APPENDIX 4.1F

Evaluation of Best Available Control Technology

SCAQMD Rule 1303(a) requires the use of best available control technology (BACT) for new permit units that result in any net increase in emissions of any nonattainment pollutant, ozone depleting compound, or ammonia. As shown in Section 4.1, maximum daily emissions of all pollutants from each permit unit will be required to evaluate BACT. This section describes the emissions control technology that will be used to minimize emissions from each permitted unit, as well as control technology options that were considered and rejected, and the reason the options were rejected.

Auxiliary Boilers

As described in Section 4.1, the auxiliary boilers will be 249 MMBtu/hr natural gas-fired superheating boilers. These boilers will be used on a daily basis, up to about 1202 equivalent full-load hours per year.

The auxiliary boilers will be used on a daily basis and are expected to take less than an hour to come up to full capacity. Startup and low loads operations (~=12.5% load) are expected to be approximately 1.7 hours per day, with operations in the load range of 25-100%expected to be on the order of 3.5 hours per day (full load equivalent hours).

Superheating boilers are typically much larger and have a higher heat flux to produce superheated steam conditions compared to boilers producing saturated steam. Both factors contribute to higher uncontrolled NOx emission rates than those from saturated steam boilers. BACT databases published by the BAAQMD, SJVAPCD, and SCAQMD were reviewed to identify BACT guidelines and determinations relevant to moderately sized superheating boilers.

South Coast Air Quality Management District – The SCAQMD does not publish a single governing BACT guideline for major sources (comparable in size to the proposed boilers), but rather maintains a database of historical BACT determinations. The largest boilers for which the SCAQMD has published a BACT determination (February 2006) are two 2,088 MMBtu/hr utility boilers at the AES Huntington Beach facility located in Huntingdon Beach, California. The AES utility boilers are equipped with a LNB/FGR, selective catalytic reduction (SCR), and oxidation catalyst systems meeting CO and NOx emission limits of 5 ppmv @ 3% O_2 each. The next largest boiler for which the SCAQMD has published a BACT determination (October 1999) is a 110 MMBtu/hr boiler at the Darling International facility located in Los Angeles, California. The Darling International boiler is equipped with a LNB/FGR and SCR system meeting CO and NOx emission limits of 100 ppmv @ 3% O_2 and 9 ppmv @ 3% O_2, respectively. As with the SJVAPCD and BAAQMD, the SCAQMD has not made a separate NOx BACT determination for moderately sized superheating auxiliary boilers.

Bay Area Air Quality Management District – The BAAQMD has established a CO BACT guideline specifying good combustion practices in conjunction with a ULNB/flue gas recirculation (FGR) system, meeting a CO emission limit of 50 ppmv @ 3% O_2 for natural

gas-fired boilers rated at 50 MMBtu/hr or more. The BAAQMD has further established, for this boiler category, a NOx BACT guideline specifying a ULNB/FGR system, meeting a NOx emission limit of 9 ppmv @ 3% O_2. The boilers for which the BAAQMD established its NOx BACT determination are three 97 MMBtu/hr boilers at the Genentech facility located in South San Francisco, California. The Genentech boilers are equipped with ULNB/FGR systems meeting a NOx emission limit of 9 ppmv @ 3% O_2. The BACT range of values per the latest tabulation for this source category (Doc# 17.3.1, 8-4-10) is as follows:

- NOx 25-40 ppm @ 3% O2 (ULNB or LNB with FGR)
- CO 100 ppm @ 3% O2 (GCP and natural gas)

The BAAQMD has not established a separate NOx BACT guideline for moderately sized superheating auxiliary boilers.

San Joaquin Valley Air Pollution Control District – The SJVAPCD recently rescinded its BACT determinations for boilers. Previously, however, the SJVAPCD had established natural gas fuel with a liquefied petroleum gas backup as BACT for CO emissions for natural gas-fired boilers rated at 20 MMBtu/hr or more. The SJVAPCD had also established a NOx BACT guideline specifying an ultra low-NOx burner (ULNB) system, meeting a NOx emission limit of 9 ppmv @ 3% O_2, for natural gas-fired boilers rated at 20 MMBtu/hr or more and operated within the operational response range of the ULNB system. The largest boiler for which the SJVAPCD had published a NOx BACT determination is a 182 MMBtu/hr boiler at the Los Gatos Tomato facility located in Huron, California. The Los Gatos Tomato boiler is equipped with an ULNB system meeting a NOx emission limit of 9 ppmv @ 3% O_2. The SJVAPCD had not established a separate NOx BACT guideline for moderately sized superheating boilers.

San Diego Air Pollution Control District – Data derived from the San Diego APCD BACT database for boiler rated at greater than 50 but less than 250 mmbtu/hr indicates that BACT for NOx, for non-base loaded process units is typically 9 ppm @ 3% O2, utilizing LNBs and FGR, with natural gas fuel. No CO BACT limit is listed.

Other Control Technology Determinations – The Mojave Desert AQMD issued a Final Determination of Compliance (2009) for the Ivanpah Solar Electric Generating System, which includes large superheating steam boilers similar to those proposed for the Rio Mesa SEGF. Emissions from those boilers were below the MDAQMD's BACT thresholds and were therefore not subject to BACT. The emission limits for the Ivanpah boilers (249 MMBtu/hr heat input) were 9 ppmc NOx, 12.6 ppmc VOC and 25 ppmc CO. The proposed limits for the PSEG boilers are consistent with these limits, with the exception of a higher proposed CO limit for the auxiliary boilers. However, the proposed 50 ppmc CO limit for the auxiliary boilers is consistent with the BAAQMD CO BACT guideline.

Feasibility of SCR or SNCR for NOx Control – As discussed above, the auxiliary boilers will cycle on and off on a daily basis and will operate at full load equivalent for only about 3.5 hours per day. Selective catalytic reduction (SCR) or selective noncatalytic reduction (SNCR, or ammonia injection) technology is generally not effective during boiler startup because exhaust temperatures are too low for effective ammonia/NOx reactivity, even in the presence of a catalyst; therefore, SCR or SNCR control would potentially be effective in reducing NOx emissions from the boilers for only about 2/3 of the boiler

operating hours. It would be very expensive (and not cost-effective) to install and maintain SCR or ammonia injection systems on the boilers for such limited operations. In addition, the use of either of these control systems would result in the need to transport and store ammonia on-site. Because these economic and environmental impacts outweigh any potential air quality benefit, SCR and ammonia injection are not being proposed for use in the auxiliary boilers.

Conclusions – The SCAQMD BACT determination for the AES Huntington Beach utility boilers constitutes the most stringent determination for a natural gas fired boiler. However, these utility boilers have operated at a maximum annual capacity factor of 31% (based upon a review of seven years of operating data contained in USEPA's Acid Rain database) and could operate at an even higher capacity factor. As such, this BACT determination for utility boilers is not relevant to much smaller superheating auxiliary boilers that will operate at a maximum capacity factor of approximately 14% (based on full load equivalent hours).

The proposed boiler emission limits are consistent with recent BACT determinations and guidance and with permitted emission limits for similar boilers.

Nighttime Preservation Boilers

The nighttime preservation boilers are small 10 MMBtu/hr boilers that will be used to provide steam to the gland systems of the steam turbine and boiler feedwater pump overnight. BACT databases published by the BAAQMD, SJVAPCD, and SCAQMD were reviewed to identify BACT guidelines and determinations relevant to small boilers. Each of these units is expected to operate approximately 14 hours per day (which includes one startup hour), and 4872 hours per year.

SCAQMD – In 2000, the SCAQMD determined that 15 ppmc NOx and 50 ppmc CO were BACT for two 16.3 MMBtu/hr steam boilers—one at UCLA Med Center and one at Liberty Container. In 2002, a slightly larger boiler (39 MMBtu/hr) at LA County Internal Services Department was permitted with a NOx limit of 9 ppmc and a CO limit of 100 ppmc.

BAAQMD – The BAAQMD BACT guideline for small boilers (between 5 and 33.5 MMBtu/hr rated heat input) indicates that typical NOx control technology includes low NOx burners, flue gas recirculation, and in some cases, SCR. The BACT guideline indicates that good combustion practices and fuel selection are typical technology for VOC, CO, SOx and PM. A 50 ppm CO emission rate is shown as being achieved in practice and technologically feasible/cost effective. The controlled emission limits proposed for the nighttime preservation boilers are consistent with these technology listings.

SJVAPCD – SJVAPCD Rule 4320 is a prohibitory rule that limits NOx and CO emissions from small (between 5 and 20 MMBtu/hr rated heat input) boilers. NOx emissions are limited to 6 to 9 ppmc, depending upon the boiler permit date, and CO emissions must not exceed 400 ppmc.

SDAPCD – Data derived from the District listing for boilers rated at less than 50 mmbtu/hr indicates that BACT for NOx is 9 ppm @ 3% O2 using LNBs and FGR, with natural gas fuel. No CO BACT value is listed.

Conclusions – The proposed controlled emission limits of 9 ppmc NOx and 50 ppmc CO are consistent with the controlled emission levels required for boilers of this size range in other air districts. Because of the minimal NOx emissions expected from these small boilers (about 0.54 ton per year total for both units), the economic and environmental impacts of SCR outweigh any potential benefit of further NOx reductions.

Cooling System

The project will use wet surface air condensers (WSACs) for cooling and condensing process steam. The WSACS have minimal air pollutant emissions. An auxiliary partial dry cooling system or air-cooled condenser (ACC) at each power block will cool the generator, steam turbine generator lubrication oil, boiler feed pump lubricating oil, SRSG circulating water pumps and other equipment requiring cooling. The ACC is a closed-loop two-stage cooling system. In the first stage, heat is rejected using ambient air in a dry cooling system. This is followed by a closed-loop evaporative fluid cooler for additional cooling. The ACC reduces plant water consumption and therefore the potential for cooling water drift in two ways. First, the dry-cooling section will reduce the amount of heat that must be rejected in the closed-loop evaporative fluid cooler, which results in a corresponding reduction in the total amount of water evaporated during the cooling process. Second, the closed-loop evaporative fluid cooler allows the contaminants in the evaporative cooling water to be concentrated to a much greater extent than in a traditional open-loop cooling system because that water does not pass through the equipment being cooled.

Most of the auxiliary cooling will be provided by a fin-fan heat exchanger at each power block. The ACCs do not use water and therefore have no air pollutant emissions because no liquid droplets are entrained in the exhaust air. However, when the ambient temperature rises above 85° F, the fin-fan heat exchangers cannot achieve adequate heat rejection and must be supplemented with a small wet surface air cooler (WSAC) at each power block. The ACCs and the WSACs are exempt from permit requirements under District rules.

Potential particulate emissions from the cooling system are minimized through the use of dry cooling to the greatest extent possible. Wet cooling will be limited to high-temperature periods when the fin-fan cooler alone cannot provide sufficient cooling. Particulate emissions from the cooling system will be further minimized by using high efficiency drift eliminators (0.0005%) and treated water with relatively low TDS levels.

Emergency Engines

The project will include three emergency diesel generators for emergency power production and three diesel fire pump engines as required by fire codes to provide backup fire water pumping pressure in the event of a failure of the primary pump systems. Operation of diesel-powered emergency engines (generators and fire pumps) will be limited to less than 60 minutes per day, and less than or equal to 50 hours per year for testing and maintenance, with total allowable operations per Rule 1304(a)(4) not to exceed 199 hours per year per engine. BACT for emergency diesel engines, including fire pump engines, is generally the use of the latest EPA Tier certification level or the CARB ATCM limits applicable for the engine horsepower range, and the use of California certified low sulfur diesel fuel (<=15 ppm S). The emergency diesel engines at PSEGS will be certified to the latest EPA Tier certification levels and/or the CARB ATCM standards applicable at the

time the engines are purchased. In addition, the proposed engines will comply with all applicable NSPS for CI engines based on size and date of manufacture.