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June 17, 2010

VIA E-MAIL & U.S. MAIL

Hon. Jaclyn Brilling Secretary State Board on Electric Generation Siting and the Environment Three Empire State Plaza, 14th Floor Albany, New York 12223-1350

Re: Case 08-F-1367 - Petition of Astoria Energy LLC and Astoria Energy II LLC, for the Amendment & Transfer of their Certificate of Environmental Compatibility & Public Need

Dear Secretary Brilling:

Enclosed please find a copy of Astoria Energy II LLC's Petition to Amend the Certificate to Allow for a New Submittal Date for the Relay Coordination Study.

Please contact me if you have any questions.

Very truly yours,

COUCH WHITE, LLP

Leonard H. Singer

Leonard H. Singer

LHS/dp Enclosure

cc: David Drexler, Esq. (Petition only via Hand Delivery) Active Parties in Case 99-F-1191 (Petition only via U.S. mail) S:\DATA\Client5 12200-12455\12307\corres\Brilling 6-17-10.doc

NEW YORK STATE BOARD ON ELECTRIC GENERATION SITING AND THE ENVIRONMENT

IN THE MATTER

-- of the --

Case 08-F-1367

Petition of Astoria Energy LLC and Astoria Energy II LLC, for the Amendment of Certificate of Environmental Compatibility and Public Need

ASTORIA ENERGY LL LLC'S PETITION TO AMEND THE CERTIFICATE TO ALLOW FOR A NEW SUBMITTAL DATE FOR THE RELAY COORDINATION STUDY

Pursuant to 16 NYCRR § 1000.15, Astoria Energy II LLC ("Astoria Energy II") hereby petitions the New York State Board on Electric Generation Siting and the Environment ("Siting Board") to amend the Certificate of Environmental Compatibility and Public Need ("Certificate") transferred to Astoria Energy LLC and Astoria Energy II on April 7, 2010 for the construction and operation of an electric generation facility in Queens, New York. Specifically, Astoria Energy II seeks to shorten the filing time for the Relay Coordination Study from twelve months to approximately eleven and a half months prior to commercial operation of Astoria Energy II's generation facility.

I. BACKGROUND

Astoria Energy LLC ("Astoria Energy") and Astoria Energy II separately own, operate, and control the two power blocks of the Astoria facility, which will ultimately comprise an approximately 1,240 MW, natural-gas fueled wholesale electric generation

complex in Queens County, New York ("Astoria Facility"). In New York State Public Service Commission ("Commission") Case No. 08-E-111¹, the Commission granted, <u>inter alia</u>, authorization for the transfer of ownership interests in the second power block of the Astoria Facility from Astoria Energy to Astoria Energy II. In Siting Board Case No. 08-F-1367², the Siting Board granted the request of Astoria Energy and Astoria Energy II to transfer the Certificate, issued for the Astoria Facility under Article X of the Public Service Law, to Astoria Energy and Astoria Energy II jointly. The second power block of the Astoria Facility is now separately owned by Astoria Energy II.

II. REQUESTED CERTIFICATE MODIFICATION

By this petition, Astoria Energy II seeks a modification to Certificate condition II. F (4), which refers to the submittal of a Relay Coordination Study. Certificate condition II. F (4) originally stated that Astoria Energy shall file with the Siting Board and the Commission a copy of a "Relay Coordination Study, which shall be filed not later than 18 months prior to the projected commercial operation date of the Project." Thereafter, on January 27, 2005, based on a request from Astoria Energy, the Board amended the Certificate by replacing Certificate condition II. F (4) with the following condition:

[A] Relay Coordination Study, which shall be filed at least 45

¹ Case 08-E-1111, Astoria Energy II LLC and Astoria Energy LLC- Petition for Approval of a Transaction pursuant to Public Service Law Section 70, Authority to issue debt Pursuant to Public Service Law section 69 and for Lightened Regulation and Request for Expedited Action, Order Approving Transfer and Financings and Making Other Findings (issued December 15, 2008).

² Case 08-F-1367, *Petition of Astoria Energy LLC and Astoria Energy II LLC for the Amendment and Transfer of Certificate of Environmental Compatibility and Public Need*, Order Granting Transfer and Amendment of Certificate of Environmental Compatibility and Public Need (issued April 7, 2009).

days prior to the projected first energization of the Facility's generator step-up (GSU) transformer at the 138 kV terminal interconnection; if the current projected first energization date of March 17, 2005 is revised, the Certificate Holder shall notify Consolidated Edison Company of New York, Inc. in writing within 3 business days of the decision to revise such date and the 45-day period shall apply to any revision of such date.³

Certificate condition II. F (4) was further modified to state that Astoria Energy II shall file with the Siting Board and the Commission a copy of "the Relay Coordination Study, which shall be filed not later than twelve months prior to the projected date for commencement of commercial operation of the facilities."

Astoria Energy II is currently in the process of constructing the second power block of the Facility and expects that power block to commence commercial operations in June 2011. Accordingly, Certificate condition II. F (4) required Astoria Energy II to file a copy of its Relay Coordination Study with the Siting Board and the Commission by June 1, 2010.

However, Astoria Energy II has only recently completed its Relay Coordination Study because the inputs needed to conduct the Relay Coordination Study have only recently become available. The completed the Relay Coordination Study is attached to this Petition.

Accordingly, Astoria Energy II is hereby requesting to shorten the time for filing the Relay Coordination Study by 2 weeks. Specifically, Astoria Energy II requests that Certificate Condition II. F (4) be revised to read as follows: "the Relay Coordination Study, which shall be filed not later than eleven and a half months prior to the projected date for

³ Case 99-F-1191, Application by Astoria Energy LLC for a Certificate of Environmental Compatibility and Public Need to Construct and Operate an Approximately 1,000 Megawatt Generating Facility in the Astoria Section of Queens County – Application for Amendment of Certificate Regarding Timing of Relay Coordination Study, Order Granting Amendment of Certificate of Environmental Compatibility and Public Need (issued January 27, 2005) at 4-5.

commencement of commercial operation of the facilities." Approval of this request will not result in any adverse impact on the environment or electric system. Also, it is significant to note that no adverse environmental or electric system impacts resulted from a previouis modification granted by the Board of the date required for the Relay Coordination Study to be filed under Certifcate condition II. F (4). Finally, because Astoria Energy II is requesting a modification of the filing date of the Relay Coordination Study of only approximately two weeks, such modification is de minimis.

III. CONCLUSION

For the reasons set forth herein, Astoria Energy II respectfully requests that the Siting Board grant this petition and amend the Certificate by changing the date for submission of the Relay Coordination Study.

Dated: June 17, 2010 Albany, New York

Respectfully submitted,

Leonard H. Singer

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PROJECT NAME: <u>CHARLES POLETTI SUBSTATION</u>

PROJECT NUMBER: <u>S029-011C</u>

CLIENT: <u>SNC LAVALIN CONSTRUCTORS INC.</u>

CALCULATIONS FOR: SHORT CIRCUIT AND RELAY SETTING

Rev.	Date	Description	Prepared	Review	Approved
А	11/09/2009	Issued for review	MSE	MSE	MSE
В	05/27/2010	Revised per NYPA and Con Ed's comments	MSE	MSE	MSE
С	06/04/2010	Revised per Con Ed's provided relay data	MSE	MSE	MSE

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EXECUTIVE SUMMARY

INTRODUCTION

A new 345kV SF6 gas insulated substation, Charles Poletti Substation, is to be constructed to support a new 650 MW combined cycle power plant, Astoria Energy II Plant (AEII Plant). The configuration of Charles Poletti Substation will be a five breaker ring bus with four installed breakers and one future breaker position. The Charles Poletti Substation will be the point of connection (POI) between the AEII Plant and existing 345kV Feeders Q35L and Q35M, owned by NYPA. These two feeders, along with Con Edison's 345kV Feeder B47 and Feeder 48, are each part of a three terminal feeder system operating between Con Edison's Farragut and East 13th Street Substations and NYPA's Poletti Generating Station. The Poletti Generating Station and its existing 345kV substation are to be retired from service and replaced by the Charles Poletti Substation. The Q35L and Q35M Feeders will each connect to a different bus section in the Charles Poletti Substation. Existing 345kV Shunt Reactors R1 and R2, utilized for Feeder Q35L and Q35M, will be relocated from the retired Poletti Substation to the Charles Poletti Substation.

The Charles Poletti Substation will be designed as a bulk power system facility. The protection system design must be in accordance with applicable NPCC criteria. The protection at the Charles Poletti Substation consists of the following new microprocessor based primary and secondary protection packages.

A. Q35L and Q35M Line Relaying

- a) Primary Line Protection System (21L-P / 21GL-P)
 - i. Relay: Areva P546
 - ii. Scheme: Direct Under-reaching Transfer Trip (DUTT)
 - iii. Communications (DTT):
 - 1. Route 1: Verizon T1 via RFL Gard 8000
 - 2. Route 2: Con Ed CCTN via RFL IMUX 2000
- b) Secondary Line Protection System (21L-S / 21GL-S)
 - i. Relay: SEL 311L
 - ii. Scheme: Direct Underreaching Transfer Trip (DUTT)
 - iii. Communications (DTT):
 - 1. Route 1: Verizon T1 via RFL Gard 8000
 - 2. Route 2: Con Ed CCTN via RFL IMUX 2000

A new two position Zone 2 Timer Bypass switch, identical in design and function as the switch provided at the Farragut Substation, is to be installed at Charles Poletti Substation.

c) High Set Fault Protection (50HS)

- i. Relay: Function with Areva P546 and SEL 311L relays described in a) and b) above
- ii. Scheme: High Set Non-directional Phase Overcurrent

This protection will be programmed into the Primary and Secondary Line Protection System's numerical relays (Areva P546 and SEL 311L) as a separate function and will provide high speed direct trip for all internal close-in phase faults. The 50HS function must not operate for remote bus faults or reverse faults (local line end) with appropriate operating margin. If this function cannot be set securely, then it shall not be used.

d) Stub Bus Protection (50SB)

i. Relay: Function with Areva P546 and SEL 311L relays described in a) and b) above This protection will be programmed into the Primary and Secondary Line Protection System's numerical relays (Areva P546 and SEL 311L) as a separate function and will be used to detect faults for the system operating condition with the associated line ring bus breakers closed and the line motor operated disconnect (MOD) switch open. The function is to be supervised by the MOD's 89b contact or other combination. This protection is not required if the voltage source is on the bus side of the MOD.

e) Switch-On-To-Fault Protection (50SOTF)

i. Relay: Function with Areva P546 and SEL 311L relays described in a) and b) above This protection will be programmed into the Primary and Secondary Line Protection System's numerical relays (Areva P546 and SEL 311L) as a separate function and will only be armed when the circuit breakers are open and the associated line is de-energized. While closing the first circuit breaker to energize the line this function shall only be in service for the first 15 cycles and will reset if no fault is detected.

f) Directional Ground Overcurrent Backup Protection (67N)

i. Relay: Function with Areva P546 and SEL 311L relays described in a) and b) above This protection will be programmed into the Primary and Secondary Line Protection System's numerical relays (Areva P546 and SEL 311L) as a separate function. The time-overcurrent (TOC) function will be used to provide backup protection for ground faults on the system. The instantaneous-overcurrent (IOC) function can be used to provide close-in ground fault detection if it can be set selectively. B. Breaker Failure Relaying

- a) Primary Breaker Failure Relaying (50BF/62-P)
 - i. Relay: Areva P141
 - ii. Communications: same routes as A. (a.)(iii.) above
- b) Secondary Breaker Failure Relaying (50BF/62-S)
 - i. Relay: GE C60
 - ii. Communications: same routes as A. (b.)(iii.) above

Although NPCC does not require dual breaker failure protection systems, the Charles Poletti Substation is designed with dual and independent breaker failure protection systems for maintenance and testing conditions. Separate primary and secondary relays of different manufacture are used for this protective function.

The fault detectors are used and set to supervise the relay operation. Normal operation of the breaker failure relaying system will energize a lockout relay after an acceptable time delay to trip all the local breakers and initiate the direct transfer trip system to open all the associated remote breakers.

- C. SF6 Bus Protection Relaying
 - a) Primary Bus Protection Relaying (87B-P)
 - i. Relay: SEL 387
 - ii. Scheme: Current Differential for fault targeting only; no tripping function except as noted below.
 - iii. The primary bus protection relaying (87B-P) will be provided for all bus sections in the Charles Poletti Substation and will be a permanent system. It will normally provide fault targeting for all ring bus sections. Initially, the 87B-P will trip circuit breakers CB-2 and CB-5 for bus faults on the bus section between these two breakers. When the future facility's interconnecting line is connected to this bus section, the 87B-P will be used for fault targeting only.
 - b) Secondary Bus Protection Relaying (87B-S only)
 - i. Relay: GE B30
 - ii. Scheme: Low Impedance Current Differential
 - iii. The secondary bus protection relaying (87B-S) will initially trip circuit breakers CB-2 and CB-4 for bus faults on the bus section between these two breakers. When

the future interconnecting line is installed, the secondary bus protection relay (87B-S) will be removed from service.

c) When the future facility is installed, new primary and secondary line protection relays will be designed and installed to protect the new interconnecting line.

D. Q35L and Q35M Current Differential Relaying

a) Primary Current Differential Relaying (85)

i. Relay: SEL 311L (Stand-alone)

ii. Communications:

1. Route 1: Verizon T1 via RFL Gard 8000 (only).

This system will include primary relays only, no secondary relaying is required. The primary function of this relay scheme will be to provide line fault targeting only; the tripping function will be enabled for certain feeder configurations. Two current differential systems will be configured; one will operate between Charles Poletti Substation and East 13th Street and the other will operate between East 13th Street and Farragut.

E. Shunt Reactor R1 and R2 Protection Relaying

a) Primary Shunt Reactor Protection (87R1(R2)-P / 51R1 (R2)-P)

i. Relay: SEL 387

ii. Scheme: Current Differential / Time Overcurrent

iii. Communications: same routes as A. (a.)(iii.) above

b) Secondary Shunt Reactor Protection (87R1& (R2)-S / 51R1& (R2)-S)

i. Relay: GE T60

ii. Scheme: Low Impedance Differential / Time Overcurrent

iii. Communications: same routes as A. (b.)(iii.) above

The existing Poletti Shunt Reactors R1 and R2 will be relocated to Charles Poletti Substation.

Both reactors are oil-filled type and equipped with sudden pressure relays (63SP) set to trip.

F. Generator (AEII Plant) - GIS (Charles Poletti Substation) Interconnection Cable Relaying

a) Primary Interconnecting Line Differential Relaying (85L1-P)

i. Relay: Areva P546

ii. Scheme: Current Differential with Distance Back-up

50HS, 50SB, 50SOTF and 67N are considered as A.(c) through A.(f) above.

iii. Communications: Dedicated Fiber Optic (Cable 1)

- b) Secondary Interconnecting Line Differential Relaying (85L1-S)
 - i. Relay: SEL 311L

ii. Scheme: Current Differential with Distance Back-up

50HS, 50SB, 50SOTF and 67N are considered as A.(c) through A.(f) above.

iii. Communications: T1 network (using an IMUX 2000 as the T1 interface).

G. Automatic Circuit Breaker Reclosing (79)

Automatic circuit breaker reclosing relays (79) are not required for Charles Poletti Substation.

H. Synchronism Check Relaying

Synchronism check relays will not be required for Charles Poletti Substation.

SCOPE OF WORK

The study addresses 345kV line protection setting, 345kV bus differential settings, and 345kV breaker failure settings etc at the Charles Poletti Substation and relay coordination between Charles Poletti Substation and its connected adjacent substations.

METHODOLOGY

The system model in ASPEN software has been received from NYISO. We have added the planned relay settings in the model. The short circuit calculation, protection calculation and coordination study were performed using ASPEN model.

ASSUMPTION

Charles Poletti Substation relay settings are set for addition of Astoria Energy II Plant (AEII Plant) only. When adjacent BERRIANS 3 station is added in the future as indicated in NYSIO Aspen model "NYISO_2012_Q308_ON.orl", reviewing and revising of Charles Poletti Substation relay setting may be necessary.

SHORT CIRCUIT STUDY

Short circuit study results at Charles Poletti Substation have been provided and can be found in Appendix 27. The results generated by ASPEN show fault values for Three-Phase-to-ground,

Phase-to-Ground, Phase-to-Phase-to-Ground and Phase-to-Phase. The numbers shown are fault magnitudes, in amps for faults at the corresponding bus. The Thevenin equivalent impedance in ohms, X/R ratio and fault angles are also given in the ASPEN report.

RELAY COORDINATION

A. Relay Coordination between Charles Poletti Station and Farragut Station

Q35L/Q35M line directional ground over-current backup protection (67N) at Charles Poletti station is set to trip for a ground fault at Farragut 345kV bus with 0.52 ~ 0.69 second time delays as shown in Appendix 28. Coordination between Q35L/M-67N at Charles Poletti and Farragut directional over-current relays has been done with the following worse case considerations:

(1) The strongest source is from upstream relay in order to have the fastest upstream relay clearing time;

(2) One of the strongest local sources to downstream relay is out of service (N-1 contingency), so that the downstream relay will clear a fault with relative slow speed comparing with normal condition.

(3) Q35L or Q35M is out of service is also considered for a fault at Farragut station, so that all the fault contributions from Charlie Poletti will not be shared by both Q35L and Q35M, and the Q35L-67N or Q35M-67N at Charlie Poletti will see the maximum contribution from Charlie Poletti.

As shown in Appendix 28, the minimum coordination time interval (CTI) is 0.25 second per case 19 which a single phase to ground fault is at relay (67N-1/B7E or 67N-2/B7E) or feeder 48 close-in with the largest source (Line 41) out of service and maximum contribution from Charlie Poletti station and line Q35M at Charlie Poletti out of service. This is considered acceptable since the 0.25 second CTI will only happen when the high speed pilot relaying schemes at feeder 48 fail to operate for the fault, with both line 41 at Farragut and line Q35M at Charlie Poletti out of service.

Q35L/Q35M-67N setting will also ensure its proper coordination with Farragut protection by considering Con Ed standard breaker failure timer of 160 ms for a ground fault. Q35L/Q35M

line high set fault protection (50HS) and directional instantaneous-over-current function are not used at Charles Poletti station side since they cannot be set securely.

Per case 20 through case 25 in Appendix 28, 67N-1/B7E or 67N-2/B7E for B47 at Farragut, or 67N-1/F2W or 67N-2/F2W for 48 at Farragut will also properly coordinate with the 67N elements used Charlie Poletti for a relay close in fault.

B. Relay Coordination between Charles Poletti Station and East 13th street Station

Relay coordination between Charles Poletti Station and East 13th street station is as shown in Appendix 29. The minimum CTI is 0.53 second which is acceptable. It is noted that coordination between Q35L-67N or Q35M-67N at Charlie Poletti and 67N/48 or 67N/B47 at East 13th street for a relay close-in fault at East 13th line 48 or B47 is not needed, since there is no 345kV breaker at East 13th station. Q35L/Q35M line distance elements at Charles Poletti Station are set per NYPA & Con Ed standard and will not over-reach transformer low side at East 13th street station. It is also noted that the ground fault contribution differences between the existing Poletti Station and the new Charles Poletti station is neglectable. No ground over-current relay setting change at East 13th street is found necessary due to the modifications to the system caused by this project.

C. Relay Coordination between Charles Poletti Station and Astoria Energy II Plant Station Relay coordination between Charles Poletti Station and Astoria Energy II Plant Station is not stringently required since there is no breaker at 345kV side of Astoria Energy II Plant Station, and distance elements at Charles Poletti Station side for the line between two stations are set per NYPA & Con Ed standard and will not over-reach transformer low side at Astoria Energy II Plant Station.

RELAY LOADABILITY CHECK

Per Standard PRC-023-1 Transmission Relay Loadability, each transmission owner, generator owner, and distribution provider shall evaluate relay loadability at 0.85 per unit voltage and a power factor angle of 30 degrees. Per equation from *Power System Relaying* by Stanley H. Horowitz, and Arun G. Phadke,

Loadability S = $(kV_{L-L})^2$ / Zsec / cos(Z1ANG-30) * (CTR/PTR). Where, kV_{L-L} – system line to line voltage, 0.85 per unit voltage shall be used per PRC-023-1.

Zsec – distance element with the longest reach setting in secondary ohm.

Z1ANG – transmission line angle.

CTR – CT ratio.

PTR – PTR ratio.

For either 345kV Q35L or Q35M line, Zone 2 setting is the distance element with the longest reach as Z2P = 0.98 secondary ohm. kV_{L-L} is 0.85*345. Line angle Z1ANG is 78.20. CTR is 600 and PTR is 3000. Zone 2 loadability is 26329.22 MVA. This is far more than 150% of the highest seasonal facility rating of the line, or 115% of the highest seasonal 15-minute facility rating of the line, or 115% of the maximum theoretical power transformer capability.

For 345kV line from Charles Poletti to Astoria II generation station, Zone 2 setting is the distance element with the longest reach as Z2P = 0.1 secondary ohm. kV_{L-L} is 0.85*345. Line angle Z1ANG is 83.96. CTR is 600 and PTR is 3000. Zone 2 loadability is 293235.87 MVA. This is far more than 150% of the highest seasonal facility rating of the line, or 115% of the highest seasonal 15-minute facility rating of the line, or 115% of the maximum theoretical power transformer capability.

CONCLUSION

Adequate protection at 345kV Charles Poletti Substation and proper coordination with the relays in its connected adjacent stations have been developed and demonstrated by this study.

REFERENCE

- 1. NYPA Protection Application Document For the 345kV SF6 Gas Insulated Substation, Revision 1.
- 2. NYPA Relay Settings Database for Poletti Station.
- 3. Power System Relaying By Stanley H. Horowitz, Arun G. Phadke

Appendix 01 11L-1-Q35L (Areva-P546) Setting Calculation

1. E	Data
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MVA_Base =	100	kV_Base =	345	Z_Base =	1190.25	ohms
CTR =	600	PTR =	3000	CTR/PTR=	0.2	
Line ID	From	То	R1(ohms)	X1(ohms)	R0(ohms)	X0(ohms)
Q35L+B47	Charles Poletti	FARRAGUT	0.499905	2.3924025	4.308705	6.1297875

Secondary Ohms = Primary Ohms • (CTR/PTR)

Line ID	From	То	R1(2nd ohm)	X1(2nd ohm)	R0(2nd ohm)	X0(2nd ohm)
Q35L+B47	Charles Poletti	FARRAGUT	0.10	0.48	0.86	1.23

Z1 = Sqrt (R1*R1+X1*X1)		Z1Ang = Arctan (X1/R1)		Z0 equations are the same.		
Line ID	From	То	Z1(2nd ohm)	Z1Ang	Z0(2nd ohm)	Z0Ang
Q35L+B47	Charles Poletti	FARRAGUT	0.49	78.20	1.50	54.90

2. Setting Criteria

2.1 Set Zone 1 phase distance at 87% of the line impedance with no time delay.

2.2 Set Zone 2 phase distance at 200% of the line impedance with 0.35 second delay. (ConEd 0.3s)

 $2.3\ \text{Set}\ \text{Zone}\ 1\ \text{ground}\ \text{distance}\ \text{at}\ 70\%\ \text{of}\ \text{the}\ \text{line}\ \text{impedance}\ \text{with}\ \text{no}\ \text{time}\ \text{delay}.$

2.4 Set Zone 2 ground distance at 200% of the line impedance with 0.6 second delay. (ConEd 0.3s) 2.5 Line differential and other distance elements are not used.

2.6 High Set Fault Protection (50HS):

For 3LG fault at Charles Poletti 345kV bus, the fault contributions are as following.





50HS shall provide high spped direct trip for all internal close-in phase faults and must not operate for remote bus faults or reverse faults with appropriate operating margin. Based on the fault current contribution above, 50HS if set to clear a fault of 24,893 Amp, it may false trip for a reverse fault (21,423 Amp), especially when Q35M is out of service (33,943 Amp), so 50HS cannot be set securely and therefore is disabled.

Noted that the Aspen model (NYISO_2012_Q308_ON) provided by NYISO shows a higher fault level due to consideration of future BERRIANS 3 station. However, it will not impact the conclusion.

2.7 Stub Bus Protection (50SB):

The voltage source of 11L-1-Q35L (Areva-P546) relay is at the bus side of the MOD, so 50SB is not required.

2.8 Switch-On-To-Fault Protection (50SOTF)

50SOTF will only be armed when the circuit breakers are open and the asscoated line is de-energized. While closing the first circuit breaker to energize the line this function shall only be in service for the first 15 cycles and will reset if no fault is detected. 50SOTF is fulfilled by SOTF tripping Zone 2 with 200 ms dropout timer, instead of 15 cycles or 250 ms drop-out timer, due to 100 ms step of the setting. 2.9 Directional Ground Overcurrent Backup Protection (67N)

67N will be used to provide backup protection for ground faults on the system. 67N pickup shall be higher than the worst unbalance and can be set at 1/3 of maximum full load (1255Amp/600/3=0.7Amp). US inverse is the selected curve for this time delay element. It shall coordinate with primary protection with a proper CTI (Coordination Time Interval) and trip a ground fault at Farragut 345kV with 0.69 second time delays under normal and 0.52 second time delay when the Q35M line is out. Refer to Appendix 28 for TCC.

The instantaneous -overcurrent (IOC) function can be used to provide close-in ground fault detection if it can be set selectively.

Applying 2LG and 1LG faults at Farragut 345kV bus under four conditions of normal, B47 out, Line 48 out, and Q35M out, the maximum ground fault current seen by 11L-1-Q35L relay would be a 2LG at Farragut 345kV bus with line 48 out, and is 6484.00 Amp

Appendix 01 11L-1-Q3	5L (Areva-P546) Setting Calculatio	'n
With margin of 30% ,	IOC = 8429.20 Primary Amp	
However, applying 1LG faults at AEII Generation	n station, Aspen voltage sag analysis shows	0.003 pu
voltage or 0.2V secondary at 11L-1-Q35L relay.	With voltage below 1V, directionality is in do	ubt. With fault
level of more than 40kA at AEII Generation stati	on 345kV bus, falsely tripping is possible. So	o, it is not
recommended to use 67N-IOC.		
<u>SYSTEM DATA:</u>		
	= English	
Sys Fn Links		
Decliption : Plant Reference		
CB CONTROL	- 00 112	
CB Control by	= Disabled	
Rst CB mon L0 by	= CB Close	
CB mon Lo RstDly	= 5.000 S	
CB1 Status Input	= 52B 3 pole	
CB Status Time	= 5.000 S	
CB2 Status Input	= 52B 3 pole	
DATE AND TIME:		
IRIG-B Sync	= Enabled	
Battery Alarm	= Enabled	
Other Time Settings	= Default	
CONFIGURATION:		
Setting Group	= Select via Menu	
Active Settings	= Group 1	
Setting Group 1	= Enabled	
Setting Group 3	= Disabled	
Setting Group 4	– Disabled	
Distance	= Enabled	# 2171 2172
Directional E/F	= Disabled	# Not used
Phase Diff	= Disabled	# Not used
Overcurrent	= Disabled	# Not used
Neg Sequence O/C	= Disabled	# Not used
Broken Conductor	= Disabled	# Not used
Earth Fault	= Enabled	# 67N
Sensitive E/F	= Disabled	# Not used
Residual O/V NVD	= Disabled	# Not used
Thermal Overload	= Disabled	# Not used
PowerSwing Block	= Disabled	# Not used
Volt Protection	= Disabled	# Not used
Freq Protection	= Disabled	# Not used
df/dt Protection	= Disabled	# Not used
	= Disabled	# NOT USED
Supervision	= Enabled	
System Checks	– Disabled – Disabled	
Innut Labels	= Visible	
Output Labels	= Visible	

Appendix	01 11L-1-Q35	L (Areva-P546)	Setting Calc	ulation
	CT & VT Ratios =	Visible		
	Record Control =	Visible		
	Disturb Recorder =	Visible		
	Measure't Setup =	VISIDIE		
	Comms Settings =	VISIDIE		
	Commission Tests =	VISIDIE		
	Setting values =	Secondary		
	Control inputs =	Invisible		
	Ctrl I/P Labels -	Invisible		
	Direct Access -	Enabled		
	InterMiCOM 64 -	Disabled		
	Function Key –	Invisible		
	I CD Contrast =	11		
CT AND VT RATIOS				
	Main VT Primary =	345.0 kV		
	Main VT Sec'v =	115 0 V		
	CB1 CS VT Prim'v =	345.0 kV		
	CB1 CS VT Sec'v =	115.0 V		
	CB2 CS VT Prim'v =	345.0 kV		
	CB2 CS VT Sec'y =	115.0 V		
	Phase CT Primary =	3000 A		
	Phase CT Sec'y =	5.000 A		
	SEF CT Primary =	1.000 A		
	SEF CT Secondary =	1.000 A		
	MComp CT Primary =	1.000 A		
	MComp CT Sec'y =	1.000 A		
	CS Input =	A-N		
	CT1 Polarity =	Standard		
	CT2 Polarity =	Standard		
	SEF CT Polarity =	Standard		
	M CT Polarity =	Standard		
	VT Connected =	Yes		
	CB1 CS VT PhShft =	0 deg		
	CB1 CS VT Mag =	1		
	CB2 CS VI PhShft =	0 deg		
	CB2 CS VT Mag =	1		
MEASURE T SETUP:	Defeult Disaleur			
	Default Display =	3Ph + N Current		
	Local Values =	Primary		
	Mooguromont Dof -			
	Measurement Mode -	0		
	Fix Dem Period -	0 30.00 min		
	Roll Sub Period -	30.00 min		
	Num Sub Periode -	1		
	Distance I Init =	Miles		
	Fault Location =	Distance		
COMMISSION TESTS				
	Monitor Bit 1 =	1060		#

Red LED1

Appendix 0 ⁴	1 11L-1-Q35	L (Areva-P	546) Setting Calcula	tion
<u>CB MONITOR SETUP:</u>	Monitor Bit 2 = Monitor Bit 3 = Monitor Bit 4 = Monitor Bit 5 = Monitor Bit 6 = Monitor Bit 7 = Monitor Bit 8 = All disabled	1062 1064 1066 1068 1070 1072 1074		# Red LED2 # Red LED3 # Red LED4 # Red LED5 # Red LED6 # Red LED7 # Red LED8 # Not required
OPTO CONFIG:	Global Nominal V = Opto Filter Cntl = Characteristic =	110/125V 11111111111 Standard 60%	111111111111 6-80%	
CONTROL INPUTS:		Not used		
CTRL I/P CONFIG: CTRL I/P LABELS:		Not used		
OTRE I/F LADELO.		NUL USEU		
Group 1: GROUP 1 LINE PARAMETE	RS:			
	Line Length =	9.635 mi		
	Line Impedance =	0.49	Ohm	
	Line Angle =	79.00	deg	
	kZN Res Comp =	0.73		
	kZN Res Angle =	-34.00		
	Mutual Comp =	Disabled	_	
	Phase Sequence =	Standard ABC		
		3 Pole		
		3 Pole		
GROUP T DISTANCE SETU	<u>IP:</u> Sotting Mode -	Advanced		
	Bhase Chore -	Auvanceu		
	Zono 1 Dh Statur -	Enabled		
	Zone 2 Ph Status =	Enabled		
	Zone 2 Ph Status =	Disabled		
	Zone / Ph Status =	Disabled		
	Ground Chars -	Ouad		
	Zone 1 Grid Stat -	Enabled		
	Zone 2 Grid Stat -	Enabled		
	Zone 3 Gnd Stat -	Disabled		
	Zone P Gnd Stat -	Disabled		
	Zone 4 Gnd Stat. =	Diabled		
	Digital Filter =	Standard		
	CVT Filters =	Disabled		# VT is used
	Load Blinders =	Disabled		# Default
	Dist. Polarizina =	1		
	Dir. Status =	Enabled		
	AidedDeltaStatus =	Disabled		
	Dir. Char Angle =	60.00 deg		# Default

Appendix 01	11L-1-Q35	L (Areva-P	546) Setting Calculation
GROUP 1 DIST. ELEMENTS:			
Z	1 Ph. Reach =	420.000	mOhm
-	Z1 Ph. Angle =	79.00	deg
R1 F	Ph. Resistive =	5	Ohm
Z1	Tilt Top Line =	-3	deg
Z1 S	Sensit. Iph>1 =	0.25	A
Z	2 Ph. Reach =	980	mOhm
2	Z2 Ph. Angle =	79.00	deg
R2 F	Ph. Resistive =	5	Ohm
Z2	Tilt Top Line =	-3	deg
Z2 S	Sensit. Iph>2 =	0.25	A
Z1	Gnd. Reach =	340	mOhm
Z1	Gnd. Angle =	79.00	deg
Z1	Dynamic Tilt =	Enabled	-
Z1	Tilt Top Line =	-3	deg
kZN1	Res. Comp =	0.73	-
kZN	1 Res. Angle =	-34.00	deg
R1 G	nd Resistive =	5	Ohm
Z1 S	ensit Ignd>1 =	0.25	A
Z2	Gnd. Reach =	980	mOhm
Z	2 Gnd. Angle =	79.00	deg
Z2	Dynamic Tilt =	Enabled	0
Z2	Tilt Top Line =	-3	deg
kZN2	Res. Comp. =	0.73	,
kZN2	2 Res. Angle =	-34.00	
R2 G	nd Resistive =	5	Ohm
Z2 S	ensit Ignd>2 =	0.25	A
GROUP 1 SCHEME LOGIC:			
Zon	e1 Tripping =	Phase And Gr	ound
tž	Z1 Ph. Delay =	0	S
tZ	1 Gnd. Delay =	0	S
Zon	e2 Tripping =	Phase And Gr	round
tž	Z2 Ph. Delay =	350	ms
tZ2	2 Gnd. Delay =	600	ms
Zon	e3 Tripping =	Disabled	
Zone	eP Tripping =	Disabled	
Zon	e4 Tripping =	Disabled	
Aid	l. 1 Selection =	Disabled	
Aid	l. 2 Selection =	Disabled	
S	SOTF Status =	Enabled Pole	Dead
	SOTF Delay =	600	ms
SC	DTF Tripping =	100010	# Allow fast fault clearance and Zone 2
	TOR Status =	Disabled	
TOCI	Reset Delay =	200	ms, # In 100ms step, 250ms in 311L.
	TOC Delay =	200	ms
Z	21 Extension =	Disabled	
	OL Scheme =	Disabled	

Appendix 01	11L-1-Q35	5L (Areva-P	546) Se	etting Calculation	on
GROUP 1 EARTH FAULT:					
	IN>1 Status =	Enabled			
	IN>1 Function =	US Inverse			
	IN>1 Directional =	 Directional Fv 	vd		
	IN>1 Current Set =	: 700.00	mA		# 67N
	IN>1 Time Dial =	: 2.5			
	IN>1 Reset Char =	: DT			
	IN>1 tRESET =	: 0	S		
	IN>2 Status =	Disabled			
	IN>3 Status =	Disabled			
	IN>4 Status =	Disabled			
	IN> Blocking =	: 000001	1		# BIOCK IN>1
	IN> Char Angle =	-60	deg		# Default
	IN> Polarisation =	 Zero Sequence 	ce		// NA 1
	IN> VINPOI Set =	= 1.000	V		# Minimum
GROUP 1 CB FAIL & P.DEAI	<u>D:</u>	050.0-4			// Defeult
		= 250.0mA			# Delault
	ISEF< Current =	= 100.0mA			# Delault
	v< =	= 10.0 V			
GROUP I SUPERVISION.	VTS Mode -				
	– Subin CTV – Sutets ZTV	· Blocking	пу		
	VTS Reset Mode -				
	VTS Time Delay =	5 000 s			
	VTS I> Inhibit =	: 3 150 A			
	VTS I2> Inhibit =	= 250.0 mA			
	l>2nd Harmonic =	: 10.00%			
	WI Inhibit =	Disabled			
	CTS Mode =	Disabled			
GROUP 1 INPUT LABELS:					
	Opto Input 1	Spare			
	Opto Input 2	Spare			
	Opto Input 3	Zone 2 Timer	Вур		
	Opto Input 4	Spare	• •		
	Opto Input 5	52b/1 status			
	Opto Input 6	52b/3 status			
	Opto Input 7	89b/FQ35L sta	atus		
	Opto Input 8	89b/F1 status			
	Opto Input 9	86TT-1/Q35L	stat		
	Opto Input 10	86TT-1/Q35L	alm		
	Opto Input 11	86-1/Q35L sta	atus		
	Opto Input 12	86-1/Q35L alr	m		
	Opto Input 13	11LTSS-1A/C	235L M		
	Opto Input 14	11LTSS-1B/C	235L M		
	Opto Input 15	89b/GS9/A st	atus		
	Opto Input 16	89b/GS9/B st	atus		
	Opto Input 17	89b/GS9/C st	atus		
	Opto Input 18	TILISK-1A/G			
		TILISK-1B/G	192 IVI		
	Opto input 20	Spare			

Appendix 01	11L-1-Q35L (Areva-P546) Setting Calculation	on
	Opto Input 21 Spare Opto Input 22 Spare Opto Input 23 Spare Opto Input 24 Spare	
GROUP I OUTPUT LABELS.	Relay 1 Any Trin (SER)	
	Relay 2 67N TRIP	
	Relay 3 21(ZONE2) TRIP	
	Relay 4 21&21G TRIP	
	Relay 5 50SOTF TRIP	
	Relay 6 Spare	# 50HS
	Relay 7 Spare	
	Relay 8 Spare	
	Relay 9 Spare	
<u>GROUP 1 OUTPUT LABELS:</u>		
	Relay 10 Spare	
	Relay 11 Spare	
	Relay 12 Spare	
	Relay 13 Spare	
	Relay 14 Spare	
	Relay 15 Spare	
	Relay 17 Spare	
	Relay 18 Spare	
	Relay 19 Spare	
	Relay 20 Spare	
	Relay 21 Spare	
	Relay 22 Spare	
	Relay 23 Spare	
	Relay 24 Spare	
	Relay 25 Spare	
	Relay 26 Spare	
	Relay 27 Spare	
	Relay 28 Spare	
	Relay 29 Spare	
	Relay 30 Spare	

Relay 31 Spare Relay 32 Spare

Appendix 02 11L-2-Q35L (SEL-311L) Setting Calculation

1. D	lata
------	------

MVA_Base =	100	kV_Base =	345	Z_Base =	1190.25	ohms
CTR =	600	PTR =	3000	CTR/PTR=	0.2	
Line ID	From	То	R1(ohms)	X1(ohms)	R0(ohms)	X0(ohms)
Q35L+B47	Charles Poletti	FARRAGUT	0.499905	2.3924025	4.308705	6.1297875

Secondary Ohms = Primary Ohms • (CTR/PTR)

Line ID	From	То	R1(2nd ohm)	X1(2nd ohm)	R0(2nd ohm)	X0(2nd ohm)
Q35L+B47	Charles Poletti	FARRAGUT	0.10	0.48	0.86	1.23

Z1 = Sqrt (R1*R	1+X1*X1)	Z1Ang = Arcta	n (X1/R1)	Z0 equations	s are the same.	
Line ID	From	То	Z1(2nd ohm)	Z1Ang	Z0(2nd ohm)	Z0Ang
Q35L+B47	Charles Poletti	FARRAGUT	0.49	78.20	1.50	54.90

2. Setting Criteria

2.1 Set Zone 1 phase distance at 87% of the line impedance with no time delay.

2.2 Set Zone 2 phase distance at 200% of the line impedance with 0.35 second delay.

2.3 Set Zone 1 ground distance at 70% of the line impedance with no time delay.

2.4 Set Zone 2 ground distance at 200% of the line impedance with 0.6 second delay.

2.5 Line differential and other distance elements are not used.

2.6 High Set Fault Protection (50HS):

For 3LG fault at Charles Poletti 345kV bus, the fault contributions are as following.





50HS shall provide high spped direct trip for all internal close-in phase faults and must not operate for remote bus faults or reverse faults with appropriate operating margin. Based on the fault current contribution above, 50HS if set to clear a fault of 24,893 Amp, it may false trip for a reverse fault (21,423 Amp), especially when Q35M is out of service (33,943 Amp), so 50HS cannot be set securely and therefore is disabled.

Noted that the Aspen model (NYISO_2012_Q308_ON) provided by NYISO shows a higher fault level due to consideration of future BERRIANS 3 station. However, it will not affect the conclusion. 2.7 Stub Bus Protection (50SB):

The voltage source of 11L-2-Q35L (SEL-311L) relay is at the line side of the MOD, so 50SB is required. 50SB is to be enabled only when MOD is open, i.e. supervised by MOD's 89b, see 67P2TC setting. For normal load current or external fault current through the stub bus, the current will ideally be zero. Set 50SB pickup at 150% of the maximum full load current by considering all three GSUs with a possibility of one set of CT test switches left shorted.

Total MVA of all three GSUs = 750 ; Maximum full load current (amps) = 1255.11 2.8 Switch-On-To-Fault Protection (50SOTF)

50SOTF will only be armed when the circuit breakers are open and the asscoated line is de-energized. While closing the first circuit breaker to energize the line this function shall only be in service for the first 15 cycles and will reset if no fault is detected. 50SOTF pickup can be set the same as 50SB.

2.9 Directional Ground Overcurrent Backup Protection (67N)

67N will be used to provide backup protection for ground faults on the system. 67N pickup shall be higher than the worst unbalance and can be set at 1/3 of maximum full load (1255Amp/600/3=0.7Amp). US inverse is the selected curve for this time delay element. It shall coordinate with primary protection with a proper CTI (Coordination Time Interval) and trip a ground fault at Farragut 345kV with 0.69 second time delays under normal and 0.52 second time delay when the Q35M line is out. Refer to Appendix 28 for TCC.

The instantaneous -overcurrent (IOC) function can be used to provide close-in ground fault detection if it can be set selectively.

Appendix 02 11L-2-Q35L (SEL-311L) Setting Calculation

Applying 2LG and 1LG faults at Farragut 345kV bus under four conditions of normal, B47 out, Line 48 out, and Q35M out, the maximum ground fault current seen by 11L-2-Q35L relay would be a 2LG at Farragut 345kV bus with line 48 out, and is 6484.00 Amp With margin of 30% , IOC = 8429.20 Primary Amp However, applying 1LG faults at AEII Generation station, Aspen voltage sag analysis shows 0.003 pu voltage or 0.2V secondary at 11L-2-Q35L relay.With voltage below 1V, directionality is in doubt. With fault level of more than 40kA at AEII Generation station 345kV bus, falsely tripping is possible. So, it is not recommended to use 67N-IOC.

Group 1 - Set 1:		
General Settings:		
Relay ID	RID = 11L-2-Q35	5L
Terminal ID	TID = CHARLES	S POLETTI
CT Ratio	CTR = 600	
Application	APP = 311L	
Advanced Setting Enable	EADVS = N	
Line Current Differential Settings: Not used		
All 87L settings are off or as default		
Backup Protection and Line Parameters:		
Polarizing (IPOL) CT Ratio	CTRP = 600	# Not used
Phase PT Ratio	PTR = 3000	
Synch Voltage (VS) PT Ratio	PTRS = 3000	# Not used
Pos-Seq Line Impedance Magnitude (Ohms secondary)	Z1MAG = 0.49	
Pos-Seq Line Impedance Angle (degrees)	Z1ANG = 78.20	
Zero-Seq Line Impedance Magnitude (Ohms secondary)	Z0MAG = 1.50	
Zero-Seq Line Impedance Angle (degrees)	Z0ANG = 54.90	
Line Length (unitless)	LL = 100	
Fault Locator Enable	EFLOC = Y	
Phase Distance:		
Enable Mho Phase Distance Elements	E21P = 2	
CCVT Transient Detection Enable	ECCVT = N	# VT is used
Reach Zone 1 (Ohms secondary)	Z1P = 0.42	# 87% of line
Reach Zone 2 (Ohms secondary)	Z2P = 0.98	# 200% of line
Phase-Phase Overcurrent Fault Detector Zone 1 (2nd Amp)	50PP1 = 0.5	# minimum
Phase-Phase Overcurrent Fault Detector Zone 2 (2nd Amp)	50PP2 = 0.5	# minimum
# Fault detectors can be set at the minimum if LOP (Loss Of P	otential) is enabled.	
Ground Distance Elements:		
Enable Mho Ground Distance Elements	E21MG = N	
Enable Quad Ground Distance Elements	E21XG = 2	
XG1 Zone 1 Reactance (Ohms secondary)	XG1 = 0.34	# 70% of line
XG2 Zone 2 Reactance (Ohms secondary)	XG2 = 0.98	# 200% of line
Zone 1 Resistance (Ohms secondary)	RG1 = 5.00	
Zone 2 Resistance (Ohms secondary)	RG2 = 5.00	
Zone 1 Phase Current FD (Amps secondary)	50L1 = 0.5	# minimum

Appendix 02	11L-2-Q35L (SEL-31	1L) Setting Calculat	tion
Zone 2 Phase Current FD (Amps se Zone 1 Residual Current FD (Amps 2 Zone 2 Residual Current FD (Amps 2 # Fault detectors can be set at the m	condary) secondary) secondary) iinimum if LOP (Loss Of Po	50L2 = 0.5 50GZ1 = 0.5 50GZ2 = 0.5 stential) is enabled.	# minimum # minimum # minimum
Zone 1 ZSC Factor Mag (unitless) Zone 1 ZSC Factor Ang (degrees) Zone 2,3,4 ZSC Factor Mag (Unitles Zone 2,3,4 ZSC Factor Ang (degrees	s) s)	k0M1 = 0.73 k0A1 = -33.74 k0M = 0.73 k0A = -33.74	# As k0M1 # As k0A1
	k0M1 ∠k0A1	$= \frac{(Z0MAG \angle Z0ANG) - (Z)}{3 \cdot (Z1MAG \angle Z)}$	ZIANG) ZIANG)
Mho Phase Distance Element Time Zone 1 Time Delay (cycles in 0.25 in Zone 2 Time Delay (cycles in 0.25 in	Delay Settings: acrements) acrements)	Z1PD = OFF Z2PD = 21	# 0.35 second
Zone 1 Time Delay (cycles in 0.25 in Zone 2 Time Delay (cycles in 0.25 in	a Delay Settings: acrements) acrements)	Z1GD = OFF Z2GD = 36	# 0.6 second
Phase Instantaneous Overcurrent El Enable Phase Overcurrent Elements Phase Instantaneous Overcurrent Le Phase Instantaneous Overcurrent Le Phase Instantaneous Overcurrent Le Phase Definite-Time Overcurrent Ele Phase Definite-Time Overcurrent Ele	ements: evel 1 (Amps secondary) evel 2 (Amps secondary) evel 3 (Amps secondary) ement Level 1 (cycles) ement Level 2 (cycles) ement Level 3 (cycles)	E50P = 3 50P1P = OFF 50P2P = 3.14 50P3P = 3.14 67P1D = 0 67P2D = 0 67P3D = 0	# 50HS OFF # 50SB # 50SOTF # Not used # Not used # Not used
Residual Ground Instantaneous Ove Enable Residual Ground Overcurren Residual Ground Inst O/C Level 1 (A	ercurrent Elements: It Elements Imps secondary):	E50G = 1 50G1P = OFF	# Section 2.9
Negative-Sequence Instantaneous E Enable Negative-Sequence Overcur	<u>Elements:</u> rent Element	E50Q = N	# Not used.
Phase Time-Overcurrent Elements: Enable Phase Time-Overcurrent Ele	ments	E51P = N	# Not used
Residual Ground Time-Overcurrent Enable Residual Ground Time Overc Residual Ground Time-Overcurrent 51GC Curve 51GTD Time Dial 51GRS Electromechanical Reset De	<u>Elements:</u> current Elements Pickup (Amp secondary) elay	E51G = Y 51GP = 0.70 51GC = U2 52GTD = 2.5 51GRS = N	# 67N-TOC
Negative-Sequence Time-Overcurre Enable Negative-Sequence Time-Ov	nt Elements: /ercurrent Elements	E51Q = N	# Not used

Out-of-Step Settings:

Append	ix 02 11L-:	2-Q35L (SEL-311	IL) Setting	g Calculatio	า
Enable Out-of-Step Elem	nents		EOOS =	Ν	# NotRequired
Lood Energeshment Ele	m o n to i				
Load-Encroachment Ele	ments:				
As per NERC Task Force	e requirement, pha	se distance settings	and other ap	plicable phase	and ground
distance zone settings m	ust permit loading	of the line without trip	p to 150% of	emergency line	e ampere
rating, with 0.85 per unit	bus voltage and a	load angle of 30 deg	rees.		
Loadability $S = (0.85*kV)$)*(0.85*kV)/(Zsec*c	cos(Z1ANG-30)*CTR	/PTR =	26329.22	MVA
Where, Zsec is Z2P in th	is application, kV is	s 345 and Z1ANG is	line angle.		
Conclusion: Loadability i	s more than 150%	of maximum generat	ion at ĂEII. r	no load encroad	hment.
Enable Load-Encroachm	ent Element		FLOAD =	N	# Calc above
			220,12		
Directional Elements:					
Enable Directional Eleme	ents		F32 -		
Loss-Of Potential Enable	۵. ۵			V1	
# When ELOP – V1 and	a lon occure direc	tional O/C elements	are blocked		
Pueber DT LOD Logio Er	a lop occurs, ullec			N	# NI/A
Busbal PT LOP Logic Er	lable				# N/A
Level 3 Direction			DIR3 =	F	# Default
Level 4 Direction			DIR4 =	F	# Default
Ground Directional Elem	ent Priority		ORDER =	Q	
Enchle Valtege Floment	<u>.</u>				
Enable Voltage Elements	<u>s.</u>			V	
Phase Luster setters Rich	5 Ivva () / alta ana angla		EVOLT =	t AF	// Nista halawa
Phase Undervoltage Pic	kup (volts seconda	iry)	27P =	45	# NOTE DEIOW
# Under-voltage setting i	s not required in N	YPA PAD revision 1.	The existing	Poletti setting	shows under-
voltage setting as 45V se	econdary. This eler	nent is set in relay ar	nd for alarm	ONLY unless a	trip is required
by NYPA/ConEd.					
Other voltage elements a	are all OFF.				
- · · · · · -·					
Synchronism Check Eler	nents				
Enable Synchronism Ch	eck Elements		E25 =	Ν	# Not used
Frequency Elements			= - 4		
Enable Frequency Eleme	ents		E81 =	N	# Not used
Delessien Deless					
Reicosing Relay:	-				<i></i>
Enable Reclosing Relay	Elements		E79 =	Ν	# Not used
Switch Onto Fault:					
Enable Switch Onto Fou	It Elemente		ESOTE -	V	# Section 2.9
Class Enable Time Dale		ara mananta)			# Section 2.0
Close Enable Time Dela	y (cycles in 0.25 in	crements)	CLOEND =	OFF	# Not used
52A Eanble Tim Delay (c	cycles in 0.25 incre	ments)	52AEND =	36	# 0.6 second
SOTF Duration (cycles in	1 0.25 increments)		SOTFD =	15	# Section 2.8
Communications Assist	kad Trianing Cabor				
	Leu Tripping Schem	ieb.		N	# National
Enable Communication /	Assisted Tripping S	cnemes		IN	# NOT USED
Zono 1 Extension Cotting	ac .				
Enable Zone 1 Extension Setting	<u>jo.</u> o Elomonto		E74EVT	N	# Not used
LINADIE ZUINE I EXTENSION				IN	# NUL USEU

Demand Metering Settings:

Appendix 02 11L-2	2-Q35L (SEL-311	L) Setting Calculatio	n
Enable Demand Metering Method DMTC Time constant Phase Pickup (Amps secondary) Residual Ground Pickup (Amps secondary) Negative-Sequence Pcikup (Amps secondar	·y)	EDEM = THM DMTC = 15 PDEMP = OFF GDEMP = OFF QDEMP = OFF	# Not used # Not used # Not used
Other Setting: Minimum Trip Duration Time (cycles in 0.25 Close Failure Time Delay (cycles in 0.25 inc Three-Pole Open Time Delay (cycles in 0.25 Open Pole Option Load Detection Phase Pickup (Ampes secor SELogic Control Equation Variable Timers: SELogic Latch Bits Enables	increments) rements) 5 increments) ndary)	TDURD = 9 CFD = 0 3POD = 0.5 OPO = 52 50LP = 0.25 ELAT = N	# Default # Not used # Default # BKR status # Minimum
SELogic Display Points Enables Enable SELogic Control Variable Timers		EDP = 8 ESV = N	
Group 1 - Logic 1: <u>Trip/CommAssisted Trip Logic:</u> Direct trip conditions TR = M # For LED2 Target; IN103 - Zone 2 timer by Switch-onto-fault trip conditions Direct transfer trip conditions Unlatch trip conditions	/1P+Z1G+M2PT+Z2 pass; 67P2T is 50SE	2GT+(M2P+Z2G)*IN103+67 3; 51GT is 67N-TOC; TRSOTF = 50P3 DTT = 0 ULTR = !52A	7P2T+51GT # SOTF # Not used # Default
<u>Close Logic Equations:</u> Circuit breaker status Close conditions Unlatch close conditions		52A = !IN104+!IN105 CL = 0 ULCL = 0	5 CB1&3 Status # Not used # Not used
Latch Bits Set/Reset Equations:			# Not used
Torque Control Equations for Inst./DefTime 67P1TC Level 1 phase 67P2TC Level 1 phase 67P3TC Level 1 phase 67G1TC Level 1 phase 51GTC Residual Ground Other Torque Controls are not enabled.	e Overcurrent Eleme	<u>ments:</u> 67P1TC = 1 67P2TC = IN106+IN301 67P3TC = 1 67G1TC = 1 51GTC = 32GF	# Not used # MOD-89b # See below # Not used # DIR = F
SELogic Control Equation Variables:			# ESV = N
Output Contacts:			# Any Trin
Output Contact101Output Contact102Output Contact103Output Contact104Output Contact105Output Contact106	OUT103 = M2PT	OUT102 = 51GT +Z2GT+(M2P+Z2G)*IN103 OUT104 = M1P+Z1G OUT105 = SOTFT OUT106 = 0	# Any Thp # 67N # 21 Zone 2 # 21 & 21G # 50SOTF # Not used

Appendix 02	11L-2-Q35L (SEL-311)	L) Setting	Calculatio	า
Output Contact 107 Output Contact 201 Output Contact 201 Output Contact 203 ~ 206, 301 ~ 312	2 are all 0.	OUT107 = OUT201 = OUT2012 =	67P2T IN106 !IN106	# 50SB # DS Open # DS Close
Display Points: Display Point 1 Display Point 2 Display Point 3 Display Point 4 Display Point 5 Display Point 6 Display Point 7 Display Point 8 Display Point 9 ~16		DP1 = DP2 = DP3 = DP4 = DP5 = DP6 = DP7 = DP8 =	0 0 IN103 IN104 IN105 IN106 IN301 3P27	# Z2T Bypass # 52b/BKR1 # 52b/BKR3 # 89b/FQ35L # 89b/F1 # Low Voltage # Not used
Setting Group Selection Equations: Select Setting Group 1 Select Setting Group 2 ~ 6 are all 0	S	SS1 = S2~SS6 =	1 0	# Not used
<u>Other Equations:</u> Event report trigger conditions ER = $\frac{1}{2}$ Fault indication FAULT = M2P + Z2G	/M2P+/Z2G+/50P2+/51G+/L(6 + 50P2 + 51G	OP		
Block synchronism check elements Close bus monitor Enable for V0 polarized and IN polar	zed elements	BSYNCH = CLMON = E32V =	0 0 1	# Not used # Not used
Stub Bus Logic Enable # 50SB is done by setting its torque of	control 67P2TC as MOD-89b	ESTUB = . 87L is not	0 used, ESTUB	# Not used won't work.
Mirrored Bits Transmit Equations:				# Not used
87L Transmit Equations:				# Not used
Group Change Delay (cycles in 0.25 Nominal Frequency (Hz) Phase Rotation Date Format	increments)	TGR = NFREQ = PHROT = Date F =	0 60 ABC MDY	# Not used
Front Panel Timeout (minutes) Display Update Rate (seconds) Length of Event Report (cycles) Cycle Length of Prefault in Event Re DC Battery LO Voltage Pickup (Vdc) DC Battery HI Voltage Pickup (Vdc)	port (cycles)	FP_TO = SCROLD = LER = PRE = DCLOP = DCHIP =	5 5 60 4 OFF OFF	# 5 minutes # 5 seconds
Optoisolated Input Timers: IN	101D ~ IN106D, IN301D ~ II	N308D =	0.5	# 0.5 cycle
<u>Breaker Monitor Settings:</u> Breaker Monitor Enable		EBMON =	N	# Not used

Appendix 02 11L-2-Q35L (SEL-311L) Setting Calculation

Synchronized Phasor Settings:

Synchronized Phasor Measurement

EPMU = N # Not used

SER:

SER1 = M1P, Z1G, M2P, M2PT, Z2G, Z2GT, 67P2T, SOTFT, 51G, 51GT, 3P27, LOP SER2 = SV1T, SV2T, IN103, IN104, IN105, IN106, IN301, IN302, IN303, IN304, IN305, IN306, IN307 SER3 = OUT102, OUT103, OUT104, OUT105, OUT106, OUT107

<u>Text:</u> Local Bit Labels Display-Point Labels

Not used

DP1 1= NA DP1_0 = NA DP2_1 = NA DP2_0 = NA DP3 1 = **ZONE 2 T BYPASS** DP3_0 = NA DP4 1= **BREAKER 1 OPEN** DP4_0 = BREAKER 1 CLOSED DP5 1= **BREAKER 3 OPEN** DP5 0= **BREAKER 3 CLOSED** DP6 1= MOD FQ35L OPEN DP6_0 = MOD FQ35L CLOSED DP7 1= MOD F1 OPEN DP7 0= MOD F1 CLOSED DP8_1 = LOW VOLTAGE DP8_0 = NA

	Appendix 03	85-Q3	5L (SEL-	311L) Setting	Calculatio	on
1. Data						
MVA_Base =	100	kV_Base =	345	Z_Base =	1190.25	ohms
CTR =	600	PTR =	3000	CTR/PTR=	0.2	

2. Setting Criteria

2.1 87LPP is to detect three-phase faults. It must be set above line charging current. Set 87LPP at its minimum of 1 secondary amp at 3000/5 CT.

2.2 87L2P is to detect all internal unbalanced faults. It must be set above expected maximum line charging current unbalance. Set 87L2P at its minimum of 0.5 secondary amp at 3000/5 CT.

2.3 87LGP is to detect all internal ground faults. It must be set above expected maximum line charging current unbalance. Set 87LGP at its minimum of 0.5 secondary amp at 3000/5 CT.

2.4 Settings of CTALRM, 87LP AND 87LANG can be at default.

<u>Group 1 - Set 1:</u>		
General Settings:		
Relay ID	RID = 85-Q35L	
Terminal ID	TID = CHARLES	S POLETTI
CT Ratio	CTR = 600	
Application	APP = 87L	
Advanced Setting Enable	EADVS = N	
Line Current Differential Settings:		
Number of 87L Terminals	E87L = 2	
High Speed Tripping	EHST = N	
Enable High Speed Direct Transfer Trip	EHSDTT = N	
Enable Disturbance Current Detect	EDD = Y	
Tapped Load Coordination	ETAP = N	
Enable Open CT Logic	EOCTL = N	
CTR at Terminal Connected to Channel X	$CTR_X = 400$	# 2000/5 CT
Phase 87L (Amp secondary)	87LPP = 1	# Minimum
Negative Sequence 87L (Amp secondary)	87L2P = 0.5	# Minimum
Ground 87L (Amp secondary)	87LGP = 0.5	# Minimum
Ph. Diff. Current Alarm Pickup (Amp secondary)	CTALRM = 0.5	# Minimum
Outer Radius	87LR = 6	# Default
Angle (Degree)	87LANG = 195	# Default
Backup Protection and Line Parameters:		# Not used
Phase Distance:		# Not used
Ground Distance Elements:		# Not used
Phase Instantaneous Overcurrent Elements:		# Not used
Residual Ground Instantaneous Overcurrent Elements:		# Not used
Negative-Sequence Instantaneous Elements:		# Not used
Phase Time-Overcurrent Elements:		# Not used
Residual Ground Time-Overcurrent Elements:		# Not used
Negative-Sequence Time-Overcurrent Elements:		# Not used
Out-of-Step Settings:		# Not used
Load-Encroachment Elements:		# Not used
Directional Elements:		# Not used
Enable Voltage Elements:		# Not used

Appendix 03	85-Q35L	(SEL-311L) Setting Calculation	
Synchronism Check Elements			# Not used
Frequency Elements			# Not used
Relcosing Relay:			# Not used
Switch-Onto-Fault:			# Not used
Commnunications Assisted Tripping S	<u>chemes:</u>		# Not used
Zone 1 Extension Settings:			# Not used
Demand Metering Settings:			# Not used
Other Setting:			# Not used
SELogic Control Equation Variable Tir	ners:		# Not used
Group 1 - Logic 1:			
Trip/CommAssisted Trip Logic:			
Direct trip conditions		TR = TRIP87	# Target Only
Switch-onto-fault trip conditions		TRSOTF = 0	# Not used
Direct transfer trip conditions		DTT = 0	# Not used
Unlatch trip conditions		ULTR = !TRIP87	# Not used
Close Logic Equations:			
Circuit breaker status		52A = 0	# Not used
Close conditions		CL = 0	# Not used
Unlatch close conditions		ULCL = 0	# Not used
Latch Bits Set/Reset Equations:			# Not used
Torque Control Equations for Inst./Def	Time Over	current Elemements:	# Not used
SELogic Control Equation Variables:			# Not used
Output Contacts:			
Output Contact 101		OUT101 = Trip	# Any Trip
Output Contact 102		OUT102 = 0	# Not used
Output Contact 103		OUT103 = Trip	# CSM@E13
Output Contact 104		OUT104 = 0	# Not used
Output Contact 105		OUT105 = 0	# Not used
Output Contact 106		OUT106 = 0	# Not used
Output Contact 107		OUT107 = 0	# Not used
Output Contact 201 ~ 206, 301 ~ 312	are all 0.		
Display Points:			# Not used
Setting Group Selection Equations:			# Not used
Other Equations:			
Event report trigger conditions $ER = /T$	RIP		
Mirrored Bits Transmit Equations:			# Not used
87L Transmit Equations:			# Not used
General Settings:			

Appendix 03	85-Q35L (S	SEL-311L) Setting Calculation	1
Group Change Delay (cycles in 0.25 Nominal Frequency (Hz) Phase Rotation Date Format	increments)	TGR = 0 NFREQ = 60 PHROT = ABC Date F = MDY	# Not used
Front Panel Timeout (minutes) Display Update Rate (seconds) Length of Event Report (cycles) Cycle Length of Prefault in Event Re DC Battery LO Voltage Pickup (Vdc) DC Battery HI Voltage Pickup (Vdc)	port (cycles)	$FP_TO = 5$ $SCROLD = 5$ $LER = 60$ $PRE = 4$ $DCLOP = OFF$ $DCHIP = OFF$	# 5 minutes # 5 seconds
Optoisolated Input Timers:	101D ~ IN106D,	, IN301D ~ IN308D = 0.5	# 0.5 cycle
Breaker Monitor Settings: Breaker Monitor Enable		EBMON = N	# Not used
Synchronized Phasor Settings: Synchronized Phasor Measurement		EPMU = N	# Not used
<u>SER:</u> SER1 = TRIP87, 87L,87L2,87LG,87 SER2 = IN101,IN102 SER3 = OUT103	LA,87LB,87LC,R	87L2,R87LG,R87LA,R87LB,R87LC	
Text:			

Reclosing Relay Labels

Not used
	Appendix 04	87B-B	S1 (SEL-38	7) Setting (Calculation	I
1. Data MVA_Base =	100	kV_Base =	345	Z_Base =	1190.25	ohms
Total MVA of al	I three GSUs =	750	; Maximum fi	ull load curren	t (amps) =	1255.11
2. Setting Criter	ia Sottingo:					
2.1 Differential	Settings.	Ma	vimum Transf	ormer MVA =	750	ΜΛΛΔ
Th	e nominal transfor	mer Winding 1	terminal volta	de VWDG1 =	345	kV
Th	e nominal transfor	mer Winding 2	terminal volta	ge VWDG2 =	345	kV
Th	e nominal transfor	mer Winding 3	terminal volta	ge VWDG3 =	345	kV
		СТ	ratio for windi	ng 1 CTR1=	600	
		СТ	ratio for windi	ng 2 CTR2=	600	
		СТ	ratio for windi	ng 3CTR3=	600	
Windir	ng 1 Current Tap 1	AP1 = MVA/(S	Sqrt(3) x VWD	$G_{1}^{0} \times CTR_{1} =$	2.09	А
Windir	ng 2 Current Tap 1	AP2 = MVA/(S	Sqrt(3) x VWD	$G2 \times CTR2) =$	2.09	А
Windir	ng 3 Current Tap 1	AP3 = MVA/(S	Sqrt(3) x VWD	G3 x CTR3) =	2.09	А
	O87P ≥ 0.1 x	5A / TAPmin =	= 0.24	Set 087P=	0.24	# Per manual
Dua	al-Slop variable-pe	ercentage differ	ential characte	eristic is used.		
	Rest	raint Slop 1 Pe	ercentage (5-10	00%) SLP 1 =	25	
	Restraint Slop	e 2 Percentag	e (OFF, 25–20	00%) SLP2 =	50	
Re	straint Current Slo	pe 1 Limit ((1–	20) multiple of	tap) IRS1 =	6.8	
Unres	trained Element C	urrent PU ((1-	20) multiple of	tap) U87P =	10.2	
Seco	ond-Harmonic Bloc	king Percentag	ge (OFF, 5–10	0%) PCT2 =	OFF	
F	ifth-Harmonic Bloc	king Percentag	ge (OFF, 5–10	0%) PCT5 =	OFF	
		Independent	t Harmonic Blo	ocking IHBL =	Ν	

2.2 Winding 1 Elems (for event triggering)

2.2.1 Set phase IOC element 50P11P at 7.3 CT secondary amp or 4,393 CT primary amp, i.e. 3.5 times of the maximum full load current (FLC).

2.2.2. Set phase TOC element 51P1P at 2.95 CT secondary amp or 1,770 CT primary amp, i.e. 1.4 times of the maximum FLC.

2.2.3. Set residual IOC element 51N11P at 2.95 CT secondary amp or 1,770 CT primary amp, i.e. 1.4 times of the maximum FLC.

2.2.4. Set residual TOC element 51N1P at 1.65 CT secondary amp or 1,004 CT primary amp, i.e. 80% of the maximum FLC.

<u>Group 1 - Set 1:</u>	
Config. Settings:	
Relay Identifier	RID = 87B-BS1
Terminal Identifier	TID = CHARLES POLETTI
Enable Wdg1 in Differential Element	E87W1 = Y
Enable Wdg2 in Differential Element	E87W2 = Y
Enable Wdg3 in Differential Element	E87W3 = Y
Enable Wdg4 in Differential Element	E87W4 = N
Enable Wdg1 O/C Elements and Dmd. Thresholds	EOC1 = Y
Enable Wdg2 O/C Elements and Dmd. Thresholds	EOC2 = N
Enable Wdg3 O/C Elements and Dmd. Thresholds	EOC3 = N

Appendix 04	87B-BS1	(SEL-387) Setting Calculation	
Enable Wdg4 O/C Elements and Dmd.	Thresholds	EOC4 = N	
Enable Combined O/C Elements		EOCC = N	
Enable RIDA Elements		E49A = N	
Enable RIDB Elements		E49B = N	
Enable SELogic Set 1		ESLS1 = Y	
Enable SELogic Set 2		ESLS2 = N	
Enable SELOgic Set 3		ESLS3 = N	
<u>General Data:</u>			
Wdg1 CT Connection		W1CT = Y	
Wdg2 CT Connection		W2CT = Y	
Wdg3 CT Connection		W3CT = Y	
Wdg4 CT Connection		W4CT = Y	# Not Used
Wdg1 CT Ratio		CTR1 = 600	
Wdg2 CT Ratio		CTR2 = 600	
Wdg3 CT Ratio		CTR3 = 600	
Wdg4 CT Ratio		CTR4 = 600	# Not Used
Maximum Power Xfmr Capacity		MVA = 750	
Define Interal CT Connection Compens	ation		
Wdg 1 Line-to-Line Voltage		VWDG1 = 345	# KV
Wdg 2 Line-to-Line Voltage		VWDG2 = 345	# KV
Wdg 3 Line-to-Line Voltage		VWDG3 = 345	# KV
wag 4 Line-to-Line voltage		VVVDG4 = 345	# NOT USED
Diff Elems:			
Restrained Element Current PU		O87P = 0.24	
Restrain Slope 1 Percentage		SLP1 = 25	
Restrain Slope 2 Percentage		SLP2 = 50	
Restraint Current Slope 1 Limit		IRS1 = 6.8	
Unrestrained Element Current PU		U87P = 10.2	
2nd Harmonic Blocking Percentage		PC12 = OFF	
5th Hamronic Blocking Percentage		PC15 = OFF	
5th Harmonic Alarm Threshold			
Independent Harmonic Blocking		IHBL = N	
Restriced Earth Fault:			# Not Used
Winding 1 Elems:			
Phase Def-Time O/C Level 1 PU		50P11P = 7.3	# 3.5xFLC
Phase Level 1 O/C Delay		50P11P = 0.5	# cycle
50P11 Torque Control (SELogic Equati	on)	50P11TC = 1	
Oher Phase Inst O/C elements			# Not used
Phase Inv-Time O/C PU		51P1P = 2.95	# 1.4x⊦LC
Phase Inv-Time O/C Curve		51P1C = C2	
Phase Inv-Time O/C Time-Dial		51P1ID = 0.2	
Phase Inv-Time O/C EM Reset		51P1RS = N	
51P1 Torque Control (SELogic Equatio	n)	51P11C = 1	// NI=1
Neg-Seq Det-Time O/C		FON(4D) = 0.05	
Residual Del-Time O/C Level 1 PU		50011P = 2.95	# 1.4XFLU
Residual Level I U/C Delay	on)	3UN ID = 0.5	# cycle
SUM IT TOIQUE CONTROL (SELOGIC EQUATI	011)	SUNTIC = 1	

Appendix 04	87B-BS1 (SEL-387) Setting Calculation	
Other Residual Inst O/C elements		# Not used
Residual Inv-Time O/C PU	51N1P = 1.65	# 80% FLC
Residual Inv-Time O/C Curve	51N1C = C2	
Residual Inv-Time O/C Time-Dial	51N1TD = 0.35	
Residual Inv-Time O/C EM Reset	51N1RS = N	
51N1 Torque Control (SELogic Equation	n) 51N1TC = 1	
Demand Ammeter Time Constant	DATC1 = 15	# Default
Phase Demand Ammeter Threshold	PDEM1P = 7	# Default
Neg-Seq Demand Ammeter Threshold	QDEM1P = 1	# Default
Residual Demand Ammeter Threshold	NDEM1P = 1	# Default
Winding 2 Elems:		# Not Used
Winding 3 Elems:		# Not Used
Winding 4 Elems:		# Not Used
Combined Elems:		# Not used
RTD A Elems:		# Not used
RTD B Elems:		# Not used
Misc. Timers		# Default
SELogic Set 1:		
Set 1 Variable 1 (SELogic Equation)	S1V1 = 87R	
S1V1 Timer Pickup	S1V1PU = 0	
S1V1 Timer Dropout	S1V1DO = 24	# 0.4 second
Set 1 Variable 2 (SELogic Equation)	S1V2 = 51P1T+51N1T	
S1V2 Timer Pickup	S1V2PU = 0	
S1V2 Timer Dropout	S1V2DO = 0	
Set 1 Variable 3 (SELogic Equation)	S1V3 = S1V2+87R	
S1V3 Timer Pickup	S1V3PU = 60	# 1 second
S1V3 Timer Dropout	S1V3DO = 300	# 5 seconds
Set 1 Variable 4 (SELogic Equation) S1	V4 = 87R+50N11T+50P11T+51P1T+51N1T	# Event trigger
S1V4 Timer Pickup	S1V4PU = 0	
S1V4 Timer Dropout	S1V4DO = 0	
Set 1 Latch Bits		# Not used
SELogic Set 2:		# Not used
<u>SELogic Set 3:</u>		# Not used
Trip Logic:		
	IR1 = 50P111 + 51P11 +50N111	+51N11
	1R2 = 8/R + 8/U	
	IR3 = 0	
		`
	ULTR1 = !(51P1 + 51N1))
	ULTR2 = !(87R + 87U)	
	ULTR3 = 0	
	ULTR5 = 0	# Nist
Close Logic:		# Not used
Output Contact Lacia	ER = /51V4	
Output Contact 101		# Any Trin
Output Contact 101	OUT101 = TRIP1+TRIP2	# Any Thp
	001102 = 0	# NUL USEU

	Appendix 04	87B-BS1 (SEL-387) Setting Calculation	
Output Contact	103	OUT103 = 0	# Not used
Output Contact	104	OUT104 = 0	# Not used
Output Contact	105	OUT105 = S1V3T	# Alarm
Output Contact	106	OUT106 = 0	# Not used
Output Contact	107	OUT107 = 0	# Not used
Output Contact	201 ~ 212 are all 0.		# Not used
Global			# Default

SER: SER1 = 87R,87U,50P11,50P11T,51P1,51P1T,50N11,50N11T,51N1,51N1T SER2 = S1V1,S1V1T,S1V2,S1V3,OUT105,S1V4 SER3 = 0 SER4 = 0

Appendix 05 11L-1-Q35M (Areva-P546) Setting Calculation

MVA_Base =	100	kV_Base =	345	Z_Base =	1190.25	ohms
CIK =	600	FIR =	3000	UIK/FIK=	0.2	
Line ID	From	То	R1(ohms)	X1(ohms)	R0(ohms)	X0(ohms)
Q35M+48	Charles Poletti	FARRAGUT	0.499905	2.42811	4.38012	6.213105

Secondary Ohms = Primary Ohms • (CTR/PTR)

Line ID	From	То	R1(2nd ohm)	X1(2nd ohm)	R0(2nd ohm)	X0(2nd ohm)
Q35M+48	Charles Poletti	FARRAGUT	0.10	0.49	0.88	1.24

Z1 = Sqrt (R1*R	1+X1*X1)	Z1Ang = Arcta	n (X1/R1)	Z0 equations	s are the same.	
Line ID	From	То	Z1(2nd ohm)	Z1Ang	Z0(2nd ohm)	Z0Ang
Q35M+48	Charles Poletti	FARRAGUT	0.49	78.37	1.52	54.82

2. Setting Criteria

2.1 Set Zone 1 phase distance at 87% of the line impedance with no time delay.

2.2 Set Zone 2 phase distance at 200% of the line impedance with 0.35 second delay. (ConEd 0.3s)

2.3 Set Zone 1 ground distance at 70% of the line impedance with no time delay.

2.4 Set Zone 2 ground distance at 200% of the line impedance with 0.6 second delay. (ConEd 0.3s)2.5 Line differential and other distance elements are not used.

2.6 High Set Fault Protection (50HS):

For 3LG fault at Charles Poletti 345kV bus, the fault contributions are as following.



Appendix 05 11L-1-Q35M (Areva-P546) Setting Calculation



50HS shall provide high spped direct trip for all internal close-in phase faults and must not operate for remote bus faults or reverse faults with appropriate operating margin. Based on the fault current contribution above, 50HS if set to clear a fault of 25,314 Amp, it may false trip for a reverse fault (21,005 Amp), especially when Q35L is out of service (33,668 Amp), so 50HS cannot be set securely and therefore is disabled.

Noted that the Aspen model (NYISO_2012_Q308_ON) provided by NYISO shows a higher fault level due to consideration of future BERRIANS 3 station. However, it will not impact the conclusion.

2.7 Stub Bus Protection (50SB):

The voltage source of 11L-1-Q35M (Areva-P546) relay is at the bus side of the MOD, so 50SB is not required.

2.8 Switch-On-To-Fault Protection (50SOTF)

50SOTF will only be armed when the circuit breakers are open and the asscoated line is de-energized. While closing the first circuit breaker to energize the line this function shall only be in service for the first 15 cycles and will reset if no fault is detected. 50SOTF is fulfilled by SOTF tripping Zone 2 with 200 ms dropout timer, instead of 15 cycles or 250 ms drop-out timer, due to 100 ms step of the setting. 2.9 Directional Ground Overcurrent Backup Protection (67N)

67N will be used to provide backup protection for ground faults on the system. 67N pickup shall be higher than the worst unbalance and can be set at 1/3 of maximum full load (1255Amp/600/3=0.7Amp). US inverse is the selected curve for this time delay element. It shall coordinate with primary protection with a proper CTI (Coordination Time Interval) and trip a ground fault at Farragut 345kV with 0.68 second time delays under normal and 0.52 second time delay when the Q35L line is out. Refer to Appendix 28 for TCC.

The instantaneous -overcurrent (IOC) function can be used to provide close-in ground fault detection if it can be set selectively.

Appendix 05 11L-1-Q35M (Areva-P546) Setting Calculation

Applying 2LG and 1LG faults at Farragut 345kV bus under four conditions of normal, B47 out, Line 48 out, and Q35L out, the maximum ground fault current seen by 11L-1-Q35M relay would be a 2LG at Farragut 345kV bus with line 48 out, and is 6484.00 Amp With margin of 30%, IOC = 8429.20 Primary Amp However, applying 1LG faults at AEII Generation station, Aspen voltage sag analysis shows 0.003 pu voltage or 0.2V secondary at 11L-1-Q35M relay.With voltage below 1V, directionality is in doubt. With fault level of more than 40kA at AEII Generation station 345kV bus, falsely tripping is possible. So, it is not recommended to use 67N-IOC.

<u>SYSTEM DATA:</u>		
	Language = English	
	Sys Fn Links = 0	
	Decription = 11L-1-Q35M	
	Plant Reference = CHARLES POLETTI	
	Frequency = 60 Hz	
CB CONTROL:		
	CB Control by = Disabled	
	Rst CB mon L0 by = CB Close	
	CB mon Lo RstDly = 5.000 S	
	CB1 Status Input = 52B 3 pole	
	CB Status Time = 5.000 S	
	CB2 Status Input = 52B 3 pole	
DATE AND TIME:		
	IRIG-B Sync = Enabled	
	Battery Alarm = Enabled	
	Other Time Settings = Default	
CONFIGURATION:		
	Setting Group = Select via Menu	
	Active Settings = Group 1	
	Setting Group 1 = Enabled	
	Setting Group 2 = Disabled	
	Setting Group 3 = Disabled	
	Setting Group 4 = Disabled	
	Distance = Enabled	# 21Z1,21Z2
	Directional $E/F = Disabled$	# Not used
	Phase Diff = Disabled	# Not used
	Overcurrent = Disabled	# Not used
	Neg Sequence $O/C = D$ isabled	# Not used
	Broken Conductor = Disabled	# Not used
	Earth Fault = Enabled	# 67N
	Sensitive $E/F = Disabled$	# Not used
	Residual O/V NVD = Disabled	# Not used
	Thermal Overload = Disabled	# Not used
	PowerSwing Block = Disabled	# Not used
	Volt Protection = Disabled	# Not used
	Freq Protection = Disabled	# Not used
	df/dt Protection = Disabled	# Not used
	CB Fail = Disabled	# Not used
	Supervision = Enabled	
	System Checks = Disabled	

Appendix 05	11L-1-Q35M (Areva-P546) Setting Calculation
	Auto-Reclose = Disabled
	Input Labels = Visible
	Output Labels = Visible
	CI & VI Ratios = Visible
F	Record Control = Visible
L	JISTURD Recorder = VISIDIE
	Vieasure t Setup = Visible
	Johnins Settings = Visible
	Southing Values - Secondary
	Control Inputs – Invisible
	Ctrl I/P Config = Invisible
	Ctrl I/P Labels = Invisible
	Direct Access = Enabled
	InterMiCOM 64 = Disabled
	Function Key = Invisible
	LCD Contrast = 11
CT AND VT RATIOS	
	/lain VT Primary = 345.0 kV
	Main VT Sec'y = 115.0 V
CE	31 CS VT Prim'y = 345.0 kV
C	B1 CS VT Sec'y = 115.0 V
CE	32 CS VT Prim'y = 345.0 kV
C	B2 CS VT Sec'y = 115.0 V
Ph	ase CT Primary = 3000 A
I	Phase CT Sec'y = 5.000 A
	SEF CT Primary = 1.000 A
SE	-CT Secondary = 1.000 A
MC	Smp CT Primary = 1.000 A
IV	COMP CT Secy = 1.000 A
	$CS input = A \cdot N$ CT1 Polority - Standard
	CT2 Polarity - Standard
	SEE CT Polarity - Standard
	M CT Polarity = Standard
	VT Connected = Yes
СВ	1 CS VT PhShft = 0 deg
	CB1 CS VT Mag = 1
CB	2 CS VT PhShft = 0 deg
(CB2 CS VT Mag = 1
<u>MEASURE'T SETUP:</u>	-
	Default Display = 3Ph + N Current
	Local Values = Primary
	Remote Values = Primary
Me	asurement Ref = VA
Mea	surement Mode = 0
	Fix Dem Period = 30.00 min
	Roll Sub Period = 30.00 min
N	um Sub Periods = 1
	Distance Unit = Miles

Appendix 05	5 11L-1-Q35M (Are	eva-P546) Setting Calculation
COMMISSION TESTS:	Fault Location = Distanc	;e
	Monitor Bit $1 = 1060$ Monitor Bit $2 = 1062$ Monitor Bit $3 = 1064$ Monitor Bit $4 = 1066$ Monitor Bit $5 = 1068$ Monitor Bit $6 = 1070$ Monitor Bit $7 = 1072$ Monitor Bit $8 = 1074$	# Red LED1 # Red LED2 # Red LED3 # Red LED4 # Red LED5 # Red LED6 # Red LED7 # Red LED7
CB MONITOR SETUP:	All disabled	# Not required
OPTO CONFIG: CONTROL INPUTS: CTRL I/P CONFIG: FUNCTION KEYS: CTRL I/P LABELS:	Global Nominal V = 110/128 Opto Filter Cntl = 111111 Characteristic = Standa Not use Not use Not use	5V 1111111111111111 rd 60%-80% ed ed ed
GROUP 1 LINE PARAMETE	RS:	
	Line Length = 9.635 n Line Impedance = 0.49 Line Angle = 79.00 kZN Res Comp = 0.73 kZN Res Angle = -34 Mutual Comp = Disable Phase Sequence = Standa CB1Tripping Mode = 3 Pole	ni Ohm deg ∌d ırd ABC
GROUP 1 DISTANCE SETU	CB2Tripping Mode = 3 Pole <u>P:</u> Setting Mode = Advance	sed
	Setting Mode = Advance Phase Chars. = Quad Zone 1 Ph Status = Enabled Zone 2 Ph Status = Enabled Zone 3 Ph Status = Disable Ground Chars. = Quad Zone 1 Gnd Stat = Enabled Zone 2 Gnd Stat. = Enabled Zone 3 Gnd Stat. = Disable Zone 9 Gnd Stat. = Disable Zone 4 Gnd Stat. = Disable Zone 4 Gnd Stat. = Disable Cone 4 Gnd Stat. = Disable	zed d d ed ed ed ed ed ed ed f und ed f t VT is used
	Load Blinders = Disable Dist. Polarizing = 1 Dir. Status = Enable	d # V is used # Default

Appendix 05	11L-1-Q35	6M (Areva-P	546) Setting Calculation	on
A	idedDeltaStatus =	Disabled		
	Dir. Char Angle =	= 60.00 deg		# Default
<u>GROUP 1 DIST. ELEMENTS:</u>		0		
	Z1 Ph. Reach =	= 420	mOhm	
	Z1 Ph. Angle =	= 79 -	deg	
ł	<1 Ph. Resistive =	: 5	Ohm	
	Z1 Lilt Lop Line =	-3	deg	
	21 Sensit. Ipn>1 =	0.25	A	
	ZZ Ph. Reach =	980	mOnm	
	ZZ PII. Angle =	= 79 - E	deg Obm	
ľ	72 Tilt Top Ling -	ະນ . າ	dog	
	$ZZ \operatorname{Till} \operatorname{TOP} \operatorname{Line} =$	0.25		
•	22 Sensit. Ipri>2 = 71 Grid Roach =	. 340	mOhm	
	Z1 Gnd. Reach =	79	deg	
	71 Dynamic Tilt =	Enabled	deg	
	71 Tilt Top Line =	: -3	dea	
k	ZN1 Res Comp =	0.73	acg	
k	ZN1 Res. Angle =	: -34	dea	
R	1 Gnd Resistive =	: 5	Ohm	
Z	1 Sensit land>1 =	0.25	A	
	Z2 Gnd. Reach =	980	mOhm	
	Z2 Gnd. Angle =	: 79	deg	
	Z2 Dynamic Tilt =	Enabled	C	
	Z2 Tilt Top Line =	: -3	deg	
kZ	ZN2 Res. Comp. =	0.73		
k	ZN2 Res. Angle =	: -34		
R	2 Gnd Resistive =	5	Ohm	
Z	2 Sensit Ignd>2 =	0.25	A	
GROUP 1 SCHEME LOGIC:		0		
	Zone1 Tripping =	Phase And G	round	
	tZ1 Ph. Delay =	= 0	S	
	tZ1 Gnd. Delay =	= 0	S	
-	Zone2 Tripping =	Phase And G	round	
	tZ2 Ph. Delay =	= 350	ms	
	tZ2 Gnd. Delay =	= 600 Dischlad	ms	
<u>-</u>	Zones I ripping =	Disabled		
2	ZoneP Tripping =			
	Zone4 mpping =			
	Aid 2 Selection -			
	SOTE Status =	Enabled Pole	Dead	
	SOTF Delay =	: 600	ms	
	SOTE Tripping =	: 100010	# Allow fast fault clearance	and Zone 2
	TOR Status =	Disabled		
тс	DC Reset Delav =	= 200	ms, # In 100ms step. 250m	s in 311L.
	TOC Delay =	= 200	ms	
	Z1 Extension =	Disabled		
	LOL Scheme =	Disabled		

Appendix 05	11L-1-Q35	5M (Areva-P	546) S	etting Calculation	on
GROUP 1 EARTH FAULT:					
	IN>1 Status =	Enabled			
	IN>1 Function =	US Inverse			
	IN>1 Directional =	Directional F	vd		
	IN>1 Current Set =	= 700	mA		# 67N
	IN>1 Time Dial =	= 2.5			
	IN>1 Reset Char =	= DT			
	IN>1 tRESET =	= 0	S		
	IN>2 Status =	Disabled			
	IN>3 Status =	Disabled			
	IN>4 Status =	Disabled			
	IN> Blocking =	= 000001			# BIOCK IN>1
	IN> Char Angle =	= -60	deg		# Default
	IN> Polarisation =	 Zero Sequent 	ce		// N.4
	IN> VINPOI Set =	= 1.000	V		# Minimum
GROUP 1 CB FAIL & P.DEAL	<u>):</u>	250.0~			# Defeuilt
	I< Current Set =	= 250.0mA			# Default
	ISEF< Current =	= 100.0mA			# Default
	V< =	= 10.0 V			# Minimum
GROUP I SUPERVISION.		Manurad			
		- Riedsureu On	пу		
	= VIS Status - VTS Posot Modo				
	VTS Time Delay -	- 5 000 c			
	VTS Infle Delay -	- 3.000 S - 3.150 Δ			
	VTS I2> Inhibit =	- 250 0 mA			
	l>2nd Harmonic =	= 0.1			
	WI Inhibit =	Disabled			
	CTS Mode =	Disabled			
GROUP 1 INPUT LABELS		Diodolog			
<u></u>	Opto Input 1	Spare			
	Opto Input 2	Spare			
	Opto Input 3	Zone 2 Timer	Βνρ		
	Opto Input 4	Spare	71		
	Opto Input 5	52b/2 status			
	Opto Input 6	52b/5 status			
	Opto Input 7	89b/FQ35M st	tatus		
	Opto Input 8	89b/F5 status			
	Opto Input 9	86TT-1/Q35M	stat		
	Opto Input 10	86TT-1/Q35M	1 alm		
	Opto Input 11	86-1/Q35M st	tatus		
	Opto Input 12	86-1/Q35M al	lm		
	Opto Input 13	11LTSS-1A/C	235M M		
	Opto Input 14	11LTSS-1B/C	235M M		
	Opto Input 15	89b/GS29/A s	status		
	Opto Input 16	89b/GS29/B s	status		
	Opto Input 17	89b/GS29/C s	status		
	Opto Input 18	11LTSR-1A/C	235M M		
	Opto Input 19	11LTSR-1B/C	235M M		
	Opto Input 20	Spare			

Appendix 05	11L-1-Q35M (Areva-P546) Setting Calculation	
GROUP 1 OUTPLIT LABELS:	Opto Input 21 Spare Opto Input 22 Spare Opto Input 23 Spare Opto Input 24 Spare	
	Relay 1 Any Trip (SER) Relay 2 67N TRIP Relay 3 21(ZONE2) TRIP	
	Relay 5 Spare Relay 6 Spare # Relay 7 Spare Relay 8 Spare	50HS
GROUP 1 OUTPUT LABELS:	Relay 9 Spare	
	Relay 10 Spare Relay 11 Spare Relay 12 Spare Relay 13 Spare Relay 14 Spare Relay 15 Spare Relay 16 Spare	
	Relay 17 Spare Relay 18 Spare Relay 19 Spare Relay 20 Spare Relay 21 Spare Relay 22 Spare	
	Relay 23 Spare Relay 24 Spare Relay 25 Spare Relay 26 Spare Relay 27 Spare Relay 28 Spare	
	Relay 30 Spare	

- Relay 31 Spare Relay 32 Spare

Appendix 06 11L-2-Q35M (SEL-311L) Setting Calculation

1. Data	1.	Data
---------	----	------

MVA_Base =	100	kV_Base =	345	Z_Base =	1190.25	ohms
CIK =	600	FIR =	3000	UIR/FIR=	0.2	
Line ID	From	То	R1(ohms)	X1(ohms)	R0(ohms)	X0(ohms)
Q35M+48	Charles Poletti	FARRAGUT	0.499905	2.42811	4.38012	6.213105

Secondary Ohms = Primary Ohms • (CTR/PTR)

Line ID	From	То	R1(2nd ohm)	X1(2nd ohm)	R0(2nd ohm)	X0(2nd ohm)
Q35M+48	Charles Poletti	FARRAGUT	0.10	0.49	0.88	1.24

Z1 = Sqrt (R1*R	1+X1*X1)	Z1Ang = Arcta	n (X1/R1)	Z0 equations	s are the same.	
Line ID	From	То	Z1(2nd ohm)	Z1Ang	Z0(2nd ohm)	Z0Ang
Q35M+48	Charles Poletti	FARRAGUT	0.49	78.37	1.52	54.82

2. Setting Criteria

2.1 Set Zone 1 phase distace at 87% of the line impedance with no time delay.

2.2 Set Zone 2 phase distace at 200% of the line impedance with 0.35 second delay. (ConEd 0.3s)

2.3 Set Zone 1 ground distance at 70% of the line impedance with no time delay.

2.4 Set Zone 2 ground distance at 200% of the line impedance with 0.6 second delay. (ConEd 0.3s) 2.5 Line differential and other distance elements are not used.

2.6 High Set Fault Protection (50HS):

For 3LG fault at Charles Poletti 345kV bus, the fault contributions are as following.





50HS shall provide high spped direct trip for all internal close-in phase faults and must not operate for remote bus faults or reverse faults with appropriate operating margin. Based on the fault current contribution above, 50HS if set to clear a fault of 25,314 Amp, it may false trip for a reverse fault (21,005 Amp), especially when Q35L is out of service (33,668 Amp), so 50HS cannot be set securely and therefore is disabled.

Noted that the Aspen model (NYISO_2012_Q308_ON) provided by NYISO shows a higher fault level due to consideration of future BERRIANS 3 station. However, it will not affect the conclusion.

2.7 Stub Bus Protection (50SB):

The voltage source of 11L-2-Q35M (SEL-311L) relay is at the line side of the MOD, so 50SB is required. 50SB is to be enabled only when MOD is open, i.e. supervised by MOD's 89b, see 67P2TC setting. For normal load current or external fault current through the stub bus, the current will ideally be zero. Set 50SB pickup at 150% of the maximum full load current by considering all three GSUs with a possibility.

of one set of CT test switches left shorted.

Total MVA of all three GSUs =750; Maximum full load current (amps) =1255.112.8 Switch-On-To-Fault Protection (50SOTF)

50SOTF will only be armed when the circuit breakers are open and the asscoated line is de-energized. While closing the first circuit breaker to energize the line this function shall only be in service for the first 15 cycles and will reset if no fault is detected. 50SOTF pickup can be set the same as 50SB.

2.9 Directional Ground Overcurrent Backup Protection (67N)

67N will be used to provide backup protection for ground faults on the system. 67N pickup shall be higher than the worst unbalance and can be set at 1/3 of maximum full load (1255Amp/600/3=0.7Amp). US inverse is the selected curve for this time delay element. It shall coordinate with primary protection with a proper CTI (Coordination Time Interval) and trip a ground fault at Farragut 345kV with 0.68 second time delays under normal and 0.52 second time delay when the Q35L line is out. Refer to Appendix 28 for TCC.

Appendix 06 11L-2-Q35M (SEL-311L) Setting Calculation

The instantaneous -overcurrent (IOC) function can be used to provide close-in ground fault detection if it can be set selectively.

Applying 2LG and 1LG faults at Farragut 345kV bus under four conditions of normal, B47 out, Line 48 out, and Q35L out, the maximum ground fault current seen by 11L-2-Q35M relay would be

a 2LG at Farragut 345kV bus with line 48 out, and is 6484.00 Amp With margin of 30% , IOC = 8429.20 Primary Amp

However, applying 1LG faults at AEII Generation station, Aspen voltage sag analysis shows 0.003 pu voltage or 0.2V secondary at 11L-2-Q35M relay.With voltage below 1V, directionality is in doubt. With fault level of more than 40kA at AEII Generation station 345kV bus, falsely tripping is possible. So, it is not recommended to use 67N-IOC.

Group 1 - Set 1:		
General Settings:		
Relay ID	RID = 11L-2-Q35	M
Terminal ID	TID = CHARLES	POLETTI
CT Ratio	CTR = 600	
Application	APP = 311L	
Advanced Setting Enable	EADVS = N	
Line Current Differential Settings: Not used	ł	
All 87L settings are off or as default		
Backup Protection and Line Parameters:		
Polarizing (IPOL) CT Ratio	CTRP = 600	# Not used
Phase PT Ratio	PTR = 3000	
Synch Voltage (VS) PT Ratio	PTRS = 3000	# Not used
Pos-Seq Line Impedance Magnitude (Ohms secondary)	Z1MAG = 0.49	
Pos-Seq Line Impedance Angle (degrees)	Z1ANG = 78.37	
Zero-Seq Line Impedance Magnitude (Ohms secondary)	Z0MAG = 1.52	
Zero-Seq Line Impedance Angle (degrees)	Z0ANG = 54.82	
Line Length (unitless)	LL = 100	
Fault Locator Enable	EFLOC = Y	
Phase Distance:		
Enable Mho Phase Distance Elements	E21P = 2	
CCVT Transient Detection Enable	ECCVT = N	# VT is used
Reach Zone 1 (Ohms secondary)	Z1P = 0.42	# 87% of line
Reach Zone 2 (Ohms secondary)	Z2P = 0.98	# 200% of line
Phase-Phase Overcurrent Fault Detector Zone 1 (2nd Amp	b) $50PP1 = 0.5$	# minimum
Phase-Phase Overcurrent Fault Detector Zone 2 (2nd Amp	b) $50PP2 = 0.5$	# minimum
# Fault detectors can be set at the minimum if LOP (Loss (Of Potential) is enabled.	
Ground Distance Elements:		
Enable Mho Ground Distance Elements	E21MG = N	
Enable Quad Ground Distance Elements	E21XG = 2	
XG1 Zone 1 Reactance (Ohms secondary)	XG1 = 0.34	# 70% of line
XG2 Zone 2 Reactance (Ohms secondary)	XG2 = 0.98	# 200% of line
Zone 1 Resistance (Ohms secondary)	RG1 = 5.00	

Appendix 06	11L-2-Q35M (SEL-311L	-) Setting Calculation	n
Zone 2 Resistance (Ohms secondar	у)	RG2 = 5.00	
Zone 1 Phase Current FD (Amps se Zone 2 Phase Current FD (Amps se Zone 1 Residual Current FD (Amps Zone 2 Residual Current FD (Amps # Fault detectors can be set at the m	condary) condary) secondary) secondary) ninimum if LOP (Loss Of Poter	50L1 = 0.5 50L2 = 0.5 50GZ1 = 0.5 50GZ2 = 0.5 ntial) is enabled.	# minimum # minimum # minimum # minimum
Zone 1 ZSC Factor Mag (unitless) Zone 1 ZSC Factor Ang (degrees) Zone 2,3,4 ZSC Factor Mag (Unitles Zone 2,3,4 ZSC Factor Ang (degree	s) s)	k0M1 = 0.74 k0A1 = -33.91 k0M = 0.74 k0A = -33.91	# As k0M1 # As k0A1
	k0M1∠k0A1 =	(Z0MAG ∠Z0ANG) – (Z1M	IAG ∠Z1ANG)
		3 • (Z1MAG∠Z1.	ANG)
Mho Phase Distance Element Time Zone 1 Time Delay (cycles in 0.25 in Zone 2 Time Delay (cycles in 0.25 in	<u>Delay Settings:</u> hcrements) hcrements)	Z1PD = OFF Z2PD = 21	# 0.35 second
Mho Ground Distance Element Time Zone 1 Time Delay (cycles in 0.25 in Zone 2 Time Delay (cycles in 0.25 in	<u>e Delay Settings:</u> ncrements) ncrements)	Z1GD = OFF Z2GD = 36	# 0.6 second
Phase Instantaneous Overcurrent El Enable Phase Overcurrent Elements Phase Instantaneous Overcurrent Le Phase Instantaneous Overcurrent Le Phase Instantaneous Overcurrent Le Phase Definite-Time Overcurrent Ele Phase Definite-Time Overcurrent Ele	lements: s evel 1 (Amps secondary) evel 2 (Amps secondary) evel 3 (Amps secondary) ement Level 1 (cycles) ement Level 2 (cycles) ement Level 3 (cycles)	E50P = 3 50P1P = OFF 50P2P = 3.14 50P3P = 3.14 67P1D = 0 67P2D = 0 67P3D = 0	# 50HS OFF # 50SB # 50SOTF # Not used # Not used # Not used
Residual Ground Instantaneous Ove Enable Residual Ground Overcurren Residual Ground Inst O/C Level 1 (A	ercurrent Elements: ht Elements Amps secondary):	E50G = 1 50G1P = OFF	# Section 2.9
Negative-Sequence Instantaneous E Enable Negative-Sequence Overcur	<u>Elements:</u> rent Element	E50Q = N	# Not used.
Phase Time-Overcurrent Elements: Enable Phase Time-Overcurrent Ele	ments	E51P = N	# Not used
Residual Ground Time-Overcurrent Enable Residual Ground Time Overc Residual Ground Time-Overcurrent 51GC Curve 51GTD Time Dial 51GRS Electromechanical Reset De	<u>Elements:</u> current Elements Pickup (Amp secondary) elay	E51G = Y 51GP = 0.70 51GC = U2 52GTD = 2.5 51GRS = N	# 67N-TOC

Negative-Sequence Time-Overcurrent Elements:

Appendix 06	11L-2-Q35M (SEL-311L	.) Setting C	alculation	า
Enable Negative-Sequence Time-Ov	ercurrent Elements	E51Q = N		# Not used
Out-of-Step Settings: Enable Out-of-Step Elements		EOOS = N		# NotRequired
Load-Encroachment Elements: As per NERC Task Froce requirement distance zone settings must permit lo rating, with 0.85 per unit bus voltage	nt, phase distance settings an bading of the line without trip to and a load angle	d other applic o 150% of em	able phase a ergency line	and ground ampere
Loadability S = $(0.85*kV)*(0.85*kV)/($ Where, Zsec is Z2P in this applicatio	Zsec*cos(Z1ANG-30)*CTR/P n, kV is 345 and Z1ANG is line	TR = 264 e angle.	416.37	MVA
Enable Load-Encroachment Element	150% of maximum generation	ELOAD = N	bad encroaci	# Calc above
Directional Elements: Enable Directional Elements Loss-Of_Potential Enable # When ELOP = Y1 and a lop occurs	, directional O/C elements are	E32 = AU ELOP = Y1 e blocked.	ТО	
Busbar PT LOP Logic Enable		EBBPT = N		# N/A
Level 3 Direction		DIR3 = F		# Default
Ground Directional Element Priority		DIR4 = F ORDER = Q		# Default
Enable Voltage Elements: Enable Voltage Elements Phase Undervoltage Pickup (Volts se # Under-voltage setting is not require voltage setting as 45V secondary. Th by NYPA/ConEd. Other voltage elements are all OFF.	econdary) ed in NYPA PAD revision 1. Th is element is set in relay and	EVOLT = Y 27P = 45 ne existing Po for alarm ONI	letti setting s ₋Y unless a t	# Note below shows under- trip is required
Synchronism Check Elements				// N 1-4 1
Enable Synchronism Check Element	S	E25 = N		# Not used
Frequency Elements Enable Frequency Elements		E81 = N		# Not used
<u>Relcosing Relay:</u> Enable Reclosing Relay Elements		E79 = N		# Not used
Switch-Onto-Fault: Enable Switch-Onto-Fault Elements Close Enable Time Delay (cycles in 0 52A Eanble Tim Delay (cycles in 0.25 SOTF Duration (cycles in 0.25 increm	0.25 increments) C 5 increments) 5 nents)	ESOTF = Y LOEND = OF 52AEND = 36 SOTFD = 15	F	# Section 2.8 # Not used # 0.6 second # Section 2.8
Commnunications Assisted Tripping Enable Communication Assisted Trip	<u>Schemes:</u> ping Schemes E	ECOMM = N		# Not used

Zone 1 Extension Settings:

Appendix 06	11L-2-Q35M (SEL-31	1L) Setting Calculatio	n
Enable Zone 1 Extension Elements		EZ1EXT = N	# Not used
Demand Metering Settings: Enable Demand Metering Method DMTC Time constant Phase Pickup (Amps secondary) Residual Ground Pickup (Amps secondary) Negative-Sequence Pcikup (Amps secondary)	ondary) econdary)	EDEM = THM DMTC = 15 PDEMP = OFF GDEMP = OFF QDEMP = OFF	# Not used # Not used # Not used
Other Setting: Minimum Trip Duration Time (cycles Close Failure Time Delay (cycles in Three-Pole Open Time Delay (cycles Open Pole Option Load Detection Phase Pickup (Ampe	in 0.25 increments) 0.25 increments) s in 0.25 increments) es secondary)	TDURD = 9 CFD = 0 3POD = 0.5 OPO = 52 50LP = 0.25	# Default # Not used # Default # BKR status # Minimum
SELogic Control Equation Variable T SELogic Latch Bits Enables SELogic Display Points Enables Enable SELogic Control Variable Tir	Fimers: ners	ELAT = N EDP = 8 ESV = N	
<u>Group 1 - Logic 1:</u> <u>Trip/CommAssisted Trip Logic:</u> Direct trip conditions # For LED2 Target; IN103 - Zone 2 t Switch-onto-fault trip conditions Direct transfer trip conditions Unlatch trip conditions	TR = M1P+Z1G+M2PT+Z imer bypass; 67P2T is 50SI	2GT+(M2P+Z2G)*IN103+67 3; 51GT is 67N-TOC; TRSOTF = 50P3 DTT = 0 ULTR = !52A	7P2T+51GT # SOTF # Not used # Default
Close Logic Equations:		520 - IIN104+IIN105	CB2&5 Status
Close conditions Unlatch close conditions		CL = 0 ULCL = 0	# Not used # Not used
Latch Bits Set/Reset Equations:			# Not used
Torque Control Equations for Inst./D 67P1TC Level 1 phase 67P2TC Level 1 phase 67P3TC Level 1 phase 67G1TC Level 1 phase 51GTC Residual Ground Other Torque Controls are not enabl	<u>efTime Overcurrent Eleme</u> ed.	<u>ements:</u> 67P1TC = 1 67P2TC = IN106+IN301 67P3TC = 1 67G1TC = 1 51GTC = 32GF	# Not used # MOD-89b # See below # Not used # DIR = F
SELogic Control Equation Variables	<u>.</u>		# ESV = N
Output Contacts: Output Contact 101 Output Contact 102		OUT101 = TRIP OUT102 = 51GT	# Any Trip # 67N
Output Contact 103	OUT103 = M2PT	+Z2GT+(M2P+Z2G)*IN103	# 21 Zone 2

Appendix 06	11L-2-Q35M (SEL-31	1L) Setting	g Calculatio	n
Output Contact 104 Output Contact 105 Output Contact 106 Output Contact 107 Output Contact 201 Output Contact 201 Output Contact 203 ~ 206, 301 ~ 3	312 are all 0.	OUT104 = OUT105 = OUT106 = OUT107 = OUT201 = OUT2012 =	M1P+Z1G SOTFT 0 67P2T IN106 !IN106	# 21 & 21G # 50SOTF # Not used # 50SB # DS Open # DS Close
Display Points: Display Point 1 Display Point 2 Display Point 3 Display Point 4 Display Point 5 Display Point 6 Display Point 7 Display Point 8 Display Point 9 ~16		DP1 = DP2 = DP3 = DP4 = DP5 = DP6 = DP7 = DP8 =	0 0 IN103 IN104 IN105 IN106 IN301 3P27	# Z2T Bypass # 52b/BKR2 # 52b/BKR5 # 89b/FQ35M # 89b/F5 # Low Voltage # Not used
Setting Group Selection Equations Select Setting Group 1 Select Setting Group 2 ~ 6 are all 0	<u>::</u> 0	SS1 = SS2~SS6 =	1 0	# Not used
Event report trigger conditions ER Fault indication FAULT = M2P + Z Block synchronism check element Close bus monitor Enable for V0 polarized and IN pol Stub Bus Logic Enable # 50SB is done by setting its torqu	= /M2P+/Z2G+/50P2+/51G+/ 2G + 50P2 + 51G s larized elements e control 67P2TC as MOD-89	LOP BSYNCH = CLMON = E32V = ESTUB = 0b. 87L is not	0 0 1 0 used, ESTUB	# Not used # Not used # Not used won't work.
Mirrored Bits Transmit Equations:				# Not used
87L Transmit Equations:				# Not used
<u>General Settings:</u> Group Change Delay (cycles in 0.2 Nominal Frequency (Hz) Phase Rotation	25 increments)	TGR = NFREQ = PHROT =	0 60 ABC	# Not used
Date Format Front Panel Timeout (minutes) Display Update Rate (seconds) Length of Event Report (cycles) Cycle Length of Prefault in Event F DC Battery LO Voltage Pickup (Vd DC Battery HI Voltage Pickup (Vd	Report (cycles) lc) c)	Date_F = FP_TO = SCROLD = LER = PRE = DCLOP = DCHIP =	MDY 5 60 4 OFF OFF	# 5 minutes # 5 seconds
Optoisolated Input Timers:	IN101D ~ IN106D, IN301D ~	IN308D =	0.5	# 0.5 cycle

Appendix 06	11L-2-Q35M (SEL-311L) Settir	ng Calculation
Breaker Monitor Settings:		
Breaker Monitor Enable	EBMON :	= N # Not used
Synchronized Phasor Settings: Synchronized Phasor Measurement	EPMU -	= N # Not used
<u>SER:</u> SER1 = M1P, Z1G, M2P, M2PT, Z2 SER2 = SV1T, SV2T, IN103, IN104, SER3 = OUT102, OUT103, OUT104	G, Z2GT, 67P2T, SOTFT, 51G, 51GT, 5 IN105, IN106, IN301, IN302, IN303, IN , OUT105,OUT106, OUT107	3P27, LOP I304, IN305, IN306, IN307
Text:		
Local Bit Labels		# Not used
Display-Point Labels	DP1_1 =	NA
	DP1_0 =	NA
	DP2_1 =	NA
	DP2_0 =	NA
	DP3_1 =	ZONE 2 T BYPASS
	DP3_0 =	
	DP4_1 =	BREAKER 2 OPEN
	DP4_0 =	BREAKER 5 ODEN
	DP5 0 =	BREAKER 5 CLOSED
	DP6 1 =	MOD EQ35M OPEN
	DP6 0 =	MOD FQ35M CLOSED
	DP7_1 =	MOD F5 OPEN
	 DP7_0 =	MOD F5 CLOSED
	DP8_1 =	LOW VOLTAGE
	DP8_0 =	NA
Reclosing Relay Labels		# Not used

	Appendix 07	85-Q35M (SEL-311L) Setting Calculation				on
1. Data						
MVA_Base =	100	kV_Base =	345	Z_Base =	1190.25	ohms
CTR =	600	PTR =	3000	CTR/PTR=	0.2	

2. Setting Criteria

2.1 87LPP is to detect three-phase faults. It must be set above line charging current. Set 87LPP at its minimum of 1 secondary amp at 3000/5 CT.

2.2 87L2P is to detect all internal unbalanced faults. It must be set above expected maximum line charging current unbalance. Set 87L2P at its minimum of 0.5 secondary amp at 3000/5 CT.

2.3 87LGP is to detect all internal ground faults. It must be set above expected maximum line charging current unbalance. Set 87LGP at its minimum of 0.5 secondary amp at 3000/5 CT.

2.4 Settings of CTALRM, 87LP AND 87LANG can be at default.

Group 1 - Set 1:		
General Settings:		
Relay ID	RID = 85-Q35M	
Terminal ID	TID = CHARLES	S POLETTI
CT Ratio	CTR = 600	
Application	APP = 87L	
Advanced Setting Enable	EADVS = N	
Line Current Differential Settings:		
Number of 87L Terminals	E87L = 2	
High Speed Tripping	EHST = N	
Enable High Speed Direct Transfer Trip	EHSDTT = N	
Enable Disturbance Current Detect	EDD = Y	
Tapped Load Coordination	ETAP = N	
Enable Open CT Logic	EOCTL = N	
CTR at Terminal Connected to Channel X	$CTR_X = 400$	# 2000/5 CT
Phase 87L (Amp secondary)	87LPP = 1	# Minimum
Negative Sequence 87L (Amp secondary)	87L2P = 0.5	# Minimum
Ground 87L (Amp secondary)	87LGP = 0.5	# Minimum
Ph. Diff. Current Alarm Pickup (Amp secondary)	CTALRM = 0.5	# Minimum
Outer Radius	87LR = 6	# Default
Angle (Degree)	87LANG = 195	# Default
Backup Protection and Line Parameters:		# Not used
Phase Distance:		# Not used
Ground Distance Elements:		# Not used
Phase Instantaneous Overcurrent Elements:		# Not used
Residual Ground Instantaneous Overcurrent Elements:		# Not used
Negative-Sequence Instantaneous Elements:		# Not used
Phase Time-Overcurrent Elements:		# Not used
Residual Ground Time-Overcurrent Elements:		# Not used
Negative-Sequence Time-Overcurrent Elements:		# Not used
Out-of-Step Settings:		# Not used
Load-Encroachment Elements:		# Not used
Directional Elements:		# Not used
Enable Voltage Elements:		# Not used

Appendix 07	85-Q35M (SEL-311L) Setting Calculation	
Synchronism Check Elements		# Not used
Frequency Elements		# Not used
Relcosing Relay:		# Not used
Switch-Onto-Fault:		# Not used
Commnunications Assisted Tripping S	chemes:	# Not used
Zone 1 Extension Settings:		# Not used
Demand Metering Settings:		# Not used
<u>Other Setting:</u>		# Not used
SELogic Control Equation Variable Tin	ners:	# Not used
Group 1 - Logic 1:		
Trip/CommAssisted Trip Logic:		
Direct trip conditions	TR = TRIP87	# Target Only
Switch-onto-fault trip conditions	TRSOTF = 0	# Not used
Direct transfer trip conditions	DTT = 0	# Not used
Unlatch trip conditions	ULTR = !TRIP87	# Not used
Close Logic Equations:		
Circuit breaker status	52A = 0	# Not used
Close conditions	CL = 0	# Not used
Unlatch close conditions	ULCL = 0	# Not used
Latch Bits Set/Reset Equations:		# Not used
Torque Control Equations for Inst./Def.	Time Overcurrent Elemements:	# Not used
SELogic Control Equation Variables:		# Not used
Output Contacts:		
Output Contact 101	OUT101 = Trip	# Any Trip
Output Contact 102	OUT102 = 0	# Not used
Output Contact 103	OUT103 = Trip	# CSM@E13
Output Contact 104	OUT104 = 0	# Not used
Output Contact 105	OUT105 = 0	# Not used
Output Contact 106	OUT106 = 0	# Not used
Output Contact 107	OUT107 = 0	# Not used
Output Contact 201 ~ 206, 301 ~ 312 a	are all 0.	
Display Points:		# Not used
Setting Group Selection Equations:		# Not used
Other Equations:		
Event report trigger conditions ER = /T	RIP	
Mirrored Bits Transmit Equations:		# Not used
87L Transmit Equations:		# Not used
General Settings:		

Appendix 07	85-Q35M (SEL-311L)	Setting (Calculation	
Group Change Delay (cycles in 0.25 Nominal Frequency (Hz) Phase Rotation Date Format	increments)	TGR = NFREQ = PHROT = Date E =	0 60 ABC MDY	# Not used
Front Panel Timeout (minutes) Display Update Rate (seconds) Length of Event Report (cycles) Cycle Length of Prefault in Event Re DC Battery LO Voltage Pickup (Vdc) DC Battery HI Voltage Pickup (Vdc)	port (cycles)	FP_TO = FP_TO = SCROLD = LER = PRE = DCLOP = DCHIP =	5 5 60 4 OFF OFF	# 5 minutes # 5 seconds
Optoisolated Input Timers: IN	1101D ~ IN106D, IN301D ~ II	N308D =	0.5	# 0.5 cycle
Breaker Monitor Settings: Breaker Monitor Enable		EBMON =	N	# Not used
Synchronized Phasor Settings: Synchronized Phasor Measurement		EPMU =	N	# Not used
<u>SER:</u> SER1 = TRIP87, 87L,87L2,87LG,87I SER2 = IN101,IN102 SER3 = OUT103	_A,87LB,87LC,R87L2,R87LG	6,R87LA,R8	7LB,R87LC	
Text:				

Reclosing Relay Labels

Not used

	Appendix 08	87B-B	S5 (SEL-38	7) Setting (Calculation	Ì
1. Data MVA_Base = CTR =	100 600	kV_Base = PTR =	345 3000	Z_Base = CTR/PTR=	1190.25 0.2	ohms
Total MVA of al	l three GSUs =	750	; Maximum f	ull load curren	t (amps) =	1255.11
2. Setting Criter 2.1 Differential	ria Settings:					
	Ū	Ma	aximum Transf	ormer MVA =	750	MVA
Th	ne nominal transfor	rmer Winding 1	terminal volta	ge VWDG1 =	345	kV
Th	ne nominal transfor	rmer Winding 2	terminal volta	ge VWDG2 =	345	kV
Th	ne nominal transfor	rmer Winding 3	terminal volta	ge VWDG3 =	345	kV
		СТ	ratio for windi	ng 1 CTR1=	600	
		СТ	ratio for windi	ng 2 CTR2=	600	
		СТ	ratio for windi	ng 3 CTR3=	600	
Windi	ng 1 Current Tap 1	FAP1 = MVA/(S	Sqrt(3) x VWD	G1 x CTR1) =	2.09	А
Windi	ng 2 Current Tap 1	FAP2 = MVA/(S	Sqrt(3) x VWD	G2 x CTR2) =	2.09	А
Windi	ng 3 Current Tap 1	FAP3 = MVA/(S	Sqrt(3) x VWD	G3 x CTR3) =	2.09	А
	O87P ≥ 0.1 x	5A / TAPmin =	= 0.24	Set 087P=	0.24	# Per manual
Du	al-Slop variable-pe	ercentage differ	ential characte	eristic is used.		
	Rest	traint Slop 1 Pe	ercentage (5-10	00%) SLP 1 =	25	
	Restraint Slop	be 2 Percentag	e (OFF, 25–20	00%) SLP2 =	50	
Re	estraint Current Slo	ppe 1 Limit ((1–	20) multiple of	tap) IRS1 =	6.8	
Unres	strained Element C	urrent PU ((1-	20) multiple of	tap) U87P =	10.2	
Seco	ond-Harmonic Bloc	king Percenta	ge (OFF, 5–10	0%) PCT2 =	OFF	
F	ifth-Harmonic Bloc	king Percentag	ge (OFF, 5–10	0%) PCT5 =	OFF	
		Independen	t Harmonic Blo	ocking IHBL =	Ν	

2.2 Winding 1 Elems (for event triggering)

2.2.1 Set phase IOC element 50P11P at 7.3 CT secondary amp or 4,393 CT primary amp, i.e. 3.5 times of the maximum full load current (FLC).

2.2.2. Set phase TOC element 51P1P at 2.95 CT secondary amp or 1,770 CT primary amp, i.e. 1.4 times of the maximum FLC.

2.2.3. Set residual IOC element 51N11P at 2.95 CT secondary amp or 1,770 CT primary amp, i.e. 1.4 times of the maximum FLC.

2.2.4. Set residual TOC element 51N1P at 1.65 CT secondary amp or 1,004 CT primary amp, i.e. 80% of the maximum FLC.

<u>Group 1 - Set 1:</u>	
Config. Settings:	
Relay Identifier	RID = 87B-BS5
Terminal Identifier	TID = CHARLES POLETTI
Enable Wdg1 in Differential Element	E87W1 = Y
Enable Wdg2 in Differential Element	E87W2 = Y
Enable Wdg3 in Differential Element	E87W3 = Y
Enable Wdg4 in Differential Element	E87W4 = N
Enable Wdg1 O/C Elements and Dmd. Thresholds	EOC1 = Y
Enable Wdg2 O/C Elements and Dmd. Thresholds	EOC2 = N
Enable Wdg3 O/C Elements and Dmd. Thresholds	EOC3 = N

Appendix 08	87B-BS5 (SE	EL-387) Setting Calculation	n
Enable Wdg4 O/C Elements and E	Omd. Thresholds	EOC4 = N	
Enable Combined O/C Elements		EOCC = N	
Enable RTDA Elements		E49A = N	
Enable RTDB Elements		E49B = N	
Enable SELogic Set 1		ESLS1 = Y	
Enable SELogic Set 2		ESLS2 = N	
Enable SELogic Set 3		ESLS3 = N	
General Data:			
Wdg1 CT Connection		W1CT = Y	
Wdg2 CT Connection		W2CT = Y	
Wdg3 CT Connection		W3CT = Y	
Wdg4 CT Connection		W4CT = Y	# Not Used
Wdg1 CT Ratio		CTR1 = 600	
Wdg2 CT Ratio		CTR2 = 600	
Wdg3 CT Ratio		CTR3 = 600	
Wdg4 CT Ratio		CIR4 = 600	# Not Used
Maximum Power Xfmr Capacity		MVA = 750	
Define Interal CT Connection Com	ipensation		4137
Wdg 1 Line-to-Line Voltage		VVDG1 = 345	# KV
Wdg 2 Line-to-Line Voltage		VVDG2 = 345	# KV
Wdg 3 Line-to-Line Voltage		VVDG3 = 345	# KV
wog 4 Line-to-Line voltage		VVVDG4 = 345	# Not used
<u>Diff Elems:</u>			
Restrained Element Current PU		O87P = 0.24	
Restrain Slope 1 Percentage		SLP1 = 25	
Restrain Slope 2 Percentage		SLP2 = 50	
Restraint Current Slope 1 Limit		IRS1 = 6.8	
Unrestrained Element Current PU		U87P = 10.2	
2nd Harmonic Blocking Percentag	e	PC12 = OFF	
5th Hamronic Blocking Percentage	9	PC15 = OFF	
5th Harmonic Alarm Threshold		TH5P = OFF	
Independent Harmonic Blocking		IHBL = N	
Restriced Earth Fault:			# Not Used
Winding 1 Elems:			
Phase Def-Time O/C Level 1 PU		50P11P = 7.3	# 3.5xFLC
Phase Level 1 O/C Delay		50P11P = 0.5	# cycle
50P11 Torque Control (SELogic E	quation)	50P11TC = 1	
Oher Phase Inst O/C elements			# Not used
Phase Inv-Time O/C PU		51P1P = 2.95	# 1.4x⊦LC
Phase Inv-Time O/C Curve		51P1C = C2	
Phase Inv-Time O/C Time-Dial		51P11D = 0.2	
Phase Inv-Time O/C EM Reset	(;)	51P1RS = N	
51P1 Torque Control (SELogic Eq	uation)	51P11C = 1	<i></i>
Neg-Seq Det-Time O/C			# Not used
Residual Det-Time O/C Level 1 PU	J	50N11P = 2.95	# 1.4XFLC
Residual Level T U/C Delay	(aution)	50N11D = 0.5	# cycle
SUNTE FORQUE CONTROL (SELOGIC E	quation)	50NTTTC = 1	

Appendix 08	87B-BS5 (SEL-387) Setting Calculation	
Other Residual Inst O/C elements		# Not used
Residual Inv-Time O/C PU	51N1P = 1.65	# 80% FLC
Residual Inv-Time O/C Curve	51N1C = C2	
Residual Inv-Time O/C Time-Dial	51N1TD = 0.35	
Residual Inv-Time O/C EM Reset	51N1RS = N	
51N1 Torque Control (SELogic Equation	n) 51N1TC = 1	
Demand Ammeter Time Constant	DATC1 = 15	# Default
Phase Demand Ammeter Threshold	PDEM1P = 7	# Default
Neg-Seq Demand Ammeter Threshold	QDEM1P = 1	# Default
Residual Demand Ammeter Threshold	NDEM1P = 1	# Default
Winding 2 Elems:		# Not Used
Winding 3 Elems:		# Not Used
Winding 4 Elems:		# Not Used
Combined Elems:		# Not used
RID A Elems:		# Not used
RID B Elems:		# Not used
Misc. Timers		# Default
<u>SELOGIC Set 1:</u>		
Set 1 Variable 1 (SELogic Equation)	STV1 = 8/R	
S1V1 Timer Prenout	SIV IPU = 0 S1V (1DO = 24)	# 0.4 accord
Set 1 Variable 2 (SEL agic Equation)	STV IDU = 24 S1V/2 = 51D1T+51N1T	# 0.4 Second
Set 1 Valiable 2 (SELOGIC Equation)	S1V2 - 51F11+51N11 S1V2D11 - 0	
S1V2 Timer Dropout	S1V210 = 0 S1V2D0 = 0	
Set 1 Variable 3 (SEL onic Equation)	S1V2D0 = 0 S1V3 = S1V2+87R	
S1V3 Timer Pickup	S1V3 = S1V2+071(S1V3PU = 60	# 1 second
S1V3 Timer Dropout	S1V3DO = 300	# 5 seconds
Set 1 Variable 4 (SEL ogic Equation) S1	V4 = 87R+50N11T+50P11T+51P1T+51N1T	# Event trigger
S1V4 Timer Pickup	S1V4PU = 0	
S1V4 Timer Dropout	S1V4DO = 0	
Set 1 Latch Bits		# Not used
SELogic Set 2:		# Not used
SELogic Set 3:		# Not used
Trip Logic:		
	TR1 = 50P11T + 51P1T +50N11T	+51N1T
	TR2 = 87R + 87U	
	TR3 = 0	
	TR4 = 0	
	TR5 = 0	
	ULTR1 = !(51P1 + 51N1))
	ULTR2 = !(87R + 87U)	
	ULTR3 = 0	
	ULTR4 = 0	
	ULTR5 = 0	
<u>Liose Logic:</u>		# INOT USED
	ED=/C11/1	
Output Contact Logic:	ER = /31V4	
Output Contact 101	$\bigcap T101 = TP D1+TP D2$	# Any Trin
Output Contact 102	OUT102 = 0	# Not used

	Appendix 08	87B-BS5 (SEL-387) Setting Calculation	
Output Contact	103	OUT103 = 0	# Not used
Output Contact	104	OUT104 = 0	# Not used
Output Contact	105	OUT105 = S1V3T	# Alarm
Output Contact	106	OUT106 = 0	# Not used
Output Contact	107	OUT107 = 0	# Not used
Output Contact	201 ~ 212 are all 0.		# Not used
Global			# Default

Global

Default

SER: SER1 = 87R,87U,50P11,50P11T,51P1,51P1T,50N11,50N11T,51N1,51N1T SER2 = S1V1,S1V1T,S1V2,S1V3,OUT105,S1V4 SER3 = 0 SER4 = 0

Appendix 09

85-1-G13 (Areva P546) Setting Calculation

1. Dulu						
MVA_Base =	100	kV_Base =	345	Z_Base =	1190.25	ohms
CTR =	600	PTR =	3000	CTR/PTR=	0.2	
Line ID	From	То	R1(ohms)	X1(ohms)	R0(ohms)	X0(ohms)
G13	Charles Poletti	AEII GEN	0.01410275	0.1332769	0.038613481	0.32084775

Secondary Ohms = Primary Ohms • (CTR/PTR)

Line ID	From	То	R1(2nd ohm)	X1(2nd ohm)	R0(2nd ohm)	X0(2nd ohm)
G13	Charles Poletti	AEII GEN	0.00	0.03	0.01	0.06

Z1 = Sqrt (R1*R1+X1*X1)	Z1Ang = Arctan (X1/R1)	Z0 equations are the same.
-------------------------	------------------------	----------------------------

Line ID From To Z1(2nd ohm) Z1Ang Z0(2nd ohm) Z0Ang							
G13 Charles Poletti AFILGEN 0.03 84.0 0.06 83.14	Line ID	From	То	Z1(2nd ohm)	Z1Ang	Z0(2nd ohm)	Z0Ang
	G13	Charles Poletti	AEII GEN	0.03	84.0	0.06	83.14

2. Setting Criteria

2.1 Zone 1 phase distace:

Set Zone 1 phase distace at 0.05 secondary ohm, or 167% of line impedance, same as the setting in 85-2-G13(SEL-311L). It may trip for a fault beyond the protected TL, such as a transformer fault. However, since there is no 345kV breaker at G13 station, such overreach is not a concern.

2.2 Set Zone 2 phase distace at 333% of the line impedance with 0.35 second delay.

2.3 Zone 1 ground distace:

Set Zone 1 ground distace at 0.05 secondary ohm, or 167% of line impedance, same as the setting in 85-2-G13(SEL-311L). It may trip for a fault beyond the protected TL, such as a transformer fault. However, since there is no 345kV breaker at G13 station, such overreach is not a concern.

2.4 Set Zone 2 ground distance at 333% of the line impedance with 0.6 second delay.

2.5 Line differential element

Set Is1, Is2 at the minimum and k1 and k2 at the default. Ph CT Corr'tion = (3000/5)/(1200/5) = 2.5 2.6 High Set Fault Protection (50HS):

50HS must not operate for reverse faults (local line end) or transformer inrush with appropriate operating margin. It may trip for a fault beyond the protected TL, such as a transformer fault. However, since there is no 345kV breaker at G13 station, such overreach is not a concern.

Both SEL-311L and Areva P546 can filter out 2nd harmonic etc major component of inrush current. Set 50HS at 7,200 Primary Amp or 12 Amp at CT secondary. It will be well below the forward fault current but above the reverse fault level. Refer to Appendix 01 Section 2.6 fault current distribution.

2.7 Stub Bus Protection (50SB):

The voltage source of 85-1-G13 (Areva P546) relay is at the bus side of the MOD. 50SB is not required. 2.8 Switch-On-To-Fault Protection (50SOTF)

50SOTF will only be armed when the circuit breakers are open and the asscoated line is de-energized. While closing the first circuit breaker to energize the line this function shall only be in service for the first 15 cycles and will reset if no fault is detected. Noting that 15 cycles or 250 ms can not be set in Areva P546 due to 100 ms step in "TOC Reset Delay" setting. 200 ms is used.

Set 50SOTF pickup the same as 50HS.

2.9 Directional Ground Overcurrent Backup Protection (67N)

67N will be used to provided backup protection for ground faults on the system. 67N pickup shall be higher than the worst unbalance and can be set 1/3 of maximum full load

1/3 of FLC = $1/3 \times 1,255$ Amp = 418.33 primary amp or 0.7 Amp at CT secondary.

Directional element is not necessary due to the strong utility source. Curve and time dial is set to provide security margin for reverse close-in faults.

Appendix 09 85-1-G13 (Areva P546) Setting Calculation

The instantaneous -overcurrent (IOC) function can be used to provide close-in ground fault detection and shall not trip for reverse faults or transformer inrush. Set it at 20 Amp CT secondary or 12kA CT primary to prevent false tripping for reverse ground faults.

SYSTEM DATA:

	Language = English	
	Sys Fn Links = 0	
	Decription = 85-1-G13	
	Plant Reference = CHARLES POLETTI	
	Frequency = 60 Hz	
CB CONTROL:		
	CB Control by = Disabled	
	Rst CB mon L0 by = CB Close	
	CB mon Lo RstDly = 5.000 S	
	CB1 Status Input = 52B 3 pole	
	CB Status Time = 5.000 S	
	CB2 Status Input = 52B 3 pole	
DATE AND TIME:		
	IRIG-B Svnc = Enabled	
	Battery Alarm = Enabled	
	Other Time Settings = Default	
CONFIGURATION:		
<u> </u>	Setting Group = Select via Menu	
	Active Settings = Group 1	
	Setting Group 1 = Enabled	
	Setting Group 2 = Disabled	
	Setting Group 3 = Disabled	
	Setting Group 4 = Disabled	
	Distance = Enabled	
	Directional $F/F = Disabled$	
	Phase Diff = Enabled	
	Overcurrent = Enabled	
	Neg Sequence $O/C = Disabled$	
	Broken Conductor = Disabled	
	Earth Fault = Enabled	
	Sensitive $F/F = Disabled$	
	Residual $O/V N/D = Disabled$	
	Thermal Overload = Disabled	
	PowerSwing Block = Disabled	
	Volt Protection = Disabled	
	Freq Protection = Disabled	
	df/dt Protection - Disabled	
	CB Fail = Disabled	
	Supervision = Enabled	
	System Checks = Disabled	
	Auto-Reclose = Disabled	
	Input Labels = Visible	
	Output Labels = Visible	
	CT & VT Batios = Visible	

Record Control = Visible

21Z1,21Z2 # Not used # 50HS # Not used # Not used # 67N # Not used # Not used

Appendix	: 09 85-1-G1:	3 (Areva P546) Setting Calculatio	n
	Disturb Recorder =		
	Measure t Setup =		
	Comms Settings =		
	Commission Tests =	VISIDIE	
	Setting values =		
	Control Inputs =		
	Ctrl I/P Labels -		
	Direct Access -		
	InterMiCOM 64 -		
	Function Key =	- Invisible	
	I CD Contrast =	: 11	
CT AND VT RATIOS	LOD CONTACT		
	Main VT Primary =	= 345.0 kV	
	Main VT Sec'v =	= 115.0 V	
	CB1 CS VT Prim'v =	= 345.0 kV	
	CB1 CS VT Sec'v =	= 115.0 V	
	CB2 CS VT Prim'y =	= 345.0 kV	
	CB2 CS VT Sec'y =	= 115.0 V	
	Phase CT Primary =	= 3000 A	
	Phase CT Sec'y =	= 5.000 A	
	SEF CT Primary =	= 3000 A	
	SEF CT Secondary =	= 5.000 A	
	MComp CT Primary =	: 1.000 A	
	MComp CT Sec'y =	= 1.000 A	
	CS Input =	A-N	
	CT1 Polarity =	Standard	
	CT2 Polarity =	Standard	
	SEF CT Polarity =	Standard	
	M CT Polarity =	Standard	
	VT Connected =	Yes	
	CB1 CS VI PhShft =	0 deg	
	CB1 CS VI Mag =		
	CB2 CS VT Mag =		
MEASURE I SETUP.	Default Display -	- Plant Reference	
	Remote Values -	· Primary	
	Measurement Ref =	· VA	
	Measurement Mode =	= 0	
	Fix Dem Period =	: 30.00 min	
	Roll Sub Period =	= 30.00 min	
	Num Sub Periods =	: 1	
	Distance Unit =	Miles	
	Fault Location =	Distance	
COMMISSION TESTS:			
	Monitor Bit 1 =	= 1060	# Red LED1
	Monitor Bit 2 =	= 1062	# Red LED2
	Monitor Bit 3 =	= 1064	# Red LED3

Appendix 0	9 85-1-G13	(Areva P54	46) Setting Calculation	ı
	Monitor Bit 4 = 7 Monitor Bit 5 = 7 Monitor Bit 6 = 7 Monitor Bit 7 = 7 Monitor Bit 8 = 7	1066 1068 1070 1072 1074		# Red LED4 # Red LED5 # Red LED6 # Red LED7 # Red LED8
CB MONITOR SETUP:	All disabled			# Not required
OPTO CONFIG:				
CONTROL INPUTS:	Opto Filter Cntl = Characteristic = S	110/1250 111111111111 Standard 60% Not used	111111111111 5-80%	
GROUP 1 LINE PARAMETER	RS:			
C	Line Length = (Line Impedance = (Line Angle = 8 kZN Res Comp = (kZN Res Angle = - Mutual Comp = 1 Phase Sequence = \$ B1Tripping Mode = 3	0.35 mi 0.06 84.0 0.33 -2 Disabled Standard ABC 3 Pole	Ohm deg	
	B2Tripping Mode = 3	3 Pole		
	Setting Mode = / Phase Chars. = 0 Zone 1 Ph Status = I Zone 2 Ph Status = I Zone 3 Ph Status = I Ground Chars. = 0 Zone 1 Gnd Stat = I Zone 2 Gnd Stat. = I Zone 3 Gnd Stat. = I Zone 4 Gnd Stat. = I Digital Filter = S CVT Filters = I Load Blinders = I Dist. Polarizing = 7 Dir. Status = I AidedDeltaStatus = I	Advanced Quad Enabled Enabled Disabled Quad Enabled Disabled Disabled Disabled Disabled Disabled Disabled Disabled Disabled Disabled Disabled 60.00 deg		# VT is used # Default # Default
GROUP 1 DIST. ELEMENTS	Z1 Ph. Reach = Z1 Ph. Angle = Z1 Ph. Angle = R1 Ph. Resistive = Z1 Tilt Top Line = Z1 Sensit. lph>1 = 0	50.000 84.0 5 -3 0.25	mOhm deg Ohm deg A	

Appendix 09	85-1-G13 (Areva	P546) Setting	Calculation
Z2	2 Ph. Reach = 100	mOhm	
Z	2 Ph. Angle = 84.0	deg	
R2 P	h. Resistive = 5	Ohm	
Z2 1	Filt Top Line = -3	deg	
Z2 S	ensit. lph>2 = 0.25	А	
Z1 (Gnd. Reach = 50.000	mOhm	
Z1	Gnd. Angle = 84.0	deg	
Z1 [Dynamic Tilt = Enabled		
Z1 7	Tilt Top Line = -3	deg	
kZN1	Res. Comp = 0.33	Ohm	
kZN1	Res. Angle = -2	deg	
R1 Gr	nd Resistive = 5	Ohm	
Z1 Se	ensit Ignd>1 = 0.25	A	
Z2	Gnd. Reach = 100	mOhm	
Z2	Gnd. Angle = 84.0	deg	
Z2 [Dynamic Tilt = Enabled		
Z2 1	Tilt Top Line = -3	deg	
kZN2	Res. Comp. = 0.33		
kZN2	Res. Angle = -2		
R2 Gr	nd Resistive = 5	Ohm	
Z2 Se	ensit Ignd>2 = 0.25	A	
GROUP 1 PHASE DIFF:			
	Phase Diff = Enabled		
	Phase Is1 = 1.000 A		# Minimum
	Phase Is2 = 10.00 A		# Minimum
	Phase k1 = 30.00%		# Default
	Phase k2 = 150.00%	•	# Default
	Phase Char = DT		# Default
Phase	Time Delay = 0 s		# Default
	PIT Time = 200.0ms		# Default
Ph	CT Corr'tion = 2.5		# Section 2.5
Co	mpensation = None		# Default
PI	I selection = Remote		# Default
GROUP 1 SCHEME LOGIC:			
Zone	1 Tripping = Phase A	nd Ground	
tZ	1 Ph. Delay = 0	S	
tZ1	Gnd. Delay = 0	S	
Zone	2 Tripping = Phase A	nd Ground	
tZ	2 Ph. Delay = 350	ms	
tZ2	Gnd. Delay = 600	ms	
Zone	3 Tripping = Disabled		
Zone	P Tripping = Disabled		
Zone	4 Tripping = Disabled		
Aid.	1 Selection = Disabled		
Aid.	2 Selection = Disabled		
S	OTF Status = Enabled	PoleDead	
S	SOTF Delay = 600	ms	
SO	TF Tripping = 000010		# Zone 2

Appendix	09 85-1-G13	(Areva P5	46) Setti	ing Calculation	า
	TOR Status = TOC Reset Delay = TOC Delay = Z1 Extension = LOL Scheme =	Disabled 200 200 Disabled Disabled	ms, ms	# 250ms in 311L,	100ms step
GROUP 1 OVERCURRENT					
	I>1 Status = I>2 Status = I>3 Status = I>3 Directional = I>3 Current Set = I>3 Time Delay = I>4 Status = I> Char Angle = I> Blocking =	Disabled Disabled Enabled Non-Direction 12.00 A 0 s Disabled 30.00 deg 000000	al		# 50HS # Section 2.6
GROUP 1 EARTH FAULT:					
	IN>1 Status = IN>1 Function = IN>1 Directional =	Enabled US Inverse Directional Fv	vd		
	IN>1 Current Set =	700.00	mA		# 67N-TOC
	IN>1 Lime Dial =	3.5 DT			
	IN>1 tRESET = IN>2 Status = IN>2 Function =	0 Enabled DT	S		# 67N-IOC
	IN>2 Directional = IN>2 Current Set = IN>2 Time delay = IN>2 Treset =	Non-Direction 20 0 s 0 s	al		# Section 2.9
	IN>3 Status =	Disabled			
	IN> Blocking = IN> Char Angle = IN> Polarisation =	000001 -60 Zero Sequend	deg ce		# Block IN>1 # Default
	IN> VNpol Set =	1.000	V		# Minimum
GROUP 1 CB FAIL & P.DEA	<u>\D:</u>	050.0mA			# Defeuit
	I< Current Set = ISEF< Current = V< =	250.0mA 100.0mA 10.0 V			# Default # Default # Minimum
GROUP 1 SUPERVISION:		Maggurad On	h.		
	VTS Nidde = VTS Status = VTS Reset Mode =	Blocking Auto	ny		
	VTS I> Inhibit =	3.150 A			
	VTS I2> Inhibit =	250.0 mA			
	I>2nd Harmonic = WI Inhibit =	10.00% Disabled			

Appendix 09	85-1-G13 (Areva P546) Setting Calculation
	CTS Mode = Disabled
GROUP 1 INPUT LABELS:	Opto Input 1 Spare
	Opto Input 2 Spare
	Opto Input 4 Spare
	Opto Input 5 52b/1-status
	Opto Input 6 52b/2-status
	Opto Input 7 89b/F2-status
	Opto Input 8 Spare
	Opto Input 9 86TT-1/G13-stat
	Opto Input 10 86TT-1/G13-alm
	Opto Input 11 86-1/G13-status
	Opto Input 12 86-1/G13-alm
	Opto Input 13 85TSS-1/G13 Mon
	Opto Input 14 85TCO-1/G13 Mon
	Opto Input 15 Spare
	Opto Input 16 Spare
	Opto Input 17 Spare
	Opto Input 18 Spare
	Opto Input 19 Spare
	Opto Input 20 Spare
	Opto Input 21 Spare
	Opto Input 22 Spare
	Opto Input 23 Spare
GROUP 1 OUTPUT LABELS	Opto hiput 24 Spare
	Relay 1 DTT RCVD
	Relav 2 67N TRIP
	Relay 3 21(ZONE2) TRIP
	Relay 4 21&21G TRIP
	Relay 5 50SOTF TRIP
	Relay 6 50HS TRIP
	Relay 7 Spare
	Relay 8 87 TRIP
	Relay 9 Spare
<u>GROUP 1 OUTPUT LABELS:</u>	
	Relay 10 General Alarm
	Relay 11 Any Trip (SER)
	Relay 12 Spare
	Relay 17 Spare
	Relay 15 Spare
	Relay 16 Spare
	Relay 17 Spare
	Relav 18 Spare
	Relay 19 Spare
	Relay 20 Spare
	Relay 21 Spare
	Relay 22 Spare

Appendix 09	85-1-G13 (Areva P546) Setting Calculation
Re	lay 23 Spare
Re	lay 24 Spare
Re	lay 25 Spare
Re	lay 26 Spare
Re	lay 27 Spare
Re	lay 28 Spare
Re	lay 29 Spare
Re	lay 30 Spare
Re	lay 31 Spare
Re	lay 32 Spare

Appendix 10 85-2-G13 (SEL-311L) Setting Calculation

1. Data	
---------	--

1. Dala						
MVA_Base =	100	kV_Base =	345	Z_Base =	1190.25	ohms
CTR =	600	PTR =	3000	CTR/PTR=	0.2	
Line ID	From	То	R1(ohms)	X1(ohms)	R0(ohms)	X0(ohms)
G13	Charles Poletti	AEII GEN	0.01410275	0.1332769	0.038613481	0.32084775

Secondary Ohms = Primary Ohms • (CTR/PTR)

Line ID	From	То	R1(2nd ohm)	X1(2nd ohm)	R0(2nd ohm)	X0(2nd ohm)
G13	Charles Poletti	AEII GEN	0.00	0.03	0.01	0.06

Z1 = Sqrt (R1*R1+X1*X1) Z1Ang = Arctan (X1/R1) Z0 equations are the same.

Line ID	From	То	Z1(2nd ohm)	Z1Ang	Z0(2nd ohm)	Z0Ang	
G13	Charles Poletti	AEII GEN	0.03	83.96	0.06	83.14	

Note: Line Z1 is less than the minimum 0.05 of Z1MAG setting. Two times of real Z1 and Z0 will be used in Z1MAG and Z0MAG settings.

2. Setting Criteria

2.1 Zone 1 phase distace:

Set Zone 1 phase distace at minimum setting of 0.05 secondary ohm, or 167% of line impedance. It may trip for a fault beyond the protected TL, such as a transformer fault. However, since there is no 345kV breaker at G13 station, such overreach is not a concern.

2.2 Set Zone 2 phase distace at 333% of the line impedance with 0.35 second delay.

2.3 Zone 1 ground distace:

Set Zone 1 ground distace at minimum setting of 0.05 secondary ohm, or 167% of line impedance. It may trip for a fault beyond the protected TL, such as a transformer fault. However, since there is no 345kV breaker at G13 station, such overreach is not a concern.

2.4 Set Zone 2 ground distance at 333% of the line impedance with 0.6 second delay.

2.5 Line differential element

Set 87LPP at the minimum setting of 1 Amp secondary; Set 87L2P and 87LGP at the minimum setting of 0.5 Amp secondary, or 300 Amp Primary, which should be above expected line charging current unbalance. 87LR and 87LANG can be set as default per SEL manual.

2.6 High Set Fault Protection (50HS):

50HS must not operate for reverse faults (local line end) or transformer inrush with appropriate operating margin. It may trip for a fault beyond the protected TL, such as a transformer fault. However, since there is no 345kV breaker at G13 station, such overreach is not a concern.

Both SEL-311L and Areva P546 can filter out 2nd harmonic etc major component of inrush current. Set 50HS at 7,200 Primary Amp or 12 Amp at CT secondary. It will well below the forward fault current but above the reverse fault level. Refer to Appendix 01 Section 2.6 fault current distribution.

2.7 Stub Bus Protection (50SB):

The voltage source of 85-2-G13 (SEL-311L) relay is at the line side of the MOD, so 50SB is required.

50SB is to be enabled only when MOD is open, i.e. supervised by MOD's 89b, see 67P2TC setting.

For normal load current or external fault current through the stub bus, the current will ideally be zero.

Set 50SB pickup at 150% of the maximum full load current by considering all three GSUs with a possibility of one set of CT test switches left shorted.

Total MVA of all three GSUs =750; Maximum full load current (amps) =1255.112.8 Switch-On-To-Fault Protection (50SOTF)

50SOTF will only be armed when the circuit breakers are open and the asscoated line is de-energized. While closing the first circuit breaker to energize the line this function shall only be in service for the first 15 cycles and will reset if no fault is detected. Set 50SOTF pickup the same as 50HS.
Appendix 10 85-2-G13 (SEL-311L) Setting Calculation

2.9 Directional Ground Overcurrent Backup Protection (67N)

67N will be used to provided backup protection for ground faults on the system. 67N pickup shall be higher than the worst unbalance and can be set 1/3 of maximum full load

1/3 of FLC = $1/3 \times 1,255$ Amp = 418.33 primary amp or 0.7 Amp at CT secondary.

Directional element is not necessary due to the strong utility source. Curve and time dial is set to provide security margin for reverse close-in faults.

The instantaneous -overcurrent (IOC) function can be used to provide close-in ground fault detection and shall not trip for reverse faults or transformer inrush. Set it at 20 Amp CT secondary or 12kA CT primary to prevent false tripping for reverse ground faults.

Group 1 - Set 1:		
General Settings:		
Relay ID	RID = 85-2-G13	
Terminal ID	TID = CHARLES POLETTI	
CT Ratio	CTR = 600	
Application	APP = 311L	
Advanced Setting Enable	EADVS = N	
Line Current Differential Settings:		
Number of 87L Terminals	E87L = 2	
High Speed Tripping	EHST = 1	
Enable High Speed Direct Transfer Trip	EHSDTT = Y	
Enable Disturbance Current Detect	EDD = Y	
Tapped Load Coordination	ETAP = N	
Enable Open CT Logic	EOCTL = N	
CTR at Terminal Connected to Channel X	CTR_X = 240	# 1200/5 CT
Phase 87L (Amp secondary)	87LPP = 1	# Minimum
Negative Sequence 87L (Amp secondary)	87L2P = 0.5	# Minimum
Ground 87L (Amp secondary)	87LGP = 0.5	# Minimum
Ph. Diff. Current Alarm Pickup (Amp secondary)	CTALRM = 0.5	# Minimum
Outer Radius	87LR = 6	# Default
Angle (Degree)	87LANG = 195	# Default
Backup Protection and Line Parameters:		
Polarizing (IPOL) CT Ratio	CTRP = 600	# Not used
Phase PT Ratio	PTR = 3000	
Synch Voltage (VS) PT Ratio	PTRS = 3000	# Not used
Pos-Seq Line Impedance Magnitude (Ohms secondary)	Z1MAG = 0.06	# 2x real Z1
Pos-Seq Line Impedance Angle (degrees)	Z1ANG = 84.0	
Zero-Seq Line Impedance Magnitude (Ohms secondary)	Z0MAG = 0.12	# 2x real Z0
Zero-Seq Line Impedance Angle (degrees)	Z0ANG = 83.14	
Line Length (unitless)	LL = 100	
Fault Locator Enable	EFLOC = Y	
Phase Distance:		
Enable Mho Phase Distance Elements	E21P = 2	
CCVT Transient Detection Enable	ECCVT = N	# VT is used
Reach Zone 1 (Ohms secondary)	Z1P = 0.05	# Minimum

Appendix 10 85-2-G13 (S	EL-311L) Setting Calcula	ition
Reach Zone 2 (Ohms secondary) Phase-Phase Overcurrent Fault Detector Zone 1 (2nd Amp) Phase-Phase Overcurrent Fault Detector Zone 2 (2nd Amp)	Z2P = 0.10 50PP1 = 0.5 50PP2 = 0.5	# 333% of line # Minimum # Minimum
# Fault detectors can be set at the minimum if LOP (Loss O	f Potential) is enabled.	
Ground Distance Elements:		
Enable Mho Ground Distance Elements	E21MG = N	
Enable Quad Ground Distance Elements	E21XG = 2	
XG1 Zone 1 Reactance (Ohms secondary)	XG1 = 0.05	# Minimum
XG2 Zone 2 Reactance (Ohms secondary)	XG2 = 0.1	# 333% of line
Zone 1 Resistance (Ohms secondary)	RG1 = 5.00	
Zone 2 Resistance (Onms secondary)	RG2 = 5.00	
Zone 1 Phase Current FD (Amps secondary)	50L1 = 0.5	# Minimum
Zone 2 Phase Current FD (Amps secondary)	50L2 = 0.5	# Minimum
Zone 1 Residual Current FD (Amps secondary)	50GZ1 = 0.5	# Minimum
Zone 2 Residual Current FD (Amps secondary)	50GZ2 = 0.5	# Minimum
# Fault detectors can be set at the minimum if LOP (Loss O	r Potential) is enabled.	
Zone 1 ZSC Factor Mag (unitless)	k0M1 = 0.33	
Zone 1 ZSC Factor Ang (degrees)	k0A1 = -1.64	
Zone 2,3,4 ZSC Factor Mag (Unitless)	k0M = 0.33	# As k0M1
Zone 2,3,4 ZSC Factor Ang (degrees)	k0A = -1.64	# As k0A1
k0M1 ∠k	$0A1 = \frac{(Z0MAG \angle Z0ANG) - (Z1M)}{(Z0MAG \angle Z0ANG)}$	IAG ∠Z1ANG)
	3• (Z1MAG∠Z1.	ANG)
Mho Phase Distance Element Time Delay Settings:		
Zone 1 Time Delay (cycles in 0.25 increments)	Z1PD = OFF	
Zone 2 Time Delay (cycles in 0.25 increments)	Z2PD = 21	# 0.35 second
Mho Ground Distance Element Time Delay Settings:		
Zone 1 Time Delay (cycles in 0.25 increments)	Z1GD = OFF	
Zone 2 Time Delay (cycles in 0.25 increments)	Z2GD = 36	# 0.6 second
Phase Instantaneous Overcurrent Elements:		
Enable Phase Overcurrent Elements	E50P = 3	
Phase Instantaneous Overcurrent Level 1 (Amps secondary	() 50P1P = 12	# 50HS
Phase Instantaneous Overcurrent Level 2 (Amps secondary	() 50P2P = 3.14	# 50SB
Phase Instantaneous Overcurrent Level 3 (Amps secondary	() 50P3P = 12	# 50SOTF
Phase Definite-Time Overcurrent Element Level 1 (cycles)	67P1D = 0	# Not used
Phase Definite-Time Overcurrent Element Level 2 (cycles)	67P2D = 0	# Not used
Phase Definite-Time Overcurrent Element Level 3 (cycles)	67P3D = 0	# Not used
Residual Ground Instantaneous Overcurrent Elements:		
Enable Residual Ground Overcurrent Elements	E50G = 1	# 0711 10 0
Residual Ground Inst O/C Level 1 (Amps secondary):	50G1P = 20	# 67N-IOC
Residual Ground Definite-Lime Overcurrent Elements:	6/G1D = <mark>0</mark>	
Negative-Sequence Instantaneous Elements:		
Enable Negative-Sequence Overcurrent Element	E50Q = N	# Not required

Appendix 10 85-2-G13 (SEL-311L) Setting Calculation

Phase Time-Overcurrent Elements:		
Enable Phase Time-Overcurrent Elements	E51P = N	# Not used
Residual Ground Time-Overcurrent Elements:		
Enable Residual Ground Time Overcurrent Elements	E51G = Y	
Residual Ground Time-Overcurrent Pickup (Amp secondary)	51GP = 0.70	
51GC Curve	51GC - U2	# 0/11 100
51GTD Time Dial	5100 = 02 52GTD = 3.5	
51GRS Electromechanical Reset Delay	51GRS - N	
STORS Electromechanical Reset Delay	510R0 - N	
Negative-Sequence Time-Overcurrent Elements:		
Enable Negative-Sequence Time-Overcurrent Elements	E51Q = N	# Not required
Out-of-Step Settings:		
Enable Out-of-Step Elements	EOOS = N	# Not required
Load-Encroachment Elements:		
As per NERC Task Froce requirement, phase distance settings	and other applicable phase a	and around distance
zone settings must permit loading of the line without trin to 150	% of emergency line ampere	rating with 0.85 per unit
bus voltage and a load angle	% of emergency line ampere	rating, with 0.05 per unit
Logability $S = (0.95*k)/(2005*k)/(7000*000/71ANG 20)*CTI$	D/DTD _ 202225.97	N <i>A</i> N/A
$V_{\rm Load ability} = (0.05 \text{ kV}) (0.05 \text{ kV})/(2 \text{ set } 0.05 \text{ cm}) (0.05 \text{ kV})/(2 \text{ set } 0.05 \text{ cm}) = 0.05 \text{ cm}$	$\nabla F I R = 292323.07$	MVA
Conclusion: Londobility is more than 150% of maximum generation	sting at AEU no load anaroad	mont
Enclusion. Loadability is more triain 150% of maximum genera		# Colo abovo
	ELOAD = N	
Directional Elements:		
Enable Directional Elements	E32 = Y	
Loss-Of_Potential Enable	ELOP = Y1	
# When ELOP = Y1 and a lop occurs, directional O/C elements	are blocked.	
Busbar PT LOP Logic Enable	EBBPT = N	# N/A
Level 3 Direction	DIR3 = F	# Default
Level 4 Direction	DIR4 = F	# Default
Ground Directional Element Priority	ORDER = Q	
Forward Dir. Z2 Threshold (Ohms secondary)	Z2F = 0.01	# Real Z1/2
Reverse Dir. Z2 Threshold (Ohms secondary)	Z2R = 0.11	# Z2F+0.1
Forward Dir. 312 Pickup (Amps secondary)	50QFP = 0.25	# Minimum
Reverse Dir. 3l2 Pickup (Amps secondary)	50QRP = 0.5	# 24% max FLC
Pos-Seg Restraint Factor I2/I1 (unitless)	$a^2 = 0.1$	# Default
Zero-Seg Restraint Factor 12/10 (unitless)	$k^2 = 0.2$	# Default
	NE - 0.2	
Enable Voltage Elements:		
Enable Voltage Elements	EVOLT = N	
Synchronism Check Elements		
Enable Synchronism Check Elements	E25 = N	# Not required
Frequency Elements		
Enable Frequency Elements	E81 = N	# Not required

Appendix 10 85-2	-G13 (SEL-311L) Setting Calculation	
Relcosing Relay:		
Enable Reclosing Relay Elements	E79 = N	# Not required
Switch-Onto-Fault:		
Enable Switch-Onto-Fault Elements	ESOTE = Y	# Section 2.8
Close Enable Time Delay (cycles in 0.25 increme)	CLOEND = OFF	# Not used
524 Earble Tim Delay (cycles in 0.25 increments)	524 END = 36	# Not used # 0.6 second
SOTE Duration (cycles in 0.25 increments)	SOTED = 30	# 0.0 3econd # Section 2.8
SOTE Duration (cycles in 0.25 increments)	301FD = 15	# Section 2.0
Commnunications Assisted Tripping Schemes:		
Enable Communication Assisted Tripping Scheme	es ECOMM = N	# Not used
Zone 1 Extension Settings:		
Enable Zone 1 Extension Elements	EZ1EXT = N	# Not used
Demand Metering Settings:		
Enable Demand Metering Method	EDEM = THM	
DMTC Time constant	DMTC = 15	
Phase Pickup (Amps secondary)	PDEMP = OFF	# Not used
Residual Ground Pickup (Amps secondary)	GDEMP = OFF	# Not used
Negative-Sequence Pcikup (Amps secondary)	QDEMP = OFF	# Not used
Other Setting:		
Minimum Trip Duration Time (cycles in 0.25 increa	ments) TDLIRD - 9	# Default
Close Eailure Time Delay (cycles in 0.25 increme)	(EE) $(ED = 0)$	# Not used
Three Pole Open Time Delay (cycles in 0.25 increment	$\frac{2POD}{2} = 0$	# Not used # Dofault
Open Bala Option	OPO = 0.5	# Delault # DKD status
Open Pole Option	0P0 = 52	# BKR Status
Load Detection Phase Pickup (Ampes secondary,	50LP = 0.25	# Minimum
SELogic Control Equation Variable Timers:		
SELogic Latch Bits Enables	ELAT = N	
SELogic Display Points Enables	EDP = 8	
Enable SELogic Control Variable Timers	ESV = N	
Group 1 - Logic 1:		
Trip/CommAssisted Trip Logic:		
Direct trip conditions $TR = TRIP87+M1P+Z1G+N$	12PT+Z2GT+67P1T+67P2T+67G1T+51GT	
#LED2 Target. 67P1T is 50HS; 67P2T is 50SB; 5	0P3 is 50SOTF; 67G1T is 67N-IOC; 51GT is 67	N-TOC;
Switch-onto-fault trip conditions	TRSOTF = $50P3$	# SOTF
Direct transfer trip conditions	DTT = 0	# Not used
Unlatch trip conditions	ULTR = !52A	
Close Logic Equations:		
Ciose Logic Equations.		
	52A = !IN104+!IN105	UBIAZ STATUS
Close conditions	CL = 0	# Not used
Unlatch close conditions	ULCL = 0	# Not used
Latch Bits Set/Reset Equations:		# Not used
Torque Control Equations for Inst./DefTime Ove	rcurrent Elemements:	

Appendix 10	85-2-G13 (SEL-311L) Setting Calculation	
67P1TC Level 1 phase 67P2TC Level 1 phase 67P3TC Level 1 phase # SOTF is enabled when breaker open 52b # SOTF is irrelevant with MOD-89b since th	67P1TC = 1 67P2TC = IN106 67P3TC = 1 =1 and the supervision is in relay internal logic. ere is a possility of switching on a bus fault	# nondirectiona # MOD-89b # nondirectiona
67G1TC Level 1 phase 51GTC Residual Ground Other Torque Controls are not enabled.	67G1TC = 1 51GTC = 1	# nondirectional # nondirectional
SELogic Control Equation Variables:		# ESV = N
Output Contacts: Output Contact 101 Output Contact 102 Output Contact 103 Output Contact 104 Output Contact 105 Output Contact 106 Output Contact 107 Output Contact 201 Output Contact 202 Output Contact 203 ~ 206, 301 ~ 312 are al	OUT101 = R1X*ROKX OUT102 = 67G1T+51GT OUT103 = M2PT+Z2GT OUT104 = M1P+Z1G OUT105 = SOTFT OUT106 = 67P1T OUT107 = 67P2T OUT201 = TRIP87 OUT202 = TRIP+R1X*ROKX	# DTT Trip # 67N # 21 Zone 2 # 21 & 21G # 50SOTF # 50SB # 50SB # 87 Trip # Any Trip
<u>Display Points:</u> Display Point 1 Display Point 2 Display Point 3 Display Point 4 Display Point 5 Display Point 6 Display Point 7 Display Point 8 Display Point 9 ~16	DP1 = 0 DP2 = 0 DP3 = 0 DP4 = IN104 DP5 = IN105 DP6 = IN106 DP7 = 0 DP8 = 0	# Not used # Not used # 52b/BKR1 # 52b/BKR2 # 89b/FQ35L # Not used # Not used # Not used
Setting Group Selection Equations: Select Setting Group 1 Select Setting Group 2 ~ 6 are all 0 Other Equations:	SS1 = 1 SS2~SS6 = 0	# Not used
Event report trigger conditions ER = /87L+/I Fault indication FAULT = 87L+M2P+Z2G+5 Block synchronism check elements Close bus monitor Enable for V0 polarized and IN polarized ele Stub Bus Logic Enable # 50SB is done by setting its torque control	M2P+/Z2G++/50P2+/51G+/R1X+/LOP $0P2+51G+R1X$ $BSYNCH = 0$ $CLMON = 0$ ements $E32V = 1$ $ESTUB = 0$ $67P2TC as MOD-89b.$	# Not used # Not used # Not used
Mirrored Bits Transmit Equations:		# Not used

87L Transmit Equations:

Appendix 10	85-2-G13 (SEL-311L) Setting Calculation	
87L Channel X, Transmit Bit 1 All other bits	T1X = IN103	# KEY DTT # Not used
<u>General Settings:</u> Group Change Delay (cycles in 0.25 increm Nominal Frequency (Hz) Phase Rotation	nents) TGR = 0 NFREQ = 60 PHROT = ABC Date, E = MDY	# Not used
Front Panel Timeout (minutes) Display Update Rate (seconds) Length of Event Report (cycles) Cycle Length of Prefault in Event Report (cy DC Battery LO Voltage Pickup (Vdc) DC Battery HI Voltage Pickup (Vdc)	$FP_TO = 5$ $SCROLD = 5$ $LER = 60$ $PRE = 4$ $DCLOP = OFF$ $DCHIP = OFF$	# 5 minutes # 5 seconds
Optoisolated Input Timers: IN101D	~ IN106D, IN301D ~ IN308D = 0.5	# 0.5 cycle
Breaker Monitor Settings: Breaker Monitor Enable	EBMON = N	# Not used
Synchronized Phasor Settings: Synchronized Phasor Measurement	EPMU = N	# Not used
<u>SER:</u> SER1 = 87L,87L2,87LG,87LA,87LB,87LC,F ,Z2G,Z2GT,67P1T,67P2T,67P3T,67G1T,5 ⁻ SER2 = SV1T, SV2T, IN103, IN104, IN105 SER3 = OUT102, OUT103, OUT104, OUT	R87L2,R87LG,R87LA,R87LB,R87LC,M1P,Z1G,M2P,M2PT 1G,51GT,LOP 5, IN106, IN301, IN302, IN303, IN304, IN305, IN306, IN307 105,OUT106, OUT107	-
Text: Local Bit Labels Display-Point Labels	$DP1_1 = NA$ $DP1_0 = NA$ $DP2_1 = NA$ $DP2_0 = NA$ $DP3_1 = NA$ $DP3_0 = NA$ $DP4_1 = BREAKER 1 OPEN$ $DP4_0 = BREAKER 1 CLOSED$ $DP5_1 = BREAKER 2 OPEN$ $DP5_0 = BREAKER 2 CLOSED$ $DP6_1 = MOD F2 OPEN$ $DP6_0 = MOD F2 CLOSED$ $DP7_1 = NA$ $DP7_0 = NA$ $DP8_1 = NA$	# Not used
Reclosing Relay Labels		# Not used

	Appendix 11	87B-B	S2 (SEL-3	87) Setting C	Calculation	1
1. Data MVA_Base = CTR =	100	kV_Base = PTR =	345 3000	Z_Base =	1190.25 0 2	ohms
Total MVA of al	I three GSUs =	750	; Maximum	full load current	t (amps) =	1255.11
2. Setting Criter	ia					
2.1 Differential	Settings:					
		Ma	aximum Tran	sformer MVA =	750	MVA
Th	e nominal transfo	rmer Winding 1	1 terminal vol	tage VWDG1 =	345	kV
Th	e nominal transfo	rmer Winding 2	2 terminal vol	tage VWDG2 =	345	kV
Th	e nominal transfo	rmer Winding 3	3 terminal vol	tage VWDG3 =	345	kV
		СТ	ratio for win	ding 1CTR1=	600	
		СТ	ratio for win	ding 2CTR2=	600	
		СТ	ratio for win	ding 3 CTR3=	600	
Windir	ng 1 Current Tap	FAP1 = MVA/(\$	Sqrt(3) x VW	DG1 x CTR1) =	2.09	A
Windir	ng 2 Current Tap	FAP2 = MVA/(\$	Sqrt(3) x VW	DG2 x CTR2) =	2.09	A
Windir	ng 3 Current Tap	FAP3 = MVA/(\$	Sqrt(3) x VW	DG3 x CTR3) =	2.09	A
	O87P ≥ 0.1 x	5A / TAPmin 🛙	= 0.24	Set 087P=	0.24	# Per manual
Dua	al-Slop variable-pe	ercentage diffe	rential charad	cteristic is used.		
	Res	traint Slop 1 Pe	ercentage (5-	·100%) SLP 1 =	25	
	Restraint Slop	pe 2 Percentag	ge (OFF, 25–	200%) SLP2 =	50	
Re	estraint Current Slo	ope 1 Limit ((1-	-20) multiple	of tap) IRS1 =	6.8	
Unres	trained Element C	Current PU ((1-	-20) multiple	of tap) U87P =	10.2	
Seco	ond-Harmonic Bloo	cking Percenta	ge (OFF, 5–1	100%) PCT2 =	OFF	
F	ifth-Harmonic Bloo	king Percenta	ge (OFF, 5–1	00%) PCT5 =	OFF	
		Independen	nt Harmonic E	Blocking IHBL =	Ν	

2.2 Winding 1 Elems (for event triggering)

2.2.1 Set phase IOC element 50P11P at 7.3 CT secondary amp or 4,393 CT primary amp, i.e. 3.5 times of the maximum full load current (FLC).

2.2.2. Set phase TOC element 51P1P at 2.95 CT secondary amp or 1,770 CT primary amp, i.e. 1.4 times of the maximum FLC.

2.2.3. Set residual IOC element 51N11P at 2.95 CT secondary amp or 1,770 CT primary amp, i.e. 1.4 times of the maximum FLC.

2.2.4. Set residual TOC element 51N1P at 1.65 CT secondary amp or 1,004 CT primary amp, i.e. 80% of the maximum FLC.

<u>Group 1 - Set 1:</u>	
Config. Settings:	
Relay Identifier	RID = 87B-BS2
Terminal Identifier	TID = CHARLES POLETTI
Enable Wdg1 in Differential Element	E87W1 = Y
Enable Wdg2 in Differential Element	E87W2 = Y
Enable Wdg3 in Differential Element	E87W3 = Y
Enable Wdg4 in Differential Element	E87W4 = N
Enable Wdg1 O/C Elements and Dmd. Thresholds	EOC1 = Y
Enable Wdg2 O/C Elements and Dmd. Thresholds	EOC2 = N
Enable Wdg3 O/C Elements and Dmd. Thresholds	EOC3 = N

Appendix 11	87B-BS2 (SEL-387)	Setting Calculation	
Enable Wdg4 O/C Elements and Dmd.	Thresholds	EOC4 = N	
Enable Combined O/C Elements		EOCC = N	
Enable RTDA Elements		E49A = N	
Enable RTDB Elements		E49B = N	
Enable SELogic Set 1		ESLS1 = Y	
Enable SELogic Set 2		ESLS2 = N	
Enable SELogic Set 3		ESLS3 = N	
General Data:			
Wdg1 CT Connection		W1CT = Y	
Wdg2 CT Connection		W2CT = Y	
Wdg3 CT Connection		W3CT = Y	
Wdg4 CT Connection		W4CT = Y	# Not Used
Wdg1 CT Ratio		CTR1 = 600	
Wdg2 CT Ratio		CTR2 = 600	
Wdg3 CT Ratio		CTR3 = 600	
Wdg4 CT Ratio		CTR4 = 600	# Not Used
Maximum Power Xfmr Capacity		MVA = 750	
Define Interal CT Connection Compens	ation	ICOM = N	
Wdg 1 Line-to-Line Voltage		VWDG1 = 345	# kV
Wdg 2 Line-to-Line Voltage		VWDG2 = 345	# kV
Wdg 3 Line-to-Line Voltage		VWDG3 = 345	# kV
Wdg 4 Line-to-Line Voltage		VWDG4 = 345	# Not used
<u>Diff Elems:</u>			
Restrained Element Current PU		O87P = 0.24	
Restrain Slope 1 Percentage		SLP1 = 25	
Restrain Slope 2 Percentage		SLP2 = 50	
Restraint Current Slope 1 Limit		IRS1 = 6.8	
Unrestrained Element Current PU		U87P = 10.2	
2nd Harmonic Blocking Percentage		PCT2 = OFF	
5th Hamronic Blocking Percentage		PCT5 = OFF	
5th Harmonic Alarm Threshold		TH5P = OFF	
Independent Harmonic Blocking		IHBL = N	
Restriced Earth Fault:			# Not Used
Winding 1 Elems:			
Phase Def-Time O/C Level 1 PU		50P11P = 7.3	# 3.5xFLC
Phase Level 1 O/C Delay		50P11P = 0.5	# cycle
50P11 Torque Control (SELogic Equati	on)	50P11TC = 1	
Oher Phase Inst O/C elements			# Not used
Phase Inv-Time O/C PU		51P1P = 2.95	# 1.4xFLC
Phase Inv-Time O/C Curve		51P1C = C2	
Phase Inv-Time O/C Time-Dial		51P1TD = 0.2	
Phase Inv-Time O/C EM Reset		51P1RS = N	
51P1 Torque Control (SELogic Equatio	n)	51P1TC = 1	
Neg-Seq Def-Time O/C			# Not used
Residual Def-Time O/C Level 1 PU		50N11P = 2.95	# 1.4xFLC
Residual Level 1 O/C Delay		50N11D = 0.5	# cycle
50N11 Torque Control (SELogic Equati	on)	50N11TC = 1	

Appendix 11	87B-BS2 (SEL-387) Setting Calculation	
Other Residual Inst O/C elements		# Not used
Residual Inv-Time O/C PU	51N1P = 1.65	# 80% FLC
Residual Inv-Time O/C Curve	51N1C = C2	
Residual Inv-Time O/C Time-Dial	51N1TD = 0.35	
Residual Inv-Time O/C EM Reset	51N1RS = N	
51N1 Torque Control (SELogic Equation	n) 51N1TC = 1	
Demand Ammeter Time Constant	DATC1 = 15	# Default
Phase Demand Ammeter Threshold	PDEM1P = 7	# Default
Neg-Seq Demand Ammeter Threshold	QDEM1P = 1	# Default
Residual Demand Ammeter Threshold	NDEM1P = 1	# Default
Winding 2 Elems:		# Not Used
Winding 3 Elems:		# Not Used
Winding 4 Elems:		# Not Used
Combined Elems:		# Not used
RID A Elems:		# Not used
<u>RID B Elems:</u>		# Not used
Misc. Timers		# Default
<u>SELOGIC SET 1:</u> Set 1 Veriable 1 (SELegia Equation)	S11/1 - 07D	
Set 1 Variable 1 (SELOgic Equation)	SIVI = 8/R	
S1V1 Timer Dropout	SIVIPU = 0 SIVIDO = 24	# 0.4 accord
Set 1 Variable 2 (SEL agic Equation)	STV IDU - 24 S1V/2 - 51D1T+51N1T	# 0.4 Second
S1/2 Timer Dickup	STV2 - STFTT+STNTT S1\/2DLL - 0	
S1V2 Timer Dropout	S1V2F0 = 0 S1V2DO = 0	
Set 1 Variable 3 (SEL onic Equation)	S1V3 = S1V2+87R	
S1V3 Timer Pickup	S1V3PU = 60	# 1 second
S1V3 Timer Dropout	S1V3DO = 300	# 5 seconds
Set 1 Variable 4 (SEL ogic Equation) S1	V4 = 87R+50N11T+50P11T+51P1T+51N1T	# Event trigger
S1V4 Timer Pickup	S1V4PU = 0	
S1V4 Timer Dropout	S1V4DO = 0	
Set 1 Latch Bits		# Not used
SELogic Set 2:		# Not used
SELogic Set 3:		# Not used
Trip Logic:		
	TR1 = 50P11T + 51P1T +50N11T	+51N1T
	TR2 = 87R + 87U	
	TR3 = 0	
	TR4 = 0	
	TR5 = 0	
	ULTR1 = !(51P1 + 51N1)
	ULTR2 = !(87R + 87U)	
	ULTR3 = 0	
	ULTR4 = 0	
	ULIR5 = 0	
Close Logic:		# Not used
<u>Event Irigger</u>		
Output Contact Logic:	ER = /S1V4	
Output Contact 101		# Any Trin
Output Contact 101	OUTIOT = TRIFTTRIFZ	
	001102 = 0	

Appendix 11 87B-BS2 (SEL-387) Setting Calculation

Output Contact 103 Output Contact 104 Output Contact 105 Output Contact 106 Output Contact 107 Output Contact 201 ~ 212 are all 0. OUT103 = 0# Not used OUT104 = 0 OUT105 = S1V3T OUT106 = 0OUT107 = 0

Not used # Alarm # Not used # Not used # Not used

Global

Default

SER: SER1 = 87R,87U,50P11,50P11T,51P1,51P1T,50N11,50N11T,51N1,51N1T SER2 = S1V1,S1V1T,S1V2,S1V3,OUT105,S1V4 SER3 = 0 SER4 = 0

	Appendix 12	87B-1-E	8S3 (SEL-38	87) Setting	Calculatio	on
1. Data MVA_Base = CTR =	100 600	kV_Base = PTR =	345 3000	Z_Base = CTR/PTR=	1190.25 0.2	ohms
Total MVA of a	III three GSUs =	750	; Maximum fu	ull load curren	t (amps) =	1255.11
2. Setting Crite 2.1 Differential	eria Settings:					
		Ma	ximum Transf	ormer MVA =	750	MVA
Т	he nominal transfor	mer Winding 1	terminal volta	ge VWDG1 =	345	# Not Used
Т	he nominal transfor	mer Winding 2	terminal volta	ge VWDG2 =	345	kV
Т	he nominal transfor	mer Winding 3	terminal volta	ge VWDG3 =	345	kV
		CT	ratio for windi	ng 1 CTR1=	600	# Not Used
		CT	ratio for windi	ng 2 CTR2=	600	
		CT	ratio for windi	ng 3 CTR3=	600	
Wind	ing 1 Current Tap 1	TAP1 = MVA/(S	Sqrt(3) x VWD	G1 x CTR1) =	2.09	# Not Used
Wind	ing 2 Current Tap 1	T AP2 = MVA/(S	Sqrt(3) x VWD	G2 x CTR2) =	2.09	А
Wind	ing 3 Current Tap 1	T AP3 = MVA/(S	Sqrt(3) x VWD0	G3 x CTR3) =	2.09	A
	O87P ≥ 0.1 x	5A / TAPmin =	• 0.24	Set 087P=	0.24	# Per manual
Du	al-Slop variable-pe	ercentage differ	ential characte	eristic is used.		
	Rest	raint Slop 1 Pe	rcentage (5-10	00%) SLP 1 =	25	
	Restraint Slop	be 2 Percentage	e (OFF, 25–20	00%) SLP2 =	50	
R	estraint Current Slo	pe 1 Limit ((1–	20) multiple of	tap) IRS1 =	6.8	
Unre	strained Element C	urrent PU ((1–2	20) multiple of	tap) U87P =	10.2	
Sec	ond-Harmonic Bloc	king Percentag	ge (OFF, 5–10	0%) PCT2 =	OFF	
F	Fifth-Harmonic Bloc	king Percentag	ge (OFF, 5–10	0%) PCT5 =	OFF	
		Independent	t Harmonic Blo	ocking IHBL =	Ν	

2.2 Winding 2 Elems (for event triggering)

2.2.1 Set phase IOC element 50P21P at 7.3 CT secondary amp or 4,380 CT primary amp, i.e. 3.5 times of the maximum full load current (FLC).

2.2.2. Set phase TOC element 51P2P at 2.95 CT secondary amp or 1,770 CT primary amp, i.e. 1.4 times of the maximum FLC.

2.2.3. Set residual IOC element 51N21P at 2.95 CT secondary amp or 1,770 CT primary amp, i.e. 1.4 times of the maximum FLC.

2.2.4. Set residual TOC element 51N2P at 1.65 CT secondary amp or 990 CT primary amp, i.e. 79% of the maximum FLC.

<u>Group 1 - Set 1:</u>		
Config. Settings:		
Relay Identifier	RID = 87B-1-BS3	
Terminal Identifier	TID = CHARLES P	OLETTI
Enable Wdg1 in Differential Element	E87W1 = N	# Not Used
Enable Wdg2 in Differential Element	E87W2 = Y	
Enable Wdg3 in Differential Element	E87W3 = Y	
Enable Wdg4 in Differential Element	E87W4 = N	
Enable Wdg1 O/C Elements and Dmd. Thresholds	EOC1 = N	
Enable Wdg2 O/C Elements and Dmd. Thresholds	EOC2 = Y	
Enable Wdg3 O/C Elements and Dmd. Thresholds	EOC3 = N	

Appendix 12	87B-1-BS3	(SEL-387) Setting	Calculation	۱
Enable Wdg4 O/C Elements and Dmd	. Thresholds	EOC4 =	N	
Enable Combined O/C Elements		EOCC =	Ν	
Enable RTDA Elements		E49A =	Ν	
Enable RTDB Elements		E49B =	Ν	
Enable SELogic Set 1		ESLS1 =	Y	
Enable SELogic Set 2		ESLS2 =	Ν	
Enable SELogic Set 3		ESLS3 =	Ν	
General Data:				
Wdg1 CT Connection		W1CT =	Y	# Not Used
Wdg2 CT Connection		W2CT =	Y	
Wdg3 CT Connection		W3CT =	Y	
Wdg4 CT Connection		W4CT =	Y	# Not Used
Wdg1 CT Ratio		CTR1 =	600	# Not Used
Wdg2 CT Ratio		CTR2 =	600	
Wdg3 CT Ratio		CTR3 =	600	
Wdg4 CT Ratio		CTR4 =	600	# Not Used
Maximum Power Xfmr Capacity		MVA =	750	
Define Interal CT Connection Compen	sation	ICOM =	N	
Wdg 1 Line-to-Line Voltage		VWDG1 =	345	# Not Used
Wdg 2 Line-to-Line Voltage		VWDG2 =	345	# kV
Wdg 3 Line-to-Line Voltage		VWDG3 =	345	# KV
Wdg 4 Line-to-Line Voltage		VWDG4 =	345	# Not used
Diff Elems:				
Restrained Element Current PU		O87P =	0.24	
Restrain Slope 1 Percentage		SLP1 =	25	
Restrain Slope 2 Percentage		SLP2 =	50	
Restraint Current Slope 1 Limit		IRS1 =	6.8	
Unrestrained Element Current PU		U87P =	10.2	
2nd Harmonic Blocking Percentage		PCT2 =	OFF	
5th Hamronic Blocking Percentage		PCT5 =	OFF	
5th Harmonic Alarm Threshold		TH5P =	OFF	
Independent Harmonic Blocking		IHBL =	Ν	
Restriced Earth Fault:				# Not Used
Winding 1 Elems:				# Not Used
Winding 2 Elems:				
Phase Def-Time O/C Level 1 PU		50P21P =	7.3	# 3.5xFLC
Phase Level 1 O/C Delay		50P21P =	0.5	# cycle
50P21 Torque Control (SELogic Equat	tion)	50P21TC =	1	
Oher Phase Inst O/C elements		= (0.0		# Not used
Phase Inv-Time O/C PU		51P2P =	2.95	# 1.4x⊦LC
Phase Inv-Time O/C Curve		51P2C =	C2	
Phase Inv-Time O/C Time-Dial		51P21D =	0.2	
Phase Inv-Time O/C EM Reset		51P2RS =	N	
51P2 Torque Control (SELogic Equation	on)	51P21C =	1	# NI=1 ··· = ··!
Neg-Seq Det-Time O/C			0.05	
Residual Det-Time U/C Level 1 PU		50N21P =	2.95	# 1.4XFLC
Residual Level TO/C Delay		50N21D =	0.5	# cycle

Appendix 12	87B-1-BS3 (SEL-387) Setting	Calculation
50N21 Torque Control (SELogic Equa	ation) 50N21TC =	1
Other Residual Inst O/C elements		# Not used
Residual Inv-Time O/C PU	51N2P =	1.65 # 80% FLC
Residual Inv-Time O/C Curve	51N2C =	C2
Residual Inv-Time O/C Time-Dial	51N2TD =	0.35
Residual Inv-Time O/C EM Reset	51N2RS =	N
51N2 Torque Control (SELogic Equat	ion) 51N2TC =	1
Demand Ammeter Time Constant	DATC2 =	15 # Default
Phase Demand Ammeter Threshold	PDEM2P =	7 # Default
Neg-Seq Demand Ammeter Threshol	d QDEM2P =	1 # Default
Residual Demand Ammeter Threshol	d NDEM2P =	1 # Default
Winding 3 Elems:		# Not Used
VVInding 4 Elems:		# Not Used
Combined Elems:		# Not used
RTD A Elems:		# Not used
<u>RIDBEIEIIIS.</u> Miss Timors		# Not used # Dofault
SEL ogic Set 1:		# Delault
Set 1 Variable 1 (SEL onic Equation)	S1\/1 =	
S1V1 Timer Pickun	S1V1= S1V1PIL=	0
S1V1 Timer Dropout	S1V1DO =	24 #0.4 second
Set 1 Variable 2 (SEL ogic Equation)	S1V2 =	51P2T
S1V2 Timer Pickup	S1V2PU =	0
S1V2 Timer Dropout	S1V2DO =	24 # 0.4 second
Set 1 Variable 3 (SELogic Equation)	S1V3 =	51N2T
S1V3 Timer Pickup	S1V3PU =	0
S1V3 Timer Dropout	S1V3DO =	24 # 0.4 second
Set 1 Variable 4 (SELogic Equation)	S1V4 = 87R+50N21T+50P21T+51P2T+	51N2T # Event trigger
S1V4 Timer Pickup	S1V4PU =	0
S1V4 Timer Dropout	S1V4DO =	0
Set 1 Latch Bits		# Not used
SELogic Set 2:		# Not used
SELogic Set 3:		# Not used
Trip Logic:		
	IR1 = 50P211 + 5	1P21 +50N211 +51N21
	IR2 =	8/R + 8/U
	IR3 =	0
	1R4 = TD5 =	0
	- 1R5 –	$U = 1(51D2 \pm 51N2)$
		1(87P + 8711)
		0
	UI TB4 =	0
	UI TR5 =	0
Close Logic:	02110	# Not used
Event Trigger		
	ER =	/S1V4
Output Contact Logic:		
Output Contact 101	OUT101 =	TRIP1+TRIP2 # Any Trip
Output Contact 102	OUT102 =	0 # Not used

Appendix 12

87B-1-BS3 (SEL-387) Setting Calculation

Output Contact 103 Output Contact 104 Output Contact 105 Output Contact 106 Output Contact 107 Output Contact 201 ~ 212 are all 0.

 OUT103 = 0
 # Not used

 OUT104 = 0
 # Not used

 OUT105 = S1V1T
 # Alarm

 OUT106 = S1V2T
 # Alarm

 OUT107 = S1V3T
 # Alarm

 Wot used
 # Not used

Global

Default

<u>SER:</u> SER1 = 87R,87U,50P21,50P21T,51P2,51P2T,50N21,50N21T,51N2,51N2T SER2 = S1V1,S1V1T,S1V2,S1V3,OUT105,S1V4 SER3 = 0 SER4 = 0

	Append	lix 13	87B-2-E	8S3 (GE-F	B30)) Setting	Calculation	
1. Data								
MVA_Base =	100		kV_Base =	345		Z_Base =	1190.25	ohms
CTR =	600		PTR =	3000		CTR/PTR=	0.2	
Total MVA of all	three GS	Us =	750	; Maximun	n ful	I load curren	t (amps) =	1255.11
2. Setting Criteri	ia							
2.1 Differential S	Settings:	refer to	"MottHaven_34	45kV_87B_	100	906.doc" for	setting criteria	ł.
Pickup	- =	•	0.170 pu	# 40% of F	FLC			
Low Slope	: =	•	25%					
Low Bpnt	t =	•	1.70 pu	# 4x of FL	С			
High Slope	: =	=	50%					
High Bpnt	: =	-	6.80 pu	# 16x of Fl	LC			
2.2 Overcurrent	Elements	(for eve	nt triggering)					
2.2.1 Set phase	IOC elem	ent at 1.	46 pu or CT pr	imary amp ·	4,38	30, i.e. 3.5 tir	nes of the max	imum full load
2.2.2. Set phase	e TOC ele	ment at (0.59 pu or CT p	primary amp	o 1,7	770 , i.e. 1.4	times of the m	aximum FLC.
2.2.3. Set groun	d IOC ele	ment at (0.6 pu or CT pr	imary amp	1,77	70 , i.e. 1.4 ti	mes of the ma	ximum FLC.
2.2.4. Set groun	d TOC ele	ement at	0.33 pu or CT	primary am	ıp 99	90 , i.e. 79%	of the maximu	ım FLC.
Device Definition	<u>n:</u>							# Default
Product Setup:								
Security:								# Default
Display Properti	es:							# Default
Clear Relay Red	cords:							# All OFF
Communications	<u>s:</u>							# Default
Modbus User M	<u>ap:</u>							# Not used
Real Time Clock	<u>C.</u>							
		IRIG	-B Signal Type	=		DC Shift		
		Al	I other settings	=		Default		

Appendix 13

87B-2-BS3 (GE-B30) Setting Calculation

User-Programmable Fault Report:

Prefault Trigger	=	ON
Fault Trigger	=	Bus Diff Op On (VO1)
Analog Channel 1	=	SRC1 la Mag
Analog Channel 2	=	SRC1 Ib Mag
Analog Channel 3	=	SRC1 Ic Mag
Analog Channel 4	=	SRC2 la Mag
Analog Channel 5	=	SRC2 Ib Mag
Analog Channel 6	=	SRC2 Ic Mag
Analog Channel 7	=	SRC1 la Angle
Analog Channel 8	=	SRC1 Ib Angle
Analog Channel 9	=	SRC1 Ic Angle
Analog Channel 10	=	SRC2 la Angle
Analog Channel 11	=	SRC2 Ib Angle
Analog Channel 12	=	SRC2 Ic Angle
Analog Channel 13	=	Bus 1 Diff A Mag
Analog Channel 14	=	Bus 1 Diff A Ang
Analog Channel 15	=	Bus 1 Diff B Mag
Analog Channel 16	=	Bus 1 Diff B Ang
Analog Channel 17	=	Bus 1 Diff C Mag
Analog Channel 18	=	Bus 1 Diff C Ang
Analog Channel 19	=	Bus 1 Rest A Mag
Analog Channel 20	=	Bus 1 Rest A Ang
Analog Channel 21	=	Bus 1 Rest B Mag
Analog Channel 22	=	Bus 1 Rest B Ang
Analog Channel 23	_	Bus 1 Rest C Mag
	—	
Analog Channel 24	=	Bus 1 Rest C Ang
Analog Channel 24 Oscillography:	=	Bus 1 Rest C Ang
Oscillography: SETTING	= = =	Bus 1 Rest C Ang
Oscillography: SETTING Number Of Records	= = =	PARAMETER
<u>Oscillography:</u> SETTING Number Of Records Trigger Mode	= = = =	Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite
<u>Oscillography:</u> SETTING Number Of Records Trigger Mode Trigger Position	= = = = =	Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50%
Analog Channel 24 Oscillography: SETTING Number Of Records Trigger Mode Trigger Position Trigger Source	= = = = = =	Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4)
Oscillography: SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms	= = = = = = =	Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle
Oscillography: SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms Digital Channel 1	= = = = = = = =	Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle OFF
Analog Channel 24 <u>Oscillography:</u> SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms Digital Channel 1 Digital Channel 2	= = = = = = = = =	Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle OFF Bus Diff Op On (VO1)
Analog Channel 24 <u>Oscillography:</u> SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms Digital Channel 1 Digital Channel 2 Digital Channel 3	= = = = = = = = = = =	Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle OFF Bus Diff Op On (VO1) Not Used On (VO2)
Analog Channel 24 <u>Oscillography:</u> SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms Digital Channel 1 Digital Channel 2 Digital Channel 3 Digital Channel 4	= = = = = = = = = = = = = = = = = = = =	Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle OFF Bus Diff Op On (VO1) Not Used On (VO2) Alarm On (VO3)
Analog Channel 24 <u>Oscillography:</u> SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms Digital Channel 1 Digital Channel 2 Digital Channel 3 Digital Channel 4 Digital Channel 5		Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle OFF Bus Diff Op On (VO1) Not Used On (VO2) Alarm On (VO3) Trig Oscill On (VO4)
Analog Channel 24 <u>Oscillography:</u> SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms Digital Channel 1 Digital Channel 2 Digital Channel 3 Digital Channel 4 Digital Channel 5 Digital Channel 6		Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle OFF Bus Diff Op On (VO1) Not Used On (VO2) Alarm On (VO3) Trig Oscill On (VO4) CT Trouble On (VO5)
Analog Channel 24 <u>Oscillography:</u> SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms Digital Channel 1 Digital Channel 2 Digital Channel 3 Digital Channel 4 Digital Channel 5 Digital Channel 6 Digital Channel 7		Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle OFF Bus Diff Op On (VO1) Not Used On (VO2) Alarm On (VO3) Trig Oscill On (VO4) CT Trouble On (VO5) BUS 1 BIASED PKP A
Analog Channel 24 <u>Oscillography:</u> SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms Digital Channel 1 Digital Channel 2 Digital Channel 2 Digital Channel 3 Digital Channel 4 Digital Channel 5 Digital Channel 6 Digital Channel 7 Digital Channel 8		Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle OFF Bus Diff Op On (VO1) Not Used On (VO2) Alarm On (VO3) Trig Oscill On (VO4) CT Trouble On (VO5) BUS 1 BIASED PKP A BUS 1 BIASED OP A
Analog Channel 24 <u>Oscillography:</u> SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms Digital Channel 1 Digital Channel 2 Digital Channel 2 Digital Channel 3 Digital Channel 4 Digital Channel 5 Digital Channel 5 Digital Channel 7 Digital Channel 8 Digital Channel 9		Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle OFF Bus Diff Op On (VO1) Not Used On (VO2) Alarm On (VO3) Trig Oscill On (VO4) CT Trouble On (VO5) BUS 1 BIASED PKP A BUS 1 BIASED PKP B
Analog Channel 24 <u>Oscillography:</u> SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms Digital Channel 1 Digital Channel 2 Digital Channel 2 Digital Channel 3 Digital Channel 4 Digital Channel 5 Digital Channel 5 Digital Channel 7 Digital Channel 8 Digital Channel 9 Digital Channel 10		Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle OFF Bus Diff Op On (VO1) Not Used On (VO2) Alarm On (VO3) Trig Oscill On (VO4) CT Trouble On (VO5) BUS 1 BIASED PKP A BUS 1 BIASED OP A BUS 1 BIASED OP B
Analog Channel 24 <u>Oscillography:</u> SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms Digital Channel 1 Digital Channel 2 Digital Channel 3 Digital Channel 3 Digital Channel 4 Digital Channel 5 Digital Channel 5 Digital Channel 6 Digital Channel 7 Digital Channel 8 Digital Channel 9 Digital Channel 10 Digital Channel 11		Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle OFF Bus Diff Op On (VO1) Not Used On (VO2) Alarm On (VO3) Trig Oscill On (VO4) CT Trouble On (VO5) BUS 1 BIASED PKP A BUS 1 BIASED PKP B BUS 1 BIASED OP B BUS 1 BIASED OP B BUS 1 BIASED PKP C
Analog Channel 24 <u>Oscillography:</u> SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms Digital Channel 1 Digital Channel 2 Digital Channel 3 Digital Channel 4 Digital Channel 5 Digital Channel 5 Digital Channel 6 Digital Channel 7 Digital Channel 8 Digital Channel 9 Digital Channel 10 Digital Channel 11 Digital Channel 12		Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle OFF Bus Diff Op On (VO1) Not Used On (VO2) Alarm On (VO3) Trig Oscill On (VO4) CT Trouble On (VO5) BUS 1 BIASED PKP A BUS 1 BIASED OP A BUS 1 BIASED OP B BUS 1 BIASED OP B BUS 1 BIASED OP C
Analog Channel 24 <u>Oscillography:</u> SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms Digital Channel 1 Digital Channel 2 Digital Channel 2 Digital Channel 3 Digital Channel 3 Digital Channel 4 Digital Channel 5 Digital Channel 5 Digital Channel 6 Digital Channel 7 Digital Channel 7 Digital Channel 8 Digital Channel 9 Digital Channel 10 Digital Channel 11 Digital Channel 12 Digital Channel 12 Digital Channel 12 Digital Channel 13		Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle OFF Bus Diff Op On (VO1) Not Used On (VO2) Alarm On (VO3) Trig Oscill On (VO4) CT Trouble On (VO5) BUS 1 BIASED PKP A BUS 1 BIASED OP A BUS 1 BIASED OP B BUS 1 BIASED OP C BUS 1 DIR A
Analog Channel 24 <u>Oscillography:</u> SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms Digital Channel 1 Digital Channel 2 Digital Channel 2 Digital Channel 3 Digital Channel 3 Digital Channel 4 Digital Channel 5 Digital Channel 5 Digital Channel 6 Digital Channel 7 Digital Channel 7 Digital Channel 8 Digital Channel 9 Digital Channel 10 Digital Channel 11 Digital Channel 12 Digital Channel 12 Digital Channel 13 Digital Channel 13 Digital Channel 14		Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle OFF Bus Diff Op On (VO1) Not Used On (VO2) Alarm On (VO3) Trig Oscill On (VO4) CT Trouble On (VO5) BUS 1 BIASED PKP A BUS 1 BIASED OP A BUS 1 BIASED OP B BUS 1 BIASED OP B BUS 1 BIASED OP C BUS 1 DIR A BUS 1 DIR B
Analog Channel 24 <u>Oscillography:</u> SETTING Number Of Records Trigger Mode Trigger Position Trigger Source AC Input Waveforms Digital Channel 1 Digital Channel 2 Digital Channel 2 Digital Channel 3 Digital Channel 4 Digital Channel 4 Digital Channel 5 Digital Channel 5 Digital Channel 6 Digital Channel 7 Digital Channel 7 Digital Channel 8 Digital Channel 9 Digital Channel 10 Digital Channel 11 Digital Channel 12 Digital Channel 12 Digital Channel 13 Digital Channel 14 Digital Channel 14		Bus 1 Rest C Ang PARAMETER 6 Automatic Overwrite 50% Trig Oscill On (VO4) 32 samples/cycle OFF Bus Diff Op On (VO1) Not Used On (VO2) Alarm On (VO3) Trig Oscill On (VO4) CT Trouble On (VO5) BUS 1 BIASED OP A BUS 1 BIASED OP A BUS 1 BIASED OP B BUS 1 BIASED OP B BUS 1 BIASED OP B BUS 1 BIASED OP C BUS 1 DIR A BUS 1 DIR B BUS 1 DIR C

Appendix 13	87B-2-BS3 (GE-B30) Setting	Calculation
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Digital Channel 17	=	BUS 1 S	AT B
Digital Channel 18	=	BUS 1 S	AT C
Digital Channel 19	=	BUS 1 U	NBIASED OP A
Digital Channel 20	=	BUS 1 U	NBIASED OP B
Digital Channel 21	=	BUS 1 U	NBIASED OP C
Digital Channel 22	=	PHASE	TOC1 PKP A
Digital Channel 23	=	PHASE	TOC1 OP A
Digital Channel 24	=	PHASE	TOC1 PKP B
Digital Channel 25	=	PHASE	TOC1 OP B
Digital Channel 26	=	PHASE	TOC1 PKP C
Digital Channel 27	=	PHASE	TOC1 OP C
Digital Channel 28	=	NEUTR	AL TOC1 PKP
Digital Channel 29	=	NEUTR	AL TOC1 OP
Digital Channel 30	=	NEUTR	AL IOC1 PKP
Digital Channel 31	=	NEUTR	AL IOC1 OP
Digital Channel 32	=	PHASE	IOC1 PKP A
Digital Channel 33	=	PHASE	IOC1 PKP B
Digital Channel 34	=	PHASE	IOC1 PKP C
Digital Channel 35	=	Trip_LE) On (VO9)
Digital Channel 36	=	51 On (V	/O8)
Digital Channel 37	=	87l On (\	VO7)
Digital Channel 38	=	OFF	
Digital Channel 39	=	OFF	
Digital Channel 40	=	OFF	
Digital Channel 41	=	OFF	
Digital Channel 42	=	OFF	
Digital Channel 43	=	OFF	
Digital Channel 44	=	OFF	
Digital Channel 45	=	OFF	
Digital Channel 46	=	OFF	
Digital Channel 47	=	OFF	
Digital Channel 48	=	OFF	
Digital Channel 49	=	OFF	
Digital Channel 50	=	OFF	
Digital Channel 51	=	OFF	
Digital Channel 52	=	OFF	
Digital Channel 53	=	OFF	
Digital Channel 54	=	OFF	
Digital Channel 55	=	OFF	
Digital Channel 56	=	OFF	
Digital Channel 57	=	OFF	
Digital Channel 58	=	OFF	
Digital Channel 59	=	OFF	
Digital Channel 60	=	OFF	
Digital Channel 61	=	OFF	
Digital Channel 62	=	OFF	
Digital Channel 63	=	OFF	
Analog Channel 1	=	SRC1	la Mag
Analog Channel 2	=	SRC1	lb Mag
Analog Channel 3	=	SRC1	lc Mag

Appendix 13	87B-2-BS3	6 (GE-B3	80) Setting (Calculation	
Ana	alog Channel 4	=	SRC1 la	Angle	
Ana	alog Channel 5	=	SRC1 lb	Angle	
Ana	alog Channel 6	=	SRC1 lc	Angle	
Ana	alog Channel 7	=	SRC2 la	Mag	
Ana	alog Channel 8	=	SRC2 lb	Mag	
Ana	alog Channel 9	=	SRC2 lc	Mag	
Anal	og Channel 10	=	Bus 1 Diff A	Mag	
Anal	og Channel 11	=	Bus 1 Diff B	Mag	
Anal	og Channel 12	=	Bus 1 Diff C	Mag	
Anal	og Channel 13	=	SRC2 la	Angle	
Anal	og Channel 14	=	SRC2 lb	Angle	
Anal	og Channel 15	=	SRC2 lc	Angle	
Anal	og Channel 16	=	SRC1 Fr	equency	
User-Programmable Leds:					
<u>LED Test.</u>	Function	_	Enabled		
	Control	_		PUSHBUTTON	I 1 ON
Trip and Alarms Leds:	Control	_	CONTROL	0011201101	
<u></u>	Trip LED Input	=	Trip LED Or	າ (VO9)	
Al	arm LED Input	=	Alarm On (V	O3)	
)	
	LED 1	=	Bus Diff Op (On (VO1)	Latched
	LED 2	=	51 On (VO8)	1	Latched
	LED 3	=	871 On (VO7)	Latched
	LED 4	=	OFF		Self-Reset
	LED 5	=	BUS 1 BIASI	ED OP A	Latched
	LED 6	=	BUS 1 BIASI	ED OP B	Latched
	LED 7	=	BUS 1 BIASI	ED OP C	Latched
	LED 8	=	OFF		Self-Reset
	LED 9	=	PHASE TOC	:1 OP A	Latched
	LED 10	=	PHASE TOC	;1 OP B	Latched
	LED 11	=	PHASE TOC	:1 OP C	Latched
	LED 12	=	OFF		Self-Reset
	LED 13	=	NEUTRAL T	OC1 OP	Latched
	LED 14	=	OFF		Self-Reset
	LED 15	=	CT Trouble C	Dn (VO5)	Latched
	LED 16	=	OFF		Self-Reset
	LED 17	=	BUS 1 UNBI	ASED OP A	Latched
	LED 18	=	BUS 1 UNBI	ASED OP B	Latched
	LED 19	=	BUS 1 UNBI	ASED OP C	Latched
	LED 20	=	OFF		Self-Reset
	LED 21	=	OFF		Self-Reset
	LED 22	=	OFF		Self-Reset
	LED 23	=	OFF		Self-Reset
	LED 24	=	OFF		Self-Reset
	LED 25	=	BUS 1 BIASI		Self-Reset
	LED 26	=	BUS 1 BIASI	ED PKP B	Self-Reset
	LED 27	=	BUS 1 BIASI	ED PKP C	Self-Reset
	LED 28	=	OFF		Self-Reset

	Append	ix 13	87B-2-BS	3 (GE-B3	80) Setting	g Calculation	1
			LED 29	=	PHASE TO	DC1 PKP A	Self-Reset
			LED 30	=	PHASE TO	OC1 PKP B	Self-Reset
			LED 31	=	PHASE TO	DC1 PKP C	Self-Reset
			LED 32	=	OFF		Self-Reset
			LED 33	=	NEUTRAL	TOC1 PKP	Self-Reset
			LED 34	=	OFF		Self-Reset
			LED 35	=	OFF		Self-Reset
			LED 36	=	BUS 1 DIF	RA	Self-Reset
			LED 37	=	BUS 1 DIF	RB	Self-Reset
			LED 38	=	BUS 1 DIF	RC	Self-Reset
			LED 39	=	OFF		Self-Reset
			LED 40	=	BUS 1 SA	ТА	Self-Reset
			LED 41	=	BUS 1 SA	ТВ	Self-Reset
			LED 42	=	BUS 1 SA	IC	Self-Reset
			LED 43	=	OFF		Self-Reset
			LED 44	=	OFF		Self-Reset
			LED 45	=	OFF		Self-Reset
			LED 46	=	OFF		Self-Reset
				=	OFF		Self-Reset
Lloor Drogromm	able Calf T	aata	LED 48	=	OFF		Sell-Reset
<u>User-Programm</u>	Bomo	<u>esis.</u> to Dovico O	ff Eurotion	_	Enabled		
	Remo	Ethornot En	il Function	=	Disabled		
	ГП	Battery Fa	il Function	_	Enabled		
		SNTP Fa	il Function	_	Enabled		
		IRIG B Fa	il Function	_	Enabled		
Control Pushbu	ttons:			_	Enabled		
PARAMETER	CPB 1	CPE	32	CPB 3			
Function	Disabled	Disa	abled	Enabled			
Events	Disabled	Disa	abled	Enabled			
Flex States:							# All OFF
User-definable	displays:						# Not used
Direct I/O:							# Not used
Teleprotection:							# Not used
Installation:							
		R	elay Name	=	87B-2/BS3	3	
System Setup:							
AC Inputs							
<u>Current</u>	<u>:</u>	PAI	RAMETER		CT F1	CT F5	
		Phase C	CT Primary	=	3000 A	3000 A	
		Phase CT	Secondary	=	5 A	5 A	
		Ground C	T Primary	=	3000 A	3000 A	
	(Ground CT	Secondary	=	5 A	5 A	
Power System	<u>:</u>						
		Nominal	Frequency	=	60 Hz		
		Phas	e Rotation	=	ABC		
	Frequency	And Phase	Reference	=	SRC 1 (SF	RC 1)	
	Freque	ncy Trackin	g Function	=	Enabled		
Signal Sources		PA	RAMETER		SOURCE	1 SOURCE 2	

	Appendix 13	87B-2-BS3	GE-B	30) Setting		tion	
		Name	=	SRC 1	SRC 2		
		Phase CT	=	F1	F5		
	Ģ	Fround CT	=	None	None		
		Phase VT	=	None	None		
		Aux VT	=	None	None		
Breakers:							# Not used
Switches							# Not used
FlexCurves:							# Not used
Bus:	PAF	RAMETER		BUS ZONE	: 1 		
		Source A	=	SRC 1 (SR	(C 1)		
		Status A	=				
		Source B	=		.0 2)		
		Status B	=		C 1)		
		Status C	_		.01)		
		Source D	_		C 1)		
		Status D	_	OFF	01)		
		Source E	_	SRC 1 (SR	(C 1)		
		Status E	_	OFF	01)		
		Source E	_	SRC 1 (SR	C 1)		
		Status F	=	OFF			
FlexLogic: Grouped Elemen	<u>ts:</u>				# See 87	7B-2-B	S3-logic-r0.pdf
Bus Differential:							
<u>Bue Binerendan</u>	Operating Character	istc Graph	=	View			
	1 0	Function	=	Enabled			
		Pickup	=	0.170 pu			# 40% of FLC
	I	Low Slope	=	25%			
		Low Bpnt	=	1.70 pu			# 4x of FLC
	F	ligh Slope	=	50%			
		High Bpnt	=	6.80 pu			# 16x of FLC
		High Set	=	10.20 pu			# 24x of FLC
		Seal-In	=	0.400 s			
		Block	=	OFF			
		Target	=	Latched			
		Events	=	Enabled			
Phase Current: Phase TOC:							
	0.	Function	=	Enabled	•		
	Sigr	nal Source	=	SRC 1 (SR	C 1)		
		Input	=	RMS			
		Ріскир	=	0.590 pu	_		# 1.4x of FLC
	тг	Curve	=		В		
	IL		=	U.Z Timed			
	\/alta=	Reset	=	Dischlad			
	voitage		=				
		Block A Block B	-	OFF			
		Block C	=	OFF			

Appendix 13	87B-2-BS	3 (GE-B	30) Setting Calcula	ation
	Target	=	Latched	
	Events	=	Enabled	
Phase IOC:	Function		Frablad	
	Function	=		
	Dickup	=	1 /60 pu	# 3 5x of ELC
	Delay	_	0.01 s	# 3.5X 011 LC
	Reset Delay	_	0.01 S	
	Block A	_	OFF	
	Block B	=	OFF	
	Block C	=	OFF	
	Target	=	Self-reset	
	Events	=	Enabled	
Neutral Current:				
Neutral TOC:				
	Function	=	Enabled	
	Source	=	SRC 1 (SRC 1)	
	Input	=	RMS	
	Pickup	=	0.330 pu	# 80% of FLC
	Curve	=	IEC Curve B	
	TD Multiplier	=	0.35	
	Reset	=	Timed	
	Block	=	OFF	
	Larget	=	Latched	
Neutral IOC	Events	=	Enabled	
Neutral IOC.	Function	_	Enabled	
	Source	_		
	Pickup	_		# 1 4x of FLC
	Delay	_	0.000 pu 0.01 s	
	Reset Delay	=	0.00 s	
	Block	=	OFF	
	Target	=	Self-reset	
	Events	=	Enabled	
Ground Current:				
Ground TOC				# Not used
Ground IOC				# Not used
Breaker Failure:				# Not used
Control Elements:				
<u>Trip Bus:</u>				# Not used
Setting Groups:				# Not used
Selector Switches:				# Not used
Digital Elements:				# Not used
Digital Counters:				# Not used
Monitoring Elements:				# Naturad
				# INOT USED
	Function	_	Enabled	
	Pickup	_		
	nelav	_	10.0 s	
	Dolay	-		

Appendix 13 87E	3-2-BS3 (GE-B3	0) Setting Calculation	
1	arget	=	Disabled	
Inputs/Outputs:	vents	=	Enabled	
Contact inputs:				# Not used
Contact Inputs Thresholds:				
Cont lp 1, Cont lp 2, Cont lp 3,	Cont Ip 4(H	15A, H50	C, H6A, H6C) =	84 Vdc
Cont lp 5, Cont lp 6, Cont lp 7,	Cont Ip 8(H	17A, H70	C, H8A, H8C) =	84 Vdc
Cont Ip 9, Cont Ip 10, Cont Ip 11,	, Cont Ip 12	(L5A, L5	(C, L6A, L6C) =	84 Vdc
Virtual Inputs:	, Cont ip 16	(L/A, L/	(1, 18A, 18C) =	84 Vac # Not used
Contact Outputs:				
[H1] Contact Outpu	it 1 ID	=	87 Trip	
[H1] Contact Output 1 Op	perate	=	Bus Diff Op On (VO1)	
[H1] Contact Output 1 S	eal-In	=	Bus Diff Op On (VO1)	
[H1] Contact Output 1 E	vents	=	Enabled	
[H2] Contact Outpu	t 2 ID	=	51 TRIP (SP)	
[H2] Contact Output 2 Op	perate	=	OFF	
[H2] Contact Output 2 S	eal-In	=	OFF	
[H2] Contact Output 2 E	vents	=	Disabled	
[H3] Contact Outpu	it 3 ID	=	NOT USED	
[H3] Contact Output 3 Op	perate	=	OFF	
[H3] Contact Output 3 S	eal-In	=	OFF	
[H3] Contact Output 3 E	vents	=	Disabled	
[H4] Contact Outpu	it 4 ID	=	NOT USED	
[H4] Contact Output 4 Op	perate	=	OFF	
[H4] Contact Output 4 S	eal-In	=	OFF	
[H4] Contact Output 4 E	vents	=	Disabled	
[L1] Contact Output	t 5 ID	=	Any Trip	
[L1] Contact Output 5 Op	perate	=	FOR TESTING On (VO11)	
[L1] Contact Output 5 S	eal-In	=	OFF	
[L1] Contact Output 5 E	vents	=	Enabled	
[L2] Contact Outpu	t 6 ID	=	50 51P Trip	
[L2] Contact Output 6 Op	perate	=	50 51P TRIP On (VO2)	
[L2] Contact Output 6 S	eal-In	=	OFF	
[L2] Contact Output 6 E	vents	=	Enabled	
[L3] Contact Outpu	it 7 ID	=	50 51N Trip	
[L3] Contact Output 7 Op	perate	=	50 51N TRIP On (VO12)	
[L3] Contact Output 7 S	eal-In	=	OFF	
[L3] Contact Output 7 E	vents	=	Enabled	
[L4] Contact Outpu	it 8 ID	=	NOT USED	
[L4] Contact Output 8 Op	perate	=	OFF	
[L4] Contact Output 8 S	eal-In	=	OFF	
[L4] Contact Output 8 E	vents	=	Disabled	

87B-2-BS3 (GE-B30) Setting Calculation

Virtual Outputs:

Teleprotection:

IEC 61850 GOOSE Analogs Inputs

Appendix 13

Virtual Outputs:			
	Virtual Output 1 ID Virtual Output 1 Events	=	Bus Diff Op Enabled
	Virtual Output 2 ID	=	50 51P TRIP
	Virtual Output 2 Events	=	Enabled
	Virtual Output 3 ID	=	Alarm
	Virtual Output 3 Events	=	Enabled
	·		
	Virtual Output 4 ID	=	Trig Oscill
	Virtual Output 4 Events	=	Enabled
	Virtual Output 5 ID	=	CT Trouble
	Virtual Output 5 Events	=	Enabled
	Virtual Output 6 ID	=	Virt Op 6
	Virtual Output 6 Events	=	Disabled
	Virtual Output 7 ID	=	871
	Virtual Output 7 Events	=	Enabled
			- /
	Virtual Output 8 ID	=	51
	Virtual Output 8 Events	=	Enabled
	Virtual Output 0 ID		
	Virtual Output 0 Events	=	Thp_LED
	vinual Output 9 Events	=	Enabled
	Virtual Output 10 ID	_	Riasod nkn
	Virtual Output 10 Events	_	Enabled
		—	LINDICU
	Virtual Output 11 ID	_	FOR TESTING
	Virtual Output 11 Events	_	Enabled
			Enabled
	Virtual Output 12 ID	=	50 51N TRIP
	Virtual Output 12 Events	=	Enabled
Remote Devices:	·		
Remote Inputs:			
Remote Outputs DNA E	<u>Bit Pairs</u>		
Remote Outputs UserS	t Bit Pairs:		
Resetting:			
Direct Inputs:			
Direct Outputs:			
Tologration			

Not used # Not used

	Appendix 1	4 87-51-1-	-R1 (SEL-387) Setting C	Calculatio	n
1. Data MVA_Base =	100 240	kV_Base =	345		
MVA rating of	Reactor R1 =	150	; Maximum full load current	(amps) =	251.02
2. Setting Crite 2.1 Differentia	eria I Settings:				
	U	Ma	ximum Transformer MVA =	150	MVA
Т	he nominal trans	sformer Winding 1	terminal voltage VWDG1 =	345	kV
Т	he nominal trans	sformer Winding 2	terminal voltage VWDG2 =	345	kV
		СТ	ratio for winding 1CTR1=	240	
		СТ	ratio for winding 2CTR2=	240	
Winc	ling 1 Current Ta	p TAP1 = MVA/(S	Sqrt(3) x VWDG1 x CTR1) =	1.05	A
Winc	ling 2 Current Ta	p TAP2 = MVA/(S	Sqrt(3) x VWDG2 x CTR2) =	1.05	A
	O87P ≥ 0.	1 x 5A / TAPmin =	= 0.48 Set 087P=	0.50	# Per manual
D	ual-Slop variable	-percentage differ	ential characteristic is used.		
	R	estraint Slop 1 Pe	rcentage (5-100%) SLP 1 =	25	
	Restraint S	Slope 2 Percentage	e (OFF, 25–200%) SLP2 =	50	
F	Restraint Current	Slope 1 Limit ((1-	20) multiple of tap) IRS1 =	3	
Unre	estrained Elemer	t Current PU ((1-2	20) multiple of tap) $U87P =$	10	
Sec	cond-Harmonic E	locking Percentag	ge (OFF, 5–100%) PCT2 =	10	# Inrush inhibit
	Fifth-Harmonic B	locking Percentag	e (OFF, 5–100%) PCT5 =	OFF	
		Independent	Harmonic Blocking IHBL =	Ν	
0.014/2 12 4	=1		0		

2.2 Winding 1 Elems

2.2.1 Set phase IOC element 50P12P at 0.25 CT secondary amp (minimum) for unlatch trip setting ULTR.

2.2.2. Set phase TOC element 51P1P at 2 CT secondary amp or 480 CT primary amp, i.e. 1.91 times of the maximum FLC. 2nd harmonic (2HB1+2HB2+2HB3) is used to block operation to prevent inrush false trip. Curve and time dial are set to make the curve to match the existing setting curve.

2.2.3 Set residual IOC element 50N12P at 0.25 CT secondary amp (minimum) for unlatch trip setting ULTR.

2.2.4. Set residual TOC element 51N1P at 1 CT secondary amp or 240 CT primary amp, i.e. 95.6% of the maximum FLC. 2nd harmonic (2HB1+2HB2+2HB3) is used to block operation to prevent inrush false trip. Curve and time dial are set to make the curve to match the existing setting curve.

2.3 Winding 2 Elems

2.3.1 Set phase IOC element 50P22P at 0.25 CT secondary amp (minimum) for unlatch trip setting ULTR.

2.3.2. Set phase TOC element 51P2P at 2 CT secondary amp or 480 CT primary amp, i.e. 1.91 times of the maximum FLC. Curve and time dial are set to make the curve to match the existing setting curve.

2.3.3 Set residual IOC element 50N12P at 0.25 CT secondary amp (minimum) for unlatch trip setting ULTR.

2.3.4. Set residual TOC element 51N1P at 1 CT secondary amp or 240 CT primary amp, i.e. 95.6% of the maximum FLC. Curve and time dial are set to make the curve to match the existing setting curve.

Group 1 - Set 1: Config. Settings:

Appendix 14	87-51-1-R1	(SEL-387) Setting	Calculation	
Relay Identifier		RID =	87-51-1-R1	
Terminal Identifier		TID =	CHARLES PO	LETTI
Enable Wdg1 in Differential Element		E87W1 =	Y	
Enable Wdg2 in Differential Element		E87W2 =	Y	
Enable Wdg3 in Differential Element		E87W3 =	Ν	
Enable Wdg4 in Differential Element		E87W4 =	Ν	
Enable Wdg1 O/C Elements and Dmd	. Thresholds	EOC1 =	Y	
Enable Wdg2 O/C Elements and Dmd	. Thresholds	EOC2 =	Y	
Enable Wdg3 O/C Elements and Dmd	. Thresholds	EOC3 =	Ν	
Enable Wdg4 O/C Elements and Dmd	. Thresholds	EOC4 =	Ν	
Enable Combined O/C Elements		EOCC =	Ν	
Enable RTDA Elements		E49A =	Ν	
Enable RTDB Elements		E49B =	N	
Enable SELogic Set 1		ESLS1 =	Y	
Enable SELogic Set 2		ESLS2 =	N	
Enable SELogic Set 3		ESLS3 =	Ν	
General Data:				
Wdg1 CT Connection		W1CT =	Y	
Wdg2 CT Connection		W2CT =	Y	
Wdg3 CT Connection		W3CT =	Y	# Not Used
Wdg4 CT Connection		W4CT =	Y	# Not Used
Wdg1 CT Ratio		CTR1 =	240	
Wdg2 CT Ratio		CTR2 =	240	
Wdg3 CT Ratio		CTR3 =	240	# Not Used
Wdg4 CT Ratio		CIR4 =	240	# Not Used
Maximum Power Xfmr Capacity	('	MVA =	150	
Define Interal CT Connection Compen	sation		Y 10	
Wdg1 CT Conn. Compensation			12	
Wdg 1 Line to Line Voltage			12	# 1/)/
Wdg 2 Line to Line Voltage			345	# KV # k\/
Wdg 3 Line-to-Line Voltage		VWDG2 =	345	# Not Llead
Wdg 4 Line-to-Line Voltage		VVDG3 =	345	# Not used
Wug 4 Eine-to-Eine Voltage		VVD04 -	0-0	
Diff Elems:		0.170	0.50	
Restrained Element Current PU		087P =	0.50	
Restrain Slope 1 Percentage		SLP1 =	25	
Restraint Slope 2 Percentage		3LP2 =	50 2	
Larostrained Element Current PL		- 1071 –	3 10	
2nd Harmonic Blocking Percentage		DOTE -	10	
5th Hamronic Blocking Percentage		PCT5 =		
5th Harmonic Alarm Threshold		TH5P =	OFF	
Independent Harmonic Blocking		IHBL =	N	
-				
Kestriced Earth Fault: Winding 1 Flems:				
Phase Def-Time O/C Level 1 PU		50P11P =	OFF	
Phase Level 1 O/C Delay		50P11P =	5	# Not used

Appendix 14

87-51-1-R1 (SEL-387) Setting Calculation

50P11 Torgue Control (SELogic Equation) Phase Def-Time O/C Level 2 PU 50P12 Torque Control (SELogic Equation) Oher Phase Inst O/C elements Phase Inv-Time O/C PU Phase Inv-Time O/C Curve Phase Inv-Time O/C Time-Dial Phase Inv-Time O/C EM Reset 51P1 Torque Control (SELogic Equation) Neg-Seg Def-Time O/C Residual Def-Time O/C Level 1 PU Residual Level 1 O/C Delay 50N11 Torgue Control (SELogic Equation) Residual Def-Time O/C Level 1 PU 50N12 Torque Control (SELogic Equation) Other Residual Inst O/C elements Residual Inv-Time O/C PU Residual Inv-Time O/C Curve Residual Inv-Time O/C Time-Dial Residual Inv-Time O/C EM Reset 51N2 Torque Control (SELogic Equation) **Demand Ammeter Time Constant** Phase Demand Ammeter Threshold Neg-Seg Demand Ammeter Threshold **Residual Demand Ammeter Threshold** Winding 2 Elems: Phase Def-Time O/C Level 1 PU Phase Level 1 O/C Delay 50P21 Torque Control (SELogic Equation) Phase Def-Time O/C Level 2 PU 50P22 Torque Control (SELogic Equation) Oher Phase Inst O/C elements Phase Inv-Time O/C PU Phase Inv-Time O/C Curve Phase Inv-Time O/C Time-Dial Phase Inv-Time O/C EM Reset 51P2 Torque Control (SELogic Equation) Neg-Seg Def-Time O/C Residual Def-Time O/C Level 1 PU Residual Level 1 O/C Delav 50N21 Torque Control (SELogic Equation) Residual Def-Time O/C Level 1 PU 50N22 Torque Control (SELogic Equation) Other Residual Inst O/C elements Residual Inv-Time O/C PU Residual Inv-Time O/C Curve Residual Inv-Time O/C Time-Dial Residual Inv-Time O/C EM Reset 51N2 Torque Control (SELogic Equation) Demand Ammeter Time Constant

50P11TC = 1 # Not used 50P12P = 0.25 # Minimum 50P12TC = 1 # Not used 51P1P = 2# 1.91xFLC 51P1C = U1 51P1TD = 0.551P1RS = N51P1TC = !(2HB1 + 2HB2 + 2HB3) # Not used 50N11P = OFF 50N11D = 5 # Not used 50N11TC = 1 # Not used 50N12P = 0.25 # Minimum 50N12TC = 1 # Not used 51N1P = 1# 95.6% FLC 51N1C = U1 51N1TD = 0.551N1RS = N51N2TC = !(2HB1 + 2HB2 + 2HB3) DATC1 = 15 # Default PDEM1P = 7# Default QDEM1P = 1# Default NDEM1P = 1# Default 50P21P = OFF # Not used 50P21P = 5# Not used 50P21TC = 1# Not used 50P22P = 0.25# Minimum 50P22TC = 1 # Not used 51P2P = 2# 1.91xFLC 51P2C = U1 51P2TD = 0.551P2RS = N 51P2TC = 1# Not used 50N21P = OFF # Not used 50N21D = 5# Not used 50N21TC = 1 # Not used 50N22P = 0.25# Minimum 50N22TC = 1# Not used 51N2P = 1# 95.6% FLC 51N2C = U1 51N2TD = 0.551N2RS = N51N2TC = 1DATC2 = 15# Default

Appendix 1	14 87-51-1-R1 (SEL-38	7) Setting Calculation	1
Phase Demand Ammeter Three Neg-Seq Demand Ammeter Th Residual Demand Ammeter Th Winding 3 Elems: Winding 4 Elems: Combined Elems: RTD A Elems: RTD B Elems: Misc. Timers SELogic Set 1:	eshold hreshold hreshold	PDEM2P = 7 QDEM2P = 1 NDEM2P = 1	# Default # Default # Default # Not Used # Not Used # Not used # Not used # Not used # Default
<u></u>		S1V1 = IN106 S1V1PU = 0	# 63SPR Ttrip
		S1V1DO = 9	
SELogic Set 2:		Other SV = OFF	# Not used # Not used
<u>SELogic Set 3:</u> Trip Logic:			# Not used
<u>Imp Logic.</u>		TR1 = 51P1T+51P2T TR2 = 51N1T+51N2T TR3 = 0 TR4 = 0 TR5 = 87R + 87U ULTR1 = !(50P12 + 50F ULTR2 = !(50N12 + 50F ULTR3 = 0 ULTR4 = 0 ULTR5 = !(87U + 87R)	r T 222) N22)
<u>Close Logic:</u>			# Not used
Event Trigger			
E	ER = /51P1 + /51N1 + /51P2 + /51	N2 + /87U + /87R	
Output Contact Logic:	# Apy Trip		
Output Contact 101 Output Contact 102 Output Contact 103 Output Contact 104 Output Contact 105 Output Contact 106 Output Contact 107 Output Contact 201 ~ 212 are	e all 0.	OUT102 = 0 OUT103 = TRIP5 OUT104 = TRIP1 OUT105 = TRIP2 OUT106 = S1V1T OUT107 = 0	# Not used # 87 Trip # 51P Trip # 51N Trip # Not used # Not used # Not used
<u>Global</u>			# Default
<u>SER:</u> SER1 = IN101,IN102,IN103,IN SER2 = OUT101,OUT102,OU SER3 = 51P1,51P1T,51N1,51 SER4 = 87R1,87R2,87R3,87U	N104,IN105,IN106 JT103,OUT104,OUT105,OUT106, IN1T,51P2,51P2T,51N2,51N2T J1,87U2,87U3	OUT107	

	Appendix 15	87-51-2	2-R1 (GE-T60) Setting Calculatior	1
1. Data				
MVA_Base = CTR =	100 240	kV_Base =	345	
MVA rating of I	Reactor R1 =	150	; Maximum full load current (amps) =	251.02
2. Setting Crite	ria			
2.1 Differential	Settings:			
		Dif	ferential Pickup in per unit = 0.50	# APP14-2.1
			Differential Slope 1 in % = 25%	# APP14-2.1
		Diff	erential Break 1 in per unit = 2	
		Diff	erential Break 2 in per unit = 3	# APP14-2.1
			Differential Slope 2 in $\% = 50\%$	# APP14-2.1
			Inrush Inhibit Function = Adapt. 2nd	# APP14-2.1
			Inrush Inhibit Mode = Per Phase	# APP14-2.1

2.2 Winding 1 Elements

ľ

2.2.1. Set phase TOC element at 0.4 pu, or 2 CT secondary amp or 480 CT primary amp, i.e. 1.91 times of the maximum FLC. 2nd harmonic (XFMR PCNT DIFF 2ND A, XFMR PCNT DIFF 2ND B, XFMR PCNT DIFF 2ND C) is used to block operation to prevent inrush false trip. Curve and time dial are set to make the curve to match the existing setting curve.

Instantaneous Differential Pickup in per unit = 10

Inrush Inhibit Level = 10%

2.2.2. Set residual TOC element at 0.2 pu or 1 CT secondary amp or 240 CT primary amp, i.e. 95.6% of the maximum FLC. 2nd harmonic (XFMR PCNT DIFF 2ND A, XFMR PCNT DIFF 2ND B, XFMR PCNT DIFF 2ND C) is used to block operation to prevent inrush false trip. Curve and time dial are set to make the curve to match the existing setting curve.

2.3 Winding 2 Elements

2.3.1. Set phase TOC element at 0.4 pu, or 2 CT secondary amp or 480 CT primary amp, i.e. 1.91 times of the maximum FLC. Curve and time dial are set to make the curve to match the existing setting curve.

2.3.2. Set residual TOC element at 0.2 pu or 1 CT secondary amp or 240 CT primary amp, i.e. 95.6% of the maximum FLC. Curve and time dial are set to make the curve to match the existing setting curve.

Device Definition:					# Default
Product Setup:					
Security:					# Default
Display Properties:					# Default
Clear Relay Records:					# All OFF
Communications:					# Default
Modbus User Map:					# Not used
Real Time Clock:					
IR	IG-B Signal Type	=	DC Shift		
	All other settings	=	Default		
User-Programmable Fault Repo	<u>rt:</u>				
	PARAMETER		FAULT R	EPORT 1	
	Function	=	Enabled		
	Prefault Trigger	=	Osc Trigg	jer On (VO3)	
	Fault Trigger	=	FR-Trigge	er On (VO5)	
Д	Analog Channel 1	=	SRC1	la Mag	
Δ	Analog Channel 2	=	SRC1	lb Mag	

APP14-2.1

APP14-2.1

Appendix 15 87-51-2-R1 (GE-T60) Setting Calculation

Analog Channel 3	=	SRC1 Ic Mag
Analog Channel 4	=	SRC2 la Mag
Analog Channel 5	=	SRC2 Ib Mag
Analog Channel 6	=	SRC2 Ic Mag
Analog Channel 7	=	SRC1 la Angle
Analog Channel 8	=	SRC1 Ib Angle
Analog Channel 9	=	SRC1 Ic Angle
Analog Channel 10	=	SRC2 la Angle
Analog Channel 11	=	SRC2 Ib Angle
Analog Channel 12	=	SRC2 Ic Angle
Analog Channel 13	=	Xfmr lad Mag
Analog Channel 14	=	Xfmr Ibd Mag
Analog Channel 15	=	Xfmr Icd Mag
Analog Channel 16	=	Xfmr lad Angle
Analog Channel 17	=	Xfmr Ibd Angle
Analog Channel 18	=	Xfmr Icd Angle
Analog Channel 19	=	Xfmr Harm2 lad Mag
Analog Channel 20	=	Xfmr Harm2 lbd Mag
Analog Channel 21	=	Xfmr Harm2 lcd Mag
Analog Channel 22	=	Xfmr Harm2 lad Angle
Analog Channel 23	=	Xfmr Harm2 lbd Angle
Analog Channel 24	=	Xfmr Harm2 lcd Angle
Analog Channel 25	=	Xfmr Harm5 lad Mag
Analog Channel 26	=	Xfmr Harm5 lbd Mag
Analog Channel 27	=	Xfmr Harm5 lcd Mag
Analog Channel 28	=	Xfmr Harm5 lad Angle
Analog Channel 29	=	Xfmr Harm5 lbd Angle
Analog Channel 30	=	Xfmr Harm5 lcd Angle
Analog Channel 31	=	SRC1 Frequency
Analog Channel 32	=	SRC1 Q
-		
SETTING		PARAMETER
Number Of Records	=	5
Trigger Mode	=	Automatic Overwrite
Trigger Position	=	30%
Trigger Source	=	Osc Trigger On (VO3)
AC Input Waveforms	=	32 samples/cycle
Digital Channel 1	=	87Trip On (VO1)
Digital Channel 2	=	Cont lp 1 Off(H5a)
Digital Channel 3	=	XFMR INST DIFF OP
Digital Channel 4	=	XFMR PCNT DIFF OP
Digital Channel 5	=	XFMR INST DIFF OP A
Digital Channel 6	=	XFMR INST DIFF OP B
Digital Channel 7	=	XFMR INST DIFF OP C
Digital Channel 8	=	XFMR PCNT DIFF 2ND A
Digital Channel 9	=	XFMR PCNT DIFF 2ND B
Digital Channel 10	=	XFMR PCNT DIFF 2ND C
Digital Channel 11	=	XFMR PCNT DIFF OP A
Digital Channel 12	=	XFMR PCNT DIFF OP B

Oscillography:

Appendix 1	15 87-5 [°]	1-2-R1	(GE-T6	0) Setting Calculation
	Digital Channe	113	=	XFMR PCNT DIFF OP C
	Digital Channe	114	=	XFMR PCNT DIFF 5TH A
	Digital Channe	l 15	=	XFMR PCNT DIFF 5TH B
	Digital Channe	116	=	XFMR PCNT DIFF 5TH C
	Digital Channe	117	=	OFF
	Digital Channe	118	=	OFF
	Digital Channe	119	=	OFF
	Digital Channe	120	=	OFF
	Digital Channe	121	=	OFF
	Digital Channe	22	=	OFF
	Digital Channe	123	=	OFF
	Digital Channe	124	=	OFF
	Digital Channe	125	=	OFF
	Digital Channe	126	=	OFF
	Digital Channe	27	=	OFF
	Digital Channe	128	=	OFF
	Digital Channe	129	=	OFF
	Digital Channe	130	=	OFF
	Digital Channe	31	=	OFF
	Digital Channe	1 32	=	OFF
	Digital Channe	1 33	=	OFF
	Digital Channe	134	=	OFF
	Digital Channe	1 35	=	OFF
	Digital Channe	136	=	OFF
	Digital Channe	37	=	OFF
	Digital Channe	138	=	OFF
	Digital Channe	139	=	OFF
	Digital Channe	I 40	=	OFF
	Digital Channe	141	=	OFF
	Digital Channe	142	=	OFF
	Digital Channe	143	=	OFF
	Digital Channe	44	=	OFF
	Digital Channe	145	=	OFF
	Digital Channe	146	=	OFF
	Digital Channe	147	=	OFF
	Digital Channe	148	=	OFF
	Digital Channe	149	=	OFF
	Digital Channe	150	=	OFF
	Digital Channe	151	=	OFF
	Digital Channe	152	=	OFF
	Digital Channe	153	=	OFF
	Digital Channe	154	=	OFF
	Digital Channe		=	OFF
	Digital Channe		=	OFF
	Digital Channe	101	=	
	Digital Channe	1 30	=	
	Digital Channe	1 29	=	
	Digital Channe	100	=	
	Digital Channe		=	
	ugital Unanne	102	=	UFF

Append	ix 15	87-51-2-R1	(GE-T	60) Setting Calculation	1
	Digital	Channel 63	=	OFF	
	Analog	g Channel 1	=	Xfmr lad Mag	
	Analog	g Channel 2	=	Xfmr Iar Mag	
	Analog	g Channel 3	=	Xfmr Harm2 lad Mag	
	Analog	g Channel 4	=	Xfmr Ibd Mag	
	Analog	g Channel 5	=	Xfmr Ibr Mag	
	Analog	g Channel 6	=	Xfmr Harm2 lbd Mag	
	Analog	g Channel 7	=	Xfmr Icd Mag	
	Analog	g Channel 8	=	Xfmr Icr Mag	
	Analog	g Channel 9	=	Xfmr Harm2 Icd Mag	
	Analog	Channel 10	=	Xfmr Harm5 lad Mag	
	Analog	Channel 11	=	Xfmr Harm5 lbd Mag	
	Analog	Channel 12	=	Xfmr Harm5 lcd Mag	
	Analog	Channel 13	=	Off	
	Analog	Channel 14	=	Off	
	Analog	Channel 15	=	Off	
	Analog	Channel 16	=	Tracking Frequency	
Data Logger:					# Default
Demand:					# Default
User-Programmable Leds:					in Donadic
I FD Test					
		Function	=	Enabled	
		Control	=		
Trip and Alarms Leds:		Control	_		
<u>- Thp and Alarmo Lodo.</u>	Tri	n I ED Innut	_	87Trin On (VO1)	
	Alarn	n I ED Input	_	51Trip On (VO2)	
	7 (1011)		-		
		LED 1	=	87Trip On (VO1)	Latched
		LED 1	=	51Trip On (VO2)	Latched
			_	XEMB INST DIFF OP	Latched
			_	XEMR PONT DIFE OP	Latched
			_		Latched
			_	XEMR INST DIFE OP B	Latched
			_		Latched
			_		Latched
			_		Latched
			_		Latched
			_		Latched
			_		Latched
			=		Latched
			=		Latched
			=		Latched
		LED 15	=	PHASE TOCT OP A	Latched
			=		Latched
		LED 1/	=	PHASE TOUL OP C	Latched
		LED 18	=	PHASE TOCZ OP A	Latched
		LED 19	=	PHASE TOUZ OP B	Latched
		LED 20	=	PHASE TOC2 OP C	Latched
		LED 21	=		Self-Reset
		LED 22	=		Self-Reset
		LED 23	=	OFF	Self-Reset

	Append	lix 15	87-51-2-R1	(GE-T6	0) Setting	Calculation	
			LED 24	=	OFF		Self-Reset
			LED 25	=	OFF		Self-Reset
			LED 26	=	OFF		Self-Reset
			LED 27	=	OFF		Self-Reset
			LED 28	=	OFF		Self-Reset
			LED 29	=	OFF		Self-Reset
			LED 30	=	OFF		Self-Reset
			LED 31	=	OFF		Self-Reset
			LED 32	=	OFF		Self-Reset
			LED 33	=	OFF		Self-Reset
			LED 34	=	OFF		Self-Reset
			LED 35	=	OFF		Self-Reset
			LED 36	=	OFF		Self-Reset
			LED 37	=	OFF		Self-Reset
			LED 38	=	OFF		Self-Reset
			LED 39	=	OFF		Self-Reset
			LED 40	=	OFF		Self-Reset
			LED 41	=	OFF		Self-Reset
			LED 42	=	OFF		Self-Reset
			LED 43	=	OFF		Self-Reset
			LED 44	=	OFF		Self-Reset
			LED 45	=	OFF		Self-Reset
			LED 46	=	OFF		Self-Reset
			LED 47	=	OFF		Self-Reset
			LED 48	=	OFF		Self-Reset
<u>User-Programm</u>	hable Self	<u>l ests:</u>					
	Remo			=	Enabled		
	PI		all Function	=	Disabled		
				=	Enabled		
			all Function	=	Enabled		
Control Duchbu	ttone:	IRIG D Fa		=	Enabled		
	CDR 1	CP	B 2	CDB 3			
Function	Enabled		abled I	Enabled			
Events	Disabled	Dis	abled I	Enabled			
Fley States	Disableu	DIS					
l Iser-definable	displays						# Not used
Direct I/O:	uispiays.						# Not used
Teleprotection:							# Not used
Installation:							
<u>motanation.</u>		R	elav Name	=	87-51-2-R1		
System Setup:						•	
AC Inputs							
Current	:	PA	RAMETER		CT F1	CT F5	
<u></u>	-	Phase (CT Primarv	=	1200 A	1200 A	
		Phase CT	Secondarv	=	5 A	5 A	
		Ground (CT Primary	=	1200 A	1200 A	
		Ground CT	Secondary	=	5 A	5 A	

Power System:

Appendix	x 15 87-51-2-R1	(GE-T6	0) Setting (Calculation	
Frequency A Frequen	Nominal Frequency Phase Rotation and Phase Reference cy Tracking Function	= = =	60 Hz ABC SRC 1 (SRC Enabled		
<u>olgnaroources.</u>	Name Phase CT Ground CT Phase VT Aux VT	= = = =	SRC 1 F1 None None None	SRC 2 F5 None None None	
Transformer: General: Referen F Load Rated Windin Top-d Winding Th <u>Windings:</u> Nom	SETTING Number Of Windings ce Winding Selection Phase Compensation d Loss At Rated Load ng Temperature Rise No Load Loss Type Of Cooling bil Rise Over Ambient Thermal Capacity ermal Time Constant PARAMETER Source Rated MVA inal Phs-phs Voltage Connection Grounding Angle Wrt Winding 1 Resistance		PARAMETE 2 Automatic S Internal (soft 225 kW 65°C (oil) 75 kW OA 35 °C 100.00 kWh 2.00 min WINDING 1 SRC 1 (SRC 150.000 MV 345.000 kV Wye Within zone 0.0 deg 10.0000 ohn	R election tware) h/°C C 1) A	WINDING 2 SRC 2(SRC 2) 150.000 MVA 345.000 kV Wye Within zone 0.0 deg 10.0000 ohms
<u>Thermal Inputs:</u> <u>Breakers:</u> <u>Switches</u> <u>FlexCurves:</u> <u>FlexLogic:</u> <u>Grouped Elements:</u> <u>Group 1:</u> Dictores:				# See 87-51-2	# Not used # Not used # Not used # Not used -R1-logic-r0.pdf
Distance: Power Swing Detect: Load Encroachment: Transformer: Percent Differential	SETTING Function Pickup Slope 1 Break 1 Break 2 Slope 2 nrush Inhibit Function Inrush Inhibit Mode	= = = = = =	PARAMETE Enabled 0.50 25% 2.00 3.00 50% Adapt. 2nd Per Phase	R	# Not used # Not used # Not used

	Appendix 15	87-51-2-R1	(GE-T6	0) Setting Calculation	
	Inrush In	hibit Level	=	10%	
	Overexcitation Inhib	it Function	=	Disabled	
	Overexcitation In	hibit Level	=	10.0 % fo	
		Block	=	OFF	
		Target	=	Self-reset	
		Events	=	Enabled	
Instantaneous Di	fferential	SETTING		PARAMETER	
		Function	=	Enabled	
		Pickup	=	10	
		Block	=	OFF	
		Target	=	Self-reset	
		Events	=	Enabled	
Hottest Spot					# Not Used
Aging Factor					# Not Used
Loss of Life					# Not Used
Phase Current:					
Phase TOC:	PAF	RAMETER		PHASE TOC1	PHASE TOC2
		Function	=	Enabled	Enabled
	Sigr	nal Source	=	SRC 1 (SRC 1)	SRC 2 (SRC2)
		Input	=	Phasor	Phasor
		Pickup	=	0.400 pu	0.400 pu
		Curve	=	IEEE Mod Inv	IEEE Mod Inv
	TC	Multiplier	=	0.5	0.5
		Reset	=	Instantaneous	Instantaneous
	Voltage	e Restraint	=	Disabled	Disabled
		Block A	=	XFMR PCNT DIFF 2ND A	OFF
		Block B	=	XFMR PCNT DIFF 2ND B	OFF
		Block C	=	XFMR PCNT DIFF 2ND C	OFF
		Target	=	Self-reset	Self-reset
		Events	=	Enabled	Enabled
Neutral Current:					
Neutral TOC:	PAF	RAMETER		NEUTRAL TOC1	Neutral TOC2
		Function	=	Enabled	Enabled
		Source	=	SRC 1 (SRC 1)	SRC 2 (SRC2)
		Input	=	Phasor	Phasor
		Pickup	=	0.200 pu	0.200 pu
	TC	Curve	=		IEEE Mod Inv
	IL		=	0.5	0.5
		Reset	=		Instantaneous
		BIOCK	=	Hamornic BIK On (VO4)	
		Target	=	Self-reset	Self-reset
Creating Courses		Events	=	Enabled	Enabled
Ground Current:					# Not used
Ground IOC					# Not used
Ground IOC Brooker Failures					# Not used
<u>Dieaker Fallure.</u>					# Not used
	<u>).</u>				# Not used
Setting Groups:					# Not used
Selector Switchor	e.				# Not used
COLORID OWNER	<u>.</u>				

A	ppendix 15	87-51-2-R1 (GE-T6	0) Setting Calcu	lation	
Underfrequency: Overfrequency: Synchrocheck: Digital Elements: Digital Counters: Monitoring Elemer Pilot Schemes: Inputs/Outputs:	<u>nts:</u>				# # # # # # #	 ^t Not used
Contact Inputs:	esholds.				#	# Not used
Contact inputs fin Cont Cont Ip 9, Cont Ip 13, Virtual Inputs:	Ip 1, Cont Ip 2, Cont Ip5, Cont Ip 6, Cont Cont Ip 10, Cont Ip 1 Cont Ip 14, Cont Ip 1	Ip 3, Cont Ip 4(H Ip 7, Cont Ip 8(H 1, Cont Ip 12(M 5, Cont Ip 16(M	15A, H50 17A, H70 5A, M50 7A, M70	C, H6A, H6C) C, H8A, H8C) F, M6A, M6C) F, M8A, M8C)	8 = 8 8 = 8 = 8 = 8 #	34 Vdc 34 Vdc 34 Vdc 34 Vdc 34 Vdc # Not used
Contact Outputs:						
	[H1] Contact C [H1] Contact Output [H1] Contact Outpu [H1] Contact Outpu	output 1 ID 1 Operate t 1 Seal-In t 1 Events	= = =	ANY TRIP FR-Trigger On (VO OFF Enabled	5)	
	[H2] Contact C [H2] Contact Output [H2] Contact Outpu [H2] Contact Outpu	Dutput 2 ID 2 Operate t 2 Seal-In t 2 Events	= =	DS-R1 OPEN 52b/DS-R1 On(H8/ OFF Enabled	۹)	
	[H3] Contact C [H3] Contact Output [H3] Contact Outpu [H3] Contact Outpu	Output 3 ID 3 Operate t 3 Seal-In t 3 Events	= = =	DS-R1 CLOSE 52b/DS-R1 Off(H8/ OFF Enabled	4)	
	[H4] Contact C [H4] Contact Output [H4] Contact Outpu [H4] Contact Outpu	Output 4 ID 4 Operate t 4 Seal-In t 4 Events	= = =	CB-R1 TRIP 52b/CB-R1 On(H70 OFF Enabled	C)	
I	[M1] Contact C [M1] Contact Output [M1] Contact Outpu [M1] Contact Outpu	output 5 ID 5 Operate t 5 Seal-In t 5 Events	= = =	87 TRIP 87Trip On (VO1) OFF Enabled		
I	[M2] Contact C [M2] Contact Output [M2] Contact Outpu [M2] Contact Outpu	Dutput 6 ID 6 Operate t 6 Seal-In t 6 Events	= = =	51P TRIP 51P Trip On (VO2) OFF Enabled		
	[M3] Contact C [M3] Contact Output [M3] Contact Outpu [M3] Contact Outpu	Dutput 7 ID 7 Operate t 7 Seal-In t 7 Events	= =	51N TRIP 51N Trip On (VO6) OFF Enabled		

Appendix 15 87-51-2-R1 (GE-T60) Setting Calculation

	[M4] Contact Output 8 ID [M4] Contact Output 8 Operate [M4] Contact Output 8 Seal-In [M4] Contact Output 8 Events	= = _	CB-R1 CLOSE 52b/CB-R1 Off(H7C) OFF Enabled
<u>Virtual Outputs:</u>	SETTING	-	PARAMETER
	Virtual Output 1 ID Virtual Output 1 Events	= =	87Trip Enabled
	Virtual Output 2 ID Virtual Output 2 Events	= =	51P Trip Enabled
	Virtual Output 3 ID Virtual Output 3 Events	= =	Osc Trigger Enabled
	Virtual Output 4 ID Virtual Output 4 Events	= =	Hamornic BIK Enabled
	Virtual Output 5 ID Virtual Output 5 Events	= =	FR-Trigger Enabled
	Virtual Output 6 ID Virtual Output 6 Events	= =	51N Trip Enabled
	Virtual Output 7 ID Virtual Output 7 Events	= =	Virt Op 7 Disabled
	Virtual Output 8 ID Virtual Output 8 Events	= =	Virt Op 8 Disabled
	Virtual Output 9 ID Virtual Output 9 Events	= =	Virt Op 9 Disabled
	Virtual Output 10 ID Virtual Output 10 Events	= =	Virt Op 10 Disabled
	Virtual Output 11 ID Virtual Output 11 Events	= =	Virt Op 11 Disabled
	' Virtual Output 12 ID Virtual Output 12 Events	= =	Virt Op 12 Disabled
	Virtual Output 13 ID Virtual Output 13 Events	=	Virt Op 13 Disabled
	Virtual Output 14 ID	=	Virt Op 14 Disabled
	Virtual Output 15 ID	=	Virt Op 15
Appendix 1587-51-2-R1 (GE-T60) Setting Calculation

Virtual Output 15 Events	=	Disabled
Virtual Output 16 ID Virtual Output 16 Events	=	Virt Op 16 Disabled
Remote Devices:		
Remote Inputs:		
Remote Outputs DNA Bit Pairs		
Remote Outputs UserSt Bit Pairs:		
Resetting:		
Direct Inputs:		
Direct Outputs:		
Teleprotection:		
IEC 61850 GOOSE Analogs Inputs		

Not used

	Appendix 1	6 87-51-1·	-R2 (SEL-387) Setting C	Calculatio	n
1. Data MVA_Base =	100 240	kV_Base =	345		
MVA rating of	Reactor R1 =	150	; Maximum full load current	(amps) =	251.02
2. Setting Crite 2.1 Differentia	eria I Settings:				
	5	Ма	ximum Transformer MVA =	150	MVA
Т	he nominal trans	sformer Winding 1	terminal voltage VWDG1 =	345	kV
Т	he nominal trans	sformer Winding 2	terminal voltage VWDG2 =	345	kV
		СТ	ratio for winding 1CTR1=	240	
		CT	ratio for winding 2CTR2=	240	
Wind	ling 1 Current Ta	p TAP1 = MVA/(S	Sqrt(3) x VWDG1 x CTR1) =	1.05	A
Wind	ling 2 Current Ta	p TAP2 = MVA/(S	Sqrt(3) x VWDG2 x CTR2) =	1.05	A
	O87P ≥ 0.	1 x 5A / TAPmin =	• 0.48 Set 087P=	0.50	# Per manual
D	ual-Slop variable	-percentage differ	ential characteristic is used.		
	R	estraint Slop 1 Pe	rcentage (5-100%) SLP 1 =	25	
	Restraint S	Slope 2 Percentage	e (OFF, 25–200%) SLP2 =	50	
R	estraint Current	Slope 1 Limit ((1-	20) multiple of tap) IRS1 =	3	
Unre	estrained Elemer	nt Current PU ((1-2	20) multiple of tap) $U87P =$	10	
Sec	cond-Harmonic E	Blocking Percentag	ge (OFF, 5–100%) PCT2 =	10	# Inrush inhibit
	Fifth-Harmonic E	locking Percentag	e (OFF, 5–100%) PCT5 =	OFF	
		Independent	Harmonic Blocking IHBL =	Ν	
0.014/5 15 4			0		

2.2 Winding 1 Elements

2.2.1 Set phase IOC element 50P12P at 0.25 CT secondary amp (minimum) for unlatch trip setting ULTR.

2.2.2. Set phase TOC element 51P1P at 2 CT secondary amp or 480 CT primary amp, i.e. 1.91 times of the maximum FLC. 2nd harmonic (2HB1+2HB2+2HB3) is used to block operation to prevent inrush false trip. Curve and time dial are set to make the curve to match the existing setting curve.

2.2.3 Set residual IOC element 50N12P at 0.25 CT secondary amp (minimum) for unlatch trip setting ULTR.

2.2.4. Set residual TOC element 51N1P at 1 CT secondary amp or 240 CT primary amp, i.e. 95.6% of the maximum FLC. 2nd harmonic (2HB1+2HB2+2HB3) is used to block operation to prevent inrush false trip. Curve and time dial are set to make the curve to match the existing setting curve.

2.3 Winding 2 Elements

2.3.1 Set phase IOC element 50P22P at 0.25 CT secondary amp (minimum) for unlatch trip setting ULTR.

2.3.2. Set phase TOC element 51P2P at 2 CT secondary amp or 480 CT primary amp, i.e. 1.91 times of the maximum FLC. Curve and time dial are set to make the curve to match the existing setting curve.

2.3.3 Set residual IOC element 50N12P at 0.25 CT secondary amp (minimum) for unlatch trip setting ULTR.

2.3.4. Set residual TOC element 51N1P at 1 CT secondary amp or 240 CT primary amp, i.e. 95.6% of the maximum FLC. Curve and time dial are set to make the curve to match the existing setting curve.

Group 1 - Set 1: Config. Settings:

Appendix 16	87-51-1-R2	(SEL-387) Setting	Calculation	
Relay Identifier		RID =	87-51-1-R2	
Terminal Identifier		TID =	CHARLES POI	ETTI
Enable Wdg1 in Differential Element		E87W1 =	Y	
Enable Wdg2 in Differential Element		E87W2 =	Y	
Enable Wdg3 in Differential Element		E87W3 =	Ν	
Enable Wdg4 in Differential Element		E87W4 =	Ν	
Enable Wdg1 O/C Elements and Dmd	. Thresholds	EOC1 =	Y	
Enable Wdg2 O/C Elements and Dmd	. Thresholds	EOC2 =	Y	
Enable Wdg3 O/C Elements and Dmd	. Thresholds	EOC3 =	Ν	
Enable Wdg4 O/C Elements and Dmd	. Thresholds	EOC4 =	N	
Enable Combined O/C Elements		EOCC =	N	
Enable RTDA Elements		E49A =	Ν	
Enable RTDB Elements		E49B =	Ν	
Enable SELogic Set 1		ESLS1 =	Y	
Enable SELogic Set 2		ESLS2 =	N	
Enable SELogic Set 3		ESLS3 =	Ν	
General Data:				
Wdg1 CT Connection		W1CT =	Y	
Wdg2 CT Connection		W2CT =	Y	
Wdg3 CT Connection		W3CT =	Y	# Not Used
Wdg4 CT Connection		W4CT =	Y	# Not Used
Wdg1 CT Ratio		CTR1 =	240	
Wdg2 CT Ratio		CTR2 =	240	
Wdg3 CT Ratio		CTR3 =	240	# Not Used
Wdg4 CT Ratio		CTR4 =	240	# Not Used
Maximum Power Xfmr Capacity		MVA =	150	
Define Interal CT Connection Compen	sation	ICOM =	Y	
Wdg1 CT Conn. Compensation		W1CTC =	12	
Wdg2 CT Conn. Compensation		W2CTC =	12	
Wdg 1 Line-to-Line Voltage		VVDG1 =	345	# KV
Wdg 2 Line-to-Line Voltage			345	# KV
Wdg 3 Line-to-Line Voltage			345	# Not Used
wog 4 Line-io-Line voltage		VVVDG4 =	340	# NOL USED
Diff Elems:				
Restrained Element Current PU		O87P =	0.50	
Restrain Slope 1 Percentage		SLP1 =	25	
Restrain Slope 2 Percentage		SLP2 =	50	
Restraint Current Slope 1 Limit		IRS1 =	3	
Unrestrained Element Current PU		U87P =	10	
2nd Harmonic Blocking Percentage		PCT2 =	10	
5th Hamronic Blocking Percentage		PCT5 =	OFF	
5th Harmonic Alarm Threshold		TH5P =	OFF	
Independent Harmonic Blocking		IHBL =	Ν	
Restriced Earth Fault:				
Winding 1 Elems:				
Phase Def-Time O/C Level 1 PU		50P11P =	OFF	
Phase Level 1 O/C Delay		50P11P =	5	# Not used

Appendix 16

87-51-1-R2 (SEL-387) Setting Calculation

50P11 Torque Control (SELogic Equation) Phase Def-Time O/C Level 2 PU 50P12 Torque Control (SELogic Equation) Oher Phase Inst O/C elements Phase Inv-Time O/C PU Phase Inv-Time O/C Curve Phase Inv-Time O/C Time-Dial Phase Inv-Time O/C EM Reset 51P1 Torque Control (SELogic Equation) Neg-Seg Def-Time O/C Residual Def-Time O/C Level 1 PU Residual Level 1 O/C Delay 50N11 Torgue Control (SELogic Equation) Residual Def-Time O/C Level 1 PU 50N12 Torque Control (SELogic Equation) Other Residual Inst O/C elements Residual Inv-Time O/C PU Residual Inv-Time O/C Curve Residual Inv-Time O/C Time-Dial Residual Inv-Time O/C EM Reset 51N2 Torque Control (SELogic Equation) **Demand Ammeter Time Constant** Phase Demand Ammeter Threshold Neg-Seg Demand Ammeter Threshold **Residual Demand Ammeter Threshold** Winding 2 Elems: Phase Def-Time O/C Level 1 PU Phase Level 1 O/C Delay 50P21 Torque Control (SELogic Equation) Phase Def-Time O/C Level 2 PU 50P22 Torque Control (SELogic Equation) Oher Phase Inst O/C elements Phase Inv-Time O/C PU Phase Inv-Time O/C Curve Phase Inv-Time O/C Time-Dial Phase Inv-Time O/C EM Reset 51P2 Torque Control (SELogic Equation) Neg-Seg Def-Time O/C Residual Def-Time O/C Level 1 PU Residual Level 1 O/C Delav 50N21 Torque Control (SELogic Equation) Residual Def-Time O/C Level 1 PU 50N22 Torque Control (SELogic Equation) Other Residual Inst O/C elements Residual Inv-Time O/C PU Residual Inv-Time O/C Curve Residual Inv-Time O/C Time-Dial Residual Inv-Time O/C EM Reset 51N2 Torque Control (SELogic Equation) Demand Ammeter Time Constant

50P11TC = 1 # Not used 50P12P = 0.25 # Minimum 50P12TC = 1 # Not used 51P1P = 2# 1.91xFLC 51P1C = U1 51P1TD = 0.551P1RS = N51P1TC = !(2HB1 + 2HB2 + 2HB3) # Not used 50N11P = OFF 50N11D = 5 # Not used 50N11TC = 1 # Not used 50N12P = 0.25 # Minimum 50N12TC = 1 # Not used 51N1P = 1# 95.6% FLC 51N1C = U1 51N1TD = 0.551N1RS = N51N2TC = !(2HB1 + 2HB2 + 2HB3) DATC1 = 15 # Default PDEM1P = 7# Default QDEM1P = 1# Default NDEM1P = 1# Default 50P21P = OFF # Not used 50P21P = 5# Not used 50P21TC = 1# Not used 50P22P = 0.25# Minimum 50P22TC = 1 # Not used 51P2P = 2 # 1.91xFLC 51P2C = U1 51P2TD = 0.551P2RS = N 51P2TC = 1# Not used 50N21P = OFF # Not used 50N21D = 5# Not used 50N21TC = 1 # Not used 50N22P = 0.25# Minimum 50N22TC = 1# Not used 51N2P = 1# 95.6% FLC 51N2C = U1 51N2TD = 0.551N2RS = N51N2TC = 1DATC2 = 15# Default

	Appendix 16	87-51-1-R2 (SE	EL-387) S	etting	Calculation	
Phase Demand Neg-Seq Dema Residual Dema Winding 3 Eler Winding 4 Eler Combined Eler RTD A Elems: RTD B Elems: Misc. Timers	d Ammeter Threshold and Ammeter Threshold and Ammeter Threshold <u>ns:</u> <u>ns:</u>	1	PD QD ND	EM2P = EM2P = EM2P =	7 1 1	 # Default # Default # Default # Not Used # Default
			S1 S1	S1V1 = V1PU = V1DO =	IN106 0 9	# 63SPR Ttrip
SELogic Set 2: SELogic Set 3: Trip Logic:			Oth	ner SV =	OFF	# Not used # Not used # Not used
				TR1 = TR2 = TR3 = TR4 = ILTR5 = ILTR1 = ILTR2 = ILTR3 = ILTR4 = ILTR5 =	51P1T+51P2T 51N1T+51N2T 0 87R + 87U !(50P12 + 50P !(50N12 + 50N 0 0 !(87U + 87R)	22) 22)
Close Logic: Event Trigger Output Contac	t Logic:					# Not used
Output Contac	t 101 #A	ny Trip	OL	JT101=TI	RIP1+TRIP2 +	TRIP5+S1V1T
Output Contac Output Contac Output Contac Output Contac Output Contac Output Contac Output Contac Output Contac Output Contac <u>Global</u>	t 102 t 102 t 103 t 104 t 105 t 106 t 107 t 201 ~ 212 are all 0.			JT102 = JT102 = JT103 = JT104 = JT105 = JT106 = JT107 =	0 51GT+67G1T TRIP5 TRIP1 TRIP2 S1V1T 0	<pre># Not used # Not used # 87 Trip # 51P Trip # 51N Trip # Not used # Not used # Not used # Default</pre>
<u>SER:</u>	740 MOD MODT 700	7007 07007 00		T 540 5		

SER1 = M1P, Z1G, M2P, M2PT, Z2G, Z2GT, 67P2T, SOTFT, 67G1T, 51G, 51GT, 3P27, LOP SER1 = IN101,IN102,IN103,IN104,IN105,IN106

Appendix 17	87-51-2-R2 (GE-T60) Setting Calculation

MVA_Base = CTR =	100 240	kV_Base =	345	
MVA rating of F	Reactor R1 =	150	; Maximum full load current (amps) =	251.02
2. Setting Criter	ria			
2.1 Differential	Settings:			
		Di	ifferential Pickup in per unit = 0.50	# APP14-2.1
			Differential Slope 1 in % = 25%	# APP14-2.1
		Dif	ferential Break 1 in per unit = 2	
		Dif	ferential Break 2 in per unit = 3	# APP14-2.1
			Differential Slope 2 in $\% = 50\%$	# APP14-2.1
			Inrush Inhibit Function = Adapt. 2nd	# APP14-2.1
			Inrush Inhibit Mode = Per Phase	# APP14-2.1
			Inrush Inhibit Level = 10%	# APP14-2.1
		Instantaneous Di	ifferential Pickup in per unit = 10	# APP14-2.1

2.2 Winding 1 Elements

1. Data

2.2.1. Set phase TOC element at 0.4 pu, or 2 CT secondary amp or 480 CT primary amp, i.e. 1.91 times of the maximum FLC. 2nd harmonic (XFMR PCNT DIFF 2ND A, XFMR PCNT DIFF 2ND B, XFMR PCNT DIFF 2ND C) is used to block operation to prevent inrush false trip. Curve and time dial are set to make the curve to match the existing setting curve.

2.2.2. Set residual TOC element at 0.2 pu or 1 CT secondary amp or 240 CT primary amp, i.e. 95.6% of the maximum FLC. 2nd harmonic (XFMR PCNT DIFF 2ND A, XFMR PCNT DIFF 2ND B, XFMR PCNT DIFF 2ND C) is used to block operation to prevent inrush false trip. Curve and time dial are set to make the curve to match the existing setting curve.

2.3 Winding 2 Elements

2.3.1. Set phase TOC element at 0.4 pu, or 2 CT secondary amp or 480 CT primary amp, i.e. 1.91 times of the maximum FLC. Curve and time dial are set to make the curve to match the existing setting curve.

2.3.2. Set residual TOC element at 0.2 pu or 1 CT secondary amp or 240 CT primary amp, i.e. 95.6% of the maximum FLC. Curve and time dial are set to make the curve to match the existing setting curve.

Device Definition:				# Default
Product Setup:				
Security:				# Default
Display Properties:				# Default
Clear Relay Records:				# All OFF
Communications:				# Default
Modbus User Map:				# Not used
Real Time Clock:				
	IRIG-B Signal Type	=	DC Shift	
	All other settings	=	Default	
User-Programmable Fault R	eport:			
-	PARAMETER		FAULT REPORT 1	
	Function	=	Enabled	
	Prefault Trigger	=	Osc Trigger On (VO3)	
	Fault Trigger	=	FR-Trigger On (VO5)	
	Analog Channel 1	=	SRC1 la Mag	
	Analog Channel 2	=	SRC1 Ib Mag	

Appendix 1787-51-2-R2 (GE-T60) Setting Calculation

Analog Channel 3	=	SRC1 Ic Mag
Analog Channel 4	=	SRC2 la Mag
Analog Channel 5	=	SRC2 Ib Mag
Analog Channel 6	=	SRC2 Ic Mag
Analog Channel 7	=	SRC1 la Angle
Analog Channel 8	=	SRC1 Ib Angle
Analog Channel 9	=	SRC1 Ic Angle
Analog Channel 10	=	SRC2 la Angle
Analog Channel 11	=	SRC2 Ib Angle
Analog Channel 12	=	SRC2 Ic Angle
Analog Channel 13	=	Xfmr lad Mag
Analog Channel 14	=	Xfmr Ibd Mag
Analog Channel 15	=	Xfmr Icd Mag
Analog Channel 16	=	Xfmr lad Angle
Analog Channel 17	=	Xfmr Ibd Angle
Analog Channel 18	=	Xfmr Icd Angle
Analog Channel 19	=	Xfmr Harm2 lad Mag
Analog Channel 20	=	Xfmr Harm2 lbd Mag
Analog Channel 21	=	Xfmr Harm2 lcd Mag
Analog Channel 22	=	Xfmr Harm2 lad Angle
Analog Channel 23	=	Xfmr Harm2 lbd Angle
Analog Channel 24	=	Xfmr Harm2 lcd Angle
Analog Channel 25	=	Xfmr Harm5 lad Mag
Analog Channel 26	=	Xfmr Harm5 lbd Mag
Analog Channel 27	=	Xfmr Harm5 lcd Mag
Analog Channel 28	=	Xfmr Harm5 lad Angle
Analog Channel 29	=	Xfmr Harm5 lbd Angle
Analog Channel 30	=	Xfmr Harm5 lcd Angle
Analog Channel 31	=	SRC1 Frequency
Analog Channel 32	=	SRC1 Q
C C		
SETTING		PARAMETER
Number Of Records	=	5
Trigger Mode	=	Automatic Overwrite
Trigger Position	=	30%
Trigger Source	=	Osc Trigger On (VO3)
AC Input Waveforms	=	32 samples/cycle
Digital Channel 1	=	87Trip On (VO1)
Digital Channel 2	=	Cont lp 1 Off(H5a)
Digital Channel 3	=	XFMR INST DIFF OP
Digital Channel 4	=	XFMR PCNT DIFF OP
Digital Channel 5	=	XFMR INST DIFF OP A
Digital Channel 6	=	XFMR INST DIFF OP B
Digital Channel 7	=	XFMR INST DIFF OP C
Digital Channel 8	=	XFMR PCNT DIFF 2ND A
Digital Channel 9	=	XFMR PCNT DIFF 2ND B
Digital Channel 10	=	XFMR PCNT DIFF 2ND C
Digital Channel 11	=	XFMR PCNT DIFF OP A
Digital Channel 12	=	XFMR PCNT DIFF OP B
0		

Oscillography:

Appendix 17	87-51	-2-R2	(GE-T	60) Setting Calculation
Digital	Channel	13	=	XFMR PCNT DIFF OP C
Digital	Channel	14	=	XFMR PCNT DIFF 5TH A
Digital	Channel	15	=	XFMR PCNT DIFF 5TH B
Digital	Channel	16	=	XFMR PCNT DIFF 5TH C
Digital	Channel	17	=	OFF
Digital	Channel	18	=	OFF
Digital	Channel	19	=	OFF
Digital	Channel	20	=	OFF
Digital	Channel	21	=	OFF
Digital	Channel	22	=	OFF
Digital	Channel	23	=	OFF
Digital	Channel	24	=	OFF
Digital	Channel	25	=	OFF
Digital	Channel	26	=	OFF
Digital	Channel	27	=	OFF
Digital	Channel	28	=	OFF
Digital	Channel	29	=	OFF
Digital	Channel	30	=	OFF
Digital	Channel	31	=	OFF
Digital	Channel	32	=	OFF
Digital	Channel	33	=	OFF
Digital	Channel	34	=	OFF
Digital	Channel	35	=	OFF
Digital	Channel	36	=	OFF
Digital	Channel	37	=	OFF
Digital	Channel	38	=	OFF
Digital	Channel	39	=	OFF
Digital	Channel	40	=	OFF
Digital	Channel	41	=	OFF
Digital	Channel	42	=	OFF
Digital	Channel	43	=	OFF
Digital	Channel	44	=	OFF
Digital	Channel	45	=	OFF
Digital	Channel	46	=	OFF
Digital	Channel	47	=	OFF
Digital	Channel	48	=	OFF
Digital	Channel	49	=	OFF
Digital	Channel	50	=	OFF
Digital	Channel	51	=	OFF
Digital	Channel	52	=	OFF
Digital	Channel	53	=	OFF
Digital	Channel	54	=	OFF
Digital	Channel	55	=	OFF
Digital	Channel	56	=	OFF
Digital	Channel	57	=	OFF
Digital	Channel	58	=	OFF
Digital	Channel	59	=	OFF
Digital	Channel	60	=	OFF
Digital	Channel	61	=	OFF
Digital	Channel	62	=	OFF

Appendi	x 17	87-51-2-R	2 (GE-T	60) Setting Calculation	
	Digital C	Channel 63	=	OFF	
	Analog	Channel 1	=	Xfmr lad Mag	
	Analog	Channel 2	=	Xfmr Iar Mag	
	Analog	Channel 3	=	Xfmr Harm2 lad Mag	
	Analog	Channel 4	=	Xfmr Ibd Mag	
	Analog	Channel 5	=	Xfmr Ibr Mag	
	Analog	Channel 6	=	Xfmr Harm2 Ibd Mag	
	Analog	Channel 7	=	Xfmr Icd Mag	
	Analog	Channel 8	=	Xfmr Icr Mag	
	Analog	Channel 9	=	Xfmr Harm2 Icd Mag	
	Analog C	Channel 10	=	Xfmr Harm5 lad Mag	
	Analog C	Channel 11	=	Xfmr Harm5 Ibd Mag	
	Analog C	Channel 12	=	Xfmr Harm5 Icd Mag	
	Analog C	Channel 13	=	Off	
	Analog C	Channel 14	=	Off	
	Analog C	Channel 15	=	Off	
	Analog C	Channel 16	=	Tracking Frequency	
Data Logger:	C				# Default
Demand:					# Default
User-Programmable Leds:					
LED Test:					
		Function	=	Enabled	
		Control	=	CONTROL PUSHBUTTO	N 1 ON
Trip and Alarms Leds:					
<u>···· p································</u>	Trip	LED Input	=	87Trip On (VO1)	
	Alarm	LED Input	=	51Trip On (VO2)	
		LED 1	=	87Trip On (VO1)	Latched
		LED 2	=	51Trip On (VO2)	Latched
		LED 3	=	XFMR INST DIFF OP	Latched
		LED 4	=	XFMR PCNT DIFF OP	Latched
		LED 5	=	XFMR INST DIFF OP A	Latched
		LED 6	=	XFMR INST DIFF OP B	Latched
		LED 7	=	XFMR INST DIFF OP C	Latched
		LED 8	=	XFMR PCNT DIFF OP A	Latched
		LED 9	=	XFMR PCNT DIFF OP B	Latched
		L FD 10	=	XFMR PCNT DIFF OP C	Latched
		LED 10	=	PHASE TOC1 OP	Latched
		LED 12	=	PHASE TOC2 OP	Latched
		LED 12	_	NEUTRAL TOCI OP	Latched
		LED 10	_	NEUTRAL TOC2 OP	Latched
			_	PHASE TOCI OP A	Latched
			_	PHASE TOOL OF B	Latched
			_		Latched
			_		Latched
			_		Latched
			-		Latchod
			_		Salf-Dooot
			-	OFF	Solf-Dooot
			-	OFF	Solf Doort
			=	UFF	Sell-Reset

	Append	lix 17	87-51-2-R	2 (GE-T6	0) Setting	Calculation	
			LED 24	=	OFF		Self-Reset
			LED 25	=	OFF		Self-Reset
			LED 26	=	OFF		Self-Reset
			LED 27	=	OFF		Self-Reset
			LED 28	=	OFF		Self-Reset
			LED 29	=	OFF		Self-Reset
			LED 30	=	OFF		Self-Reset
			LED 31	=	OFF		Self-Reset
			LED 32	=	OFF		Self-Reset
			LED 33	=	OFF		Self-Reset
			LED 34	=	OFF		Self-Reset
			LED 35	=	OFF		Self-Reset
			LED 36	=	OFF		Self-Reset
			LED 37	=	OFF		Self-Reset
			LED 38	=	OFF		Self-Reset
			LED 39	=	OFF		Self-Reset
			LED 40	=	OFF		Self-Reset
			LED 41	=	OFF		Self-Reset
			LED 42	=	OFF		Self-Reset
			LED 43	=	OFF		Self-Reset
			LED 44	=	OFF		Self-Reset
			LED 45	=	OFF		Self-Reset
			LED 46	=	OFF		Self-Reset
			LED 47	=	OFF		Self-Reset
			LED 48	=	OFF		Self-Reset
<u>User-Programm</u>	hable Self 7	<u>Fests:</u>					
	Remo	te Device O	ff Function	=	Enabled		
	Pri	Ethernet Fa	il Function	=	Disabled		
		Battery Fa	il Function	=	Enabled		
		SNTP Fa	il Function	=	Enabled		
		IRIG B Fa	il Function	=	Enabled		
Control Pushbu	ttons:						
PARAMETER	CPB 1	CPI	32	CPB 3			
Function	Enabled	Disa	abled	Enabled			
Events	Disabled	Disa	abled	Enabled			
Flex States:							# All OFF
User-definable	<u>displays:</u>						# Not used
Direct I/O:							# Not used
Teleprotection:							# Not used
Installation:							
•		R	elay Name	=	87-51-2-R2		
System Setup:							
AC Inputs					:		
<u>Current</u>	<u>:</u>	PAI	RAMETER		CT F1	CT F5	
		Phase C	T Primary	=	1200 A	1200 A	
		Phase CT	Secondary	=	5 A	5 A	
		Ground	Primary	=	1200 A	1200 A	
		Ground CT	Secondary	=	5 A	5 A	

Power System:

A	ppendix 17	87-51-2-F	R2 (GE-T6	0) Setting	Calculation	
	Nominal	Frequency	=	60 Hz		
	Pha	se Rotation	=	ABC		
Fre	equency And Phase	Reference	=	SRC 1 (SRC	C 1)	
	Frequency Trackir	ng Function	=	Enabled		
Signal Sources:	PA	RAMETER		SOURCE 1	SOURCE 2	
		Name	=	SRC 1	SRC 2	
		Phase CT	=	F1	F5	
		Ground CT	=	None	None	
		Phase VT	=	None	None	
		Aux VT	=	None	None	
Transformer:		0577110				
<u>General:</u>		SETTING		PARAMETE	:R	
	Number C	of vvindings	=	2		
	Reference Windin	g Selection	=	Automatic S	election	
	Phase Cor	npensation	=	Internal (sor	tware)	
Pa	LOad Loss At I	ratura Diao	=			
Γd			=			
			_			
	Ton-oil Rise Ov	er Ambient	_	35 °C		
	Therm	al Canacity	=	100 00 kWb	n/°C	
M	/inding Thermal Tim	e Constant	_	2 00 min	"	
Windings:	PA	RAMETER		WINDING 1		WINDING 2
<u></u>		Source	=	SRC 1 (SRC	C 1)	SRC 2(SRC 2)
		Rated MVA	=	150.000 MV	A	150.000 MVA
	Nominal Phs-p	hs Voltage	=	345.000 kV		345.000 kV
		Connection	=	Wye		Wye
		Grounding	=	Within zone		Within zone
	Angle Wr	Winding 1	=	0.0 deg		0.0 deg
		Resistance	=	10.0000 ohr	ns	10.0000 ohms
Thermal Inputs:						# Not used
Breakers:						# Not used
Switches						# Not used
FlexCurves:						# Not used
FlexLogic:					# See 87-51-2	2-R1-logic-r0.pdf
Grouped Elements	<u>s:</u>					
Group 1:						// Nist us a d
Distance:	a di					# Not used
Power Swing Dele	<u>ect.</u>					# Not used
Transformer:	<u>HIL.</u>					# NOT USED
Percent Differenti:	al	SETTING			R	
		Eunction	_	Enabled	.1X	
		Pickup	_	0.50		
		Slope 1	=	25%		
		Break 1	=	2.00		
		Break 2	=	3.00		
		Slope 2	=	50%		
	Inrush Inhil	it Function	=	Adapt. 2nd		
	Inrush Ir	nhibit Mode	=	Per Phase		

ŀ	Appendix 17	87-51-2-R2	(GE-T6	0) Setting Calculation	
	Inrush Ir	hibit Level	=	10%	
	Overexcitation Inhib	it Function	=	Disabled	
	Overexcitation Ir	hibit Level	=	10.0 % fo	
		Block	=	OFF	
		Target	=	Self-reset	
		Events	=	Enabled	
Instantaneous Dif	fferential	SETTING		PARAMETER	
		Function	=	Enabled	
		Pickup	=	10	
		Block	=	OFF	
		Target	=	Self-reset	
		Events	=	Enabled	
Hottest Spot					# Not Used
Aging Factor					# Not Used
Loss of Life					# Not Used
Phase Current:					
Phase TOC:	PAI	RAMETER		PHASE TOC1	PHASE TOC2
		Function	=	Enabled	Enabled
	Sig	nal Source	=	SRC 1 (SRC 1)	SRC 2 (SRC2)
	5	Input	=	Phasor	Phasor
		Pickup	=	0.400 pu	0.400 pu
		Curve	=	IEEE Mod Inv	IEEE Mod Inv
	T	D Multiplier	=	0.5	0.5
		Reset	=	Instantaneous	Instantaneous
	Voltage	e Restraint	=	Disabled	Disabled
	Ũ	Block A	=	XFMR PCNT DIFF 2ND A	OFF
		Block B	=	XFMR PCNT DIFF 2ND B	OFF
		Block C	=	XFMR PCNT DIFF 2ND C	OFF
		Target	=	Self-reset	Self-reset
		Events	=	Enabled	Enabled
Neutral Current:					
Neutral TOC:	PAI	RAMETER		NEUTRAL TOC1	Neutral TOC2
		Function	=	Enabled	Enabled
		Source	=	SRC 1 (SRC 1)	SRC 2 (SRC2)
		Input	=	Phasor	Phasor
		Pickup	=	0.200 pu	0.200 pu
		Curve	=	IEEE Mod Inv	IEEE Mod Inv
	T	D Multiplier	=	0.5	0.5
		Reset	=	Instantaneous	Instantaneous
		Block	=	Hamornic BIK On (VO4)	OFF
		Target	=	Self-reset	Self-reset
		Events	=	Enabled	Enabled
Ground Current:					
Ground TOC					# Not used
Ground IOC					# Not used
Breaker Failure:					# Not used
Control Elements	<u>):</u>				
<u>Trip Bus:</u>					# Not used
Setting Groups:					# Not used
Selector Switches	<u>s:</u>				# Not used

Aj	opendix 17	87-51-2-R2 (GE-T6	0) Setting Calcu	lation	
Underfrequency: Overfrequency: Synchrocheck: Digital Elements: Digital Counters: Monitoring Element Pilot Schemes:	<u>ts:</u>					# Not used # Not used # Not used # Not used # Not used # Not used # Not used
<u>Contact inputs</u>	ashalda:					# Not used
Cont lp 13, 0 Virtual Inputs:	o 1, Cont lp 2, Cont lp5, Cont lp 6, Cont Cont lp 10, Cont lp 1 Cont lp 14, Cont lp 1	Ip 3, Cont Ip 4(H Ip 7, Cont Ip 8(H 1, Cont Ip 12(M 5, Cont Ip 16(M	15A, H50 17A, H70 5A, M50 7A, M70	C, H6A, H6C) C, H8A, H8C) C, M6A, M6C) C, M8A, M8C)	= = =	84 Vdc 84 Vdc 84 Vdc 84 Vdc # Not used
Contact Outputs:						
[[H1] Contact O H1] Contact Output [H1] Contact Output [H1] Contact Outpu	1 Operate 1 Seal-In t 1 Seal-In t 1 Events	= = =	FR-Trigger On (VO) OFF Enabled	5)	
[[H2] Contact O H2] Contact Output [H2] Contact Output [H2] Contact Output	output 2 ID 2 Operate t 2 Seal-In t 2 Events	= =	DS-R2 OPEN 52b/DS-R2 On(H8A OFF Enabled	A)	
[[H3] Contact O H3] Contact Output [H3] Contact Output [H3] Contact Outpu	utput 3 ID 3 Operate t 3 Seal-In t 3 Events	= =	DS-R2 CLOSE 52b/DS-R2 Off(H8A OFF Enabled	A)	
[[H4] Contact O H4] Contact Output [H4] Contact Output [H4] Contact Outpu	Putput 4 ID 4 Operate t 4 Seal-In t 4 Events	= = =	CB-R2 TRIP 52b/CB-R2 On(H7C OFF Enabled	2)	
[1	[M1] Contact O M1] Contact Output [M1] Contact Output [M1] Contact Outpu	output 5 ID 5 Operate t 5 Seal-In t 5 Events	= = =	87 TRIP 87Trip On (VO1) OFF Enabled		
[1	[M2] Contact O M2] Contact Output [M2] Contact Output [M2] Contact Outpu	output 6 ID 6 Operate t 6 Seal-In t 6 Events	= = =	51P TRIP 51P Trip On (VO2) OFF Enabled		
נו	[M3] Contact O M3] Contact Output [M3] Contact Outpu [M3] Contact Outpu	output 7 ID 7 Operate t 7 Seal-In t 7 Events	= =	51N TRIP 51N Trip On (VO6) OFF Enabled		

Appendix 17 87-51-2-R2 (GE-T60) Setting Calculation

	[M4] Contact Output 8 ID [M4] Contact Output 8 Operate [M4] Contact Output 8 Seal-In	= =	CB-R2 CLOSE 52b/CB-R2 Off(H7C) OFF
Virtual Outputs:	[M4] Contact Output 8 Events	=	Enabled
	SETTING Virtual Output 1 ID Virtual Output 1 Events	= =	PARAMETER 87Trip Enabled
	Virtual Output 2 ID	_	51D Trip
	Virtual Output 2 Events	=	Enabled
	Virtual Output 3 ID	=	Osc Trigger
	Virtual Output 3 Events	=	Enabled
	Virtual Output 4 ID	=	Hamornic BIK
	Virtual Output 4 Events	=	Enabled
	Virtual Output 5 ID	=	FR-Trigger
	Virtual Output 5 Events	=	Enabled
	Virtual Output 6 ID	=	51N Trip
	Virtual Output 6 Events	=	Enabled
	Virtual Output 7 ID	=	Virt Op 7
	Virtual Output 7 Events	=	Disabled
	Virtual Output 8 ID	=	Virt Op 8
	Virtual Output 8 Events	=	Disabled
	Virtual Output 9 ID	=	Virt Op 9
	Virtual Output 9 Events	=	Disabled
	Virtual Output 10 ID	=	Virt Op 10
	Virtual Output 10 Events	=	Disabled
	Virtual Output 11 ID	=	Virt Op 11
	Virtual Output 11 Events	=	Disabled
	Virtual Output 12 ID	=	Virt Op 12
	Virtual Output 12 Events	=	Disabled
	Virtual Output 13 ID	=	Virt Op 13
	Virtual Output 13 Events	=	Disabled
	Virtual Output 14 ID	=	Virt Op 14
	Virtual Output 14 Events	=	Disabled
	Virtual Output 15 ID	=	Virt Op 15

Appendix 1787-51-2-R2 (GE-T60) Setting Calculation

	Virtual Output 15 Events	=	Disabled
	Virtual Output 16 ID Virtual Output 16 Events	= =	Virt Op 16 Disabled
Remote Devices:			
Remote Inputs:			
Remote Outputs DNA	<u> Bit Pairs</u>		
Remote Outputs UserS	t Bit Pairs:		
Resetting:			
Direct Inputs:			
Direct Outputs:			
Teleprotection:			
IEC 61850 GOOSE An	alogs Inputs		

Not used

4	Appendix 18	50-62-1-B	KR1 (Are	eva P141) Setti	ng Calcu	lation
1. Data						
MVA_Base =	= 100	kV_Base =	345	Z_Base =	1190.25	ohms
CTR =	600	PTR =	3000	CTR/PTR=	0.2	
Total MVA of	f all three GSUs =	750	; Maximu	um full load curren	t (amps) =	1255.11

2. Setting Criteria

2.1. Set phase IOC element, i.e. phase fault detector, above load if possible but not more than 2/3 of the minimum phase to phase fault at remote bus with the largest source out. For the minimum phase to phase fault at Farragut station under minimum condition which is considered as the largest unit (STG1) of the three units out of service, the contributions from Charlie Poletti are 1,454 Amp via Q35M line and 1,349 Amp via Q35L line. Since each breaker failure relay will normally see only half of the fault contribution per feeder. The IOC1 element shall be set at 0.15 pu or 0.75 CT secondary amp or 450 CT primary amp, or 1/3 of 1,349 Amp or 35.8% of maximum full load. Fault detector picking up on load is considered acceptable here per IEEE standard.

2.2. Set residual IOC element, i.e. ground fault detector, above maximum expected unbalance, but not more than 2/3 of the minimum ground fault at remote bus with the largest source out. For the minimum line to ground fault at Farragut station under minimum condition with is considered as the largest unit (STG1) of the three units out of serivce, the fault contributions from Chaerlie Poletti are 2,021 Amp via Q35L and 2,129 Amp via Q35M. Since each breaker failure relay will normally see only half of the fault contribution on each feeder, set residual IOC element at 0.1 pu or 0.5 CT secondary amp, 300 CT primary amp, or 24% of maximum full load, which is less than 1/3 of minimum phase to ground fault at Farragut.

2.3 Breaker failure timer of 130 ms is used for 3 phase fault and 160 ms is used for unbalanced fault per ConEd standard. Existing Poletti settings show that 120 ms breaker failure time is used regardless fault type.

SYSTEM DATA:

	Language =	English
	Sys Fn Links =	0
	Decription =	50-62-1-BKR1
	Plant Reference =	CHARLES POLETTI
	Frequency =	60 Hz
CB CONTROL:		
	CB Control by =	Disabled
	Reset Lockout by =	CB Close
	Man Close RstDly =	5.000 s
	CB2 Status Input =	52A
DATE AND TIME:	-	
	IRIG-B Sync =	Enabled
	Battery Alarm =	Enabled
	Other Time Settings =	Default
CONFIGURATION:	_	
	Setting Group =	Select via Menu
	Active Settings =	Group 1
	Setting Group 1 =	Enabled
	Setting Group 2 =	Disabled
	Setting Group 3 =	Disabled
	Setting Group 4 =	Disabled
	System Config =	Invisible

Appendix 1	8 50-62-1-BKR1 (Arev	a P141) Setting Calculati	on
<u>CT AND VT RATIOS</u>	Overcurrent = Enabled Neg Sequence O/C = Enabled Broken Conductor = Disabled Earth Fault 1 = Disabled Earth Fault 2 = Enabled Sensitive E/F Prot'n = Disabled Residual O/V NVD = Disabled Thermal Overload = Disabled Neg Sequence O/V = Disabled Cold Load Pickup = Disabled Selective Logic = Disabled Admit Protection = Disabled Volt Protection = Disabled freq Protection = Disabled CB Fail = Enabled Supervision = Enabled Fault Locator = Disabled Input Labels = Visible CT & VT Ratios = Visible Disturb Recorder = Visible Commission Tests = Visible Setting Values = Secondary Control Inputs = Invisible Ctrl I/P Config = Invisible Direct Access = Disabled LCD Contrast = 11		# 50FD-P # Unbalance # Not used # Not used
DISTURB RECORDER:	Main VT Primary = 110.0 V Main VT Sec'y = 110.0 V Phase CT Primary = 3000 A Phase CT Sec'y = 5.000 A E/F CT Primary = 3000 A E/F CT Secondary = 5.000 A SEF CT Primary = 1.000 A SEF CT Secondary = 1.000 A See setting file for detail		# Not used # Not used
MEASUKE I SETUP:	Default Display = Descriptio Local Values = Primary Remote Values = Primary Measurement Ref = VA Measurement Mode = 0 Fix Dem Period = 30.00 min Roll Sub Period = 30.00 min	n	

Appendix 18	50-62-1-BK	R1 (Areva I	P141) Setting Calcula	ation
	Num Sub Periods =	1		
COMMISSION TESTS:	Monitor Dit 1	64		
	Monitor Bit 2 -	64 65		
	Monitor Bit 2 =	66 66		
	Monitor Bit 4 =	67		
	Monitor Bit 5 =	68		
	Monitor Bit 6 =	69		
	Monitor Bit 7 =	70		
	Monitor Bit 8 =	71		
CB MONITOR SETUP:				
	Broken I [^] =	2.000		
	I^ Maintenance =	Alarm Disable	ed	
	I^ Lockout =	Alarm Disable	ed	
	No. CB Ops Maint =	Alarm Disable	ed	
	No. CB Ops Lock =	Alarm Disable	ed	
	CB Time Maint =	Alarm Disable	ed	
	CB TIME LOCKOUT =	Alarm Disable	ed	
	Fault Freq Lock =	Alarm Disable	ea	
OF TO CONFIG.	Global Nominal V –	110/125\/		
	Opto Filter Cntl =	11111111		
	Characteristic =	Standard 60%	6-80%	
Group 1:				
GROUP 1 OVERCURRENT	<u>Γ:</u>			
	I>1 Function =	DT		
	I>1 Direction =	Non-Direction	nal	
	I>1 Current Set =	0.75		# 50FD-P
	I>1 Time Delay =	0		
	I>1 tRESET =	0	S	
	I>2 Status =	Disabled		
	I>3 Status =	Disabled		
	1>4 Status =			
	I> Char Angle -	45	dea	# Default
	VC0 Status =	Disabled	uug	" Deludit
GROUP 1 NEG SEQ O/C		Dicabica		
	I2>1 Status =	Enabled		
	I2>1 Function =	DT		
	<pre>l2>1 Directional =</pre>	Non-Direction	nal	
	I2>1 Current Set =	500.0mA		
	I2>1 Time Delay =	0 s		
	I2>1 Treset =	0 s		
	12>2 Status =	Disabled		
	$I_2>3$ Status =	Disabled		
	12>4 Status =			
	12 > Diocking = 12> Char Angle =	-60.00 dea		
	2> V2nol Set =	5.000 V		
	0.00.			

GROUP 1 EARTH FAULT 2

Appendix 18	50-62-1-BKR1 (Areva P141) Setting	g Calculation
	IN2> Input = Derived IN2>1 Function = DT IN2>1 Direction = Non-Directional IN2>1 Current = 500.0mA IN2>1 Time Delay = 0 s IN2>1 tRESET = 0 s IN2>2 Function = Disabled IN2>3 Status = Disabled IN2>4 Status = Disabled IN2> Blocking = 0000000 IN2> = POL IN2> Char Angle = -45.00 deg IN2> Pol = Zero Sequence IN2> VNpol Set = 5.000 V	# 50FD-G
<u>GROUP 1 CB FAIL & I<:</u>	CB Fail 1 Status = Enabled GB Fail 1 Timer = 0 s CB Fail 2 Status = Enabled CB Fail 2 Timer = 130.0 ms Volt Prot Reset = I < only Ext Prot Reset = I < only I< Current Set = 500.0 mA IN< Current Set = 500.0 mA ISEF< Current = 20.00 mA Remove I> Start = Disabled Remove IN> Start = Disabled	
GROUP 1 SUPERVISION:	V/TS Status - Indication	
GROUP 1 INPUT LABELS:	VTS Reset Mode = Manual VTS Time Delay = 5.000 s VTS I> Inhibit = 50.0 A VTS I2> Inhibit = 250.0 mA CTS Mode = Disabled	
	Opto Input 2 Input L2 Opto Input 3 30-TC2/1 ALM Opto Input 4 86BF-1/1 TRIP Opto Input 5 30-86BF-1/1 ALM Opto Input 6 BF Initiation Opto Input 7 Input L7 Opto Input 8 Input L8	
GROUP 1 OUTPUT LABELS	S: Relay 1 Trip 86BF Relay 2 ReTrip BkrTC2 Relay 3 Any Trip Relay 4 Output R4 Relay 5 Output R5 Relay 6 Output R6 Relay 7 Output R7	

	Appendix 19	50-62-2-	BKR1 (G	SE-C60) Setting Calculat	tion
1. Data					
MVA_Base =	= 100	kV_Base =	345	Z_Base = 1190.25	ohms
CTR =	600	PTR =	3000	CTR/PTR= 0.2	
Total MVA of	f all three GSUs =	750	; Maxim	um full load current (amps) =	1255.11

2. Setting Criteria

2.1. Set phase IOC element, i.e. phase fault detector, above load if possible but not more than 2/3 of the minimum phase to phase fault at remote bus with the largest source out. For the minimum phase to phase fault at Farragut station under minimum condition which is considered as the largest unit (STG1) of the three units out of service, the contributions from Charlie Poletti are 1,454 Amp via Q35M line and 1,349 Amp via Q35L line. Since each breaker failure relay will normally see only half of the fault contribution per feeder. The IOC1 element shall be set at 0.15 pu or 0.75 CT secondary amp or 450 CT primary amp, or 1/3 of 1,349 Amp or 35.8% of maximum full load. Fault detector picking up on load is considered acceptable here per IEEE standard.

2.2. Set residual IOC element, i.e. ground fault detector, above maximum expected unbalance, but not more than 2/3 of the minimum ground fault at remote bus with the largest source out. For the minimum line to ground fault at Farragut station under minimum condition with is considered as the largest unit (STG1) of the three units out of serivce, the fault contributions from Chaerlie Poletti are 2,021 Amp via Q35L and 2,129 Amp via Q35M. Since each breaker failure relay will normally see only half of the fault contribution on each feeder, set residual IOC element at 0.1 pu or 0.5 CT secondary amp, 300 CT primary amp, or 24% of maximum full load, which is less than 1/3 of minimum phase to ground fault at Farragut.

2.3 Breaker failure timer of 130 ms is used for 3 phase fault and 160 ms is used for unbalanced fault per ConEd standard. Existing Poletti settings show that 120 ms breaker failure time is used regardless fault type.

Device Definition:				# Default
Product Setup:				
Security:				# Default
Display Properties:				# Default
Clear Relay Records	<u>.</u>			# All OFF
Communications:				# Default
Modbus User Map:				# Not used
Real Time Clock:				
	IRIG-B Signal Type	=	DC Shift	
	All other settings	=	Default	
Fault Report:	SETTING		PARAMETER	
	Fault Report 1 Source	=	SRC 1 (SRC 1)	
	Fault Report 1 Trigger	=	Trig Oscill On (VO4)	
Fault Re	port 1 Positive Seq (Z1) Mag	=	0.49 ohms	# See data
Fault Repo	ort 1 Positive Seq (Z1) Angle	=	78 deg	# at Appendix
Fault	Report 1 Zero Seq (Z0) Mag	=	1.50 ohms	# 01 or 05
Fault R	eport 1 Zero Seq (Z0) Angle	=	54 deg	# Section 1
Fau	It Report 1 Line Length Units	=	mile	
	Fault Report 1 Line Length	=	7.74	
Fa	ault Report 1 VT Substitution	=	None	
Fa	ult Report 1 System Z0 Mag	=	0.49 ohms	
Fau	It Report 1 System Z0 Angle	=	78 deg	
Oscillography:				
	SETTING		PARAMETER	

Appendix 19	50-62-2-BKR1	(GE-C	60) Setting Calculation
Numb	er Of Records	=	6
	Trigger Mode	=	Automatic Overwrite
Т	rigger Position	=	30%
-	Trigger Source	=	Trig Oscill On (VO4)
AC Inp	out Waveforms	=	32 samples/cycle
Dig	gital Channel 1	=	OFF
Dig	gital Channel 2	=	OFF
Dię	gital Channel 3	=	OFF
Diç	gital Channel 4	=	OFF
Diç	gital Channel 5	=	OFF
Dig	gital Channel 6	=	86BF TRIP On (VO1)
Diç	gital Channel 7	=	RETRIP BKR On (VO2)
Dig	gital Channel 8	=	UNIT ALARM On (VO3)
Diç	gital Channel 9	=	
Digi	tal Channel 10	=	NEUTRAL IOC1 PKP
Digi	tal Channel 11	=	
Digi	tal Channel 12	=	PHASE IOC1 PKP A
Digi	tal Channel 13	=	
Digi	tal Channel 14	=	
Digi	tal Channel 15	=	
Digi		=	
Digi	tal Channel 17	=	PHASE IOCT OF C
Digi Digi	tal Channel 10	=	
Digi	tal Channel 20	_	
Digi Digi	tal Channel 21	_	BKR FAIL 1 T2 OP
Digi	tal Channel 22	_	BKR FAIL 2 T2 OP
Digi	tal Channel 23	=	86BF TRIP On (VO1)
Digi	tal Channel 24	=	RETRIP BKR On (VO2)
Digi	tal Channel 25	=	BKR FAIL 1 RETRIPA
Digi	tal Channel 26	=	BKR FAIL 1 RETRIPB
Digi	tal Channel 27	=	BKR FAIL 1 RETRIPC
Digi	tal Channel 28	=	OFF
Digi	tal Channel 29	=	OFF
Digi	tal Channel 30	=	OFF
Digi	tal Channel 31	=	OFF
Digi	tal Channel 32	=	OFF
Digi	tal Channel 33	=	OFF
Digi	tal Channel 34	=	OFF
Digi	tal Channel 35	=	OFF
Digi	tal Channel 36	=	OFF
Digi	tal Channel 37	=	OFF
Digi	tal Channel 38	=	OFF
Digi	tal Channel 39	=	OFF
Digi	tal Channel 40	=	
Digi	tal Channel 41	=	
Digi	tal Channel 42	=	
Digi	tal Channel 43	=	
Digi	tal Channel 44	=	
Digi	tai Unannél 45	=	UFF

Appendix	19	50-62-2-BKR1	(GE-C	60) Sett	ing Calculatio	n
	Digital	Channel 46	=	OFF		
	Digital	Channel 47	=	OFF		
	Digital	Channel 48	=	OFF		
	Digital	Channel 49	=	OFF		
	Digital	Channel 50	=	OFF		
	Digital	Channel 51	=	OFF		
	Digital	Channel 52	=	OFF		
	Digital	Channel 53	=	OFF		
	Digital	Channel 54	=	OFF		
	Digital	Channel 55	=	OFF		
	Digital	Channel 56	=	OFF		
	Digital	Channel 57	=	OFF		
	Digital	Channel 58	=	OFF		
	Digital	Channel 59	=	OFF		
	Digital	Channel 60	=	OFF		
	Digital	Channel 61	=	OFF		
	Digital	Channel 62	=	OFF		
	Digital	Channel 63	=	OFF		
	Analo	g Channel 1	=	SRC1	la Mag	
	Analo	g Channel 2	=	SRC2	la Mag	
	Analo	g Channel 3	=	SRC1	lb Mag	
	Analo	g Channel 4	=	SRC2	lb Mag	
	Analo	g Channel 5	=	SRC1	Ic Mag	
	Analo	g Channel 6	=	SRC2	Ic Mag	
	Analo	g Channel 7	=	SRC1	In Mag	
	Analo	g Channel 8	=	SRC2	In Mag	
	Analo	g Channel 9	=	SRC1	la Angle	
	Analog	Channel 10	=	SRC2	la Angle	
	Analog	Channel 11	=	SRC1	Ib Angle	
	Analog	Channel 12	=	SRC2	Ib Angle	
	Analog	Channel 13	=	SRC1	Ic Angle	
	Analog	Channel 14	=	SRC2	Ic Angle	
	Analog	Channel 15	=	Off	Ū	
	Analog	Channel 16	=	Off		
Data Logger:						# Default
Demand:						# Default
User-Programmable Leds:						
LED Test:						
		Function	=	Enabled		
		Control	=	CONTRO	L PUSHBUTTON	1 ON
Trip and Alarms Leds:						
	Tr	ip LED Input	=	86BF TRI	IP On (VO1)	
	Alar	m LED Input	=	UNIT ALA	ARM On (VÓ3)	
			_			Latched
			_			Latched
			_			Latched
			_		$D \cap (1/(\Omega))$	Latched
			_	OFF		Latched
			=	OFF		Self-Reset
				- · ·		

Appendix 19	50-62-2-BKR1	(GE-0	C60) Setting Calculatio	on
	LED 7	=	OFF	Self-Reset
	LED 8	=	OFF	Self-Reset
	LED 9	=	Phase A Trip On (VO10)	Latched
	LED 10	=	Phase B Trip On (VO11)	Latched
	LED 11	=	Phase C Trip On (VO12)	Latched
	LED 12	=	Ground Trip On (VO13)	Latched
	LED 13	=	OFF	Self-Reset
	LED 14	=	OFF	Self-Reset
	LED 15	=	OFF	Self-Reset
	LED 16	=	OFF	Self-Reset
	LED 17	=	OFF	Self-Reset
	LED 18	=	OFF	Self-Reset
	LED 19	=	OFF	Self-Reset
	LED 20	=	OFF	Self-Reset
	LED 21	=	OFF	Self-Reset
	LED 22	=	Bkr Fail Int On(M7a)	Self-Reset
	LED 23	=	BKR FAIL 1 T2 OP	Self-Reset
	LED 24	=	BKR FAIL 2 T2 OP	Self-Reset
	LED 25	=	OFF	Self-Reset
	LED 26	=	OFF	Self-Reset
	LED 27	=	OFF	Self-Reset
	LED 28	=	OFF	Self-Reset
	LED 29	=	OFF	Self-Reset
	LED 30	=	OFF	Self-Reset
	LED 31	=	OFF	Self-Reset
	LED 32	=	OFF	Self-Reset
	LED 33	=	OFF	Self-Reset
	LED 34	=	OFF	Self-Reset
	LED 35	=	OFF	Self-Reset
	LED 36	=	OFF	Self-Reset
	LED 37	=	OFF	Self-Reset
	LED 38	=	OFF	Self-Reset
	LED 39	=	OFF	Self-Reset
	LED 40	=	OFF	Self-Reset
	LED 41	=	OFF	Self-Reset
	LED 42	=	OFF	Self-Reset
	LED 43	=	OFF	Self-Reset
	LED 44	=	OFF	Self-Reset
	LED 45	=	OFF	Self-Reset
	LED 46	=	OFF	Self-Reset
	LED 47	=	OFF	Self-Reset
	LED 48	=	OFF	Self-Reset
User-Programmable Self Tests:			••••	
Remote Dev	vice Off Function	=	Enabled	
Pri Ether	net Fail Function	=	Enabled	
Batt	erv Fail Function	=	Enabled	
SN	TP Fail Function	=	Enabled	
IRIC	G B Fail Function	=	Enabled	
Control Pushbuttons:				
PARAMETER CPB 1	CPB 2 C	PB 3		

1	Appendix	19 50)-62-2-E	SKR1	(GE-C	C60) Setting	g Calculatio	on
Function Events Flex States:	Enabled Disabled	Disa Disa	oled oled	Disab Disab	oled oled			# All OFF
User-definable Direct I/O: Teleprotection:	displays:							# Not used # Not used # Not used
Installation:		Po	lov Nomo		_	50/62 2 Pro	okor 1	
System Setup: AC Inputs		Re	ay name		=	50/02-2 DIE		
Curren	<u>t:</u>	PAR	AMETER			CT F1		
		Phase C	Г Primary		=	3000 A		
		Phase CT S	econdary		=	5 A		
		Ground C	Γ Primary		=	3000 A		
	(Ground CT S	econdary		=	5 A		
Voltage	e:							# Not used
Power System	<u>1:</u>							
		Nominal F	requency		=	60 Hz		
		Phase	Rotation		=	ABC		
	Frequency	And Phase F	Reference		=	SRC 1 (SRC	21)	
	Freque	ncy Tracking	Function		=	Enabled		
Signal Sources	<u>s:</u>	PAR	AMETER			SOURCE 1	SOURCE 2	
			Name		=	SRC 1	SRC 2	
		F	Phase CT		=	F1	None	
		G	round CT		=	None	None	
		F	Phase VT		=	None	None	
			Aux VT		=	None	None	
Breakers	<u>s:</u>		SETTING			PARAMETE	R	
	. .	Breaker 1	Function		=	Disabled		
	Breaker	1 Push Butto	n Control		=	Disabled		
		Breake	r 1 Name		=	Bkr 1		
		Breake	er 1 Mode		=	3-Pole		
		Breake	er 1 Open		=	OFF		
		Breaker 1 Bi	JCK Open		=			
		Dieake Prookor 1 Pk			=	OFF		
	Brooker 1 B	baco $\Lambda/2$ Do			=			
F	Brookor 1 Ph	11250 A/3-POL	o Ononod		_	OFF		
L	Breaker I FI	kar 1 Phasa	B Closed		_	OFF		
	Brook	or 1 Phase	D Closed S Onened		_	OFF		
	Brea	ker 1 Phase	C Closed		_	OFF		
	Break	er 1 Phase (C Closed		_	OFF		
	Broak	Breaker 1	Toperate		_	0.070 s		
	Bre	aker 1 Exter	nal Alarm		_	OFF		
	F	Breaker 1 Ala	rm Delav		=	0.000 s		
Br	- eaker 1 Mar	ual Close Re	ecal Time		=	0.000 s		
21	Bre	aker 1 Out C	of Service		=	OFF		
		Breaker	1 Events		=	Disabled		
		Breaker 2	Function		=	Disabled		

Appendix 19 50-62-2-BKR1 (GE-C60) Setting Calculation

Breaker 2 Push Button Control	=	Disabled	
Breaker 2 Name	=	Bkr 2	
Breaker 2 Mode	=	3-Pole	
Breaker 2 Open	=	OFF	
Breaker 2 Block Open	=	OFF	
Breaker 2 Close	=	OFF	
Breaker 2 Block Close	=	OFF	
Breaker 2 Phase A/3-Pole Closed	=	OFF	
Breaker 2 Phase A/3-Pole Opened	_	OFF	
Breaker 2 Phase B Closed	_	OFF	
Breaker 2 Phase B Opened	_	OFF	
Broaker 2 Phase C Closed	_		
Breaker 2 Phase C Closed	_		
Breaker 2 Filase C Openeu	=		
Breaker 2 Toperate	=	0.070 \$	
Breaker 2 External Alarm	=		
Breaker 2 Alarm Delay	=	0.000 s	
Breaker 2 Manual Close Recal Time	=	0.000 s	
Breaker 2 Out Of Service	=		
Breaker 2 Events	=	Disabled	
<u>Switches</u>			# Not used
<u>FlexCurves:</u>			# Not used
<u>FlexLogic:</u>		#	See 50-62-2-BKR1-r0.pdf
Grouped Elements:			
Group 1:			
Phase Current:			
Phase TOC:			# Not used
Phase IOC:			
Function	=	Enabled	
Source	=	SRC 1 (SRC 1)	
Pickup	=	0.15 pu	
Delay	=	0.00 s	
Reset Delav	=	0.00 s	
Block A	=	OFF	
Block B	=	OFF	
Block C	_	OFF	
Target	_	Self-reset	
Events	_	Enabled	
Neutral Current:	-	Enabled	
Noutral TOC:			# Not used
Neutral IOC:			# Not used
Neutral IOC.		Enchlad	
Function	=		
Source	=	SRUT (SRUT)	
Ріскир	=	0.100 pu	
Delay	=	0.00 s	
Reset Delay	=	0.00 s	
Block	=	OFF	
Target	=	Self-reset	
Events	=	Enabled	
Ground Current:			
Ground TOC			# Not used

Appendix 19

50-62-2-BKR1 (GE-C60) Setting Calculation

100 Brea

Ground IOC				# Not used
Breaker Failure:	PARAMETER		BF1	BF2
	Function	=	Enabled	Enabled
	Mode	=	3-Pole	3-Pole
	Source	=	SRC 1 (SRC 1)	SRC 1 (SRC1)
	Current Supervision	=	Yes	Yes
	Use Seal-In	=	No	No
	Three Pole Initiate	=	Bkr Fail Int On(M7a);	
	Block	=	NEUTRAL IOC1 PKP	OFF
Pha	se Current Supv Pickup	=	0.15 pu	# 50FD-P
Neut	ral Current Supv Pickup	=	0.100 pu	# 50FD-G
	Use Timer 1	=	No	No
	Timer 1 Pickup Delay	=	0.000 s	0.000 s
	Use Timer 2	=	Yes	Yes
	Timer 2 Pickup Delay	=	0.130 s	0.160 s
	Use Timer 3	=	No	No
	Timer 3 Pickup Delay	=	0.000 s	0.000 s
Br	eaker Pos1 Phase A/3P	=	OFF	OFF
Br	eaker Pos2 Phase A/3P	=	OFF	OFF
	Breaker Test On	=	OFF	OFF
Pha	se Current HiSet Pickup	=	0.15 pu	0.15 pu
Neut	ral Current HiSet Pickup	=	0.100 pu	0.100 pu
Phas	se Current LoSet Pickup	=	0.15 pu	0.15 pu
Neutr	al Current LoSet Pickup	=	0.100 pu	0.100 pu
	LoSet Time Delay	=	0.000 s	0.000 s
	Trip Dropout Delay	=	0.000 s	0.000 s
	Target	=	Latched	Latched
	Events	=	Enabled	Enabled
	Phase A Initiate	=	OFF	OFF
	Phase B Initiate	=	OFF	OFF
	Phase C Initiate	=	OFF	OFF
	Breaker Pos1 Phase B	=	OFF	OFF
	Breaker Pos1 Phase C	=	OFF	OFF
	Breaker Pos2 Phase B	=	OFF	OFF
	Breaker Pos2 Phase C	=	OFF	OFF
Voltage Elements:				# Not used
Power:				# Not used
Control Elements:				
<u>Trip Bus:</u>				# Not used
Setting Groups:				# Not used
Selector Switches:				# Not used
<u>Synchrocheck:</u>				# Not used
Digital Elements:				# Not used
Digital Counters:				# Not used
Monitoring Elements:				# Not used
Autoreclose 1P				# Not used
Inputs/Outputs:				
Contact inputs:	<u>SETTING</u>		PARAMETER	
[H5A] Contact Input 1 ID	=	<u>CSM-2 (E13)</u>	
[H5A] Contact	Input 1 Debounce Time	=	<u>2.0 ms</u>	

Appendix 1950-62-2-BKR1 (GE-C60) Setting Calculation

	-	
[H5A] Contact Input 1 Events	=	Enabled
[HEC] Contact Input 2 ID	_	
[H5C] Contact Input 2 Debourge Time	=	$\frac{\text{COM-2}(\text{TE})}{2.0 \text{ ma}}$
[HEC] Contact Input 2 Events	=	Z.U IIIS Epobled
[H5C] Contact Input 2 Events	=	Enabled
[H6A] Contact Input 3 ID	=	Bkr TC1 Mont
[H6A] Contact Input 3 Debounce Time	=	<u>2.0 ms</u>
[H6A] Contact Input 3 Events	=	Enabled
[H6C] Contact Input 4 ID	=	86BF-2 Oper
[H6C] Contact Input 4 Debounce Time	=	<u>2.0 ms</u>
[H6C] Contact Input 4 Events	=	Enabled
[H7A] Contact Input 5 ID	=	86BF-2 Mont
[H7A] Contact Input 5 Debounce Time	=	2.0 ms
[H7A] Contact Input 5 Events	=	Enabled
[H7C] Contact Input 6 ID	=	<u>43L/R</u>
[H7C] Contact Input 6 Debounce Time	=	<u>2.0 ms</u>
[H7C] Contact Input 6 Events	=	Enabled
[H8A] Contact Input 7 ID	=	<u>CSM-2 (OFF)</u>
[H8A] Contact Input / Debounce Time	=	<u>2.0 ms</u>
[H8A] Contact Input 7 Events	=	Enabled
[H8C] Contact Input 8 ID	=	CSM-2 (FARR)
[H8C] Contact Input 8 Debounce Time	=	2.0 ms
[H8C] Contact Input 8 Events	=	Enabled
<u> </u>		
[M5A] Contact Input 9 ID	=	<u>11LTSR-2A</u>
[M5A] Contact Input 9 Debounce Time	=	<u>2.0 ms</u>
[M5A] Contact Input 9 Events	=	Enabled
INFOL Original transit 40 ID		
[MSC] Contact Input 10 ID	=	<u>11LISR-2B</u>
INSCI Contact Input 10 Debounce Time	=	<u>2.0 ms</u>
[M5C] Contact Input 10 Events	=	Enabled
[M6A] Contact Input 11 ID	=	<u>Cont lp 11</u>
[M6A] Contact Input 11 Debounce Time	=	2.0 ms
[M6A] Contact Input 11 Events	=	Disabled
· · · · · · · · · · · · · · · · · · ·		
[M6C] Contact Input 12 ID	=	<u>spare</u>
[M6C] Contact Input 12 Debounce Time	=	<u>2.0 ms</u>
[M6C] Contact Input 12 Events	=	<u>Disabled</u>
INTAL Contract land 40 ID		
[IVI/A] Contact Input 13 ID	=	
INTAL CONTACT INPUT 13 DEDOUNCE TIME	=	<u>∠.∪ ms</u>
IM/AJ Contact Input 13 Events	=	Enabled

Appendix 19	50-62-2-BKR1	(GE-C	60) Setting Cal	culatio	n
[M7C] Contac	t Input 14 ID	=	Cont lp 14		
[M7C] Contact Input 14 Det	pounce Time	=	<u>2.0 ms</u>		
[M7C] Contact Inp	ut 14 Events	=	<u>Disabled</u>		
[M8A] Contac	t Input 15 ID	=	Cont lp 15		
[M8A] Contact Input 15 Deb	<u>oounce Time</u>	=	<u>2.0 ms</u>		
[M8A] Contact Inp	ut 15 Events	=	<u>Disabled</u>		
[M8C] Contac	<u>t Input 16 ID</u>	=	Cont lp 16		
[M8C] Contact Input 16 Det	<u>oounce Time</u>	=	<u>2.0 ms</u>		
[M8C] Contact Inp	ut 16 Events	=	<u>Disabled</u>		
Contact Inputs Thresholds:					
Cont lp 1, Cont lp 2, Co	nt lp 3, Cont lp 4(I	15A, H50	C, H6A, H6C)	=	84 Vdc
Cont Ip5, Cont Ip 6, Co	nt lp 7, Cont lp 8(H	H7A, H70	C, H8A, H8C)	=	84 Vdc
Cont Ip 9, Cont Ip 10, Cont I	p 11, Cont lp 12(M	5A, M5C	C, M6A, M6C)	=	84 Vdc
Cont lp 13, Cont lp 14, Cont lj	p 15, Cont Ip 16(M	7A, M7C	C, M8A, M8C)	=	84 Vdc
Virtual Inputs:	SETTING		PARAMETER		
Virtual Inpu	ut 1 Function	=	Enabled		
Virtu	ial Input 1 ID	=	Bkr Trip		
Virtual	Input 1 Type	=	Self-Reset		
Virtual In	put 1 Events	=	Enabled		
Virtual Ipp	it 2 Eurotion	_	Enabled		
Virtual hipt		_	Bkr Close		
Virtual	Innut 2 Type	_	Salf-Rasat		
Virtual In	nut 2 Events	_	Fnahled		
Other Virtual Inputs (from \	/103 to //164)	-	Enabled		# Not used
Contact Outputs:					# Hot dood
[H1] Contact	t Output 1 ID	=	Any Trip		
[H1] Contact Outp	ut 1 Operate	=	TRIP LED On (VO	6)	
[H1] Contact Out	put 1 Seal-In	=	OFF	- /	
[H1] Contact Out	put 1 Events	=	Enabled		
	•				
[H2] Contact	t Output 2 ID	=	spare		
[H2] Contact Outp	ut 2 Operate	=	OFF		
[H2] Contact Out	put 2 Seal-In	=	OFF		
[H2] Contact Out	put 2 Events	=	Disabled		
[H3] Contact	t Output 3 ID	=	Not Used		
[H3] Contact Outp	ut 3 Operate	=	OFF		
[H3] Contact Out	put 3 Seal-In	=	OFF		
[H3] Contact Out	put 3 Events	=	Disabled		
[H4] Contact		=			
	ut 4 Operate	=			
	put 4 Seal-IN	=	UFF		
	put 4 Events	=	DISADIEU		
[M1] Contact	t Output 5 ID	_	BE TRIP		
[M1] Contact Outp	ut 5 Operate	=	86BF TRIP On (V(D1)	
[] contact outp				- • /	

Α	ppendix 19	50-62-2-BKR1	(GE-C	60) Setting Calculation
	[M1] Contact C	output 5 Seal-In	=	86BF TRIP On (VO1)
	[M1] Contact C	Output 5 Events	=	Enabled
	[M2] Conta	act Output 6 ID	=	RETRIP BKR
	[M2] Contact Ou	utput 6 Operate	=	RETRIP BKR On (VO2)
	[M2] Contact C	output 6 Seal-In	=	RETRIP BKR On (VO2)
	[M2] Contact C	Output 6 Events	=	Enabled
	[M3] Conta	act Output 7 ID	=	Bkr Trip
	[M3] Contact Ou	utput 7 Operate	=	Bkr Trip On (VO7)
	[M3] Contact O	utput 7 Seal-In	=	OFF
	[M3] Contact C	Output 7 Events	=	Enabled
	[M4] Cont	act Output 8 ID	=	Bkr Close
	[M4] Contact Ou	utput 8 Operate	=	Bkr Close On (VO8)
	[M4] Contact C	output 8 Seal-In	=	OFF
	[M4] Contact C	Output 8 Events	=	Enabled
Virtual Outputs:		SETTING		PARAMETER
	Virt	ual Output 1 ID	=	86BF TRIP
	Virtual C	Dutput 1 Events	=	Enabled
	Virt	ual Output 2 ID	=	RETRIP BKR
	Virtual C	Output 2 Events	=	Enabled
	Virt	ual Output 3 ID	=	UNIT ALARM
	Virtual C	Output 3 Events	=	Enabled
	Virt	ual Output 4 ID	=	Tria Oscill
	Virtual C	output 4 Events	=	Enabled
	Virt	ual Output 5 ID	=	ALARM NC
	Virtual C	Output 5 Events	=	Enabled
	Virt	ual Output 6 ID	=	TRIP LED
	Virtual C	Output 6 Events	=	Enabled
	Virt	ual Output 7 ID	=	Bkr Trip
	Virtual C	Output 7 Events	=	Enabled
	Virt	ual Output 8 ID	_	Bkr Close
	Virtual C	output 8 Events	=	Enabled
				2.100.000
	Virt	ual Output 9 ID	=	Retrip LED
	Virtual C	Output 9 Events	=	Enabled
	1 <i>P</i>			
	Virtua Virtual O		=	Phase A Trip
	virtual Ot	itput 10 Events	=	Enabled
	Virtu	al Output 11 ID	=	Phase B Trip
	Virtual Ou	utput 11 Events	=	Enabled

Appendix 1950-62-2-BKR1 (GE-C60) Setting Calculation

Virtual Output 12 ID Virtual Output 12 Events	= =	Phase C Trip Enabled
Virtual Output 13 ID Virtual Output 13 Events	= =	Ground Trip Enabled
Other Virtual Outputs (from VO14 to VO96)		
Remote Devices:		
Remote Inputs:		
Remote Outputs DNA Bit Pairs		
Remote Outputs UserSt Bit Pairs:		
Resetting:		
Direct Inputs:		
Direct Outputs:		
Teleprotection:		
IEC 61850 GOOSE Analogs Inputs		

Not used # Not used

	Appendix 20	50-62-1-BI	KR2 (Are	eva P141) Setti	ing Calcu	lation
1. Data						
MVA_Base	= 100	kV_Base =	345	Z_Base =	1190.25	ohms
CTR =	600	PTR =	3000	CTR/PTR=	0.2	
Total MVA of	of all three GSUs =	750	; Maximu	um full load curren	it (amps) =	1255.11

2. Setting Criteria

2.1. Set phase IOC element, i.e. phase fault detector, above load if possible but not more than 2/3 of the minimum phase to phase fault at remote bus with the largest source out. For the minimum phase to phase fault at Farragut station under minimum condition which is considered as the largest unit (STG1) of the three units out of service, the contributions from Charlie Poletti are 1,454 Amp via Q35M line and 1,349 Amp via Q35L line. Since each breaker failure relay will normally see only half of the fault contribution per feeder. The IOC1 element shall be set at 0.15 pu or 0.75 CT secondary amp or 450 CT primary amp, or 1/3 of 1,349 Amp or 35.8% of maximum full load. Fault detector picking up on load is considered acceptable here per IEEE standard.

2.2. Set residual IOC element, i.e. ground fault detector, above maximum expected unbalance, but not more than 2/3 of the minimum ground fault at remote bus with the largest source out. For the minimum line to ground fault at Farragut station under minimum condition with is considered as the largest unit (STG1) of the three units out of serivce, the fault contributions from Chaerlie Poletti are 2,021 Amp via Q35L and 2,129 Amp via Q35M. Since each breaker failure relay will normally see only half of the fault contribution on each feeder, set residual IOC element at 0.1 pu or 0.5 CT secondary amp, 300 CT primary amp, or 24% of maximum full load, which is less than 1/3 of minimum phase to ground fault at Farragut.

2.3 Breaker failure timer of 130 ms is used for 3 phase fault and 160 ms is used for unbalanced fault per ConEd standard. Existing Poletti settings show that 120 ms breaker failure time is used regardless fault type.

SYSTEM DATA:

	Language = English
	Sys Fn Links = 0
	Decription = 50-62-1-BKR2
	Plant Reference = CHARLES POLETTI
	Frequency = 60 Hz
CB CONTROL:	
	CB Control by = Disabled
	Reset Lockout by = CB Close
	Man Close RstDly = 5.000 s
	CB2 Status Input = 52A
DATE AND TIME:	·
	IRIG-B Sync = Enabled
	Battery Alarm = Enabled
	Other Time Settings = Default
CONFIGURATION:	° °
	Setting Group = Select via Menu
	Active Settings = Group 1
	Setting Group 1 = Enabled
	Setting Group 2 = Disabled
	Setting Group 3 = Disabled
	Setting Group 4 = Disabled
	System Config = Invisible
	, ,

Appendix 2	20 50-62-1-BKR	2 (Areva P141) Setting Calculat	ion
Appendix 2	20 50-62-1-BKR Overcurrent = E Neg Sequence $O/C = E$ Broken Conductor = D Earth Fault 1 = D Earth Fault 2 = E Sensitive E/F Prot'n = D Residual O/V NVD = D Thermal Overload = D Neg Sequence $O/V = D$ Cold Load Pickup = D Selective Logic = D Admit Protection = D Volt Protection = D CB Fail = E Supervision = E Fault Locator = D Input Labels = V Output Labels = V CT & VT Ratios = V Record Control = I Disturb Recorder = V Measure't Setup = V Setting Values = S Commission Tests = V Setting Values = I Direct Access = D	R2 (Areva P141) Setting Calculat Enabled Enabled Enabled Disabled Visible /visible /visible Visible Visible Nvisible Nvisible Nvisible Disabled	ion # 50FD-P # Unbalance # Not used # Not used # S0FD-G # Not used # Not used
<u>CT AND VT RATIOS</u> <u>DISTURB RECORDER:</u> <u>MEASURE'T SETUP:</u>	Main VT Primary = 1 Main VT Sec'y = 1 Phase CT Primary = 3 Phase CT Sec'y = 5 E/F CT Primary = 3 E/F CT Secondary = 5 SEF CT Primary = 1 SEF CT Secondary = 1 See setting file f	110.0 V 110.0 V 3000 A 5.000 A 5.000 A 1.000 A 1.000 A for detail	# Not used # Not used
	Default Display = I Local Values = F Remote Values = F Measurement Ref = V Measurement Mode = 0 Fix Dem Period = 3 Roll Sub Period = 3	Description Primary Primary /A 30.00 min 30.00 min	

Appendix 20	50-62-1-BK	R2 (Areva I	P141) Setting Calcul	ation
	Num Sub Periods =	1		
COMMISSION TESTS:	Monitor Dit 1	64		
	Monitor Bit 2 -	65		
	Monitor Bit 2 =	66		
	Monitor Bit 4 =	67		
	Monitor Bit 5 =	68		
	Monitor Bit 6 =	69		
	Monitor Bit 7 =	70		
	Monitor Bit 8 =	71		
CB MONITOR SETUP:				
	Broken I [^] =	2.000		
	I^ Maintenance =	Alarm Disable	ed	
	I^ Lockout =	Alarm Disable	ed	
	No. CB Ops Maint =	Alarm Disable	ed	
	No. CB Ops Lock =	Alarm Disable	ed	
	CB Time Maint =	Alarm Disable	ed	
	CB TIME LOCKOUT =	Alarm Disable	ed ad	
	Fault Fled Lock =	Alarm Disable	eu	
OF TO CONFIG:	Global Nominal V –	110/125\/		
	Opto Filter Cntl =	11111111		
	Characteristic =	Standard 60%	%-80%	
Group 1:				
GROUP 1 OVERCURRENT	<u>Γ:</u>			
	I>1 Function =	DT		
	I>1 Direction =	Non-Direction	nal	
	I>1 Current Set =	0.75		# 50FD-P
	I>1 Time Delay =	0		
	I>1 trest =	0 Disable l	S	
	I>2 Status =	Disabled		
	I>3 Status =	Disabled		
	I>4 Status =			
	I> Char Angle =	45	dea	# Default
	VC0 Status =	Disabled	uog	# Doladit
GROUP 1 NEG SEQ O/C				
	l2>1 Status =	Enabled		
	I2>1 Function =	DT		
	I2>1 Directional =	Non-Direction	nal	
	I2>1 Current Set =	500.0mA		
	I2>1 Time Delay =	0 s		
	I2>1 Treset =	0 s		
	12>2 Status =	Disabled		
	$I_2>3$ Status =	Disabled		
	12>4 Status =			
	12 > Diotking = 12> Char Angle =	-60.00 dea		
	2> V2nol Set =	5.000 V		
	0.00(=			

GROUP 1 EARTH FAULT 2

Appendix 20	50-62-1-BKR2 (Areva P141) Setting Ca	alculation
	IN2> Input = Derived IN2>1 Function = DT IN2>1 Direction = Non-Directional IN2>1 Current = 500.0mA IN2>1 Time Delay = 0 s IN2>1 tRESET = 0 s IN2>2 Function = Disabled IN2>3 Status = Disabled IN2>4 Status = Disabled IN2> Blocking = 0000000 IN2> = POL IN2> Char Angle = -45.00 deg IN2> VNpol Set = 5.000 V	# 50FD-G
<u>GROUP 1 CB FAIL & I<:</u>	CB Fail 1 Status = Enabled GB Fail 1 Timer = 0 s CB Fail 2 Status = Enabled CB Fail 2 Timer = 130.0 ms Volt Prot Reset = I < only Ext Prot Reset = I < only I< Current Set = 500.0 mA IN< Current Set = 500.0 mA ISEF< Current = 20.00 mA Remove I> Start = Disabled Remove IN> Start = Disabled	
GROUP 1 SUPERVISION:	VTS Status Indication	
GROUP 1 INPUT LABELS:	VTS Reset Mode = Manual VTS Time Delay = 5.000 s VTS I> Inhibit = 50.0 A VTS I2> Inhibit = 250.0 mA CTS Mode = Disabled	
	Opto Input 1 Input L1 Opto Input 2 Input L2 Opto Input 3 30-TC2/1 ALM Opto Input 4 86BF-1/1 TRIP Opto Input 5 30-86BF-1/1 ALM Opto Input 6 BF Initiation Opto Input 6 BF Initiation Opto Input 7 Input L7 Opto Input 8 Input L8	
<u>GROUP 1 OUTPUT LABELS</u>	S: Relay 1 Trip 86BF Relay 2 ReTrip BkrTC2 Relay 3 Any Trip Relay 4 Output R4 Relay 5 Output R5 Relay 6 Output R6 Relay 7 Output R7	

	Appendix 21	50-62-2-BKR1 (GE-C60) Setting Calculation				
1. Data						
MVA_Base =	= 100	kV_Base =	345	Z_Base = 1190.25	ohms	
CTR =	600	PTR =	3000	CTR/PTR= 0.2		
Total MVA of	all three GSUs =	750	; Maxim	um full load current (amps) =	1255.11	

2. Setting Criteria

2.1. Set phase IOC element, i.e. phase fault detector, above load if possible but not more than 2/3 of the minimum phase to phase fault at remote bus with the largest source out. For the minimum phase to phase fault at Farragut station under minimum condition which is considered as the largest unit (STG1) of the three units out of service, the contributions from Charlie Poletti are 1,454 Amp via Q35M line and 1,349 Amp via Q35L line. Since each breaker failure relay will normally see only half of the fault contribution per feeder. The IOC1 element shall be set at 0.15 pu or 0.75 CT secondary amp or 450 CT primary amp, or 1/3 of 1,349 Amp or 35.8% of maximum full load. Fault detector picking up on load is considered acceptable here per IEEE standard.

2.2. Set residual IOC element, i.e. ground fault detector, above maximum expected unbalance, but not more than 2/3 of the minimum ground fault at remote bus with the largest source out. For the minimum line to ground fault at Farragut station under minimum condition with is considered as the largest unit (STG1) of the three units out of serivce, the fault contributions from Chaerlie Poletti are 2,021 Amp via Q35L and 2,129 Amp via Q35M. Since each breaker failure relay will normally see only half of the fault contribution on each feeder, set residual IOC element at 0.1 pu or 0.5 CT secondary amp, 300 CT primary amp, or 24% of maximum full load, which is less than 1/3 of minimum phase to ground fault at Farragut.

2.3 Breaker failure timer of 130 ms is used for 3 phase fault and 160 ms is used for unbalanced fault per ConEd standard. Existing Poletti settings show that 120 ms breaker failure time is used regardless fault type.

Device Definition: Product Setup:				# Default
Security:				# Default
Display Properties:				# Default
Clear Relay Records:				# All OFF
Communications:				# Default
Modbus User Map:				# Not used
Real Time Clock:				
	IRIG-B Signal Type	=	DC Shift	
	All other settings	=	Default	
Fault Report:	SETTING		PARAMETER	
	Fault Report 1 Source	=	SRC 1 (SRC 1)	
	Fault Report 1 Trigger	=	Trig Oscill On (VO4)	
Fault Report 1 Positive Seg (Z1) Mag		=	0.49 ohms	
Fault Report 1 Positive Seq (Z1) Angle		=	78 deg	
Fault Report 1 Zero Seg (Z0) Mag		=	1.50 ohms	
Fault Report 1 Zero Seg (Z0) Angle		=	54 deg	
Fault Report 1 Line Length Units		=	mile	
Fault Report 1 Line Length		=	7.74	
Fault Report 1 VT Substitution		=	None	
Fault Report 1 System Z0 Mag		=	0.49 ohms	
Fault Report 1 System Z0 Angle		=	78 deg	
Oscillography:			<u> </u>	
	SETTING		PARAMETER	

Appendix 21	50-62-2-BKR1	(GE-C	60) Setting Calculation
Numbe	er Of Records	=	6
	Trigger Mode	=	Automatic Overwrite
Tri	gger Position	=	30%
Т	rigger Source	=	Trig Oscill On (VO4)
AC Inpu	it Waveforms	=	32 samples/cycle
Digi	tal Channel 1	=	OFF
Digi	tal Channel 2	=	OFF
Digi	tal Channel 3	=	OFF
Digi	tal Channel 4	=	OFF
Digi	tal Channel 5	=	OFF
Digi	tal Channel 6	=	86BF TRIP On (VO1)
Digi	tal Channel 7	=	RETRIP BKR On (VO2)
Digi	tal Channel 8	=	UNIT ALARM On (VO3)
Digi	tal Channel 9	=	
Digita	al Channel 10	=	
Digita	al Channel 11	=	
Digita	al Channel 12	=	
Digita	al Channel 13	=	
Digita	al Channel 14	=	
Digita		=	
Digita		=	
Digita		=	PHASE IOCT OP C
Digita	al Channel 10	=	
Digita	al Channel 20	_	
Digita	al Channel 20	_	
Digita	al Channel 22	_	BKR FAIL 2 T2 OP
Digit	al Channel 23	=	86BE TRIP On (VO1)
Digita	al Channel 24	=	RETRIP BKR On (VO2)
Digita	al Channel 25	=	BKR FAIL 1 RETRIPA
Digita	al Channel 26	=	BKR FAIL 1 RETRIPB
Digita	al Channel 27	=	BKR FAIL 1 RETRIPC
Digita	al Channel 28	=	OFF
Digita	al Channel 29	=	OFF
Digita	al Channel 30	=	OFF
Digita	al Channel 31	=	OFF
Digita	al Channel 32	=	OFF
Digita	al Channel 33	=	OFF
Digita	al Channel 34	=	OFF
Digita	al Channel 35	=	OFF
Digita	al Channel 36	=	OFF
Digita	al Channel 37	=	OFF
Digita	al Channel 38	=	OFF
Digita	al Channel 39	=	OFF
Digita	al Channel 40	=	OFF
Digita	al Channel 41	=	OFF
Digita	al Channel 42	=	OFF
Digita	al Channel 43	=	OFF
Digita	al Channel 44	=	OFF
Digita	al Channel 45	=	OFF

Appendix 21 50-62-2-BKR1 (GE-C60) Setting Calculation
Appendix 21	50-62-2-BK	R1	(GE-C	60) Sett	ing Calculation	n
Digita	I Channel 46		=	OFF		
Digita	l Channel 47		=	OFF		
Digita	l Channel 48		=	OFF		
Digita	l Channel 49		=	OFF		
Digita	l Channel 50		=	OFF		
Digita	l Channel 51		=	OFF		
Digita	l Channel 52		=	OFF		
Digita	l Channel 53		=	OFF		
Digita	l Channel 54		=	OFF		
Digita	l Channel 55		=	OFF		
Digita	l Channel 56		=	OFF		
Digita	l Channel 57		=	OFF		
Digita	l Channel 58		=	OFF		
Digita	l Channel 59		=	OFF		
Digita	Channel 60		=	OFF		
Digita	Channel 61		=	OFF		
Digita	Channel 62		=	OFF		
Digita	Channel 63		=	OFF		
Analo	o Channel 1		=	SRC1	la Mag	
Analo	og Channel 2		=	SRC2	la Mag	
Analo	og Channel 3		=	SRC1	Ib Mag	
Analo	og Channel 4		=	SRC2	Ib Mag	
Analo	og Channel 5		=	SRC1	Ic Mag	
Analo	og Channel 6		=	SRC2	Ic Mag	
Analo	og Channel 7		_	SRC1	In Mag	
Analo	og Channel 8		_	SRC2	In Mag	
Analo	og Channel 9		_	SRC1	la Angle	
Analoo	Channel 10		=	SRC2	la Angle	
Analog	Channel 11		_	SRC1	lb Angle	
Analog	Channel 12		=	SRC2	lb Angle	
Analog	Channel 13		_	SRC1	lc Angle	
Analog	Channel 14		_	SRC2	lc Angle	
Analog	Channel 15		_	Off	io / ligic	
Analog	Channel 16		_	Off		
Data Logger:			-	OII		# Default
Demand:						# Default
User-Programmable Leds:						
I ED Test:						
	Function		_	Enabled		
	Control		_	CONTRO		1 ON
Trip and Alarms Lods:	Control		-	CONTINC		
Tr	in LED Input		_	86BE TR	$IP \cap n(1/01)$	
۸lar	m LED Input		_		$\Delta RM On (VO3)$	
			-			
			_	86RE TD		Latched
			_			Latched
			_			Latched
			_	Retrin I E	$D \cap (1/(0))$	Latched
			_	OFF		Latched
	LED 6		=	OFF		Self-Reset

Appendix 2	21 50-62-2-BKF	R1 (GE-0	C60) Setting Calculation	on
	LED 7	=	OFF	Self-Reset
	LED 8	=	OFF	Self-Reset
	LED 9	=	Phase A Trip On (VO10)	Latched
	LED 10	=	Phase B Trip On (VO11)	Latched
	LED 11	=	Phase C Trip On (VO12)	Latched
	LED 12	=	Ground Trip On (VO13)	Latched
	LED 13	=	OFF	Self-Reset
	LED 14	=	OFF	Self-Reset
	LED 15	=	OFF	Self-Reset
	LED 16	=	OFF	Self-Reset
	LED 17	=	OFF	Self-Reset
	LED 18	=	OFF	Self-Reset
	LED 19	=	OFF	Self-Reset
	LED 20	=	OFF	Self-Reset
	LED 21	=	OFF	Self-Reset
	LED 22	=	Bkr Fail Int On(M7a)	Self-Reset
	LED 23	=	BKR FAIL 1 T2 OP	Self-Reset
	LED 24	=	BKR FAIL 2 T2 OP	Self-Reset
	LED 25	=	OFF	Self-Reset
	LED 26	=	OFF	Self-Reset
	LED 27	=	OFF	Self-Reset
	LED 28	=	OFF	Self-Reset
	LED 29	=	OFF	Self-Reset
	LED 30	=	OFF	Self-Reset
	LED 31	=	OFF	Self-Reset
	LED 32	=	OFF	Self-Reset
	LED 33	=	OFF	Self-Reset
	LED 34	=	OFF	Self-Reset
	LED 35	=	OFF	Self-Reset
	LED 36	=	OFF	Self-Reset
	LED 37	=	OFF	Self-Reset
	LED 38	=	OFF	Self-Reset
	LED 39	=	OFF	Self-Reset
	LED 40	=	OFF	Self-Reset
	LED 41	=	OFF	Self-Reset
	LED 42	=	OFF	Self-Reset
	LED 43	=	OFF	Self-Reset
	LED 44	=	OFF	Self-Reset
	LED 45	=	OFF	Self-Reset
	LED 46	=	OFF	Self-Reset
	LED 47	=	OFF	Self-Reset
	LED 48	=	OFF	Self-Reset
User-Programmable Self Te	sts:			
Remote	Device Off Function	=	Enabled	
Pri E	thernet Fail Function	=	Enabled	
	Battery Fail Function	=	Enabled	
	SNTP Fail Function	=	Enabled	
	IRIG B Fail Function	=	Enabled	
Control Pushbuttons:		005.0		
PARAMETER CPB1	CPB 2	CPB 3		

A	ppendix	21	50-62-2-E	KR1	(GE-C	C60) Setting	g Calculatio	n
Function Events <u>Flex States:</u> <u>User-definable</u> <u>Direct I/O:</u> Teleprotection:	Enabled Disabled <u>displays:</u>		Disabled Disabled	Disab Disab	led led			# All OFF # Not used # Not used # Not used
Installation:								
			Relay Name		=	50/62-2 Brea	aker 2	
System Setup: AC Inputs								
Current:	-	F	PARAMETER			CT F1		
		Phase	e CT Primary		=	3000 A		
		Phase C	T Secondary		=	5 A		
		Groun	d CT Primary		=	3000 A		
	(Ground C	T Secondary		=	5 A		
Voltage:								# Not used
Power System:	<u>.</u>							
		Nomin	al Frequency		=	60 Hz		
		Ph	ase Rotation		=	ABC		
I	Frequency	And Pha	se Reference		=	SRC 1 (SRC	C 1)	
	Freque	ncy Tracl	king Function		=	Enabled		
Signal Sources:	-	F	PARAMETER			SOURCE 1	SOURCE 2	
			Name		=	SRC 1	SRC 2	
			Phase CT		=	F1	None	
			Ground CT		=	None	None	
			Phase VT		=	None	None	
			Aux VT		=	None	None	
Breakers:	.		SETTING			PARAMETE	R	
		Break	er 1 Function		=	Disabled		
	Breaker	1 Push B	utton Control		=	Disabled		
		Bre	aker 1 Name		=	Bkr 1		
		Bre	eaker 1 Mode		=	3-Pole		
		Bre	eaker 1 Open		=	OFF		
		Breaker ?	Block Open		=	OFF		
		Bre	aker 1 Close		=	OFF		
-	l Dua a lua u d. D	Breaker 1	BIOCK Close		=	OFF		
E	Sreaker 1 P	nase A/3	-Pole Closed		=	OFF		
В	reaker 1 Pr	lase A/3-	Pole Opened		=	OFF		
	Break	Ker 1 Pha	ase B Closed		=	OFF		
	Break	er i Pha	se B Opened		=	OFF		
	Break	ker i Pha			=	OFF		
	Break	er i Pha	se C Opened		=			
	Dro	Dieake			=	0.070 S		
	DIE	aker i E			=			
Dro	akor 1 Man				-	0.000 S		
Bre	akei i ividi Dra				=			
	Dre	anel I U	at OI SEIVICE		_	Disabled		
		DIGS			-	DISADIEU		
		Break	er 2 Function		=	Disabled		

Appendix 21 50-62-2-BKR1 (GE-C60) Setting Calculation

	•		
Breaker 2 Push Button Control	=	Disabled	
Breaker 2 Name	=	Bkr 2	
Breaker 2 Mode	=	3-Pole	
Breaker 2 Open	=	OFF	
Breaker 2 Block Open	=	OFF	
Breaker 2 Close	=	OFF	
Breaker 2 Block Close	=	OFF	
Breaker 2 Phase A/3-Pole Closed	=	OFF	
Breaker 2 Phase A/3-Pole Opened	=	OFF	
Breaker 2 Phase B Closed	=	OFF	
Breaker 2 Phase B Opened	=	OFF	
Breaker 2 Phase C Closed	=	OFF	
Breaker 2 Phase C Opened	=	OFF	
Breaker 2 Toperate	=	0.070 s	
Breaker 2 External Alarm	=	OFF	
Breaker 2 Alarm Delay	=	0.000 s	
Breaker 2 Manual Close Recal Time	=	0.000 s	
Breaker 2 Out Of Service	=	OFF	
Breaker 2 Events	=	Disabled	
Switches			# Not used
FlexCurves:			# Not used
FlexLogic:		# \$	See 50-62-2-BKR1-r0.pdf
Grouped Elements:			
Group 1:			
Phase Current:			
Phase TOC:			# Not used
Phase IOC:			
Function	=	Enabled	
Source	=	SRC 1 (SRC 1)	
Pickup	=	0.15 pu	
Delay	=	0.00 s	
Reset Delay	=	0.00 s	
Block A	=	OFF	
Block B	=	OFF	
Block C	=	OFF	
Target	=	Self-reset	
Events	=	Enabled	
Neutral Current:			
Neutral TOC:			# Not used
Neutral IOC:			
Function	=	Enabled	
Source	=	SRC 1 (SRC 1)	
Pickup	=	0.100 pu	
Delav	=	0.00 s	
Reset Delay	=	0.00 s	
Block	=	OFF	
Target	=	Self-reset	
Events	=	Enabled	
Ground Current:			
Ground TOC			# Not used

Appendix 21

50-62-2-BKR1 (GE-C60) Setting Calculation

100 Brea

Ground IOC				# Not used
Breaker Failure:	PARAMETER		BF1	BF2
	Function	=	Enabled	Enabled
	Mode	=	3-Pole	3-Pole
	Source	=	SRC 1 (SRC 1)	SRC 1 (SRC1)
	Current Supervision	=	Yes	Yes
	Use Seal-In	=	No	No
	Three Pole Initiate	=	Bkr Fail Int On(M7a);	
	Block	=	NEUTRAL IOC1 PKP	OFF
	Phase Current Supv Pickup	=	0.15 pu	# 50FD-P
Ν	leutral Current Supv Pickup	=	0.100 pu	# 50FD-G
	Use Timer 1	=	No	No
	Timer 1 Pickup Delay	=	0.000 s	0.000 s
	Use Timer 2	=	Yes	Yes
	Timer 2 Pickup Delay	=	0.130 s	0.160 s
	Use Timer 3	=	No	No
	Timer 3 Pickup Delay	=	0.000 s	0.000 s
	Breaker Pos1 Phase A/3P	=	OFF	OFF
	Breaker Pos2 Phase A/3P	=	OFF	OFF
	Breaker Test On	=	OFF	OFF
I	Phase Current HiSet Pickup	=	0.15 pu	0.15 pu
N	leutral Current HiSet Pickup	=	0.100 pu	0.100 pu
F	Phase Current LoSet Pickup	=	0.15 pu	0.15 pu
N	eutral Current LoSet Pickup	=	0.100 pu	0.100 pu
	LoSet Time Delay	=	0.000 s	0.000 s
	Trip Dropout Delay	=	0.000 s	0.000 s
	Target	=	Latched	Latched
	Events	=	Enabled	Enabled
	Phase A Initiate	=	OFF	OFF
	Phase B Initiate	=	OFF	OFF
	Phase C Initiate	=	OFF	OFF
	Breaker Pos1 Phase B	=	OFF	OFF
	Breaker Pos1 Phase C	=	OFF	OFF
	Breaker Pos2 Phase B	=	OFF	OFF
	Breaker Pos2 Phase C	=	OFF	OFF
Voltage Elements:				# Not used
Power:				# Not used
Control Elements:				
<u>Trip Bus:</u>				# Not used
Setting Groups:				# Not used
Selector Switches:				# Not used
Synchrocheck:				# Not used
Digital Elements:				# Not used
Digital Counters:				# Not used
Monitoring Elements:				# Not used
Autoreclose 1P				# Not used
Inputs/Outputs:				
Contact inputs:	<u>SETTING</u>		<u>PARAMETER</u>	
	[H5A] Contact Input 1 ID	=	<u>Spare</u>	
[H5A] Con	tact Input 1 Debounce Time	=	2.0 ms	

Appendix 2150-62-2-BKR1 (GE-C60) Setting Calculation

	-	
[H5A] Contact Input 1 Events	=	Disabled
[H5C] Contact Input 2 ID	_	Spare
[H5C] Contact Input 2 Debounce Time	_	20 ms
[H5C] Contact Input 2 Events	_	<u>Disabled</u>
[1130] Contact input 2 Events	=	Disableu
[H6A] Contact Input 3 ID	=	Bkr TC1 Mont
[H6A] Contact Input 3 Debounce Time	=	<u>2.0 ms</u>
[H6A] Contact Input 3 Events	=	Enabled
[H6C] Contact Input 4 ID	=	<u>86BF-2 Oper</u>
[H6C] Contact Input 4 Debounce Time	=	<u>2.0 ms</u>
[H6C] Contact Input 4 Events	=	Enabled
[H7A] Contact Input 5 ID	_	86BE-2 Mont
[H7A] Contact Input 5 Debourse Time	_	2.0 mc
[HZA] Contact Input 5 Debourice Time	=	<u>Z.U IIIS</u> Enchlad
[H/A] Contact Input 5 Events	=	Enabled
[H7C] Contact Input 6 ID	=	<u>43L/R</u>
[H7C] Contact Input 6 Debounce Time	=	<u>2.0 ms</u>
[H7C] Contact Input 6 Events	=	Enabled
[H8A] Contact Input 7 ID	=	<u>Spare</u>
[H8A] Contact Input 7 Debounce Time	=	<u>2.0 ms</u>
[H8A] Contact Input 7 Events	=	<u>Disabled</u>
[H8C] Contact Input 8 ID	=	Spare
[H8C] Contact Input 8 Debounce Time	_	2.0 ms
[H8C] Contact Input 8 Events	_	<u>Disabled</u>
TIOC CONTACT INPUT O EVENIS	=	Disableu
[M5A] Contact Input 9 ID	=	<u>Spare</u>
[M5A] Contact Input 9 Debounce Time	=	<u>2.0 ms</u>
[M5A] Contact Input 9 Events	=	Disabled
		•
[M5C] Contact Input 10 ID	=	<u>Spare</u>
M5C Contact Input 10 Debounce Time	=	<u>2.0 ms</u>
[M5C] Contact Input 10 Events	=	Disabled
[M6A] Contact Input 11 ID	=	Cont lp 11
[M6A] Contact Input 11 Debounce Time	=	2.0 ms
[M6A] Contact Input 11 Events	_	Disabled
		Dicubica
[M6C] Contact Input 12 ID	=	<u>spare</u>
[M6C] Contact Input 12 Debounce Time	=	<u>2.0 ms</u>
[M6C] Contact Input 12 Events	=	Disabled
[M7A] Contact Input 13 ID	=	Bkr Fail Int
[M7A] Contact Input 13 Debounce Time	=	2.0 ms
[M7A] Contact Input 13 Events	=	Enabled

Appendix 21	50-62-2-BKR1	(GE-C	60) Setting (Calculation	on
[M7C] Contac	ct Input 14 ID	=	Cont lp 14		
[M7C] Contact Input 14 De	bounce Time	=	<u>2.0 ms</u>		
[M7C] Contact Inp	out 14 Events	=	Disabled		
[M8A] Contac	ct Input 15 ID	=	Cont lp 15		
[M8A] Contact Input 15 De	<u>bounce Time</u>	=	<u>2.0 ms</u>		
[M8A] Contact Inp	out 15 Events	=	<u>Disabled</u>		
[M8C] Conta	et Input 16 ID	_	Cont In 16		
[M8C] Contact Input 16 De	bounce Time	_	2.0 ms		
[M8C] Contact Inc	out 16 Events	=	Disabled		
Contact Inputs Thresholds:			Diodolog		
Cont lp 1. Cont lp 2. Co	ont lp 3. Cont lp 4(H	15A. H5C	C. H6A. H6C)	=	84 Vdc
Cont lp5. Cont lp 6. Co	ont lp 7. Cont lp 8(F	17A. H7C	C. H8A. H8C)	=	84 Vdc
Cont lp 9, Cont lp 10, Cont l	p 11, Cont lp 12(M	5A, M5C	, M6A, M6C)	=	84 Vdc
Cont lp 13, Cont lp 14, Cont l	p 15, Cont lp 16(M	7A, M7C	, M8A, M8C)	=	84 Vdc
Virtual Inputs:	SETTING		PARAMETER		
Virtual Inp	ut 1 Function	=	Enabled		
Virtu	ual Input 1 ID	=	Bkr Trip		
Virtual	Input 1 Type	=	Self-Reset		
Virtual Ir	put 1 Events	=	Enabled		
Virtual Inp	ut 2 Function	=	Enabled		
Virtu	ual Input 2 ID	=	Bkr Close		
Virtual	Input 2 Type	=	Self-Reset		
Virtual Ir	nput 2 Events	=	Enabled		
Other Virtual Inputs (from	V103 to V164)				# Not used
Contact Outputs:			Any Trin		
	ut 1 Operate	=			
	tout 1 Sool-In	=		(000)	
[H1] Contact Out	tout 1 Events	_	Enabled		
		-	Enabled		
[H2] Contac	t Output 2 ID	=	spare		
[H2] Contact Outp	out 2 Operate	=	OFF		
[H2] Contact Out	tput 2 Seal-In	=	OFF		
[H2] Contact Ou	tput 2 Events	=	Disabled		
[H2] Contoo		_	Not Llood		
	a Oulpul 3 ID	=			
[H3] Contact Out		_	OFF		
[H3] Contact Out	tout 3 Events	_	Disabled		
		-	Disabled		
[H4] Contac	t Output 4 ID	=	NOT USED		
[H4] Contact Outp	out 4 Operate	=	OFF		
[H4] Contact Out	tput 4 Seal-In	=	OFF		
[H4] Contact Ou	tput 4 Events	=	Disabled		
[N 441 October		_			
[N1] Contact [M1] Contact Outr	Nut 5 Operate	=		(1/O1)	
	ou o operate	-			

A	Appendix 21	50-62-2-BKR1	(GE-C	60) Setting Calculation
	[M1] Contact C	output 5 Seal-In	=	86BF TRIP On (VO1)
	[M1] Contact C	Output 5 Events	=	Enabled
	[M2] Cont	act Output 6 ID	=	RETRIP BKR
	[M2] Contact Ou	utput 6 Operate	=	RETRIP BKR On (VO2)
	[M2] Contact C	output 6 Seal-In	=	RETRIP BKR On (VO2)
	[M2] Contact C	Output 6 Events	=	Enabled
	[M3] Cont	act Output 7 ID	=	Bkr Trip
	[M3] Contact Ou	utput 7 Operate	=	Bkr Trip On (VO7)
	[M3] Contact C	output 7 Seal-In	=	OFF
	[M3] Contact C	Output 7 Events	=	Enabled
	[M4] Cont	act Output 8 ID	=	Bkr Close
	[M4] Contact Ou	utput 8 Operate	=	Bkr Close On (VO8)
	[M4] Contact C	output 8 Seal-In	=	OFF
	[M4] Contact C	Output 8 Events	=	Enabled
Virtual Outputs.	<u> </u>		_	
	Virtual C	uar Oulpul 1 ID Jutput 1 Events	_	Enabled
	Viituare		-	Enabled
	Virt	ual Output 2 ID	=	RETRIP BKR
	Virtual C	Output 2 Events	=	Enabled
	Virt	ual Output 3 ID	=	UNIT ALARM
	Virtual C	Output 3 Events	=	Enabled
	Virt	ual Output 4 ID	=	Tria Oscill
	Virtual C	Output 4 Events	=	Enabled
	Virt	ual Output 5 ID	=	ALARM NC
	Virtual C	Output 5 Events	=	Enabled
	Virt	ual Output 6 ID	=	TRIP LED
	Virtual C	Output 6 Events	=	Enabled
	Virt	ual Output 7 ID	=	Bkr Trip
	Virtual C	Output 7 Events	=	Enabled
	Virt	ual Output 8 ID	=	Bkr Close
	Virtual C	Output 8 Events	=	Enabled
	Virt	ual Output 9 ID	=	Retrip LED
	Virtual C	Output 9 Events	=	Enabled
	Virtu	al Output 10 ID	_	Phase A Trip
	Virtual Ou	utput 10 Events	=	Enabled
	11.4			
	Virtu Virtual O	al Output 11 ID	=	Filase B Trip Enabled
	viituai Ot		-	

Appendix 2150-62-2-BKR1 (GE-C60) Setting Calculation

Virtual Output 12 ID Virtual Output 12 Events	= =	Phase C Trip Enabled
·		
Virtual Output 13 ID	=	Ground Trip
Virtual Output 13 Events	=	Enabled
Other Virtual Outputs (from VO14 to VO96)		
Remote Devices:		
Remote Inputs:		
Remote Outputs DNA Bit Pairs		
Remote Outputs UserSt Bit Pairs:		
Resetting:		
Direct Inputs:		
Direct Outputs:		
Teleprotection:		
IEC 61850 GOOSE Analogs Inputs		

Not used # Not used

	Appendix 22	50-62-1-BI	KR3 (Are	eva P141) Setti	ng Calcul	lation
1. Data						
MVA_Base =	= 100	kV_Base =	345	Z_Base =	1190.25	ohms
CTR =	600	PTR =	3000	CTR/PTR=	0.2	
Total MVA o	f all three GSUs =	750	; Maximu	um full load curren	t (amps) =	1255.11

2.1. Set phase IOC element, i.e. phase fault detector, above load if possible but not more than 2/3 of the minimum phase to phase fault at remote bus with the largest source out. For the minimum phase to phase fault at Farragut station under minimum condition which is considered as the largest unit (STG1) of the three units out of service, the contributions from Charlie Poletti are 1,454 Amp via Q35M line and 1,349 Amp via Q35L line. Since each breaker failure relay will normally see only half of the fault contribution per feeder. The IOC1 element shall be set at 0.15 pu or 0.75 CT secondary amp or 450 CT primary amp, or 1/3 of 1,349 Amp or 35.8% of maximum full load. Fault detector picking up on load is considered acceptable here per IEEE standard.

2.2. Set residual IOC element, i.e. ground fault detector, above maximum expected unbalance, but not more than 2/3 of the minimum ground fault at remote bus with the largest source out. For the minimum line to ground fault at Farragut station under minimum condition with is considered as the largest unit (STG1) of the three units out of serivce, the fault contributions from Chaerlie Poletti are 2,021 Amp via Q35L and 2,129 Amp via Q35M. Since each breaker failure relay will normally see only half of the fault contribution on each feeder, set residual IOC element at 0.1 pu or 0.5 CT secondary amp, 300 CT primary amp, or 24% of maximum full load, which is less than 1/3 of minimum phase to ground fault at Farragut.

2.3 Breaker failure timer of 130 ms is used for 3 phase fault and 160 ms is used for unbalanced fault per ConEd standard. Existing Poletti settings show that 120 ms breaker failure time is used regardless fault type.

SYSTEM DATA:

	Language = English
	Sys Fn Links = 0
	Decription = 50-62-1-BKR3
	Plant Reference = CHARLES POLETTI
	Frequency = 60 Hz
CB CONTROL:	
	CB Control by = Disabled
	Reset Lockout by = CB Close
	Man Close RstDly = 5.000 s
	CB2 Status Input = 52A
DATE AND TIME:	
	IRIG-B Sync = Enabled
	Battery Alarm = Enabled
	Other Time Settings = Default
CONFIGURATION:	
	Setting Group = Select via Menu
	Active Settings = Group 1
	Setting Group 1 = Enabled
	Setting Group 2 = Disabled
	Setting Group 3 = Disabled
	Setting Group 4 = Disabled
	System Config = Invisible

Appendix 2	22 50-62-1-BK	R3 (Areva P141) Setting Calculat	ion
	Overcurrent =	Enabled	# 50FD-P
	Neg Sequence O/C =	Enabled	# Unbalance
	Broken Conductor =	Disabled	# Not used
	Earth Fault 1 =	Disabled	# Not used
	Earth Fault 2 =	Enabled	# 50FD-G
	Sensitive E/F Prot'n =	Disabled	# Not used
	Residual O/V NVD =	Disabled	# Not used
	Thermal Overload =	Disabled	# Not used
	Neg Sequence O/V =	Disabled	# Not used
	Cold Load Pickup =	Disabled	# Not used
	Selective Logic =	Disabled	# Not used
	Admit Protection =	Disabled	# Not used
	Volt Protection =	Disabled	# Not used
	Freq Protection =	Disabled	# Not used
	df/dt Protection =	Disabled	# Not used
	CB Fail =	Enabled	
	Supervision =	Enabled	
	Fault Locator =	Disabled	
	Input Labels =	Visible	
	Output Labels =	Visible	
	CT & VT Ratios =	Visible	
	Record Control =	Invisible	
	Disturb Recorder =	Visible	
	Measure't Setup =	Visible	
	Comms Settings =	Visible	
	Commission Tests =	Visible	
	Setting Values =	Secondary	
	Control Inputs =	Invisible	
	Ctrl I/P Config =	Invisible	
	Ctrl I/P Labels =	Invisible	
	Direct Access =	Disabled	
	LCD Contrast =	11	
<u>CT AND VI RATIOS</u>		140.034	
	Iviain VI Primary =	110.0 V	# Not used
	IVIAIN VI Sec y =	110.0 V	# Not used
	Phase CT Phimary =	5000 A	
	E/E CT Drimony	3.000 A	
	E/F CT Secondary =	5000 A	
	E/F CT Secondary =	1.000 A	
	SEF CT Secondary =	1.000 A	
	SEF CT Secondary =	for detail	
MEASURE'T SETUP	See setting inc		
WEAGONE I GETUF.	Default Dieplay –	Description	
		Primary	
	Remote Values –	Primary	
	Measurement Ref –	VA	
	Measurement Mode -	0	
	Fix Dem Period =	- 30.00 min	
	Roll Sub Period =	30.00 min	

Appendix 22	2 50-62-1-BK	R3 (Areva I	P141) Setting Calcu	llation
COMMISSION TESTS:	Num Sub Periods =	1		
<u>COMMISSION 12313.</u>	Monitor Bit 1 –	64		
	Monitor Bit 2 –	65		
	Monitor Bit 3 –	66		
	Monitor Bit 4 –	67		
	Monitor Bit 5 =	68		
	Monitor Bit 6 =	69		
	Monitor Bit 7 –	70		
	Monitor Bit 8 =	70		
CB MONITOR SETUP:				
	Broken I ^A =	2.000		
	I^ Maintenance =	Alarm Disable	ed	
	I^ Lockout =	Alarm Disable	ed	
	No. CB Ops Maint =	Alarm Disable	ed	
	No. CB Ops Lock =	Alarm Disable	ed	
	CB Time Maint =	Alarm Disable	ed	
	CB Time Lockout =	Alarm Disable	ed	
	Fault Freq Lock =	Alarm Disable	ed	
OPTO CONFIG:				
	Global Nominal V =	110/125V		
	Opto Filter Cntl =	11111111		
	Characteristic =	Standard 60%	%-80%	
Group 1:				
GROUP 1 OVERCURREN	<u>Г:</u>			
	I>1 Function =	DT		
	I>1 Direction =	Non-Direction	nal	
	I>1 Current Set =	0.75		# 50FD-P
	I>1 Time Delay =	0		
	I>1 tRESET =	0	S	
	l>2 Status =	Disabled		
	l>3 Status =	Disabled		
	l>4 Status =	Disabled		
	I> Blocking =	00000000		
	I> Char Angle =	45	deg	# Default
	VC0 Status =	Disabled		
<u>GROUP 1 NEG SEQ O/C</u>				
	I2>1 Status =	Enabled		
	I2>1 Function =	DT		
	I2>1 Directional =	Non-Direction	nal	
	I2>1 Current Set =	500.0mA		
	12>1 Time Delay =	0 s		
	12>1 reset =	0 s		
	12>2 Status =	Disabled		
	I2>3 Status =			
	IZ>4 Status =			
	IZ> BIOCKING =			
		-00.00 deg		
	12> v2poi Set =	5.000 V		

GROUP 1 EARTH FAULT 2

Appendix 22	50-62-1-	BKR3 (Areva P	141) Setting Calculat	ion
	IN2> Inpu IN2>1 Functio	ut = Derived on = DT		
	IN2>1 Direction	on = Non-Directiona	al	
	IN2>1 Curre	nt = 500.0mA		# 50FD-G
I		ay = 0s		
	IN2>2 Function	n = Disabled		
	IN2>3 State	us = Disabled		
	IN2>4 State	us = Disabled		
	IN2> Blockir	ng = 00000000		
	IN2	> = POL		
	IN2> Char Ang	ne = -45.00 deg	Δ	
	IN2> VNpol S	et = 5.000 V	6	
<u>GROUP 1 CB FAIL & I<:</u>	1			
	CB Fail 1 State	us = Enabled		
	GB Fail 1 Tim	er = 0 s		
	CB Fail 2 State	us = Enabled		
	Volt Prot Res	$e_1 = 130.0 \text{ ms}$		
	Ext Prot Res	et = I < only		
	I< Current S	et = 500.0 mA		
	IN< Current S	et = 500.0 mA		
	ISEF< Curre	nt = 20.00 mA		
ſ	Remove INS Sta	art = Disabled		
GROUP 1 SUPERVISION:		art - Disabled		
	VTS State	us = Indication		
	VTS Reset Mod	de = Manual		
	VIS Time Dela	ay = 5.000 s		
	VIS I> Innii VTS I25 Inhii	DII = 50.0 A		
	CTS Mod	de = Disabled		
GROUP 1 INPUT LABELS:				
	Opto Input	1 Input L1		
	Opto Input	12 Input L2		
	Opto Input Opto Input	4 868F-1/1 TRIP		
	Opto Input Opto Input	5 30-86BF-1/1 AI	LM	
	Opto Input	6 BF Initiation		
	Opto Input	t 7 Input L7		
	Opto Input	t 8 Input L8		
GROUP I OUTPUT LABELS	Relay 1 T	Trin 86BF		
	Relav 2	ReTrip BkrTC2		
	Relay 3 A	Any Trip		
	Relay 4 (Dutput R4		
	Relay 5 C	Dutput R5		
	Relay 6 (Jutput R6 Jutput P7		
	itelay / C			

	Appendix 23	50-62-2-	BKR3 (GE	E-C60) Setting	g Calculat	ion
1. Data						
MVA_Base =	100	kV_Base =	345	Z_Base =	1190.25	ohms
CTR =	600	PTR =	3000	CTR/PTR=	0.2	
Total MVA of	all three GSUs =	750	; Maximun	n full load curren	t (amps) =	1255.11

2.1. Set phase IOC element, i.e. phase fault detector, above load if possible but not more than 2/3 of the minimum phase to phase fault at remote bus with the largest source out. For the minimum phase to phase fault at Farragut station under minimum condition which is considered as the largest unit (STG1) of the three units out of service, the contributions from Charlie Poletti are 1,454 Amp via Q35M line and 1,349 Amp via Q35L line. Since each breaker failure relay will normally see only half of the fault contribution per feeder. The IOC1 element shall be set at 0.15 pu or 0.75 CT secondary amp or 450 CT primary amp, or 1/3 of 1,349 Amp or 35.8% of maximum full load. Fault detector picking up on load is considered acceptable here per IEEE standard.

2.2. Set residual IOC element, i.e. ground fault detector, above maximum expected unbalance, but not more than 2/3 of the minimum ground fault at remote bus with the largest source out. For the minimum line to ground fault at Farragut station under minimum condition with is considered as the largest unit (STG1) of the three units out of serivce, the fault contributions from Chaerlie Poletti are 2,021 Amp via Q35L and 2,129 Amp via Q35M. Since each breaker failure relay will normally see only half of the fault contribution on each feeder, set residual IOC element at 0.1 pu or 0.5 CT secondary amp, 300 CT primary amp, or 24% of maximum full load, which is less than 1/3 of minimum phase to ground fault at Farragut.

2.3 Breaker failure timer of 130 ms is used for 3 phase fault and 160 ms is used for unbalanced fault per ConEd standard. Existing Poletti settings show that 120 ms breaker failure time is used regardless fault type.

Device Definition:				# Default
Product Setup:				
Security:				# Default
Display Properties:				# Default
Clear Relay Records:				# All OFF
Communications:				# Default
Modbus User Map:				# Not used
Real Time Clock:				
	IRIG-B Signal Type	=	DC Shift	
	All other settings	=	Default	
Fault Report:	SETTING		PARAMETER	
-	Fault Report 1 Source	=	SRC 1 (SRC 1)	
	Fault Report 1 Trigger	=	Trig Oscill On (VO4)	
Fault Repor	t 1 Positive Seq (Z1) Mag	=	0.49 ohms	
Fault Report	1 Positive Seq (Z1) Angle	=	78 deg	
Fault Re	port 1 Zero Seq (Z0) Mag	=	1.50 ohms	
Fault Rep	ort 1 Zero Seq (Z0) Angle	=	54 deg	
Fault R	eport 1 Line Length Units	=	mile	
F	ault Report 1 Line Length	=	7.74	
Fault	Report 1 VT Substitution	=	None	
Fault	Report 1 System Z0 Mag	=	0.49 ohms	
Fault F	Report 1 System Z0 Angle	=	78 deg	
Oscillography:	. , 3		5	

Appendix 23	50-62-2-BKR3	(GE-C	60) Setting Calculation
	SETTING		PARAMETER
Number	Of Records	=	6
Т	rigger Mode	=	Automatic Overwrite
Trig	ger Position	=	30%
Tri	gger Source	=	Trig Oscill On (VO4)
AC Input	Waveforms	=	32 samples/cycle
Digita	al Channel 1	=	OFF
Digita	al Channel 2	=	OFF
Digita	al Channel 3	=	OFF
Digita	al Channel 4	=	OFF
Digita	al Channel 5	=	OFF
Digita	al Channel 6	=	86BF TRIP On (VO1)
Digita	al Channel 7	=	RETRIP BKR On (VO2)
Digita	al Channel 8	=	UNIT ALARM On (VO3)
Digita	al Channel 9	=	OFF
Digital	Channel 10	=	NEUTRAL IOC1 PKP
Digital	Channel 11	=	NEUTRAL IOC1 OP
Digital	Channel 12	=	PHASE IOC1 PKP A
Digital	Channel 13	=	PHASE IOC1 OP A
Digital	Channel 14	=	PHASE IOC1 PKP B
Digital	Channel 15	=	PHASE IOC1 OP B
Digital	Channel 16	=	PHASE IOC1 PKP C
Digital	Channel 17	=	PHASE IOC1 OP C
Digital	Channel 18	=	Bkr Fail Int On(H7c)
Digital	Channel 19	=	BKR FAIL 1 TRIP OP
Digital	Channel 20	=	BKR FAIL 2 TRIP OP
Digital	Channel 21	=	BKR FAIL 1 T2 OP
Digital	Channel 22	=	BKR FAIL 2 T2 OP
Digital	Channel 23	=	86BF TRIP On (VO1)
Digital	Channel 24	=	RETRIP BKR On (VO2)
Digital	Channel 25	=	BKR FAIL 1 RETRIPA
Digital	Channel 26	=	BKR FAIL 1 RETRIPB
Digital	Channel 27	=	BKR FAIL 1 RETRIPC
Digital	Channel 28	=	OFF
Digital	Channel 29	=	OFF
Digital	Channel 30	=	OFF
Digital	Channel 31	=	OFF
Digital	Channel 32	=	OFF
Digital	Channel 33	=	OFF
Digital	Channel 34	=	OFF
Digital	Channel 35	=	OFF
Digital	Channel 36	=	OFF
Digital	Channel 37	=	OFF
Digital	Channel 38	=	OFF
Digital	Channel 39	=	OFF
	Channel 40 Channel 41	=	
	Channel 41	=	
Digital	Channel 42	_	OFF
Digital	Channel 11	_	OFF
Digital		-	

Appendix 23	3	50-62-2	-BKR3	(GE-C	60) Set	ting Calculatio	n
	Digital	Channel	45	=	OFF		
	Digital	Channel	46	=	OFF		
	Digital	Channel	47	=	OFF		
	Digital	Channel	48	=	OFF		
	Digital	Channel	49	=	OFF		
	Digital	Channel	50	=	OFF		
	Digital	Channel	51	=	OFF		
	Digital	Channel	52	=	OFF		
	Digital	Channel	53	=	OFF		
	Digital	Channel	54	=	OFF		
	Digital	Channel	55	=	OFF		
	Digital	Channel	56	=	OFF		
	Digital	Channel	57	=	OFF		
	Digital	Channel	58	=	OFF		
	Digital	Channel	59	_	OFF		
	Digital	Channel	60	_	OFF		
	Digital	Channel	61	_	OFF		
	Digital	Channel	62	_			
	Digital	Channel	63	_	OFF		
	Analo		11	_		la Mag	
	Analog	y Channe a Channa	10	_	SRUI	la Mag	
	Analog	y Channe	31 Z	_	SRC2	la Mag	
	Analog	y Channe 7 Channa	13	=	SRUI	ID Mag	
	Analo	y Channe	914 	=	SRU2	ID Mag	
	Analo	y Channe		=	SRUT		
	Analo	g Channe		=	SRC2	IC Mag	
	Analog	g Channe		=	SRC1	In Mag	
	Analog	g Channe	8 8	=	SRC2	in iviag	
	Analog	g Channe	19	=	SRUI	la Angle	
	Analog	Channel	10	=	SRC2	la Angle	
·	Analog	Channel	11	=	SRC1	Ib Angle	
	Analog	Channel	12	=	SRC2	Ib Angle	
	Analog	Channel	13	=	SRC1	Ic Angle	
	Analog	Channel	14	=	SRC2	Ic Angle	
	Analog	Channel	15	=	Off		
	Analog	Channel	16	=	Off		
Data Logger:							# Default
Demand:							# Default
User-Programmable Leds:							
LED Test:							
		Functi	on	=	Enabled		
		Cont	rol	=	CONTR	OL PUSHBUTTON	1 ON
Trip and Alarms Leds:							
	Tri	p LED Inp	out	=	86BF TF	RIP On (VO1)	
	Alarr	n LED Inp	out	=	UNIT AL	ARM On (VO3)	
		LED	D 1	=	86BF TF	RIP On (VO1)	Latched
		LED	2	=	BKR FA	IL 1 TRIP OP	Latched
		LED	03	=	BKR FA	IL 2 TRIP OP	Latched
		LED	04	=	Retrip LI	ED On (VO9)	Latched
		LED	D 5	=	OFF	- ·	Latched

Appendix 23	50-62-2-BKR	3 (GE-	C60) Setting Calculation	on
	LED 6	=	OFF	Self-Reset
	LED 7	=	OFF	Self-Reset
	LED 8	=	OFF	Self-Reset
	LED 9	=	Phase A Trip On (VO10)	Latched
	LED 10	=	Phase B Trip On (VO11)	Latched
	LED 11	=	Phase C Trip On (VO12)	Latched
	LED 12	=	Ground Trip On (VO13)	Latched
	LED 13	=	OFF	Self-Reset
	LED 14	=	OFF	Self-Reset
	LED 15	=	OFF	Self-Reset
	LED 16	=	OFF	Self-Reset
	LED 17	=	OFF	Self-Reset
	LED 18	=	OFF	Self-Reset
	LED 19	=	OFF	Self-Reset
	LED 20	=	OFF	Self-Reset
	LED 21	=	OFF	Self-Reset
	LED 22	=	Bkr Fail Int On(H7c)	Self-Reset
	LED 23	=	BKR FAIL 1 T2 OP	Self-Reset
	LED 24	=	BKR FAIL 2 T2 OP	Self-Reset
	LED 25	=	OFF	Self-Reset
	LED 26	=	OFF	Self-Reset
	LED 27	=	OFF	Self-Reset
	LED 28	=	OFF	Self-Reset
	LED 29	=	OFF	Self-Reset
	LED 30	=	OFF	Self-Reset
	LED 31	=	OFF	Self-Reset
	LED 32	=	OFF	Self-Reset
	LED 33	=	OFF	Self-Reset
	LED 34	=	OFF	Self-Reset
	LED 35	=	OFF	Self-Reset
	LED 36	=	OFF	Self-Reset
	LED 37	=	OFF	Self-Reset
	LED 38	=	OFF	Self-Reset
	LED 39	=	OFF	Self-Reset
	LED 40	=	OFF	Self-Reset
	LED 41	=	OFF	Self-Reset
	LED 42	=	OFF	Self-Reset
	LED 43	=	OFF	Self-Reset
	LED 44	=	OFF	Self-Reset
	LED 45	=	OFF	Self-Reset
	LED 46	=	OFF	Self-Reset
	LED 47	=	OFF	Self-Reset
	LED 48	=	OFF	Self-Reset
User-Programmable Self Tests:				
Remote Device	Off Function	=	Enabled	
Pri Ethernet F	Fail Function	=	Enabled	
Battery F	Fail Function	=	Enabled	
SNTP F	Fail Function	=	Enabled	
IRIG B F	Fail Function	=	Enabled	

Control Pushbuttons:

A	ppendix 23	50-62-2-B	KR3 (GE-C	60) Setting	g Calculatio	n
PARAMETER Function Events Flex States:	CPB 1 Enabled Disabled	CPB 2 Disabled Disabled	CPB 3 Disabled Disabled			# All OFF
User-definable Direct I/O: Teleprotection: Installation:	<u>displays:</u>					# Not used # Not used # Not used
System Setup:		Relay Name	=	50/62-2 Brea	aker 3	I
AC Inputs						
Current:		PARAMETER		CT F1		
	Pha	ase CT Primary	=	3000 A		
	Phase	CT Secondary	=	5 A		
	Grou	und CT Primary	=	3000 A		
	Ground	CT Secondary	=	5 A		
Voltage: Power System:		,				# Not used
<u> </u>	Nom	ninal Frequency	=	60 Hz		
		Phase Rotation	=	ABC		
	Frequency And Pl	hase Reference	=	SRC 1 (SRC	; 1)	
	Frequency Tra	acking Function	=	Enabled	,	
Signal Sources:		PARAMETER		SOURCE 1	SOURCE 2	
		Name	=	SRC 1	SRC 2	
		Phase CT	=	F1	None	
		Ground CT	=	None	None	
		Phase VT	=	None	None	
		Aux VT	=	None	None	
Breakers:		SETTING		PARAMETE	R	
	Bre	aker 1 Function	=	Disabled		
	Breaker 1 Push	Button Control	=	Disabled		
	E	Breaker 1 Name	=	Bkr 1		
	E	Breaker 1 Mode	=	3-Pole		
	E	Breaker 1 Open	=	OFF		
	Breake	er 1 Block Open	=	OFF		
	E	Breaker 1 Close	=	OFF		
	Breake	r 1 Block Close	=	OFF		
E	Breaker 1 Phase A	V3-Pole Closed	=	OFF		
B	reaker 1 Phase A	3-Pole Opened	=	OFF		
	Breaker 1 F	Phase B Closed	=	OFF		
	Breaker 1 P	hase B Opened	=	OFF		
	Breaker 1 F	Phase C Closed	=	OFF		
	Breaker 1 Pl	nase C Opened	=	OFF		
	Brea	aker 1 Toperate	=	0.070 s		
	Breaker 1	External Alarm	=	OFF		
_	Breake	r 1 Alarm Delay	=	0.000 s		
Bre	aker 1 Manual Cl	ose Recal Time	=	0.000 s		
	Breaker 1	Out Of Service	=	OFF		
	Bi	reaker 1 Events	=	Disabled		

Appendix 2350-62-2-BKR3 (GE-C60) Setting Calculation

Breaker 2 Function	=	Disabled	
Breaker 2 Push Button Control	=	Disabled	
Breaker 2 Name	=	Bkr 2	
Breaker 2 Mode	=	3-Pole	
Breaker 2 Open	=	OFF	
Breaker 2 Block Open	=	OFF	
Breaker 2 Close	_	OFF	
Breaker 2 Block Close	_	OFF	
Breaker 2 Phase A/3-Pole Closed	_	OFF	
Brooker 2 Phase A/3-Fole Closed	_	OFF	
Breaker 2 Phase A/3-Fulle Openieu	=		
Breaker 2 Phase B Closed	=	OFF	
Breaker 2 Phase B Opened	=	OFF	
Breaker 2 Phase C Closed	=	OFF	
Breaker 2 Phase C Opened	=	OFF	
Breaker 2 Toperate	=	0.070 s	
Breaker 2 External Alarm	=	OFF	
Breaker 2 Alarm Delay	=	0.000 s	
Breaker 2 Manual Close Recal Time	=	0.000 s	
Breaker 2 Out Of Service	=	OFF	
Breaker 2 Events	=	Disabled	
Switches			# Not used
FlexCurves:			# Not used
Flext opic:		#	* See 50-62-2-BKR1-r0 pdf
Grouped Elements:			
Group 1:			
Phase Current:			
Phase TOC:			# Not used
Phase IOC:			# Not used
<u>Flidse IOC.</u>		Frablad	
Function	=		
Source	=		
Ріскир	=	0.15 pu	
Delay	=	0.00 s	
Reset Delay	=	0.00 s	
Block A	=	OFF	
Block B	=	OFF	
Block C	=	OFF	
Target	=	Self-reset	
Events	=	Enabled	
Neutral Current:			
Neutral TOC:			# Not used
Neutral IOC:			
Function	=	Enabled	
Source	=	SRC 1 (SRC 1)	
Pickup	_		
Delay	_	0.100 pu	
Delay React Delay	_	0.00 5	
	=		
	=	UFF Solf recet	
	=	Sell-reset	
Events	=	Enabled	
Ground Current:			

Appendix 23

50-62-2-BKR3 (GE-C60) Setting Calculation

Ground TOC
Ground IOC
Breaker Failure:

Ground TOC				# Not used
Ground IOC				# Not used
Breaker Failure:	PARAMETER		BF1	BF2
	Function	=	Enabled	Enabled
	Mode	=	3-Pole	3-Pole
	Source	=	SRC 1 (SRC 1)	SRC 1 (SRC1)
	Current Supervision	=	Yes	Yes
	Use Seal-In	=	No	No
	Three Pole Initiate	=	Bkr Fail Int On(H7c);	Cont lp 2 On(H5c)
	Block	=	NEUTRAL IOC1 PKP	ÓFF
PI	nase Current Supv Pickup	=	0.15 pu	# 50FD-P
Ne	utral Current Supv Pickup	=	0.100 pu	# 50FD-G
	Use Timer 1	=	No	No
	Timer 1 Pickup Delav	=	0.000 s	0.000 s
	Use Timer 2	=	Yes	Yes
	Timer 2 Pickup Delay	=	0.130 s	0.160 s
	Use Timer 3	=	No	No
	Timer 3 Pickup Delay	=	0.000 s	0.000 s
	Breaker Pos1 Phase A/3P	=	OFF	OFF
	Breaker Pos2 Phase A/3P	=	OFF	OFF
	Breaker Test On	_	OFF	OFF
Ph	ase Current HiSet Pickup	_	0 15 pu	0.15 pu
Ne	utral Current HiSet Pickup	_	0.10 pu	0.10 pu
Ph	ase Current LoSet Pickup	_	0.15 pu	0.100 pu 0.15 pu
Νοι	itral Current LoSet Pickup	_	0.10 pu	0.10 pu
THE C		_	0.100 pu	0.100 pu
	Trip Dropout Delay	_	0.000 s	0.000 s
	Target	_	Latched	Latched
	Events	_	Enabled	Enabled
	Phase A Initiate	_	OFF	
	Phase R Initiate	_	OFF	
	Phase C Initiate	_	OFF	
	Procker Dest Desse P	_	OFF	OFF
	Breaker Dool Phase D	=		
	Breaker Post Phase C	=		
	Breaker Dos2 Phase B	=		
Valtara Elamanta	Breaker Posz Phase C	=	OFF	UFF # Not wood
Voltage Elements:				# Not used
Power:				# Not used
Control Elements:				// Nist
<u>Trip Bus:</u>				# Not used
Setting Groups:				# Not used
Selector Switches:				# Not used
Synchrocheck:				# Not used
Digital Elements:				# Not used
Digital Counters:				# Not used
Monitoring Elements:				# Not used
Autoreclose 1P				# Not used
Inputs/Outputs:			B 4 B 4 M ====	
Contact inputs:	<u>SETTING</u>		PARAMETER	
	[H5A] Contact Input 1 ID	=	<u>Spare</u>	

Appendix 23 50-62-2-BKR3 (GE-C60) Setting Calculation

[H5A] Contact Input 1 Debounce Time	=	<u>2.0 ms</u>
[H5A] Contact Input 1 Events	=	Disabled
[H5C] Contact Input 2 ID	=	Spare
[H5C] Contact Input 2 Debounce Time	=	2.0 ms
[H5C] Contact Input 2 Events	=	Disabled
<u></u>		
[H6A] Contact Input 3 ID	=	Bkr TC1 Mont
[H6A] Contact Input 3 Debounce Time	_	2.0 ms
[H6A] Contact Input 3 Events	_	Enabled
[H6C] Contact Input 4 ID	_	86BE-2 Oper
[H6C] Contact Input 4 Debounce Time	_	20 ms
[H6C] Contact Input 4 Events	_	Enabled
[1100] Contact Input 4 Events	—	
[H7A] Contact Input 5 ID	_	86BE-2 Mont
	_	2.0 mg
[H7A] Contact Input 5 Debounce Time	=	<u>Z.U IIIS</u> Epobled
[H7A] Contact input 5 Events	=	Enabled
	=	<u>43L/R</u>
[H/C] Contact Input 6 Debounce Time	=	<u>2.0 ms</u>
[H/C] Contact Input 6 Events	=	Enabled
		•
[H8A] Contact Input 7 ID	=	<u>Spare</u>
[H8A] Contact Input / Debounce Time	=	<u>2.0 ms</u>
[H8A] Contact Input 7 Events	=	Disabled
[H8C] Contact Input 8 ID	=	<u>Spare</u>
[H8C] Contact Input 8 Debounce Time	=	<u>2.0 ms</u>
[H8C] Contact Input 8 Events	=	Disabled
[M5A] Contact Input 9 ID	=	<u>Spare</u>
[M5A] Contact Input 9 Debounce Time	=	<u>2.0 ms</u>
[M5A] Contact Input 9 Events	=	<u>Disabled</u>
[M5C] Contact Input 10 ID	=	<u>Spare</u>
[M5C] Contact Input 10 Debounce Time	=	<u>2.0 ms</u>
[M5C] Contact Input 10 Events	=	<u>Disabled</u>
[M6A] Contact Input 11 ID	=	<u>Cont lp 11</u>
[M6A] Contact Input 11 Debounce Time	=	<u>2.0 ms</u>
[M6A] Contact Input 11 Events	=	Disabled
[M6C] Contact Input 12 ID	=	<u>spare</u>
[M6C] Contact Input 12 Debounce Time	=	<u>2.0 ms</u>
[M6C] Contact Input 12 Events	=	Disabled
· · · · · · · · · · · · · · · · · · ·		
[M7A] Contact Input 13 ID	=	<u>Bkr Fa</u> il Int
[M7A] Contact Input 13 Debounce Time	=	2.0 ms
[M7A] Contact Input 13 Events	=	Enabled
<u> </u>		

Appendix 23 50-62-2-BKR3 (GE-C60) Setting Calculation

[M7C] Contact Input 14 ID	=	Cont lp 14		
[M7C] Contact Input 14 Debounce Time	=	2.0 ms		
[M7C] Contact Input 14 Events	=	Disabled		
[M8A] Contact Input 15 ID	=	Cont lp 15		
[M8A] Contact Input 15 Debounce Time	=	<u>2.0 ms</u>		
[M8A] Contact Input 15 Events	=	Disabled		
[M8C] Contact Input 16 ID	=	<u>Cont lp 16</u>		
[M8C] Contact Input 16 Debounce Time	=	<u>2.0 ms</u>		
[M8C] Contact Input 16 Events	=	Disabled		
Contact Inputs Thresholds:				
Cont Ip 1, Cont Ip 2, Cont Ip 3, Cont Ip	o 4(H5A, H5	5C, H6A, H6C)	=	84 Vdc
Cont Ip5, Cont Ip 6, Cont Ip 7, Cont Ip	א 8(H7A, H7	7C, H8A, H8C)	=	84 Vdc
Cont Ip 9, Cont Ip 10, Cont Ip 11, Cont Ip 1	2(M5A, M5	C, M6A, M6C)	=	84 Vdc
Cont lp 13, Cont lp 14, Cont lp 15, Cont lp 1	6(M7A, M7	C, M8A, M8C)	=	84 Vdc
Virtual Inputs: SETTING		PARAMETER		
Virtual Input 1 Function	=	Enabled		
Virtual Input 1 ID	=	Bkr Trip		
Virtual Input 1 Type	=	Self-Reset		
Virtual Input 1 Events	=	Enabled		
Virtual Input 2 Function	=	Enabled		
Virtual Input 2 ID	=	Bkr Close		
Virtual Input 2 Type	=	Self-Reset		
Virtual Input 2 Events	=	Enabled		
Other Virtual Inputs (from VI03 to VI64)				# Not used
Contact Outputs:				
[H1] Contact Output 1 ID	=	Any Trip		
[H1] Contact Output 1 Operate	=	TRIP LED On (\	/06)	
[H1] Contact Output 1 Seal-In	=	OFF		
[H1] Contact Output 1 Events	=	Enabled		
		Enabled		
[H2] Contact Output 2 ID	_	spare		
[H2] Contact Output 2 Operate	_	OFF		
[H2] Contact Output 2 Seal-In	_	OFF		
[H2] Contact Output 2 Events	_	Disabled		
	_	Diodolog		
[H3] Contact Output 3 ID	_	Not Used		
[H3] Contact Output 3 Operate	_	OFF		
[H3] Contact Output 3 Seal-In	_	OFF		
[H3] Contact Output 3 Events	_	Disabled		
	—	Disabled		
[H4] Contact Output 4 ID	_			
[H/] Contact Output 4 D	_			
[H4] Contact Output 4 Operate	_	OFF		
[H4] Contact Output 4 Seal-III	_	Disabled		
	-	DISADICU		
[M11 Contract Output 5 ID	_			
	=			

Α	ppendix 23	50-62-2-BKR3	GE-C	60) Setting Calculation
	[M1] Contact Outp	out 5 Operate	=	86BF TRIP On (VO1)
	[M1] Contact Out	put 5 Seal-In	=	86BF TRIP On (VO1)
	[M1] Contact Out	tput 5 Events	=	Enabled
	[M2] Contac	t Output 6 ID	=	RETRIP BKR
	[M2] Contact Outp	out 6 Operate	=	RETRIP BKR On (VO2)
	[M2] Contact Out	put 6 Seal-In	=	RETRIP BKR On (VO2)
	[M2] Contact Out	tput 6 Events	=	Enabled
	[M3] Contac	t Output 7 ID	=	Bkr Trip
	[M3] Contact Outp	out 7 Operate	=	Bkr Trip On (VO7)
	[M3] Contact Out	put 7 Seal-In	=	OFF
	[M3] Contact Out	tput 7 Events	=	Enabled
	[M4] Contac		_	Bkr Close
	[M4] Contact Outr	ut 8 Operate	_	Bkr Close Op (V/O8)
			=	
	[M4] Contact Out	put o Seal-In	=	
	[M4] Contact Ou		=	
virtual Outputs:	C Vietus			
	Virtua Virtual Out		=	
	virtual Out	tput 1 Events	=	Enabled
	Virtua	l Output 2 ID	=	RETRIP BKR
	Virtual Out	tput 2 Events	=	Enabled
	Virtua		_	
	Virtual Out	tout 3 Events	_	Enabled
			-	Endoled
	Virtua	l Output 4 ID	=	Trig Oscill
	Virtual Out	tput 4 Events	=	Enabled
	Virtuo			
	Virtual Out	n Oulpul 5 ID	=	
	virtual Ou	ipul 5 Evenis	=	Enabled
	Virtua	I Output 6 ID	=	TRIP LED
	Virtual Out	tput 6 Events	=	Enabled
	Virtuo		_	Pkr Trin
	Virtual Out	tout 7 Evente	=	Enchlad
	virtual Ou	iput / Events	=	Enabled
	Virtua	I Output 8 ID	=	Bkr Close
	Virtual Out	tput 8 Events	=	Enabled
	Virtua	I Output 9 ID	=	Retrip LED
	Virtual Out	tput 9 Events	=	Enabled
	Virtual	Output 10 ID	=	Phase A Trip
	Virtual Outr	out 10 Events	=	Enabled
	Virtual	Output 11 ID	=	Phase B Trip

Appendix 23	50-62-2-BKR3	(GE-C	60) Setting	Calculation
Virtual Outpu	t 11 Events	=	Enabled	
Virtual C Virtual Outpu	output 12 ID t 12 Events	=	Phase C Trip Enabled	
Virtual C Virtual Outpu	output 13 ID t 13 Events	=	Ground Trip Enabled	
Other Virtual Outputs (from VO1	4 to VO96)	_	Enabled	# Not used
Remote Devices:	,			# Not used
Remote Inputs:				# Not used
Remote Outputs DNA Bit Pairs				# Not used
Remote Outputs UserSt Bit Pairs:				# Not used
Resetting:				# Not used
Direct Inputs:				# Not used
Direct Outputs:				# Not used
Teleprotection:				# Not used
IEC 61850 GOOSE Analogs Inputs				# Not used

MSE Power Systems

	Appendix 24	50-62-1-BI	alculation		
1. Data					
MVA_Base	= 100	kV_Base =	345	Z_Base = 1190.	.25 ohms
CTR =	600	PTR =	3000	CTR/PTR= 0.2	
Total MVA o	of all three GSUs =	750	; Maximu	im full load current (amp	os) = 1255.11

2.1. Set phase IOC element, i.e. phase fault detector, above load if possible but not more than 2/3 of the minimum phase to phase fault at remote bus with the largest source out. For the minimum phase to phase fault at Farragut station under minimum condition which is considered as the largest unit (STG1) of the three units out of service, the contributions from Charlie Poletti are 1,454 Amp via Q35M line and 1,349 Amp via Q35L line. Since each breaker failure relay will normally see only half of the fault contribution per feeder. The IOC1 element shall be set at 0.15 pu or 0.75 CT secondary amp or 450 CT primary amp, or 1/3 of 1,349 Amp or 35.8% of maximum full load. Fault detector picking up on load is considered acceptable here per IEEE standard.

2.2. Set residual IOC element, i.e. ground fault detector, above maximum expected unbalance, but not more than 2/3 of the minimum ground fault at remote bus with the largest source out. For the minimum line to ground fault at Farragut station under minimum condition with is considered as the largest unit (STG1) of the three units out of serivce, the fault contributions from Chaerlie Poletti are 2,021 Amp via Q35L and 2,129 Amp via Q35M. Since each breaker failure relay will normally see only half of the fault contribution on each feeder, set residual IOC element at 0.1 pu or 0.5 CT secondary amp, 300 CT primary amp, or 24% of maximum full load, which is less than 1/3 of minimum phase to ground fault at Farragut.

2.3 Breaker failure timer of 130 ms is used for 3 phase fault and 160 ms is used for unbalanced fault per ConEd standard. Existing Poletti settings show that 120 ms breaker failure time is used regardless fault type.

SYSTEM DATA:

	Language = English
	Sys Fn Links = 0
	Decription = 50-62-1-BKR5
	Plant Reference = CHARLES POLETTI
	Frequency = 60 Hz
CB CONTROL:	
	CB Control by = Disabled
	Reset Lockout by = CB Close
	Man Close RstDly = 5.000 s
	CB2 Status Input = 52A
DATE AND TIME:	
	IRIG-B Sync = Enabled
	Battery Alarm = Enabled
	Other Time Settings = Default
CONFIGURATION:	
	Setting Group = Select via Menu
	Active Settings = Group 1
	Setting Group 1 = Enabled
	Setting Group 2 = Disabled
	Setting Group 3 = Disabled
	Setting Group 4 = Disabled
	System Config = Invisible
	-

Appendix 2	24 50-62-1-BK	R5 (Areva P141) Setting Calculat	tion
	Overcurrent =	Enabled	# 50FD-P
	Neg Sequence O/C =	Enabled	# Unbalance
	Broken Conductor =	Disabled	# Not used
	Earth Fault 1 =	Disabled	# Not used
	Earth Fault 2 =	Enabled	# 50FD-G
	Sensitive E/F Prot'n =	Disabled	# Not used
	Residual O/V NVD =	Disabled	# Not used
	Thermal Overload =	Disabled	# Not used
	Neg Sequence O/V =	Disabled	# Not used
	Cold Load Pickup =	Disabled	# Not used
	Selective Logic =	Disabled	# Not used
	Admit Protection =	Disabled	# Not used
	Volt Protection =	Disabled	# Not used
	Freq Protection =	Disabled	# Not used
	df/dt Protection =	Disabled	# Not used
	CB Fail =	Enabled	
	Supervision =	Enabled	
	Fault Locator =	Disabled	
	Input Labels =	Visible	
	Output Labels =	Visible	
	CT & VT Ratios =	Visible	
	Record Control =	Invisible	
	Disturb Recorder =	Visible	
	Measure't Setup =	Visible	
	Comms Settings =	Visible	
	Commission Tests =	Visible	
	Setting Values =	Secondary	
	Control Inputs =	Invisible	
	Ctrl I/P Config =	Invisible	
	Ctrl I/P Labels =	Invisible	
	Direct Access =	Disabled	
	LCD Contrast =	11	
<u>CT AND VT RATIOS</u>		440.034	
	Main VI Primary =	110.0 V	# Not used
	IVIAIN VI Sec'y =	110.0 V	# Not used
	Phase CT Primary =	3000 A	
	Finase CT Sec y =	5.000 A	
	E/F CT Primary =	3000 A	
	E/F CT Secondary =	5.000 A	
	SEF CI Primary =	1.000 A	
	SEF CT Secondary =	1.000 A	
MEASURE'T SETUP:	See setting me	e for detail	
	Default Display =	Description	
	Local Values =	Primary	
	Remote Values =	Primary	
	Measurement Ref =	VA	
	Measurement Mode =	0	
	Fix Dem Period =	30.00 min	
	Roll Sub Period =	30.00 min	

Appendix 24	50-62-1-BK	R5 (Areva I	P141) Setting Calcula	ation
	Num Sub Periods =	1		
	Monitor Bit 1 –	64		
	Monitor Bit 2 –	04 65		
	Monitor Bit 3 –	66		
	Monitor Bit 4 =	67		
	Monitor Bit 5 =	68		
	Monitor Bit 6 =	69		
	Monitor Bit 7 =	70		
	Monitor Bit 8 =	71		
CB MONITOR SETUP:				
<u> </u>	Broken I ^A =	2.000		
	I^ Maintenance =	Alarm Disable	ed	
	I^ Lockout =	Alarm Disable	ed	
	No. CB Ops Maint =	Alarm Disable	ed	
	No. CB Ops Lock =	Alarm Disable	ed	
	CB Time Maint =	Alarm Disable	ed	
	CB Time Lockout =	Alarm Disable	ed	
	Fault Freq Lock =	Alarm Disable	ed	
OPTO CONFIG:				
	Global Nominal V =	110/125V		
	Opto Filter Cntl =	11111111		
	Characteristic =	Standard 60%	% - 80%	
Group 1:				
GROUP 1 OVERCURRENT	<u>r:</u>			
	I>1 Function =	DT		
	I>1 Direction =	Non-Direction	nal	
	I>1 Current Set =	0.75		# 50FD-P
	I>1 Time Delay =	0		
	I>1 trest =	0 Dia akta d	S	
	I>2 Status =	Disabled		
	I>3 Status =	Disabled		
	1>4 Status =			
	I> DIUCKING =	45	dog	# Default
		Disabled	deg	# Delault
GROUP 1 NEG SEO O/C		Disabled		
	l2>1 Status -	Enabled		
	12>1 Function =	DT		
	I2>1 Directional =	Non-Direction	nal	
	I2>1 Current Set =	500.0mA		
	l2>1 Time Delav =	0 s		
	l2>1 Treset =	0 s		
	I2>2 Status =	Disabled		
	l2>3 Status =	Disabled		
	I2>4 Status =	Disabled		
	I2> Blocking =	0000000		
	I2> Char Angle =	-60.00 deg		
	I2> V2pol Set =	5.000 V		

GROUP 1 EARTH FAULT 2

Appendix 24	50-62-1-BKR5 (Areva P141) Setting C	alculation
	IN2> Input = Derived IN2>1 Function = DT IN2>1 Direction = Non-Directional IN2>1 Current = 500.0mA IN2>1 Time Delay = 0 s IN2>1 tRESET = 0 s IN2>2 Function = Disabled IN2>3 Status = Disabled IN2>4 Status = Disabled IN2> Blocking = 00000000 IN2> = POL IN2> Char Angle = -45.00 deg IN2> VNpol Set = 5.000 V	# 50FD-G
<u>GROUP 1 CB FAIL & I<:</u>	CB Fail 1 Status = Enabled GB Fail 1 Timer = 0 s CB Fail 2 Status = Enabled CB Fail 2 Timer = 130.0 ms Volt Prot Reset = I < only Ext Prot Reset = I < only I < Current Set = 500.0 mA IN< Current Set = 500.0 mA ISEF< Current = 20.00 mA Remove I> Start = Disabled Remove IN> Start = Disabled	
GROUP 1 SUPERVISION:	V/TC Status Indication	
GROUP 1 INPUT LABELS:	VTS Reset Mode = Manual VTS Time Delay = 5.000 s VTS I> Inhibit = 50.0 A VTS I2> Inhibit = 250.0 mA CTS Mode = Disabled	
	Opto Input 1 Input L1 Opto Input 2 Input L2 Opto Input 3 30-TC2/1 ALM Opto Input 4 86BF-1/1 TRIP Opto Input 5 30-86BF-1/1 ALM Opto Input 6 BF Initiation Opto Input 7 Input L7 Opto Input 8 Input L8	
<u>GROUP 1 OUTPUT LABELS</u>	S: Relay 1 Trip 86BF Relay 2 ReTrip BkrTC2 Relay 3 Any Trip Relay 4 Output R4 Relay 5 Output R5 Relay 6 Output R6 Relay 7 Output R7	

	Appendix 25	50-62-2-	tion			
1. Data						
MVA_Base =	100	kV_Base =	345	Z_Base =	1190.25	ohms
CTR =	600	PTR =	3000	CTR/PTR=	0.2	
Total MVA of	all three GSUs =	750	; Maximi	um full load curren	it (amps) =	1255.11

2.1. Set phase IOC element, i.e. phase fault detector, above load if possible but not more than 2/3 of the minimum phase to phase fault at remote bus with the largest source out. For the minimum phase to phase fault at Farragut station under minimum condition which is considered as the largest unit (STG1) of the three units out of service, the contributions from Charlie Poletti are 1,454 Amp via Q35M line and 1,349 Amp via Q35L line. Since each breaker failure relay will normally see only half of the fault contribution per feeder. The IOC1 element shall be set at 0.15 pu or 0.75 CT secondary amp or 450 CT primary amp, or 1/3 of 1,349 Amp or 35.8% of maximum full load. Fault detector picking up on load is considered acceptable here per IEEE standard.

2.2. Set residual IOC element, i.e. ground fault detector, above maximum expected unbalance, but not more than 2/3 of the minimum ground fault at remote bus with the largest source out. For the minimum line to ground fault at Farragut station under minimum condition with is considered as the largest unit (STG1) of the three units out of serivce, the fault contributions from Chaerlie Poletti are 2,021 Amp via Q35L and 2,129 Amp via Q35M. Since each breaker failure relay will normally see only half of the fault contribution on each feeder, set residual IOC element at 0.1 pu or 0.5 CT secondary amp, 300 CT primary amp, or 24% of maximum full load, which is less than 1/3 of minimum phase to ground fault at Farragut.

2.3 Breaker failure timer of 130 ms is used for 3 phase fault and 160 ms is used for unbalanced fault per ConEd standard. Existing Poletti settings show that 120 ms breaker failure time is used regardless fault type.

Device Definition:				# Default
Ploduci Selup. Socurity:				# Dofault
<u>Display Properties:</u>				# Default
Clear Relay Records:				
Communications:				# Default
Modbus User Man				# Not used
Real Time Clock:				
Iteal Time Clock.	IRIG-B Signal Type	_	DC Shift	
	All other settings	_	Default	
Fault Report:	SETTING	-	PARAMETER	
<u>r adit Report.</u>	Fault Report 1 Source	_	SBC 1 (SBC 1)	
	Fault Report 1 Trigger	_	Tria Oscill On $(1/04)$	
Fault Reno	ort 1 Positive Seg (71) Mag	_	0.49 obms	
Fault Report	t 1 Positive Seg (71) Angle	_	78 deg	
Fault R	eport 1 Zero Seg (Z1) Angle	_	1 50 obms	
Fault Ro	port 1 Zero Seg (Z0) Mag	_	54 deg	
Fault	Report 1 Line Length Units	_	mile	
i duit i	Fault Report 1 Line Length	_	7 74	
Fau	It Report 1 VT Substitution	_	None	
Faul	t Peport 1 System 70 Mag	_		
Fault	Penort 1 System 70 Angle	_	78 dog	
Oscillography:	Report i Oystelli 20 Aligie	_	70 dog	
Oschlography.				

Appendix 25	50-62-2-BKR5	(GE-C	60) Setting Calculation
	SETTING		PARAMETER
Number	Of Records	=	6
Т	rigger Mode	=	Automatic Overwrite
Trig	ger Position	=	30%
Tri	gger Source	=	Trig Oscill On (VO4)
AC Input	Waveforms	=	32 samples/cycle
Digita	al Channel 1	=	OFF
Digita	al Channel 2	=	OFF
Digita	al Channel 3	=	OFF
Digita	al Channel 4	=	OFF
Digita	al Channel 5	=	OFF
Digita	al Channel 6	=	86BF TRIP On (VO1)
Digita	al Channel 7	=	RETRIP BKR On (VO2)
Digita	al Channel 8	=	UNIT ALARM On (VO3)
Digita	al Channel 9	=	OFF
Digital	Channel 10	=	NEUTRAL IOC1 PKP
Digital	Channel 11	=	NEUTRAL IOC1 OP
Digital	Channel 12	=	PHASE IOC1 PKP A
Digital	Channel 13	=	PHASE IOC1 OP A
Digital	Channel 14	=	PHASE IOC1 PKP B
Digital	Channel 15	=	PHASE IOC1 OP B
Digital	Channel 16	=	PHASE IOC1 PKP C
Digital	Channel 17	=	PHASE IOC1 OP C
Digital	Channel 18	=	Bkr Fail Int On(H7c)
Digital	Channel 19	=	BKR FAIL 1 TRIP OP
Digital	Channel 20	=	BKR FAIL 2 TRIP OP
Digital	Channel 21	=	BKR FAIL 1 T2 OP
Digital	Channel 22	=	BKR FAIL 2 T2 OP
Digital	Channel 23	=	86BF TRIP On (VO1)
Digital	Channel 24	=	RETRIP BKR On (VO2)
Digital	Channel 25	=	BKR FAIL 1 RETRIPA
Digital	Channel 26	=	BKR FAIL 1 RETRIPB
Digital	Channel 27	=	BKR FAIL 1 RETRIPC
Digital	Channel 28	=	OFF
Digital	Channel 29	=	OFF
Digital	Channel 30	=	OFF
Digital	Channel 31	=	OFF
Digital	Channel 32	=	OFF
Digital	Channel 33	=	OFF
Digital	Channel 34	=	OFF
Digital	Channel 35	=	OFF
Digital	Channel 36	=	OFF
Digital	Channel 37	=	OFF
Digital	Channel 38	=	OFF
Digital	Channel 39	=	
	Channel 40 Channel 41	=	
	Channel 41	-	
	Channel 42	_	
Digital	Channel 43	-	OFF
Digital		-	

Appendix 25		50-62-2 [.]	-BKR5	(GE-C	:60) \$	Setti	ng Calculatio	n
	Digital	Channel 4	45	=	OFF			
	Digital	Channel 4	46	=	OFF			
	Digital	Channel 4	47	=	OFF			
	Digital	Channel 4	48	=	OFF			
	Digital	Channel 4	49	=	OFF			
	Digital	Channel &	50	=	OFF			
	Digital	Channel &	51	=	OFF			
	Digital	Channel :	52	=	OFF			
	Digital	Channel :	53	=	OFF			
	Digital	Channel :	54	=	OFF			
	Digital	Channel 5	55	=	OFF			
	Digital	Channel 5	56	=	OFF			
	Digital	Channel !	57	=	OFF			
	Digital	Channel !	58	=	OFF			
	Digital	Channel [#]	59	_	OFF			
	Digital	Channel (50	_	OFF			
	Digital	Channel (50 51	_	OFF			
	Digital	Channel (32	_	OFF			
	Digital	Channel (33	_	OFF			
	Analoc	Channel	1	_	SPC	1	la Mag	
	Analog	y Channel	່ ∣ 2	_		י ו יי	la Mag	
	Analog	y Channel	2	-	SNC SDC	·Z ·1	la Mag	
	Analog		3	=		· I	ID Mag	
	Analog) Channel	4	=	SRU	-Z		
	Analog) Channel	C C	=	SRU	· I		
	Analog) Channel	0	=	SRU	-Z		
	Analog	Channel	1	=	SRC	-1 -0	In Mag	
	Analog) Channel	8	=	SRU	-Z		
	Analog) Channel	9	=	SRC	-1 -0	la Angle	
4	Analog		10	=	SRC	2	la Angle	
4	Analog		11	=	SRC	1	Ib Angle	
P.	Analog	Channel '	12	=	SRC	2	Ib Angle	
P.	Analog	Channel '	13	=	SRC	1	Ic Angle	
A	Analog	Channel '	14	=	SRC	2	Ic Angle	
A	Analog	Channel '	15	=	Off			
Α	Analog	Channel '	16	=	Off			
Data Logger:								# Default
Demand:								# Default
User-Programmable Leds:								
<u>LED Test:</u>								
		Functio	on	=	Enab	bled		
		Contr	ol	=	CON	ITRO	L PUSHBUTTON	1 ON
Trip and Alarms Leds:								
	Trip	> LED Inp	ut	=	86BF	= TRI	P On (VO1)	
	Alarm	ו LED Inp	ut	=	UNIT	Γ ALA	RM On (VO3)	
		LED	1	=	86BF	= TRI	P On (VO1)	Latched
		LED	2	=	BKR	FAIL	1 TRIP OP	Latched
		LED	3	=	BKR	FAIL	2 TRIP OP	Latched
		LED	4	=	Retri	ip LE[D On (VO9)	Latched
		LED	5	=	OFF			Latched

Appendix 25	50-62-2-BKR5	GE-C	60) Setting Calculatio	on
	LED 6	=	OFF	Self-Reset
	LED 7	=	OFF	Self-Reset
	LED 8	=	OFF	Self-Reset
	LED 9	=	Phase A Trip On (VO10)	Latched
	LED 10	=	Phase B Trip On (VO11)	Latched
	LED 11	=	Phase C Trip On (VO12)	Latched
	LED 12	=	Ground Trip On (VO13)	Latched
	LED 13	=	OFF	Self-Reset
	LED 14	=	OFF	Self-Reset
	LED 15	=	OFF	Self-Reset
	LED 16	=	OFF	Self-Reset
	LED 17	=	OFF	Self-Reset
	LED 18	=	OFF	Self-Reset
	LED 19	=	OFF	Self-Reset
	LED 20	=	OFF	Self-Reset
	LED 21	=	OFF	Self-Reset
	LED 22	=	Bkr Fail Int On(H7c)	Self-Reset
	LED 23	=	BKR FAIL 1 T2 OP	Self-Reset
	LED 24	=	BKR FAIL 2 T2 OP	Self-Reset
	LED 25	=	OFF	Self-Reset
	LED 26	=	OFF	Self-Reset
	LED 27	=	OFF	Self-Reset
	LED 28	=	OFF	Self-Reset
	LED 29	=	OFF	Self-Reset
	LED 30	=	OFF	Self-Reset
	LED 31	=	OFF	Self-Reset
	LED 32	=	OFF	Self-Reset
	LED 33	=	OFF	Self-Reset
	LED 34	=	OFF	Self-Reset
	LED 35	=	OFF	Self-Reset
	LED 36	=	OFF	Self-Reset
	LED 37	=	OFF	Self-Reset
	LED 38	=	OFF	Self-Reset
	LED 39	=	OFF	Self-Reset
	LED 40	=	OFF	Self-Reset
	LED 41	=	OFF	Self-Reset
	LED 42	=	OFF	Self-Reset
	LED 43	=	OFF	Self-Reset
	LED 44	=	OFF	Self-Reset
	LED 45	=	OFF	Self-Reset
	LED 46	=	OFF	Self-Reset
	LED 47	=	OFF	Self-Reset
	LED 48	=	OFF	Self-Reset
User-Programmable Self Tests:			F I	
Remote Device		=	Enabled	
Pri Ethernet I		=	Enabled	
Battery		=	Enabled	
SNTPI		=	Enabled	
IRIG B I	-all Function	=	Enabled	

Control Pushbuttons:

A	ppendix 25	50-62-2-B	KR5 (GE-C	60) Setting	g Calculatio	n
PARAMETER Function Events Flex States:	CPB 1 Enabled Disabled	CPB 2 Disabled Disabled	CPB 3 Disabled Disabled			# All OFF
Direct I/O: Teleprotection: Installation:	<u>aispiays:</u>					# Not used # Not used # Not used
System Setup:		Relay Name	=	50/62-2 Brea	aker 5	
AC Inputs						
Current:	<u>.</u>	PARAMETER		CT F1		
	Pha	ase CT Primary	=	3000 A		
	Phase	CT Secondary	=	5 A		
	Grou	und CT Primary	=	3000 A		
	Ground	I CT Secondary	=	5 A		
Voltage: Power System:						# Not used
	Nom	ninal Frequency	=	60 Hz		
		Phase Rotation	=	ABC		
I	Frequency And Pl	nase Reference	=	SRC 1 (SRC	; 1)	
	Frequency Tra	acking Function	=	Enabled		
Signal Sources:	-	PARAMETER		SOURCE 1	SOURCE 2	
		Name	=	SRC 1	SRC 2	
		Phase CT	=	F1	None	
		Ground CT	=	None	None	
		Phase VT	=	None	None	
		Aux VT	=	None	None	
Breakers:		SETTING		PARAMETE	R	
	Brea	aker 1 Function	=	Disabled		
	Breaker 1 Push	Button Control	=	Disabled		
	B	Freaker 1 Name	=	Bkr 1		
	E	Breaker 1 Mode	=	3-Pole		
	E	Breaker 1 Open	=	OFF		
	Breake	er 1 Block Open	=	OFF		
	E	Breaker 1 Close	=	OFF		
	Breake	r 1 Block Close	=	OFF		
E	Breaker 1 Phase A	V3-Pole Closed	=	OFF		
B	reaker 1 Phase A/	'3-Pole Opened	=	OFF		
	Breaker 1 F	Phase B Closed	=	OFF		
	Breaker 1 Pl	hase B Opened	=	OFF		
	Breaker 1 F	hase C Closed	=	OFF		
	Breaker 1 Pl	nase C Opened	=	OFF		
	Brea	aker 1 Toperate	=	0.070 s		
	Breaker 1	External Alarm	=	OFF		
	Breake	r 1 Alarm Delay	=	0.000 s		
Bre	aker 1 Manual Clo	ose Recal Time	=	0.000 s		
	Breaker 1	Out Of Service	=	OFF		
	Br	eaker 1 Events	=	Disabled		

Appendix 2550-62-2-BKR5 (GE-C60) Setting Calculation

Breaker 2 Function	=	Disabled	
Breaker 2 Push Button Control	_	Disabled	
Breaker 2 Name	_	Bkr 2	
Breaker 2 Mode	_	3-Polo	
Breaker 2 Mode	_		
Breaker 2 Bleak Open	=	OFF	
	=	OFF	
Breaker 2 Close	=	OFF	
Breaker 2 Block Close	=	OFF	
Breaker 2 Phase A/3-Pole Closed	=	OFF	
Breaker 2 Phase A/3-Pole Opened	=	OFF	
Breaker 2 Phase B Closed	=	OFF	
Breaker 2 Phase B Opened	=	OFF	
Breaker 2 Phase C Closed	=	OFF	
Breaker 2 Phase C Opened	=	OFF	
Breaker 2 Toperate	=	0.070 s	
Breaker 2 External Alarm	=	OFF	
Breaker 2 Alarm Delay	=	0.000 s	
Breaker 2 Manual Close Recal Time	=	0.000 s	
Breaker 2 Out Of Service	=	OFF	
Breaker 2 Events	=	Disabled	
Switches			# Not used
FlexCurves:			# Not used
Flext ogic:		# See	50-62-2-BKR1-r0 pdf
Grouped Elements:			
Group 1:			
Phase Current			
Phase TOC:			# Not used
Phase IOC:			
Fildse IOC.	_	Enabled	
Fullculon	=		
Dialaur	=		
Pickup	=	0.15 pu	
Delay	=	0.00 s	
Reset Delay	=	0.00 s	
Block A	=	OFF	
Block B	=	OFF	
Block C	=	OFF	
Target	=	Self-reset	
Events	=	Enabled	
Neutral Current:			
Neutral TOC:			# Not used
Neutral IOC:			
Function	=	Enabled	
Source	=	SRC 1 (SRC 1)	
Pickup	=	0.100 pu	
Delay	=	0.00 s	
Reset Delav	=	0.00 s	
Block	=	OFF	
Target	=	Self-reset	
Events	=	Enabled	
Ground Current:			

Appendix 25

50-62-2-BKR5 (GE-C60) Setting Calculation

Ground TOC
Ground IOC
Breaker Failure:

Ground TOC				# Not used
Ground IOC				# Not used
Breaker Failure:	PARAMETER		BF1	BF2
	Function	=	Enabled	Enabled
	Mode	=	3-Pole	3-Pole
	Source	=	SRC 1 (SRC 1)	SRC 1 (SRC1)
	Current Supervision	=	Yes	Yes
	Use Seal-In	=	No	No
	Three Pole Initiate	=	Bkr Fail Int On(H7c):	Cont lp 2 On(H5c)
	Block	=	NEUTRAL IOC1 PKP	OFF
F	hase Current Supy Pickup	=	0.15 pu	# 50FD-P
N	eutral Current Supy Pickup	=	0.100 pu	# 50FD-G
	Use Timer 1	=	No	No
	Timer 1 Pickup Delay	=	0.000 s	0.000 s
	Use Timer 2	=	Yes	Yes
	Timer 2 Pickup Delay	=	0 130 s	0 160 s
	Use Timer 3	=	No	No
	Timer 3 Pickup Delay	_	0.000 s	0.000 s
	Breaker Post Phase A/3P	_	OFF	OFF
	Breaker Pos2 Phase A/3P	_	OFF	OFF
	Breaker Test On	_	OFF	OFF
D	base Current HiSet Dickup	_	0.15 pu	0.15 pu
F No	nutral Current HiSet Pickup	_	0.10 pu	0.15 pu 0.100 pu
	base Current LeSet Pickup	_	0.15 pu	0.100 pu
FI No	nase Current LoSet Fickup	_	0.15 pu	0.15 pu
INE		=	0.100 pu	0.100 pu
	Trip Dropout Delay	=	0.000 s	0.000 s
		=	0.000 S	0.000 S
	Target	=		Latched
	Events	=		Enabled
	Phase A Initiate	=	OFF	OFF
	Phase B Initiate	=	OFF	OFF
	Phase C Initiate	=	OFF	OFF
	Breaker Pos1 Phase B	=	OFF	OFF
	Breaker Pos1 Phase C	=	OFF	OFF
	Breaker Pos2 Phase B	=	OFF	OFF
	Breaker Pos2 Phase C	=	OFF	OFF
Voltage Elements:				# Not used
Power:				# Not used
Control Elements:				
<u>Trip Bus:</u>				# Not used
Setting Groups:				# Not used
Selector Switches:				# Not used
Synchrocheck:				# Not used
Digital Elements:				# Not used
Digital Counters:				# Not used
Monitoring Elements:				# Not used
Autoreclose 1P				# Not used
Inputs/Outputs:				
Contact inputs:	<u>SETTING</u>		PARAMETER	
	[H5A] Contact Input 1 ID	=	<u>CSM-2 (E13)</u>	

Appendix 2550-62-2-BKR5 (GE-C60) Setting Calculation

[H5A] Contact Input 1 Debounce Time [H5A] Contact Input 1 Events	= =	<u>2.0 ms</u> Enabled
[H5C] Contact Input 2 ID [H5C] Contact Input 2 Debounce Time	= =	<u>CSM-2 (TIE)</u> 2.0 ms
[H5C] Contact Input 2 Events	=	Enabled
[H6A] Contact Input 3 Debounce Time [H6A] Contact Input 3 Events	=	2.0 ms Enabled
[H6C] Contact Input 4 ID	_	86BE-2 Oper
[H6C] Contact Input 4 Debounce Time	_	2 0 ms
[H6C] Contact Input 4 Events	=	Enabled
[H7A] Contact Input 5 ID	=	86BF-2 Mont
[H7A] Contact Input 5 Debounce Time	=	<u>2.0 ms</u>
[H/A] Contact Input 5 Events	=	Enabled
[H7C] Contact Input 6 ID	=	<u>43L/R</u>
[H7C] Contact Input 6 Debounce Time	=	<u>2.0 ms</u>
[H7C] Contact Input 6 Events	=	<u>Enabled</u>
[H8A] Contact Input 7 ID	=	<u>CSM-2 (OFF)</u>
[H8A] Contact Input 7 Debounce Time	=	<u>2.0 ms</u>
[H8A] Contact Input 7 Events	=	Enabled
[H8C] Contact Input 8 ID	=	<u>CSM-2 (FARR)</u>
[H8C] Contact Input 8 Debounce Time	=	<u>2.0 ms</u>
[H8C] Contact Input 8 Events	=	Enabled
[M5A] Contact Input 9 ID	=	11LTSR-2A
M5A Contact Input 9 Debounce Time	=	<u>2.0 ms</u>
[M5A] Contact Input 9 Events	=	Enabled
[M5C] Contact Input 10 ID	=	<u>11LTSR-2B</u>
[M5C] Contact Input 10 Debounce Time	=	<u>2.0 ms</u>
[M5C] Contact Input 10 Events	=	Enabled
[M6A] Contact Input 11 ID	=	<u>Cont lp 11</u>
[M6A] Contact Input 11 Debounce Time	=	<u>2.0 ms</u>
[M6A] Contact Input 11 Events	=	Disabled
[M6C] Contact Input 12 ID	=	<u>spare</u>
INIGUI Contact Input 12 Debounce Time	=	<u>2.0 ms</u>
[M6C] Contact Input 12 Events	=	Disabled
[M7A] Contact Input 13 ID	=	Bkr Fail Int
[M7A] Contact Input 13 Debounce Time	=	<u>2.0 ms</u>
[M7A] Contact Input 13 Events	=	<u>Enabled</u>
Appendix 25 50-62-2-BKR5 (GE-C60) Setting Calculation

[M7C] Contact Input 14 ID	=	Cont lp 14		
[M7C] Contact Input 14 Debounce Time	=	2.0 ms		
[M7C] Contact Input 14 Events	=	Disabled		
[M8A] Contact Input 15 ID	=	Cont lp 15		
[M8A] Contact Input 15 Debounce Time	=	<u>2.0 ms</u>		
[M8A] Contact Input 15 Events	=	Disabled		
[M8C] Contact Input 16 ID	=	Cont lp 16		
[M8C] Contact Input 16 Debounce Time	=	<u>2.0 ms</u>		
[M8C] Contact Input 16 Events	=	Disabled		
Contact Inputs Thresholds:				
Cont lp 1, Cont lp 2, Cont lp 3, Cont l	p 4(H5A, H5	5C, H6A, H6C)	=	84 Vdc
Cont Ip5, Cont Ip 6, Cont Ip 7, Cont I	p 8(H7A, H7	7C, H8A, H8C)	=	84 Vdc
Cont lp 9, Cont lp 10, Cont lp 11, Cont lp 1	2(M5A, M5	C, M6A, M6C)	=	84 Vdc
Cont lp 13, Cont lp 14, Cont lp 15, Cont lp 1	16(M7A, M7	C, M8A, M8C)	=	84 Vdc
Virtual Inputs: SETTING	- ()	PARAMETER		
Virtual Input 1 Function	=	Enabled		
Virtual Input 1 ID	=	Bkr Trip		
Virtual Input 1 Type	=	Self-Reset		
Virtual Input 1 Events	=	Enabled		
		Enabled		
Virtual Input 2 Function	=	Enabled		
Virtual Input 2 ID	_	Bkr Close		
Virtual Input 2 Type	_	Self-Reset		
Virtual Input 2 Events	_	Enabled		
Other Virtual Inputs (from VI03 to VI64)	_	Enabled		# Not used
Contact Outputs:				<i>"</i> 1101 0000
[H1] Contact Output 1 ID	_	Any Trip		
[H1] Contact Output 1 Operate	_	TRIP ED On ()	(O6)	
[H1] Contact Output 1 Seal-In	_	OFF	,00)	
[H1] Contact Output 1 Events	_	Enabled		
	-	Enabled		
[H2] Contact Output 2 ID	_	snare		
[H2] Contact Output 2 Operate	_	OFF		
[H2] Contact Output 2 Spellin	_	OFF		
[H2] Contact Output 2 Seal-III [H2] Contact Output 2 Events	_	Disabled		
	-	Disabled		
[H3] Contact Output 3 ID	_	Not Llead		
[H3] Contact Output 3 Operate	_			
[H3] Contact Output 3 Spallin	_	OFF		
[H3] Contact Output 3 Seal-III	_	Disabled		
	=	Disableu		
[44] Contact Output 4 D	_			
	=			
	=			
[H4] Contact Output 4 Seal-IN	=	Disabled		
	=	DISADIEU		
IN11 Contact Output 5 1D	_			
	=	DETRIP		

A	ppendix 25	50-62-2-BKR5	GE-C	60) Setting Calculation
	[M1] Contact Outp	ut 5 Operate	=	86BF TRIP On (VO1)
	[M1] Contact Out	out 5 Seal-In	=	86BF TRIP On (VO1)
	[M1] Contact Out	put 5 Events	=	Enabled
	[M2] Contact	Output 6 ID	=	RETRIP BKR
	[M2] Contact Outp	ut 6 Operate	=	RETRIP BKR On (VO2)
	[M2] Contact Out	out 6 Seal-In	=	RETRIP BKR On (VO2)
	[M2] Contact Out	put 6 Events	=	Enabled
	[M3] Contact	Output 7 ID	=	Bkr Trip
	[M3] Contact Outp	ut 7 Operate	=	Bkr Trip On (VO7)
	[M3] Contact Out	out 7 Seal-In	=	OFF
	[M3] Contact Out	put 7 Events	=	Enabled
	[M4] Contact	Output 8 ID	=	Bkr Close
	[M4] Contact Outp	ut 8 Operate	=	Bkr Close On (VO8)
	[M4] Contact Out	out 8 Seal-In	=	OFF
	[M4] Contact Out	put 8 Events	=	Enabled
Virtual Outputs:	S	ETTING		PARAMETER
	Virtual	Output 1 ID	=	86BF TRIP
	Virtual Out	put 1 Events	=	Enabled
	Virtual	Output 2 ID	=	RETRIP BKR
	Virtual Out	put 2 Events	=	Enabled
	Virtual	Output 3 ID	=	UNIT ALARM
	Virtual Out	put 3 Events	=	Enabled
	Virtual	Output 4 ID	=	Trig Oscill
	Virtual Out	put 4 Events	=	Enabled
	Virtual	Output 5 ID	=	ALARM NC
	Virtual Out	put 5 Events	=	Enabled
	Virtual	Output 6 ID	=	TRIP LED
	Virtual Out	put 6 Events	=	Enabled
	Virtual	Output 7 ID	=	Bkr Trip
	Virtual Out	put 7 Events	=	Enabled
	Virtual	Output 8 ID	=	Bkr Close
	Virtual Out	put 8 Events	=	Enabled
	Virtual	Output 9 ID	=	Retrip LED
	Virtual Out	put 9 Events	=	Enabled
	Virtual	Output 10 ID	=	Phase A Trip
	Virtual Outp	ut 10 Events	=	Enabled
	Virtual	Output 11 ID	=	Phase B Trip

Appendix 25	50-62-2-BKR5	(GE-C	C60) Setting	Calculation
Virtual Outpu	ut 11 Events	=	Enabled	
Virtual C	Output 12 ID	=	Phase C Trip	
Virtual Outpu	it 12 Events	=	Enabled	
Virtual C	Output 13 ID	=	Ground Trip	
Virtual Outpu	ut 13 Events	=	Enabled	
Other Virtual Outputs (from VO	14 to VO96)			# Not used
Remote Devices:				# Not used
Remote Inputs:				# Not used
Remote Outputs DNA Bit Pairs				# Not used
Remote Outputs UserSt Bit Pairs:				# Not used
Resetting:				# Not used
Direct Inputs:				# Not used
Direct Outputs:				# Not used
Teleprotection:				# Not used
IEC 61850 GOOSE Analogs Inputs				# Not used

Appendix 26 CT Evaluation

NO.	CALCULATION	DATA	UNIT	BASIS (DATA SOURCE)
	The maximum fault current If in primary amperes	37994	A	Per Aspen 1LG (Twice lead)
	The corresponding primary circuit X/R ratio, i.e. tan(angle)	4.96	N/A	Calculated per fault angle
	Fault angle	78.6	degree	PER ASPEN
	CT Voltage Rating	800		Per One
	CT Ratio	3000	: 5	Breaker Drawing
	Actual CT Ratio	3000	: 5	PER ONE-LINE Drawing 001-Sheet 1
1	The CT secondary maximum fault current Imax-ct-secondary	63.32	A	
	Check that CT secondary current does not exceed			
	100A for maximum fault condition	CT OK		
2	Effective C-Rating = CT Tap/Max CT Ratio * (C-Rating)	800.00		
				C-Rating is two times of the excitation voltage
	Burden Maximum Allow = Eff C-Rating/(2*Imax-ct-secondary)	6.32		Refer (IEEE C37-110 1996)
	CT winding 600 turns at 0.00207 ohms/turn	1.242	ohms	0.00207ohms/turn per Breaker DWG
	CT leads One Way length In Feet	400	feet	Per Physical layout or cable list
	Single Phase Fault, Y/N?	Y		
	CT lead Wiring Size (AWG)	10	AWG	Per Physical layout or cable list
	Ohms/1000ft of CT Lead	1.00	ohms/1000ft	
	CT leads burden	<u>0.80</u>	ohms	1 Ph or Netural CT: Two Way ; 3 Ph: One-Way
	Relay burden	0.01	ohms	NEGILIBLE PER SEL PAPER 6142.PDF
	Actual CT burden in total	2.05	ohms	
	Compare actual CT burden in total and maximum allowed Burden	CT OK		
	CT Steady State Saturation Evaluation Final Conclusion	CT OK		

345kV CT (3000:5, C800) Steady State Evaluation

Note 1: Equation per IEEE C37-110 2007

Note 2. During normal operation, i.e. the ring bus is complete, the fault current through one CT will be half of the fault level used.

3. The fault current used in CT evaluation is the maximum CT primary current with addition of Astoria Energy II generating plant. Note It is the largest part of the fault current which relay will see, instead of the total fault current.

Appendix 26 CT Evaluation

NO.	CALCULATION	DATA	UNIT	BASIS (DATA SOURCE)
1	The maximum fault current If in primary amperes	37994	A	Per Aspen 1LG (Twice lead)
2	The corresponding primary circuit X/R ratio, i.e. tan(angle)	4.96	N/A	Calculated per fault angle
	Fault angle	78.6	degree	PER ASPEN
3	CT Voltage Rating	800		Per One
	CT Ratio	3000	: 5	Breaker Drawing
	Actual CT Ratio	3000	: 5	PER ONE-LINE Drawing 001-Sheet 1
4	Maximum fault current in per unit of actual CT rating If	12.66	pu	
	CT Standard Burden	8	ohms	
	Actual CT Standard Burden	8.00	ohms	
	CT winding 600 turns at 0.00207 ohms/turn	<u>1.242</u>	ohms	0.00207ohms/turn per Breaker DWG
	CT leads One Way length In Feet	400	feet	Per Physical layout or cable list
	Single Phase Fault or Netural CT, "Y" or "N"?	Y		
	CT lead Wiring Size (AWG)	10	AWG	Per Physical layout or cable list
	Ohms/1000ft of CT Lead	1.00	ohms/kft	
	CT leads burden	<u>0.80</u>	ohms	1 Ph or Netural CT: Two Way ; 3 Ph: One-Way
	Relay burden	<u>0.01</u>	ohms	NEGILIBLE PER SEL PAPER 6142.PDF
	Actual CT burden in total	2.05	ohms	
	Actual CT burden in per unit of the actual CT standard burden Zb	0.26	pu	
5	X/R+1 * If * Zb =	19.36	N/A	
6	20 > = X/R+1 * If * Zb ?	<u>CT OK</u>	N/A	CONCLUSION

345kV CT (3000:5, C800) Transient State Evaluation

Note 1: Equation per SEL paper 6027.pdf

Note 2. During normal operation, i.e. the ring bus is complete, the fault current through one CT will be half of the fault level used.

3. The fault current used in CT evaluation is the maximum CT primary current with addition of Astoria Energy II generating plant. Note It is the largest part of the fault current which relay will see, instead of the total fault current.

Appendix 27 - Short Circuit Study Results

Appendix 27 - 1 Summary of fault being displayed:Prefault voltage: From a linear network solutionGenerator impedance: SubtransientMOV iteration:[Off]Ignore shunts with + seq value: [Yes]Ignore loads:[Yes]Ignore line G+jB:[Yes]

1. Bus Fault on: 0 CharlesPolet 345. kV 3LG FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 46291.0@ -83.0 0.0@ 0.0 0.0@ 0.0 46291.0@ -83.0 46291.0@ 157.0 46291.0@ 37.0 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 27888.7 X/R RATIO= 13.5481 R0/X1= 0.3945 X0/X1= 1.13748

 CURRENT TO FAULT (A)
 > 46291.0@ -83.0
 0.0@ 0.0
 0.0@ 0.0
 46291.0@ -83.0
 46291.0@ 157.0
 46291.0@ 37.0

 THEVENIN IMPEDANCE (OHM)
 > 4.33825@ 85.8
 4.36211@ 85.2
 5.20885@ 70.9

Appendix 27 - Short Circuit Study Results

 Appendix 27 – 2 Summary of fault being displayed:

 Prefault voltage: From a linear network solution

 Generator impedance: Subtransient

 MOV iteration:
 [Off]

 Ignore shunts with + seq value: [Yes]

 Ignore loads:
 [Yes]

 Ignore line G+jB:
 [Yes]

2. Bus Fault on: 0 CharlesPolet 345. kV 2LG Type=B-C FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 29889.4@ -80.5 16393.4@ 93.0 13728.5@ 107.3 0.0@ 0.0 48112.2@ 162.3 41677.2@ 36.3 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 28986.0 X/R RATIO= 8.44801 R0/X1= 0.3945 X0/X1= 1.13748

 CURRENT TO FAULT (A)
 > 29889.4@ -80.5
 16393.4@ 93.0
 13728.5@ 107.3
 0.0@
 0.0
 48112.2@ 162.3
 41677.2@ 36.3

 THEVENIN IMPEDANCE (OHM)
 > 4.33825@ 85.8
 4.36211@ 85.2
 5.20885@ 70.9

Appendix 27 - Short Circuit Study Results

 Appendix 27 – 3 Summary of fault being displayed:

 Prefault voltage: From a linear network solution

 Generator impedance: Subtransient

 MOV iteration:
 [Off]

 Ignore shunts with + seq value: [Yes]

 Ignore loads:
 [Yes]

 Ignore line G+jB:
 [Yes]

3. Bus Fault on: 0 CharlesPolet 345. kV 1LG Type=A FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 14548.7@ -77.2 14548.7@ -77.2 43646.1@ -77.2 0.0@ 0.0 0.0@ 0.0 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 26295.3 X/R RATIO= 5.68069 R0/X1= 0.3945 X0/X1= 1.13748

Appendix 27 - Short Circuit Study Results

Appendix 27 - 4 Summary of fault being displayed:Prefault voltage: From a linear network solutionGenerator impedance: SubtransientMOV iteration:[Off]Ignore shunts with + seq value: [Yes]Ignore loads:[Yes]Ignore line G+jB:[Yes]

4. Bus Fault on: 0 CharlesPolet 345. kV LL Type=B-C FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 23082.3@ -82.7 23082.3@ 97.3 0.0@ 0.0 0.0@ 0.0 39979.8@-172.7 39979.8@ 7.3 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 24086.4 X/R RATIO= 12.638 R0/X1= 0.3945 X0/X1= 1.13748

 CURRENT TO FAULT (A)
 > 23082.3@ -82.7
 23082.3@ 97.3
 0.0@ 0.0
 0.0@ 0.0
 39979.8@ -172.7
 39979.8@ 7.3

 THEVENIN IMPEDANCE (OHM)
 > 4.33825@ 85.8
 4.36211@ 85.2
 5.20885@ 70.9

Appendix 27 - Short Circuit Study Results

 Appendix 27 - 5 Summary of fault being displayed:

 Prefault voltage: From a linear network solution

 Generator impedance: Subtransient

 MOV iteration:
 [Off]

 Ignore shunts with + seq value: [Yes]

 Ignore loads:
 [Yes]

 Ignore line G+jB:
 [Yes]

5. Close-In Fault on: 0 CharlesPolet 345.kV - 0 AEII 345.kV 2L 3LG FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 46291.0@ -83.0 0.0@ 0.0 0.0@ 0.0 46291.0@ -83.0 46291.0@ 157.0 46291.0@ 37.0 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 27888.7 X/R RATIO= 13.5481 R0/X1= 0.3945 X0/X1= 1.13748

 BUS
 0 CharlesPolet
 345.KV
 AREA
 7
 ZONE
 10
 TIER
 0
 (PREFAULT V=1.008@
 2.8 PU)

 +
 SEQ
 SEQ
 0
 SEQ
 A
 PHASE
 B
 PHASE
 C
 PHASE

 VOLTAGE (KV, L-G)
 >
 0.000@
 0.0
 0.000@
 0.0
 0.000@
 0.0
 0.000@
 0.0
 0.000@
 0.0
 0.000@
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 0.0
 0.0
 <t

 CURRENT TO FAULT (A)
 > 46291.0@ -83.0
 0.0@
 0.0
 0.0@
 0.0
 46291.0@ -83.0
 46291.0@
 37.0

 THEVENIN IMPEDANCE (OHM)
 > 4.33825@
 85.8
 4.36211@
 85.2
 5.20885@
 70.9

MONITORED BRANCH: 0 CharlesPolet 345.KV -> 0 AEII 345.KV 2L

 + SEQ
 - SEQ
 0 SEQ
 A PHASE
 B PHASE
 C PHASE

 RELAY CURRENT (A)
 42434.6@ -85.4
 0.0@
 0.0
 0.0@
 0.0
 42434.6@
 154.6
 42434.6@
 34.6

BUS VOLTAGES (KV, L-G)

Appendix 27 - Short Circuit Study Results

 Appendix 27 - 6 Summary of fault being displayed:

 Prefault voltage: From a linear network solution

 Generator impedance: Subtransient

 MOV iteration:
 [Off]

 Ignore shunts with + seq value: [Yes]

 Ignore loads:
 [Yes]

 Ignore line G+jB:
 [Yes]

6. Close-In Fault on: 0 CharlesPolet 345.kV - 0 AEII 345.kV 2L 2LG Type=B-C FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 29889.4@ -80.5 16393.4@ 93.0 13728.5@ 107.3 0.0@ 0.0 48112.2@ 162.3 41677.2@ 36.3 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 28986.0 X/R RATIO= 8.44801 R0/X1= 0.3945 X0/X1= 1.13748

 BUS
 0 CharlesPolet
 345.KV
 AREA
 7
 ZONE
 10
 TIER
 0
 (PREFAULT V=1.008@
 2.8 PU)

 + SEQ
 - SEQ
 0
 SEQ
 A PHASE
 B PHASE
 C PHASE

 VOLTAGE (KV, L-G)
 >
 71.510@
 -1.8
 71.510@
 -1.8
 214.529@
 -1.8
 0.000@
 0.0
 0.000@
 0.0

 BRANCH CURRENT (A) TO
 >
 0
 0
 AEII
 345. 2L
 3072.8@
 136.4
 1522.3@
 -88.6
 3134.8@
 -90.5
 3367.0@
 -131.1
 4472.4@
 -19.2
 5781.2@
 -111.1

 16
 E15ST 48
 345. 1L
 13611.1@
 95.6
 7362.0@
 -86.9
 5344.4@
 -67.6
 1675.0@
 48.5
 21616.4@
 -17.6
 18275.5@
 -148.5

 0
 E15ST 47
 345. 1L
 13881.8@
 95.8
 7509.8@
 -86.7
 5441.5@
 -67.6
 1692.0@
 49.3
 22025.3@
 -17.5
 18659.0@
 -148.4

CURRENT TO FAULT (A) > 29889.4@ -80.5 16393.4@ 93.0 13728.5@ 107.3 0.0@ 0.0 48112.2@ 162.3 41677.2@ 36.3 THEVENIN IMPEDANCE (OHM) > 4.33825@ 85.8 4.36211@ 85.2 5.20885@ 70.9

MONITORED BRANCH: 0 CharlesPolet 345.KV -> 0 AEII 345.KV 2L

 + SEQ
 - SEQ
 0 SEQ
 A PHASE
 B PHASE
 C PHASE

 RELAY CURRENT (A)
 27492.9@ -84.3
 14871.8@ 93.2
 10785.9@ 112.4
 3367.0@ -131.1
 43641.7@ 162.5
 36934.5@ 31.5

BUS VOLTAGES (KV, L-G)

0 CharlesPolet 345.kV 71.510@ -1.8 71.510@ -1.8 71.510@ -1.8 214.529@ -1.8 0.000@ 0.0 0.000@ 0.0 0 AEII 345.kV 71.806@ -1.6 71.310@ -1.8 70.500@ -1.7 213.615@ -1.7 0.955@-151.5 1.344@ 161.9 3Io= 32357.6@ 112.4 A Va/Ia= 63.7@ 129.3 Ohm (Va-Vb)/(Ia-Ib)= 5.06@ 19.9 Ohm (Zo-Z1)/3Z1 = 0.4866@ -1.9

Appendix 27 - Short Circuit Study Results

Appendix 27 - 7 Summary of fault being displayed:Prefault voltage: From a linear network solutionGenerator impedance: SubtransientMOV iteration:[Off]Ignore shunts with + seq value: [Yes]Ignore loads:[Yes]Ignore line G+jB:[Yes]

7. Close-In Fault on: 0 CharlesPolet 345.kV - 0 AEII 345.kV 2L 1LG Type=A FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 14548.7@ -77.2 14548.7@ -77.2 43646.1@ -77.2 0.0@ 0.0 0.0@ 0.0 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 26295.3 X/R RATIO= 5.68069 R0/X1= 0.3945 X0/X1= 1.13748

MONITORED BRANCH: 0 CharlesPolet 345.KV -> 0 AEII 345.KV 2L

 + SEQ
 - SEQ
 0 SEQ
 A PHASE
 B PHASE
 C PHASE

 RELAY CURRENT (A)
 13539.4@ -85.4
 13198.3@ -77.1
 11430.3@ -72.1
 37994.2@ -78.6 4038.9@ 76.5
 2147.1@ 18.3

BUS VOLTAGES (KV, L-G)

0 CharlesPolet 345.kV 138.170@ 0.2 63.463@-172.1 75.782@ 173.6 0.000@ 0.0 192.662@-123.0 222.409@ 122.9 0 AEII 345.kV 138.287@ 0.3 63.285@-172.1 74.712@ 173.7 1.348@ 3.4 192.306@-122.7 221.693@ 122.8 3Io= 34290.8@ -72.1 A Va/Ia= 1.14e-015@ 88.0 Ohm (Va-Vb)/(Ia-Ib)= 4.62@ 137.9 Ohm (Zo-Z1)/3Z1 = 0.4866 @ -1.9

Appendix 27 - Short Circuit Study Results

 Appendix 27 - 8 Summary of fault being displayed:

 Prefault voltage: From a linear network solution

 Generator impedance: Subtransient

 MOV iteration:
 [Off]

 Ignore shunts with + seq value: [Yes]

 Ignore loads:
 [Yes]

 Ignore line G+jB:
 [Yes]

8. Close-In Fault on: 0 CharlesPolet 345.kV - 0 AEII 345.kV 2L LL Type=B-C FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 23082.3@ -82.7 23082.3@ 97.3 0.0@ 0.0 0.0@ 0.0 39979.8@-172.7 39979.8@ 7.3 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 24086.4 X/R RATIO= 12.638 R0/X1= 0.3945 X0/X1= 1.13748

MONITORED BRANCH: 0 CharlesPolet 345.KV -> 0 AEII 345.KV 2L

 + SEQ
 - SEQ
 0 SEQ
 A PHASE
 B PHASE
 C PHASE

 RELAY CURRENT (A)
 21413.7@ -87.7
 20939.8@ 97.5
 0.0@ 0.0
 1963.9@-161.2
 35690.0@-175.5
 37595.7@ 5.2

BUS VOLTAGES (KV, L-G)

0 CharlesPolet 345.kV 100.688@ 2.5 100.688@ 2.5 0.000@ 0.0 201.375@ 2.5 100.688@-177.5 100.688@-177.5 0 AEII 345.kV 100.920@ 2.6 100.406@ 2.5 0.000@ 0.0 201.325@ 2.6 100.462@-177.2 100.866@-177.7 3Io= 0.0@ -92.3 A Va/Ia= 103@ 163.6 Ohm (Va-Vb)/(Ia-Ib)= 8.94@ -1.2 Ohm (Zo-Z1)/3Z1 = 0.4866@ -1.9

Appendix 27 - Short Circuit Study Results

Appendix 27 - 9 Summary of fault being displayed:Prefault voltage: From a linear network solutionGenerator impedance: SubtransientMOV iteration:[Off]Ignore shunts with + seq value: [Yes]Ignore loads:[Yes]Ignore line G+jB:[Yes]

9. Close-In Fault on: 0 CharlesPolet 345.kV - 0 E15ST 47 345.kV 1L 3LG FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 46291.0@ -83.0 0.0@ 0.0 0.0@ 0.0 46291.0@ -83.0 46291.0@ 157.0 46291.0@ 37.0 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 27888.7 X/R RATIO= 13.5481 R0/X1= 0.3945 X0/X1= 1.13748

 BUS
 0 CharlesPolet
 345.KV
 AREA
 7
 ZONE
 10
 TIER
 0
 (PREFAULT V=1.008@
 2.8 PU)

 + SEQ
 - SEQ
 0
 SEQ
 A PHASE
 B PHASE
 C PHASE

 VOLTAGE (KV, L-G)
 >
 0.000@
 0.0
 0.000@
 0.0
 0.000@
 0.0
 0.000@
 0.0

 BRANCH CURRENT (A) TO
 >
 0
 0.0@
 0.0
 0.0@
 0.0
 4266.3@
 1.2
 4266.3@-118.8

 16
 E15ST 48
 345.
 1L
 21007.8@
 94.6
 0.0@
 0.0@
 0.0
 21426.8@
 94.7
 21426.8@
 -25.3
 21426.8@-145.3

MONITORED BRANCH: 0 CharlesPolet 345.KV -> 0 E15ST 47 345.KV 1L

 + SEQ
 - SEQ
 0 SEQ
 A PHASE
 B PHASE
 C PHASE

 RELAY CURRENT (A)
 24895.8@ -81.0
 0.0@
 0.0
 0.0@
 0.0
 24895.8@ -81.0
 24895.8@ 39.0

BUS VOLTAGES (KV, L-G)

Appendix 27 - Short Circuit Study Results

 Appendix 27 - 10 Summary of fault being displayed:

 Prefault voltage: From a linear network solution

 Generator impedance: Subtransient

 MOV iteration:
 [Off]

 Ignore shunts with + seq value:
 [Yes]

 Ignore loads:
 [Yes]

 Ignore line G+jB:
 [Yes]

10. Close-In Fault on: 0 CharlesPolet 345.kV - 0 E15ST 47 345.kV 1L 2LG Type=B-C FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 29889.4@ -80.5 16393.4@ 93.0 13728.5@ 107.3 0.0@ 0.0 48112.2@ 162.3 41677.2@ 36.3 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 28986.0 X/R RATIO= 8.44801 R0/X1= 0.3945 X0/X1= 1.13748

 BUS
 0 CharlesPolet
 345.KV
 AREA
 7
 ZONE
 10
 TIER
 0
 (PREFAULT V=1.008@
 2.8 PU)

 + SEQ
 - SEQ
 0
 SEQ
 A PHASE
 B PHASE
 C PHASE

 VOLTAGE (KV, L-G)
 >
 71.510@
 -1.8
 71.510@
 -1.8
 214.529@
 -1.8
 0.000@
 0.0
 0.000@
 0.0

 BRANCH CURRENT (A) TO
 >
 0
 0
 AEII
 345.
 21
 3072.8@
 136.4
 1522.3@
 -88.6
 3134.8@
 -90.5
 3367.0@
 -131.1
 4472.4@
 -19.2
 5781.2@
 -111.1

 16<E15ST 48</td>
 345.
 1L
 13611.1@
 95.6
 7362.0@
 -86.9
 5344.4@
 -67.6
 1675.0@
 48.5
 21616.4@
 -17.6
 18275.5@
 -148.5

 0<E15ST 47</td>
 345.
 1L
 13881.8@
 95.8
 7509.8@
 -86.7
 5441.5@
 -67.6
 1692.0@
 49.3
 22025.3@
 -17.5
 18659.0@
 -148.4

 CURPENT TO FAULT (A)
 >
 29889.4@
 -80.5
 16393.4@
 93.0
 13728.5@
 107.3

CURRENT TO FAULT (A) > 29889.4@ -80.5 16393.4@ 93.0 13728.5@ 107.3 0.0@ 0.0 48112.2@ 162.3 41677.2@ 36.3 THEVENIN IMPEDANCE (OHM) > 4.33825@ 85.8 4.36211@ 85.2 5.20885@ 70.9

MONITORED BRANCH: 0 CharlesPolet 345.KV -> 0 E15ST 47 345.KV 1L

 + SEQ
 - SEQ
 0 SEQ
 A PHASE
 B PHASE
 C PHASE

 RELAY CURRENT (A)
 16063.6@ -77.2
 8883.7@ 92.8
 8322.0@ 104.0
 1692.0@ 49.3
 26087.2@ 162.1
 23135.2@ 40.2

BUS VOLTAGES (KV, L-G)

0 CharlesPolet 345.kV 71.510@ -1.8 71.510@ -1.8 71.510@ -1.8 214.529@ -1.8 0.000@ 0.0 0.000@ 0.0 0 E15ST 47 345.kV 98.453@ -2.9 57.028@ -0.1 40.399@ 6.2 195.513@ -0.2 50.727@-145.4 54.158@ 127.9 3Io= 24966.1@ 104.0 A Va/Ia= 127@ -51.1 Ohm (Va-Vb)/(Ia-Ib)= 8.01@ 12.7 Ohm (Zo-Z1)/3Z1 = 0.7127@-33.1

Appendix 27 - Short Circuit Study Results

 Appendix 27 - 11 Summary of fault being displayed:

 Prefault voltage: From a linear network solution

 Generator impedance: Subtransient

 MOV iteration:
 [Off]

 Ignore shunts with + seq value:
 [Yes]

 Ignore loads:
 [Yes]

 Ignore line G+jB:
 [Yes]

11. Close-In Fault on: 0 CharlesPolet 345.kV - 0 E15ST 47 345.kV 1L 1LG Type=A FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 14548.7@ -77.2 14548.7@ -77.2 14548.7@ -77.2 43646.1@ -77.2 0.0@ 0.0 0.0@ 0.0 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 26295.3 X/R RATIO= 5.68069 R0/X1= 0.3945 X0/X1= 1.13748

 BUS
 0 CharlesPolet
 345.KV
 AREA
 7
 ZONE
 10
 TIER
 0
 (PREFAULT V=1.008@
 2.8 PU)

 +
 SEQ
 SEQ
 0
 SEQ
 A
 PHASE
 B
 PHASE
 C
 PHASE

 VOLTAGE (KV, L-G)
 >
 138.170@
 0.2
 63.463@-172.1
 75.782@
 173.6
 0.000@
 0.0
 192.662@-123.0
 222.409@
 122.9

 BRANCH CURRENT (A) TO
 >
 0
 AEII
 345.
 2L
 2249.0@
 162.1
 1351.0@
 101.1
 3322.1@
 85.0
 5730.3@
 111.6
 4038.9@
 76.5
 2147.1@
 18.3

 16 E15ST 48
 345.
 1L
 6703.6@
 94.5
 6533.5@
 102.9
 5663.7@
 107.9
 18813.5@
 101.4
 2000.9@
 1075.1@
 162.1

 0 E15ST 47
 345.
 1L
 6835.9@
 94.6
 6664.8@
 103.0
 5766.6@
 107.8
 19180.7@
 101.5
 2038.0@
 103.1
 1072.1@
 162.1

 CURRENT TO FAULT (A)
 >
 14548.7@
 -77.2
 14548.7@
 -77.2</td

 + SEQ
 - SEQ
 0 SEQ
 A PHASE
 B PHASE
 C PHASE

 RELAY CURRENT (A)
 7841.6@ -70.1
 7884.0@ -77.4
 8819.2@ -80.5
 24474.0@ -76.2
 2038.1@ -103.1
 1072.1@ -161.4

BUS VOLTAGES (KV, L-G)

Appendix 27 - Short Circuit Study Results

 Appendix 27 - 12 Summary of fault being displayed:

 Prefault voltage: From a linear network solution

 Generator impedance: Subtransient

 MOV iteration:
 [Off]

 Ignore shunts with + seq value:
 [Yes]

 Ignore loads:
 [Yes]

 Ignore line G+jB:
 [Yes]

12. Close-In Fault on: 0 CharlesPolet 345.kV - 0 E15ST 47 345.kV 1L LL Type=B-C FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 23082.3@ -82.7 23082.3@ 97.3 0.0@ 0.0 0.0@ 0.0 39979.8@-172.7 39979.8@ 7.3 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 24086.4 X/R RATIO= 12.638 R0/X1= 0.3945 X0/X1= 1.13748

THEVENIN IMPEDANCE (OHM) > 4.33825@ 85.8 4.36211@ 85.2 5.20885@ 70.9

MONITORED BRANCH: 0 CharlesPolet 345.KV -> 0 E15ST 47 345.KV 1L

 + SEQ
 - SEQ
 0 SEQ
 A PHASE
 B PHASE
 C PHASE

 RELAY CURRENT (A)
 12344.9@ -78.4
 12508.5@ 97.1
 0.0@
 0.0
 991.1@
 18.9
 21995.9@ -170.4
 21018.4@
 9.1

BUS VOLTAGES (KV, L-G)

0 CharlesPolet 345.kV 100.688@ 2.5 100.688@ 2.5 0.000@ 0.0 201.375@ 2.5 100.688@-177.5 100.688@-177.5 0 E15ST 47 345.kV 121.347@ 0.5 80.297@ 4.2 0.000@ 0.0 201.543@ 1.9 111.981@-159.5 101.778@ 161.5 3Io= 0.0@-100.7 A Va/Ia= 203@-16.4 Ohm (Va-Vb)/(Ia-Ib)= 13.1@ -7.5 Ohm (Zo-Z1)/3Z1 = 0.7127 @-33.1

Appendix 27 - Short Circuit Study Results

 Appendix 27 - 13 Summary of fault being displayed:

 Prefault voltage: From a linear network solution

 Generator impedance: Subtransient

 MOV iteration:
 [Off]

 Ignore shunts with + seq value:
 [Yes]

 Ignore loads:
 [Yes]

 Ignore line G+jB:
 [Yes]

13. Close-In Fault on: 0 CharlesPolet 345.kV - 16 E15ST 48 345.kV 1L 3LG FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 46291.0@ -83.0 0.0@ 0.0 0.0@ 0.0 46291.0@ -83.0 46291.0@ 157.0 46291.0@ 37.0 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 27888.7 X/R RATIO= 13.5481 R0/X1= 0.3945 X0/X1= 1.13748

 BUS
 0 CharlesPolet
 345.KV
 AREA
 7
 ZONE
 10
 TIER
 0
 (PREFAULT V=1.008@
 2.8 PU)

 + SEQ
 - SEQ
 0
 SEQ
 A PHASE
 B PHASE
 C PHASE

 VOLTAGE (KV, L-G)
 >
 0.000@
 0.000@
 0.000@
 0.000@
 0.000@
 0.000@
 0.000@
 0.000@
 0.000@
 0.000@
 0.000@
 0.000@
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 0.000@
 0.000@
 0.000@
 0.000@
 0.000@
 0.000@
 0.000@
 0.000@

 CURRENT TO FAULT (A)
 > 46291.0@ -83.0
 0.0@
 0.0
 0.0@
 0.0
 46291.0@ -83.0
 46291.0@
 37.0

 THEVENIN IMPEDANCE (OHM)
 > 4.33825@
 85.8
 4.36211@
 85.2
 5.20885@
 70.9

MONITORED BRANCH: 0 CharlesPolet 345.KV -> 16 E15ST 48 345.KV 1L

 + SEQ
 - SEQ
 0 SEQ
 A PHASE
 B PHASE
 C PHASE

 RELAY CURRENT (A)
 25317.9@ -81.0
 0.0@
 0.0
 0.0@
 0.0
 25317.9@ -81.0
 25317.9@
 39.0

BUS VOLTAGES (KV, L-G)

Appendix 27 - Short Circuit Study Results

 Appendix 27 - 14 Summary of fault being displayed:

 Prefault voltage: From a linear network solution

 Generator impedance: Subtransient

 MOV iteration:
 [Off]

 Ignore shunts with + seq value:
 [Yes]

 Ignore loads:
 [Yes]

 Ignore line G+jB:
 [Yes]

14. Close-In Fault on: 0 CharlesPolet 345.kV - 16 E15ST 48 345.kV 1L 2LG Type=B-C FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 29889.4@ -80.5 16393.4@ 93.0 13728.5@ 107.3 0.0@ 0.0 48112.2@ 162.3 41677.2@ 36.3 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 28986.0 X/R RATIO= 8.44801 R0/X1= 0.3945 X0/X1= 1.13748

 BUS
 0 CharlesPolet
 345.KV
 AREA
 7
 ZONE
 10
 TIER
 0
 (PREFAULT V=1.008@
 2.8 PU)

 + SEQ
 - SEQ
 0
 SEQ
 A PHASE
 B
 B PHASE
 C
 C

 VOLTAGE (KV, L-G)
 >
 71.510@
 -1.8
 71.510@
 -1.8
 214.529@
 -1.8
 0.000@
 0.0
 0.000@
 0.0

 BRANCH CURRENT (A) TO
 >
 0
 0
 AEII
 345. 2L
 3072.8@
 136.4
 1522.3@
 -88.6
 3134.8@
 -90.5
 3367.0@
 -131.1
 4472.4@
 -19.2
 5781.2@
 -111.1

 16
 E15ST 48
 345. 1L
 13611.1@
 95.6
 7362.0@
 -86.9
 5344.4@
 -67.6
 1675.0@
 48.5
 21616.4@
 -17.6
 18275.5@
 -148.5

 0
 E15ST 47
 345. 1L
 13881.8@
 95.8
 7509.8@
 -86.7
 5441.5@
 -67.6
 1692.0@
 49.3
 22025.3@
 -17.5
 18659.0@
 -148.4

 CURRENT TO FAULT (A)
 > 29889.4@ -80.5
 16393.4@ 93.0
 13728.5@ 107.3
 0.0@
 0.0
 48112.2@ 162.3
 41677.2@ 36.3

 THEVENIN IMPEDANCE (OHM)
 > 4.33825@ 85.8
 4.36211@ 85.2
 5.20885@ 70.9

MONITORED BRANCH: 0 CharlesPolet 345.KV -> 16 E15ST 48 345.KV 1L

 + SEQ
 - SEQ
 0 SEQ
 A PHASE
 B PHASE
 C PHASE

 RELAY CURRENT (A)
 16336.8@ -77.2
 9031.5@ 92.9
 8419.0@ 104.1
 1675.0@ 48.5
 26495.9@ 162.2
 23519.6@ 40.1

BUS VOLTAGES (KV, L-G)

Appendix 27 - Short Circuit Study Results

 Appendix 27 - 15 Summary of fault being displayed:

 Prefault voltage: From a linear network solution

 Generator impedance: Subtransient

 MOV iteration:
 [Off]

 Ignore shunts with + seq value:
 [Yes]

 Ignore loads:
 [Yes]

 Ignore line G+jB:
 [Yes]

15. Close-In Fault on: 0 CharlesPolet 345.kV - 16 E15ST 48 345.kV 1L 1LG Type=A FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 14548.7@ -77.2 14548.7@ -77.2 14548.7@ -77.2 43646.1@ -77.2 0.0@ 0.0 0.0@ 0.0 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 26295.3 X/R RATIO= 5.68069 R0/X1= 0.3945 X0/X1= 1.13748

MONITORED BRANCH: 0 CharlesPolet 345.KV -> 16 E15ST 48 345.KV 1L

 + SEQ
 - SEQ
 0 SEQ
 A PHASE
 B PHASE
 C PHASE

 RELAY CURRENT (A)
 7973.9@ -70.3
 8015.2@ -77.3
 8922.0@ -80.5
 24842.1@ -76.2
 2000.9@ -103.9
 1075.1@ -162.1

BUS VOLTAGES (KV, L-G)

0 CharlesPolet 345.kV 138.170@ 0.2 63.463@-172.1 75.782@173.6 0.000@ 0.0 192.662@-123.0 222.409@122.9 16 E15ST 48 345.kV 151.108@ -0.5 50.868@-170.4 43.375@-178.6 58.593@ -10.6 191.639@-117.2 204.325@119.3 3Io= 26766.1@ -80.5 A Va/Ia= 1.74e-015@ 85.7 Ohm (Va-Vb)/(Ia-Ib)= 8.34@130.8 Ohm (Zo-Z1)/3Z1 = 0.7127 @-33.1

Appendix 27 - Short Circuit Study Results

 Appendix 27 - 16 Summary of fault being displayed:

 Prefault voltage: From a linear network solution

 Generator impedance: Subtransient

 MOV iteration:
 [Off]

 Ignore shunts with + seq value:
 [Yes]

 Ignore loads:
 [Yes]

 Ignore line G+jB:
 [Yes]

16. Close-In Fault on: 0 CharlesPolet 345.kV - 16 E15ST 48 345.kV 1L LL Type=B-C FAULT CURRENT (A @ DEG) + SEQ - SEQ 0 SEQ A PHASE B PHASE C PHASE 23082.3@ -82.7 23082.3@ 97.3 0.0@ 0.0 0.0@ 0.0 39979.8@-172.7 39979.8@ 7.3 THEVENIN IMPEDANCE (OHM) 0.31934+j4.32648 0.36693+j4.34665 1.70682+j4.92127

SHORT CIRCUIT MVA= 24086.4 X/R RATIO= 12.638 R0/X1= 0.3945 X0/X1= 1.13748

CURRENT TO FAULT (A) > 23082.3@ -82.7 23082.3@ 97.3 0.0@ 0.0 0.0@ 0.0 39979.8@-172.7 39979.8@ 7.3 THEVENIN IMPEDANCE (OHM) > 4.33825@ 85.8 4.36211@ 85.2 5.20885@ 70.9

MONITORED BRANCH: 0 CharlesPolet 345.KV -> 16 E15ST 48 345.KV 1L

 + SEQ
 - SEQ
 0 SEQ
 A PHASE
 B PHASE
 C PHASE

 RELAY CURRENT (A)
 12557.1@ -78.4
 12716.5@ 97.2
 0.0@ 0.0
 972.8@ 18.8
 22351.8@ -170.4
 21392.2@ 9.2

BUS VOLTAGES (KV, L-G)

Appendix 28 Relay Coordination between Charles Poletti Station and Farragut Station

CTR =	400												PTR =	3000
Case	3I0 Mag (Amp)	3I0 Angle	V0 Mag (kV)	V0 Angle	kVA Product	VA @ Relay	Per Unit of Pickup VA	Relay	Pickup VA	Time Dial	Time (Sec)	Q35L-67N Time (Sec)	Q35M-67N Time (Sec)	CTI (Sec)
1	55651	-82.2	61.22	176	9709533.869	8091.28	80.91	67N-1/F4E 67N-2/F4E	100	3	0.15	0.66	0.67	0.51
FDR45	Case 1: 1LG fault at relay (67N-1/F4E or 67N-2/F4E) close-in with the largest source (Line 41) out of service and maximum contribution from Charlie Poletti station.													
2	55293	-82.1	61.69	175.7	9743211.971	8119.34	81.19	67N-1/F4E 67N-2/F4E	100	3	0.15	-	0.52	0.37
FDR45	R45 Case 2: 1LG fault at relay (67N-1/F4E or 67N-2/F4E) close-in with the largest source (Line 41) out of service and maximum contribution from Charlie Poletti station. Line Q35L at Charlie Poletti is out of service.													
3	55294	-82.1	61.71	175.7	9746547.004	8122.12	81.22	67N-1/F4E 67N-2/F4E	100	3	0.15	0.52	-	0.37
FDR45	Case 3: 1LG fault at relay (67N-1/F4E or 67N-2/F4E) close-in with the largest source (Line 41) out of service and maximum contribution from Charlie Poletti station. Line Q35M at Charlie Poletti is out of service.													
4	55820	-82.4	61.22	176	9727783.122	8106.49	81.06	67N-1/F8W 67N-2/F8W	100	3	0.15	0.66	0.67	0.51
FDR46	Case 4: 1 Charlie P	ILG fau oletti si	ilt at relay tation.	(67N-1/F	F8W or 67N-2/F	8W) close	e-in with the	largest sourc	e (Line 4	1) out	of service an	d maximum	contribution f	rom
5	55500	-82.2	61.69	175.7	9774192.486	8145.16	81.45	67N-1/F8W 67N-2/F8W	100	3	0.15	-	0.52	0.37
FDR46	Case 5: 1 Charlie P	ILG fau oletti si	ılt at relay tation. Lin	(67N-1/F e Q35L a	- 8W or 67N-2/F t Charlie Polett	8W) close i is out of	e-in with the service.	largest sourc	e (Line 4	1) out	of service an	d maximum	contribution f	rom
6	55500	-82.2	61.71	175.7	9777361.295	8147.80	81.48	67N-1/F8W 67N-2/F8W	100	3	0.15	0.52	-	0.37
FDR46	Case 6: 1 Charlie P	LG fau oletti st	ilt at relay tation. Lin	(67N-1/F e Q35M ;	F8W or 67N-2/F at Charlie Polet	8W)close ti is out of	e-in with the I f service.	argest source	e (Line 4'	1) out c	of service and	d maximum c	contribution f	om
7	53026	-82.6	61.22	176	9230084.493	7691.74	38.46	67N-1/F2E 67N-2/F2E	200	2.5	0.2	0.66	0.67	0.46
FDR61	Case 7: 1 Charlie P	ILG fau oletti st	ilt at relay tation.	(67N-1/F	2E or 67N-2/F	2E) close·	-in with the la	argest source	(Line 41) out o	f service and	maximum co	ontribution fr	om
8	52690	-82.4	61.69	175.7	9268800.459	7724.00	38.62	67N-1/F2E 67N-2/F2E	200	2.5	0.2	-	0.52	0.32

		1			,									
CTR =	400												PTR =	3000
	Case 8: 7	ILG fau	ilt at relay	(67N-1/F	=2E or 67N-2/F	2E) close-	in with the I	argest source	(Line 41) out o	f service and	maximum co	ontribution fr	om
FUROI	Charlie P	oletti st	tation. Lin	e Q35L a	at Charlie Polett	i is out of	service.							
								67N-1/F2E						
9	52667	-82.4	61.71	175.7	9267758.133	7723.13	38.62	67N-2/F2E	200	2.5	0.2	0.52	-	0.32
	Case 9: 1	ILG fau	lt at relav	(67N-1/		2E) close-	in with the l	argest source	(Line 41) out o	f service and	maximum co	ontribution fr	om
FDR61	Charlie P	oletti st	ation. Lin	e Q35M	at Charlie Polet	ti is out of	service.	0	、	,				
								67N-1/F4W						
10	53886	-82.6	61 22	176	9379782 239	7816 49	39.08	67N-2/F4W	200	25	0.2	0.66	0.67	0.46
10	C_{250} 10:	11 C fo		170 v (67NL1	(E4) or 67 M ₋ 2	(E4)(A) close	oo.oo	e largest sour	co (Lino	41) ou	t of service a	nd maximum	contribution	from
FDR62	Case 10. Charlie B	olotti et	tation		/1 400 01 0711-2/	1 400) 0103		e largest sour		41) 00	t of service a		Contribution	mom
			auon.				[
	50550	00.5	04.00		0445754 40	704040	00.00	67N-1/F4VV	000	0.5	<u> </u>		0.50	0.00
11	53556	-82.5	61.69	1/5./	9415751.46	7846.46	39.23	67N-2/F4VV	200	2.5	0.2		0.52	0.32
FDR62	R62 Charles Deletti station Line Q25L at Charlie Deletti is sut of service and maximum contribution from [
	Charlie P	oletti st	tation. Lin	e Q35L a	at Charlie Polett	i is out of	service.							
								67N-1/F4W						
12	53533	-82.5	61.71	175.7	9414759.09	7845.63	39.23	67N-2/F4W	200	2.5	0.2	0.52	-	0.32
EDB62	Case 12: 1LG fault at relay (67N-1/F4W or 67N-2/F4W) close-in with the largest source (Line 41) out of service and maximum contribution from													
FDR02	Charlie P	oletti st	tation. Lin	e Q35M	at Charlie Polet	ti is out of	service.							
								67N-1/FBT						
13	52970	-82.6	61.22	176	9220336.733	7683.61	38.42	67N-2/FBT	200	2.5	0.2	0.66	0.67	0.46
	Case 13:	1LG fa	ult at rela	v (67N-1	/FBT or 67N-2/	FBT) clos	e-in with the	e largest sourc	e (Line 4	1) out	of service an	d maximum	contribution	from
FDR63	Charlie P	oletti st	ation.	.) (0111) 0.00	•	, al geet eeu e	0 (0	,				
								67N-1/FBT						
14	52634	-82.4	61 69	175 7	9258949 39	7715 79	38 58	67N-2/FBT	200	25	0.2	_	0.52	0.32
- 17	Coco 14:	1L C fo	ult at role	170.7 v (67N 1	/EPT or 67N 2/		o in with the		200 a (Lina (2.0	of convice on	d movimum	oontribution	from
FDR63	Case 14.	ILG IA	uit at reia	IY (07 IN- I.	/FDI UI 0/IN-2/I	i in out of		angest sourc	e (Line 4	FI) Out	or service an	iu maximum	contribution	nom
	Chanle P	oletti si	ation. Lin	e Q35L a	at Chanle Polett	I IS OUT OF	service.							
l								67N-1/FBT						
15	52610	-82.4	61.71	175.7	9257727.901	7714.77	38.57	67N-2/FBT	200	2.5	0.2	0.52	-	0.32
EDB63	Case 15:	1LG fa	ult at rela	iy (67N-1	/FBT or 67N-2/	FBT) clos	e-in with the	e largest sourc	e (Line 4	1) out	of service an	d maximum	contribution	from
	Charlie P	oletti st	tation. Lin	e Q35M	at Charlie Polet	ti is out of	service.							
								67N-1/B7E						
16	55224	-81.9	61.22	176	9651488.993	8042.91	26.81	67N-2/B7E	300	3	0.29	0.66	0.67	0.37

Appendix 28 Relay Coordination between Charles Poletti Station and Farragut Station

CTR -	400	-	•		•						•		PTR -	3000
	400 Case 16:	11 G fa	ult at rola	v (67N-1)	/B7E or 67N-2/	B7E) close	a-in with the	largest source	o (Lino /	11) out	of service an	d maximum	- FTIX -	from
B47	Charlie P	oletti st	ation	y (071 1 -17				largest source		ri) Out	of service an		contribution	nom
	onanio i							67N-1/B7E						
17	58244	-82	61.69	175.7	10268944.91	8557.45	28.52	67N-2/B7E	300	2.5	0.27	-	0.52	0.25
_	Case 17:	1LG fa	ult at rela	v (67N-1/	/B7E or 67N-2/	B7E) close	e-in with the	largest source	e (Line 4	1) out	of service an	d maximum	contribution	from
B47	⁴⁷ Charlie Poletti station. Line Q35L at Charlie Poletti is out of service.													
								67N-1/F2W						[]
18	55868	-82	61.22	176	9758521.651	8132.10	27.11	67N-2/F2W	300	3	0.29	0.66	0.67	0.37
FDD 40														
FDR48	Case 18:	ILG fa	uit at reia	y close-ir	n with the larges	st source	(Line 41) ou	t of service an	ia maxin	num co	ontribution fro	m Charlie Po	letti station.	
								67N-1/F2W						Γ
19	58950	-82.1	61.71	175.7	10390981.77	8659.15	28.86	67N-2/F2W	300	3	0.27	0.52	-	0.25
	Case 19:	1LG fa	ult at rela	y (67N-1/	/B7E or 67N-2/	B7E) close	e-in with the	largest source	e (Line 4	1) out	of service an	d maximum	contribution	from
FUR40	Charlie P	oletti st	ation. Lin	e Q35M a	at Charlie Polet	ti is out of	service.							
								67N-1/B7E						
20	15788	-70.4	34.95	-173.6	1584719.7	1320.60	4.40	67N-2/B7E	300	3	1.7	-	0.47	1.23
B47	Case 20:	1LG fa	ult at rela	y (Q35M∙	-67N @ Charlie	e Poletti) c	lose-in with	the AEII (G13) station	in of s	ervice, which	is normal.		
		(170.0			- 10	67N-1/B7E					o 17	
21	17522	-75.4	38.79	-1/8.6	1952008.096	1626.67	5.42	6/N-2/B/E	300	2.5	1.4	-	0.47	0.93
B47	Case 21:	1LG fa	uit at reia	y (Q35M∙	-67N @ Charlie	e Poletti) c	lose-in with	the AEII (G13) station	out of	service.			r
22	15920	70.4	24.05	172.6	1500020 022	1224 97	1 10	07IN-1/F2VV 67N-2/F2\//	200	2	17	0.45		1.25
	Case 22:	-70.4 11 G fa	oult at rela	-173.0 av (0351 -	-67N @ Charlie	Poletti) c	4.42	the AFII (G13) station	in of s	ervice which	is normal	-	1.20
1 DI(40	0030 22.			ly (QUUL				67N-1/F2W	/ 31211011	11 01 3		is normal.		r
23	17579	-75.4	38.79	-178.6	1958358.082	1631.97	5.44	67N-2/F2W	300	3	1.4	0.46	-	0.94
FDR48	Case 23:	1LG fa	ult at rela	y (Q35L-	67N @ Charlie	Poletti) cl	ose-in with t	he AEII (G13)	station	out of	service.			0.01

Appendix 28 Relay Coordination between Charles Poletti Station and Farragut Station

CTR = 400 PTR												PTR =	3000	
Cono	3I0 Mag	310	V0 Mag	V0	kVA	VA @	Per Unit of		Pickup	Time	Time	G13-67N		CTI
Case	(Amp)	Angle	(kV)	Angle	Product	Relay	Pickup VA	Relay	VA	Dial	(Sec)	Time (Sec)		(Sec)
								67N-1/F2W						
24	15788	-70.4	34.95	-173.6	1584719.7	1320.60	4.40	67N-2/F2W	300	3	1.7	0	-	1.7
FDR48	Case 14:	1LG fa	ult at rela	y (G13-6	7N @ Charlie F	Poletti) clo	se-in.							
								67N-1/F2W						
25	15839	-70.4	34.95	-173.6	1589838.822	1324.87	4.42	67N-2/F2W	300	3	1.7	0	-	1.7
Case	ase Case 25: 1LG fault at relay (G13-67N @ Charlie Poletti) close-in.													

TYPE CWC AND CWP RELAYS ____



Fig. 11. Typical Time Curves of the Type CWP Relay at Maximum Torque Angle - Curves Apply if the Multiple of Tap Product in Volt-Amperes Does Not Exceed the Polarizing Voltage in Volts.




















CTR =	400												PTR =	3000
Cono	3I0 Mag	310	V0 Mag	V0	kVA	VA @	Per Unit of		Pickup	Time	Time	Q35L-67N	Q35M-67N	CTI
Case	(Amp)	Angle	(kV)	Angle	Product	Relay	Pickup VA	Relay	VA	Dial	(Sec)	Time (Sec)	Time (Sec)	(Sec)
								67N/Q35M						
1	16989	-72.1	43.37	-178.6	2149364.19	1791.14	5.97	@E13	300	3	1.3	0.47	-	0.83
Q35M	Case 1: 1	ILG fau	lt at relay	(Q35L-6	7N @ Charlie I	Poletti) clo	se-in with th	e AEII (G13)	station in	n of se	rvice, which is	s normal.		
								67N/Q35M						
2	18855	-77.2	48.13	176.3	2647251.292	2206.04	7.35	@E13	300	3	1	0.47	-	0.53
Q35M	Case 2: 1	LG fau	lt at relay	(Q35L-6	7N @ Charlie I	Poletti) clo	se-in with th	e AEII (G13)	station o	ut of s	ervice.			
Case	3I0 Mag	310	V0 Mag	V0	kVA	VA @	Per Unit of		Pickup	Time	Time	G13-67N		CTI
Case	(Amp)	Angle	(kV)	Angle	Product	Relay	Pickup VA	Relay	VA	Dial	(Sec)	Time (Sec)		(Sec)
								67N/Q35M						
3	16989	-72.1	43.37	-178.6	2149364.19	1791.14	5.97	@E13	300	3	1.3	0	-	1.3
Q35M	Case 3: 1	LG fau	lt at relay	(G13-67	N @ Charlie P	oletti) clos	e-in.							
								67N/Q35M						
4	23667	-66.9	36.25	-176.9	2534684.654	2112.24	7.04	@E13	300	3	1.1	0	-	1.1
Q35M	Case 4: 1	LG fau	It at relay	(G13-67	N @ Charlie P	oletti) clos	e-in with Q3	5L line out of	serice.					
Case	3I0 Mag	310	V0 Mag	V0	kVA	VA @	Per Unit of		Pickup	Time	Time	Q35L-67N	Q35M-67N	CTI
Case	(Amp)	Angle	(kV)	Angle	Product	Relay	Pickup VA	Relay	VA	Dial	(Sec)	Time (Sec)	Time (Sec)	(Sec)
								67N/Q35L						
5	17297	-72.2	42.81	-178.3	2156401.729	1797.00	5.99	@E13	300	3	1.3	-	0.47	0.83
Q35L	Case 5: 1	LG fau	It at relay	(Q35M-6	67N @ Charlie	Poletti) cl	ose-in with th	ne AEII (G13)	station i	n of se	rvice, which	is normal.		
								67N/Q35L						
6	19198	-77.2	47.51	176.6	2657305.932	2214.42	7.38	@E13	300	3	1	-	0.47	0.53
Q35L	Case 6: 1	LG fau	It at relay	(Q35M-6	67N @ Charlie	Poletti) cl	ose-in with th	ne AEII (G13)	station	out of s	service.	-		
Case	3I0 Mag	310	V0 Mag	V0	kVA	VA @	Per Unit of	_	Pickup	Time	Time	G13-67N		CTI
ouco	(Amp)	Angle	(kV)	Angle	Product	Relay	Pickup VA	Relay	VA	Dial	(Sec)	Time (Sec)		(Sec)
								67N/Q35L				_		
7	17297	-72.2	42.81	-178.3	2156401.729	1797.00	5.99	@E13	300	3	1.3	0	-	1.3
Q35L	Case 7: 1	LG fau	It at relay	(G13-67	N @ Charlie P	oletti) clos	e-in.							
	00040	07	25.00	170 5	0540040 455	2000.04	7.00	0/IV/Q35L	200	2		0		
8 Oper	23946	-67	35.66	-1/0.5	2518846.455	2099.04	7.00		300	১	1.1	U	-	1.1
Q35L	Case 8: 1	LG Tau	it at relay	(613-6/	in e Charile P	Dietti) Clos	e-in with Q3		serice.					

Note: It is noted that coordination between Q35L-67N or Q35M-67N at Charlie Poletti and 67N/48 or 67N/B47 at East 13th street for a relay close-in fault at East 13th line 48 or B47 is not needed, since there is no 345kV breaker at East 13th station.

Con Ed requires to confirm if there is no need for setting changes of the ground backup relays at E13th street station because of the new GSU's.

The following short circuit calculations have been done for this purpose.

1. Applying a single phase to ground fault at E15ST-47 bus with Poletti Generation (existing) Station in and Charles Poletti (New) Station out.

2. Applying a single phase to ground fault at E15ST-47 bus with Poletti Generation (existing) Station out and Charles Poletti (New) Station in.

3. Applying a single phase to ground fault at E15ST-48 bus with Poletti Generation (existing) Station in and Charles Poletti (New) Station out.

4. Applying a single phase to ground fault at E15ST-48 bus with Poletti Generation (existing) Station out and Charles Poletti (New) Station in.

Note:

1. In NYISO Aspen model, E15ST is used for East 13th street station.

2. The impact of the adjacent BERRIANS 3 station to be built shall be evaluated during its design and engineering in the future.

Ground Fault Comparision between the Poletti Station (existing) and Charles Poletti (New) Station.

	Total 1LG fault current (A)	Differen	1LG Contribution From Poletti (A)	1LG Contribution From Charles Poletti (A	Difference
Case 1	53615		6881	0	
Case 2	53747	0.25%	0	6933	0.76%
Case 3	52895		6878	0	
Case 4	53021	0.24%	0	6930	0.76%

Conclusion: the ground fault differences between the existing Poletti station and the new Charles Poletti station are neglectable.



Case 1 A single phase to ground fault at E15ST-47 bus with Poletti Generation (existing) Station in and Charles Poletti (New) Station out.



Case 2 A single phase to ground fault at E15ST-47 bus with Poletti Generation (existing) Station out and Charles Poletti (New) Station in.



Case 3 A single phase to ground fault at E15ST-48 bus with Poletti Generation (existing) Station in and Charles Poletti (New) Station out.



Case 4 A single phase to ground fault at E15ST-48 bus with Poletti Generation (existing) Station out and Charles Poletti (New) Station in.





Attachment 01

Transmission Line Impedance Calculation

ACSR Table Data

Description	Posistivity	Resistance	GMP	Inductive	Conductor
Lesenption		ra @ 25c	GINIK	Ха	per Phase
	ohm-meters	ohm/mile	ft	ohm/mile	N/A
1192.5kcmil 45/7 ACSR Bunting	100	0.08050	0.04310	0.38200	2
Equivalent depth of return De = 2160	*sqrt(p/f) in feet =	2788.55		wh	ere f = 60 Hz
Description	Longth	Ground	dab	dbc	dea
	mile	Wire Num	ft	dDC ft	uca ft
1192 5kcmil 45/7 ACSR Bunting	0.35038		18.00	18.00	36.00
1102.0komin 40/1 /Koork Bunking	0.00000		10.00	10.00	30.00
GMD in feet =		22 67858			
Zero-sequence impedance - no grou	nd wire Z0 (a) in feet =	0.36670	+i	2 51192	
Zero-sequence self impedance Z0(g)	in ohms per mile =	0.52770	; 	4 03250	
		0.02110	•,	1.00200	
Design Data 1					
Description	Length	Ground	dag1	dbg1	dcg1
	mile	Wire Num	ft	ft	ft
1192.5kcmil 45/7 ACSR Bunting	0.35038	1	15.00	33.00	51.00
Zero-sequence ground mutal impeda	nce Z0(ag) ohms/mile =	0.28620	+j	1.65795	
	Z0(ag)^2 =	-2.66688	+j	0.94901	
	Z0(ag)^2/Z0(g) =	0.14629	+j	0.68049	
	Z0 = Z0(a) - Z0(ag)^2/Z0(g) =	0.22041	+j	1.83143	
Description	kV	R1	X1	R0	X0
		ohms/mile	ohms/mile	ohms/mile	ohms/mile
1192.5kcmil 45/7 ACSR Bunting	345	0.04025	0.38038	0.11020	0.91572
Description	k\/	R1	X1	R0	X0
	N V	ohms	ohms	ohms	ohms

Zbase = 1190.25 ohms @ 100 MVA

1192.5kcmil 45/7 ACSR Bunting

Description	k)/	R1	X1	R0	X0
		per unit	per unit	per unit	per unit
1192.5kcmil 45/7 ACSR Bunting	345	0.00001	0.00011	0.00003	0.00027
CTR = 600	PTR =	3000			
CTR/PTR= 0.2					
Description			V/A	D 0	Vo

0.01410

0.13328

0.03861

345

	Description	<i>L</i> //	R1	X1	R0	XU
		K V	2nd Ohms	2nd Ohms	2nd Ohms	2nd Ohms
1192.5kcm	nil 45/7 ACSR Bunting	345	0.00282	0.02666	0.00772	0.06417
				Z1		Z0
				2nd Ohms		2nd Ohms
				0.02680		0.06463

0.32085

Attachment 02 Transformer Data

Data provided via an email

From: Cliff.Nebeker@slthermal.com [mailto:Cliff.Nebeker@slthermal.com] Sent: Monday, June 08, 2009 12:39 PM To: Scott Chiappetta; Astoria II Project; Eric.Anderson@nypa.gov; Fred.Pagano@nypa.gov; MURPHYP@coned.com; mazzattor@coned.com; Nick.Johnson@slthermal.com; Cliff.Nebeker@slthermal.com Cc: David Klein Subject: RE: Astoria II relay meeting notes

Zero sequence impedances and X/R ratioes are assumptions.

B.1 Combu	stion turb	ine-gener	ator step-up trans	sformer (typ	ical for t	wo units)		
H Voltage	345	KV	Wye grounded	@	129	172	215	MVA
X Voltage	18	KV	Delta	@	129	172	215	MVA
Zps =	8.50%	@129MV'	A	X/R=	45	(assumed)		
Zps =	0.0019	+j	0.0850	Zps0 =	0.0019	+j	0.0850	(assumed)
		@ MVA=	129			@ MVA=	129	
B.2 Steam	turbine-ge	enerator st	tep-up transforme	er				
H Voltage	345	KV	Wye grounded	@	192	256	320	MVA
X Voltage	18	KV	Delta	@	192	256	320	MVA
Zps =	8.50%	@192MV'	A	X/R=	45	(assumed)		
Zps =	0.0019	+j	0.0850	Zps0 =	0.0019	+j	0.0850	(assumed)
		@ MVA=	192			@ MVA=	192	

Attachment 03 Turbine Generator Data

Data provided via an attachment of "345KV InterconnectionReq.doc" from an email

From: Cliff.Nebeker@slthermal.com [mailto:Cliff.Nebeker@slthermal.com]

Sent: Monday, June 08, 2009 12:39 PM

To: Scott Chiappetta; Astoria II Project; Eric.Anderson@nypa.gov; Fred.Pagano@nypa.gov;

MURPHYP@coned.com; mazzattor@coned.com; Nick.Johnson@slthermal.com;

Cliff.Nebeker@slthermal.com

Cc: David Klein

Subject: RE: Astoria II relay meeting notes

C.1 Combustion turbine-generator (typical for two units)

		())	
1	Unit Rating in MVA	226.0000	
2	Connection Type:	WYE	

2					
3	Substransient impedance in R+jX" format.	0.0029	+j	0.145	'@ Unit MVA
	Transient impedance in R+jX' format.	0.0029	+ <i>j</i>	0.255	'@ Unit MVA
	Synchronous impedance in R+jX format	0.0029	+ <i>j</i>	2.04	'@ Unit MVA
	Negative sequence impedance in R+jX format	0.0136	+ <i>j</i>	0.146	'@ Unit MVA
	Zero sequence impedance in R+jX format	0.0072	+ <i>j</i>	0.12	'@ Unit MVA
	Neutral Impedance (in actual Ohms) in R+jX format	0	+ <i>j</i>	0.3456	ohms

C.2 Steam turbine-generator

- 1 Unit Rating in MVA <u>325.0000</u>
- 2 Connection Type: <u>WYE</u>
- 3 Substransient impedance in R+jX" format. '@ Unit MVA 0.0028 0.175 +j Transient impedance in R+jX' format. '@ Unit MVA 0.0028 0.26 +j Synchronous impedance in R+jX format 0.0028 '@ Unit MVA +j 1.96 Negative sequence impedance in R+jX format 0.0139 0.177 '@ Unit MVA +j Zero sequence impedance in R+iX format 0.0063 '@ Unit MVA 0.125 +j Neutral Impedance (in actual Ohms) in R+jX format 0.3456 0 +j ohms

	Data provided r	or Asnen Mor		13 CV08 AT	RA rov3a	
MVA_Base = CTR =	100 600	kV_Base = PTR =	345 3000	Z_Base =	1190.25	ohms
Line ID	From	То	R1(pu)	X1(pu)	R0(pu)	X0(pu)
Q35L	Charles Poletti	E13th Street.	0.00033	0.0016	0.00279	0.00408
Q35M	Charles Poletti	E13th Street.	0.00033	0.0016	0.00279	0.00408
B47	E13th Street.	FARRAGUT	0.00009	0.00041	0.00083	0.00107
48	E13th Street.	FARRAGUT	0.00009	0.00044	0.00089	0.00114
B43 [Note 1]	FARRAGUT	B43 Bus	0.00001	0.00004	0.0001	0.00016
B45	FARRAGUT	E13th Street.	0.00009	0.00043	0.0008	0.0011
46	FARRAGUT	E13th Street.	0.00009	0.00044	0.00089	0.00112
63	FARRAGUT	RAINEY	0.00031	0.00174	0.00332	0.00486
61	FARRAGUT	RAINEY	0.00031	0.00174	0.00334	0.0049
62	FARRAGUT	RAINEY	0.00034	0.00189	0.00383	0.0055
42	FARRAGUT	Gow S SR	0.00017	0.00096	0.00192	0.00279
41	FARRAGUT	Gow S SR	0.00017	0.00096	0.00177	0.00267

Attachment 04 345KV CABLE DATA

Note 1: B43 is the shortest 345 line out from Farrgut station.

Line ID	From	То	R1(ohms)	X1(ohms)	R0(ohms)	X0(ohms)
Q35L	Charles Poletti	E13th Street.	0.3927825	1.9044	3.3207975	4.85622
Q35M	Charles Poletti	E13th Street.	0.3927825	1.9044	3.3207975	4.85622
B47	E13th Street.	FARRAGUT	0.1071225	0.4880025	0.9879075	1.2735675
48	E13th Street.	FARRAGUT	0.1071225	0.52371	1.0593225	1.356885
B43 [Note 1]	FARRAGUT	B43 Bus	0.0119025	0.04761	0.119025	0.19044
B45	FARRAGUT	E13th Street.	0.1071225	0.5118075	0.9522	1.309275
46	FARRAGUT	E13th Street.	0.1071225	0.52371	1.0593225	1.33308
63	FARRAGUT	RAINEY	0.3689775	2.071035	3.95163	5.784615
61	FARRAGUT	RAINEY	0.3689775	2.071035	3.975435	5.832225
62	FARRAGUT	RAINEY	0.404685	2.2495725	4.5586575	6.546375
42	FARRAGUT	Gow S SR	0.2023425	1.14264	2.28528	3.3207975
41	FARRAGUT	Gow S SR	0.2023425	1.14264	2.1067425	3.1779675
Line ID	From	To	R1(ohms)	X1(ohms)	R0(ohms)	X0(ohms)

Line ID	From	То	R1(ohms)	X1(ohms)	R0(ohms)	X0(ohms)
Q35L+B47	Charles Poletti	FARRAGUT	0.499905	2.3924025	4.308705	6.1297875
Q35M+48	Charles Poletti	FARRAGUT	0.499905	2.42811	4.38012	6.213105

SIZE	DWG NO			SH	REV						
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					REV		DESCR	IPTION		DATE	APPROVED
	$) \in$										
	REV STATUS	OF SHEE	TS								
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1	-										
2	-										
3	-										
4	-										
5	-										
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					Co	nstructors Inc.	NO EXCEP	TIONS TAKEN, A	CCEPTED AS FINAL, RESU WITH FABRICATION.	BMITTAL	
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					and design drawi This review does	ng. L ² not relieve	PROCEED	WITH FABRICATI	ION.	ERENCE	
					the vendor of his for errors in desig	responsibility in and detailing	ONLY. CANCELLE	Đ			
					Vendor: GEN	IERAL ELECTRIC - 0	GENE No.: CO	- 1 3-10	707 (Rev: - D	ate Rec'd	
					Doc. Title:	ELECTRICAL DATA	, GENERATOR	IS Page	۲ <u>ه</u> ا	19/2008	
			+		Client Code:	VTC	Project: A	Astoria II Coge	eneration Project	Submittel	
					Date: 26	- Sept-0	8 0620 - T17	70-0003 - 001		01	
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					SNC LA	VALIN CON	ISTRUCT	ORS INC	C. CONTRAC	T NO. 062	0
					P.O. NU	MBER 6200)0001, SF	PECIFICA	ATION SP-T1	70	
					PROJE	CT NAME: F	PHASE II			XPANSIO	
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3 PL DECIMALS <u>+</u> ANGLES+					SSUED H.A. S	OUTH	9/17/2008	-	Astoria E	nergy II LL	C
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DT-2N				+	SIM TO: NON	E		SCALE	DFT U	NIT NR5E	SHEET 1

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SIZE DWG NO A 237A7271	SH F 2 -	REV					
	ESTIMATE	D GENERAT	OR DA	TA			
Customer: Astor	ria Energy II LLC	C					
Station/Project: Phase	e II Astoria Ene	rgy Expansio	on Proje	ect			
Senerator Number: 290T	769						
Generator Type: 324LI	D						
Data for Proposal No/Electrical Design	ο· G347T19Δ	Sa	n 11 20	10.8			
ATB 2 325000 kVA 3600 RI	PM 18000 Volts	s 0.85 PF 4	l5 osia	40 °C 0	as 27	6250 kW 10424 Amp	;
700 Field Volt	s 12 Ft Alt 0.5	SCR 60 Hz	3 Ph	ase WY	E Conn	nection	-
Exciter Rating							
Type Static							
 235 kW 700 Volts 1764 D.C.Amps	Field Amps @) Generator ra	ated Loa	ad 1568			
Fotal temperatures are guaranteed	not to exceed	Inculati	ion Cla	ee		Tomporaturo Piso	
Stator coils: 104 °C by embedded deta	ector	Armatu	re	F		R	
		Field cla		F		B	
Field coils 120 °C by Resistance		1 16 16 1 1 11					
Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD				ı			
Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD Cooling water Requirements @ Ge r	nerator Rating (<u> C901 - Data)</u>					
Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD <u>Cooling water Requirements @ Ger</u> Generator Output:	herator Rating (325000	C901 - Data) Kva					
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Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD <u>Cooling water Requirements @ Ger</u> Generator Output: Loss to Coolers: Inlet Water Temperature:	<u>nerator Rating ((</u> 325000 2275 Kw 30 °C	C901 - Data) Kva					
Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD <u>Cooling water Requirements @ Ger</u> Generator Output: Loss to Coolers: Inlet Water Temperature: Outlet Cold Gas Temperature	nerator Rating (4 325000 2275 Kw 30 ℃ 40 ℃	C901 - Data) Kva					
Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD <u>Cooling water Requirements @ Ger</u> Generator Output: Loss to Coolers: Inlet Water Temperature: Outlet Cold Gas Temperature Coolant	<u>nerator Rating (4</u> 325000 2275 Kw 30 ℃ 40 ℃ 40% Propyl	C901 - Data) Kva ene glycol					
Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD <u>Cooling water Requirements @ Ger</u> Generator Output: Loss to Coolers: Inlet Water Temperature: Outlet Cold Gas Temperature Coolant Maximum Fouling Factor:	nerator Rating (4 325000 2275 Kw 30 °C 40 °C 40% Propyl 0.0005	C901 - Data) Kva ene glycol (hrs_ft^2.c	leg F) /	btu			
Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD Cooling water Requirements @ Ger Generator Output: Loss to Coolers: Inlet Water Temperature: Outlet Cold Gas Temperature Coolant Maximum Fouling Factor: Total Water Flow Required:	nerator Rating (4 325000 2275 Kw 30 °C 40 °C 40% Propyl 0.0005 2460 GPM	C901 - Data) Kva ene glycol (hrs ft^2 c (total for all	deg F) / I cooler	btu s)			
Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD Cooling water Requirements @ Ger Generator Output: Loss to Coolers: Inlet Water Temperature: Outlet Cold Gas Temperature Coolant Maximum Fouling Factor: Total Water Flow Required: Head Loss Per Cooler:	nerator Rating (4 325000 2275 Kw 30 °C 40 °C 40% Propyl 0.0005 2460 GPM 22.5 Feet 6	C901 - Data) Kva ene glycol (hrs ft^2 c (total for all of Water	deg F) / I cooler	btu s)			
Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD Cooling water Requirements @ Ger Generator Output: Loss to Coolers: Inlet Water Temperature: Outlet Cold Gas Temperature Coolant Maximum Fouling Factor: Total Water Flow Required: Head Loss Per Cooler: Maximum Operating Pressure:	Derator Rating (325000 2275 30 °C 40 °C 40% Propyl 0.0005 2460 GPM 22.5 Feet of 150 psig	C901 - Data) Kva ene glycol (hrs ft^2 c (total for all of Water (10.3 bal	deg F) / I cooler r)	btu s)			
Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD Cooling water Requirements @ Ger Generator Output: Loss to Coolers: Inlet Water Temperature: Outlet Cold Gas Temperature Coolant Maximum Fouling Factor: Total Water Flow Required: Head Loss Per Cooler: Maximum Operating Pressure: Dielectric tests (Between coils and g	nerator Rating (325000 2275 Kw 30 °C 40 °C 40% Propyl 0.0005 2460 GPM 22.5 Feet o 150 psig ground, 50/60 he	C901 - Data) Kva ene glycol (hrs ft^2 c (total for all of Water (10.3 bal rtz AC for 1 m	deg F) / I cooler r) nin)	btu s)			
Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD Cooling water Requirements @ Ger Generator Output: Loss to Coolers: Inlet Water Temperature: Outlet Cold Gas Temperature Coolant Maximum Fouling Factor: Total Water Flow Required: Head Loss Per Cooler: Maximum Operating Pressure: Dielectric tests (Between coils and g Stator 37000V	nerator Rating (325000 2275 Kw 30 °C 40 °C 40% Propyl 0.0005 2460 GPM 22.5 Feet o 150 psig ground, 50/60 he	C901 - Data) Kva ene glycol (hrs ft^2 c (total for all of Water (10.3 bai rtz AC for 1 m	deg F) / I cooler r) hin)	btu s)			
Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD Cooling water Requirements @ Ger Generator Output: Loss to Coolers: Inlet Water Temperature: Outlet Cold Gas Temperature Coolant Maximum Fouling Factor: Total Water Flow Required: Head Loss Per Cooler: Maximum Operating Pressure: Dielectric tests (Between coils and g Stator 37000V Rotor 5400V	nerator Rating (4 325000 2275 Kw 30 °C 40 °C 40% Propyl 0.0005 2460 GPM 22.5 Feet 6 150 psig ground, 50/60 he	C901 - Data) Kva ene glycol (hrs ft^2 c (total for all of Water (10.3 bai rtz AC for 1 m	deg F) / I cooler r) hin)	btu s)			
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Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD Cooling water Requirements @ Ger Generator Output: Loss to Coolers: Inlet Water Temperature: Outlet Cold Gas Temperature Coolant Maximum Fouling Factor: Total Water Flow Required: Head Loss Per Cooler: Maximum Operating Pressure: Dielectric tests (Between coils and g Stator 37000V Rotor 5400V	Derator Rating (325000 2275 Kw 30 °C 40 °C 40% Propyl 0.0005 2460 GPM 22.5 Feet of 150 psig ground, 50/60 he	C901 - Data) Kva ene glycol (hrs ft^2 c (total for all of Water (10.3 bai rtz AC for 1 m	deg F) / I cooler r) hin) CODE	btu s)	DWG NG	Ъ	
Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD Cooling water Requirements @ Ger Generator Output: Loss to Coolers: Inlet Water Temperature: Outlet Cold Gas Temperature Coolant Maximum Fouling Factor: Total Water Flow Required: Head Loss Per Cooler: Maximum Operating Pressure: Dielectric tests (Between coils and g Stator 37000V Rotor 5400V GENERAL ELEC	325000 2275 200 2275 30 40 0.0005 2460 22.5 Feet of 150 psig ground, 50/60 he	C901 - Data) Kva ene glycol (hrs ft^2 c (total for all of Water (10.3 bai rtz AC for 1 m	deg F) / I cooler r) hin) CODE	btu s)	DWG NG	237A7271	
Field coils 120 °C by Resistance Collector Gas Rise 20 °C by RTD Cooling water Requirements @ Ger Generator Output: Loss to Coolers: Inlet Water Temperature: Outlet Cold Gas Temperature Coolant Maximum Fouling Factor: Total Water Flow Required: Head Loss Per Cooler: Maximum Operating Pressure: Dielectric tests (Between coils and g Stator 37000V Rotor 5400V GENERAL ELEC Correct Content Scher	2275 Kw 30 °C 40 °C 40% Propyl 0.0005 2460 GPM 22.5 Feet 0 150 psig ground, 50/60 he	C901 - Data) Kva ene glycol (hrs ft^2 c (total for all of Water (10.3 bai rtz AC for 1 m	deg F) / l cooler r) hin)	btu s)	DWG NG	237A7271	

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SIZE DWG NO SH	REV				
REACTANCES (Per Unit): Direct Axis				Duadrat	ure Axis
Saturated Synchronous X ₄ , 1.96	3		×	av 1	.87
Unsaturated Synchronous X _{di} 1.9	6		Х	ai 1	.87
Saturated Transient X' _{dv} 0.26	3			.	
Unsaturated Transient X'di 0.28	35		Х	C _q C).49
Saturated Sub transient X" _{dv} 0.1	75		Х	C' _{qv} C	0.175
Unsaturated Sub transient X ^{''} di 0.2	2		Х	(ⁱ qi C).22
Saturated Negative Sequence $X_{2v} = 0.1$	/b				
Unsaturated Negative Sequence X ₂₁ 0.22	2				
Saturated Zero Sequence $X_{0v} = 0.1$	20				
Saturated Leakage Reactance X ₁ , 0.1	55				
Unsaturated Leakage Reactance $X_{\rm H} = 0.10$	35 35				
FIELD TIME CONSTANTS (Seconds @ <u>125 °C</u>)					
Open Circuit T' _{d0} 6.3			Т	⁷ q0 (0.53
Three Phase Short Circuit Transient T' _{d3} 0.7	5		Т	" _q (0.14
Line To Line Short Circuit Transient T _{d2} 1.2	8				
Line To Neutral Short Circuit Transient I'd1 1.5	6		-	-11 -	
Short Circuit Sub transient $\Pi_{d}^{"}$ 0.0	26		ן ד	iq (J.U26
	or (Secon	പട <i>ത</i> 100 °C	· ۱	q0 (5.071
	(000011		1		
Three Phase Short Circuit $T_{a3} = 0.47$					
Line To Line Short Circuit $I_{a2} = 0.47$					
Line to Neutral Short Circuit 1 _{a1} 0.50					
ARMATURE WINDING SEQUENCE RESISTANCES	6 (Per U	nit)			
Positive R ₁ 0.0028					
Negative R ₂ 0.0139					
Zero R ₀ 0.0063					
Reactance, Resistance and Time Constant data may	be inter	preted per IF	-FF 115. s	ection \	/11.
The base reactance ("LINIT") is calculated by the arm	nature k\	/ squared / N	, . ЛVA		
Pase reactance = 0.9969		Ohme			
Dase reactance - 0.9909		Onns			
Rotor Short-Time Thermal Capacity, (I ₂) ² t			10 s		
Turbine-Generator Combined Inertia Constant H			3 335 km-	s/k∖/A	
Three Phase Armature Winding Capacitance			1.4195 uF	U. I. V / V	
Armature Winding DC Resistance (Per Phase)			0.0012.0 i	(100 °C)	
Field Winding DC Resistance			0.3424 Ω i	(125 °C)	
Field Current At Rated Kva. Armature Voltage. & PF			1568 A	(120 0)	
Field Current At Rated Kva, Armature Voltage, 0 PF	Laddind		1948 A		
(Ear Systems Study Only Not Allowable Operating I	Doint\				
(For Systems Study Only - Not Allowable Operating F	-onit)				
GENERAL ELECTRIC COMPANY	SIZE	CAGE CODE		DWG NO)
	A				
GE POWER GENERATION SCHENECTADY, NY					237A7271
DRAWN: H.A. SOUTH					
ISSUED: H.A. SOUTH	SCALE				SHEET 3

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SIZE DWG NO	SH	REV		
A 25/A/2/1	I			
MACHINE SATURAT	ION DATA			
S/1.0 = 0.0572	Machine saturation may be ca	alculated from the d	ata of curves A and	Bof
S/1.2 = 0.4604	"ESTIMATED SATUF	RATION AND SYNC	HRONOUS IMPE	DANCE CURVES".
	"S/1.0" is the field amp differe	nce from B to A divi	ded by the field am	p of A at 1.0 pu voltage.
X/R RATIO				
X/R = 152	X/R ratio equals "XPP/DV" * b	base reactance / arn	nature DC resistand	ce at 100 C
	GENERAL ELECTRIC COMPANY		DWG NC)
GE POWER GENER	ATION SCHENECTADY, NY			237A7271
DRAWN: H.A. SOUTH				
ISSUED: H.A. SOUTH		SCALE	l	SHEET 4





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SIZE	DWG NO			SH REV							
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15				_		NC+LAVALIN		VO EXCEPTIONS TAKEN	RESUBMIT DOCUM	ENT AS CERTIFIED.	
						Constructors Inc.		NO EXCEPTIONS TAKEN	ACCEPTED AS FINA ED WITH FABRICATI	AL, RESUBMITTAL	
					Vondor's drawi comormity with and design draw	ng review for I specifications		WITH FABRICATION INCL	USIVE OF MARKUP	SMIT. PROCEED S. SMIT. DO NOT	
					This review doe	es not relieve		PROCEED WITH FABRIC	ATION. ED. FOR INFORMATI	ON / REFERENCE	
a mai di 2011					for errors in dealed in h	sign and detailing is contract.		ONLY. CANCELLED			
					Vendor: GE	NERAL ELECTR	IC - GENE N	lo.: C902-237A7261	Rev: -	Date Rec'd	
		-			Doc. Title:	ELECTRICAL E	DATA, GENE	RATOR - 15 PAGES		9/17/2008	
					Reviewed by	VIS	Do	ocument No	generation Proje	Submittal	
					Date: 2	b- Sept-	08 06	20 - T160-0121 - 001		01	
			-				×				
				SNC	LAVALIN CO	DNSTRUCT	ORS IN	IC CONTRAC	T NO 0620)	
					NUMBER 62	2000001, SI	PECIFIC	ATION SP-T	160		
				PRC		PHASE II	ASTOR	IA ENERGY I	EXPANSION	I PROJECT	
					JECT LOCA	HON ASI	JRIA, IN	<u>Y</u>			
				COPYRIGH	T <u>2008</u> GENERAL	ELECTRIC CC	MPANY				
				PROPRIETAR PROPRIETAR	Y INFORMATION Y INFORMATION	- THIS DOCUM OF GENERAL I	ENT CONT	AINS			
				COMPANY AN	ID MAY NOT BE U	SED OR DISCU	OSED TO	-			
				GENERAL ELE	ECTRIC COMPAN	Y.			OENEDAL		
UNLES	JUINERW	ISE SPEC		SIGNATURE	-	DATE	(CA)		GENERALI		λνι⊬ΑΝΥ
	SIONS ARE	IN INCHE	S	DRAWN T.Han	nmell	9/11/2008	GE GE	E POWER GENE	RATION	SCHENECT	ADY, NY
2 PL DE	CIMALS <u>+</u>			CHECKED H. S	iouth mell	9/16/2008		FLECTRICAL			
3 PL DE ANGI F	CIMALS <u>+</u> S+			ISSUED C.J.Pe	eck	08/09/16	Astoria	a Energy II	UNIA, GENEI		
FRACTI	IONS <u>+</u>						EIDOT N		380 3307300	~	000
							SIZE		209, 228X390	C§	<i>⊅</i> ∪∠
					·		A		237A72	61	
DT-2N				SIM TO: NO	NE		SCALE	DF	T UNIT NR5E	SHEET 1	
							1			1	

SIZE DWG NO A 237A7261	SH 2	REV -			
	ESTIMAT	ED GEI		ΑΤΑ	
Customer: Asto	ria Energy II, Ll	LC			
Station/Project: Phas	e II Astoria Ene	ergy Ex	pansion Pro	oject	
Generator Number: 338X	389, 338X390				
Generator Type: 7FH2	2 LU				
GENERATOR RATING					
Data for Proposal No/Electrical Design	r: F317T160D		Jul 22 2	008	
ATB 2 226000 kVA 3600 F	RPM 18000 Vol	lts 0.8	5 PF 30 ps	ig 40 °C	Gas 192100 kW 7249 Amps
375 Field Volt	s 12 Ft Alt 0.	5 SCR	60 Hz 3 P	hase W	YE Connection
Exciter Rating					
Type Static					
705 KW 375 Volts 1880 D.C.Amps	Field Amps (@ Gene	erator rated L	oad 1622.	2
Total temperatures are guaranteed	not to exceed:		nsulation C	lass	Temperature Rise
Stator coils: 107 °C by embedded det	ector	- /	Armature	F	B
Field coils 120 °C by Resistance		F	-ield class	F	В
Collector Gas Rise 20 °C by RTD				·	_
·····					
Cooling water Requirements @ Ge	perator Rating	(C901 -	Data)		
Generator Output:	226000 Kv	a			
Loss to Coolers:	1618 Kw				
Inlet Water Temperature:	31.5°C				
Outlet Cold Gas Temperature	40°C				
Coolant	40% Proph	vene Gl	vcol		
Maximum Fouling Factor:	0.0005 (hrs	s*ft^2*d	ea F)/btu		
Total Water Flow Required:	1860 GPM	1 (total f	or all coolers	5)	
Coolant temperature Max	46 °C	,		,	
Head Loss Per Cooler:	20.8 Feet	of Wate	er		
Maximum Operating Pressure:	150 psig [1	0.3 bar	.]		
, 2			-		
Dielectric tests (Between coils and c	around, 50/60 he	ertz AC	for 1 min)		
Stator 37000V			···· /		
Rotor 3128V					
GENERAL ELEC	CTRIC COMPANY	SIZE	CAGE CODE		DWG NO
GENERAL ELEC	CTRIC COMPANY	SIZE A	CAGE CODE		DWG NO
GENERAL ELEC	CTRIC COMPANY NECTADY, NY	SIZE A	CAGE CODE		DWG NO 237A7261

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SIZE DWG NO S	SH RE	V			
A 23/A/261 REACTANCES (Per Unit): Direct				Quadr	aturo Axis
Saturated Synchronous X	2 04			X	1 92
Unsaturated Synchronous X _{di}	2.04			Xqv Xqi	1.92
Saturated Transient X'dv	0.225			- qi	
Unsaturated Transient X' _{di}	0.255			X'q	0.45
Saturated Sub transient X" _{dv}	0.145			X" _{qv}	0.145
Unsaturated Sub transient X" _{di}	0.19			X'' _{qi}	0.19
Saturated Negative Sequence X_{2v}	0.145				
Unsaturated Negative Sequence X ₂₁	0.19				
$\sum_{i=1}^{N} \sum_{j=1}^{N} \sum_{i=1}^{N} \sum_{i=1}^{N} \sum_{i=1}^{N} \sum_{i=1}^{N} \sum_{i$	0.12				
Saturated Leakage Reactance	0.12				
Unsaturated Leakage Reactance X _{II}	0.145				
FIELD TIME CONSTANTS (Seconds @ 125 °C	3)				
Open Circuit	7.1			T' _{a0}	0.57
Three Phase Short Circuit Transient T'da	0.71			T'a	0.13
Line To Line Short Circuit Transient Td2	1.2			7	
Line To Neutral Short Circuit Transient T' _{d1}	1.51				
Short Circuit Sub transient T''d	0.026			Т'' ₉	0.026
	0.04	conde@	100 °C)	₀ و" ا	0.079
ARMATURE WINDING SEQUENCE RESISTANPositive R_1 0.0029Negative R_2 0.0136Zero R_0 0.0072	NCES (P	er Unit)			
Reactance, Resistance and Time Constant data	may be	interprete	ed per IEEE	115, sectior	ר VII.
The base reactance ("UNIT") is calculated by the	e armatu	re kV sau	ared / MVA		
Base reactance = 1.43	336	, Oł	ims		
Rotor Short-Time Thermal Canacity $(L_{1})^{2}$ t			10 s		
Turbing Congrater Combined Inertia Constant	_		E 00	7 1001 - 11010	
Turbine-Generator Compilted Inertia Constant, F			0.U3 0.91	71 UE	N
			0.01	ィュル 117 Ω (1∩∩ º	C)
Field Winding DC Resistance			0.00	29 Ω (125 °	C)
Field Current At Rated Kva. Armature Voltage 8	& PF		162	2 A	-,
Field Current At Rated Kva, Armature Voltage, 0) PF Lag	ging	197	7 A	
(For Systems Study Only - Not Allowable Operat	ting Poir	it)			
GENERAL ELECTRIC COMF	PANY S		E CODE	DWG	NO
GE POWER GENERATION SCHENECTADY, N	٩Y	A			237A7261
DRAWN: T.Hammell					
ISSUED:	S	CALE			SHEET 3

€, j - j - *

SIZE DWG NO A 237A7261	SH 4	REV	
S/1.0 - 0.068	<u>FION DATA</u> Machine saturation may be c	valculated from the data	of curves A and B of
S/1.2 = 0.5806	"ESTIMATED SATU	RATION AND SYNCHE	PONOLIS IMPEDANCE CURVES"
0/1.2 - 0.0000	"S/1 0" is the field amp differe	ence from B to A divider	the field amp of A at 1.0 pu voltage
X/R RATIO			
X/R = 125	X/R ratio equals "XPP/DV" *	base reactance / armati	ure DC resistance at 100 C
	GENERAL ELECTRIC COMPANY	SIZE CAGE CODE	DWG NO
	RATION SCHENECTADY, NY	A	237A7261
DRAWN: T.Hammell		-	
ISSUED:		SCALE	SHEET 4

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HEAD OFFICE & CHANGWON PLANT 555 GUYGOK-DONG CHANGWON KYONGSANGNAM-DO 641-792,KOREA (P.O BOX 77, CHANGWON,KOREA) TEL(055)278-6114 FAX(055)264-5551~2

INSPECTION REPORT



Droperalling	Poviewed by	Annuou of hu

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QUALITY VERIFICATION DOCUMENT LIST

 PROJECT :
 7C068
 COMPLETE GENARATOR

 P/O No :
 181094165

CUSTOMER SHOP ORDER : 338X390

STATOR (VOL.I)	page no
GQC (GEN. QUALITY CERT).tif	A~C
FHPT (STATOR FINAL HIPOT).tif	20
HPT (STATOR HIPOT TEST DATA).tif	18~ 20
PI (STATOR POLARIZATION INDEX).tif	20
RTD (RTD DATA).tif	24
QCS-G-12 (FRAME AIR TEST).tif	3~6
QCS-G-08 (STATOR FRAME DATA).tif	1~101
QCS-G-09 (STATOR CORE DATA).tif	1~34
QCS-G-10 (STATOR BAR DATA).tif	1~27
QCS-G-13 (STATOR ASSEMBLY).tif	1~24
QCS-G-14 (GEN ASSEMBLY) UF	1~28
(COOLER):til	1~27
(AUX PIPING)).tif	A1~E1
QCS-G-11 (BEARING & OUTER ENDISHIELDS)	1~62

2009-03-03 18:35/발전) 터빈/박전기플링과리부 발전기검사과 딸전기검사만/H5075과2/성기수 ROTOR (VOL:1) * 발전기검사과 딸전기검사면 Dade no

	pageno
MAC (ROTOR MATL CERT)	5~7
QCS-G-01 (FIELD FORGING MAT'L PROPERTIES)	1~23
QCS-G-01-1 (FIELD MACHINING & ASSM DATA)	1~29
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QCS-G-04 (FIELD COIL DATA)	1~21
QCS-G-05 (FIELD WEDGE DATA)	1~2
QCS-G-06 (COLLECTOR RING DATA)	1~3
QCS-G-07 (FIELD FAN RING DATA)	1
RT-1 (FIELD WINDING RESISTANCE)	3
RT-2 (FIELD HIPOT TEST)	1~3
RT-3 (FIELD FLUX PROBE DATA)	1~3
RT-4 (FIELD BALANCE AND OVERSPEED)	1~28
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RUNOUT (3RD LATHE DIM RUNOUTS)	22~25
3DR (SDR LOG)	1~8
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DOOSAN HEAVY INDUSTRIES & CONSTRUCTION CO., LTD.

HEAD OFFICE & CHANGWON PLANT 555 GUYGOK-DONG CHANGWON KYONGSANGNAM-DO 641-792,KOREA (P.O BOX 77, CHANGWON,KOREA) TEL(055)278-6114 FAX(055)264-5551~2

CERTIFICATE OF CONFORMANCE

NO: COCDCASSPR0038



· 2009-03-09 10:33/발전) 터빈/발전기품질폰티부 발전기검사과 발전기검사관/H507542/성기수

WE HEREBY CERTIFY THAT THE ITEMS LISTED ABOVE HAVE BEEN MANUFACTURED, TESTED AND INSPECTED IN COMPLIANCE WITH THE REQUIREMENTS SPECIFIED IN THIS CONTRACT, APPLICABLE SPECIFICATION, DRAWING AND OWNER REQUIREMENTS.

	GENERAL MANAGER DATE TG QC. DEPT.	
(품질보증15100-050)	Page No. A 도산중공업명 (A4/복사용지)	

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DOOSAN HEAVY INDUSTRIES	AND CONSTRUCTION COI TD				
CHANGWON, KOREA		DOOSAN09-0	03	2009-02	-26
		NO. & DATE OF	L/C		
•	·			2009-02	-27
FOR ACCOUNT & RISK OF ME	SSRS	REMARK			
Building 59E Rom 240. 1 River	Road	Contract No.			•
Schenectady, NY 12345 USA		Contract No. : Shop Order No.	181094165		
	•	GE P/O Line No.	; 2		
Same as above			· .		
NOTIFY PARTY					
Att.: Joanne Langley (Tel : 518-	385-3294)				
	FINAL DESTINATION	_			
r	USA	_			
CARRIER	SAILING DATE		· .		
Multi-loader	2009-02-27				
MARKS NO. OF PKGS	DESCRIPTION / GOODS	QUANTITY	NET_W'T	GROSS_W'T	MEASURE'T
General Electric PJT : Astoria Electric	7FH2 Complete Generator (7C068)				
CONT, NO.: 181094165					1 * .
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and the second				· · .	
가지, 이 사람이 바람한 것이 좋아. 		국 고려한 문화.		en de la deservação. A companya de la deservação	
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		3 EA	231,507.000	234,054.011	170
		1 SE	(KG)	(KG)	(CBN
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GUYGOK~DO	I NG 555 CHANG WON KYUNG NAM,			· · · · · · · · · · · · · · · · · · ·	<u> </u>
KOREA					9/.
P.O.BOX C.P.O BOX 77	CHANG WON	SIGNED BY	de	any my	K MAR
TELEPHONE : 055-278-618	36		S.S.KIM	/ General Manar	161
AX : 055-278-843	39		Logistics and	Service Dept	
	· .				
		TRA A. ANICA			
<i>L</i>	DOOSAN HEAVY INDUSTR	IES & CONSI	RUCTION., L	LTD	

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		I AOR						
MARKS OF PKGS	PACK	NG TYPE		MEASUREM	ENT			•
OWNER TAG	DESC	RIPTION OF GOODS		Quantity	Juc	M	Net_Wgt(Kg)	(OBM
SPECIFICATION	Level	Parent Item No.	Position	Child Item N	lo.		Gross_WgtKg>	
Packing List No. : PK2	2009-02	-0037						
PKG # 001		SKID			9420 X		4300 X	42
C068-181094165-10	STAT	DR FINAL ASSY			1	set	231,500.000	•
		T071131~117E1628		T071131-11	17E1628		231,500.000	
		SUB_TOTAL =	1999 1999 1999		1.		231,500.000	170.1
							234,046.500	
rkg # 002		BOX			980 X		880 X	2
C068-181094165-20	FILLEF	PLATE			1	EA	3.000	
.5T x 114.3W x 579.6L	2	798L241G0005		124E2393P0	004		3.000	
C068-181094165-30	FILLEF	PLATE			1	EA	1.000	
.5T x 67.1W x 74.2L	2	798L241G0005		124E2393P0	0005		1.000	
C068-181094165-40	FILLEF	PLATE			1	EA	3.000	
.5T X 114.3W X 579.6L	2	798L241G0005		124E2393P0	009		3.000	
<u> </u>		SUB_TOTAL =			3		7.000	0.1
							7,511	
		GRAND TOTAL =		A the start	. 4		231,507.000	170.3

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Heavy Industries & Construction	ELECTRICAL TE (FINAL)	PCG NO : PC-SW-015 PAGE : 1 of 1		
ITEM	STATOR WINDING	PJT. NAME	7FH2 7C068	GEN. STATOR .
P/O NO.	181094165 (338X390)	M/O NO.	т0711:	3
APPLIED DOOSAN	DWG NO / Rev No	135E3454 Rev.J (June.30.2008)	
APPLIED GE SPEC No / Rev No		P12A-AL-7486 Re	v.L (AUG.15.200	95.)
STATOR FRAME	ID 7S110	TEST DATE	2009.02.	20

*** INSTRUCTION**

1) Winding resistance : Within ± 6 % of drawing requirement

2) Pre-hipot test

- Insulation resistance to be above 1000 megaohms and the polarization index to be greater than 2.0 (DC.500V)

3) Hi-pot test : Test voltage AC 37000 V, Duration 1 Minute

4) Post hi-pot test (30 minutes after hi-pot test)

- Insulation resistance is not less than 85% of pre-hipot test reading

and not less than 1000 megahoms (DC 500V)

INSTRUMENTS ID No

EQUIPMENT NAME	I.D NO	Ì	Ambient (Condi	tion
Low resistance ohm meter	08E2J2022-0001		Amb' Temp'	10	Ĉ
Insulation tester	08E1F0112-0004]	Amb' humi'	31	%
Hi-pot equipment	08E1F1068-0001	· .	Core temp'	10.5	C

B. Winding resistance check

Drawing requirement : 0.00129 Ω at 25 °C

	Phase	Act'l Resistance	(at 10.	5 C)	Call Resistance	e (25 °C)	Act'l / Drawing (%)
•	T1- T4	0.001171	Ω,		0.0012403	Q.	-3.85%
	T2 - T5	0.001181	Ω	An.S. 2.11.	0.0012509	Ω^{*}	-3.03%
	T3 - T6	0.001173	Ω		0.0012424	Ω	-3.69%
Nelson Se				-74			

C. Polarization index check

'Time Phase	1 min (M2)	5 min (M2)	10 min (M2)	P.I Value
Ground, T1 - T4	4780	20800	30100	6.30
Ground, T2 - T5	5010	29600	48900	9.76
Ground, T3 - T6	5390	28800	52300	9.70

D. Hi-pot test

(TEST VOLTAGE : 500VOLT D.C)

Phase	Test voltage	Holding	Ins	ulation resist:	ance	Decult
I MAOC		time	Pre-hipot	Post-hipot	%	Kesun
T1, T4 - E	AC 37 KV	1. min	4780 MΩ	4670 MΩ	98%	Pass
T2, T5 - E	AC 37 KV	1 min	5010 MQ	4780 MΩ	95%	Pass
T3, T6 - E	AC 37 KV	1 min	5390 MΩ	5500 MΩ	102%	' Pass

E. After Hi-pot test

Visual Inspection : No indication

TESTED BY

Reviewed / Witnessed By: Andy Ang SLCI

WITNESSED BY

Page No. 20

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QUALITY VERIFICATION DOCUMENT LIST

PROJECT : 7C068 COMPLETE GENARATOR

P/O No: 181094165

CUSTOMER SHOP ORDER :

338X390

STATOR (VOL.I)	page no
GQC (GEN. QUALITY CERT).tif	A~C
FHPT (STATOR FINAL HIPOT).tif	20
HPT (STATOR HIPOT TEST DATA).tif	18~20
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QCS-G-12 (FRAME AIR TEST).tif	3~6
QCS-G-08 (STATOR FRAME DATA).tif	1~101
QCS-G-09 (STATOR CORE DATA).tif	1~34
QCS-G-10 (STATOR BAR DATA).tif	1~27
QCS-G-13 (STATOR ASSEMBLY).tif	1~24
QCS-G-14 (GEN ASSEMBLY) tit	1~28
(COOLER).tif	1~27
(AUXPIRING).ttf	A1~E1
QCS-G-11 (BEARING & OUTER END SHIELDS)	1~62

2009-03-03 18:35/발전)터뷔/방전기플전구리부 발전기검사과 율전기급사탄/M5075-2/성기수

	puge no
MAC (ROTOR MATL CERT)	5~7
QCS-G-01 (FIELD FORGING MAT'L PROPERTIES)	1~23
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RUNOUT (3RD LATHE DIM RUNOUTS)	22~25
SDR (SDR LOG)	1~8

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2008~08~28 10:39/주단)주단품질관리부 단조검사과 주단검사직 단조검사반/H506311/이기봉

Allen and		
DUISMI	Doosan Keavy Industries	

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	CUSTOMER : GENERIAL ELECTRIC Co	CMTR No : 12008080018
	CUSTOMER'S PURCHASE changed Plaz 18/1094165 ORDER No.: 181094085	MATERIAL : B50A375A85
	CUSTOMER'S P14A-AL-0200 Rev.L	
	SPECIFICATION No. : B50A375-D	HEAT No. ; 2B82821
	G.E SERIAL No. : 48163	
	PRODUCT NAME : 7FH2 GEN ROTOR #70C070 68	· · · · · · · · · · · · · · · · · · ·
	IDENTIFICATION OF MATERIAL : F07479 140	
· .	DOOSAN M/O No. : F07479	
\leq	DOOSAN PURCHASE SPEC No. : N/A	
	-	
	The attachments described hereunder are part of this Cer	tified Material Test Report :
	1. Material Acceptance Certification (MAC) : MAC808-00	18 (2 Sheet)
	2. Forging Work Report #WR8080618	ANTENNESS A
	3. Report of Heat Treatments RH18005-0018	
	4. Samping Drawing RM-IN-/PH2001	
	6. Micro Stuckure Test D	
	7. Benet of Uterania Evententia a 1999	
A. 8. 7 13	7. Report of Oltrasonic Examination : U080526-056-000	
106-16	 26. Borert of Magnetic Deticle Eventing Magnetic States 	<u> 수단검사적 단조검사면/H508311/017</u> 년
	10 Report of Magnetic Particle Examination : M080825-00	
	11 Dimensional Check Roport : DD02 02 42 004 KOM A	9-140
	Plank	0020-140
·		
	We hereby certify that the contents of this report are corre-	ot and accurate and that all test
	and examination results and operations performed by Doo	san Heavy Industries & Construction co. Ltd
	are in compliance with the requirements of the material sp	ecification and the applicable material
	requirements as designeted by the Customer's Order	
· · ·		DRC Palation
	Certified	by 0, 12, 55 2 1/02/ 00
		CFQC Dept Gen Manager Date
	•	

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2008~08-28 10:35/주단)주단품질관리부 단조검사과 주단검사직 단조검사반/H506311/이기봉

			MAT	ERIAL A	CCEPTAN	NCE CER	TIFICATE	(MAC)		
				-		_	Re	port No. : <u>N</u>	AC808-00	18
	GE SPEC,	B50A375	ISSUE	D	CLASS _	A85	\$	heet No. : 1	of 2	
	Forging	Supplier Drawing Serial No.	DOOSAN 120E9018P01 F07479 140	Rev.B	۲ ۲	Thru Bore	ore	*	<u></u>	
		Heat No.(s) 2B82821		······································					
•		MPP No.	MIP-CF-B50	A375	Rev.	No. 01	B Rev	Date Oct	. 25. '04	
		Mening MR	actice VSD	VCL	, * VAI	DE	SRV	AR LR	Oth	ier
	ge, pgo	Purchase (Special Re	Order quirements [181094 N/A	083- jong-	iangea 1/1		65		
	····			ME		PROPERTI	ES :			
	(Radial Bod	(9 V)	Dra	wina	тя	0,0;	2% (0,2%) YS	FI	RA	
\bigcirc		Mid Bo	<u>Loc</u> dy	ation	<u>(KSI)</u>		(KSI)	<u>(%)</u>		
No.		Body "A	," .	0° 120° 240°	114.0 113.0	96	0 (97.0)	22.0 23.0 24.0	69.0 68.0	
		Turbine	End Prolone		115.0		0 (99.0)	23.0	68,0	
	<u>Charpy V–N</u> (Radial Body	otch Test)			secHol/Co	idián a Su	EATE			
r.	Mid Body	Location	<u>(Ft%)</u>		<u>emio((E))</u> (Etellos)	<u>((f))</u>			
7663-	88-28 TC	1:35/775		[Wal=		AF IN SAG	許強利率		W/H500	31 (OT73
2	Body "A"	0° 10° 120°	" " <u>130</u> " " <u>'</u>	 	+75	74				
	• •	130° 240° 250°	պո պո		10 +-20 +-50	68 95 119				
. 1	Bore Propertie	es Location	T.S	0.02% Y.	(0,2%) S	El	RA	Charpy (Et alloc)	FATT	
. (Collector End		1000	(K		(%)	(%)	(1-1-105)	<u>(F)</u>	
ŗ	Thru Bore		4 <u></u>			· .			•	
•			······································	······		· · · · · · · · · · · · · · · · · · ·		•••••••••••••••••	·	·
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A	PPROVED SE)R(s)		******* <u>*</u> **	······································	·			······································	·. *

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•	사직 단소	No.: MA	lo.: 2 o		AI	0.003							0.003	0.003		•			, c	<u>v</u>		
	い い 上 一 一 で	Report	Sheet N		-us	0.0021							0.0024	0:0023			-					
	단조검사				As	0.0027							0.0025	0023								
	通 は こ 一 七				Sb	.0007					-		0008	0008								
	B				>	0.10							0.11 0	010							,	
	8 10:35/3				Mo	0.31	Blank	-					0.31	0.30	Blank					2 ?	, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10	
	08-08-2				ບັ	1.43								240 ³¹						, to act	וסספון גוו	
	.50				W	3.13		 					30.5	3.02			· ·			17 AM		
	•				Si	0.07					1440 - 1749		0.08	100-0 10-0 10-0		·				9年茶代三	0 0 1	
					S	0.001							0.001	0.00						- 1 td		
					۵.	0.006							0.005	0.006						truction	100000	
				nalysis	Min	0.29		 					0.29	24 6.29	- 14 - 14 - 14 - 14					nd Cons		
	. ·	NOLLI		Heat A	0	0.25						(%	0.24	3- 0624°						di tetriae s	* ***	
		SUMPOS		rcent(%)			•					nalysis (ZOG						Heavy Inc		
	•. • •	CHEMICAL C		I. Weight pe		(B82821						. Product A	ОР	OTTOM						hw DOCSAN	2	
	•		. EM			_ • N			· .	E CE)age	No No	L +- \ 7					· · · ·		Coovright	····.»	
·.	· · · ·	;	* • .	· ·	· · ·	•	. •*			•			••				•			•	• .	

Heavy Industries & Construction	ELECTRICAL TE (FINAL I	ST FOR STATOR HI-POT)		PCG NO: PC-SW-015 PAGE: 1 of 1	
ITEM	STATOR WINDING	PJT. NAME	7FH2 7C068	GEN. STATOR	
P/O NO.	181094165 (338X390)	M/O NO,	T0711:	3	
APPLIED DOOSAN	DWG NO / Rev No	135E3454 Rev.J	(June.30.2008)		
APPLIED GE SPEC	No / Rev No	P12A-AL-7486 Rev.L (AUG.15.2005.)			
STATOR FRAME	ID 7S110	TEST DATE	2009.02.	20	

*** INSTRUCTION**

1) Winding resistance : Within ± 6 % of drawing requirement

2) Pre-hipot test

- Insulation resistance to be above 1000 megaohms and the polarization

index to be greater than 2.0 (DC 500V)

3) Hi-pot test : Test voltage AC 37000 V, Duration 1 Minute

4) Post hi-pot test (30 minutes after hi-pot test)

- Insulation resistance is not less than 85% of pre-hipot test reading

and not less than 1000 megahoms (DC 500V)

INSTRUMENTS ID No

EQUIPMENT NAME	I.D NO
Low resistance ohm meter	08E2J2022-0001
Insulation tester	08E1F0112-0004
Hi-pot equipment	08E1F1068=0001

Ambient (Condi	tion
Amb' Temp'	10	C
Amb' humi'	31	%
Core temp'	10.5	Ċ

B. Winding resistance check

Drawing requirement : 0.00129 Q at 25 C

Phase	Act'l Resistanc	e (at	(0.5 °C):	Call Resistan	ce (25 °C)	Act'l / Drawing (%)
T1- T4	0.001171	Q		0.0012403	.	-3.85%
T2 - T5	0.001181	Q		0.0012509	Ω	-3.03%
T3 - T6	0.001173	Ω		0.0012424	Q	-3 69%

C. Polarization index check

'Time Phase	e 1 min (MΩ)	5 min (MΩ)	10 min (MΩ)	P.I Value
Ground, T1 - T4	4780	20800	30100	6.30
Ground, T2 - T5	5010	29600	48900	9.76
Ground, T3 - T6	5390	28800	52300	9.70
۰.			(TEST VO	LTAGE: 500VOLT 1

D. Hi-pot test

Phase	Test voltage	Holding	Ins	Danult		
		time '	Pre-hipot	Post-hipot	%	Kesuit
T1, T4 - E	AC 37 KV	1 min	4780 MQ	4670 MΩ	98%	Pass
T2, T5 - E	AC 37 KV	1 min	5010 MΩ	4780 MΩ	95%	Pass
Т3, Т6 - Е	AC 37 KV	1 min	.5390 MΩ	5500 MΩ	102%	· Pass

E. After Hi-pot test

Visual Inspection : No indication

TESTED BY

Reviewed / Witnessed By: Andy Ang SICT \mathcal{D}

WITNESSED BY

Page No. 20

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REVIEWED BY

2008-11-11 14:11/품질)비파괴검사부 소재검사과 소재검사직 단조검사반/H507265/정해광



REPORT ()F MAGNETIC P	ARTICLE EX	MINATION	Repo	ort No.	M081110-018-001								
지	기탐상 /	시험보고	хł	F	'age	1 OF 1								
Customer GE		· · · · · · · · · · · · · · · · · · ·		l										
Project T07113 /	7FH2 Complete (14	Unit)T07113	Unit 1 / 7FH2 GEN. CPL-'09년 납풍											
WBS 1020201	BOTOR FORGING &	MACH	Activity 1020201M020 / ROTOR MACH											
ltem T071131-1	34E3617P0001 / FI	ELD MACHINING												
TRV No.	Rev.	Oper, Seq.	Procedure No	. & Rev No. (조	적용규격 (& 개정번호)								
100477258	0	110	P3C-AL-215	3 Rev.E										
Material Type B50A37	'5A85		Thickness	N/A mm	······									
Examination Phase (검사시기) : Afte	r Final Machine	d											
Surface Condition (표면상태) : As M	lachined Conditi	งก											
Magnetization Hea	ad Shot-DC-Circula	r	Method			· · · · · · · · · · · · · · · · · · ·								
자 화법 Co	il-DC-Longitudinal		검사방법 ₩e	at-Non Fluoreso	cent-Cont	inuous								
		Testing Equip	ment (시험장E	II)		······································								
ID No. (번호)	Type (형식)	Mode	(모델)	Maker (XI	 작처)	Due Date (유효일)								
43-01-28	· PROD	PICOMAG S-	2000(20000AMP)	NAWOO		2009-03-04								
	Magnetic P	article (자분)			Field Indicator (자장지시									
Maker (제조처)	Color/Typ	e (색상/형태)	Densit	y (농도)		GE Taper Block								
MAGNAFLUX(U.S.A)	MAGNAFL	UX 7C BLACK	1	.5 ml/100ml	Tes	t Temp (시험온도)								
Current Power (전류) Lighting Eq	uip. (조명장치)	B/L Intensi	ty (록광광도)	-	Amblent 상온								
100~125 Amp/in	GIC N	w Lamp lin. 1000 Lux		N/A µW/cm*	Demagnetization (탈자) Yes									
★Exam Areas: All Extern on the Tu	nal, Visibly Acces rblne end & Collec	sible, Finishec tor end.	l Surfaces, Wh	ich are Outbor	ad of thi	ë Rotor Body								
Joint(Part) No. 01	응(부품)번호 0	ecision (판정)	Interpretat	ion (평가)	Remarks (비고)									
07479 140	. A	ccept t	lo Recordable	Indication N	N/A									
··				· · · · · · · · · · · · · · · · · · ·										
		· · · · · · · · · · · · · · · · · · ·												
	<u>.</u>													
Examined By 시 형 자 최진오 JI	N OH, CHOI	Le	evel Witness	ed By	N/A	N/A								
Reviewed & Approved By 검토/승인자/정해광구AA	KWANG. JEONG 2	Le 008-11-11	·····································	d By Tł	N/A									
품질~NDE-003) /		두산림	등공업	Page No 2	41	 (A4백상지)								

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REPORT OF MAGNETI	C PARTICLE EX		Rep	port No.	NO81224-033-001								
자 기 탐 상	· 시 험 보 고	. H		Page	1 OF 1								
Customer GE													
Project T07113 / 7FH2 Complete	e (14 Unit)_T07113	Unit 1 / 7FH2 GEN. CPL-'09년 납풍											
WBS 1020203 / FIELD WINDIN	IG	Activity 1020203M030 / THIRD LATHE											
ltem T071131-135E6004G0002	/ GEN ROTOR THIRD L	L											
TRV No. Rev.	Oper. Seq.	Procedure No. & Rev No. (적용규격 & 개정번호)											
100477272 0	70	P3C-Al -0003 Rev R											
Material Type B50A375A85	· · · · · · · · · · · · · · · · · · ·	Thickness	N/A mm		·····								
Examination Phase (김사시기) :	After Final Machin												
Surface Condition (표면상태) :	As Machined Condit	ion											
MagnetIzation		Method											
자 화법 Yoke-AC-Longitud	linal	검사방법 ₩	et-Non Fluores	scent-Cont	Inuous								
· · · · · · · · · · · · · · · · · · ·	Testing Equi	ipment (시험장I			······································								
ID No. (번호) Type (Mod	el (모델)	Maker (A	[작처]	Due Date (유호일								
43-02-11 AC YO	Ke	MPEAS	KYUNG	-D0	2009-05-16								
Magnet	ic Particle (자분)			Field	ndicator (자장지시)								
Maker (제조처) Colo	/Type (생상/형태)	Densif	<u>《</u> · · · · · · · · · · · · · · · · · · ·		GE Taper Block								
NAWOO(KOREA)	ACK(NMP-B) CAN		2.0 ml/100ml	Tes	t Temp (从献金厅)								
Lifting (자력) Lightin	ng Equip. 《조명장凤) B/I: Intensi	1√ (富淵聖도)	-	Ambient 상온								
Mingio Bound (4.5 Kg) / 1	Glow Lamp Min. 1000 Lux		N/A WW/cm	Dema	gnetization (탈자) Yes								
Examination Areas : Third Lathe	Machined areas, (Co	upling & oil c	leflector area	s)									
				,									
•													
.loipt(Part) No. 이은(님프)배승	· Dealsion (正전)	Interpretet	ion (178-71)	0									
7479 140		No Becordable	Indication	<u>תי</u> או/א	emarks (0112)								
LANK		INO TIEGOT GADTE	Thurcation	N/A									
· · · · · · · · · · · · · · · · · · ·													
				•									
		; ;											
······		· .			······								
		•			·								
amined By	<u> </u>	evel Witness	sed By	1977	<u> </u>								
헐 자 박진석 JW SEOK, PARK	2008-12-30	입 회	자 .	N/A									
viewed & Approved By	A . · · L	evel Reviewe	ed By .	N / A									
토/승인자 임영태 YOUNG TAE, LINF	12-30	비 경 토	자	N/A									
·질-NDE-003)	두산	중공업 🎧	ade No 2	9]	(A4백상지								

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RW-005
OR ROTOR
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*. INSTRUCTION

1) Winding Resistance : Design Value ± 2 %

2) Impedance : Design Value ± 25 %

3) Pre-hipot

- Insulation Resistance : Min 25 Mohm (DC 500V MEGGER)

- Polarization index

Insulation Resistance	Polarization Index
25 - 199 Mohm	Min 1.10
≥ 200 Mohm	Min 1.00

TEST CONDITION ambient temp: 17 °C humidity : 30 %

))	Hi-pot	Test :	Test Voltage :	AC 3500	V, Holding	Time:1	Min
----	--------	--------	----------------	---------	------------	--------	-----

5) Post-hipot

Insulation resistance at 1 minute after hipot should be 2510 or greater and at least 60 percent of the one-minute pre-high potential measurement, or 200MQ or greater.

1. WINDING RESISTANCE CHECK

RESISTANCE (Q) at 12.5 (RESISTANCE (Q)	at 25 °C	REMARKS
0.1315. 0.13815		-1.53%
*. Design value = 0.1403 () at 25 C	*********	

Winding temperature measurement

Section	1	2	3 Average REMARKS
Temp(℃)	12.3	12.5	12.7 12.4 12.5 12.5

2. IMPEDANCE CHECK

-	VOLTAGE	CURRENT	ACT'L DATA	DESIGN VALUE	DIFFERENCE(%)
	100 Vac	12.2 A	<u>8.20</u> ନ	8.49 ନ୍ <u>ର</u>	-3.45%

3. INSULATION RESISTANCE CHECK

	INSULATION RESISTANCE	Ration of Insulation resistance between
PRE HI - POT TEST	6430 MΩ	pre and post Hi-pot Test(%)
POST HI - POT TEST	4520 NΩ	70.3

4. POLARIZATION INDEX TEST (BEFORE HI POT)

	TIME	1 MIN	5 MIN	10 MIN	P.I
•	MΩ	6430	24200	41100	6.39

5. HI - POT TEST

				· · · ·	
••	TEST VOLTAGE	HOLDING TIME	RESULT	REM	IARKS
	3500V. AC	60 SEC	Pass		-
Rt.	K 32 1/19/109	(2-1/19/09 13	age No. 3	E concres (Span 1/19/09	Reviewed / Witnessed By: Andy Ang
TEST	TED BY REVI	EWED BY APPR	OVED BY	WITNESSED BY	WITNESSED BY

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From No. HPCT-401 Generator Rotor DOOSAN Rev. No 1 Flux Probe Data DooSan Heavy Industries Rev. Date 2001-04-11 & Construction Co.,Ltd M/O NO : TO71 13 Project Name : 7FH2 #7C068 Customer : GE ¥١ Date/Time : 2009-01-13(09:38:31) 281 Submit results to manager 2345432T1 455 Т of test operation if a short indication exists. Before Thermal (�) 00.0 After Thermal ()Field S/N # : 338X390 345543 RPM : 3600 T2845432T1 2 Field Amps : 200 # Of Poles : 2 # Colls/Pole : 5 Physical Count 'FP' Mark = 350 Deg. Angles increase with rot. (�) *2 Angles decrease with rot.() TESTER : 홍현택 $2_{34554,1}^{2}$ T2345432T1 Directions : Locate'FP'Mark on drive shaft and record angle on field 00.0 at same location. Determine if the angles are increasing or decreasing as 5432 4-5-23454321 field turns on TG 13 Location of Short(s) Coil# Pole Pole. Coil# Coil# Polé Coi!# Pøle Pole Coil# Good Comments : Page No. Short is speed sensitive (No) Signature Attempt was made to burn short out procedure (No) Reviewed / Witnessed By: 1 Andy Ang 🗹 SLCI Rep 14 Jan Duc ÷ X

DODSAN BALANCING SHOP

GENERATOR SHORTED TURN TEST

 \odot

	SLOT, P-POLE TOTAL : 80				[~~~	j.							5						hand dorts to							tithessed By:	X	4 Jan 200
	LEGEND : T-TOOTH, S			Remarks	Robaro Ther		DICTURE X 1				Remarks	Roloro Thorn		DICIMHE X 7		·										Reviewed / y	Ancy Ang	PLUT REP
, ,	30HL : 16	/POLE Y		T,D.R(%)	0.7	2.5	1.3	0.3	0.5		T.D.B(%)	0.4	2,3	0.1	1.3	2.1						36 %	36 %	, i to An on Tan Vinternan and Tan and Tan And				
	NS/#2~5 (FOLE X		Result	1.0066	0.9750	0.9872	0.9970	1.0054	 	Result	1.0038	1.0232	1.0008	0.9874	0.9788) L(%)	~ 7.8	~ 7.8					
1911 #	# TUR		-	Average	19.72	21.84	21.02	20.24	19.40			19.91	19.65	19.11	18.68	18.20					NGE OF CO	74 %	74 %		(1)0 (%)			
			IGHT	Amplitude	17.81	21.55	20.88	20.15	19.45			18.26	19.31	18,99	18.70	18.16					SHORT RA	4	4.		ENTIAL R			
		POLE Y		Location	Si-P	S2-11	S3-72	S4-T3	S5-74		POLE Y'	S1-P	S2-11	S3-T2	S4-T3	S5-T4		(u)				1.56	1.56		L DIFFER			
	IL: 16		EFT	Amplitude	21.62	22.12	21.16	20.32	19,35			21.56	19.99	19.23	18.66	18.24		by desig				6.3±	6.3±		() > TOTA			
	NS/#1 COI	·		Location	T1-S1	T2-S2	T3-S3	T4-S4	T5-S5			T1-S1	T2S2	T3-S3	T4-S4	T5-S5		per slot	-		格부	20	26		T RANGE(
	# TUR			Average	19.85	21.29	20.75	20.18	19.51			19.99	20.11	19.13	18.45	17.82		1/Turns	il Numbe		-				HOHS : (1			
			GHT	Amplitude	18.19	20.91	20.65	20.18	19.46			18.27	19.85	19.04	18.34	17.85		± 0.25 (f each Co		erance	016	016		(NO SHORT			
#700co		POLE X	R	Location	S1-P	S2-T1	S3-T2	S4-13	S5-T4		POLE X'	S1-P	S2-T1	S3-T2	S4-T3	S5-T4		mula:	erance o		+ 10-	0.(0.0		RITERIA			
NUMIN DA	POLE: 5		EFT	Amplitude	21.50	21.67	20.85	20.17	19.55			21.70	20.36	19.21	18.55	17.78		teria For	rtage Tol		No	1#1	#2~5		ÉPTANCE C			
TL9 TL9	# collcs/i			Location	T1-S1	T2-S2	T3-S3	T4S4	T5-S5			T1-S1	T2-S2	T3-S3.	T4-S4	T5S5		* Cri	* Shoi		00	Coi	Coil		* ACCI	RY.	**********	
			COL	Ю	#1	¥	#3	#4	#5			, #	拀	#3	#4	ŧ5			2	C.		- LL		22	;e	UNO.	s show	





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Heavy Industries & Construction

Field Information

BALANCING TEST REPORT

(Generator Field)



Balancing Shop

Project	7FH2 #7C068	M/O No.	T07113
Material No.	F07479-140	Rotor Type	Gen Field(230Mw)
Serial No.	338X390	Customer	General Electric
P/O No.	181094165		
Rated Speed	3600rpm	Overspeed	120% of Rated Speed(4320rpm)

		Applied GF		Test Spo	ed & Condition			Pomarko	
	Test Name	Spec No./Rev. No.	Test Speed	Test Condit	ion(Specification C	riterion)	Results	Remarks	
Dverspeed Tes		Rpm	4320Rpm Holding Time	Max.Limits ()m) of M/C during Bal	Balancing ancing	Actual(Max /m)	Results		
	P24C-AL-6502/E			Coupling	508	145			
ſ	· · · · , · · · · ,	·(APR.2006)	100~ 4320	ЗMin.	Journal	254	62.6	GOOD	
				Collector	508	293	•		

Flux Droho Toot	(APR.2006)						1.1	
Flux mione resu	E50A42/A	2600	2004	<u> </u>	ng (perset the sheet the sheet is a	「麗恋」記	2 Woodd 1	an gr
	(MAN 2000)	3000	2007	fica fic h	era " Froints, i ng hinit Azdrej (El	. Kopas timik Kasa basa		10 42, Hen 7
	(10/~1.2000)					· · · · · · · · · · · · · · · · · · ·		

ĺ						ate a	
			Test Group	Speed Range	Spec.(Ω)	Actual(Ω)	Results
	Impedance	P24A-AL-5080/-	Refere Final Palapaina	5ŗpm	0.0077	8.7111	
	Check	(OCT.2000)	Delote Final Datationg	3600rpm	0,36/5 ~ 10.6125	8.4911	GOOD
	· .		After Final Balancing	5rpm		8.9135	
)			· · ·			

· []	t-			X		
	And the second	Position	Speed Range	Spec.(/m)	Actual(Max)	Results
		Coupling & Collector	125 ~ 3780rpm	76.2	24.6	·
Final Balancing	P24C-AL-6502/E		125 ~ 2880rpm	76.2	18.2	
	(APR.2006)	lournal	2880 ~ 3240rpm	50.8	19.1	GOOD
		·······································	3240 ~ 3600rpm	50.8	13.9	
	· .		0000 0700	70.0	7.04	

	· -		3600 ~ 3780rpm 76.2	1.91
				SLCI Rep. 14 Jan 2009
01. 14. 2009	वि ही ही	异全智慧	To K & Joing	6 E. 2 mort of Y. B. Mill 11-4/200 g
Date	Prepared by Balancing Engineer	Reviewed by Balancing Manager	Approved bý QA	Witnessed by Customer
ight by DOC	SAN Heavy Industries a	d Construction, Co.,Ltd.,	두산중공업 All Rights Reserved.	

Page No.



Heavy Industries & Construction BALANCING TEST REPORT

(Generator Field)



Balancing Shop

Project	7FH2 #7C068	M/O No.	T07113
Material No.	F07479-140	Rotor Type	Gen Field(230Mw)
Serial No.	338X390	Customer	General Electric
P/O No.	181094165		·
Rated Speed	3600rpm	Overspeed	120% of Rated Speed(4320rpm)

	Applied GE		Test Speed & Condition		Deputto	Approved	
Test Name	Spec No./Rev. No.	Test Speed	Test Condition(Specification Crit	erion)	Results	by QA	
		Rpm	Specification	Probe	Actual(//m)	Results	
·)				CH1	3.108		
			Not exceed 7.62 µm peak-to-peak,	CH2	0.4439		
			at frequencies higher than 40% of	CH3	0,3233		
Response Spectra Test	P24C-AL-6502/E (APR 2006)	3600	rated frequency, other than 1/rev	CH4	0.6657	GOOD	
Opecita (car	(111)(12000)		or 2/rev at any probe in the frequency	CH5	1.212		en en en
			2009_01_14_14:04 Irange between 9 and 200Hz.	CH6	<u>に</u> 書きは 3.215	바이 예가 가 안 있었다.	sti s
			40% of rated frequency=24Hz	CH17	1.356		
				CH8	1.966		
······································							

	· · · ·	Position	Speed Range	Spec.(#m)	Actual(Max ,m)	Results
			125~500rpm	25.4	5.09	
γ		Coupling / Collector	500~3600rpm	101.6	84.6	• •
2/rev	/ P24C-AL-6502/E (APR.2006)		3600~3780rpm	50.8	12.8	GOOD
	(AFI(.2000)		125~500rpm	12.7	4.28	• •
		Journal	500~3600rpm	25.4	19.2	
			3600~378 0 rpm	12.7	3.03	
U						

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Page No. 2

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Measuring Values

Rotor: 7FH2_7C068

Run: OVERSPEED TEST from 2009-01-12 17:13

Comment:

1 per rev

(:

Measuring Values

		TE CPLG CH	WEST 1	TE CPLO	EAST 2	TE JNL ' CH	WEST 3	TE JNL EAST CH 4	
Speed Immi	Timo fel	Amount	Angle	Amount	Angle	Amount	Angle	Amount	Angle
obeed [thui]	tune [2]	[µm pp]	<u>[°]</u>	[µm pp]	[°]	[µm pp]	[°]	[µm pp]	[°]
100.000	33.6	7,87	146	15.9	196	0.691	270	2.76	180
200.000	57.6	7.87	146	11.1	191	0.691	270	0.977	225
300.000	76.2	9.26	135	11.8	202	0.691	270	0.977	225
400.000	95,3	9.26	135	11.1	191	0.977	225	1.54	243
500.000	116.2	9.26	135	11.1	191	0.691	270	2.49	236
600,000	138.2	9.26	135	11.1	191	0.691	270	4.03	239
700.000	157.0	10.9	127	11.1	191	0.691	0	5.26	247
800,000	176.7	12.7	121	11.8	202	0,691	0	8,54	256
900.000	199.3	17.0	130	13.8	198	3.45	53.1	14.5	273
1000.00	223.1	21.8	143	12.7	211	4.83	90.0	22.4	304
1100.00	250,4	19.8	174	12.7	211	4.88	135	24.0	348
1200.00	271.5	15.3	180	10.9	217	2.49	146	18,0	4.40
1300.00	295.3	6.55	180	11.1	259	3.91	45.0	16.8	9.46
1400.00	319.3	16.6	113	8.73	90.0	14.6	109	15.8	28.8
1500.00	343.6	18.8	144	11.8	158	9.96	146	12.4	26.6
1600.00	369.7	17.6	150	13.3	171	7.72	153	10.5	23.2
1700.00	398.4	17.6	150	15.3	180	7.11	151	11.4	14.0
1800.00	421.5	17.6	150	15.3	180	7.11	151	11.4	14.0
1900.00	446.0	19.5	153	15.3	180	7.11	151	12.7	12.5
2000.00	466.0	19.5	153	15.3	180	6.51	148	12.7	12.5
2100.00	492.3	22.5	151	17.6	187	6.37	139	12.5	6,34
2200.00	512.4	22.5	151	19.8	186	7.34	131	13.8	2.86
2300.00	537.2	22.5	151	19.8	186	7.87	128	15.9	Q
2400.00	586.2	26.4	156	19.8	186	9.29	132	18.1	6.58
2500.00	613.1	25.5	160	19.8	186	10.3	138	19.7	18.4
2600.00	634.9	22.8	163	19.8	186	9,39	144	17.9	27.6
2700.00	650.9	20.7	162	19.8	186	8.32	138	15.5	32.3
2800.00	678.8	21.5	156	19.8	186	8.32	138	14.4	35.2
2900.00	707.9	20.7	162	21.9	186	8.32	138	13.8	36.9
3000.00	725.9	20.7	162	22.8	197	8.79	135	12.7	40.6
3100.00	744.8	17.6	150	20.7	198	9.81	141	11.7	45.0
3200.00	772.3	17.0	140	20.7	198	9,59	150	9.39	54.0
3300.00	801.7	21.8	143	20,1	193	8.08	160	8.43	55.0
3400.00	826.0	23.6	146	22.8	197	7.44	158	7.47	56.3
3500.00	856.5	25.4	149	22.8	197	6.55	162	6.51	58.0
3600.00	880.4	31.2	155	26.4	204	9.39	163	5.57	82.9
3700.00	916.5	32.2	152	25.4	211	6.51	148	3,45	180
3800.00	943.5	38.1	156	26.3	222	5.86	135	7.47	304
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SLCI Rep

14 Jan 2019

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			CH	()	C/,	12	CH	3	CH	4
	3900.00	974.9	47.1	167	26.6	235	6.51	122	8.08	340
	4000.00	1004.7	76.5	177	21.9	264	8.43	125	12.1	347
,	4100.00	1025.9	91.0	226	23.6	146	8.84	141	8.84	38.7
	4200.00	1049.9	107	239	86.5	227	9.29	132	6.25	276
. Y	4300.00	1077.6	131	306	105	313	9.39	144	19,6	321
	4322.00	1098.0	105	313	82.9	325	7.87	142	19.0	327
	4322.00	1163.6	130	316	111	328	8.79	135	22.0	328
	4320.00	1223.9	145	317	129	330	9.81	129	23.9	327
· · · · · · · · · · · · · · · · · · ·	4323.00	1286.2	136	316	118	330	9.81	129	23.6	328

3 MIN HOLDING

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Reviewed / Witnessed By: Andy Ang Sicz Rep 14 Jan Jug

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Page No. 4

Measuring Values

Rotor: 7FH2_7C068

Run: OVERSPEED TEST from 2009-01-12 17:13

Comment:

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Measuring Values

			CE JNL WEST CH 5		EAST	COLLECTOR WEST CH 7		COLLECTOR EAST CH 8		
Constant Francis	7791	Amount	Angle	Amount	Angle	Amount	Angle	Amount	Angle	
Speed [rpm]	Time [s]	[µm pp]	[°]	[µm pp]	ſ°Ĭ	[µm pp]	[°]	[µm pp]	[°]	
100.000	33.6	0	0	2.18	198	7.87	146	2.18	90.0	
200.000	57.6	0.977	135	0.691	270	6.17	135	2.18	90.0	
300.000	76.2	0.691	270	1.54	207	4.88	153	2,18	90.0	
400.000	95.3	0.691	270	1.54	207	4.88	153	3.09	45.0	
500.000	116.2	0.691	270	1.54	207	4.88	153	2.18	0	
600.000	138.2	0.691	270	2,49	236	4.88	153	2.18	0	
700.000	157.0	0.977	315	4,37	252	7.87	124	4.88	333	
800.000	176.7	0.691	0	6.25	264	7.87	146	4.36	0	
900.000	199.3	1.95	45.0	11.9	280	6,90	162	8.73	0	
1000.00	223.1	4.20	80.5	19.6	312	7.87	146	13.3	9.46	
1100.00	250.4	4.20	99.5	20.9	352	7.87	146	12.3	45.0	
1200.00	271.5	4.42	129	18.1	17.7	9.76	153	9.00	76.0	
1300.00	295.3	3,52	101	17.3	28.6	20.7	162	9.00	104	
1400.00	319.3	9.81	129	14,2	67.2	23.6	236	9.26	225	
1500.00	343.6	6.55	162	8.34	65.6	6.90	288	7.87	304	
1600.00	369.7	5.57	173	7,47	56.3	6.90	288	6.90	342	
1700.00	398.4	4.83	180	6.80	66.0	7.87	304	4.88	333	
1800.00	421.5	4.83	180	6.80	66.0	4.88	333	4.88	333	
1900.00	446.0	4.14	180	5.69	76.0	4.88	333	4.88	333	
2000:00	466.0	3.52	191	5.57	82.9	4.88	333	4.88	297	
2100.00	492.3	3.52	191	6.21	90.0	2.18	0	4.88	297	
2200.00	512.4	3.52	191	5.90	111	4.36	0	6.90	288	
2300.00	537.2	3.45	217	7.34	131	9.00	346	8.73	270	
2400.00	586.2	2.18	252	7.60	180	11.1	11.3	9.00	284	
2500.00	613.1	0.977	315	7.87	218	21.5	24.0	13.1	270	
2600.00	634.9	0.691	90.0	6.25	264	19.5	63.4	17.6	300	
2700.00	650.9	1.54	117	5.03	286	13.3	80.5	20.1	311	
2800.00	678.8	1.54	117	5,39	310	11.1	78.7	21.8	323	
2900.00	707.9	1.95	135	5.39	320	11.1	78.7	20.6	328	
3000.00	725.9	0.977	135	6.37	319	9.00	76.0	23.6	326	
3100.00	744.8	2.07	90.0	7.87	322	14.0	51.3	28.5	328	
3200.00	772.3	3.52	78.7	8,98	337	15.7	56.3	30,4	339	
3300.00	801.7	5.57	97.1	9.00	356	19.5	63.4	29.7	343	
3400.00	826.0	5.90	111	9.69	356	20.7	71.6	33.9	345	
3500.00	856.5	7.11	119	9.77	8.13	24.4	79.7	36.0	346	
3600.00	880.4	8.32	138	6,18	26.6	28.5	85.6	40.8	344	
3700.00	916.5	9.69	176	5.94	35.5	35.0	93.6	47.7	344	
3800,00	943.5	8.79	225	3.45	90.0	42.0	99.0	62.1	342	
1		<u> </u>				······································				

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ļ			C.A.	45	CH	'6	CH	7	CH	P
	3900.00	974.9	9.08	261	3.52	191	51.9	112	84.3	350
	4000.00	1004.7	18.2	307	10.9	235	80.5	147	164	0.764
1	4100.00	1025.9	27.1	19.4	33.9	356	85.8	263	210	59.4
	4200.00	1049.9	36.8	55.7	30.3	153	114	48.1	218	76.1
<u> </u>	4300.00	1077.6	42.4	127	51.5	302	168	159	278	144
	4322.00	1098.0	37.2	138	46.3	327	133	179	232	156
	4322.00	1163.6	42.6	140	57.6	326	167	174	268	157
	4320.00	1223.9	45.2	141	62.6	326	191	174	293	159
	4323.00	1286.2	42.2	140	61.0	329	184	175	286	160

3 MIN HOLDING

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Technician 호 한 단 ²⁰⁰⁹ QC 강 서와 1/12 Customer

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1/12/09

Measuring Values

Rotor: 7FH2_7C068

Run: OVERSPEED TEST from 2009-01-12 17:13

Comment:

Unfiltered

Measuring Values

		TE CPLG WEST	TE CPLG EAST	TE JNL WEST	TE JNL EAST
		VC4000	VC4000	VC4000	VC4000
		CH 1	CH 2	CH 3	CH 4
Speed	Time	Amount	Amount	Amount	Amount
		<u>[μm]</u>	[μm]	[µm]	[µm]
100.000	53.0	15.0	19.1	5.30	5.90
200.000	57.6	14,4	17.0	5.90	6.40
300,000	16.2	14.5	14.9	5.40	5,80
400.000	95.3	14.5	14.8	5.20	6.80
500.000	116.2	13.9	14.9	5.20	8.90
600.000	138.2	15.6	15.6	3.60	9.80
700.000	157.0	15.6	19.5	5.20	9.60
800.000	176.7	15.7	14.6	4.20	9.70
900.000	199.3	20.4	14.9	5.60	14.9
1000.00	223.1	24,9	15.8	7.50	22.7
1100.00	250.4	24.0	14.8	7.30	26.0
1200.00	271.5	17.8	13.7	4.60	22.1
1300.00	295.3	13.5	12.3	5.90	21.6
1400.00	319.3	23.9	13.8	17.1	24.2
1500.00	343.6	25.7	17.1	11.6	20.6
1600.00	369.7	28.4	21.6	10.1	18.7
1700.00	398,4	28.4	23.5	9.00	16.8
1800.00	421.5	27.9	23.1	8.70	15.7
1900.00	446.0	29.4	22.5	8.60	16.8
2000.00	466.0	30.2	22.5	8.00	15.3
2100.00	492,3	30.9	28.2	8.30	15.9
2200.00	512,4	29.7	23.5	8,70	16.1
2300.00	537.2	37.6	28.8	9.30	19,4
2400.00	586.2	49.8	37.8	11.6	26.5
2500.00	613.1	58.7	67.6	17.2	32.1
2600.00	634.9	34.4	41.5	15.1	29.9
2700,00	650.9	29.9	34.5	14.2	27.9
2800.00	678.8	24.7	28,7	13.0	23.0
2900.00	707.9	25.3	25.9	12.8	21,9
3000.00	725.9	25.3	25.4	12.7	20.6
3100.00	744.8	22.0	26,4	12.9	19.9
3200.00	772.3	24.1	26.5	13.0	17.2
3300:00	801.7	25.2	23.6	11.7	17.1
3400.00	826.0	26.0	25.6	11.0	15.9
3500.00	856.5	29.4	24.9	10.4	14.8
3600,00	880.4	33.0	24.9	9.60	14.0
3700.00	916.5	35.0	27.8	9.30	12.0
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Andy Ang - ANN SLEE Rep

1/12/09

14 Jun 2009

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		CH I	CHZ	CH3	CH4
3800.00	943.5	41.5	27.1	8.70	14.8
3900.00	974,9	52.1	27.1	8.70	16.4
4000.00	1004.7	78.1	25,8	11,3	19.8
4100.00	1025.9	93.4	28.3	11.5	15.6
4200.00	1049.9	104	78.5	11.1	10.8
4300.00	1077.6	133	109	11.6	23.3
4322.00	1098.0	129	102	11.9	24.7
4322,00	1163.6	142	125	11.5	26.7
4320.00	1223.9	149	132	12.0	28.2
4323.00	1286.2	157	139	12,4	29.1

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Reviewed / Witnessed By: Andy Ang ______ SLCL Rup 14 Jan 2019

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1/12/09

Measuring Values

Rotor: 7FH2_7C068

Run: OVERSPEED TEST from 2009-01-12 17:13

Comment:

Unfiltered

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Measuring Values

		CE JNL WEST	CE JNL EAST	COLLECTOR WEST	COLLECTOR EAST
		VC4000	VC4000	VC4000	VC4000
Spood	Time	CFI D	CH 6	СН 7	CH 8
[rpm]	i ime	Amount	Amount	Amount	Amount
100 000	226	<u>[µm]</u>	[µm]		
200.000	57.6	4 70	4.90	10.5	5.20
300.000	76.0	4.70	5.80	8,90	3.40
400.000	06.2	4.00	5.10	5.60	5.70
600,000	446.0	4.60	6.50	5.50	5.60
600.000	420.0	5.00	9.20	6.30	6.40
700,000	130.2	4,10	8.70	6.90	8.90
700.000	107.0	4.30	8.30	13.8	13.5
800.000	1/6./	3.70	7.70	8.60	8.90
900.000	199.3	4.40	12.7	8.10	12.1
1000.00	223.1	6.10	22.8	9.70	18.3
1100.00	250.4	6.40	27.4	10.3	18.0
1200.00	271.5	6.20	24.9	11.4	14.4
1300.00	295.3	5.80	25.9	20.1	14.1
1400.00	319.3	11.6	23.3	24.3	18.1
1500.00	343.6	8.30	15,4	10.5	19.1
1600.00	369.7	7.00	15.5	16.5	17.6
1700.00	398.4	6.90	14.9	16.8	13.8
1800.00	421.5	6.50	13.4	13.7	13.5
1900.00	446.0	6.30	12.5	.13.7	11.9
2000.00	466.0	5.60	13.7	18.2	14.8
2100.00	492.3	6.00	10.8	10.6	37.5
2200.00	512.4	5.50	13.5	26.3	32,4
2300.00	537.2	6,00	15.8	26.7	37.5
2400.00	586.2	7.00	18.9	44.3	54.2
2500.00	613.1	8.50	23,8	103	79.4
2600.00	634.9	8.60	18.2	74.1	52.0
2700.00	650.9	7.70	13.6	53.5	46.2
2800.00	678.8	6.40	11.0	38.7	37.6
2900.00	707.9	5.20	10.5	31.6	35.2
3000.00	725.9	4.40	10.5	28.8	35.4
3100.00	744.8	4.40	11.5	26.6	37.9
3200.00	772.3	5.90	22.1	28.4	39.9
3300.00	801.7	6.90	26.7	30.9	40.7
3400.00	826.0	7.20	33.1	33.0	41.3
3500.00	856.5	7.90	30.5	37.5	45.4
3600.00	880.4	9.40	33.7	36.5	49.6
3700.00	916.5	10.9	35.7	43.0	58.5
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Reviewed / Winessed By: Andy Ang - Jus SICTLEP 14 Jan 2009 1/12/09

		CH 5	CH 6	CH 1	CH P
3800.00	943.5	10.2	. 27.7	45.3	71.8
3900.00	974.9	11.8	19.4	58.6	94.5
4000.00	1004.7	20.0	32.1	81.4	164
4100.00	1025.9	31.3	54.1	100	231
4200.00	1049.9	34.6	44.7	118	212
4300.00	1077.6	45.8	64.4	181	297
4322.00	1098.0	45.7	64.8	166	272
4322.00	1163.6	47.8	71.7	197	290
4320,00	1223.9	48.6	74.5	204	295
4323.00	1286.2	49.4	76.6	207	. 303

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Andy Ang	MX
SLCI Rep	14 Jan Duly

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Measuring Values

Rotor: 7FH2_7C068

Run: OVERSPEED TEST from 2009-01-12 17:13

Comment:

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Measuring Values

Amount [µm pp] 5.03 3.52 3.52 1.54 4.42 6.25 2.85 3.09 3.52 3.09 3.52 3.09 3.91 4.98 7.34 8.79 10.9 14.6 12.4 14.2 12.4	Angle [°] 344 349 11.3 333 309 354 76.0 333 349 333 315 304 319 315 325 341 0 14.0	Amount [μm pp] 4.20 4.42 3.45 3.91 4.42 9.62 0.691 0.691 0.691 2.85 2.76 4.20 9.63 9.81 9.39	Angle [°] 9.46 38.7 53.1 36.9 45.0 51.3 111 180 0 0 0 0 0 0 0 0 0 14.0 0 351 4.09 39.3 54.0	Amount [μm pp] 0 2.07 1.38 2.07 1.38 2.07 1.38 2.07 1.38 2.85 1.54 0.691 0.691 0.977 0.691 0.977 0.977 2.93 2.07	Angle [°] 0 180 180 214 270 194 297 270 270 270 270 225 270 225 225 225 225 225 225	Amount [μm pp] 2.76 1.54 0.977 2.85 5.26 5.86 5.52 3.52 2.18 1.95 2.49 3.72 4.88 5.39 7.11 8.34 7.72	Angle [°] 270 26.6 315 14.0 66.8 135 180 191 198 225 236 248 225 236 248 225 220 209 204
[µm pp] 5.03 3.52 1.54 4.42 6.25 2.85 3.09 3.52 3.09 3.52 3.09 3.91 4.98 7.34 8.79 10.9 14.6 12.4 14.2 12.4	[°] 344 349 11.3 333 309 354 76.0 333 349 333 349 333 315 304 319 315 325 341 0 14.0	[µm pp] 4.20 4.42 3.45 3.45 3.91 4.42 9.62 0.691 0.691 0.691 1.38 2.07 2.85 2.76 4.20 9.69 9.81 9.39	[[°]] 9.46 38.7 53.1 36.9 45.0 51.3 111 180 0 0 0 0 0 0 0 14.0 0 351 4.09 39.3 54.0	[µm pp] 0 2.07 1.38 2.07 2.49 1.38 2.85 1.54 0.691 0.691 0.691 0.977 0.691 0.977 0.977 2.93 2.07	[°] 0 180 180 214 270 194 297 270 270 270 225 270 225 225 225 225 225 225 270	[µm pp] 2.76 1.54 0.977 2.85 5.26 5.86 5.52 3.52 2.18 1.95 2.49 3.72 4.88 5.39 7.11 8.34 7.72	[°] 270 26.6 315 14.0 66.8 135 180 191 198 225 236 248 225 236 248 225 220 209 204
5.03 3.52 3.52 1.54 4.42 6.25 2.85 3.09 3.52 3.09 3.52 3.09 3.52 3.09 3.91 4.98 7.34 8.79 10.9 14.6 12.4 14.2 12.4	344 349 11.3 333 309 354 76.0 333 349 333 349 333 315 304 319 315 325 341 0 14.0	4.20 4.42 3.45 3.91 4.42 9.62 0.691 0.691 0.691 1.38 2.07 2.85 2.76 4.20 9.69 9.81 9.39	9.46 38.7 53.1 36.9 45.0 51.3 111 180 0 0 0 0 14.0 0 351 4.09 39.3 54.0	0 2.07 1.38 2.07 2.49 1.38 2.85 1.54 0.691 0.691 0.691 0.977 0.691 0.977 0.977 2.93 2.07	0 180 180 214 270 194 297 270 270 270 225 270 225 225 225 225 225 270	2.76 1.54 0.977 2.85 5.26 5.86 5.52 3.52 2.18 1.95 2.49 3.72 4.88 5.39 7.11 8.34 7.72	270 26.6 315 14.0 66.8 135 180 191 198 225 236 248 225 248 225 220 209 204
3.52 3.52 1.54 4.42 6.25 2.85 3.09 3.52 3.09 3.91 4.98 7.34 8.79 10.9 14.6 12.4 14.2 12.4	349 11.3 333 309 354 76.0 333 349 333 349 333 315 304 319 315 325 341 0 14.0	4.42 3.45 3.91 4.42 9.62 0.691 0.691 0.691 1.38 2.07 2.85 2.76 4.20 9.69 9.81 9.39	38.7 53.1 36.9 45.0 51.3 111 180 0 0 0 0 0 351 4.09 39.3 54.0	2.07 1.38 2.07 2.49 1.38 2.85 1.54 0.691 0.691 0.977 0.691 0.977 0.977 2.93 2.07	180 180 180 214 270 194 297 270 270 270 225 225 225 225 225 225 225 225 225 225 225 225 225 225 225 225	1.54 0.977 2.85 5.26 5.86 5.52 3.52 2.18 1.95 2.49 3.72 4.88 5.39 7.11 8.34 7.72	26.6 315 14.0 66.8 135 180 191 198 225 236 248 225 236 248 225 220 209 204
3.52 1.54 4.42 6.25 2.85 3.09 3.52 3.09 3.91 4.98 7.34 8.79 10.9 14.6 12.4 14.2 12.4	11.3 333 309 354 76.0 333 349 333 315 304 319 315 325 341 0 14.0	3.45 3.45 3.91 4.42 9.62 0.691 0.691 0.691 1.38 2.07 2.85 2.76 4.20 9.69 9.81 9.39	53.1 36.9 45.0 51.3 111 180 0 0 0 0 0 0 14.0 0 351 4.09 39.3 54.0	1.38 2.07 2.49 1.38 2.85 1.54 0.691 0.691 0.691 0.977 0.691 0.977 0.977 2.93 2.07	180 180 214 270 194 297 270 270 270 225 225 225 225 225 225 225 225 225 225 225 225 225 225 225 225 225	0.977 2.85 5.26 5.86 5.52 3.52 2.18 1.95 2.49 3.72 4.88 5.39 7.11 8.34 7.72	315 14.0 66.8 135 180 191 198 225 236 248 225 220 209 204
1.54 4.42 6.25 2.85 3.09 3.52 3.09 3.91 4.98 7.34 8.79 10.9 14.6 12.4 14.2 12.4	333 309 354 76.0 333 349 333 315 304 319 315 325 341 0 14.0	3.45 3.91 4.42 9.62 0.691 0.691 0.691 1.38 2.07 2.85 2.76 4.20 9.69 9.81 9.39	36.9 45.0 51.3 111 180 0 0 0 0 0 14.0 0 351 4.09 39.3 54.0	2.07 2.49 1.38 2.85 1.54 0.691 0.691 0.977 0.691 0.977 0.977 2.93 2.07	180 214 270 194 297 270 270 270 225 270 225 225 225 225 225 225 225 225 225 225 225 225 225 225 225 225	2.85 5.26 5.86 5.52 3.52 2.18 1.95 2.49 3.72 4.88 5.39 7.11 8.34 7.72	14.0 66.8 135 180 191 198 225 236 248 225 220 209 204
4.42 6.25 2.85 3.09 3.52 3.09 3.91 4.98 7.34 8.79 10.9 14.6 12.4 14.2 12.4	309 354 76.0 333 349 333 315 304 319 315 325 341 0 14.0	3.91 4.42 9.62 0.691 0.691 1.38 2.07 2.85 2.76 4.20 9.69 9.81 9.39	45.0 51.3 111 180 0 0 0 14.0 0 351 4.09 39.3 54.0	2.49 1.38 2.85 1.54 0.691 0.691 0.977 0.691 0.977 0.977 2.93 2.07	214 270 194 297 270 270 270 225 270 225 225 225 225 225 225 225	5.26 5.86 5.52 3.52 2.18 1.95 2.49 3.72 4.88 5.39 7.11 8.34 7.72	66.8 135 180 191 198 225 236 248 225 220 209 204
6.25 2.85 3.09 3.52 3.09 3.91 4.98 7.34 8.79 10.9 14.6 12.4 14.2 12.4	354 76.0 333 349 333 315 304 319 315 325 341 0 14.0	4.42 9.62 0.691 0.691 1.38 2.07 2.85 2.76 4.20 9.69 9.81 9.39	51.3 111 180 0 0 0 14.0 0 351 4.09 39.3 54.0	1.38 2.85 1.54 0.691 0.691 0.977 0.691 0.977 0.977 2.93 2.07	270 194 297 270 270 225 270 225 270 225 225 225 225 225 270	5.86 5.52 3.52 2.18 1.95 2.49 3.72 4.88 5.39 7.11 8.34 7.72	135 180 191 198 225 236 248 225 220 209 204
2.85 3.09 3.52 3.09 3.91 4.98 7.34 8.79 10.9 14.6 12.4 14.2 12.4	76.0 333 349 333 315 304 319 315 325 341 0 14.0	9,62 0,691 0,691 1,38 2,07 2,85 2,76 4,20 9,69 9,81 9,39	111 180 0 0 0 14.0 0 351 4.09 39.3 54.0	2.85 1.54 0.691 0.691 0.977 0.691 0.977 0.977 2.93 2.07	194 297 270 270 225 270 225 225 225 225 225 225 225	5.52 3.52 2.18 1.95 2.49 3.72 4.88 5.39 7.11 8.34 7.72	180 191 198 225 236 248 225 220 209 204
3.09 3.52 3.09 3.91 4.98 7.34 8.79 10.9 14.6 12.4 14.2 12.4	333 349 333 315 304 319 315 325 341 0 14.0	0.691 0.691 1.38 2.07 2.85 2.76 4.20 9.69 9.81 9.39	180 0 0 14.0 0 351 4.09 39.3	1.54 0.691 0.691 0.977 0.691 0.977 0.977 0.977 2.93 2.07	297 270 270 225 270 225 225 225 225 225 225 270	3.52 2.18 1.95 2.49 3.72 4.88 5.39 7.11 8.34 7.72	191 198 225 236 248 225 220 209 204
3.52 3.09 3.91 4.98 7.34 8.79 10.9 14.6 12.4 14.2 12.4	349 333 315 304 319 315 325 341 0 14.0	0.691 0.691 1.38 2.07 2.85 2.76 4.20 9.69 9.81 9.39	0 0 0 14.0 0 351 4.09 39.3 54.0	0.691 0.691 0.977 0.691 0.977 0.977 0.977 2.93 2.07	270 270 225 270 225 225 225 225 225 225 270	2.18 1.95 2.49 3.72 4.88 5.39 7.11 8.34 7.72	198 225 236 248 225 220 209 204
3.09 3.91 4.98 7.34 8.79 10.9 14.6 12.4 14.2 12.4	333 315 304 319 315 325 341 0 14.0	0.691 1.38 2.07 2.85 2.76 4.20 9.69 9.81 9.39	0 0 14.0 0 351 4.09 39.3 54.0	0.691 0.691 0.977 0.691 0.977 0.977 2.93 2.07	270 270 225 270 225 225 225 225 225 270	1.95 2.49 3.72 4.88 5.39 7.11 8.34 7.72	225 236 248 225 220 209 204
3.91 4.98 7.34 8.79 10.9 14.6 12.4 14.2 12.4	315 304 319 315 325 341 0 14.0	1.38 2.07 2.85 2.76 4.20 9.69 9.81 9.39	0 0 14.0 0 351 4.09 39.3 54.0	0.691 0.977 0.691 0.977 0.977 2.93 2.07	270 225 270 225 225 225 225 225 270	2.49 3.72 4.88 5.39 7.11 8.34 7.72	236 248 225 220 209 204
4.98 7.34 8.79 10.9 14.6 12.4 14.2 12.4	304 319 315 325 341 0 14.0	2.07 2.85 2.76 4.20 9.69 9.81 9.39	0 14.0 0 351 4.09 39.3 54.0	0.977 0.691 0.977 0.977 2.93 2.07	225 270 225 225 225 225 270	3.72 4.88 5.39 7.11 8.34 7.72	248 225 220 209 204
7.34 8.79 10.9 14.6 12.4 14.2 12.4	319 315 325 341 0 14.0	2.85 2.76 4.20 9.69 9.81 9.39	14.0 0 351 4.09 39.3 54.0	0.691 0.977 0.977 2.93 2.07	270 225 225 225 225 270	4.88 5.39 7.11 8.34 7.72	225 220 209 204
8.79 10.9 14.6 12.4 14.2 12.4	315 325 341 0 14.0	2.76 4.20 9.69 9.81 9.39	0 351 4.09 39.3	0.977 0.977 2.93 2.07	225 225 225 270	5.39 7.11 8.34 7.72	220 209 204
10.9 14.6 12.4 14.2 12.4	325 341 0 14.0	4.20 9.69 9.81 9.39	351 4.09 39.3	0.977 2.93 2.07	225 225 270	7.11 8.34 7.72	209 204
14.6 12.4 14.2 12.4	341 0 14.0	9.69 9.81 9.39	4.09 39.3	2.93 2.07	225 270	8.34 7.72	204
12.4 14.2 12.4	0 14.0	9.81 9.39	39.3 54.0	2.07	270	7,72	
14.2 12.4	14.0	9.39	54.0	a second s			190
12.4		BANK L K	04.0	3.72	21.8	6.80	204
A REAL PROPERTY OF THE PROPERT	3.18	9.59	59.7	0.977	315	3.52	259
15.6	12.8	8.08	70.0	0.691	270	3.45	217
10.8	39.8	14.4	73.3	0	0	1.38	270
13.3	351	9.39	54.0	0.691	180	6.25	264
19.3	2.05	13.6	59,5	2,07	180	8,98	270
30.0	23.0	23.5	61.9	3.72	202	10.7	255
39.6	73.8	52.6	107	9.81	219	13.9	207
17.4	96.8	29.3	165	10,4	278	15.2	177
11.9	100	19.3	178	7.72	297	12.1	193
9.21	103	15.9	185	6.84	315	11.2	202
8.29	90.0	10.4	188	5.94	324	9.59	210
8.32	85.2	6.94	186	4,63	333	7.87	218
5.94	126	10.7	195	3:72	338	7.47	214
6.91	127	12.6	189	3.72	338	5.94	216
4.20	99.5	8.54	194	3.52	349	6.37	221
2.49	33.7	7.11	241	3.52	349	6.84	225
6.25	83.7	4.63	207	2.85	14.0	5.94	234
7.72	79.7	2.07	180	2.18	18.4	5.94	234
6.55	108	6.25	186	2.49	33,7	5.94	234
0.00	82.9	2.49	214	1.54	63.4	5.26	247
	8.32 5.94 6.91 4.20 2.49 6.25 7.72 6.55 5.57	8.32 85.2 5.94 126 6.91 127 4.20 99.5 2.49 33.7 6.25 83.7 7.72 79.7 6.55 108 5.57 82.9	8.32 85.2 6.94 5.94 126 10.7 6.91 127 12.6 4.20 99.5 8.54 2.49 33.7 7.11 6.25 83.7 4.63 7.72 79.7 2.07 6.55 108 6.25 5.57 82.9 2.49	8.32 85.2 6.94 186 5.94 126 10.7 195 6.91 127 12.6 189 4.20 99.5 8.54 194 2.49 33.7 7.11 241 6.25 83.7 4.63 207 7.72 79.7 2.07 180 6.55 108 6.25 186 5.57 82.9 2.49 214	8.32 85.2 6.94 186 4.63 5.94 126 10.7 195 3.72 6.91 127 12.6 189 3.72 4.20 99.5 8.54 194 3.52 2.49 33.7 7.11 241 3.52 6.25 83.7 4.63 207 2.85 7.72 79.7 2.07 180 2.18 6.55 108 6.25 186 2.49 5.57 82.9 2.49 214 1.54	8.32 85.2 6.94 186 4.63 333 5.94 126 10.7 195 3.72 338 6.91 127 12.6 189 3.72 338 4.20 99.5 8.54 194 3.52 349 2.49 33.7 7.11 241 3.52 349 6.25 83.7 4.63 207 2.85 14.0 7.72 79.7 2.07 180 2.18 18.4 6.55 108 6.25 186 2.49 33.7 5.57 82.9 2.49 214 1.54 63.4	$\begin{array}{c c c c c c c c c c c c c c c c c c c $

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	CH I			CHZ		CH 3		CH 4	
3900.00	974.9	9.39	107	5.86	135	0.691	90.0	5.26	247
4000.00	1004.7	3.45	127	6.37	167	1.54	63.4	5.03	254
4100.00	1025.9	2.18	342	5.26	157	0.691	180	2,18	288
4200.00	1049.9	6.21	0	7.81	135	1.54	243	2.49	236
4300.00	1077.6	12.4	19.4	13.3	152	2.93	315	4.83	180
4322.00	1098.0	13.8	17.5	13.8	162	2.93	315	4.88	188
4322.00	1163.6	13.6	24.0	12.9	164	2.49	326	4.88	188
4320.00	1223.9	13.6	30.5	12.9	164	2.18	342	4.37	198
4323.00	1286.2	13.3	27.9	13.8	162	1.54	333	4.37	198

Reviewed / Witnessed By: Andy Ang Kurk SICI Rep 14 Jan 2009

Page No. 12
Rotor: 7FH2_7C068

Run: OVERSPEED TEST from 2009-01-12 17:13

Comment:

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Measuring Values

		CE JNL	WEST	CE JNL	EAST	COLLECTO	R WEST	COLLECTO	REAST
		2X	_	2X	[2X		2X	
	<u> </u>	CH	5	СН	6	CH	7	СН	8
Speed [rnm]	lime [e]	Amount	Angle	Amount	Angle	Amount		Amount	Angle
100.000	23.6	2.07	100	<u>lhu hhl</u>	204	[hu bb]		linu bbl	
200.000	57.6	2.52	100	2.60	204	4.00	239	1.04	243
300.000	76.2	2 85	10/	2.07	0	3.52	209	0.091	180
400 000	95.3	3.52	104	2.07	26.6	2.70	210	1.04	243
500.000	116.2	4.03	214	5.09	20.0	2.00	200	0,977	225
600.000	138.2	2.03	211	5.50	120	3.5Z	239	2.10	198
700 000	157.0	2.00	222	4.99	120	0.70	2/0	3.43	2007
800.000	176 7	2.40	255	2 1 9	100	0.13	00.0	1.12	297
900.000	100.1	1.64	202	2.10	190	1.30	90.0 495	0.977	220
1000.000	223.1	0.077	240	2.10	190	0.977	100	2.10	202
11000.00	250 /	0.377	220	2.93	220	0.977	130	2.07	270
1200.00	230.4	0.877	400	3.40	200	0.977	135	2.85	284
1200.00	205.3	0.601	100	4.20	201	1,38	180	0.977	315
1400.00	210 3	2 4 8	100	4.00	2/0	4.00	172	4.63	243
1500.00	2/26	0.077	190	4.37	200	3,45	2/0.	1.12	280
1600.00	343.0	0.977	220	0.07	300	3.09	297	8,32	312
1700.00	209.1	2.40	140	0.91	323	9.67	U co. 4	8.98	337
1800.00	101 5	2.49	140	5.57	303	9.20	03.4	5.57	353
1900.00	421.5	2.00	100	3.20	331	6.94	84.3	5.69	346
2000.00	440.0	3.32	104	4.03	329	0.21	90.0	4.03	329
2100.00	400.0	3.32	191	2.60	194	12.9	74.5	9.69	2/4
2100.00	432.3	3.72	248	2.49	214	3.45	90.0	30.5	322
2200.00	527.2	4.05	310	6.11	241	18.3	101	24.9	1.59
2300.00	507.2	1.95	45,0	9.67	270	20.1	106	31.6	10,1
2400,00	500.2 649.4	4.14	90.0	12.4	304	33.7	101	48.3	31.0
2500.00	624.0	7.11	119	17.7	339	87.5	129	66.2	82.2
2700.00	650.0	1.14	170	10.4	1.59	58.5	197	31.9	120
2200.00	670 0	6.20	180	4.63	333	38.1	215	23.5	133
2000.00	707.0	2.03	190	3.72	292	28.3	227	19.1	139
2900.00	707.9	4.03	211	4.20	279	22.8	235	16.5	147
3000.00	744.0	4.03	211	3:45	270	19.3	255	15.8	157
3100.00	744.8	2.49	214	3.45	270	19.8	241	13.8	162
3200.00	112.3	2.49	214	2.76	270	16.6	253	12.1	167
3300.00	800.0	2.18	198	3.52	281	15.3	252	9.00	176
3400.00	020.0	1.54	207	3.52	281	14.5	267	13.1	177
3600.00	000.0	1.34	207	4.20	279	17.3	272	12.9	196
3000.00	880,4	1.54	153	4.03	301	10.4	266	12.2	196
3/00.00	910.5	0.977	135	4.98	304	15.2	273	12.3	218
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		CH	5	C/1	6	Ċŀ,	9 1	CH	P
3800.00	943.5	1,54	117	4,88	315	10.4	262	11.8	267
3900.00	974.9	3.52	101	5.86	315	13.0	295	9.21	283
4000.00	1004.7	6.18	117	7.34	319	20.5	303	3.45	233
4100.00	1025.9	6.37	139	7.87	345	13.6	345	13.6	210
4200.00	1049.9	7.87	142	9.39	343	16.6	315	14.9	236
4300.00	1077.6	9.39	144	11.7	0	18.3	10.9	29.8	275
4322.00	1098.0	10.2	152	11.7	0	14.9	21.8	29.1	284
4322.00	1163.6	10.2	152	11.1	356	14.9	21.8	29.5	286
4320.00	1223.9	10.2	152	11.8	357	15.5	20.9	30.2	286
4323.00	1286.2	10.2	152	11.8	357	15.3	18.4	29.3	285

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SICI Rep	14 Jan July

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Rotor: 7FH2_7C068

Run: 1 per rev , Speed UP from 2009-01-13 17:12

Measuring Values

Runout corrected

· · · · ·		TE CPLG CH	WEST 1	TE CPLO CH	EAST	TE JNL CH	WEST 3	TE JNL CH	EAST 4
Speed [rpm]	Time [s]	Amount [µm pp]	Angle [°]	Amount [µm pp]	Angle [°]	Amount [µm pp]	Angle [°]	Amount [um pp]	Angle
500.000	67.4	2.79	51.3	0.436	90.0	0.437	162	0.276	270
600.000	92.3	2.23	101	0.436	90.0	0.437	162	0.967	270
700.000	108.3	2.23	101	0.436	90.0	0.437	162	1.80	293
800.000	126.9	2.23	101	0.436	90.0	0.437	162	2.16	310
901.000	145.4	3.41	140	0.436	90.0	0,926	117	3.63	320
1000.00	167.6	2.62	180	0.436	90.0	1.38	143	5.53	357
1100.00	189.4	2.23	259	0.436	90.0	1.80	176	5.67	43.0
1200.00	206.8	0.436	180	0.436	90.0	0.437	162	3.24	50.2
1301.00	231.4	2.79	51.3	2.23	11.3	0.926	117	2.84	60.9
1400.00	251.7	5.09	121	3.41	130	3.28	165	1.80	90.0
1500.00	267.7	3.41	140	2.23	169	1,88	197	0.414	90.0
1600.00	286.4	3.41	140	2.23	169	1.88	197	0.744	338
1700.00	317.6	3.41	140	2.23	169	1.11	173	2.09	352
1800.00	335,4	5.27	156	2.23	169	1.11	173	2.93	341
1900.00	353.6	7.32	163	2.79	219	1.11	173	3.59	344
2000.00	370.1	5.27	156	2.23	169	0.437	162	3.46	355
2100.00	385.0	5.27	156	4.39	174	0.926	117	3,59	344
2200.00	400.1	7.32	163	6.77	195	1.57	105	5.11	341
2300.00	417.7	11.6	169	6.77	195	2,47	117	7.77	348
2400.00	431.1	13.7	171	7.63	211	4.37	125	11.7	2.02
2500.00	453.8	15.9	188	7.63	211	5.28	137	14.2	13.0
2600.00	473.2	14.2	198	7.63	211	5,80	142	14:1	28.1
2700.00	488.8	13.1	210	4.49	241	5,06	154	12.6	39.6
2800.00	506.6	8.23	212	4.70	202	4.15	159	10.5	43.9
2900.00	522.6	7.32	197	6.77	195	3,87	145	10.6	49.2
3000.00	539.0	10.2	205	9.57	204	4.30	138	11.3	56.5
3100.00	555.9	8.23	212	8.95	223	6.25	137	11.2	64.4
3201.00	571.6	7.05	248	10.6	232	8,15	154	10.3	78.4
3300.00	590.6	5.09	239	4.49	241	8.83	170	9,42	85.8
3400.00	607.5	3.41	220	4.49	241	8.01	179	8.73	94.5
3500.00	626.2	4.80	180	2.79	219	8.03	184	7.45	101
3600.00	643.4	9.16	180	2.79	219	10.1	179	6,55	115
3700.00	660.9	8.23	212	2.79	219	7.42	190	3.46	113
3780.00	679.1	9.57	223	2 23	169	6.91	106	4.39	61.8

Reviewed / Witnessed By: Andy Ang SLCI Rep in Mi 10

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Rotor: 7FH2_7C068

Run: 1 per rev , Speed UP from 2009-01-13 17:12

Measuring Values

Runout corrected

		CEJNL	WEST	CE JNL	EAST	COLLECTO	R WEST	COLLECTO	DR EAST
	T					<u> </u>		CH	<u>8</u>
Speed [rpm]	Time [s]	[µm pp]	Angle [°]	Amount [µm pp]	Angle [°]	Amount [µm pp]	Angle [°]	Amount	Angle
500,000	67.4	0.437	288	0	0	0	0	2.18	0
600.000	92.3	0.437	288	0	0	0	0	2,18	0
700.000	108.3	0.437	288	0.691	0	0	0	3.09	315
800.000	126.9	0.691	217	1.38	0	0	0	2.18	0
901.000	145.4	0.618	153	3.52	349	0	0	2.1.8	0
1000.00	167.6	1.27	167	5.57	7.13	0	0	2.18	0
1100.00	189.4	1.95	172	7.47	56.3	2.18	180	3.09	45.0
1200.00	206.8	2.23	210	6.37	77.5	3.09	225	0	0
1301.00	231.4	1.98	192	6.25	83.7	3.09	225	2.18	270
1400.00	251.7	3,49	198	5.69	104	4.88	297	4.88	297
1500.00	267.7	3.18	214	5.03	106	2.18	0	3.09	315
1600.00	286.4	2.64	223	5.03	106	4.36	0	3.09	315
1700.00	.317.6	3.15	232	6.55	108	6.55	0	2.18	270
1800.00	335.4	3.72	239	7.11	119	4.36	0	2.18	270
1900.00	353.6	3.72	239	7.87	128	6.55	0	3.09	225
2000.00	370.1	4.32	243	8.84	129	7.87	33.7	2.18	270
2100.00	385.0	5.26	240	10.9	125	6.17	45.0	0	0
2200.00	400.1	6.49	246	12.7	135	6,17	45.0	3.09	225
2300:00	417.7	6.91	254	15.2	150	7.87	56.3	4.88	243
2400.00	431.1	8.03	266	17.1	166	4.36	90.0	6.90	342
2500.00	453.8	7.37	276	18.0	180	11.1	349	14.6	117
2600.00	473.2	7.48	282	16.8	189	10.9	53.1	15.4	188
2700.00	488.8	6.80	283	15.7	195	7.87	56.3	16.6	203
2800.00	506.6	6.80	283	16.2	200	9.26	45.0	17.0	220
2900.00	522.6	6.68	277	15.5	201	9.26	45.0	17.0	230
3000.00	539.0	7.37	276	14.2	209	6.90	71.6	16.6	247
3100.00	555.9	8.31	285	12.3	218	4.88	63,4	19.6	270
3201.00	571.6	8.15	296	8.84	231	6.55	0	19.5	297
3300.00	590.6	6.36	304	4.98	236	9.76	26.6	17.0	320
3400.00	607.5	4.83	307	3.45	233	10.9	36.9	14.6	333
3500.00	626.2	3.87	305	1.95	225	9.76	26,6	13.3	351
3600.00	643.4	3.52	296	0.691	270	9.76	26.6	10.9	0
3700.00	660.9	3.33	312	1.38	270	8.73	0	9.76	26.6
3780.00	679.1	2.25	349	3.52	349	11.8	338	12.7	59.0

Reviewed / Witnessed By: Andy Ang SICZ Rep 14 Tan Ina

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Rotor: 7FH2_7C068

Run: Final Balancing (1 per rev) Speed Down from 2009-01-14 13:29

Measuring Values

Runout corrected

			TE CPLG	WEST	TE CPLG	EAST	TE JNL	WEST	TE JNL	EAST	
					Сн	2	СН	3	СН	4	
	Speed [rpm]	Time [s]	[µm pp]	Angle [°]	Amount [µm pp]	Angle	Amount	Angle [°]	tnuomA [ממ תוג]	Angle [°]	
	3780.00	299.0	14.4	245	9.57	294	6.12	186	2.10	23.2	
	3700.00	320.5	12.0	226	8.74	267	6.77	180	3.27	152	1
	3600.00	336.8	8.95	227	10.9	268	4.24	161	7.91 🖌	117	\leftarrow
	3500.00	385.1	10.6	218	11.2	257	8.18	185	10.7	102	`
\sim	3400.00	405.7	13.6	220	13.4	259	9.55	184	12.7	96.9	
\bigcirc	3300.00	420.8	13.6	220	17.7	261	10,9	176	13.9	90.6	
	3200.00	436.0	18.2	226	20.2	256	11.4	162	16.8	83,4	\leftarrow
	3100.00	452.0	21.5	218	24.6	243	10.7	140	19,1	71.4	
	3000.00	467.0	23.1	202	23.5	220	6.28	130	18.3	61.1	
	2900.00	514.0	19.7	193	18.0	209	4.31	140	16.9	55.7	
	2800.00	570.5	17.2	187	16.3	196	4.87	145	16.1	47.4	<
	2700.00	604.0	19.3	186	13.7	189	5.77	159	17.6	45.6	
	2600.00	628.0	19.2	180	13.7	189	6.05	153	18.2	37.9	1
	2500.00	656,5	19.3	174	13.5	180	6,05	153	16.7	30.4	:
	2400.00	678.5	18.2	159	11.3	180	4.87	145	.15.4	21.5	1
	2300.00	710,5	. 17.2	150	11.3	180	4.31	140	12,6	13.3	1
	2200.00	731.6	16.7	139	11.6	169	3.34	142	9,65	9.06	1
	2100.00	748.4	12.0	134	9.42	167	2.97	152	7.61	11.5	i
	2000.00	772.7	10.7	125	10.2	155	2.71	165	6,26	14.0	
	1900.00	789.5	7.63	121	8.23	148	2.62	180	4.28	20.8	
	1800.00	811.5	7.63	121	8.23	148	2,62	180	4.40	41.2	
\bigcirc	1700.00	838.8	5.87	132	.8.23	148	3.39	192	4.89	47.3	
~	1600.00	859.2	5.87	132	8.23	148	4.06	190	5.33	68.7	
	1500.00	879.4	5.87	132	9.57	137	6.08	180	7.17	62.4	
	1400.00	899.0	13.7	107	13.4	101	10.2	137	10.3	48.8	
	1300.00	919.6	5.09	59.0	2.79	51.3	2.08	86.2	8.82	39.9	
	1200.00	938.0	2.79	129	3.41	140	2.05	160	11.1	30.7	
	1100.00	955.2	7.51	144	3.41	140	3,81	134	15,1	358	
	1000.00	969,4	11.6	110	3.41	140	3.46	87.7	11.1	307	
	900.000	984.0	8.74	87.1	3.41	140	1.61	59.0	6.20	282	
	800,000	1002.8	6.56	86.2	3.41	140	1.08	39.8	4.01	268	
	700.000	1023.9	5.09	59.0	3.41	140	0.138	0	2.63	267	
	600.000	1039.2	4.39	84.3	3.41	140	0.138	0	1.25	264	
	500.000	1054.6	4.39	84.3	2.62	180	0.138	0	0.569	256	
ľ.	400.000	1069.8	4.39	84.3	3.41	140	0.138	0	0.569	256	
. [300.000	1086.5	4.39	84.3	3.41	140	0.138	0	0.569	256	
	200.000	1100.8	2.23	78.7	2.62	180	0.704	78.7	0,195	135	
	125.000	1123.8	4,49	151	2.23	259	0.138	0	0.195	135	

Beviewed / Witnessed By: Andy Ang & SICI Ъp 14 Jan Jang

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Page No. 거

Rotor: 7FH2_7C068

Run: Final Balancing (/ per rev) Speed Down from 2009-01-14 13:29

Measuring Values

Runout corrected

	•		CE JNL	WEST	CE JNL	EAST	COLLECTO	RWEST	COLLECTO	REAST	1
	f 				UH	10 	CH	1	СН	8	-
	Speed [rpm]	Time [s]	[µm pp]	Angle [°]	Amount [µm pp]	Angle [°]	Amount	Angle	Amount	Angle	
	3780.00	299.0	3.32	343	2.18	342	12,0	316	9.81	111	1
	3700.00	320.5	3.42	317	0.977	315	9.57	336	1.95	297	1
≯	3600.00	336.8	3.93	309	1.54	297	11.0	351	8.05	311	k
	3500.00	385.1	4.40	316	3,45	270	11.0	351	8.05	311	
[3400.00	405.7	5.37	316	4.14	270	13.2	352	11.1	312	
	3300.00	420.8	6.44	325	6.37	283	14.4	335	14.7	300	
1	3200.00	436.0	8.80	312	11.1	266	15.4	305	15.7	289	<u> </u>
	3100.00	452.0	9.78	289	12.4	243	15.5	254	14,9	265	l l
	3000.00	467.0	8.57	273	12.3	218	14.4	205	11.0	252	ł
	2900.00	514.0	6.50	268	11.1	210	11.9	156	7.04	240	
1	2800.00	570.5	5.82	274	12.4	207	9.57	133	8,34	227	F
	2700.00	604.0	5.13	275	12.4	207	13.1	120	9.95	218	
	2600.00	628.0	5.82	274	13.8	198	17.9	90.0	9.21	149	
	2500.00	656.5	6.50	268	13.8	183	5.27	65,6	15.4	61.3	
	2400.00	678.5	5.81	267	13.3	171	9.42	103	11.8	2.12	
ſ	2300.00	710.5	5.20	259	12.7	158	11.3	90.0	7.62	347	
ſ	2200.00	731.6	4.72	249	10.9	145	11.3	90.0	7.43	3.37	ĺ
ſ	2100.00	748.4	4.08	246	9.77	135	9.42	103	9.76	350	/
Γ	2000.00	772.7	4.41	238	8.84	129	10.2	64.5	5.52	342	
ſ	1900.00	789.5	3.84	232	7.72	117	10.2	64.5	7.62	347	
	1800.00	811.5	2.87	235	6.80	114	9.57	46.8	7.62	347	
Γ	1700.00	838.8	2.87	235	5.69	104	9.96	28.8	8.39	332	
	1600.00	859.2	3,84	218	5,57	97.1	9.96	28.8	10.4	338	
	1500.00	879.4	3.84	218	5.03	106	9.11	16.7	11.4	328	
	1400.00	899.0	3.85	195	11.2	112	11.3	293	12.7	264	
·	1300.00	919.6	1.92	210	11.2	68.2	2.23	169	2.18	233	
·	1200.00	938.0	3.19	198	10.8	50.2	3.41	130	3.09	8.13	
	1100.00	955.2	2,44	133	11.9	10.0	3.41	130	5.52	342	
	1000.00	969.4	0.586	45.0	7.11	331	2.62	90.0	8.39	332	
	900.000	984.0	0.498	326	3.45	307	2.62	90.0	6.55	323	
[800.000	1002.8	1.05	293	1.54	297	2.62	90.0	4,98	308	
	700.000	1023.9	1.05	293	0.691	270	3.41	50.2	6.83	297	
Γ	600.000	1039.2	1.05	293	0	0	2.62	90.0	4.98	308	
	500.000	1054.6	1.71	284	0.691	180	2.62	90.0	4.98	308	
	400.000	1069.8	1:71	284	.0	0	2.62	90.0	4.98	308	
Г	300.000	1086.5	1.71	284	0.691	180	2.23	11.3	4.02	283	
	200.000	1100.8	0.391	225	0.977	45.0	2.62	90.0	3.52	330	
	125.000	1123.8	0.391	225	0	0	2.62	90.0	0.976	26,6	

Reviewed / Witnessed By: Andy Ang SLCI Rep Jan Javy 1.4.

2009 Technician |Page No.ン QC 1**14/05 9** 1/14/09 Customer

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Rotor: 7FH2_7C068

Run: Final Balancing (2 per rev) Speed Down from 2009-01-14 13:29

Measuring Values

Runout corrected

			TE CPLG V	VEST 2X	TE CPLG E	EAST 2X	TE JNL W	EST 2X	TE JNL E	AST 2X	1
			СН	1	СН	2	СН	3	СН	4	
	Speed [rpm]	Time [s]	Amount	Angle	Amount	Angle	Amount	Angle	Amount	Angle	
	3780.00	200 0		102			[µm pp]		[µm pp]		ĺ
	3700.00	320.5	6.24	102	7.20	229	2.07	323	3.03	210	
_>	3600.00	336.8	5.24	170	6.29	217	1./5	342	3,03	210	
1	3500.00	385.1	7 20	150	3.00	242	1.75	342	3.03	210	5
	3400.00	405 7	7.59	109	0.20	232	2.35	3.37	3.16	247	
	3300.00	400.1	11 8	100	12.8	250	3,04	2.60	4.70	246	
	3200.00	426.0	47.0	100	12.1	210	5,04	2.00	4.70	246	
	3100.00	450.0	15.7	100	17.4	202	3.73	2,12	5.62	242	
ł	3000.00	452.0	10.7	102	15.9	213	4.42	1.79	6.87	248	ĺ
	2000,00	544.0	10.1	100	13.2	217	5,14	354	9.33	245	
	2800.00	570 F	10.0	122	17.4	207	6.61	349	11.4	233	
ł	2700.00	070,0 604.0	16.9	117	19.8	197	7.63	328	12.4	215	
ł	2200.00	629.0	20.0	95.9	23.1	182	9,38	314	16.1	201	
ŀ	2500.00	020.0	20.2	72.1	28.0	166	10.9	290	· 19.2	180	
	2500.00	030.5	28.3	67.1	47.8	115	9.12	235	17.6	201	
.	2400.00	0/8.5	23.8	16.5	21.2	63.8	3.18	236	9.77	226	
}	2300.00	710,5	14.6	354	10.9	52,7	1,66	228	6.38	265	
}	2200.00	731.6	9.03	337	5.98	49.7	0.691	233	3.59	272	
	2100.00	748.4	6.82	35.9	8.28	62.2	1.11	330	1.53	275	
	2000.00	772.7	9.68	3.27	3,65	60.5	1.57	308	3.03	210	
-	1900.00	789.5	8.42	350	5.00	50.6	2.07	323	2.54	241	
-	1800.00	811.5	4.23	349	5.00	39.4	2.18	215	7.36	203	
-	1700.00	838.8	9.43	342	7.08	20.6	2,80	290	8.15	181	
-	1600.00	859.2	11.8	315	10.1	330	2.23	240	8,00	201	
	1500.00	879.4	8.87	288	6.31	293	0.618	297	6.12	208	
╞	1400.00	899.0	7.76	275	4.44	275	1.57	308	4.94	216	
-	1300.00	919.6	7.18	259	3.89	287	1.27	283	3.49	236	
	1200.00	938.0	6.30	244	4.56	284	1.27	283	1.96	231	
Ļ	1100.00	955.2	4.53	232	4.43	266	0.618	297	1.25	186	
Ļ	1000.00	969.4	3.54	219	4.43	266	1.11	330	1.25	186	
	900.000	984.0	3.03	227	4.52	258	1 .11	330	2.63	183	
	800.000	1002.8	3,56	234	5.00	242	2.07	323	4.01	182	
	700.000	1023.9	3.96	151	5.13	117	1.24	207	4.19	163	
Ŀ	600.000	1039.2	3.21	295	1.47	319	2.16	297	6.17	130	
≯_	500.000	1054.6	5.09 🖌	237	1,99	304	1.31	252	4.28	69.2	<
L	400.000	1069.8	3.54	219	2.59	295	0.437	162	0.996	33.7	
L	300,000	1086.5	2.57	216	2.38	280	0.309	26.6	0.195	315	
	200.000	1100.8	2.61	238	2.04	332	1.24	207	0.996	33.7	1
	125.000	1123.8	2.97	118	2,59	155	0.691	233	0.781	135	

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Rotor: 7FH2_7C068

Run: Final Balancing (2 per rev) Speed Down from 2009-01-14 13:29

Measuring Values

Runout corrected

			CE JNL	WEST	CE JNL	EAST	COLLECTO	DR WEST	COLLECT	OR EAST	7
			2)	<	2)	(2>	C	22	(
	Proced	Time	CH	5	CH	6	СН	7	CH	8	
	Irnm1	l lime	Amount	Angle	Amount		Amount	Angle	Amount	Angle	
	3780.00	299.0	2 23	829	1 60	200			[qq mu]		-[
	3700.00	320.5	1.80	57.5	1.02	290	2,09	20,2	12.0	1 270	-
\rightarrow	3600.00	336.8	0.873	716	0.840	200	7.25	231	0.30	103	
1	3500.00	385.1	0.977	813	3.02	254	1.25	210	9.00	102	-
	3400.00	405.7	0.873	71.6	3.02	254	10.0	214	11.0	160	
	3300.00	420.8	0.309	26.6	3 00	204	14.0	202	13.0	103	4
	3200.00	436.0	0.691	233	4.82	241	17.4	201	9.95	100	
	3100.00	452.0	1 24	207	6.08	240	19.7	240	10.7	100	-
	3000.00	467.0	1.88	197	7 39	240		232	10.2	140	
	2900.00	514.0	2 55	193	8.56	200	<u> </u>	244	24.0	139	4
	2800.00	570.5	3.18	178	6 35	200	24.5	220	24.9	126	-{
ł	2700.00	604.0	4.63	170	6.55	209	29.0	207	20.2	115	
ł	2600.00	628.0	5.28	127	8 96	2 500		404	30,2	90.0	-
	2500.00	656.5	6.43	813	41.9	204	94.0	191	29.7	80.0	-
ł	2400.00	678 5	3 34	60.2	0 50	324	04.0	130	50.5	(1,1	╡.
ŀ	2300.00	710.5	2 /0	10.3	7 60	210		105	44.0	26.1	
ł	2200.00	731.6	4.40	249	7.10	240	25.6	107	33.9	2.80	
ŀ	2100.00	7/8 /	1.10	044	F 47	21/		101	27.9	352	-
ŀ	2000.00	770 7	1.30	479	5,17	214	13.2	104	27.7	318	-
ŀ	1900.00	780.5	2 /0	477	0.12	188	19.3	72.5	10.1	274	4
-	1800.00	211 5	2.43	140	2.40	322	13.0	82.6	6.74	325	-
ŀ	1700.00	011.0	2.30	140	2.40	322	13.7	80,2	7.60	335	-
┢	1600.00	850.0	4.20	101	4.01	308	15.4	56.3	8.23	337	-
$\left \right $	1600.00	005.2	0.200	40.0	0,38	318	12.0	1.97	11.6	321	4
+	-1/00.00	800.0	0.309	20.0	4.32	2//	1.68	351	10.5	285	_
┢	1200.00	010.6	0.309	20.0	3.69	257	0.498	56.3	7.82	249	4.
-	1200.00	919.0	0.309	26.6	4.62	231	2,54	135	4.25	167	4
· -	1200.00	930.0	0.309	20.0	4.22	212	2.54	135	2.45	73.6	4
-	1000.00	900.2	0.018	297	3.69	193	3.07	126	2.29	25.0	_
-	1000.00	909.4	0.018	297	3.59	182	3.07	126	2.29	25.0	,
+	900.000	984.0	0.309	26.6	2.90	183	4.26	115	1.41	11.3	
+	800.000	1002.8	0.618	297	2.90	183	5.95	94.0	1.80	67.4	1
-	700:000	1023.9	1.95	278	6.38	175	7.23	315	7.45	281	_
┢	500.000	1039.2	1,66	228	5.91	127	0.498	214	2.27	232	1
1-	400,000	1054.6	1.88	197	4.04	82,1	1.84	167	1.19	126	$ \leftarrow$
-	400.000	1069.8	1.80	176	1.36	66.0	2.11	148	0.967	90.0	_
-	300.000	1086,5	1.80	176	0.195	225	2.11	148	0.967	90.0	
-	200.000	1100.8	1.11	173	0.781	45.0	1.18	159	1.19	54.5	1
1	125.000	1123.8	U.977	8.13	1.49	124	1.05	23.2	1.41	11.3	1

Page No. 24

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Sec. 1

TESTER : 홍현택 DATE : 2009-01-13



DATF: 2009-01-14 TESTER: 雲角탶

Do &	DOOSA oSan Heavy Indu Construction Co	N Istries 5.,Ltd	IM C A	PEDAN After Trimal	CE TEST 19 Balancing	Г •)	Page No. Rev. Date	1 2001–04–
	PROJECT NAME	E : 7FH2 #	70068	Design Val	ue: 8.49	* Tol	erance : Deslç F 6.30	n Value ±25 675 ~ 10.612
	SPEED	VOL		AMP.	IMPEDANCE	DEVIATION	REMA	NRK
				(A)		(%)		
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	Heavy Industri & Construction	ies LOC	ATION	OF VI	B. SEN	ISOR		
	Field Information	1			лт, ₎	•	DALA	HPCT-904
	PROJECT	; 7FH2#7C()68	M	/0 NO.	: T07	113	
	MATERIAL NO.	: F07479-	140	R	TR TYPE	: GEN	FIELD	
	SERIAL NO.	: 338X390		CI	JSTOMER	: GE		
·•• ``	P/0 NO	: 18109416	35					
)				·				
	SENSOR POS	<u>SITION</u>		<u>GENE</u>	RATOR F	ROTOR D	SCRIPTIC	<u>DN</u>
· · .	WEST	EAST						
	СНЗ,СН5,СН7 С	H4, CH6, CH8						
	Rotation					, 1 , F (, I , I , I , I		
								1
)	CH1	. CH2	TE C	PLG	JNL	CE	JNL a	DLL , RING
	CH1	CH2 E : Motor End E : Door End	JNL :	PLG PLG : JOURNAL	JNL W:	WEST	E : EAST	DLL , RING
	CH1	CH2 E : Motor End E : Door End	JNL :	PLG : JOURNAL	JNL W :	CE	E : EAST	DLL,RING
	CH1	CH2 E : Motor End E : Door End CH2	JNL CH3	PLG : JOURNAL	JNL W:	CE WEST CH6	JNL E : EAST CH7	DLL , RING
	CH1 LEGEND ME DE Channel CH1 G DOQSAN TE CPt Facilities W	CH2 E : MOTOR END E : DOOR END CH2 _G TE CPLG F	JNL TE JNL TE JNL	PLG PLG : JOURNAL : JOURNAL CH4 TE JNL F	JNL W: CH5 CE JNL W	CE WEST CH6 CE JNL F	E : EAST	CH8 COLL-RING
	CH1 LEGEND ME DE Rotor Type Channel CH1 CH1 G Facilities N SIDE END	CH2 = : MOTOR END = : DOOR END CH2 _G TE CPLG E TBN END	CH3 TE JNL W TBN END	CH4 TE JNL E TBN END	JNL W: CH5 CE JNL W COLL END	CE WEST CH6 CE JNL E COLL END	E : EAST	CH8 COLL-RING E COLL END
	CH1 LEGEND ME DE Channel CH1 DE CH1 CH1 G DOQSAN TE CPE Facilities W TBN/CEN SIDE END	CH2 E : MOTOR END E : DOOR END CH2 CH2 CH2 E TE CPLG E TBN END	TE C. JNL CH3 TE JNL W TBN END	CH4 TE JNL E TBN END	JNL W: CH5 CE JNL W COLL END	CE WEST CH6 CE JNL E COLL END	CiH7 COLL-RING W COLL END Reviewed /	CH8 COLL-RING E COLL-RING END Witnessed By:

2009.01.14 10:28 / 발전)발전품질관리부 / H502302 /

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DUTA - 11 Doosan I & Constr	liteay industries ELECTRICAL	TEST (Final hi-r	oot Test)	PCG No : PCG-RW-005
ITEM	FIELD WINDING	PJT. NAME	7FH2 7C68	GENERATOR ROTOR
P/O NO.	181094165(338X390)	M/O NO.	T07113	
APPLIED DC	OSAN DWG NO / Rev No	138E7050 Rev.A	(MAR.27.2008)	
APPLIED GE	SPEC No / Rev No	P12A-AL-6129.Re	ev.K (AUG.2006)	
VF. NO.	F07479-140	TEST DATE	2009.01.19	·
*. INSTRUCT		•		٠.

1) Winding Resistance : Design Value ± 2 %

2) Impedance : Design Value ± 25 %

3) Pre-hipot

- Insulation Resistance : Min 25 Mohm (DC 500V MEGGER)

- Polarization index

Insulation Resistance	Polarization Index
25 - 199 Mohm	Min 1.10
≥ 200 Mohm	Min 1.00

I) Hi-pot Test : Test Voltage : AC 3500 V, Holding Time : 1 Min

5) Post-hipot

Insulation resistance at 1 minute after hipot should be 25 w or greater and at least 60 percent of the one-minute pre-high potential measurement, or 200 w or greater.

1. WINDING RESISTANCE CHECK

RESISTANCE (Ω) at	12.5 C	RESISTANCE	(-&-) at 25 C	REMARKS
0.1315.		0.1	3815.	-1.53%
※. Design value = 0.	1403 (🔊) at	25°C		

Winding temperature measurement

Section	1	2	3 4 5 Average	REMARKS
Temp(°C)	12.3	12.5	12.7 12.4 12.5 12.5	

24年8月14日18月16日28月1日月月月日前周辺開始日本市民的市场合理的中国合理的中国市场的目标。

2. IMPEDANCE CHECK

)-	VOLTAGE	CURRENT	ACT'L DATA	DESIGN VALUE	DIFFERENCE(%)
/	100 Vac	12.2 A	<u>8.20</u> ହ	8.49 ନ	-3.45%

3. INSULATION RESISTANCE CHECK

	INSULATION RESISTANCE	Ration of Insulation resistance between
PRE HI - POT TEST	6430 MΩ	pre and post Hi-pot Test (%)
POST HI - POT TEST	4520 MΩ	70.3

4. POLARIZATION INDEX TEST (BEFORE HI POT)

	TIME	1 MIN	5 MIN	10 MIN	·P.1
•	MΩ	6430	24200	41100	6.39

5. HI - POT TEST

	TEST VOLTAGE	HOLDING TIM	E RESULT	F	REMARKS
	3500V. AC	60 SEC	Pass		
TEST	K 3/ 1/19/109 4 RED BY REV	7 2- 1/19/69 /IEWED BY	Page No. 3 123 /19/29 APPROVED BY	VITNESSED BY	Reviewed / Witnessed By: Andy Ang CW SICI Rap 19 Jan 2009 WITNESSED BY

TEST CONDITIONambient temp:17 °Chumidity:30 %

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He	illy avy Industrie	9	(AFT]	ER FINA	L HI-POT TES	ST)	
8.0	Construction		(~~~~~~				PAGE: / UF/ 2
ж та	CONDITION	דדראז			,	PROJECT NAME	7FH2 7C068.GEN
× IN	SIRUU.	LION	•1			M/O NO	107113
1) DIF	Έ : [(A	B + A-C) ÷	2] - B-C			DWG NO	135E3545 Rev.J
2)TEM	1P: (DII	F-100)*2.5	44			SPEC' NO	P24A -AL -5068Q
3) All	the tempera	ature should	be within ± 2	2°C of ambi	ent temperature.	P/O	181094165 (338X390)
- An	nbient temp	perature is the	e average of	the all meas	sured temperature.	CHECK DATE	2009.02.21
RTD	A~B	A~C	B∼C	DIFF	TEMP	AT 07 110	
NO	A'~B'	A'~C'	B'~C'	Ω	° °	SLOT NO	REMARKS
<u> </u>	105.38	105.38	0.85	104.53	11.5		DWG NO:
1	105.29	105.29	0.85	104.44	11.3	1 TE SIDE	U7189D1096P04045
	105.75	105.75	1.05	104.70	12.0	10 1. · · · · · · · · · · · · · · · · · ·	1
2	105.72	105.72	1.04	104 68	119	21 TE SIDE	
	105.45	105.45	1.01	104.40	11.2		*****
3	105.41	105.41	1.03	104 37	11.2	41 TE SIDE	
	105 10	105.10	0.45	104 74	17.1		
4	105 13	105.12	0.45	104 68	11.0	3 CE SIDE	
$\{-$	105.75	105.15	0.55	105 10	12.7		
۶5 /	105.75	105.75	0.65	105.00	12.0	23 CE SIDE	
	105.74	105.74	0.05	103.09	14.7	·	<u></u>
6	105.21	105.21	0.01	104.00	11.7	43 CE SIDE	
	105.22	105.22	0.01	104.01	11./		DWG NO.
7	105.10	105.10	0.57	104.59	11./	2 CE CENTER	
	105.00	105.00	0.30	13-104-00 10-10-10-02-00	11.4	A State of the second second	0/1891/10902/09945
8	105.04	105,04	0.78	104.80	12.4 ACCENTARIA (1997)	22 CE CENTER	
	105.66	105.66	0.78	104.88	12.4		
9	105.09	105.09	0//4	104.35	11.1	42 CE CENTER	
	105.22	105.22	074	104:48	<u>11.4</u>		
-10	104.65	104.65	0.81	103.84	98	TEFRAME	DWG NO:
· .	104.65	104.65	0.82	103,84	9.8	COLDGAS	U7193DLXXXPXXX55
11	103.89	103.89	0.26	103.63	92	CEFRAME	
	103.96	103.96	0.27	103.70	9.4	COLD GAS	
12	<u>104.05</u> ⊃	<u>104.05 </u>	/ 0;2 <u>7</u>	103.78	9.6	CE FRAME	
	103.95	103.95	0.26	103.68	9.4	COLD GAS	
via L	104.49	104.49	0.82	103.67	9.3	TE FRAME	
	104.51	104.51	0.82	103.69	. 9.4	COLD GAS	
20	105.43	105.43	0.69	104.74	12.1	11 CE CENTER	DWG NO:
	105.47	105,47	0.70	104.77	12.1		U7189D1096P09945
21 L	105.61	105.61	0.86	104.75	12.1	31 CE CENTER	
~· 1	105.60	105.60	0.85	104.75	12.1	51 CE CERTER	· ·
52 T	105.12	105.12	0.66	104.46	11.3		
<u>~</u> [105.07	105.07	0.66	104.41	11.2	JI CE CENTER	¥
20	104.52	104.52	0.48	104.04	10,3	CENTER FRAME	DWG NO:
²⁰ [104.47.	104.47	0.48	103.99	10.2	HOT GAS	U7193DIXXXPXXX55
	104.38	104.38	0.48	103.90	9.9	CENTER FRAME	
29	104.35	104:35	0.48	103.87	9.8	HOT GAS	↓
			0.48				· .
OMN	IENTS :	Ī	SLOT	COOLER		1	A A A A A A
		ŀ	TEMP(°C)	TEMP (°C)	· . /	$\Lambda \Lambda $: $\Lambda \Lambda \Lambda$	I WW WW
: F	Min. Tem	perature	11.1	9.2	•	'∦¶ `∳⊻V♠	. • * * • * *
· -	Max. Tem	perature	13.0	10.3			
F	Verяge Te	mperature	11.8	9.5	À	BC ABC	A COOLER RTD
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TESTED BY

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Page No. 24

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1. TBN S	IDE DIM	CHECK		Unit: mm
GR	СР	DWG	ACT'L	비고
S	D1	Ф812.8±0.5	Φ812.78	COUPLING 외경
C	D2	Ф 507.61±0.01	Ф507.60	RABBIT FIT
с	D3	Φ 140.024 ± 0.006	Ф140.03	BALANCE FIT
С	D4	Φ469.9±0.5	Ф469.92	
с	D5	Φ 457.20 \pm 0.05	Ф457.22	OUT OIL DEF.
S	L1	20.8±0.5	20.8	
S	L2	48.8±0.5	48.80 ***	,
S	L3	41,4±0.5	41.4	

(품질-B-073/03)

두산중공업㈜

Page No. 2

(A4/복사용지)

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		-	DWG		7.6	25.4	50.8	635	254	254	635	50.8	25.4	2.6	7.6	7.6	25.4	50.8	50.8	25.4	25.4	25.4	163-07-60	
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CERTIFIC IDENT	CATION TO SHIP THE GEI IFIED ABOVE HAS BEEN BY THE FOLLOWING:	NERATOR GIVEN PASS FOR LOAD DATE 29 DEC 20 DATE 29 DEC 20 DATE 12-29-00 DATE DATE DATE DATE DATE DATE DATE DATE DATE DATE DATE DATE DATE DATE	<u>/11</u> 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2

<u> </u>					GE POWER SY Test Operation PCG-5811A	/STEMS ns PJR 02/23/0
		Armature	e Hipot Te	st Data		
For	<u>Medium (C</u>	onventional	lly Cooled)	Armatures	- Split Phas	e
Wir	nd Stand Hipot:	<u> </u>		Shipping Hipot	; 	
SER#	181167351	Customer	ASTORIA	ENERGY	Date	9/28/09
	Sta	tor Phase Resist	tance Test (Per	P24A-AL-50690	<u>2)</u>	
Therm. S/Ns	78560064	78490014	Cal Due	2/9/10	2/9/10	· .
B	ridge Serial#	1390	Cal Due	6/9/10	•	:
Measured Windir	ng Temps TE	23.6°C	Design Re	esistance/Phase	0.0009	D .
	CE	23,5°C	Circuit Res	sistance/Circuit	· (2
Measured:	Phase 1-4	2.568	Phase 2-5	2.598	Phase 3-6	2.605
Measured:	Phase 1-4	2.607	Phase 2-5	2.651	Phase 3-6	2.564
Measured:	Phase 1-4	2.645	Phase 2-5	2.585	Phase 3-6	2.652
N N	IETER SCALE:		n Onm	(I D	u Ohm	
Note: write		eter Reading, Do	NOT COVERT. AT	tach Program /	Analysis Sneet (P	CI-409)
Testers	<u>.</u>			Date	9/28/09	<u> </u>
Insul	ation Resistanc	e Test (500 volt)	Megger) Before	& After Hipot (Per P12A-AL-7486	5)
Insul Ambient Temp Rel. Humidity Megger S/N	ation Resistance 23.4°C 51.8% 2233	ce Test (500 volt) C % Cal Due_	Megger) Before RH S/N <u>4/8/10</u>	& After Hipot (100-04-02352	Per P12A-AL-7486 Cal Due	5) <u>10/10/10</u>
Insul Ambient Temp Ret. Humidity Megger S/N	ation Resistance 23.4°C 51.8% 2233	ce Test (500 voit ℃ % Cal Due_	Megger) Before RH S/N 4/8/10	& After Hipot (100-04-02352	Per P12A-AL-7486 Cal Due After Hipot	5) 10/10/10 Min Reg.
Insul Ambient Temp Rel. Humidity Megger S/N Before Hipot Phase MΩ	ation Resistance 23.4°C 51.8% 2233 1 Min	ce Test (500 voit) C % Cal Due_ 3 Min	Megger) Before RH S/N <u>4/8/10</u> 10 Min	& After Hipot (100-04-02352 Pl	Cal Due Cal Due After Hipot	5) 10/10/10 Min Req. 1 Min
Insul Ambient Temp Rel. Humidity Megger S/N Before Hipot Phase MΩ	ation Resistance 23.4°C 51.8% 2233 1 Min 3300	ce Test (500 voit) C % Cal Due_ 3 Min 9700	Megger) Before RH S/N <u>4/8/10</u> 10 Min 24400	& After Hipot (100-04-02352 Pl 7.4	Cal Due Cal Due After Hipot	5) 10/10/10 Min Req. 1 Min 2805
Insul Ambient Temp Rel. Humidity Megger S/N Before Hipot Phase MΩ 1-4 2-5	ation Resistance 23.4°C 51.8% 2233 1 Min 3300 3460	cal Due_ 3 Min 9700 10500	Megger) Before RH S/N 4/8/10 10 Min 24400 26600	& After Hipot (100-04-02352 Pl 7.4 7.65	Per P12A-AL-7486 Cal Due After Hipot 1 Min 2960 3200	5) 10/10/10 Min Req. 1 Min 2805 2941
Insul Ambient Temp Rel. Humidity Megger S/N Before Hipot Phase MΩ 1-4 2-5 3-6	ation Resistance 23.4°C 51.8% 2233 1 Min 3300 3460 3080	cal Due_ Cal Due_ 3 Min 9700 10500 9750	Megger) Before RH S/N 4/8/10 10 Min 24400 26600 24000	& After Hipot (100-04-02352 PI 7.4 7.65 7.55	Per P12A-AL-7486 Cal Due After Hipot 1 Min 2960 3200 2780	5) 10/10/10 Min Req. 1 Min 2805 2941 2703
Insul Ambient Temp Rel. Humidity Megger S/N Before Hipot Phase MΩ 1-4 2-5 3-6 Notes: Procee ninutes after hipo Testers	ation Resistance 23.4°C 51.8% 2233 1 Min 3300 3460 3080 d with hipot if r 1000 C Hipot (Group	cal Due C C C C C C C C C C C C C C C C C C C	Megger) Before RH S/N 4/8/10 10 Min 24400 26600 24000 0 MΩ AND PI > 2 10 be ≥ 85% of initial for any out of t	After Hipot (100-04-02352 PI 7.4 7.65 7.55 2.0 After hipot n itial, before-hip colerance readir Date	Per P12A-AL-7486 Cal Due After Hipot 1 Min 2960 3200 2780 negger to be done ot, one minute va ngs. 9/28/09	5) 10/10/10 Min Req. 1 Min 2805 2941 2703 2703 a t least 30 lue and also
Insul Ambient Temp Rel. Humidity Megger S/N Before Hipot Phase MΩ 1-4 2-5 3-6 Notes: Procee hinutes after hipo Testers	ation Resistance 23.4°C 51.8% 2233 1 Min 3300 3460 3080 d with hipot if r 1000 G Hipot (Grour 53436	cal Due C C C C C C C C C C C C C C C C C C C	Megger) Before RH S/N 4/8/10 10 Min 24400 26600 24000 0 MΩ AND PI > 2 10 be ≥ 85% of initiation of the second	& After Hipot (<u>100-04-02352</u> PI 7.4 7.65 7.55 2.0 After hipot n itial, before-hip colerance readif Date Inding (Per P12 2/14/10	Per P12A-AL-7486 Cal Due 1 Min 2960 3200 2780 negger to be done ot, one minute va ngs. 9/28/09	5) 10/10/10 Min Req. 1 Min 2805 2941 2703 at least 30 lue and also
Insul Ambient Temp Rel. Humidity Megger S/N Before Hipot Phase MΩ 1-4 2-5 3-6 Notes: Procee hinutes after hipo Testers	ation Resistance 23.4°C 51.8% 2233 1 Min 3300 3460 3080 d with hipot if r 1000 G Hipot (Grour 53436 Hipot Safety Ch	cal Due C C C C C C C C C C C C C C C C C C C	Megger) Before RH S/N 4/8/10 10 Min 24400 26600 24000 0 MΩ AND PI > 2 d be ≥ 85% of initian for any out of t it)- Complete Wi Cal Due Date: T-004 had been	& After Hipot (<u>100-04-02352</u> PI 7.4 7.65 7.55 2.0 After hipot n itial, before-hip olerance readif Date inding (Per P12 2/14/10 completed and	Per P12A-AL-7486 Cal Due After Hipot 1 Min 2960 3200 2780 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	5) 10/10/10 Min Req. 1 Min 2805 2941 2703 at least 30 lue and also
Insul Ambient Temp Rel. Humidity Megger S/N Before Hipot Phase MΩ 1-4 2-5 3-6 Notes: Procee ninutes after hipo Testers ipot Set Serial#	ation Resistance 23.4°C 51.8% 2233 1 Min 3300 3460 3080 d with hipot if resistance thipot (Grour 53436 Hipot Safety Che tand & Shippin	cal Due C C C C C C C C C C C C C C C C C C C	Megger) Before RH S/N 4/8/10 10 Min 24400 26600 24000 0 MΩ AND PI > 2 d be ≥ 85% of initian for any out of t it)- Complete Wit Cal Due Date: T-004 had been Hipotted @_	& After Hipot (<u>100-04-02352</u> PI 7.4 7.65 7.55 2.0 After hipot n itial, before-hip olerance readir Date inding (Per P12 2/14/10 completed and 37	After Hipot Cal Due 1 Min 2960 3200 2780 negger to be done tot, one minute va ngs. 9/28/09 A-AL-7486) is attached () kVac for 1 Minute	5) 10/10/10 Min Req. 1 Min 2805 2941 2703 e at least 30 lue and also
Insul Ambient Temp Rel. Humidity Megger S/N Before Hipot Phase MΩ 1-4 2-5 3-6 Notes: Procee in utes after hipo Testers ipot Set Serial#	ation Resistance 23.4°C 51.8% 2233 1 Min 3300 3460 3080 d with hipot if re- 10001 G Hipot (Grour 53436 Hipot Safety Che- tand & Shipping Phase 1-4	cal Due_ Cal Cal Cal Cal Cal Cal Cal Cal Cal Cal	Megger) Before RH S/N 4/8/10 10 Min 24400 26600 24000 0 MΩ AND PI > 2 d be ≥ 85% of initian for any out of t it)- Complete Wi Cal Due Date: T-004 had been Hipotted @ Phase 2-5	& After Hipot (<u>100-04-02352</u> PI 7.4 7.65 7.55 2.0 After hipot n itial, before-hip olerance readir Date inding (Per P12 2/14/10 completed and 37	After Hipot Cal Due 1 Min 2960 3200 2780 negger to be done ot, one minute va ngs. 9/28/09 A-AL-7486) S	5) 10/10/10 Min Req. 1 Min 2805 2941 2703 2703 at least 30 lue and also
Insul Ambient Temp Rel. Humidity Megger S/N Before Hipot Phase MΩ 1-4 2-5 3-6 Notes: Procee ninutes after hipo Testers ipot Set Serial# For Wind S Enter Pass/Fail:	ation Resistand 23.4°C 51.8% 2233 1 Min 3300 3460 3080 d with hipot if r 1000 d with hipot if r 1000 G Hipot (Grour 53436 Hipot Safety Ch tand & Shippin Phase 1-4 PASS	cal Due C C C C C C C C C C C C C C C C C C C	Megger) Before RH S/N 4/8/10 10 Min 24400 26600 24000 0 MΩ AND PI > 2 d be ≥ 85% of initial for any out of t it)- Complete Wi Cal Due Date: T-004 had been Hipotted @ Phase 2-5 PASS	After Hipot (<u>100-04-02352</u> PI 7.4 7.65 7.55 2.0 After hipot n itial, before-hip colerance readir Date inding (Per P12 2/14/10 completed and 37 Enter Pass/Fail:	Per P12A-AL-7486 Cal Due 1 Min 2960 3200 2780 negger to be done ot, one minute va ngs. 9/28/09 A-AL-7486) A-AL-7486) I is attached () kVac for 1 Minute Phase 3-6 PASS	5) 10/10/10 Min Req. 1 Min 2805 2941 2703 at least 30 lue and also
Insul Ambient Temp Rel. Humidity <u>Megger S/N</u> <u>Before Hipot</u> Phase MΩ 1-4 2-5 3-6 Notes: Procee hinutes after hipo Testers ipot Set Serial# <u>For Wind S</u> Enter Pass/Fail; <u>Testers</u>	ation Resistand 23.4°C 51.8% 2233 1 Min 3300 3460 3080 d with hipot if r 1000l G Hipot (Grour 53436 Hipot Safety Ch tand & Shipping hase 1-4 PASS	cal Due C C C C C C C C C C C C C C C C C C C	Megger) Before RH S/N 4/8/10 10 Min 24400 26600 24000 0 MΩ AND PI > 2 d be ≥ 85% of initial for any out of t it)- Complete Wi Cal Due Date: T-004 had been Hipotted @ Phase 2-5 PASS	After Hipot (<u>100-04-02352</u> PI 7.4 7.65 7.55 2.0 After hipot n itial, before-hip colerance readif Date inding (Per P12 2/14/10 completed and 37 Enter Pass/Fail: Date	Per P12A-AL-7486 Cal Due 1 Min 2960 3200 2780 negger to be done ot, one minute va ngs. 9/28/09 A-AL-7486) Is attached () KVac for 1 Minute Phase 3-6 PASS 9/28/09	5) 10/10/10 Min Req. 1 Min 2805 2941 2703 e at least 30 lue and also

	STATOR PHASE RESISTANCE MEASUREMENT	PC - T00604353
	290T769 324 Generator Serial Number - 18116735 [PCT 409
	ASTORIA	Software Rev 1.0
:	PHASE 1	
	Engineering Design Resistance @ 25 DegC is: 0.0009 Ohms	
	At Measured Temperature of 23.6 DegC .0008688 Ohms was measured	•
	This Corrects to a Resistance of: .0008735 Ohms @ 25 DegC	
	Compared to the Design Resistance, This is 2.95% LOWER Than the Design Resistance	
	* * * WITHIN TOLERANCE * * *	
	PHASE 2	
	Engineering Design Resistance @ 25 DegC is: 0.0009 Ohms	
	At Measured Temperature of 23.6 DegC .0008703 Ohms was measured	
	This Corrects to a Resistance of: .0008751 Ohms @ 25 DegC	
	Compared to the Design Resistance, This is 2.77% LOWER Than the Design Resistance	•
	* * * WITHIN TOLERANCE * * *	
	PHASE 3	<u></u>
	Engineering Design Resistance @ 25 DegC is: 0.0009 Ohms	:
•	At Measured Temperature of 23.6 DegC .0008688 Ohms was measured	
	This Corrects to a Resistance of: .0008735 Ohms @ 25 DegC	·
	Compared to the Design Resistance. This is 2.94% LOWER Than the Design Resistance	¥
	METER CALIBRATION	
luke T	hermometer S/N 78560064 Used Calibration Due: 2/9/10 BIDDLE DLRO S/N 13910 USED CAL DU	JE: 6/9/10
luke T	hermometer S/N 78490014 Used Calibration Due: 2/9/10	
	TEST MEN WORKING UNIT: GH MMTS BM DATE: 9/0	8/09
	TEST DATA REVIEWED BY: M DATE: 1/2	8/11

RTD WIRE CHECK RECORD SHEET (PER P24A-AL-5068Q)

PCG-5810 Rev DPI 10/06

PC - GFBADRE

290T769 Gen S/N - 181167351

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ASTORIA

Res. Meter: Valhalla 4020 S/N 28-876 Cal Due: 8/11/2010

TC Meter: Fluke 51 S/N 78850473 Cal Due: 8/11/2010

Date: 10/22/2009

Operator: BL/BH		RESULTS:	(A-B) & (A-C) High to Low Comparison Diff = .550	All RTD's within Limits ALL RTD's WITHIN TOLERANCE	Date.	10/22/,
	•		Comparison with Ambient	ALL RTD'S WITHIN LIMITS	Ambient Temp	= 26.2

Flux Probe Reading was 6.28 Ohms

	RTD #	LOCN	A-B	A-C	B-C	DIFF	Temp DEG C	(A-B)&(A-C) Comparison	Comparison w/ Ambient	Comparison Hi to Lo
	1A	SLOT	111.580	111.580	1.410	110.170	26.2	ок	OK	OK OK
	1B	SLOT	111.530	111.530	1.350	110.180	26.2	OK	OK	OK
	2A 🐪	SLOT	111.750	111.780	1.620	110,145	26.1	OK	OK OK	OK
	2B	SLOT	111.690	111.690	1.620	110.070	25.9	OK	ÖK	OK
	3A	\$LOT	111.530	111.530	1.630	109.900	25.5	OK	OK	OK OK
	3B	SLOT	111.600	111.600	1.620	109.980	25.7	OK	OK	ÖK.
	4A	SLOT	110.900	110.870	.920	109.965	25.6	OK	OK	ÖK
	4B	SLOT	110.790	110.810	.880	109.920	25.5	OK [·]	OK	оĸ
	5A	SLOT	110.580	110.580	.650	109.930	25.5	OK	OK	OK
	5B	SLOT	110.540	110.520	.620	109.910	25.5	OK	OK	OK
	6A	SLOT	110.380	110.380	.640	109.740	25.0	OK	OK	OK
	6B	SLOT	110.350	110.350	.630	109.720	25.0	OK	OK	OK.
	20A	SLOT	111.970	111.960	1.890	110.075	25.9	OK	OK	OK
	20B	SLOT	112.010	112.010	1.880	110.130	26.1	OK	OK	OK
	21A	SLOT	112.310	112.310	2.120	110.190	26.2	OK	OK	OK
	21B	SLOT	112.280	112.270	2.120	110.155	26.1	OK	OK	OK
	22A	SLOT	111.740	111.760	1.890	109.860	25.4	OK	OK	OK.
. '	22B	SLOT	111.760	111.770	1.880	109.885	25.4	OK	OK	OK
	31A	SLOT	111.800	111.760	1.750	110.030	25.8	OK	OK	OK
:	31B	SLOT	111.850	111.850	1.730	110.120	26.0	OK	OK	OK
•	32A	SLOT	112.140	112.140	1.980	110.160	26.1	OK	OK	OK
•	32B	SLOT	112.230	112.250	1.970	110.270	26.4	OK	OK	ОК
ļ	33A	SLOT	111.990	111.990	1.950	110.040	25.8	OK	OK	OK
	33B	SLOT	112.020	112.030	1.940	110.085	25.9	OK	OK	OK
	34A	SLOT	111.150	111.150	1.100	110.050	25.8	OK	OK	OK
	348	SLOT	111.110	111.110	1.100	110.010	25.7	OK	OK	OK
•	35A	SLOT	111.340	111.350	1.120	110.225	26.3	OK	OK	OK
	30B	SLUI	111.180	111.190	1.140	110.045	25.8	OK	OK .	OK
	30A	SLUT	110.890	110.890	.890	110.000	25.7	OK	OK	OK
	30B	SLUT	110.930	110.940	.880	110.055	25.9	OK	OK	OK

Approved:

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X:\Test-Data\RTD\181167351_WIRE _2Rtd.dat

Pg 1 of 1

RTD WIRE CHECK RECORD SHEET (PER P24A-AL-5068Q) PCG-5810 Rev DPI 10/06

PC - GFBADRE

290T769 Gen S/N - 181167351

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ASTORIA

Res. Meter: Valhalla 4020 S/N 28-876 Cal Due: 8/11/2010

TC Meter: Fluke 51 S/N 78850473 Cal Due: 8/11/2010

Date: 10/22/2009

Operator: BL/BH	RESULTS:	(A-B) & (A-C)	All RTD's within Limits	
-		High to Low Comparison Diff = .000	ALL RTD's WITHIN TOLERANCE	
		Comparison with Ambient	ALL RTD'S WITHIN LIMITS	Ambient Temp = 26.2

Flux Probe Reading was 6.30 Ohms

RID					·	Temp	(A-B)&(A-C)	Comparison w/	Comparison
'#	LOCN	A-B	A-C	B-C	DIFF	DEG C	Comparison	Ambient	Hi to Lo
10A	GAS	111.050	111.030	1.260	109,780	25.2	OK	ОК	OK
10B	GAS	111.190	111.200	1.270	109.925	25.5	OK	OK	OK
11A	GAS	110.360	110.360	.540	109.820	25.3	OK	OK	OK
11B	GAS	110.320	110.310	.540	109.775	25.1	OK	. OK	OK
12A	GAS	110.000	109.990	.270	109.725	25.0	OK	OK	OK
12B	GAS	110.020	110.010	.260	109.755	25.1	OK	OK	OK
13A	GAS	111.350	111.360	1.570	109.785	25.2	OK	OK	OK
13B	GAS	111.450	111.430	1.570	109.870	25.4	OK	OK	OK
15A	GAS	110.410	110.410	.660	109.750	25.1	OK	OK	OK
15B	GAS	110.380	110.380	.660	109.720	25.0	OK	OK	OK
16A	GAS	110.960	110.960	1.180	109.780	25.2	OK	OK	OK
16B	GAS	110.990	110.990	1.160	109.830	25.3	OK	OK	OK .
18A	GAS	111.510	111.510	1.690	109.820	25.3	OK	° OK	0K
18B	GAS	111.480	111.470	1.690	109.785	25.2	OK	OK	OK
19A	GAS	110.160	110.120	.370	109.770	25.1	OK	OK	OK
19B	GAS	110.160	110.160	.370	109.790	25.2	OK	OK	OK

Approved:

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GE Generator Field Balance Facility

29 Shot	290T769 Shot 22P5	Generator Field RUN 38			Astoria OPERATOR - BS/AA	181 10/5/20	Page 1			
SPEE RPM	D	VI T	BRATION E Coup	N - Mils Peak-Peak TEJ CEJ Coll				STATIC	COUPLE	Time
301	F	S	0.5 155	0.5 352	0.0 0	2.0 111		0.3 353	0.2 351	7:34:36 AM
		N	0.6 251	0.4 228	0.0 0	2.0 203		0.2 232	0.2 224	
300	F	S	0.2 0	0.0 0	0.0 0	2.1 111		0.0 0	0.0 0	7:35:09 AM
		N	0.1 0	0.0 0	0.0 0	2.0 201		0.0 0	0.0 0	
860	F	S	0.3 188	0.2 43	0.2 53	2.1 109		0.2 47	0.0 10	7:36:56 AM
		N	0.2 0	0.4 286	0.6 253	2.0 202		0.5 267	0.2 22	
950	F	S	0.4 216	0.1 105	0.3 123	1.9 113		0.2 118	0.1 314	7:37:10 AM
		N	0.3 358	0.5 349	0.7 338	1.8 202		0.6 343	0.1 127	
1100	F	S	0.4 274	0.5 354	0.7 351	2.9 76		0.6 352	0.1 159	7:37:31 AM
		N	1.0 1	0.9 9	0.7 11	0.8 223		0.8 10	0.1 3	
2155	F	S	0.6 214	0.2 102	0.1 0	2.5 78		0.1 83	0.1 11 9	7:40:05 AM
		N	0.1 0	0.9 26	1.0 199	2.3 189		0.1 167	0.9 22	

F/B



GE Generator Field Balance Facility

290T769 Shot 22P5		Generator Field RUN 38			Astoria OPERATOR - BS/AA	181 10/5/20	Page 2			
SPEE RPM	D	VI T	BRATION E Coup	DN - Mils Peak-Peak) TEJ CEJ Coll			<u>, 212 (1997) — 212 — 212 - 219 (1997) - 219 (1997) - 219 (1997) - 219 (1997) - 219 (1997) - 219 (1997) - 219 (</u>	STATIC	COUPLE	Time
2766	F	Ŝ	0.1 0	0.9 114	1.1 306	2.1 95		0.1 352	1.0 120	7:41:35 AM
		N	0.3 267	0.4 119	0.8 279	1.9 193		0.2 259	0.6 106	
3405	F	S	1.1 119	0.2 65	0.3 29	2.2 96		0.2 45	0.1 157	7:43:30 AM
		N	0.7 229	0.6 299	0.7 290	1.6 181		0.6 294	0.1 78	
3511	F	S	1.3 124	0.3 65	0.3 35	2.7 106		0.3 51	0.1 129	7:43:52 AM
		N	0.8 236	0.7 315	0.7 299	1.4 178		0.7 307	0.1 48	
3600	F	S	1.5 140	0.2 64	0.2 44	2.2 114		0.2 54	0.0 137	7:44:11 AM
		N	0.7 239	0.8 335	0.8 322	1.5 166		0.8 329	0.1 52	
3780	F	S	1.6 157	0.7 50	0.4 32	1.1 125		0.6 43	0.2 74	7:45:11 AM
		N	1.3 232	0.8 2	0.6 5	1.9 1 76		0.7 3	0.1 353	
3781	F	S	1.6 156	0.7 52	0.5 42	1.1 126		0.6 48	0.1 75	7:45:22 AM
		N	1.3 232	0.8 3	0.6 9	1.9 177		0.7 6	0.1 348	



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GE Generator Field Balance Facility

290T769 Shot 22P5		Ger	N erator RUN 38	Field	Astoria OPERATOR - BS/AA	181 10/5/20	Page 3			
SPEI RPM	SPEED VIBRATIO RPM TE Coup		ON - Mils F TEJ	Peak-Pea CEJ	ik Coll		STATIC COUPLE		Time	
Starti	ng	Re	verse S\	/ Run						
3781	F	S	1.5 158	0.7 55	0.4 41	0.9 123		0.6 50	0.1 77	7:45:52 AM
		N	1.3 232	0.7 5	0.5 14	1.9 178		0.6 9	0.1 346	
3698	F	S	1.3 160	0.5 57	0.3 25	0.9 119		0.4 44	0.1 103	7:46:56 AM
		N	1.0 230	0.6 12	0.5 15	1.9 168		0.5 13	0.1 1	
3597	F	S	1.4 172	0.3 91	0.2 121	1.3 142		0.2 102	0.1 59	7:47:43 AM
		N	0.6 246	0.8 20	0.7 14	1.4 160		0.7 17	0.1 60	
3495	F	S	1.4 161	0.4 99	0.3 74	2.2 136		0.3 87	0.1 158	7:48:30 AM
		N	0.6 261	0.8 357	0.8 352	1.1 177		0.8 355	0.0 84	
3396	F	S	1.3 155	0.4 98	0.3 69	2.2 111		0.3 84	0.1 161	7:49:16 AM
		N	0.6 255	0.7 349	0.8 338	1.6 188		0.7 343	0.1 102	
3295	F	S	1.1 149	0.3 102	0.4 68	2.2 116		0.3 82	0.1 204	7:50:02 AM
		N	0.5 252	0.6 341	0.8 332	1.6 182		0.7 336	0.1 132	

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GE Generator Field Balance Facility

290T769 Shot 22P5		Gen	erator RUN 38	Field	Astoria OPERATOR - BS/AA	181 10/5/20	Page 4		
SPEED RPM	V	IBRATION TE Coup	N - Mils Peak-Peak TEJ CEJ Coll			2001/2 00 - 11	STATIC COUPL		Time
3197 F	= S	0.8 147	0.2 127	0.5 51	2.4 114		0.3 74	0.2 202	7:50:49 AM
	N	0.4 246	0.4 342	0.8 328	1.6 181		0.6 333	0.2 130	
3100 F	₹ S	0.7 150	0.2 152	0.6 59	2.4 111		0.3 82	0.3 217	7:51:32 AM
	N	0.3 248	0.3 353	0.7 334	1.6 184		0.5 339	0.3 145	
3000 F	s s	0.6 150	0.4 169	0.7 43	2.5 110		0.3 76	0.5 205	7:52:19 AM
	N	0.2 0	0.1 1	0.8 334	1.6 185		0.4 337	0.3 150	
2900 F	S	0.4 155	0.6 173	0.9 32	2.8 98		0.3 75	0.7 196	7:53:06 AM
	N	0.2 0	0.1 0	0.9 335	1.4 1 77		0.5 336	0.4 154	
2792 F	S	0.2 0	1.3 157	1.3 354	2.1 92		0.2 70	1.3 166	7:53:55 AM
	N	0.4 314	0.4 119	1.2 324	1.4 183		0.4 336	0.8 138	
2699 F	S	0.3 195	1.4 109	1.2 295	2.0 101		0.1 80	1.3 112	7:54:38 AM
	Ν	0.6 283	0.7 91	1.4 300	1.4 194		0.4 321	1.0 111	



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GE Generator Field Balance Facility

2 Shot	290T769 Shot 22P5		Generator Field RUN 38			Astoria OPERATOR - BS/AA	181 10/5/20	Page 5		
SPEE RPM	ED	VI T	BRATIOI E Coup	N - Mils Peak-Peak TEJ CEJ Coll		k Coll		STATIC COUPLE		Time
2600	F	S	0.3 193	0.8 76	0.5 249	2.2 106		0.2 87	0.7 73	7:55:25 AM
		'N	0.5 237	0.6 62	1.0 284	1.4 195		0.3 321	0.7 88	
2499	F	S	0.3 222	0.6 68	0.3 222	2.5 106		0.2 85	0.4 60	7:56:11 AM
		N	0.3 201	0.6 65	1.1 280	1.5 203		0.3 312	0.8 87	
2399	F	S	0.3 223	0.4 63	0.2 175	2.6 103		0.2 87	0.2 45	7:56:58 AM
		N	0.3 180	0.6 61	1.0 277	1.7 202		0.3 312	0.8 84	
2298	F	S	0.4 235	0.3 66	0.1 0	2.7 100		0.2 52	0.1 84	7:57:44 AM
		N.	0.2 0	0.7 57	1.0 268	1.8 199		0.3 307	0.8 76	
2197	F	S	0.5 231	0.2 77	0.2 78	2.8 95		0.2 77	0.0 67	7:58:31 AM
		N	0.2 135	0.8 53	1.0 257	1.8 196		0.2 304	0.9 67	
2097	F	S	0.5 215	0.2 92	0.2 67	2.7 90		0.2 80	0.0 163	7:59:17 AM
		N	0.2 0	0.7 35	0.9 243	2.0 197		0.2 301	0.8 50	



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GE Generator Field Balance Facility

29 Shot	290T769 Shot 22P5		Generator Field RUN 38			Astoria OPERATOR - BS/AA	181 10/5/20	Page 6		
SPEE RPM	D	V	BRATIO	N - Mils F TEJ	eak-Pea CEJ	k Coll		STATIC	COUPLE	Time
1998	F	S	0.5 197	0.2 116	0.2 49	2.4 86		0.1 86	0.1 165	8:00:04 AM
		N	0.1 0	0.7 17	0.6 223	2.1 192		0.1 318	0.6 29	
1896	F	S	0.5 186	0.2 10 9	0.1 28	1.9 92		0.1 85	0.1 136	8:00:51 AM
		N	0.1 0	0.6 11	0.4 206	1.7 185		0.1 338	0.5 17	
1797	F	S	0.5 171	0.3 105	0.1 0	2.0 94		0.1 91	0.1 117	8:01:37 AM
		N	0.1 0	0.5 3	0.3 191	1.9 194		0.1 352	0.4 6	
1697	F	S	0.4 159	0.2 99	0.0 0	2.0 99		0.1 97	0.1 101	8:02:24 AM
		N	0.1 0	0.3 353	0.2 166	1.9 194		0.1 358	0.2 351	
1594	F	S	0.3 157	0.2 95	0.0 0	2.0 101		0.1 85	0.1 105	8:03:10 AM
		Ν	0.1 0	0.3 347	0.1 145	2.0 193		0.1 359	0.2 341	
1500	F	s	0.3 159	0.2 94	0.1 0	2.0 103		0.1 77	0.1 111	8:03:54 AM
		N	0.1 0	0.3 347	0.1 0	2.0 193		0.2 350	0.1 343	



GE Generator Field Balance Facility

290T769 Shot 22P5			69	Generator Field RUN 38			Astoria OPERATOR - BS/AA	181 10/5/20	Page 7	
SPEED VIBRATION RPM TE Coup		N - Mils Peak-Peak TEJ CEJ Coll				STATIC	COUPLE			
1400	F	S	0.3 160	0.3 94	0.2 160	2.0 104		0.2 118	0.1 58	8:04:40 AM
		N	0.1 0	0.3 348	0.1 99	2.0 192		0.1 5	0.2 334	
1295	F	S	0.2 168	0.2 93	0.2 143	2.1 105		0.2 117	0.1 34	8:05:30 AM
		N	0.1 0	0.2 354	0.1 0	2.1 192		0.1 356	0.1 350	
1198	F	S	0.2 0	0.3 94	0.3 121	2.2 106		0.3 109	0.1 0	8:06:13 AM
		N	0.3 113	0.2 15	0.1 82	2.0 188		0.1 42	0.1 332	
1099	F	S	0.4 71	0.9 64	0.8 52	3.0 96		0.9 58	0.1 139	8:07:00 AM
		N	0.8 71	0.7 34	0.5 42	1.6 148		0.6 37	0.1 16	
999	F	S	0.3 226	0.0 0	0.2 194	1.8 108		0.1 196	0.1 12	8:07:46 AM
		N	0.2 0	0.4 326	0.3 323	1.9 212		0.3 325	0.1 333	
898	F	S	0.3 188	0.2 79	0.3 86	2.2 109		0.2 83	0.0 293	8:08:33 AM
		Ν	0.1 0	0.5 298	0.6 276	2.0 205		0.5 286	0.1 40	



GE Generator Field Balance Facility

290T769 Shot 22P5			69	Generator Field RUN 38 N - Mils Peak-Peak TEJ CEJ Coll			Astoria Operator - BS/AA	181073326 10/5/2009		Page 8
SPEED VIBRATIC RPM TE Coup		BRATION E Coup	STATIC					COUPLE	Time	
798	F	FS	0.1 0	0.1 21	0.1 2	2.1 106		0.1 12	0.0 77	8:09:19 AM
		N	0.0 0	0.1 239	0.3 206	2.1 201		0.2 217	0.1 359	
69 9	F	S	0.1 0	0.1 25	0.1 0	2.1 107		0.1 16	0.0 50	8:10:06 AM
		N	0.0 0	0.1 0	0.1 175	2.0 201		0.0 172	0.1 356	
598	F	S	0.1 0	0.1 0	0.0 0	2.1 108		0.0 0	0.0 0	8:10:52 AM
		N	0.1 0	0.1 0	0.1 0	2.1 200		0.1 0	0.0 270	
496	F	S	0.2 0	0.1 0	0.0 0	2.1 108		0.0 0	0.0 0	8:11:39 AM
		N	0.0 0	0.1 0	0.1 0	2.1 199		0.1 0	0.0 270	
397	F	S	0.1 0	0.1 0	0.0 0	2.1 109		0.0 0	0.0 0	8:12:25 AM
		N	0.1 0	0.0 0	0.0 0	2.1 199		0.0 0	0.0 0	
300	F	Ş	0.1 0	0.1 0	0.0 0	2.1 109		0.0 0	0.0 0	8:13:12 AM
		N	0.1 0	0.0 0	0.0 0	2.1 199		0.0 0	0.0 180	

RAW DATA - ENGINEERING INTERPRETATION MAY BE REQUIRED 2P5 RUN 38 Page 8

Shot 22P5


290T769 Shot 22P5		Generator Field RUN 38			Astoria OPERATOR - BS/AA	181 10/5/20	Page 9			
SPEI RPM	ED	VII T	BRATION E Coup	l - Mils F TEJ	eak-Peal CEJ	k Coll		STATIC	COUPLE	Time
298	F	S	0.1 0	0.1 0	0.0 0	2.1 109		0.0 0	0.0 0	8:13:15 AM
		N	0.1 0	0.0 0	0.0 0	2.1 199		0.0 0	0.0 270	

Shot 22P5

RUN 38

Page 9

Final Balance complete Bryon J. Sempriar 10/5/09



290T769 Shot 13-14		Generator Field RUN 20			Astoria OPERATOR - BS / JE	181 10/2/20	Page 1			
SPEE RPM	ED.	VI T	BRATION E Coup	- Mils P TEJ	eak-Peal CEJ	k Coll		STATIC	COUPLE	Time
303	F	S	0.4 201	0.0 0	0.0 0	2.1 117		0.0 0	0.0 0	11:20:12 AM
		N	0.2 0	0.1 0	0.1 0	2.0 207		0.1 0	0.0 270	
854	F	S	0.3 210	0.1 0	0.3 320	2.0 110		0.1 327	0.1 129	11:21:51 AM
		N	0.1 0	0.2 185	0.6 169	2.3 204		0.4 173	0.2 342	
967	F	S	0.5 197	0.1 91	0.2 60	2.1 113		0.1 74	0.0 179	11:22:07 AM
		N	0.3 317	0.2 294	0.7 227	2.2 207		0.4 240	0.3 31	
1101	F	S	0.6 230	0.3 290	0.5 323	1.6 91		0.4 312	0.2 171	11:22:29 AM
		N	0.7 314	0.5 327	0.5 268	2.3 210		0.4 297	0.2 29	
2152	F	S	1.6 328	0.3 273	0.2 155	3.4 128		0.1 216	0.2 303	11:25:13 AM
		N	0.8 144	1.9 137	1.9 312	1.4 228		0.1 205	1.9 135	
2751	F	S	1.8 19	3.5 237	3.3 54	0.8 140		0.2 268	3.4 236	11:26:56 AM
		N	1.5 99	3.3 208	2.8 44	0.5 168		0.5 156	3.0 215	

RAW DATA - ENGINEERING INTERPRETATION MAY BE REQUIREDShot 13-14RUN 20Page 1

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29 Shot	290T769 Shot 13-14		69	Generator Field RUN 20			Astoria OPERATOR - BS / JE	181 10/2/20	Page 2	
SPEE RPM	٤D	V	BRATION E Coup	l - Mils P TEJ	eak-Peal CEJ	k Coll		STATIC	COUPLE	Time
3500	F	S	5.1 20	2.2 301	1.3 209	5.1 353		1.3 271	1.3 330	11:29:38 AM
		Ν	3.2 161	3.9 189	2.9 159	0.5 172		3.3 176	1.0 236	
3600	F	S	6.6 39	2.1 307	1.1 209	6.6 23		1.1 279	1.3 332	11:30:13 AM
		N	3.4 180	4.8 208	3.1 192	0.8 44		3.9 202	1.0 233	
3780	F	S	8.1 64	3.7 295	2.7 245	7.6 60		2.9 274	1.4 340	11:31:19 AM
		N	3.3 159	6.0 237	3.5 239	4.8 73		4.7 238	1.2 234	
4322	F	S	13.8 123	6.0 19	1.1 152	14.8 320		2.6 28	3.4 12	11:34:46 AM
		N	7.0 209	7.5 311	3.3 139	4.1 359		2.1 305	5.4 313	
4322	D	S	1.1 138	0.1 319	0.9 265	0.5 351		2.7 33	3.3 15	11:34:49 AM
		N	0.1 0	0.7 282	0.3 175	0. 9 243		2.1 307	5.5 313	
4322	U	S	14.0	6.3	2.6	14.9		2.7 33	3.3 13	11:34:50 AM
		N	7.4	8.2	3.8	4.5		2.1 307	5.4 313	

RAW DATA - ENGINEERING INTERPRETATION MAY BE REQUIRED Shot 13-14 RUN 20 Page 2



290T769 Shot 13-14			69	Generator Field RUN 20			Astoria OPERATOR - BS / JE	181 10/2/20	Page 3		
SPEED RPM		VIBRATION TE Coup		N - Mils Peak-Peak TEJ CEJ Coll		k Coll		STATIC	COUPLE	Time	
4322	F	S	13.7 123	5.8 24	1.2 152	14.7 320		2.6 34	3.3 16	11:34:55 AM	
		N	7.1 210	7.6 311	3.4 137	4.2 1		2.1 306	5.5 313		
4321	F	S	13.4 125	5.7 20	0.9 164	13.8 325		2.5 26	3.2 15	11:37:50 AM	
		N	6.6 211	7.3 312	3.1 142	3.2 3		2.2 305	5.2 315		

Shot 13-14

RUN 20

Page 3

Overspeed completed 4320 rpm for 3 minutes Brun J- Serfinin 10/2/09 J. S. Elling J. 10/2/2009





GE POWER SYSTEMS GE FLUX PROBE TEST DATA - 2 POLE REPORT



Test Timing: After Thermal; Field Current: 418; Field Voltage: 114; Time & Date: 21:13:25 2009/10/02; File Path: Run_02.dat Licensed to: GE Test Facility SN:0x00

(FE)			C 140
		Test Operations	
Customer: N/A Sha	p Order: <u>290 T 7 6 9</u>	PCT-367	PJR 06/29/04
Generator Field	Balance Bunker	Weight Resolu	tion
Location of Balance Plane	No. of Weights	Ounces	Angle
TE Coupling			
TE Body Fan Ring	/	1.937	83°
TE Spindle			
CE Spindle			
CE Body Fan Ring		1,937	83°
Collector Fan Rim			
Coll. Fan Hub Groove	2	1.0	240°
Coll. End Bal. Ring or Coupling			
Brushiess Exciter			
eights are installed at least 1/2" away light openings to allow for proper weigh staking procedures.	from Balancer / Te ht TC / N	ichnician:	Date:

i.

PCT-367

		Field Sh	nipping Hipo	ot	PCG-562
		Per F	P12A-AL-6129		
Shop Order/DL:	290T	769	Customer:	ASTORIA ENER	RGY
S/N:	18107	3326	Prototype:	324	
		, F	Rated Field Volta	ge: 675	
		Field Re	sistance Data		
Bridge S/N:	1485 Ca	l Due: 6/12/2	2010	Thermometer S/Ns:	Cal Due:
Engineering ca	lc. resistance	at 25 deg C =	<u>0.24600</u> Ω	78560062	5/28/2010
Measured resist	ance at 25.8	<u>6</u> deg C = at 25 deg C =	0.24590 Ω	78590014	2/9/2010
Borcont Differer	nce resistance	at 25 deg C =	0.27%	78560064	2/9/2010
i ne maximum a	allowable di	fference is 25 TH	%. The meas FIIMITS	ured field resistance	is WITHIN
I NƏ MAXIMUM (allowable dii	ference is 29 THI Field N	%. The meas E LIMITS Hegger Data	ured field resistance	is WITHIN
I NƏ MAXIMUM (allowable dh	Field N Megger S/N	%. The meas E LIMITS Megger Data	ured field resistance	8/4/2010
ГЛӨ MAXIMUM (Allowable dh Megohms	Field Megger S/N	%. The meas E LIMITS Megger Data N: 2233	ured field resistance Cal Due: 2352 Cal Due:	8/4/2010
ГЛӨ MAXIMUM (Time (min)	Allowable dh Megohms 2320	Field N Megger S/N RH S/N	%. The meas E LIMITS Iegger Data I: 2233 I: 100-04-0 tage: 500	ured field resistance Cal Due: 2352 Cal Due:	8/4/2010 10/10/2010
ГЛӨ <i>maximum</i> a Time (min) 1 2	Megohms 2320 3000	Field N Field N Megger S/N RH S/N Megger Vol	%. The meas E LIMITS Megger Data N: 2233 N: 100-04-0 tage: 500	ured field resistance Cal Due: 2352 Cal Due: VDC Rel Humidity	8/4/2010 10/10/2010 : 38 %
Time (min) 1 3	Megohms 2320 3000 3340	Field N Field N Megger S/N RH S/N Megger Vol P.I. (Polariza	%. The meas E LIMITS Iegger Data I: 2233 I: 100-04-0 tage: 500 ation index) = 10	ured field resistance Cal Due: 2352 Cal Due: VDC Rel Humidity Min Reading/1 Min Read	8/4/2010 10/10/2010 38 %
тіте (min) 1 2 3 4	Megohms 2320 3000 3340 3520	Field N Field N Megger S/N RH S/N Megger Vol P.I. (Polariza	%. The meas E LIMITS Megger Data N: 2233 N: 100-04-0 tage: 500 ation index) = 10	ured field resistance Cal Due: 2352 Cal Due: VDC Rel Humidity Min Reading/1 Min Read	8/4/2010 10/10/2010 : 38 % ing
Time (min) 1 2 3 4 5	Megohms 2320 3000 3340 3520 3560	Field N Field N Megger S/N RH S/N Megger Vol P.I. (Polariza PI = 1.6	%. The meas E LIMITS Megger Data N: 2233 N: 100-04-0 tage: 500 ation index) = 10 8	ured field resistance Cal Due: 2352 Cal Due: VDC Rel Humidity Min Reading/1 Min Read	8/4/2010 10/10/2010 : 38 % ing
Тіте (min) 1 2 3 4 5 6	Megohms 2320 3000 3340 3520 3560 3640	Field N Field N Megger S/N RH S/N Megger Vol P.I. (Polariza PI = <u>1.6</u> NOTE: P	%. The meas E LIMITS E LIMITS Iegger Data 2233 N: 2233 N: 100-04-0 tage: 500 ation Index) = 10 8 I must be greate 100-04-0	ured field resistance Cal Due: 2352 Cal Due: VDC Rel Humidity Min Reading/1 Min Read	8/4/2010 10/10/2010 : 38 % ing
Тіте (min) 1 2 3 4 5 6 7	Megohms 2320 3000 3340 3520 3560 3640 3740	Field N Field N Megger S/N RH S/N Megger Vol P.I. (Polariza PI = <u>1.6</u> NOTE: P	%. The meas E LIMITS Megger Data N: 2233 N: 100-04-0 tage: 500 ation index) = 10 10 8 1 I must be greate	ured field resistance Cal Due: 2352 Cal Due: VDC Rel Humidity Min Reading/1 Min Read r than 1.00 for hipot te	8/4/2010 10/10/2010 : 38 % ing st
Time (min) 1 2 3 4 5 6 7 8	Megohms 2320 3000 3340 3520 3560 3640 3740 3820	Field N Field N Megger S/N RH S/N Megger Vol P.I. (Polariza PI = <u>1.6</u> NOTE: P	%. The meas E LIMITS Iegger Data Iegger Data I: 2233 I: 100-04-0 tage: 500 ation Index) = 10 10 8 1 I must be greate 1 PI (Polarizatio 1	ured field resistance Cal Due: 2352 Cal Due: VDC Rel Humidity Min Reading/1 Min Read r than 1.00 for hipot te n Index) is IN TOLEF	8/4/2010 10/10/2010 : 38 % ing st RANCE
Time (min) 1 2 3 4 5 6 7 8 9	Megohms 2320 3000 3340 3520 3560 3640 3740 3820 3880	Field N Field N Megger S/N RH S/N Megger Vol P.I. (Polariza PI = <u>1.6</u> NOTE: P	%. The meas E LIMITS Jegger Data N: 2233 N: 100-04-0 tage: 500 ation index) = 10 10 8 1 I must be greate PI (Polarization)	ured field resistance Cal Due: 2352 Cal Due: VDC Rel Humidity Min Reading/1 Min Read r than 1.00 for hipot te n Index) is IN TOLEF	8/4/2010 10/10/2010 : 38 % ing st RANCE

The post-hipot megger must be >= 25Mohm and >=60% of the 1 minute pre-hipot reading or >= 200MohmBefore HIPOT (1 min) megger x 0.6 =1392After HIPOT (1 min) megger =1160

The Pre- to Post-Hipot Megger Comparison is WITHIN TOLERANCE

			Hipot Da	ata			
Hipot S/N:	053142			Hipot Cal Due:	2/14/2010		
🗹 Comple	ted Safety	/ Check Sl	neet PCT-004:	-			
Passed Hipot at	5.350	KV AC	for 1 min.	and @	1.5	amps	
Tester: MB/BP			Test Review:	LL			
Date:	10/7/	/2009		Date:	10/7/09		

stomer Astaria		ERATOR FIELDS
ield Rotor Description:	324 - 60HZ	Date: 10/5/09
1 FIELD ROTOR ISSUE QCR IF I OVERSPEED A	BALANCE AND OVERSPEED COMPLETE. FAILED & RECORD AT ITEM 2. CHIEVED <u>4320</u> RPM @ <u>120</u>	PERCENT RATED SPEED
Te	st Signature / anna V. G/his	Date: 10/05/200 6
\$0911043		
<u>\$0911043</u> <u>\$0911073</u> ATTENTION: RO 3 ENGINEERING M MI # <u>387A2501</u> MI #	TOR INSPECTION TO RECORD THESE QCR'S IN THE II's COMPLETED: Test Signature <u>Banda Banda</u> Test Signature	TE ROTOR FOLDER. Date: <u>/0/57</u> Date:
<u>\$0911043</u> <u>\$0911073</u> ATTENTION: RO 3 ENGINEERING M MI # <u>387A2501</u> MI # MI # MI #	TOR INSPECTION TO RECORD THESE QCR'S IN THE Il's COMPLETED: Test Signature Am A Bay Test Signature Test Signature Test Signature	IE ROTOR FOLDER. Date: /0/57 Date: Date:
<u>\$ 0911043</u> <u>\$ 0911043</u> <u>\$ 0911073</u> ATTENTION: RO 3 ENGINEERING M MI # <u>3 87 A 2501</u> MI # MI # 4 FLUX PROBE CHE Test 3 5 THERMAL APPRO Test 5	TOR INSPECTION TO RECORD THESE QCR'S IN THE Test Signature <u>B</u> <u>B</u> <u>B</u> <u>B</u> Test Signature <u>Test Signature</u> Test Signature <u>Test Signature</u> Test Signature <u>B</u>	Date: $10/57$ Date: $10/57$ Date: Date: Date: Date: Date: Date: Date:
<u>d 0911043</u> <u>50911073</u> ATTENTION: RO 3 ENGINEERING M MI # <u>387A2501</u> MI # MI # 4 FLUX PROBE CHE Test 3 5 THERMAL APPRO Test 5 6 COMMENTS:	TOR INSPECTION TO RECORD THESE QCR'S IN THE If's COMPLETED: Test Signature <u>Bandard</u> Test Signature Test Signature Test Signature Test Signature ECK FOR SHORTED TURNS APPROVED FOR SHIP Signature <u>Bandard</u> VED FOR SHIP: Signature <u>Amadard</u>	The rotor folder. Date: $10/5$ Date: Date: Date: Date: Date: Date:

FORGING:	Supplier Nam	ię	Energi	atechnik Est	sen GmbH	CLASS 16
WATE.	Drawing No.			203 D 47	36 -01 Rev. A	annannati Millionanna
	Supplier Serie	al Number uring Prog	ase Plan	5002180	5100 957	
	No. <u>SQ-0</u>	19530-MP	P-1_Rev.	No	Rev. Date	30 MAY 200
MELTING:	Heat Number	E2823	32			· · · · · · · · · · · · · · · · · · ·
	Electrode Me	Iting Practi	ce: LR	X AOD _	VCD \	/SD VOD
Location	Tensile Strength (ksi)	0.2% Y.S. (ksi)	El. (%)	P.A. _(%)	Charpy R.T. Energy (ft-lbs.)	κ.
(Spec. min) 174	164	19	48	60	
A-1 (1)	182,5	179,5	27	66	145	
A-2 (2)	187,5	186,0	27	62	133	•
B-1 (3)	NA				, mininining ng pinanana ang antara	,
8-2 (4)	NA		,	<u>en eksine elien</u>		
	ITY	1,0013				
PERMEABIL	i i i i i i i i i i i i i i i i i i i					
PERMEABIL		ERTIES.				
PERMEABIL METALLUR	SICAL PROP	<u>ERTIES;</u>		and the second second second second second		

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Energietechnik Essen	CERTIFICATE (Inspection - Cent No.: 09030	MAC) Page -2- of 6 1
Purchaser : GE Power S	ystems, 1 River Ro	ad, Schenectady, NY123
Supplier Serial Number:	5002180 5100 957	Ì
RE-MELT CHEMICAL CO	POSITION:	
Method Used: Ingot	X Billet	Forging
TESTING LOCATION ELEMENT	тор	волтом
	Weight	Percentage
C.	0,076	0,061
Mn	19,46	18,63
P	0,019	0,015
S	<0,001	0,001
Si	0,31	0,35
Cr	17,83	17,76
N	0,59	0,54
V	0,069	0,070
Sb	0,0005	0,0004
As	0,003	0,003
Sn	0,002	0,002
A !		<u> </u>
AUTHORIZED SIGNATUR	E E	Jane -

Energieto Canoli - sed 191	echnik Essen	Abnahm Inspection Nr./No. Authing - Hrs. Drog. Mol. Note commence	eprüfzeu - <i>Certifi</i> cal 0 9 0301	gnia i to / Corti Salte/Pago	EN 102(licat de l 3 vo 5002180)4/3.1 réception monde 6
Destalled Runchs sed Commetitien Destallung-Net/Order No /Comm	nande No.:	GE Power see Page -	Systems, 1 1-	River Road	, Schened	ctady NY 12345
Linfervorschrift/Funch Spec./C	ontitions de livraison:	P14A-AL-0	201 Rev. E	, B50A743-	Ė.	
	. <u> </u>			ri- an nam state fi	чш <u>қ</u> асаланы -	Construction of the constr
Location of Specimen No.	Lateral Expansion of Impact Specimen (m)	<u>n)</u>				
A-1 (1) A-2 (2)	1,86 1,81					
HARDNESS Equation	6					
Location of Specimen 1 - 8 TOP 1 - 8 BOTTO Location of Specimen	No. 1 = 640 642 M = 644 644 No.	2 644 642 646 645	2 644 642 646 646	645 64 644 64	2	
All tensile and impact Location of test specin	specimens taken fron nen as per GE's Spec	inside diemete flication P14A-	r, as per GE AL-0201 Rev	s drawing. E Paragrap	¥16.4.	
INGOT SIZE:	mm dia.	1030	INGOT	WEIGHT	ł	3420 kg's
INGOT DISCARDS:	Top end Battom end	400 270	kg's kg's			
ORIENTATION OF FO	DEIGING WITHIN INC	IOT:	Middle			
HEAT TREATMENT:	Quenching	1080°C / wate	er -			
	Stress relie heating and	ving: 10h - 400 I cooling rate 25	'C/ fumace c °C per hour.	ooling down,	i	
ULTRASONIC TEST:	see attache	d ULTRASONI	C TEST REF	PORT (page	-4-)	
•						
Es when translation, doin the Live We reveally configs that the mane Inspection and dimetational con	enting des Verencerungen ni describer abdys has been nu without competints	an der Berdeller i Die Nationalistic completer d	e an provident Br teo and provident of the	an a	Salasing o f	rie Generalite Multon
Nous contributs que la livraison des dimensions sans objection	est conforme aux stipulations	la l'acception de le co	ninianda. Interactu	m et contrôles F		1
DenumyDelle Essen, O	3-112009			9		Bongen



·2.....

ULTRASCHALL - PRÜFPROTOKOLL

Utrasonic Test Report

Enclosure to Certificare - No.	PR0304	Page v	<u>4</u> 16	
Purchase Order No. Serial No. Purchase Specification Examination Specification Manufacturing Stage Drawing Number	600 009 34 600 009 34 P 14A-AL-020 P 3C-AL-0853 final machined 203 D 4 7 3	2 Roy. "E" Roy. "B" / P 3C-A -OH REU: A	L-8501 Rey. "C"	
Ultrasonic Examination				
Examination No. Examination instruction Equipment and No. Couplant Surface Condition	5002180 / 51 PV - KR 1/72 I : Symphonic 31 : Water : turned	1009571 Rev. 7 07 2002 - 117		

Search Unit. Design	Freq.		Celibret	Gates - Lengths and Thresholds	Noise Level	
NO.1 Long Warm rad.	2,25	DAC 1.6mm + 6 dB	1.BE 80%	29,0 + 30,0 = 59,0 dB	46,1 mm 20%	2-7/10 %
No.2 Long Waye roll.	2,25	DAC 1,6mm + 6 dB	1.8E 80%	30,5 + 30,0 = 60,5 dB	45,1 mm 20%	2-8/10 %
NO.3	2,25	1.BE 80%		33,9 dB	· · · · · · · · · · · · · · · · · · ·	: .
No.4 Sheat Wave tang	2,25	Notch Echo 80%	(0,75mm dep)	39 + 6 = 45 dB	100 mm 20%	1-6/9 %
No.5 Sheet Wave targe	2,25	Notch Echo 80%	(0,75mm dep)	44 + 6 = 50 dB	100 mm 20%	2-7/10 %
NO.6 Show Wave and	2,25	Edge Echo 80%		33 + 10 = 43 dB	30 mm 20%	1-5/7 %
NO.7 Shar Wine ad	2,25	Edge Echo 80%	an a suit ann an stàr ann an si	42 + 8 = 50 dB	30 mm 20%	3-10/13 %
NO.8	2,25	1.BE 40%	1	28,0 dB	- and a stand	

Remark: Ø A= 1046 mm Ø 1= 915 mm

L= 646 mm

W= 65.1 mm

Recordable Indications:	Dete / Operator
⊗ no O yes, page:	03.03.2009 Centervel
Released	Date / Exam. Superviser
O Released, acceptable indications	nens ha all
O Hold, unaccepted indications	

.

Annex: C- plot "print of all probes" 3-8 plot



Abnahmeprüfzeugnis EN 10204/3.1

Inspection-Certificate / Certificat de reception Nr:/No. 090301 Seite/Page 5 voni/olide 6 Auftrage Nr.: Draw No.: Note commande No.:



51009571 03.03.09 PRINT OF ALL PROBES CH.1 59dB CH.2 60.5dB DAC 1.6mm + 6dB GATES 20% CH.4 45dB CH.5 50dB NOTCH ECHOS 80% + 6dB GATES 20% CH.6 33+10dB CH.7 42+8dB EDGE ECHOS 80% GATES 20%





Abnahmeprüfzeugnis EN 10204/3.1 Inspection-Certificate / Certificat de réception

Nr:/No. 090301 Sette/Page 6 vonto/tde 6 Autriege-No: 5002180 Note commande No:



51009571 03.03.09 BE ATTENUATION CH.3 - CH.8 CH.3 1.BE 801 33.9dB CH.8 1.BE 401 28.0dB

Location (Spec. min A-1 (1) A-2 (2) B-1 (3) B-2 (4) ERMEABI	Strength (ksi) 174 184,5 187,0 NA NA NA	1.5. (ksi) 164 <u>179,5</u> 186,0 1,0013	 19 	<u>(%)</u> 48 <u>61</u> <u>60</u>	<u>(((-i))53)</u> <u>60</u> <u>106</u> <u>81</u>	
Location (Spec. min A-1 (1) A-2 (2) B-1 (3) B-2 (4)	Strength (ksi) 174 184,5 187,0 NA NA	1.5. (ksi) 164 179,5 186,0	 19 	<u>(%)</u> 48 <u>61</u> 60	<u>60</u> <u>106</u> <u>81</u>	
Location (Spec. min A-1 (1) A-2 (2) B-1 (3)	Strength (ksi) 174 184,5 187,0 NA	1.5. (ksi) 164 179,5 186,0		(%) 48 <u>61</u> 60	60 106 81	
Location (Spec. min A-1 (1)	Strength (ksi)) 174 <u>184,5</u>	1.3. (ksi) 164 <u>179,5</u>	(%) 	<u>(%)</u> 48 <u>61</u>	(((-iosa)) 60 106	
Location	Strength (ksi) .) 174	1.3, (ksi) 164	<u>(%)</u> 19	<u>(%)</u> 48	<u>(11-1053)</u> 60	
Location	Strength (ksi)	1.3, <u>(ksi)</u>	(%)		(115)557)	•
•	Tensile	0.2%	EI.	R.A.	Charpy R.T. Energy	
Melting: Serial Nui Mechanici	Heat Number Electrode Ma MBER: AL PROPERT	r <u>E282:</u> Ilting Practi 600 (IES: (at i i	21 ice: LR 009.386/1 nner diem	X AOD	VCD	/SD VOD
	Drawing No. Supplier Seri GE Manufaci No. <u>SQ-0</u>	al Number luring Proc 119530-MP	ess Plan: P-1_ Rev.	203 D 47 5002180 No.	96-01 Rev. A 5100-956 Rev. Date	30 <u>-30 MAY 2007</u>
FORGING: DATE:	Supplier Nam	10'	Energi	etechnik Es 03-11-20	sen GimbH 09	CLASS65
OE SPEC:	B50A743	IŠŠI		-		
Purchasei	: GE Powe	er Syster	ns, 1 Ri	ver Road	l, Schenecta	dy, NY12345
			J. and S. S.	onenn bill debe de ligige Tel)	1 1996 - Angelen Martine, angelen and and and and and and and and and an
GmbH.	set 1811		No	b.: 09030(noero	· · · · · · · · · · · · · · · · · · ·

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an master fort	No.; 09	0300
rchaser : GE Power S	ystems, 1 Rive	Road, Schenectady, NY12
pplier Serial Number:	5002180 5100	9560
MELT CHEMICAL CO	WPOSITION:	
thod Used: Ingot	X_Billet	Forging
TESTINGLOCATION	: 	· ····
ELEMENT	Тор	BOTTOM
	Wa	ght Percentage
C	0,069	0,061
Mn	19,14	18,36
P	0,019	0,017
S	0,001	0,001
Si	0,26	0,30
Cr	17,89	17,62
N	0,63	0,56
V	0,071	0,069
Sb	0,0004	0,0004
As	0,003	0,003
Sn	0,002	0,002
Al	0,004	
ITHORIZED SIGNATUR		1
n i standing di sensering di selangang di selangan selang selang selang selang selang selang selang selang sela	n para	Bonsen -

Energietechnik E	Essen	Abnahm Inspection Nr./No: Autrage-Nr.: Order No:	e prüfze n-Ce <i>rtifici</i> 090300	ugnis ate / Cer sete/Page	EN 1 tilicat 3 5002	0204/3.1 de réception von/ol/de 2180	0/1 6
Henteber/Purchason Commentant Bistetung Ha Xirder No Xommende No: Liefervorschift/Purch: Spec Xonditions de	livraisón:	GE Power See Page	Systems, 1 1-	F B50474	id, Sch	enectady N	12345
		F 14/17/1-1				and a state of the	
Location of Lateral E Specimen No. Impact S	xpansion of pecimen (mm	<u>).</u>					
A-1 (1) 1,42 A-2 (2) 1,17							
HARDNESS Equotip G							
Location of Specimen No. 1 - 8 TOP = 1 - 8 BOTTOM = Location of Specimen No.	1 642 644 643 645	645 643 646 645	2 644 64 646 64	14 646) 16 645 1	344 345		
All tensile and impact specimen Location of test specimen as pe	s taken from Ir GE's Specif	heide diamet Ication P14A	er, as per G AL-0201 Re	E's drawing iv, E Paragr	aph 6.4		
INGOT SIZE:	mm dia.	1030	INGO	<u>t weight:</u>		26230	kg's
INGOT DISCARDS:	Top end Bottom end	790 520	kgʻs kgʻs				;
ORIENTATION OF FORGING	WITHIN ING	21:	Middle	9			
HEAT TREATMENT:	Quenching:	1080°C/ wat	9ť				
	Stress relievi heating and i	ng: 10h - 400 cooling rate 2	°C/ furnace 5°C per hou	cooling dow	'n,		
ULTRASONIC TEST:	see attached	ULTRASON	ic test ri	PORT (pa	je -4-)		
Es with best light, det, die Lieferens den V We hereby certify that the material described inspection and demonstrational control without s	fensisiberbrigen be febbye nes been te ompleinte:	der Netscheine Sted and comptes	me entepricht: I with the terms of	health they have a set the order confirm	d Alienees etion.	ing ohne Beenste	ndung,
blaite certificites que la tivreison est conforme des dimensione dans abjection	mus stipulėtions de	Cacception de la ci	ommende. Inspec	tion et cantrôle I	F		1
D#um//2009 Essen, 03-112009	ł			j.	S		



ULTRASCHALL - PRÜFPROTOKOLL

Utrasonic Test Report Sens / Page 1 von / of 3

Enclosure to Certificare - No.	090300	Page	4	of ,		<u>91 :</u>	
Purchase Order No. Serial No. Purchase Specification Examination Specification Manufacturing Stage Drawing Number	6 6 6 6 7 3 9 14A-AL-020 9 3C-AL-0653 final machine 2 6 3 D Y 7	ырс 1 сс. 1 4 11 Rev. "Е" 1 Rev. "В" / Р d 36 - Фл. R	3C-AL	-6501	Rev. "C"		
Ultrasonic Examination							
Marine and the second states	CODION I C	1000600					

Examination No. Examination Instruction Equipment and No. Couplant Surface Condition

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: 5002180 / 51009660 : PV - KR 1/72 Rev. 7 : Symphonic 310 / 2002 - 117 : Water : turned

Search Unit. Freq. Design (MHz)		· · · ·	Gates - Lengths and Thresholds	Noise Level		
NO.1	2,25	DAC 1,8mm + 6 dB	1.BE 90%	28,3 + 30,0 = 58,3 dB	48,0 mm 20%	1-6/8 %
NO.2 Long Water red.	2,25	DAC 1.8mm + 8 dB	1.BE 80%	30,5 + 30,0 = 60,5 dB	45,0 mm 20%	2-8/10 %
NO.3 Long Wave red	2,25	1.BE 80%		33,7 dB) 	- 100 100 11 10 -
NO.4 Shirar Wave tang	2,25	Notch Echo 80%	(0,75mm dep)	39 + 8 = 45 dB	100 mm 20%	1-5/8 %
NO.5 Sileer Wave tailig	2,25	Notch Echo 80%	(0.75mm dep)	43 + 0 = 49 dB	100 mm 20%	1-7/10 %
NO.8 Slied Wave ad	2,25	Edge Echo 80%		38 + 10 = 43 dB	30 mm 20%	1-5/7 %
NO.7 Stiegt Wave and	2,25	Edge Echo 80%		40 + 10 = 50 dB	30 mm 20%	2-7/12 %
No.8 Long. White rad.	2,25	1.BE 40%		27,9 dB		******

Remark: Ø A= 1046 mm 915 mm 646 mm Ø.1=

La. 65,0 mm W=

Rec	ordable indications;	Date / Operator
0	no o yes, page:	03.03/2009 Certainak
10	Released	Date / Exam Supervisor
0	Released, acceptable indications	100 ng 1000 Jamph
0	Hold, unaccepted indications	10,00, nor four
Ann	tex: C-plot "print of all probes"	

Annex: C- plot "print of all probes" 3-8 plot



Abnahmeprützeugnis EN 10204/3.1 Inspection-Certificate / Certificat de réception

Ne //No. 090300 Selfe/Page 5 vonfolide 6 Auftrage Nr.: 5002180 Onler No.: 5002180 Note commende No.:



51009560 03.03.09 PRINT OF ALL PROBES CH.1 58.3dB CH.2 60.5dB DAC 1.6mm + 6dB GATES 20% CH.4 45dB CH.5 49dB NOTCH ECHOS 80% + 6dB GATES 20% CH.6 43dB CH.7 50dB EDGE ECHOS 80% + 10dB GATES 20%



Abnahmeprüfzeugnis EN 10204/3.1

Inspection-Certificate / Certificat de réception Nr./No. 090300 Setu/Page 6 vonJolide 6 Autores-Hr.: 5002180 Nore commende No:



51009560 03.03.09 BE ATTENUATION CH.3 - CH.8 CH.3 1.BE 80% 33.7dB CH.8 1.BE 40% 27.9dB

111

CUS	CUSTOMER'S REPRESENTATIVE				
WITNESS	WITNESS/REVIEW OF TEST / INSPECTION				
CUSTOMER PART DESCRIPTION DWG # OF PART SERIAL # DATE	ASTORIA ENERGY Field 134E5709 181073326 10/7/09	· · · · · · · · · · · · · · · · · · ·			

THE SIGNING OF THIS FORM BY THE CUSTOMER(S) REPRESENTATIVE / WITNESS DOES NOT IMPLY ACCEPTANCE OR REJECTION OF THE TEST OR OF THE DATA BEING DEMONSTRATED. THIS FORM REPRESENTS THE PRESENCE AND/OR REVIEW OF THE DATA OF SAID CUSTOMER(S).

NAME OF TEST /DATA BEING DEMONSTRATED :

SHIPPING

CUSTOMER(S) REPRESENTATIVE SIGNATURE

A.

DATE

GE COMPANY REPRESENTATIVE SIGNATURE

DATE

Date Accessed: 1/14/2009

IRBINE GENERATOR MANUFACTURING PCT-316

PJR REV. 03/13/02

CUSTOMER'S REPRESENTATIVE WITNESS/REVIEW OF TEST / INSPECTION

CUSTOMER	Astoria Energy 2907769
PART DESCRIPTION	STATOR 324 (20)
DWG # OF PART	138E8462
SERIAL #	181167351
DATE	9-28-89

THE SIGNING OF THIS FORM BY THE CUSTOMER(S) REPRESENTATIVE / WITNESS DOES NOT IMPLY ACCEPTANCE OR REJECTION OF THE TEST OR OF THE DATA BEING DEMONSTRATED. THIS FORM REPRESENTS THE PRESENCE AND/OR REVIEW OF THE DATA OF SAID CUSTOMER(S).

NAME OF TEST /DATA BEING DEMONSTRATED :

Wind Stand Final at 37.0 KV for 1 minute.

CUSTOMER(S) REPRESENTATIVE SIGNATURE

DATE

GE COMPANY REPRESENTATIVE SIGNATURE _______

DATE 9-28-09.

Date Accessed: 9/28/2009

TURBINE GENERATOR MANUFACTURING

PCT-316 PJR REV. 03/13/02

CUSTOMER'S REPRESENTATIVE WITNESS/REVIEW OF TEST / INSPECTION

CUSTOMER	Astoria	
PART DESCRIPTION	324-60HZ	
DWG # OF PART	134E5700	
SERIAL #	181073326	
DATE	10/5/09	

THE SIGNING OF THIS FORM BY THE CUSTOMER(S) REPRESENTATIVE / WITNESS DOES NOT IMPLY ACCEPTANCE OR REJECTION OF THE TEST OR OF THE DATA BEING DEMONSTRATED, THIS FORM REPRESENTS THE PRESENCE AND/OR REVIEW OF THE DATA OF SAID CUSTOMER(S).

NAME OF TEST /DATA BEING DEMONSTRATED :

Final BALANCE au Tais G A **CUSTOMER(S) REPRESENTATIVE SIGNATURE** DATE Ocr 5, 2009 Brown J. Surfrand DATE 10/5/09 GE COMPANY REPRESENTATIVE SIGNATURE

			GE	Ste	am I	Furbine Manu	facturing
	Turl	Mag blne Rotor	ynetic Par s, Genera	ticle tor R	Test otors	, & Shafts	
QCR's #1			#2			#3	
Turbine Rotor Ma	g Test Befo	ore Bucket As	sembly	Indic	ations		
		Sign Offs	Amperes	Yes	No	Operator	Date
Bore Visual (Including the blind bore).	Radius in a	PCR-336					
		Sign Offs	Amperes	Yes	No	Operator	Date
Bore (Including radius in end of a blind bore)	"1st Mag" Headshot 2nd Mag Headshot	PCR-336					
"Plug Bore" Mag			\square	\mathbf{T}	R		
Demagnetization after cor	npletion of bore	e mag.	V	Y			
Periphery Test (No heat test)	"1st Mag" <u>Headshot</u> "2nd Mag" Wrap	FQP or PC- 382					

-	
	110
	- L L
	_

Coupling / Coupling Holes (Integral Coupling) Demagnetization after periphery mag.

7

Generator Rotor Mag Test

•	-	Sign Offs	Amperes	Yes	No	Operator	Date
	"1st Mag" Headshot	G7600A,B,N					
Mag Bore	"2nd Mag" Headshot	G7629 A,					,
	Demag.	PCR-336		• • • • • • • • •			
	"1st Mag" Headshot	G7600A,B,N	3600		X	ywaly	1-24-09
Mag Ends	"2nd Mag" Wrap	G7629 A,	3600	,	X	qualif	1.24-09
	Demag.	PCR-336				invalle	7-24-09

Note: When all mag tests before assembly have been signed off on this form, place original in master folder at inspection.

	Serial #: Drawing	#: <u>134E \$ 160</u>
U Workstation:	Inspector Audit:	Date: 7-29-09
Ro	tor Production Operation	
	1 of 2	8/12/2008
	U Workstation:	Workstation: Inspector Audit: Rotor Production Operation

GE Steam Turbine Manufacturing

Generator Field - 3rd Lathe Machining

Do all machining to the drawing. - This PC Form is for record only!

	Designate Area		Diameters	Pay #	Date
	TE CPLG O.D.	D	32.750	SUZal	9/
		A	32.745	37507	125
	TE RABBET FIT	D	17.995 17 A 45	INSP	9.
	· · · ·	Α	17.9990	07741	248-04
	TE SPIN FIT	D	5.5130	INSP 4(137	•
		Α	5.5125	P\$ 0	9.26
	TE CPLG	D	.001"	17/01/	
	(flatness)	Α	OK	13194	: .
	TE OB DEFL	D	17.000		9/
		A	17,000	3917	27
	TE IB DEFL	D "	19.000	120-11	9/
	· · · · ·	A	19.001	10017	10-1
1		<u> </u>			
	<u> </u>	<u> </u>			
	CE FAN ASSY	D	Verify Y/N		
	(fan face recessed	A	off	67889	19:16
┢	CE FAN OD	n	20 5875		9.1
	CLIANOD	A	20.5015	62874	1/22
	CE FAN FIT	D	0.9995	INSP (789	
Ψ.		A	1.000	20	9-22
	CE RABBET FIT	D	r.	INSP	
	(if static start-unit)				<u> </u>
\vdash	CE IB DEFL	$\mathbf{\overline{D}}$	19.000		01
		Ā	19,000	13194	1/22
	CE OB DEFL	D	17.000	l	
		A	16.9995	07241	9/23
	COLL RINGS	D	13.50 MIN	1010-1	9/
		A	OK	13149	122
\square					
		<u> </u>	·		_
		L		1	
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1	ľ	1	1	1	I \

Instructions:

- Runout opposite tool post to be less than .001" 1.
- Record all dimensions required. Call for inspector 2. verification. All others are operator verification.
- When a QCR is written, list the QCR # next to the error. 3.
- Operator is responsible to report all out of tolerance 4. conditions.

FAN RU	of RID'S A	NOT VORLIFIED	BY INSPECTO	P.,
Required aft	Fan Rin er setup on o	g Runout Check il deflectors, PRIOI	R to Machining	σ.
Location	TIR	Pay No.	Date	
CE	.0019	07372	1/16	
TE	.0018	07372	9/16	N
Inspector		Date:		-

If fan ring total Runout is > 0.002", review setup and 12 point plot. Contact ops leader to review If fan ring total Runout and electronic 1/rev plot data remain out of tolerance, Stop - contact Methods/OPE.

T.E. Journal						
	Inboard	Center	Outboard			
Diameter	16.000	16.000	16.000			
Runout *		*,0007				
Lobe		.0001				
Oper. Pay N	No.: 13194	Date: 9	119/09			
Insp Dia. C	heck: H	_ Date:	9/19/09			

C.E. Journal					
	Inboard	Center	Outboard		
Diameter	16.000	15.9998	16:000		
Runout *	·····	*.0006			
Lobe		,0002			
Oper. Pay No	D.: 13/94	Date: 91	17/09		
Insp Dia. Ch	eck:	Date:	3/17/09		

	Inspector Sign	* Date
H Stamp Verification	+7,	9/29
M Stamp Verification	72	9/29

- 5. Inspector visual signoff required for final Journal acceptance after Profilometer check.
- The H-Stamp (high spot of the coupling face Runout) is to be stamped in the coupling face relief. The M-Stamp is to be stamped on the coupling outer diameter and to be located 180° away from the H-Stamp. 6.
- 7.
- All dimensions to be machined in lathe 8.

Notify inspector and operations leader for any discrepancies between measurements and drawing dimensions

Shop Order:	2.90T 71	69	Serial #:	181 073	326	Drawing #:	134ES	5700
Prototype:	224	Workstation:	76-3	Inspecto	or Audit:	72050	410 Date:	9/29/09
							y	
		5	·	1 of 3	· · · ·	, ·		

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GE Steam Turbine Manufacturing

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Generator Field Journal Surface Finish Inspection And Final Visual Inspection

	Fin	ish Journ	al Machin	ing				
Inch	CE	TE	Inch	CE	TE			
1	6	10	13	5	٩		TE	CE
2	6	13	14	5	11			
3	5		15	5	11	Date:	9-30-09	9.30.69
4	35	11	16	5	10		22/10	<u> </u>
5	5	9	17	6	12_	Inspector:	P. Detitippo	Mitacer
6	5	9	18	6	12		_0	0
7	6	10	19	5	14	Degree Loc:	<u>O</u> *	
8	Ģ	9	20	5.	12			AV
9	6	11	21	5	9	Comments:	<u> </u>	0~
10	5	12	22	6	10		_	IM. Frank
11	5	12	23			Final Visual	21Dan	
12	6	12	24			Inspection:	1.5.4.9-30.09	9.30.09

1. Wipe Journal prior to taking measurements.

2. Position Profilometer directly on top of the journal (working form outboard to inboard).

3. Record surface finish every 1" along both Collector and Turbine End Journals.

If the data appears to vary significantly - recheck the data point.

Degree Location is the field degree location where the measurements are being taken (ex. 0, 30, 60, etc)

6. Profilometer measurements recorded at the final visual inspection of the journals at 3rd lathe and prior to removal of the rotor from the lathe.

Shop Order:			Serial #:	181073326	Drawing #:	13485	700
Prototype:	324	Workstation:	6-7	Inspector Audit	: <u></u>	Date:	9-30-09
				a din di si di			-2
				3 of 3		•	

D^{4.} 5.

GENERATOR FIELD FORGING RELEASE FORM

SUPPLIER SERIAL NO.: 62365-07/GEU 866	MATERIAL SPEC.: B50A375A90 R	lev. D	
GE SERIAL NO.: 181073326	SUPPLIER: 92151 - Buderus		
PURCHASE ORDER NO.: 181073326	HEAT NO: 78002		
FORGING DRAWING NO.: 117E1716P0001 Rev. E	TRIAL ORDER: YES	NO	<u> </u>
SDR/a, V08104108			

RELEASE BY SOURCING QUALITY AND PRODUCTIVITY

The aforementioned Rotor has been evaluated based on the Purchase Order and specification requirements and all known written Engineering requirements. Based on this evaluation, this rotor has met all the requirements and is now released to Manufacturing for further processing. GE non-destructive tests were not completed prior to receipt of the forging unless otherwise noted. The tests to be done prior to machining include those tests not performed by the supplier, those required for audit/qualification purposes and those required because the supplier is not qualified to perform the final test.

COMPLETED PRIOR TO RECEIPT IN COM	SCHENE	CTADY E GE REP	. PRIOR TO	TO BE DON	E PRIOR
SHIF	MENT FRO	M FORG	ING SUPPLIER	TO MACHI	NING
APPLICABLE TESTS	Y	N	N/A	Y	N
Periphery Ultrasonic Test (P3C-AL-2214)	X				X
Ultrasonic Bore Eccentricity Test (P3C-AL-2146)	X				x
THRU BORE OR UNDERBODY BORE ONLY			·	<u> </u>	
Boresonic Test (P3C-AL-2201)			х		х
Bore Visual Inspection (P3C-AL-2160)	·····	····	x		x
Bore Magnetic Particle Test (P3C-AL-2120)			x	<u> </u>	x
COLLECTOR BORE ONLY	****				·*
Boresonic Test (P3C-AL-2201)			х		Х
(Boresonic test P3C-AL-2201 – ONLY AT ENGINED	RING REQU	EST)			
Bore Visual Inspection (P3C-AL-2160)	X				х
Bore Magnetic Particle Test (P3C-AL-2120)	X			·	X
1 10 16			······		
SIGNATURE:	tin	DAT	E: January 30), 2009	A
/	Y				- M
RELEASED FROM OCHOLD IN COPICS	: DATE	Decembe	r 2, 2008	INITIAL /	L
-	-				
RIP#S8492801MS				/	
UNRESOLV	'ED (OPEN)	SDRs OR S	SUPPLIER QCR	3	
>>MUST BI	3 RESOLVEI) PRIOR T	O SHIPMENT <<	:	
(1) SDR or QCR Number(s) None					
2) All SDRs or QCRs Described Above At	tached:	Yes	No I	Not Applicable	e_X
FILE TRANSFER STATUS		······		OTAL	
SOURCING QUALITY ASSURANCE	a PRODUC		U GENERA I OF	QUALITY	
Source of the support of the second s					
Date Sent:	Signature:				
Signature signifies that all Engineering tests	required to	be revie	wed by Sourci	ng in Paragra	ogh 4.1 of
P3B-AL-3000 have been completed and me	et the prese	ribed req	uirements		
DISTRIBUTION: GENERATOR QUALITY-INS	PECTOR				
GENERATOR QUALITY					
PRODUCTION CONTROL/M	RP				
SOURCING QUALITY ENGI	NEERING	DICI			
SIKUCIUKAL MATERIALS	ENGINEEK	ING			

Rev. A - March 12, 02

B50A375		<u>GE Power G</u> Materials and Scheneolady	Page 10 of 12					
		Material Ac	contance (entificate	(MAC)			
E-SPEC: <u>860A376</u>	issue:	D	Class: A	90		DATE	of Repor	T:24,10.2008
Forging: Drawing: Serial No.:	<u>Generator Shat</u> 117E1718 Rev. 181073326	1 <u>t</u> E		N	Supplier: Thru Bore: of Thru Bore:	Buderus E D Ø	ideistahi Gi	<u>mbH</u>
Heat No(s). MPP No.: Melting Pi	: <u>78002</u> 92151-97097 wolkce:	Rev. No. VSD 12	.: <u>4</u> F VCD ⊡ V	lev. Date: /AD El	<u>12.11.1999</u> ESR 🗇			0ther⊡
SE, PGO Purchase Special Re	order: iquirements:	181073326	•			EBW job-r	10.;	<u>82385-07</u>
<u>Tensile Tests</u> (Radial Body)		MECHAN	NICAL PRO	PERTIES				
Collector Collector Collector Turbine E	End (CE1) End (CE2) End (CE3) Ind Proiong (TE)		Drawing <u>Location</u> <u>0"</u> <u>120"</u> 249"	T.8. (KSI) 122.0 121.5 122.0 122.0	0,02% Y.S. (KSI) <u>101.0</u> <u>100.0</u> <u>100.0</u> <u>101.5</u>	EI (%) 22.7 23.8 23.8 22.6	RA (%) <u>69</u> 70 71 70	
Charpy V-Notch To (Collector End) CE1+CE2+CE3	<u>1513</u>							
	0*	Location & 120° & 24	0• =[~	RT (Ft-lbs) <u>108</u>	Hot# Temp (°F) <u>-148</u>	Cold Ft-ibs <u>34</u>	FATT (°F) <u>-38</u>	
	0*	& 120° & 24	0* *I*		-112	34		
	0*	8. 120° & 24	0• "l"		<u>-76</u>	<u>36</u>		
	0*	& 120° & 24	0* " f"		-40	45		
	0*	& 120° & 24	0• "I"		-4	<u>83</u>		

Approved SDR(s)

V08104108

Buderus Edeistahi Grabil 35576 Wetzlan cha Quality control department Works inspector

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Enclosed: FATT-datermination of the positions: CE1+CE2+CE3 (collector end)

CHEMICAL COMPOSITION

B50A375 MAC 2

GE-order no.: 181073326

EBW-order no.:

62365-07

WT. PERCENT														PPM	
	С	Mn	Р	5	81	N	Cr	Мо	v	Sb	As	Sn	AI	0	H
HEAT ANALYSIS OR WEIGHTED AVERAGE HEAT ANALYSIS	0.23	<u>0.30</u>	0.004	0.001	<u>0.26</u>	3.56	1.72	0.41	<u>0.13</u>	<u>0.0015</u>	<u>0.005</u>	<u>0.008</u>	<u>0.015</u> •	13	10
HEAT #1	:	:	-	-	z		=	. 1	=	:		\$	=	2	2
HEAT # 2	=	=	Ξ	÷	=	Ξ	:	:	:	:	Ξ	:	5	=	:
HEAT # 3	=		-	:	Ξ		Ξ		=	-	11	ta	8	50	:
HEAT#4	=	Ξ	=	1	=	:	3		=	=		ε	:	:	1
HEAT # 5	=	:	-	:	Ξ	5	=	2	=	=	۲	=	z	3	=
HEAT # 6	:	=	z	=	=	=	=	:	ž	=	=	٤	F C		:
PRODUCT ANALYSIS					-										
тор	0.25	<u>0.29</u>	<u>0.004</u>	<u>0.001</u>	0.26	<u>3.53</u>	1.69	0.41	<u>0.12</u>	<u>0.0015</u>	0.004	<u>0.008</u>	0.015	19	<u>0.5</u>
MID POINT	=	:	:	Ξ	=	:	₽	=	:	:	=	=	=	۲	=
BOTTOM	0.25	0.30	0.003	<u>0.001</u>	0.26	<u>3.66</u>	<u>1.69</u>	<u>0.39</u>	<u>0.12</u>	<u>0.0015</u>	0.004	0.007	<u>0.014</u>	11	<u>0.5</u>

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Buderus Edelstahi 3mbH 35576 Wetztar Quality conton department Works inspector -ol