TRANSMISSION LINE & SUBSTATION PROJECTS

COMPANY: ENTERGY GULF STATES LOUISIANA

FACILITIES STUDY

EJO # F4PPGS0430

PID 215 INTERCONNECTION

Revision:
1

Rev	Issue Date	Description of Revision	Prepared By	Approved By
A	12/19/08	1st Draft including Tu Nguyen's input	Ibrahim Khan	Kevin Wright
0	1/07/09	Based on JET review	Ibrahim Khan	Kevin Wright
1	1/14/09	Classified Upgrades & Posted	Daniel Epperson	Jody Holland

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1. PROJECT SUMMARY

1.1. Background and Project Need

The purpose of this Facilities Study is to identify Entergy system requirements enabling 31 MW of generation to be connected at 13.8 kV to Entergy system via existing 13.8/69 kV Sphere substation owned and operated by the applicant.

A system impact study prepared by SPP ICT dated 8/7/2008 indicated no constraints on Entergy system from study state or stability points of view.

The facility study has studied operational contingencies and determined relaying and operational requirement for customer to implement in order to safeguard Entergy system prior to connecting their generation to the Entergy system. It also identifies cost estimates incurred by Entergy and to be compensated by customer for work to be done prior to commissioning of the generating units.

1.2. Scope Summary

- Purpose of this study is to identify operational, relaying and data requirements as well as cost associated with establishing means to connect customers 31 MW of generation to Entergy system

  The single substation involved is Sphere 13.8/69 kV which is owned and operated by the applicant and connected to Entergy 69 kV system through 69 kV lines Flake L682 and Mossville (Cokhan) L282

- All implementation work is to be done at Sphere by the customer meeting with Entergy requirements

- Entergy will review/consent/inspect/approve work associated with Sphere Substation prior to connecting generation to the Entergy System

- Work at Sphere Substation includes installation of relaying to ensure that 69 kV ungrounded transformer and 69 kV lines in the event 69 kV line end breakers are open are protected adequately from ground and phase faults and isolated. In addition, bidirectional metered quantities and status of 13.8 kV breaker (numbered 52-U2 as per customer one line diagram) at which synchronizing takes place will be transmitted to Entergy's System Operations Center (SOC) in Arkansas via a dedicated phone line connected to RTU in the substation.

1.3. Cost Summary

- The estimated total project cost is **$80, 000.** This cost represents the estimated Entergy expenditures for review and testing in the Sphere Substation. All other costs relating to work in Sphere Substation will be the responsibility of the Substation owner or Customer. This cost does not include Tax Gross Up which may apply.

- The ICT has assigned $___0___ as Base Case upgrades and $_80,000_ as Supplemental Upgrade based on Attachment "T" of Entergy's ICT (Independent Coordinator of Transmission) filing to the FERC.

1.4. Schedule Summary

Since all the work is to be carried out by the applicant, a schedule would have to be developed in concert with Entergy team. Deliverables from Entergy would be review of drawings, settings, edit sheets for RTU, inspection of facility, acceptance of metered data and status and acceptance of generator as-built data for system modeling.

Entergy requires a 4 week turn around for review, comment and consent of documentation. The same 4 weeks notice would be required for participation in the field for site inspections.

1.5. Automatic Generation Control

- Not applicable

2. SAFETY REQUIREMENTS

Safety is a priority with Entergy. Safety will be designed into substations and lines. The designs will be done with the utmost safety for personnel in mind for construction, operation, and maintenance of the equipment.

All employees working directly or indirectly for Entergy shall adhere to all rules and regulations outlined within the Entergy Safety manual. Entergy requires safety to be the highest priority for all projects. All Entergy and Contract employees must follow all applicable safe work procedures.

Should the work contained within this Facility Study be approved, Entergy's participation would generally adhere to the motto described above and reflect in their finished product and expect the same from the applicant in their product.

3. GENERAL ASSUMPTIONS

- All costs above represent good faith estimates in 2008 dollars. Price escalation for work in future years has not been included

- Applicant is trusted to have validated system impact study, and conducted their own studies and ensured that all abnormal conditions appearing on Entergy 69 kV system are taken into consideration in designing safeguards and renders safe and reliable operation of generating units to be connected to the system

and Entergy will not be held accountable for any damages to their system. Entergy's review and inspection would not hold Entergy, employees and its contractors accountable for any damages

4. SCOPE OF WORK

.Background and Concerns:

It is understood that the applicant will connect 31 MW of generation to 13.8 kV side of existing Sphere 13.8/69 kV Substation. The substation, including the 69 kV line protection is owned by the applicant. 69 kV lines are terminated on breakers and are terminated at Mossville and Flake Substations. Applicant has identified 13.8 kV breaker numbered 52-U2 to be the point of synchronization with Entergy system.

While System Impact Study did not identify any constraints on Entergy system to connect the generation, Entergy has studied further and identified the need for adding redundant ground fault protection to alarm and isolate ground fault on transformer HV delta connected winding and 69 kV lines supported by the generators while the 69 kV line end breakers are open. The same concern applies for phase faults in case of islanding the generation. Hence a weak feed backup line protection should be provided.

The proposed scope of work at Spherelene Substation includes:

4.1.Option 1

4.1.1 Relaying

Ground faults

Provide a ground fault protection for ungrounded delta transformer and 69 kV lines while (remote) breakers at Mossville and Flake are open and Spherelene generator is connected to the Entergy system.

Three 69 kV CCVTs, connected between 69 kV side of transformer and transformer breaker, will be installed to provide over voltage protection for ground fault on transformer delta winding or on 69 kV lines under islanding situations. In addition to alarm for ungrounded fault detection, an under voltage time delay trip of 1 second is recommended for 13.8 kV (52-U2) and 69 kV transformer breaker. This is based on understanding and assumption that all arresters and line insulators within the 69 kV loop would withstand phase to phase over voltage for at least 1 second without flashing over. (The 1 second duration affords the under voltage trip to coordinate with all other external line faults beyond remote breakers at Mossville and Flake). Longer durations would require replacement of arresters. Reverse power relay will be implemented as the back up relay for the under/over voltage scheme. The reverse power relay can be operate with few cycles delay if it is supervised by 69 kV line companion trip or under/over frequency relay trip. The relay can be set to trip unsupervised with definite time tripping and high set settings.

A good practice of segregating DC sources for 69 kV relaying and reverse power relay for 13.8 kV side is highly recommended.

All faults

Ensure that all faults on one line while line end breaker on the other line is open can be detected by the line protection (under weak feed condition). New line protection is most likely required to accommodate for weak in feed conversion trip of the 69 kV Sphere breaker, to provide companion trip supervision for the 13.8 kV 52U-2 synchronizing breaker and breaker failure trip for the local 69 kV bus differential.

The 69 kV bus should have a primary high impedance bus differential relay. Also, a separate non directional partial back up bus over-current relay should be implemented to provide last resort trip for 13.8 kV DC loss.
The partial bus over-current relay must coordinate with downstream transformer primary and back up protection.

Synchronization after islanding

It is understood that the applicant will connect 31 MW of generation to 13.8 kV 52-U2 transformer's breaker. This is with the assumption and understanding that this will be used for isolating Entergy system from the generating 13.8 kV bus and synchronizing with the Entergy system.

While the 13.8 kV breaker numbered 52-U2 would be used for synchronizing with Entergy system, install synch-check relays on all 69 kV breakers to prevent inadvertent closing.

4. 1.2 Metering

Following revenue class metering on 52-U2 and status transmitting the following quantities to Entergy SOC located in Arkansas via a dedicated phone line:

kV and bidirectional MW, MVAR, MWhr, MVARhr, pulse rate of 1 MWhr per pulse and 1 MVARhr per pulse

Status of breaker 52-U2

Use existing RTU to communicate these quantities and status to SOC Arkansas via a dedicated phone circuit using DNP protocol.

4.1.3 Generator Data

Applicant is required to provide generator as-commissioned parameters (impedances, time constants, etc) to Entergy Planning department after the units are tested and connected to the system.

4.1.4 Entergy Participation

Entergy will work with the applicant in reviewing all drawings and settings prior to implementation. Construction specialists will inspect the agreed upon facilities protecting Entergy system and grant consent to connect generator. Personnel will work with applicant on verifying metering and status information at SOC.

4.2 Option 2

4.2.1 Transformer and Relaying at Sphere Substation

Replace existing transformer at Sphere Substation to delta star (13.8/69 kV) configuration and ensure that the phase and ground faults on 69 kV line (while one line end breaker is open) are detectable by the line protection. If not, install alternate line protection or set over current relays on transformer 69 kV side to cater for faults under such scenario.

It is understood that the applicant will connect 31 MW of generation to 13.8 kV 52-U2 transformer breaker. This is with the assumption and understanding that this will be used for isolating Entergy system from the generating 13.8 kV bus and synchronizing with the Entergy system.

Sync-check – While 13.8 kV breaker numbered 52-U2 would be used for synchronizing with Entergy system, install synch-check relays on all 69 kV breakers to prevent inadvertent closing.

4.2.2 Metering

Same as 4.1.2 above

4.2.3 Generator Data

Same as 4.1.3 above

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4.2.4 Entergy Participation

Same as 4.1.4 above

5. COST

The ICT has reviewed and determined whether each required upgrade will be considered a Base Plan Upgrade or a Supplemental Upgrade. For more information

on cost responsibility for Base Plan and Supplemental Upgrades, see Attachment T to Entergy's OATT.

The costs shown in the table include overheads and AFUDC, but do not include tax gross up (average 35%) which may be applicable. Entergy incurs a tax liability proportional to the amount of customer contributions. Indirect cost and tax gross up rates are subject to change.

Projected Costs

	TOTAL including 40% indirect
Entergy cost for review/consent/inspect/approve	$ 80,000
TOTAL	$ 80,000

6. UPGRADE CLASSIFICATION

The ICT has reviewed the projects identified and have determined that all projects are classified as Supplemental Upgrades. For more information on cost responsibility for Base Plan and Supplemental Upgrades, see Attachment T to Entergy's OATT.

	Base Plan	Supplemental
Entergy cost for review/consent/inspect/approve	N/A	$80,000
TOTAL	N/A	$80,000

7. SCHEDULE

Applicant is required to provide a schedule for submission of documentation for Entergy's review/consent and allow 4 weeks for response. Same 4 weeks notice should be given for site inspection and approval. A schedule should identify when the metering and status will be verified at SOC.

Any work to be done at Sphere requiring line outage should take into consideration of approvals from SOC/TOC and sensitivity to loading season and booking outages several months ahead of time and developing alternate plans should the outage be not granted when it was scheduled for.

8. RISK ASSESSMENT

None identified

9. ATTACHMENTS

A) Relaying Description from Applicant

Purpose:
This document is prepared for the purpose of providing all parties involved with information to facilitate the Facility Study under FERC guidelines.

Plant Description:
The plant consist of three generation units as defined in Attachment A to Appendix 1 of the
Interconnection Request Application.

The Southwest Power Pool issued the following reports per agreements with PID 215 and SPP:

1. Feasibility Study Report PID 215 31 MW Spherelene, Revision 0, dated 11/28/2007
2. System Impact Study Report PID 215, Revision 1, dated 8/7/2008

Reference documentation sent to SPP as requested on 9/9/2008:

Location plan drawings
21001-0 (Site Plan).pdf
79019-0 (Cable Tray – Nort East).pdf (From Sphere "Sphereline" Substation to Cogeneration Area)
51001-0 (General Arrangement).pdf (Cogeneration Area)

Simplified One Line Diagram of the Plant and Station Facilities
78001-1 (13.8kV Distribution One Line Diagram).pdf

13.8kV Distribution Protection One Line Diagram
78004-0 (13.8 KV Distribution Protection One Line Diagram).pdf
78003-0 (480V Dist One Line Diag).pdf

SphereDrawings.pdf (Provided by Dashiell Corporation for this Attachment)
Includes Dashiell Corporation drawings:
8842-1100 Revision 5, dated 1/15/97, Sphere Substation 69-13.8kV Single Line
8842-1200 Revision 5, dated 12/30/96, 69-13.8kV Three Line
8842-1400 Revision 5, dated 12/30/96, 69-13.8kV AC & DC Auxiliary Loads
8842-1700 Revision 6, dated 12/31/96, 69-13.8kV Substation Electrical Plan

Relay Protections:

General

The protective relays shall be designed as Utility grade, following IEEE Standard C37.90. IEEE 1547: 2003 “Standard for Interconnecting Distributed Resources with Electric Power Systems” is used as a guide for interconnection.

1.01 Interconnect Protections

A. The Utility Feeder Breaker, 52-U2 shall have two multifunction microprocessor relays***, Schweitzer model SEL 351-7.*** This protection shall be redundant so that one relay can be isolated and tested at a time and to maintain electric service. The interconnect protection is modeled on the IEEE 1547 guide and provides adequate protection by opening breaker 52-U2 in the event that incoming electrical power at breaker 52-U2 is lost. Import power control at 52-U2 shall be maintained by automatic control so that when utility power is lost, a frequency shift measured at 52-U2 from the sudden load change shall open breaker 52-U2 isolating the generation from the utility system. Initiation of synchronization back to the utility system will be at 52-U2 operation initiation of automatic synchronizing of the generator(s) across 52-U2 when all three utility phases have returned with proper phase rotation within the voltage range, closing angle and frequency slip allowed by the synchronizing check relay.

B. The relays shall use the following signals:

1. Current sensing through the mains breaker bushing current transformers

2. Voltage sensing from the line side and bus side potential transformers.

C. The relay shall have a lockout function (86) which shall require manual reset.

D. The relay shall have the following protection functions:

Note: Forward direction is defined as current into the switchgear and Reverse direction is defined as current into the Entergy Line.

1. Directional Overcurrent (67 & 67N)

(a) Directional overcurrent protection in the Reverse direction is provided by directional overcurrent tripping (67).

(b) Directional neutral overcurrent protection in the Reverse direction is provided by directional neutral overcurrent tripping (67N).

2. Overcurrent Protection (51 & 51N)

(a) Overcurrent for phase and ground faults is provided by inverse-time overcurrent functions (51 &51N).

(b) Overcurrent protection is provided in both Forward and Reverse Directions.

3. Reverse Power (32)

(a) The relays and controls shall allow a limited amount of power to be exported to Entergy.

(b) A maximum export level shall be established with the following constraints:

(i) A definite time reverse power element (32) is provided establishing a maximum allowed power export into the Entergy system.

(ii) A time setting of 30 to 60 seconds is provided to allow temporary export in excess of the setting to allow the generator control to respond in the event of a loss of a substantial load.

(c) Operation of element 32 will trip the respective utility breaker. (Operation of the 32 function may be disabled during commissioning.)

4. Loss of Potential

(a) The relay shall have a voltage supervision function internal to the relay which shall:

(i) Detect a blown bus PT secondary fuse.

(ii) Enable an alarm.

5. Synchronizing Check Protection (25)

(a) A synchronizing check element (25) is provided to protect against inadvertent closing of the breaker.

(b) The relay logic does not allow closing 52-U2 onto a dead line and only when utility voltage is within range and is balanced.

6. Under-Frequency Protection (81U)

(a) Normally set at about 59.0 to 59.5 Hz with a time delay of about 0.1 seconds.

(b) Under-frequency is only active when any generator is operating in parallel with the utility line.

(c) The relay shall be capable of additional 81U settings in order to speed up the delay to simulate a higher rate of frequency

decay. In addition rate of frequency change may be used to insure detection of loss of utility power.

7. Over-frequency (81O)

(a) Normally set at about 60.5 Hz with a time delay of about 0.1 seconds.

(b) Over-frequency is only active when any generator is operating in parallel with the utility line.

(c) The relay shall be capable of additional 81O settings.

8. Undervoltage (27)

(a) Set at approximately 85% of rated nominal with a time delay of approximately 2 seconds.

(b) Secondary setting of 50% of nominal with a time delay of approximately 0.1 seconds.

(c) The undervoltage element is only active when any generator is operating in parallel with the utility line.

9. Overvoltage (59)

(a) Set at approximately 106% to 110% of rated nominal output with a time delay of approximately 2 seconds

(b) Secondary setting of 120% of nominal with a time delay of approximately 0.1 seconds.

(c) The overvoltage element is only active when any generator is operating in parallel with the utility line.

E. Operation of any voltage, frequency, or reverse power protection element will cause tripping of 52-U2.

F. Operation of any overcurrent (51, 51N), or directional overcurrent (67, 67N) will trip the U2 lockout relay (86).

1.02 Line Differential Protection

A. A single line differential relay shall be provided and installed in the switchgear to protect the 13.8kV incoming cable feed from Sphere Substation.

B. The relay shall be connected to CTs as indicated on drawing 194.01-E2A.

C. The relay shall be ready to accept a 1300nm single mode fiber optic connection.

D. The relays shall be a Schweitzer ***SEL-311L.*** One relay shall be provided at the Power Generation Switchgear breaker 52-U2, and the other at the Sphere Substation.

E. A cable fault within the protected zone shall high speed tripping of the respective lockout relay for breakers 52-U2 and GCB-D to isolate the cable.

1.03 Transfer Trip from Sphere Substation to open 13.8kV breaker 52-U2

A. At a minimum, breaker transfer trip logic should be provided at the Sphere 69 kV substation as an input into a new SEL-311L relay installed at Sphere substation. Transfer trip will be transmitted via the fiber optic connection between the two SEL-311L relays to trip breaker 52-U2.

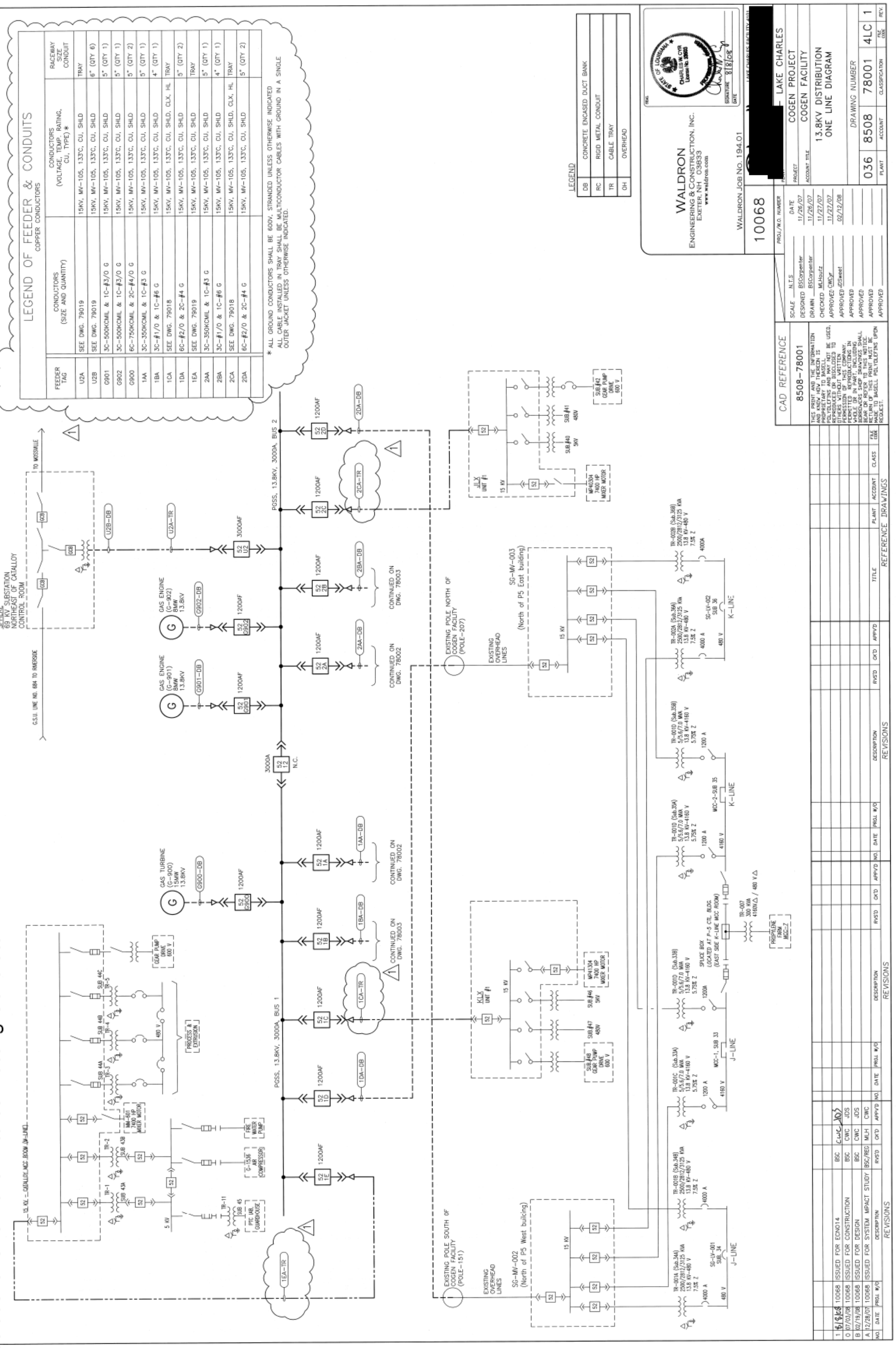
B. If either the 69kV breaker GCB-D is tripped or both GCB-A and GCB-C breakers are tripped, then the input into the new SEL-311L relay should be activated for breaker 52-U2 through mirrored bit communications through the fiber connection to the SEL-311 relay at the 13.8kV Power Generation Station Service (PGSS) breaker 52-U2.

B) Estimates for 215

Entergy estimates for review/inspections
Interconnection at Sphere substation

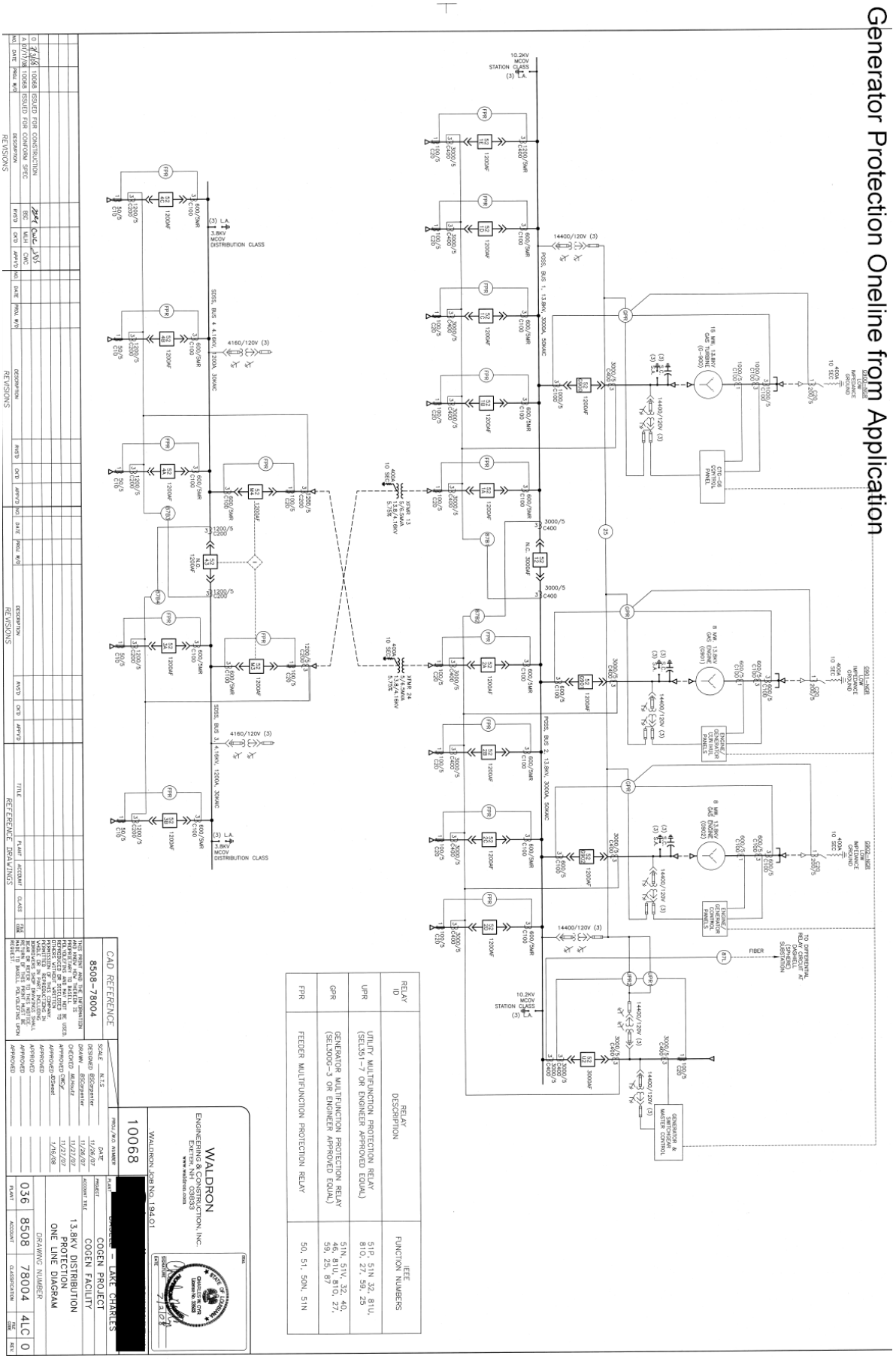
		Hrs	rate		Total
Review customer speficiations, drawings, settings, edit sheets, develop configuration, etc		320	$	75	$ 24,000
Site insepctions and witness testing		350	$	75	$ 26,250
Expenses					$ 4,922
Total					$ 55,172
Indirect	45%				$ 24,827
Full financial					$ 80,000

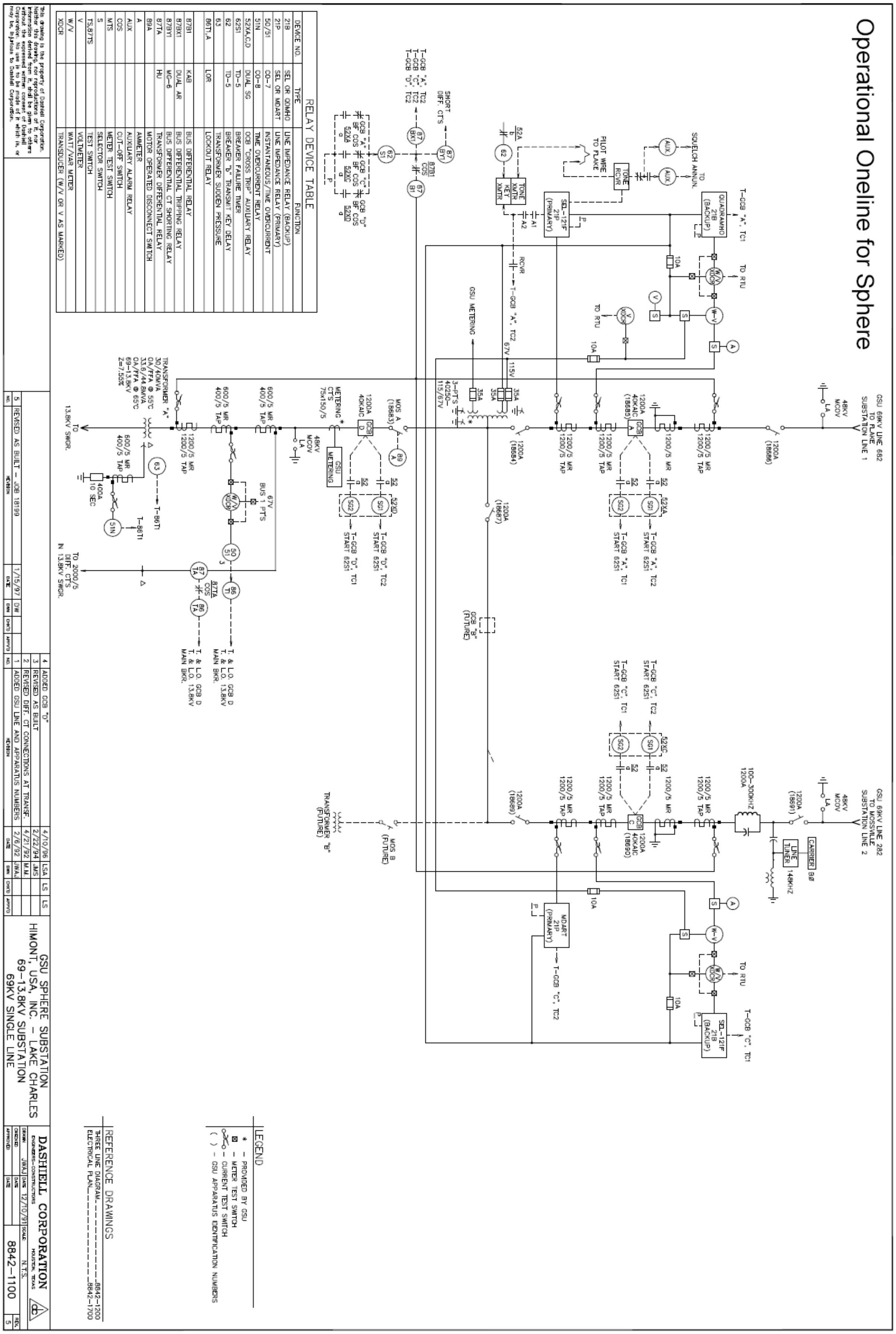
C) Onelines



Operational Oneline for Interconnecting Generator

Generator Protection Oneline from Application




Operational Oneline for Sphere
GSU 69KV LINE 662 SUBSTATION TO FLAKE SUBSTATION LINE 1
GSU 69KV LINE 282 TO MOSSVILLE SUBSTATION LINE 2
RELAY DEVICE TABLE
LEGEND
REFERENCE DRAWINGS
GSU SPHERE SUBSTATION
HIMONT, USA, INC. - LAKE CHARLES
69-13.8KV SUBSTATION
69KV SINGLE LINE
DASHIELL CORPORATION
8842-1100