***TRANSMISSION LINE & SUBSTATION PROJECTS***

***COMPANY: ETI***

***CUSTOMER: PID 291***

# ***ALTERNATE FACILITIES STUDY***

***EJO # F4PPTX0101***

## ***PID 291INTERCONNECTION***
## ***LAKE LIVINGSTON***

**Revision:**
**1**

| Rev | Issue Date | Description of Revision | Prepared By | Approved By |
|---|---|---|---|---|
| 0 | 06/10/2013 | ETI approved FS | KC | R Riley |
| 1 | 06/11/2013 | ICT Review and Upgrade Classification | WM | V Godbole |
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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 27 MW of generation (3 x 8.865 MW) from PID 291's (customer) new hydro-electric plant at Lake Livingston, TX to be connected to 138 kV Entergy's transmission system at SHECO's Rich 138 kV substation.

SHECO will be reconfiguring Sam Houston Electric Company's (SHECO) Rich Substation, and will remove the line to Poco (L-415) from the existing location and re-route and re-terminate on to a new breaker dead-end structure. The vacated location will be used for terminating the new line from Lake Livingston Substation.

The line between Lake Livingston and Rich will be engineered, constructed, owned and operated by the customer.

The customer has requested Energy Resource Interconnection Service (ERIS) for 27 MW.

The following work is required for the interconnection:

### 1.1.1 L- 415 Rich to Poco at Rich Substation: Entergy Texas Inc (Entergy or ETI or ITC in future)

Customer will re-route the 138 kV line at SHECO Rich Substation to Poco Substation to accommodate the expansion of SHECO Rich substation. Redesign of structures and re-conductoring of a span of line may be required to address uplifting issues.

The customer has requested completion date of spring 2014. The customer has requested to perform this work. Entergy approves this request with the stipulation that SHECO completes and owns these facilities.

### 1.1.2 Lake Livingston Switchyard (Customer)

The Customer will build the Lake Livingston Switchyard and terminate the line from Rich Substation. It will be operated by Customer.

Line relaying to protect the line between Lake Livingston and Rich Substation will be between SHECO and the customer. SHECO owns Rich Substation.

Communication between Lake Livingston and Rich Substation will be via fiber optic shield wires (OPGW) installed on new transmission line by the customer. Rich Substation has a microwave system.

ETI will specify and supply revenue metering panel with redundant meters for installation on 138 kV line at Lake Livingston by customer and field verification by ETI.

ETI will specify revenue metering class 138 kV CTs/PTs. Entergy will field verify witness test metering.

Customer will procure, engineer and install revenue class CTs/PTs at Lake Livingston Switchyard.

Revenue meter will be required for auxiliary load ranging 25 – 50 KVA. ETI will specify CT/PT ratios and accuracy for procurement and installation by customer in the switchgear. Customer will also connect a phone circuit with modem to the meter for MV90 interrogation and the data will be transmitted to SOC along with 138 kV metering data and generator metering data along with the breaker status.

ETI will provide specifications and supply the meter for installation by customer. ETI will check wiring and perform testing.

Customer will specify, engineer and install the RTU at Lake Livingston capable of communicating to Rich Substation (and ultimately to Entergy SOC/TOC) and MISO.

The requested in-service date for completing work at Rich Substation is (spring) May 2014.

### 1.1.3 Rich Substation (owned and operated by SHECO)

The System Impact Study has identified no issues with stability of the system as a result of addition of generation by PID 291. Therefore, redundant communication for line relays between Rich and Poco Substations will not be required.

Customer and SHECO will be responsible for making modifications to microwave system at Rich Substation to enable it to route ETI data from Lake Livingston to SHECO's Batiste Creek Substation via SHECO Rich Substation.

### 1.1.4 Telecommunications – Batiste Creek (owned and operated by SHECO)

From SHECO's Batiste Creek Substation, ETI will route data and generator breaker status to the Entergy TOC and SOC. Work at the Batiste Creek site will be performed by ETI and funded by the customer.

A RFL channel bank will be installed at Batiste Creek Substation to accommodate the 2 circuits coming in from SHECO Rich Substation.

### 1.2 Scope Summary (ERIS)

**Customer:**

- Build Switchyard at Lake Livingston installing revenue metering system specified and supplied by Entergy

**SHECO:**

- Remove line to Poco from existing point of termination at SHECO Rich Substation, re-route line and terminate on to new dead-end structure connecting to new circuit breaker. ETI to review and provide comment for design and construction.
- Undertake work to connect line relaying for line between Rich and Poco Substations connecting to the new circuit breaker and accordingly providing line relaying for line to Lake Livingston Switchyard.
- Undertake necessary work for termination of OPGW from Lake Livingston at Rich Substation.
- Undertake modification of microwave system to transmit data from Lake Livingston to SHECO's Batiste Creek Substation.

**ETI**:

- ETI to specify revenue class CT/PTs for installation at Lake Livingston. ETI to specify, engineer, procure and supply revenue metering panel for installation at Lake Livingston. ETI to specify the revenue metering scheme on generator auxiliary transformer to be installed by the customer.
- ETI to design, procure and install communication equipment at SHECO Batiste Creek Substations enabling data from Rich Substation to be routed to Entergy's TOC and SOC.
- ETI to provide review of design and construction of t-line re-configurations performed by customer. ETI will need to complete administrative processing (retirements) of line asset removals.

### 1.3 Cost Summary

#### A. ERIS

- The estimated total project cost is $736,042 Full Financial. This cost **does not include Tax Gross Up** (24.85%) which may apply. This estimate includes indirect cost and is subject to change resulting in impact on the overall cost of project at completion. Should customer elect to sign a prepayment agreement, AFUDC will be waived.
- The ICT has assigned $0 as Base Plan upgrades and $ 736,042 as Supplemental Upgrade based on Attachment "T" of Entergy's ICT (Independent Coordinator of Transmission) filing to the FERC.

### 1.4 Schedule Summary

A milestone schedule is developed assuming approval to proceed with the development of PEP/Estimates by September 2013. See attachment for details.

### 1.5 Automatic Generation Control

- Upgrades required by Entergy for (automatic generator control) AGC service are discussed in Entergy's OASIS posting "Entergy Transmission Guidelines for Automatic Generator Control Applications". See link http://www.oatioasis.com/EES/EESDocs/INFO.htm

## 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:

- Sufficient time will be allowed in approving the project enabling Entergy to prepare a Project Execution Plan and be able to complete the project as per outlined in the schedule described provided below.
- Assumptions have been made in developing estimates without performing site visits, surveys, and soil borings. During Project Execution Plan these tasks will be completed and could have an impact on estimates and schedule. Estimates refined during Project Execution Plan Development may be higher than currently estimated due to this information not being available for consideration at the time of development of this Facilities Study.
- All permits will be attainable in a reasonable period.
- MISO and N-1 processes will make provision to meet the required in-service dates
- Due to timing and/or funding constraints, topographic surveys and soil borings were not performed in order to develop this facility study.
- System changes will be modeled in ASPEN. Relay Impact Analysis will be performed by a settings engineer during PEP stage to identify requirements for relay/CT replacement and settings revisions at the local and remote stations in the area. For example, affected elements include Z2, Z3, and ground over current settings, and so on. Some obsolete relays may need to be replaced.
- New RTU configurations or revisions will be necessary to communicate the project and protection coordination with nuclear, generation plants, load customers and other interconnected utilities as appropriate.
- Comply with PRC-001, PRC-023 and relevant procedures, standards and guidelines as appropriate.
- Facility studies are done without the advantage of having relay impact studies.

- Transmission Engineering Services shall coordinate all setting changes in the project with Generator interconnection plant as per PRC-001 (power plant protection and related control elements must be set and configured to prevent unnecessarily tripping the generator prior to any transmission protection and related control systems acting first, unless the generator is in jeopardy by exceeding its design limits due to operating conditions, generator system faults, or other adverse potentially damaging conditions.)

**Customer premise:**

- Customer will fund and SHECO will perform all work at the SHECO owned and operated Rich Substation.
- Customer will fund all work at Lake Livingston relating to revenue metering panel, auxiliary metering and transmission of generator data to Rich SS and then on to Batiste and SOC/TOC.
- Customer will comply with ETI's requirements to provide generator data before and after installation of unit(s) and install stabilizer, etc., as specified.
- The connection of the generator must adhere to the latest Generator Interconnection Customer Requirements Standard PM3901.

## 4. SCOPE OF WORK

### 4.1 L- 415 at SHECO Rich Substation

**Background**

Currently 138kV T/Line L-415 runs from Poco to Rich (SHECO) Substations for 14.99 circuit miles. The existing Line 415 Right Of Way identified is 100'.

Line 415 is a single circuit of 649.5 kcmil 18/19 ACAR or 666.6 kcmil 24/7 ACSR code name "Flamingo" conductor rated for 883 amps.

Reference drawing G0415P16.DWG (see attached).

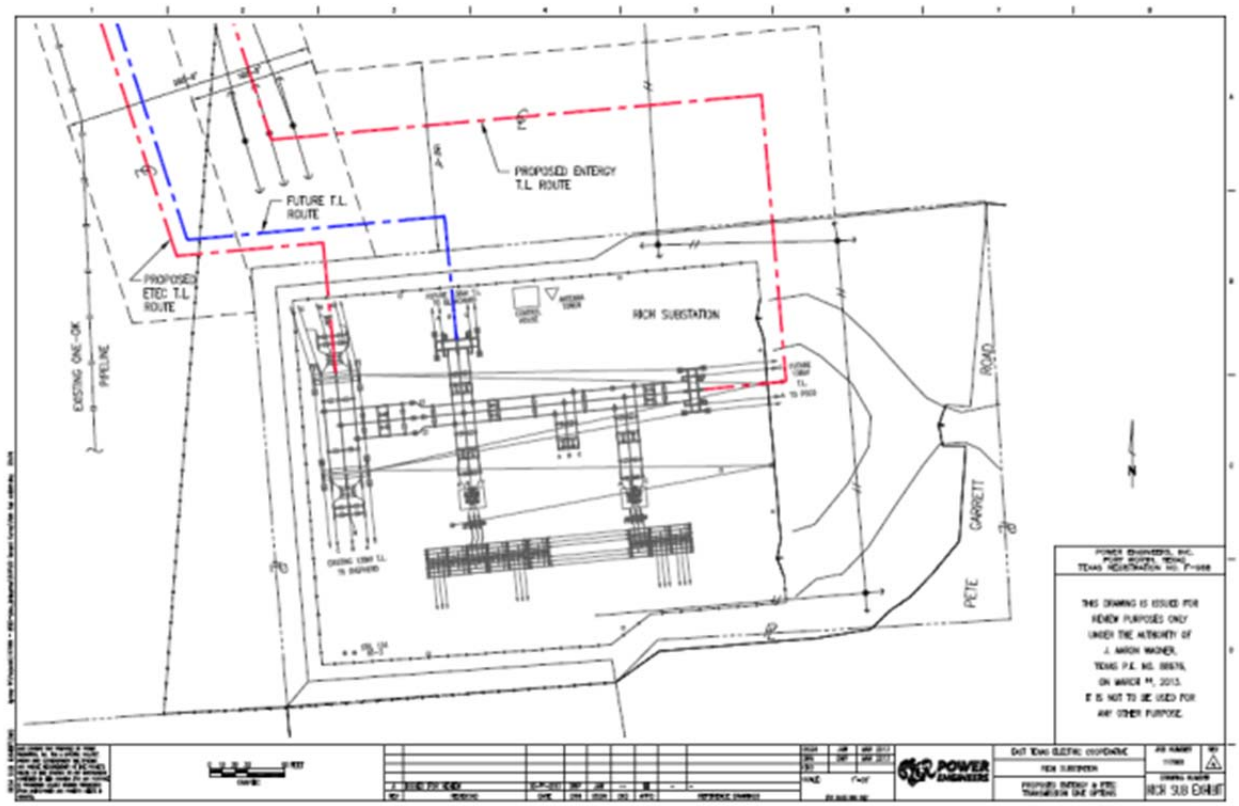
**Project Description**

PID 291 plans to expand Rich substation in Polk County, Texas. As a result, Entergy must re-route 138kV transmission line 415 for approximately 0.13 miles to accommodate the expansion.

SHECO will be performing the design and construction of transmission line re-configuration work. ETI will provide review and comment for customer's design and construction.

- Customer has proposed line route depicted below.

- Note: Oversight estimate was based on the existing Plan & Profile G0415P16 and PID 291 layout drawings.




## Removals

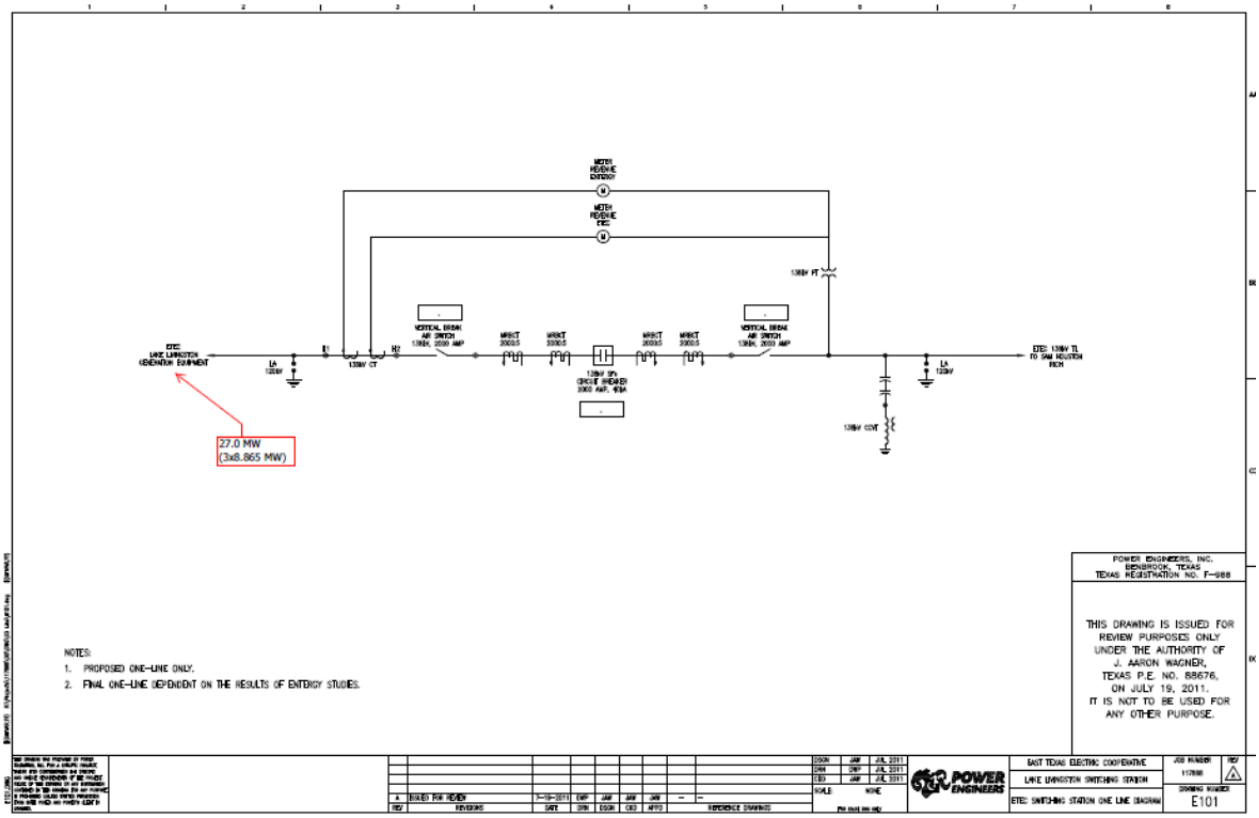
Customer will perform removals.

ETI will have to complete retirements on line assets removed.

**Outage requirements and duration**

- Customer will coordinate with ETI to get line outages for construction.

### 4.2 Lake Livingston Switchyard (by PID 291)




**Site:**

**NA**

**Foundations:**

**NA**

**Electrical:**

**NA**

**Relaying:**

- This substation will be a customer-owned substation and all work performed within the substation will be done by the customer per ETI specifications. Exceptions: ETI will supply the revenue metering panel for 138 kV and the revenue metering scheme on generator auxiliary transformer.
- Customer confirmed that space will be provided in their Control House for the meter panel.
- Customer will work closely with Entergy to determine location of the metering panel.
  - Proximity to CTs will determine the size of conductor required.
  - This will be determined during design.
- Customer to provide AC and DC power to equipment.
  - 125V DC will be required.

- It was determined that an Entergy owned RTU may not be necessary.
- Data can to be sent to TOC and SOC via non-Entergy RTU at SHECO Rich Substation.
    - SHECO should allocate 2 ports on RTU (1 for TOC and 1 for SOC)
    - For reasons unknown at this time, should it be determined in future that an Entergy owned RTU is required to be installed at Rich Substation, additional funds will be required – the present estimate does not include an Entergy RTU.

Note – This FS is scoped and estimated based on data and status from Lake Livingston transmitted to Rich SS and on to Entergy SOC/TOC via Batiste Creek. No scope or estimate of work for RTU has been included for Rich or Batiste Substations.

**Revenue Metering:**

- ETI will design, purchase, and supply indoor metering panel (with two meters) to PID 291 for installation complying with ETI standard with current and potential inputs from the CT/PT cables and hardwired for pulse data.
    - The output from the panel would be wired to transmit metering data to SOC complying with their requirements (32 bit data requirements).
- Entergy will provide specifications for customer for the following:
    - Purchase 3 Metering CTs
        - Ratio: 100/5, Rating Factor 2.0, Extended Range
        - Minimum accuracy of 0.15-B1.8
        - 2 cores/secondary winding
            - 1 core will be for Entergy Primary metering
            - 1 core will be for PID 291 metering and ETI Backup metering
    - Purchase 1 CT Junction Box
    - Purchase 3 138kV Metering PTs (with 2-secondary windings) 0.3 WXYZ, ZZ accuracy
    - Purchase 1 PT Junction Box

- <u>Auxiliary transformer metering in the Hydro plant</u> – ETI will purchase the revenue meter panel and provide specifications for customer to purchase CT/PTs and for installation in 13.8 kV switchgear for metering on the auxiliary transformer situated in the plant.
    - <u>Plant RTU routing metering data and generator breaker status and instantaneous values</u>:
      Auxiliary transformer meter output will be connected to plant RTU; its output for metering data would be routed to the RTU at Rich Substation and from there the data will be sent ETI's SOC.
      In addition, the plant RTU would also route generator breaker status, and instantaneous A, MW, MVAR readings derived from a relay to Rich Substation to transmit to ETI's SOC.
    - Auxiliary meter would be connected to a phone circuit with modem for interrogation by Entergy using MV90 system

- o In integrating the meter/metering panel, customer shall adhere to the Transmission Metering Applications Standard #M10301 latest revision.

**Long Delivery Material:**

| Description | Quantity | Delivery period |
|---|---|---|
| Revenue metering panel – 138 kV | 1 | 10-12 weeks |

**Relay Settings and RTU configuration:**

NA

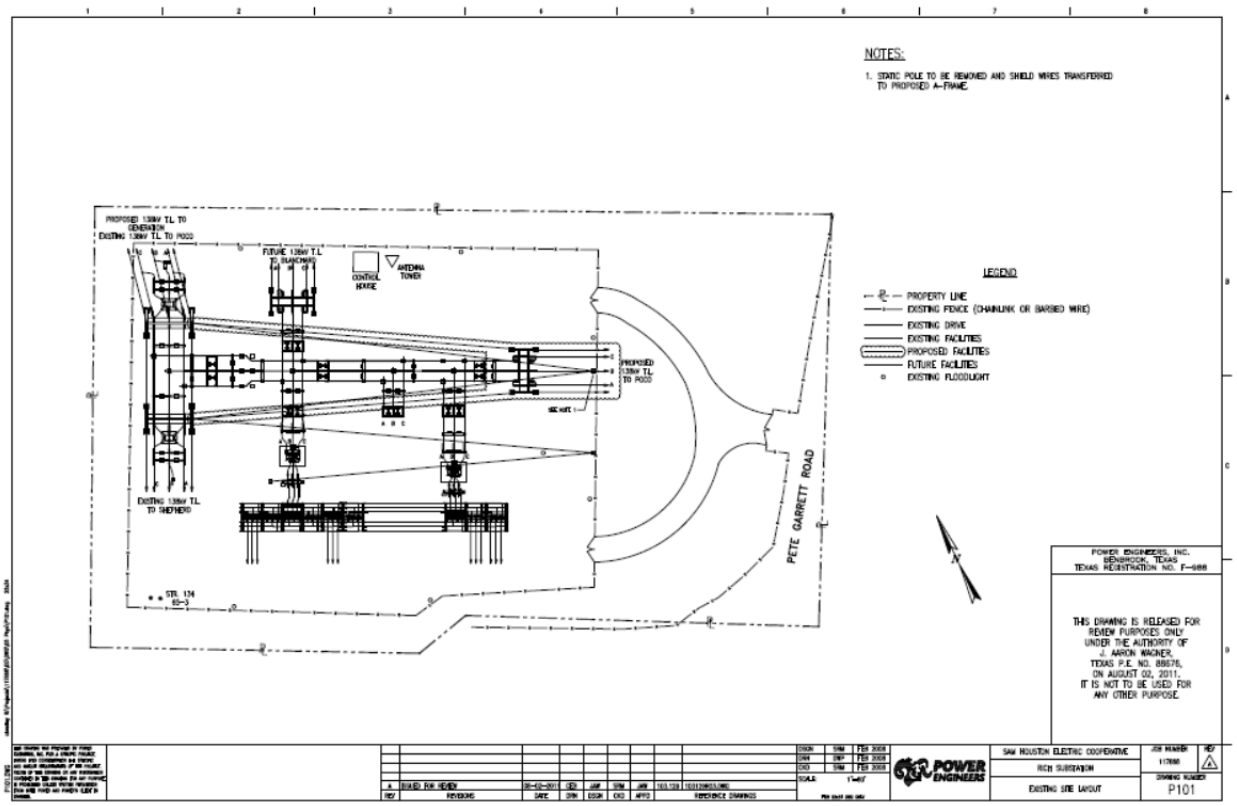
**Construction Methodology:**

- Field testing of 138 kV revenue metering panel and associated verification of data at SOC.
- Field testing of auxiliary revenue metering scheme and associated verification of data at SOC and via MV90 system.

**Outage Requirements and duration:**

NA

**4.3 SHECO Rich Substation:**




**General:**

SHECO Rich Substation is owned and operated by SHECO. All work inside Rich Substation will be engineered and constructed by SHECO. ETI will work with SHECO in determining the means of terminating Poco line on to new dead-end structure.

SHECO will coordinate relay settings working with PID 291 and ETI settings engineer on line to Poco Substation.

**Site:**

NA

**Foundations:**

NA

**Electrical:**

ETI to review termination details working with SHECO and ETI Transmission Line Design and Construction for terminating line on to new dead end structure.

SHECO to perform engineering and procure material for terminating the line.

**Long Delivery Material:**

| Description | Quantity | Delivery period |
|---|---|---|
| SHECO to procure material for line termination | | |

**Relay Design:**

- Existing line protection is suitable for protecting Poco line connected to new circuit breaker with revised CT ratios.
- It was determined that an Entergy owned RTU may not be necessary
    - Data can to be sent to TOC and SOC via non-Entergy RTU at Rich Substation .
    - SHECO should allocate 2 ports on RTU (1 for TOC and 1 for SOC).
    - If it is determined later that an Entergy owned RTU will be necessary at Rich, then additional costs could be incurred for this.

**Telecommunications:**

- Modifications to microwave system to receive data from Lake Livingston and to transmit to Batiste Creek Substation will be customer's responsibility and SHECO would make the modifications.

**Long Delivery Material:**

| ***Quantity*** | ***Material Description*** | ****Lead Time (Weeks)*** |
|---|---|---|
| | All material to be supplied by SHECO | |

**Relay Settings and RTU configuration:**

SHECO to determine if any setting changes will be required as a result of new CT ratios on the new breaker. If the setting changes are due to re-routing of line, then SHECO will communicate with ETI Settings Engineer allowing change of settings at Poco.

- Due to the addition of generation from Lake Livingston, the following should be considered in the future relay impact analysis:
    - Evaluate the change in fault current before and after the addition of Lake Livingston generation at Rich (SHECO) Substation. If the change in fault current is greater than 5%, revise all overcurrent relays at Rich Substation.
    - For a change in fault current greater than 5% at Rich Substation:
        - Evaluate the change in fault current before and after addition of Lake Livingston generation at Poco Substation. If the change in fault current is greater than 5%, revise all overcurrent relays at Poco Substation.

        - Evaluate the change in fault current before and after addition of Lake Livingston generation at Shepherd Substation. If the change in fault current is greater than 5%, revise all overcurrent relays at Shepherd Substation.
        - The above process should be followed for all remote stations out of Poco and Shepherd Substations until a change of fault current less than 5% is detected.
    - PRC-001: Coordination of relays for Poco-Rich transmission line should be evaluated and agreed upon by SHECO, ETI and Customer.
    - PRC-001: Coordination of relays for Shepherd-Rich transmission line should be evaluated and agreed upon by SHECO, ETI and Customer.
    - PRC-001: Coordination of relays for Rich-Poco transmission line should be evaluated and agreed upon by SHECO, ETI and Customer.

**Construction Methodology:**

SHECO to perform construction.

**Outage Requirements and duration:**

Entergy will arrange for outage on line to Poco Substation to reroute and termination.

**4.4 Telecommunications – SHECO's Batiste Creek (work by ETI):**

**Scope:**

The customer is installing OPGW on the line between Lake Livingston and Rich substation. There is an existing microwave path from Rich Substation to SHECO and all communications will go through this path.

PID 291 will send data (metering, generation, breaker status, etc.) to SHECO Rich Substation where it will be transported to Batiste Creek Substation via microwave path. Entergy will need a 4-wire handoff with two circuits (one for the TOC, one for the SOC).

No RTU work at this location is included in this FS and should any be needed in future, additional funds would be required.

**Material:**

A RFL channel bank needs to be installed at Batiste Creek Substation to accommodate the 2 circuits coming in from SHECO Rich Substation.

**Construction Methodology:**

Installation of the RFL channel bank at Batiste Creek Substation will be completed by ETI's Telecommunications group.

**Outage Requirements and duration:**

An outage is not required.

## 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 all applicable overheads (indirect) but do not include tax gross up. Indirect cost is subject to change resulting in impact on the overall cost and should be reviewed before the prepayment plan is approved. ETI incurs a tax liability proportional to the amount of customer contributions.

Based on available time to complete the Facilities Study and in light of a lack of survey, soil borings, environmental permitting, potential property owner issues, etc., a good faith estimate has been provided. Many assumptions had to be made which could affect the overall accuracy of this estimate.

**ERIS**

| | 2013 | 2014 | Total |
|---|---|---|---|
| 4.1 L-415 at SHECO Rich Substation | $ 25,402 | $ 84,444 | $ 109,846 |
| 4.2 Lake Livingston Switchyard | $ 39,607 | $ 223,080 | $ 262,687 |
| 4.3 SHECO Rich Substation: | $ 43,839 | $ 187,845 | $ 231,684 |
| 4.4 Telecom – Batiste Creek Substation | $ 18,412 | $ 113,413 | $ 131,824 |
| Total | **$ 127,260** | **$ 608,782** | **$ 736,042** |

## 6. UPGRADE CLASSIFICATION

The ICT has reviewed and determined whether each required upgrade will be considered a Supplemental Upgrade. For more information on cost responsibility for Base Plan and Supplemental Upgrades, see Attachment T to Entergy's OATT.

| Task | Total Cost | Base Plan | Supplemental | Reference |
|---|---|---|---|---|
| 4.1 L-415 at SHECO Rich Substation | $ 109,846 | | $ 109,846 | 4.1 |
| 4.2 Lake Livingston Switchyard | $ 262,687 | | $ 262,687 | 4.2 |
| 4.3 SHECO Rich Substation | $ 231,684 | | $ 231,684 | 4.3 |
| 4.4 Telecom – Batiste Creek Substation | $ 131,824 | | $ 131,824 | 4.4 |
| Total | **$ 736,042** | | **$ 736,042** | |

## 7. SCHEDULE

A detailed schedule will be prepared subsequent to customer approval to proceed with the project. Based on the task duration schedules listed below, should the approval to proceed be given by September 2013, work could be completed by October 2014.

## 8. INTERCONNECTION STANDARDS

The interconnection standards are detailed at the link shown below.

http://entergy.com/energydelivery/facility_requirements.aspx

## 9. RISK ASSESSMENT

The following risks may be considered by PID 291, SHECO and ETI in undertaking the projects.

| Risk | Comment | Impact |
|---|---|---|
| Material costs steel & Equipment | Rising steel, copper, fuel and other market conditions could greatly affect estimated cost. | **** |
| Storm-water plan implementation | Best guess on SWPPP creation, implementation and monitoring can vary greatly dependent upon outcome of environmental study. | ** |
| Weather & Equipment Lead Times | Unexpected delays on material lead times, unusually inclement weather will impact schedule but might impact AFUDC costs as well. | ** |
| Outages may not be available | Preliminary schedule only considers general outage constraints. Specific project schedule may be delayed by days, weeks or months dependent upon system conditions. Delays of months = increased project costs. | ** |
| Scope based on design assumptions which may change | Varied impact on cost and schedule. | *** |

*-low impact to cost, ** - moderate impact to cost, ***- high impact to cost, **** - very high

## 10. ATTACHMENTS

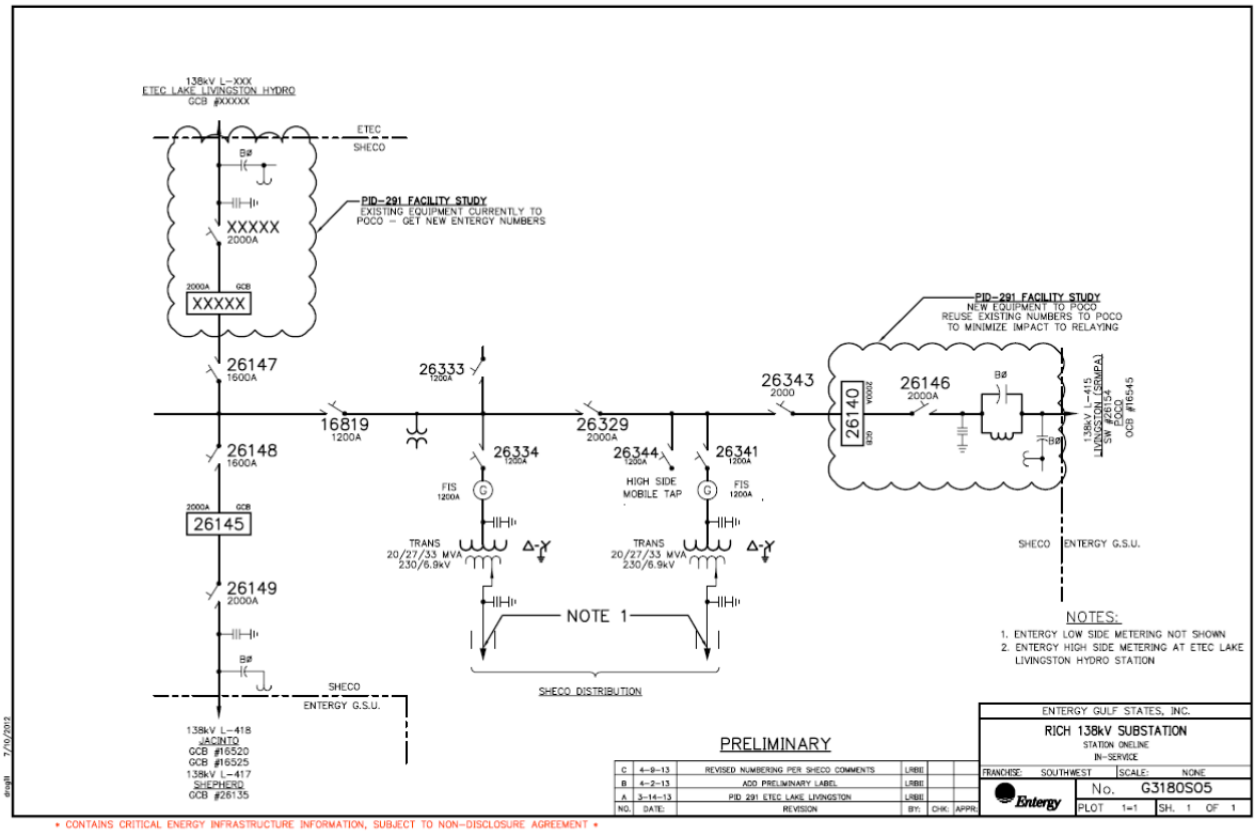
Schedule

| Summary: | Completed by end of |
|---|---|
| Submit Facilities Study | May-13 |
| Receive approval to proceed with project from customer | Sep-13 |
| Create FP/WO. Begin PEP development. | Oct-13 |
| Complete PEP/estimates and submit to customer for approval to proceed with project. Submit PEP for MISO requirements. | Jan-14 |
| Secure revised FP. Begin design and oversight of customer's design. | Feb-14 |
| Order material including meter, metering panel and telecom equipment for Batiste Creek. | Mar-14 |
| Issue design packages for Construction. | Jun-14 |
| Deliver metering panel and aux meter to customer for installation, and perform testing at Lake Livingston and relaying/control, etc at Rich SS. | Jul-14 |
| Complete work at Batiste Creek, configuration at SOC and TOC and enable customer to energize lines from Rich SS to Poco SS and Lake Livingston Switchyard. | Aug-14 |
| Complete revenue meter panel testing at Lake Livingston, verify data at SOC. | Sep-14 |
| Complete remaining work at Lake Livingston, Batiste Creek and SOC. | Oct-14 |

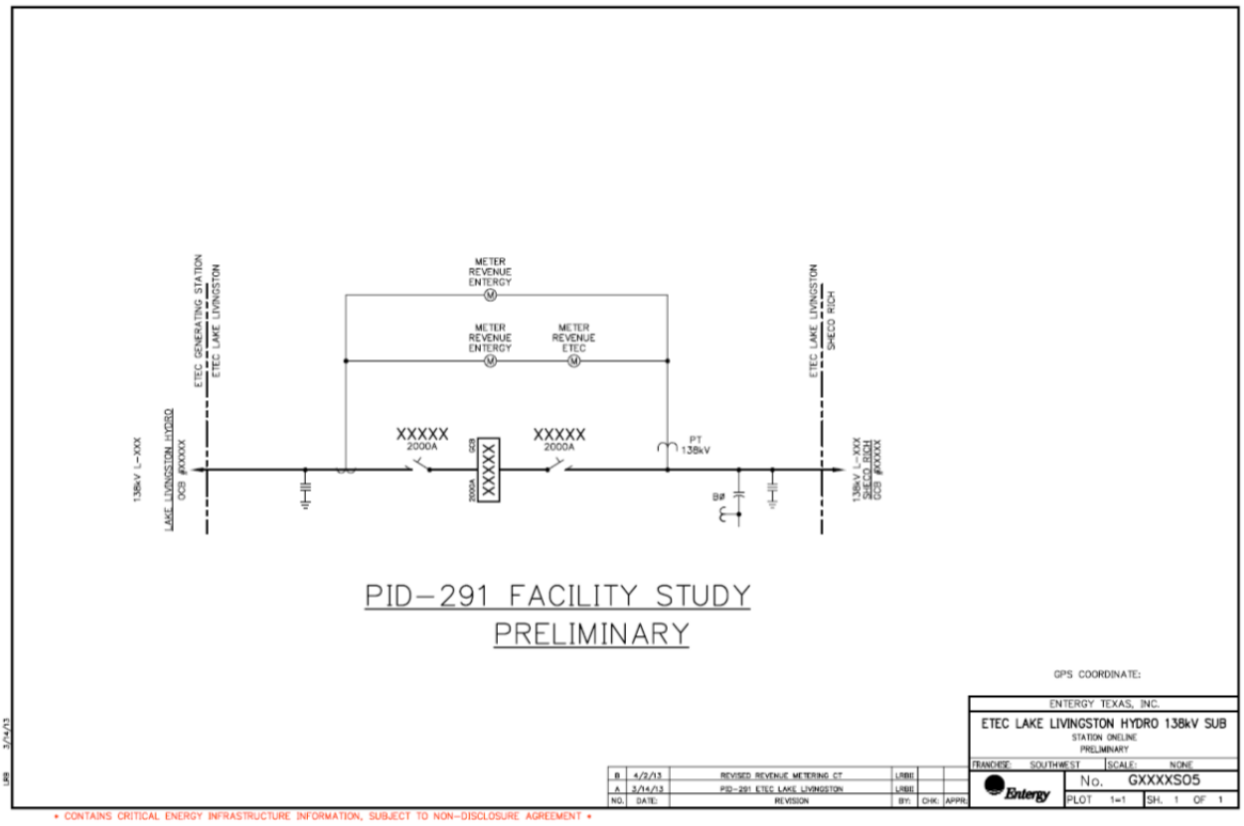
Note – the above schedule assumes that customer will have facilities constructed at Lake Livingston, Rich Substation and Batiste Creek enabling Entergy to complete their work by the dates identified above. This includes review, approval of drawings, specifications, etc.

## One Line Diagrams and Drawings

SHECO Rich Substation



Lake Livingston Switchyard



T-line Re-configuration - G0415P16