# Facilities Cost Report

Generation Interconnection

## GWF Power Systems

## Henrietta Peaking Plant Project

Final

**Revision 1**
**Includes Results from Supplemental SIS**

**August 7, 2001**

# Executive Summary

GWF Power Systems is evaluating the feasibility of a 95.8 MW[1] generating facility in Lemoore, California. The proposed generation project will be called the Henrietta Peaking Plant Project. PG&E had previously performed a Generation Transmission Interconnection Study (GTIS) for this Project based upon an interconnection date in Summer 2001. The GTIS is a preliminary study that determines the project's impact on PG&E's grid in a limited number of outages. GWF Power Systems has requested that PG&E conduct a Facilities Cost Report (FCR) for this project with a revised on-line operation date of the proposed project is Summer 2002.

The FCR is will determine:

1) The facilities necessary to interconnect the generating facility to the grid.

2) The transmission system impacts caused solely by the addition of the Henrietta Peaking Plant Project.

3) The system reinforcements, if any, necessary to mitigate the impact of the proposed project under all system conditions.

To determine the system impacts caused by Henrietta Peaking Plant Project, studies were performed using the 2002 Summer and 2003 Spring Full Loop Base Cases. The studies performed included:

- Steady State Power Flow.
- Dynamic Stability Analysis.
- System Protection.

The results of these studies were used in the transmission line and substation evaluations.

PG&E's evaluation has concluded that the addition of Henrietta Peaking Plant Project will cause no normal or emergency transmission line overloads. During summer peak hours, there are no facilities with Category B or Category C overloads. However, under the T-1 outage of the 230/70 kV Henrietta Bank, the Henrietta Peaking Plant Project would be islanded from the system with the 70 kV load at Henrietta. A Special Protection Scheme would be needed to ensure that the Henrietta Peaking Plant Project would be tripped when it is islanded from the rest of the grid.

[1] This is the nominal rating of the generating facility.

The addition of Henrietta Peaking Plant Project will not affect the transmission grid stability and will not cause any added overstress due to increased short circuit duties.

The facilities costs for interconnecting Henrietta Peaking Plant Project to PG&E's grid will are estimated to be $1,804,980[2].

This revision 1 of the FCR includes the results of a Supplemental System Impact Study performed evaluate the impact of the Henrietta Peaking Plant Project during Summer Off-Peak conditions. The results of the Summer Off-Peak study indicated that this project would have no additional impacts requiring mitigation.

[2] These costs are not final and will need to be reconciled with actual costs upon the signing of the interconnection agreements

## Table of Contents

## Appendices

# 1. Project Information

Based upon information provided by GWF Power Systems, the proposed Henrietta Peaking Plant Project will be located Lemoore, California. Figure 1 shows the area in which the project will be constructed.

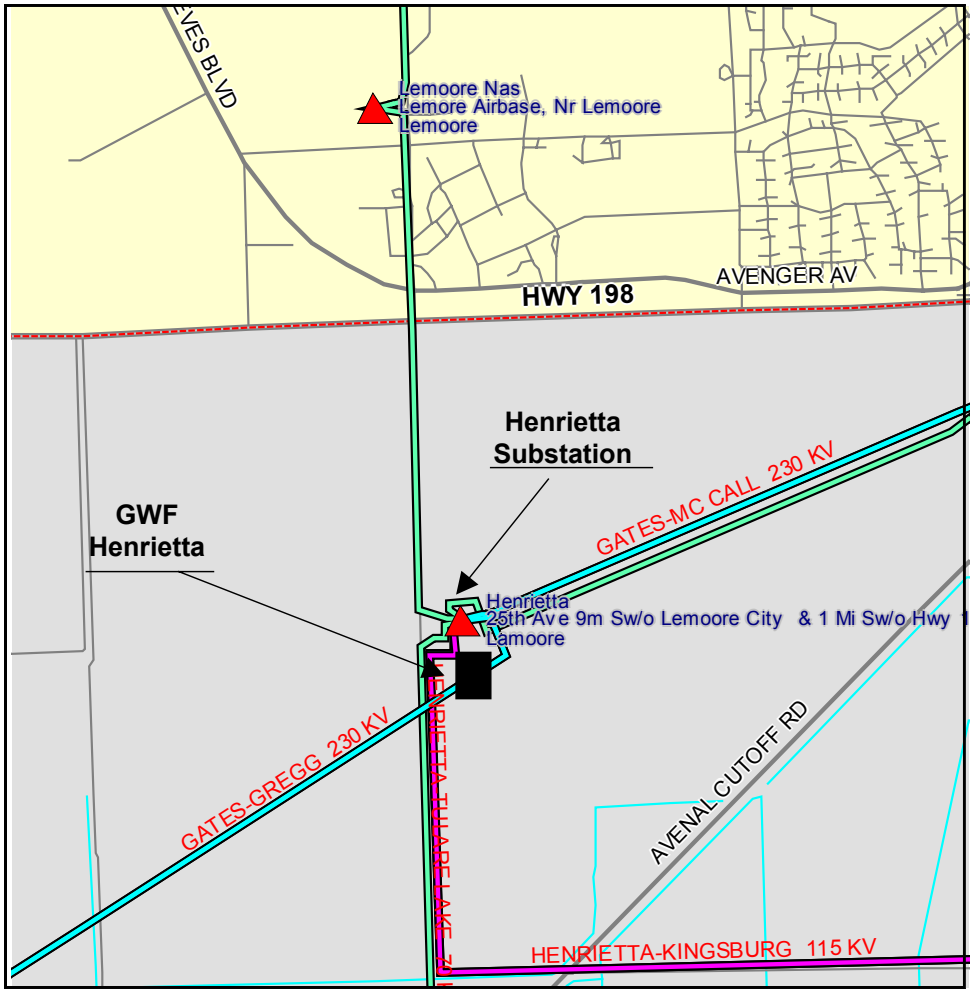


Figure 1: GWF Power Systems Henrietta Peaking General Vicinity

The Project will have a maximum output of 95.8 MW to PG&E's grid. The project will consist of two (2) combustion/turbine generators (CTG) rated 71.2 MVA (nominal) each. The power factor range of these units is 85% (lag) to 95% (lead). Each CTG will have its own 13.8/70 kV step-up transformer.

The Henrietta Peaking Plant will be connected to PG&E's system via an express line connecting directly to PG&E's Henrietta Substation 70 kV bus. The express line is assumed to be approximately 1000 feet. PG&E will own, operate and maintain the express line.

A single-line diagram for the Henrietta Peaking Plant Project is shown in Figure 2.

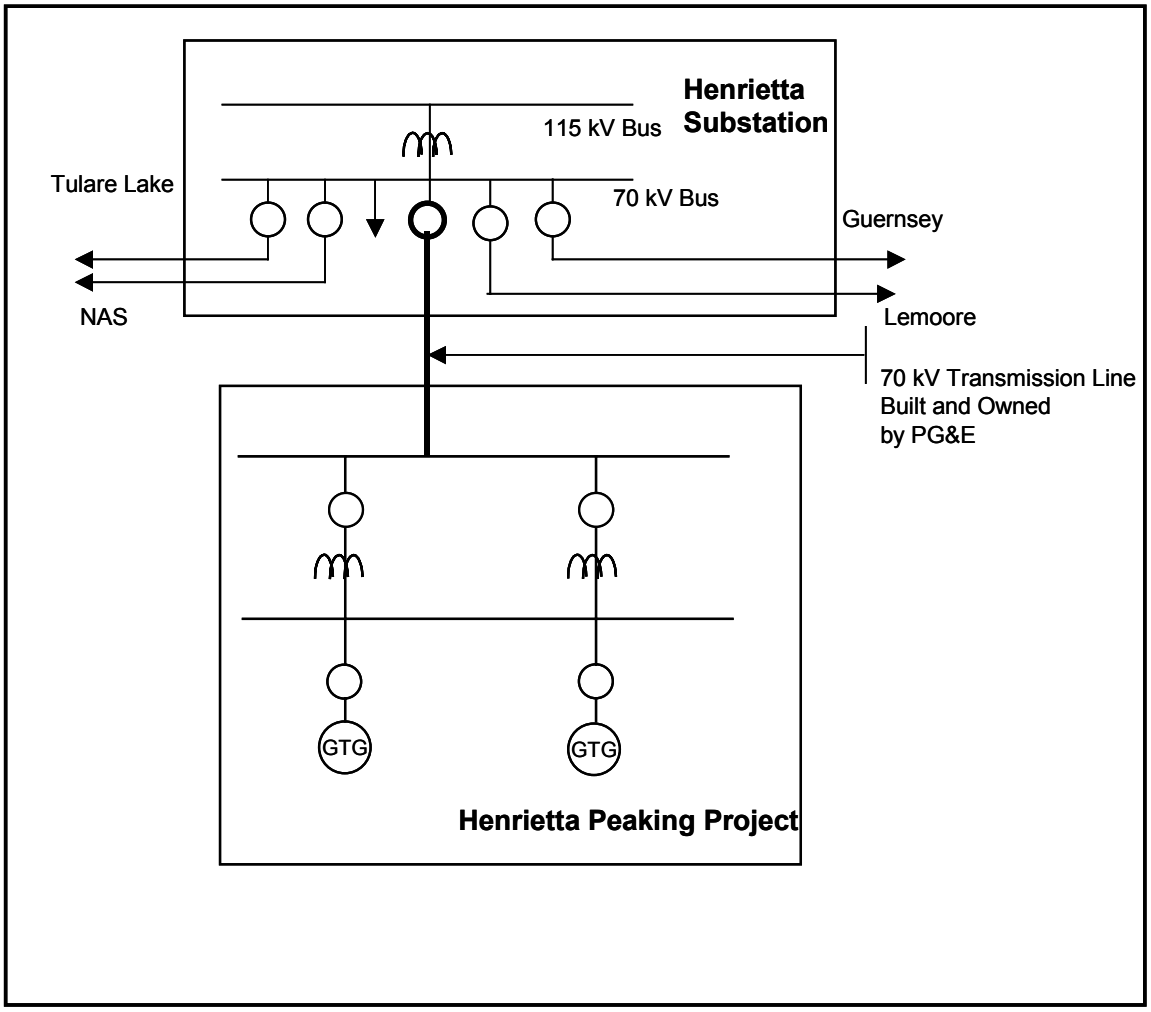


Figure 2: Single Line Diagram – Henrietta Peaking Plant Project Generation Project

# 2. Study Summary

## 2.1 Steady State Power Flow Study

Steady state power flow studies were conducted using 2002 Summer Full Loop and 2003 Spring Full Loop base cases. A supplemental study was performed using a 2002 Summer Off-Peak Full Loop Base Case. The following is a summary of the results.

### 2.1.1 Normal Overloads (NERC Category A – No Contingencies)

During the summer peak, summer off peak, and spring hours, no facilities are loaded above 100% of their normal ratings as a

result of the addition of Henrietta Peaking Plant Project's 95.8 MW of generation.

#### 2.1.2 Emergency Overloads (CAISO Category B)

During the summer peak, summer off-peak, and spring hours, no facilities are overloaded above their emergency ratings due to Category B contingencies as a result of the addition of Henrietta Peaking Plant Project's 95.8 MW of generation.

#### 2.1.3 Emergency Overloads (CAISO Category C)

During the summer peak, summer off-peak, and spring hours, no facilities are overloaded above their emergency ratings due to Category C contingencies as a result of the addition of Henrietta Peaking Plant Project's 95.8 MW of generation.

### 2.2 Dynamic Stability Study

Dynamic stability studies were conducted to determine whether the Henrietta Peaking Plant Project would create instability following certain outages. Section 7 outlines the outage scenarios assumed for this analysis and provides a complete analysis of the results.

Dynamic Stability Study results indicated that the Henrietta Peaking Plant Project would have no adverse impact on the stable operation of the transmission system following the selected disturbances.

### 2.3 System Protection Study

Short circuit studies were conducted to determine whether the Henrietta Peaking Plant Project would result in overstressing of the existing substation facilities. Section 8 describes the results of the system protection study in detail.

### 2.4 Substation Evaluation

The substation evaluation identified no existing equipment requiring upgrades to mitigate problems caused by overstress or overloading.

### 2.5 Transmission Line Evaluation

The Transmission Line Evaluation was conducted in conjunction with the Steady State Power Flow Study. Henrietta Peaking Plant Project causes no transmission line overloads during Category A (normal), B or C contingencies.

# 3. Cost Estimate Summary

The following table provides a summary of the facilities cost estimates[3] for interconnecting the Project with PG&E's transmission system. Appendix G includes the scope of the required work. Please note that these costs are not final and will need to be reconciled with actual costs upon GWF Power System's signing of the interconnection agreements.

## 3.1 Interconnection Cost Summary

| | | |
|---|---|---|
| **Substation Work** | | |
| *Station Equipment, Engineering, Project Management* | *$ 954,000* | |
| **Substation Subtotal** | | $ 954,000 |
| **Telecommunications Work** | | |
| *Telecommunications Work* | *$109,000* | |
| **Land Work Subtotal** | | $ 109,000 |
| **Land Work** | | |
| *Land and Land Rights Evaluation* [4] | *$ 18,000* | |
| **Land Work Subtotal** | | $ 18,000 |
| **Transmission Line Work** | | |
| *Engineering, Maintenance. Construction, and Operations*[5] | *$ 233,000* | |
| *Install Fiber Optic Cable* | *$ 30,000* | |
| **Transmission Line Work Subtotal** | | $ 266,000 |
| **Subtotal Interconnection Cost** | | **$ 1,347,000** |
| **ITCC Tax**[6] @ 34 % | | **$ 457,980** |
| ***Total*** | | ***$ 1,804,980*** |

[3] The PG&E interconnection engineering cost estimates are developed with a theoretical confidence level of 25 percent. Billing will be based on an actual cost basis.

[4] Land costs include surveying, mapping, document preparation, title searching, engineering support, staking of structures, easement grant to GWF and 131d compliance. Permitting and CEQA compliance will be the responsibility of GWF, including any mitigation for endangered species. Land cost estimates were developed with a 30 percent confidence level.

[5] Transmission Line cost estimates were developed with a 50 percent confidence level.

[6] Both the Federal Government and the State of California consider funds and property received by the Utility in order to provide utility service as income. From IRS Notice 87-82, Section III on Fair Market Value of Income Tax Component of Contribution (ITCC), "[a] Utility shall include as income the amount of any cash received as a CIAC (Contribution in aid of construction) and the fair marketing value of all property received as a CIAC." ITCC charge is collected from a customer to keep PG&E's ratepayers from being negatively impacted by the customer's service. The ITCC tax charge represents the current tax rates that PG&E must pay on its revenue to the Federal Government and the State of California. PG&E's current tax rate for electric revenue is 34%.

## 4. Interconnection Study Assumptions

PG&E conducted the FCR under the following assumptions:

1) The maximum net delivery from the proposed project to the PG&E transmission grid will be 95.8 MW modeled at 0.85 lagging power factor.

2) The project will be on line at the above capacity by Summer 2002.

3) The new generating facility will be connected to PG&E's grid via an express line to the Henrietta Substation 70 kV bus. GWF Power Systems will design, build, own, and maintain its generation facility and step-up substation.

4) GWF Hanford 96 MW generation project will be connected to the Henrietta – Kingsburg 115 kV circuit.

5) The study will take into account all the approved PG&E reliability projects that will be operational by Summer 2002.

6) The Summer-Off Peak Base Case will model the following generation projects in Fresno/Yosemite areas to reflect the proper generator queuing position of this project:

   - Dinuba Energy Generation Facility
   - Fresno Peaker Project
   - Chowchilla #2 Project
   - Madera Power Project
   - GWF Hanford Project
   - Cal Peak's Panoche Peaker Project
   - Wellhead's Los Banos Peaker Project
   - Wellhead's Panoche Peaker Project
   - Wellhead's Gates Peaker Project
   - Wellhead's Panoche Peaker #2 Project

# 5. Base Case Assumptions Used for Power Flow Study

Power flow analyses were performed using PG&E's 2002 Summer Full Loop and 2003 Spring Full Loop Base Cases (in General Electric Powerflow format). These base cases were developed from PG&E's 2001 base case series. A supplemental study was performed using a 2002 Summer Off-Peak base case developed by CAISO.

## 5.1 Study Criteria Summary

The CAISO Controlled Grid Reliability Criteria, which incorporate the Western Systems Coordinating Council (WSCC) and the North American Electric Reliability Council (NERC) planning criteria, were used to evaluate the impact of the project on the PG&E transmission system. Table 1 provides a summary of the CAISO Controlled Grid Reliability Criteria.

| | Loading [7] | Transient Voltage Dip & Frequency |
|---|---|---|
| All Lines in Service Category "A" | ≤ Normal Ratings | ---- |
| ISO Category "B" Contingency[8] | ≤ Emergency Ratings | ≤ 25% at load buses,<br>≤ 30% at non-load buses,<br>> 20% voltage, ≤ 20 cycles at load buses,<br>> 59.6 Hz<br>< 59.6 Hz for 6 cycles |
| ISO Category "C" Contingency[9] | ≤ Emergency Ratings | ≤ 30% at any bus<br>> 20% voltage, ≤ 40 cycles,<br>> 59 Hz<br>< 59 Hz for 6 cycles |

Table 1: CAISO Controlled Grid Reliability Criteria

## 5.2 Steady State Study Criteria – Normal Overloads

Normal overloads are those that exceed 100 percent of normal ratings. The CAISO Controlled Grid Reliability Criteria requires the loading of all transmission system facilities to be within their normal summer ratings.

## 5.3 Steady State Study Criteria – Emergency Overloads

Emergency overloads are those that exceed 100 percent of emergency ratings. The emergency overloads refer to overloads that occur during single element contingencies (CAISO Category "B") and multiple element contingencies (CAISO Category "C").

[7] The ratings are listed in the CAISO Transmission Register.
[8] CAISO Category "B" contingency refers to all single component outages such as the loss of a transmission line (L-1), a generator (G-1), a transformer (T-1). Also, it refers to the loss of the combination of a single transmission line and a single generator unit.
[9] CAISO Category "C" contingency refers to outages resulted from the loss of two or more (multiple) components except the loss of the combination of a single transmission line and a single generator unit.

### 5.4 Dynamic Stability Study Criteria

According to the WSCC Disturbance-Performance Table of Allowable Effects on Other Systems10, after a Category "B" disturbance, the transmission system performance should meet the following criteria:

- Transient voltage dip should not be below 25 percent at load buses or 30 percent at non-load buses at any time.
- The duration of the transient voltage dip greater than 20 percent should not exceed 20 cycles at load buses.
- The minimum transient frequency should not fall below 59.6 Hz for more than 6 cycles at load buses.

After a Category "C" disturbance, the transmission system performance should meet the following criteria:

- Transient voltage dip should not be below 30 percent at any bus at any time.
- The duration of a transient voltage dip greater than 20 percent should not exceed 40 cycles at load buses.
- The minimum transient frequency should not fall below 59.0 Hz for more than 6 cycles at load buses.

## 6. Steady State Power Flow Study

The 2002 Summer Peak Full Loop and 2003 Spring Full Loop Base Cases were used to simulate the impact of the new facility during normal operating conditions, as well as, selected single (ISO Categories "B") outages. The study will cover the transmission facilities within PG&E's Yosemite, Fresno, and Kern planning area.

The 2002 Summer Off-Peak Full Loop Base Case was used to simulate the impact of the new facility during normal operating conditions and all single (CAISO Categories "B") outages in the PG&E's Fresno and Yosemite planning areas.

### 6.1 Results

Appendix D includes selected power flow plots for summer peak and spring operating conditions.

[10] Cited from Draft Western System Coordinating Council (WSCC) Planning Standards published in December 2, 1999.

### 6.1.1 2002 Summer Peak Steady State Power Flow Results

Power flow studies were conducted with and without the Henrietta Peaking Plant Project connected to the PG&E's grid under 2002 Summer Full Loop operating conditions. The results showed no normal overloads due to the addition of the Henrietta Peaking Plant Project under normal system conditions (Category A).

For CAISO Category B outage conditions no transmission facilities were overloaded above their emergency ratings. However, during the T-1 outage of the 230/70 kV Henrietta Bank the Henrietta Peaking Plant Project would be islanded.

For CAISO Category C outages, no transmission facilities are overloaded above their emergency ratings.

### 6.1.2 2003 Spring Steady State Power Flow Results

Power flow studies were conducted with and without the Henrietta Peaking Plant Project connected to PG&E's grid under 2003 Spring operating conditions. The results showed no normal or emergency overloads due to the addition of the Henrietta Peaking Plant Project under normal system conditions (Category A) or under CAISO Category B, and CAISO Category C outage conditions.

During the T-1 outage of the 230/70 kV Henrietta Bank the Henrietta Peaking Plant Project would be islanded.

### 6.1.3 2003 Summer Off Peak Steady State Power Flow Results

Power flow studies were conducted with and without the Henrietta Peaking Plant Project connected to PG&E's grid under 2002 Summer Off Peak operating conditions. The results showed no normal or emergency overloads due to the addition of the Henrietta Peaking Plant Project under normal system conditions (Category A) or under CAISO Category B outage conditions.

During the T-1 outage of the 230/70 kV Henrietta Bank the Henrietta Peaking Plant Project would be islanded.

## 7. Dynamic Stability Study

Dynamic stability studies were conducted using the base cases described in Section 5 and the generator models shown in Appendix E to determine whether the transmission system would attain operating equilibrium following selected outages.

## 7.1 Results

The results indicated that the transmission system performed within the CAISO reliability guidelines following the disturbances outlined below. It was determined that the Henrietta Peaking Plant Project would have no adverse impact on the stable operation of the transmission system.

The results of the study are provided in the form of plots in Appendix F. A switch-deck script describing the switching sequence precedes each group of plots.

## 7.2 Dynamic Stability Study Scenarios

The following outage scenarios were simulated for a study period of up to 20 seconds:

### 7.2.1 NERC/CAISO Category "B" Contingencies:

**a)** Full load rejection of the proposed 95.8 MW facility.

A three-phase fault with normal clearing time at:

**b)** The GWF Henrietta Peaking Plant 70 kV bus followed by the loss of the Guernsey – Henrietta 70 kV Circuit.

**c)** The GWF Henrietta Peaking Plant 70 kV bus followed by the loss of the Henrietta – Lemoore 70 kV Circuit.

**d)** The GWF Henrietta Peaking Plant 70 kV bus followed by the loss of the Henrietta 230/70 kV Transformer Bank #2.

### 7.2.2 NERC/CAISO Category "C" Contingencies:

A three-phase fault with normal clearing time at:

**e)** The Henrietta Substation 70 kV bus.

## 7.3 Parameters Monitored to Evaluate System Stability Performance

### 7.3.1 Rotor Angle

The rotor angle plots shown in Appendix F provide a measure for determining how the proposed generation units would swing with respect to one another. The plots also provide a measure of how the units would swing with respect to other generation units in the area.

### 7.3.2 Bus Voltage

The bus voltage plots, in conjunction with the relative rotor angle plots, also shown in Appendix F, provide a means of detecting out-of-step conditions. The bus voltage plots are useful in assessing the magnitude and the duration of post disturbance voltage dips and peak-to-peak voltage oscillations. The bus voltage plots also give an indication of system damping and the level to which voltages are expected to recover in steady state conditions.

### 7.3.3 Bus Frequency

The bus frequency plots provide information on the magnitude and the duration of post fault frequency swings with the project in service. These plots indicate the extent of possible over-frequency or under-frequency, which can occur because of the imbalance between the generation and load within an area.

### 7.3.4 Other Parameters

- Generator Terminal Power
- Generator Terminal Voltage
- Generator Rotor Speed
- Generator Field Voltage
- Bus Angle
- Line Flow
- Voltage Spread
- Frequency Spread

## 8. System Protection Study

Short circuit studies were performed for the Generation Transmission Interconnection Study. They are repeated here.

### 8.1 Fault Duties

Short circuit studies were performed to determine the impact of adding the Project to PG&E's transmission system. The fault duties were calculated before and after the addition of the Project. Included are

duties with the GWF Hanford 130 MW cogen on the Henrietta - Kingsburg 115kV that is being built this year.

Table 3 summarizes the results of the short circuit study. Only the Henrietta 70, 115, and 230 kV buses and all other buses showing an increase of greater than 10% are included in the table.

| | | Existing System | | GWF 70kV Peaker and GWF 115kV 130MW | | | |
|---|---|---|---|---|---|---|---|
| Substation | kV | 3 phase | slg | 3 phase | increase | slg | increase |
| Contadina | 115 | 6,377 | 4,029 | 8,841 | 39% | 8,787 | 118% |
| Guardian | 115 | 11,666 | 8,324 | 12,052 | 3% | 11,701 | 41% |
| Henrietta | 70 | 6,371 | 7,506 | 10,494 | 65% | 12,692 | 69% |
| Henrietta | 115 | 7,530 | 7,912 | 8,367 | 11% | 8,752 | 11% |
| Henrietta | 230 | 11,584 | 8,896 | 12,537 | 8% | 9,776 | 10% |
| Lemoore | 70 | 3,413 | 3,584 | 4,230 | 24% | 4,154 | 16% |
| Lemoore NAS | 70 | 5,188 | 5,190 | 7,560 | 46% | 7,140 | 38% |
| Leprino | 70 | 3,354 | 3,383 | 4,137 | 23% | 3,883 | 15% |

Table 3: Short Circuit Fault Duty Results

All circuit breakers at Henrietta have a minimum interrupting rating of 20,000 Amps. The other stations are not owned by PG&E. If the Henrietta Peaking Project were to cause overstressed equipment at the non-PG&E substations, GWF would be responsible for the replacement of this equipment.

## 9. Transmission Line Evaluation

Cost estimates for the transmission line facilities necessary to interconnect the Henrietta Peaking Plant Project to PG&E's Grid are provided in Section 3. These costs include rearranging the existing facilities to allow installation of the tie line into the new bus extension and construction of the new line. This estimate includes the installation of one engineered structure to hold the existing 70 kV lines just outside of the substation and installation of the fiber optic cable.

## 10. Substation Evaluation

As shown by the System Protection Study, the addition of Henrietta Peaking Plant Project would not create a sufficient increase in the short circuit fault duties to overstress existing breakers at PG&E owned facilities. However, relaying changes would be necessary.

Appendix G provides a preliminary outline of the substation work that would be required to add Henrietta Peaking Plant Project to the transmission grid.

# 11. Land Evaluation

The Land Evaluation Costs provided in the Summary in Section 3 include surveying, mapping, document preparation, title searching, engineering support, staking of structures, and easement grant to GWF and General Order 131-D compliance. Permitting and CEQA compliance will be the responsibility of GWF, including any mitigation for endangered species.

The California Public Utilities Commission (CPUC) has jurisdiction over the construction and operation of electric transmission facilities by Pacific Gas and Electric Company. The CPUC's General Order 131-D provides for the construction of needed electric transmission lines or substations to interconnect electric generation plants. In cases where the utility owned electric transmission line or substation is part of a larger project that that has undergone environmental review by a local agency, General Order 131-D exempts PG&E Company from obtaining a Permit to Construct (PTC) from the CPUC. In order to be exempted from the PTC, the final California Environmental Quality Act (CEQA) document issued by the local agency must find no significant unavoidable environmental impacts caused by PG&E's facility. Obtaining a PTC can take as much as 18 months because the CPUC is the lead agency under CEQA and may require an environmental impact report (EIR).

PG&E Company recommends that the generator include PG&E Co.'s work to interconnect the generator to the grid in its CEQA application to the local agency. The local agency must consider the environmental impacts of the PG&E Co. electric facility, whether built by the developer or PG&E Co., and make a finding of no significant unavoidable environmental impacts. Once an authorizing document is issued by the local agency with this finding, PG&E Co. can then file an advice letter with the CPUC and claim an exemption from a Permit to Construct because the facilities have undergone environmental review. With the advice letter filing, PG&E Co. must advertise a notice of construction and invite the public to review the authorizing document and describe how to file a protest against PG&E Company's part of the project. The process can be as short as 50 days, (includes preparation of the notice) or as long as 90 days if a protest is filed and the CPUC determines whether or not a PTC is required.

Please see Section III, B.1. (f) in General Order 131-D. This document can be found in the CPUC's web page at:
http://www.cpuc.ca.gov/published/index_pages/general_orders_index.htm