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## FIGURES



## APPENDICES

# 4.0 TRANSMISSION FACILITIES

This section describes the transmission facilities proposed to interconnect the Willow Pass Generating Station (WPGS) with the Pacific Gas and Electric Company (PG&E) transmission switchyard located within the Pittsburg Power Plant (PPP) site and adjacent to the WPGS project site. One single-circuit 230-kV transmission line will be required to deliver the project electrical output to the PG&E transmission grid. The 230-kV single circuit will be designed and constructed in accordance with General Order (GO) 95, "Rules for Overhead Line Construction," and other applicable state and local codes.

## 4.1 INTERCONNECTION TO TRANSMISSION GRID

The 230-kV single circuit connection for the project will be a direct intertie between the WPGS and PG&E's 230-kV switchyard, adjacent to the WPGS site (see Figure 2.5-1). A conceptual diagram showing the proposed interconnection is presented on Figure 4-1. The transmission line interconnection will be approximately 1,600 feet in length. The line will be located along the south side of the units on the WPGS site, cross the PPP site, and then connect directly into the PG&E switchyard.

It is anticipated that the new generating units will be connected to an existing sulfur hexafluoride ($SF_6$) breaker that was originally assigned to PPP Unit 4. Unit 4 is no longer operational and therefore will not have to be reconnected to the grid.

Mirant filed an application for interconnection of the project with the California Independent System Operator (CAISO) on March 14, 2008 (see Appendix H).

## 4.2 TRANSMISSION LINE CONFIGURATION

### 4.2.1 Structures

The new 230-kV circuit line from the project switchyard to the PG&E's switchyard will use six steel pole structures. These will be constructed of weathered or galvanized steel. The structures will be bolted or slip-fit or lattice design. The structures will be 85 to 150 feet tall, with phase conductors that may be arranged horizontally, vertically, or in a delta configuration, depending on the requirements for particular structures. The configuration type is shown on Figure 4-2. Two shield wires will be used as necessary, depending on the type of structure. The specified maximum mid-span line sag will be calculated at an ambient temperature of 130 degrees Fahrenheit under maximum load conditions. One of these structures will be a new 150-foot transmission tower located within the PG&E switchyard (see Figure 4-2). The five remaining structures will consist of double circuit poles within the WPGS site.

### 4.2.2 Conductors

The 230-kV circuit will use a bundle of two per phase 1,590 thousand circular mil, aluminum conductor steel reinforced "Lapwing" conductors with a nominal ampacity rating of 2,760 amps (25 degrees Celsius [°C] ambient, 75°C conductor temperature, and 1.4 miles per hour wind speed).

### 4.2.3 Foundations

All structures will have cast-in-place concrete foundations designed to support the imposed loads. The diameter and the depth of each foundation will be determined during detailed design and will be based on soil conditions and actual tower loads.

### 4.2.4 Ground Wires

Two ground wires will be installed on the 230-kV structures. A 0.5-inch extra high strength steel ground wire will be used, unless one of the ground wires is replaced by an optical ground wire of approximately the same diameter. The optical wire will be used, as necessary, for the communication requirement between the WPGS and the PG&E switchyard.

### 4.2.5 Switchyard

The WPGS will interconnect with the existing PG&E 230-kV switchyard adjacent to the WPGS site. Each combustion turbine generator (CTG) unit and steam turbine generator will connect to the switchyard via a generator step-up transformer.

It is anticipated that one of the existing 230-kV $SF_6$ breakers will be used. The Flex Plant 10 blocks will be connected to the switchyard by the common breaker. Surge arresters will be provided for the outgoing lines in the area of the takeoff towers.

Disconnect switches will be located on each side of the breakers to isolate the breaker, and one switch will be provided for each line termination or transformer connection for isolation of the lines or transformer for maintenance. Connections between the $SF_6$ breakers and outgoing lines will be by aluminum conductor steel reinforced cables. Cables will meet all electrical and mechanical design requirements. Instrument transformers (current and voltage transformers) will be included for protection and synchronization. The switchyard design will meet the requirements of the National Electrical Safety Code—American National Standards Institute (ANSI) C2.

A grounding grid will be provided to control step and touch potentials in accordance with IEEE Standard 80, Safety in Substation Grounding. All metallic equipment, structures, and fencing will be connected to the grounding grid of buried conductors and ground rods, as required for personnel safety. The switchyard ground grid will be tied to the plant ground grid.

Lightning protection will be provided by shield wires and/or lightning masts. The lightning protection system will be designed in accordance with IEEE 998 guidelines. All faults will be detected, isolated, and cleared in a safe and coordinated manner as soon as practical to ensure the safety of equipment, personnel, and the public. Protective relaying will meet IEEE requirements and will be coordinated with the utility. Each circuit breaker will be provided with independent breaker failure relay protection schemes. Revenue metering in compliance with CAISO regulations will be provided on the 230-kV transmission line(s) to record net power to or from the switchyard.

### 4.2.6 Transformers

The generators will be connected to the 230-kV switchyard through main step-up transformers. The step-up transformers will be designed in accordance with ANSI standards C57.12.00, C57.12.90, and C57.91. The main transformers will be two-winding, delta-wye, ONAF/ONAF/ONAF. The neutral point of high voltage (HV) winding will be solidly grounded. Each main step-up transformer will have metal oxide surge arrestors connected to the HV terminals and will have manual de-energized ("no-load") tap changers located in HV windings.

The auxiliary power to the plant will be provided by two 16.5-kV to 4,160-V unit auxiliary transformers. The HV side (16.5-kV) of the unit auxiliary transformers will be connected to the outputs of each of the CTGs.

## 4.3 CONSTRUCTION

Construction of the interconnection line between the PG&E switchyard and the WPGS will be undertaken by the engineering, procurement, and construction contractor or other specialized contractor for the WPGS.

Construction of the interconnection will be entirely on the WPGS site, the PPP site, and the PG&E switchyard and will not disturb any offsite areas. Currently, no offsite transmission system upgrades have been identified.

Construction associated with the transmission interconnection is included in the staffing, equipment, and deliveries information provided in Tables 2.7-1, 2.7-2, and 2.7-3, respectively.

## 4.4 TRANSMISSION SYSTEM OPERATION AND MAINTENANCE

WPGS will own, operate, and maintain the transmission line up to the point of interconnection with PG&E's switchyard. PG&E will own, operate, and maintain the facilities within the switchyard. Transmission system operation and maintenance are described below. Transmission line safety and nuisance is addressed in Section 4.6.

### 4.4.1 Inspections

Transmission line structures and accessways will be inspected on a routine, periodic basis in accordance with good utility practice.

### 4.4.2 Emergency/Safety Repairs

Emergency repairs will be made if the transmission line is damaged and requires immediate attention. Maintenance crews will use tools and other such equipment, as necessary, for repairing and maintaining insulators, conductors, structures, and accessways.

### 4.4.3 Insulator Washing

The buildup of particulate matter on ceramic insulators supporting the conductors on electric transmission lines increases the potential for flashovers, which affects the safe and reliable operation of the line. Structures with particulate matter buildup are identified for washing during routine inspections of the lines. Washing consists of spraying the insulators with deionized water through high-pressure equipment mounted on a truck.

### 4.4.4 Transmission System Reliability Criteria

The North America Electric Reliability Council and the Western System Coordinating Council Reliability Criteria for Transmission System Planning, the Industry Standards Organization, and the PG&E Reliability Criteria have been used in the evaluation of the transmission system.

## 4.5 NEW GENERATION INTERCONNECTION PROCESS

In March 2008, an interconnection request was submitted to the CAISO for the WPGS.

As part of the CAISO's Generator Interconnection Process Reform (GIPR) process, the interconnection queue process is being revised. As part of this revision, the CAISO desires to abolish the existing System Impact Study (SIS) process. On May 15, 2008, CAISO filed a request with the Federal Energy Regulatory Commission (FERC) seeking to discontinue all pending SISs except for a select number of

projects that have been grandfathered in under the existing rules (the so-called Serial Group). Based on discussions with CAISO, the WPGS application (as well as all other non-grandfathered projects) is not eligible to be a member of the Serial Group. The WPGS interconnection request has been accepted by CAISO into the interconnection queue as complete, and is included in the so-called "Transition Group." The applicant has been informed by the CAISO that a SIS study application will not be provided for the WPGS or any other project that has not already executed a SIS study application. The applicant continues to work with CAISO during the GIPR process. Appendix H includes Mirant's Motion to Intervene and Answer filed with FERC regarding the GIPR process.

The current SIS process is to be replaced by a new interconnection study program called the Phase I study. The replacement of the SIS process with the Phase I study process is subject to approval by FERC. As of May 2008, this approval has not been granted by FERC and as such, no generation interconnection applicants are able to execute a Phase I study agreement. Based on CAISO's estimated timelines, WPGS will be able to execute a Phase I study agreement by October 31, 2008. The Phase I study is estimated by CAISO to be completed in summer 2009.

## 4.6 TRANSMISSION LINE SAFETY AND NUISANCE

### 4.6.1 Electric and Magnetic Fields

The electrical transmission interconnection and other electrical devices that will be constructed as part of the project emit electromagnetic fields (EMF) when in operation. These fields are typically measured near ground level, where they are encountered by people. EMF fields, to the extent they occur, could impact receptors on the properties adjacent to the project site.

The WPGS and transmission interconnection will be located entirely within the WPGS and PPP properties and the PG&E switchyard. Site access is restricted and will be limited to station workers, incidental construction and maintenance personnel, other company personnel, regulatory inspectors, and approved guests. Since access will not be available to the general public, general public exposure to EMF is not expected to occur from the WPGS or the transmission facilities to be constructed as part of the project.

### 4.6.2 Audible Noise and Radio and TV Interference

An electric field is generated in the air surrounding a transmission line conductor when the transmission line is in operation. A corona discharge occurs at the conductor surface when the intensity of the electric field at the conductor surface exceeds the breakdown strength of the surrounding air. The electrical energy released from the conductors during this process is known as corona loss and is manifested as audible noise and radio/television interference.

Energized electric transmission lines can also generate audible noise by a process called corona discharge, most often perceived as a buzz or hum. This condition is usually worse when the conductors are wet. The Electric Power Research Institute (EPRI) has conducted several transmission line tests and studies that measured sound levels for several power line sizes with wet conductors (EPRI, 1982). EPRI (1982) notes that the noise produced by a conductor attenuates (decreases) by 2 to 3 decibels for each doubling of the distance from the source.

Radio and television interference, known as gap-type noise, is caused by a film on the surface of two hardware pieces that are in contact. The film acts as an insulator between the surfaces, and results in small electric arcs that produce noise and interference. This type of noise is not a problem in well-maintained transmission lines. Well-trained transmission line maintenance crews will maintain the project transmission line so that problems that might occur can be readily pinpointed and corrected.

Furthermore, it is unlikely that the project transmission line would have any effect on radio or television reception due to the approximate 1,200-foot distance from the transmission line to the nearest residence.

Many factors contribute to the pre-project ambient noise levels in the plant area. The project transmission line will be designed such that noise from the line will continue to be well below undesirable levels. Any noise or radio/television interference complaints will be logged, investigated, and, to the degree possible, mitigated.

### 4.6.3 Induced Currents and Hazardous/Nuisance Shocks

Metallic objects near a transmission line can cause hazardous or nuisance shocks when touched, if they are not properly constructed. Because the electric fields of the project's transmission line will be negligible above ground, and because the lines will be constructed in conformance with the requirements of California Public Utilities Commission (CPUC) GO 95 and Title 8 California Code of Regulations (CCR) 2700, hazardous shocks are highly unlikely to occur as a result of the project's construction and operation.

### 4.6.4 Fire Prevention

The WPGS will comply with Title 14, CCR, Section 1250, Article 4, which establishes fire prevention standards for electric power generation facilities.

### 4.6.5 Conclusion

No significant EMF mechanisms have been identified within a typical power plant facility that could potentially disrupt or otherwise interfere with communications or other electromagnetic based devices and systems outside the plant boundary. This is reflected in the lack of U.S. standards governing any such emissions, as well as the lack of any significant anecdotal references to such phenomenon. It is noted that many existing power plant facilities are in very close proximity to other facilities and businesses, with no observed EMF interference problems. The electrical interconnection will be located entirely within the existing WPGS and PPP sites and PG&E switchyard. Access to this area will be generally limited to power plant and substation employees, incidental construction and maintenance personnel, other employees, and regulatory inspectors. Since access to the general public is not anticipated, general public exposure to EMF is not expected to occur.

## 4.7 TRANSMISSION LINE AGREEMENTS AND NECESSARY APPROVALS

The project to be certified includes the transmission line up to the first point of interconnection with the transmission system. For this project, the portion of the transmission line from the generator step-up transformers on the project site to PG&E's switchyard are tie lines that will be designed, constructed, and operated by WPGS. No regulatory approvals other than California Energy Commission (CEC) certification and approvals obtained through the CAISO large generator interconnection process should be necessary.

## 4.8 LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

A description of the laws, ordinances, regulations, and standards (LORS) that pertain to the transmission system interconnection is included in Table 2.10-1 and discussed below.

### 4.8.1 Federal Authorities and Administering Agencies

**47 U.S. Code § 15.25.** This authority requires mitigation for any device that causes communications interference.

The administering agency for the above authority is the Federal Aviation Administration.

### 4.8.2 State Authorities and Administering Agencies

**California Public Resources Code §25000 et seq., Warren-Alquist Act, §25520 Subdivision (g).** This authority requires a detailed description of the transmission line, including all rights-of-way.

The administering agency for the above authority is the CEC.

**GO 52 CPUC.** This authority requires the prevention or mitigation of any inductive interference caused by the transmission line.

The administering agency for the above authority is the CPUC.

**GO 95 CPUC.** This authority establishes rules and guidelines for transmission line construction.

The administering agencies for the above authority are the CPUC and CEC.

### 4.8.3 Local Authorities and Administering Agencies

The City of Pittsburg General Plan describes general policies regarding energy development in the county.

The administering agency for the above authority is the City of Pittsburg Planning Department.

### 4.8.4 Industry Codes and Standards

**Radio and Television Interference Criteria.** Criteria are established to determine whether any mitigation is necessary.

The administering agency for the above authority is the CEC.

### 4.8.5 WPGS Compliance with Transmission Line Safety and Nuisance LORS

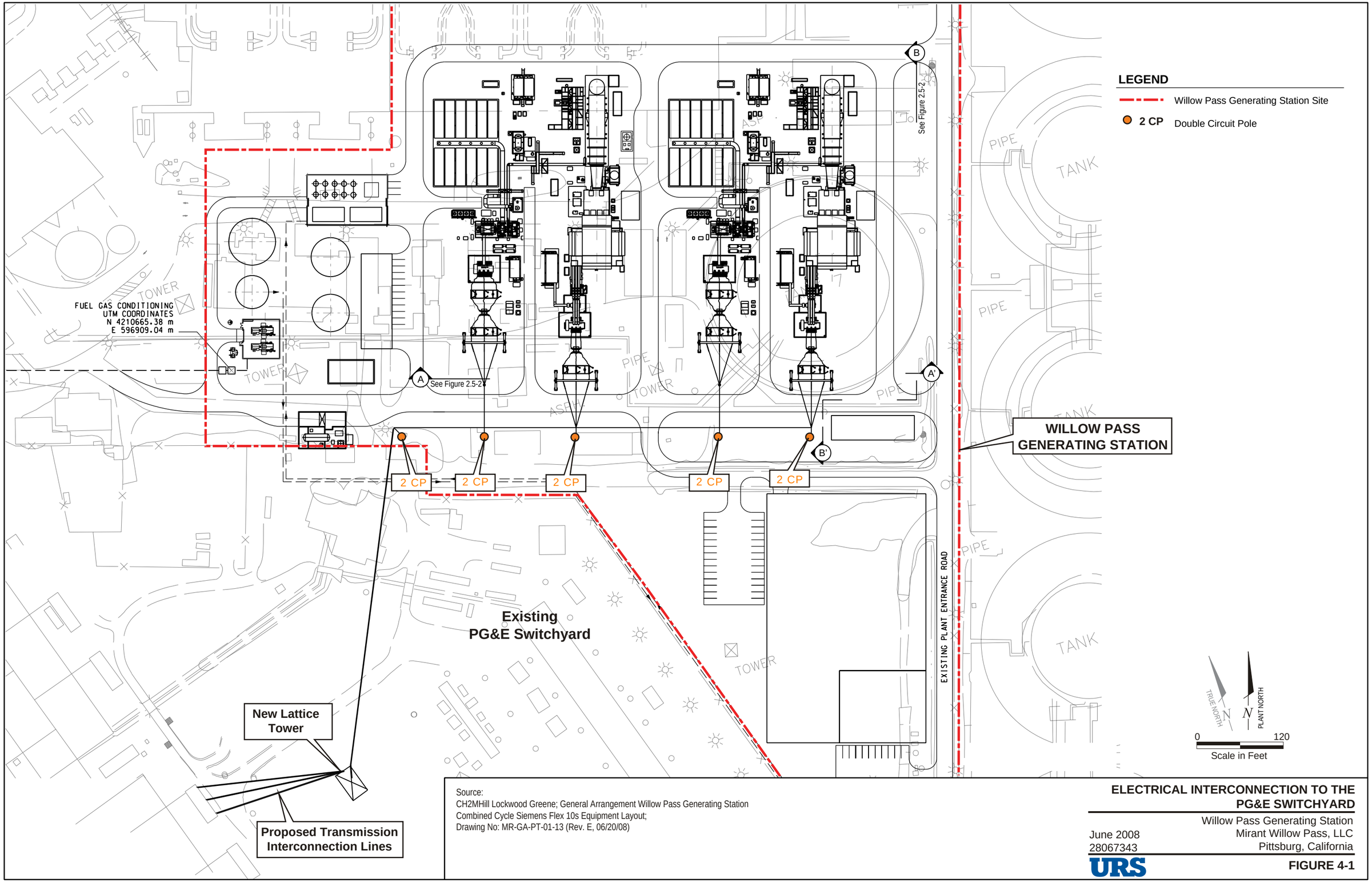
The WPGS' design will comply with all audible noise, communication interference, and hazards LORS.

## 4.9 INVOLVED AGENCIES AND AGENCY CONTACTS

A list of agencies and agency contacts that pertain to the transmission system is included in Section 2.11 in Chapter 2.

## 4.10 REFERENCES

Electric Power Research Institute (EPRI), 1978. Transmission line Reference Book: 115 – 345-kV Compact Line Design (Blue Book). Palo Alto, CA.




Source:
CH2MHill Lockwood Greene; General Arrangement Willow Pass Generating Station
Combined Cycle Siemens Flex 10s Equipment Layout;
Drawing No: MR-GA-PT-01-13 (Rev. E, 06/20/08)

**ELECTRICAL INTERCONNECTION TO THE PG&E SWITCHYARD**

Willow Pass Generating Station
Mirant Willow Pass, LLC
Pittsburg, California

June 2008
28067343

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**FIGURE 4-1**

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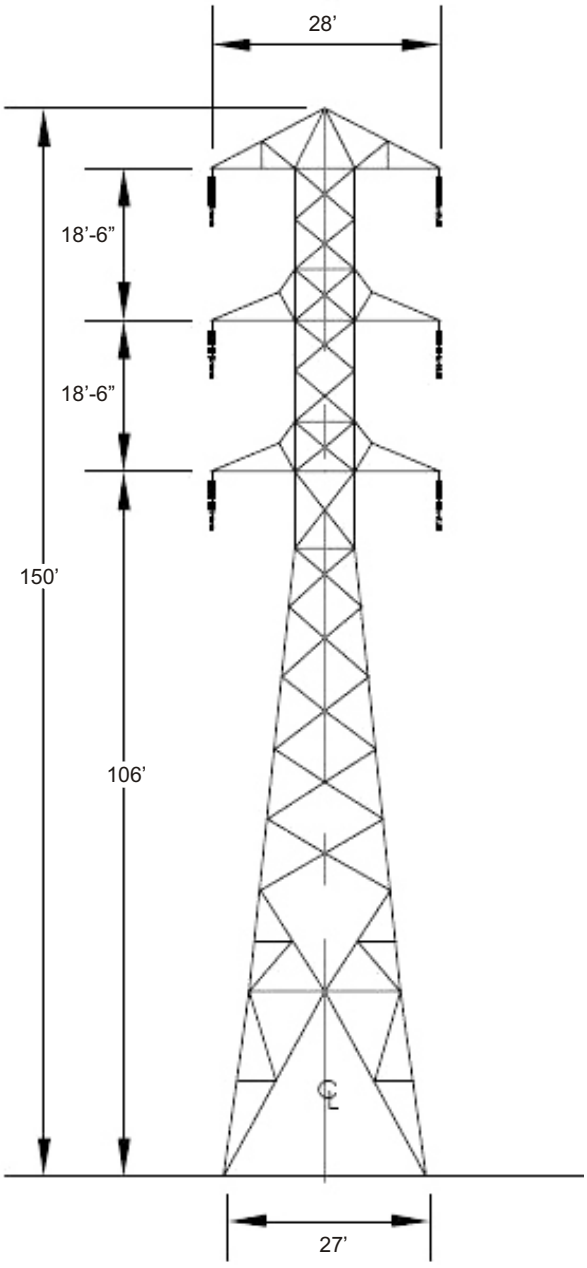
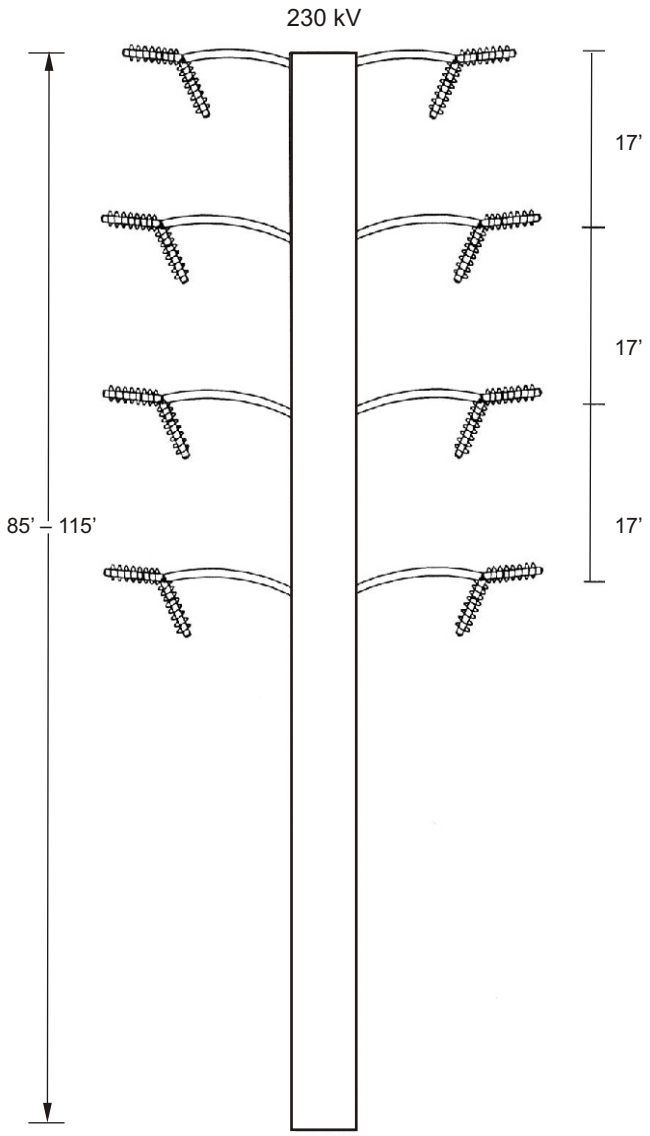



**Lattice Tower**




**Double Circuit Pole**

No Scale

Source:
CH2MHill, January 2008

**TYPICAL HIGH VOLTAGE MONOPOLE TOWERS**

Willow Pass Generating Station
Mirant Willow Pass, LLC
Pittsburg, California

June 2008
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**FIGURE 4-2**

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