and **FREQUENCY METER SELECTOR** switch is provided to allow the operator to manually monitor the frequency of each generator and the generator bus. The **FREQUENCY METER SELECTOR** switch can be operated via the Touch Screen to the desired source.
6. A **VOLTAGE ADJUST** switch is shown. An operator may adjust the generator voltage using this switch via the Touch Screen.
7. A **SPEED ADJUST** switch is shown. An operator may adjust the generator frequency using this switch via the Touch Screen.
8. A generator **CIRCUIT BREAKER CONTROL** switch is shown.

An operator can start an engine-generator using the **ENGINE SELECTOR** switch.

(This assumes the **ENGINE SELECTOR** switch located on the face of the equipment is in the *Auto* position. The Touch Screen controls will never over ride the ***Lock-out/Reset*** or ***Off*** positions of the **ENGINE SELECTOR** switch located on the equipment.)

The operator sees the generator start and build voltage using the generator voltmeter.
(This voltage level can be adjusted using the **VOLTAGE ADJUST** software switch, located on the touchscreen.)
The operator sees the generator speed increase using the frequency meter.

(This speed level can be adjusted using the **SPEED ADJUST** software switch, located on the touchscreen.)

The operator can then close the generator circuit breaker using the **CIRCUIT BREAKER CONTROL** switch.

The closing of the generator circuit breaker is manually initiated through the touch screen. Hard wire interlocks within the equipment will always need to be satisfied before any circuit breaker will close.

If a circuit breaker is opened via the Touch Screen, then the automatic controls are shut off. The automatic re-closure of this circuit breaker will not take place. Any circuit breaker opened via the touch screen must be re-closed either via the touch screen or manually.

The operator can shut down the generator in a similar manner using the selector switches shown on this screen.

1.3.4 System Metering Screen

The following areas are accessible to an operator through the **System Metering Screen**.

1. An operator may select any area of the system using the One-Line screen, which reflects the equipment supplied. He does this by touching the device of interest on the touch screen.

2. If the operator selects a circuit breaker, the touch screen displays all the power parameters that circuit breaker is supplying. (The control gets this information from the Multilin "SR489" on the engine circuit breaker, The Multilin "SR750" on the Utility circuit breaker, and the Multilin "SR735" relays on the Distribution Circuit Breakers. The touch screen also depicts the present status of that circuit breaker (OPEN, CLOSED, NOT AVAILABLE).

   * **Circuit Breaker Not Available** is a combination of the following conditions:

   Circuit breaker withdrawn.

   Protective Relay tripped.

   Control Voltage Failure.

   Springs not Charged.

   Failure to Trip.

   Failure to Close.

3. If the operator selects the generator bus, the touch screen displays the voltage and current levels supplied by the generator plant.
4. An operator can determine where the engine start signal is coming from by looking at the system One-Line screen. The One-Line is shown in color's **Red** for energized and **Green** for de-energized. If an engine start signal is coming from the utility feeder the color of that feeder is Green, and a notation is shown that the engine start signal is coming from that location.
5. A **VOLTMETER** and **VOLTMETER SELECTOR** switch is shown for the Utility Source. The voltmeter reflects the voltage that the Utility is supplying. The **VOLTMETER SELECTOR** switch can be operated via the Touch Screen to select the desired phase to monitor.
6. A **Kilowatt meter** is shown for the Utility Source. This meter reflects the real power that the Utility is supplying to the load.
7. A **Power Factor** meter is shown for the Utility Source. This meter reflects the power factor of the Load.
8. An **AMMETER** and **AMMETER SELECTOR** switch is shown for the Utility Source. The ammeter reflects the current that the Utility is supplying. The **AMMETER SELECTOR** switch can be operated via the Touch Screen to select the desired phase to monitor.

1.3.5 System Control Screen

The following areas are accessible to an operator through the **System Control Screen**.

1. Setting and changing load priority assignments for all the load shed devices in the equipment.

   Each load device is given a priority value. A priority one load device is the first load to be supplied during a utility power failure.

   Setting and changing various time delay timers (examples: ***"Time delay before engine starting", "Time delay on return to utility power")***
2. Selecting either ***Automatic*** or ***Manual*** return to utility after a utility outage.
3. Selecting either ***Automatic*** or ***Manual*** for the system.

Placing the system in Automatic or Manual can be done from either the software or the* AUTO/MANUAL *switch located on the equipment.

4. Percentage of generator capacity for over load operation.
5. Overload time delay set point.
6. Underfrequency set point.
7. Underfrequency time delay set point.
8. Overfrequency set point.
9. Overfrequency time delay set point.
10. Undervoltage set point.
11. Undervoltage time delay set point.
12. Overvoltage set point.
13. Overvoltage time delay set point.
14. Transfer Failure Alarm

    During a transfer failure the Touch Screen defaults to the One-Line screen and displays the location of the device which failed. This allows the fastest means for an operator to locate the source of the transfer failure. Once the failed device has been corrected, the operator can reset the transfer failure alarm, either via the Touch Screen or by a push button located on the equipment. Once the transfer failure has been reset the controls complete the transfer operation.

15. System One-Line

- Manual paralleling of Generator with the Utility source is accomplished here. The necessary generator and generator bus metering displays. A synchroscope is shown, which displays the slip rate between the generator bus and the Utility Source. A **CIRCUIT BREAKER CONTROL** switch is shown, which closes the appropriate circuit breaker.

The closing of the generator circuit breaker is manually initiated through the touch screen. Hard wire interlocks within the equipment will always need to be satisfied before any circuit breaker will close.

16. There is a (Medium Voltage) Automatic Transfer Scheme between the Utility Circuit Beaker and the Generator Circuit Breaker. The load of these circuit breakers feed two Distribution Circuit Breakers. Automatic trip and close operation to these circuit breakers is initiated from the controls. Manual operation of these circuit breakers is accomplished via the trip, & close switches on each circuit breaker. Should an operator open a circuit breaker manually, automatic controls will not re-close it. An operator may close it either via the local close switch, or via the touch screen in the controls.

Interlocks are in place to ensure proper operation. An operator will never be allowed to parallel the utility source and the generator source until hardwire interlocks are satisfied. If the generator plant becomes overloaded automatic controls override the local controls and shed lower priority loads.

Upon receipt of an alarm, the Touch Screen automatically displays an Annunciator screen. An amber OPERATOR INTERFACE ALARM indicator on the "CC" door also illuminates, and the alarm horn is sounded. All alarms can be reset using the **VOLTAGE/FREQUENCY FAILURE RESET** push button on the "CC", or by a similar control in the software.

1.3.6 Annunciator Screen

The **Annunicator Screen** allows the operator to view various alarm, and status functions.

Manual Mode	Automatic Mode	No-Load Engine Test
Load Test	Utility Power Failure	Load Shed On
Load Shed Bypassed		
Base Fuel Tank Low Fuel Level	System Not In Auto	Bus Under Frequency
Bus Over Voltage	Bus Under Voltage	Bus Over Frequency
Alarm Horn Silenced	Transfer Failure	PLC Fault
Communication Failure	Engine Alarm	Gen. Circuit Breaker Open
Engine Shutdown	Utility Circuit Breaker Open	Gen. Circuit Breaker Closed
Critical Control Voltage Failure	Utility Circuit Breaker closed	Gen. Circuit Breaker Not
	Utility Circuit Breaker not Available	Available

Additional screens from the **Annunicator Status Screen** allow the operator to view the following functions.

Approach Low Coolant Temp.	Approach High Coolant Temp.	Approach Low Oil Pressure.
Battery Charger Failure	Base Tank High Fuel Level	Day Tank Low Fuel Level
Base Tank Rupture	Engine Controls Not In Auto	Engine Controls Manual (Run)
Protective relay trip	Engine Over Speed	Engine Over Crank
	High Coolant Temp.	Low Oil Pressure
	Engine Controls Ready	Failure to Sync.

1.3.7 Generator Settings Screen

The following are areas accessible to an operator through the **Generator Settings Screen**.

1. Generator rating
2. Generator cool-down time
3. Percentage of generator capacity available

1.3.8 Reports Screens

The following are areas accessible to an operator through the **Reports Screens.**

1. Description of alarms (Examples: GENERATOR LOW OIL PRESSURE, REVERSE POWER)
2. Alarm state
3. Current value
4. Acknowledge time
5. Alarm time
6. Generator/utility voltage (phase to phase)
7. Generator/utility frequency
8. Generator/utility amps
9. Generator/utility kilowatts
10. Generator/utility power factor
11. Engine-Generator water temperature (if available through the engine interface device)
12. Engine-Generator oil pressure (if available through the engine interface device)
13. Engine-Generator running hours
14. Engine-Generator battery voltage
15. Engine coolant temperature (if available through the engine interface device)
16. Engine oil temperature (if available through the engine interface device)
17. **ENGINE SELECTOR** switch position (engine-mounted)

Generator Indicators

Each engine generator is provided with individual colored lights to indicate the following conditions:

GENERATOR RUNNING

SUMMARY ALARM

GENERATOR LOCKED-OUT

If a malfunction occurs, control circuitry will: open the generator circuit breaker, shed low priority load, shut down the engine, sound the alarm horn, and illuminate the flashing (red) ENGINE LOCKED OUT light. The nature of the failure is displayed on the Industrial Operator Interface computer.

After the trouble has been corrected, the system must be reset manually by rotating the **ENGINE SELECTOR** switch to the ***Lockout/Reset*** position. The alarm light goes out and the switch can then be placed in the desired mode of operation.

The generator is protected by a **"Generator Management Relay".** This relay is a multi function protective relay capable of the following devices. (12, 21, 24, 27, 50/27, 32, 38, 39, 40, 40Q, 46, 47, 49, 50, 50BF, 50, 50/51GN, 51V, 59, 59GN/27TN, 60FL, 67, 76, 81, 86, 87G.) These devices are programmable within the relay. (Note: some of these devices may not be used. See the

appropriate relay coordination documentation for more information.)

If a generator fails to synchronize (or its circuit breaker fails to close while operating in the automatic mode), then it is automatically shut down and locked out of the system after a time delay period, adjustable from 0-300 seconds.

A four-position **ENGINE SELECTOR** switch is provided for each engine-generator set to provide the following modes of operation:

1). In the ***Lockout/Reset*** position, the engine-generator is locked out. Whenever the **ENGINE SELECTOR** switch is placed in the ***Lockout/Reset*** position while the engine-generator is operating, it is immediately shut down and its circuit breaker trips. The ***Lockout/Reset*** position resets the engine starting and failure controls if an engine is locked out due to a malfunction.

2). In the ***Off*** position, the engine-generator can normally shut down with a time delay to allow the engine to cool after operating under load. Whenever the **ENGINE SELECTOR** switch is placed in the ***Off*** position while the engine-generator is operating, the generator circuit breaker trips; but the engine continues to operate until the expiration of the time delay setting of the cool down timer. The ENGINE RUNNING light flashes during cool down operation.

3). In the ***Auto*** position, the engine-generator set is on standby and starts whenever a signal is given from the automatic transfer system (or when a system test is performed). The circuit breaker is tripped when the commercial power returns, and the transfer system signals the engine-generator to shut down (or when the system test operation is terminated). The engine continues to operate for the cool down time delay period before shutting down in readiness for the next operation.

4). In the ***Run*** position, the engine-generator starts and comes up to speed and voltage. It continues to operate until the **ENGINE SELECTOR** switch is rotated to another position. This position is to be used for testing or for manual operation. If a power failure occurs while the engine is operating in the ***Run*** position and the **MASTER CONTROL** switch is in the ***Auto*** position, then the engine-generator automatically synchronizes, closes its generator circuit breaker to the bus and otherwise performs as described under *Section 1.1, Automatic Operation.*

A flashing red ENGINE LOCKED OUT light indicates that the **ENGINE SELECTOR** switch is in either the ***Lockout/Reset*** or the ***Off*** position, or that the engine-generator has been shut down due to a malfunction, as described previously.

The engine generator controls monitor the status of all DC control voltage fuses associated with the individual generator controls. If the fuse opens for the annunciator lamp test, annunciator lamp voltage, critical lamp voltage, governor power, back-up control voltage or auxiliary device input voltage, then the horn sounds and the Touch Screen indicates a control voltage problem. If any of these fuses open, (with the exception of the governor power), the engine generator can continue to operate.

An automatic DC control voltage sensor system (Master Control Battery Selector) provides DC control voltage to the switchboard from the best engine starting battery, and a converted 48 vdc source from the station battery. If the battery supplying the DC control voltage decreases in voltage below that of another battery input, the sensor automatically switches the control voltage to the better battery without interruption of the system. The DC control voltage sensor system ensures a stable DC control voltage supply as long as at least one of the input batteries is available.

A station alarm horn and silencing circuit with indicating lamp is provided to sound an audible alarm if a malfunction occurs. If the alarm is silenced after a malfunction, receipt of another signal causes the horn to sound again (Annunciator Ring Back). When the failed circuit is corrected, the alarm horn is automatically reset.

A two-position **MASTER CONTROL** switch is provided in the master control section to provide the following modes of operation:

- In the ***Auto*** position, the system is in readiness to perform as outlined under Automatic Operation (Section 1.1).
- In the ***Manual*** position, the automatic synchronizer is locked out of the system. Receipt of an engine start signal starts all of the standby engine-generators, but synchronizing and paralleling procedures must be performed manually. A flashing red CONTROLS NOT IN AUTO light is provided to indicate when this switch is in the ***Manual*** position.

Voltage and frequency monitoring are provided for the emergency bus. Alarms are given for Bus Over or Under Voltage, and Bus Over Frequency. Bus Under Frequency results in an alarm and load shedding. All alarms are latching and manually reset by use of the **VOLTAGE/FREQUENCY FAILURE RESET** push button.

Generator bus metering is provided, a bus voltmeter, 0-15KV scale, with **VOLTMETER SELECTOR** switch marked: OFF, 1, 2, 3.

The following alarms and indicators are provided.

CONTROLS NOT IN AUTO (Red)
FREQUENCY ALARM (Amber)
ALARM HORN SILENCED (Amber)
PLC FAILURE (Red)
CRITICAL CONTROL VOLTAGE FAILURE (Red)
TRANSFER FAILURE (Red)
OPERATOR INTERFACE ALARM (Red)
TOUCH SCREEN DISABLED (Amber)
COMMUNICATION FAILURE (Red)

System No-Load Test

A System No-Load Test function is provided within the Touch Screen to permit supervised testing of the system. When this function is selected, the system automatically starts the standby engine-generator set. but the automatic transfer scheme will remain connected to the normal supply, and the generator circuit breakers remains open.

System Load Test

A System Load Test function is provided within the Touch Screen to permit supervised testing of the system. The utility bus can be tested via the operation of the Touch Screen. When this function is selected, and the system is in the close transition mode, the system automatically starts the standby engine-generator set, synchronizes it to the Utility source, and close the breaker to the bus. The controls will then gradually load the generator until a set point is reached when a trip signal will be sent to the Utility Circuit Breaker. This connects generator power to the load.

When the load test is terminated via the Touch Screen, the controls will again synchronize the generator to the Utility source, and when in synchronism a close signal will be sent to the Utility Circuit Breaker. The controls will then gradually unload the generator until a set point is reached when the generator circuit breaker will signaled to open. The controls will then run the generator through their cool-down mode.

The 15 KV Utility circuit breaker circuit breaker is protected by a **"Feeder Management Relay".** This relay is a multi function protective relay capable of the following devices. (27, 47, 50, 51, 51G, 59, 67, 81.) These devices are programmable within the relay. (Note: some of these devices may not be used. See the appropriate relay coordination documentation for more information.)

Each 15 KV Distribution circuit breaker circuit breaker is protected by a **"Feeder Management Relay".** This relay is a multi function protective relay capable of the following devices. (50, 51, & 51G) These devices are programmable within the relay. (Note: some of these devices may not be used. See the appropriate relay coordination documentation for more information.)

1.5 Load Controls

During generator operation, an under frequency or overload condition causes facility loads to be shed. Once the bus is restored to normal limits, any loads that were shed are restored in sequence. Add and shed signals for distribution circuit breakers control are included for all priorities except priority #1 circuit breakers, which need no controls. The feeder circuit breaker priorities may be adjusted through the Touch Screen. The priorities are 1, & 1A. Priority 1A will close to the bus after an adjustable time delay.

Upon detecting a bus under frequency condition load shedding will operate load control contacts similar to overload except at a more rapid shedding rate. This feature ensures the greatest continuity of service to the priority #1 loads. Automatic restoration of load occurs after the bus has returned to normal frequency and the under-frequency alarm has been reset using the **VOLTAGE/FREQUENCY FAILURE RESET** push button.

An Auto Load Shed function within the Touch Screen prevents overload load shed when disabled. This allows supervised loading of the engines up to their maximum rating. If an underfrequency condition occurs, the bypass is defeated and load shedding occurs as described previously (Note: The normal mode for this function is in the enabled mode.)

The Add (Non-Essential) Load function on the Touch Screen allow an operator to manually add lower priority distribution circuit breakers to the emergency generator system. Each time the Touch Screen function is depressed, the next distribution circuit breaker in *sequence* is added. This function remains functional only while the Auto Load Shed function is disabled.

The Load Shed function within the Touch Screen allows immediate load shed of the next lowest priority. Each time this function is operated, the next priority load is shed. This function remains functional in both manual and automatic operation; however, in the automatic mode, any shed load is re-added once the function is released, provided the bus is capable of increased load.

1.6 Customer Interface

Provisions are in place to allow the Building Management System (BMS) to directly connect into PLC to monitor the generator control and distribution switchgear. The CPU of PLC is equipped with a 25-pin D shell connector and configured for MODBUS/RTU communications.

All generator and system status and alarm points previously described are provided through this communications ports.

Provisions are in place to direct connect the CM-4000 circuit monitors to the Building management system via Ether connections at the circuit monitor.

The following are a list of dry contacts available for use by the building management system:

Bus Over Voltage	Communication failure	PLC fault
Utility power failure	Bus Under Frequency	Bus Over Frequency
Critical Control Voltage Failure	Gen Circuit Breaker Open	Gen Circuit Breaker Closed
System Not In Auto	Station Battery Charger Failure	Bus under Voltage
Transfer Failure	Fail to sync.	Gen. Pre-alarm Summary

1.7 Transfer Failure

If the PLC, Touch Screen, or the PC fail the system will allow manual start up at the engine skid. Hard wire controls will allow for open transition transfer of the Utility, and Generator Circuit Breakers.

If a transfer failure occurs while transferring the building loads to the generator source during a utility outage the following occurs.

(1) The controls have sensed a utility outage, and start the generator.

(2) A trip signal was sent to the utility circuit breaker, however the utility circuit breaker did not open.

(3) A transfer failure alarm is sounded and displayed on the Touch Screen.

(4) The Touch Screen defaults to the **One-Line Screen** displaying the transfer failure location.

(5) Once the operator manually opens the utility circuit breaker and resets the transfer failure alarm, the controls complete the transfer to the emergency source and the close signal is sent to the generator circuit breaker.

If a transfer failure occurs while transferring the building loads to the utility source after a utility outage the following occurs.

(1) The controls sense that utility power is available at the utility circuit breaker.

(2) The controls trip the generator circuit breaker.

(3) The controls then send a close signal to the utility main circuit breaker. (This circuit breaker doesn't close.)

(4) A transfer failure alarm is sounded and displayed on the Touch Screen.

(5) The Touch Screen defaults to the **One-Line Screen** and displays the transfer failure location.

(6) The controls send a close signal to the generator circuit breaker.

Once the operator determines why the utility main circuit breaker did not close the transfer failure can be reset.

(7) The controls then retransfer to the utility source by opening the generator circuit breaker, and closing the utility circuit breaker.

In the closed transition mode, the utility and generator sources will be paralleled to allow transfer without an interruption of power to the loads. Once initiated, a closed transition return to normal will automatically parallel the generator to the utility supply, followed by the closure of the Utility Circuit Breaker. The generator will then gradually unload. During any power transfers between the Utility and Generator sources, the loading and unloading of the generators will be at a controlled rate. When the generator has unloaded sufficiently, the Generator Breaker (52G) will trip, and the engine-generator will continue to operate unloaded for a 0-10 minute adjustable cooldown period. The closed transition mode is enabled at the Touch Screen.

If a transfer failure occurs (generator fail to unload or the generator breaker fails to trip) the building loads will be transferred back to the generator and the utility breaker will trip. The TRANSFER FAILURE light will illuminate and the horn will sound. Resetting the alarm will initiate another retransfer attempt.