**Technical Support Document**
**APS West Phoenix Power plant**
**Permit Number V95-006**
**Permit Renewal V95-006 – 3.0.0.0**
**Issue date: xxxxxxxxxx**

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## 1. APPLICANT:

Arizona Public Service Company
PO Box 53933, Mail Station 4120
Phoenix, AZ 85043

## 2. PROJECT LOCATION:

The West Phoenix Power Plant (WPPP) is located at 4606 West Hadley Street in Phoenix, Maricopa County, Arizona.

With respect to the National Ambient Air Quality Standards (NAAQS), this location is designated as marginal non-attainment for ozone and serious non-attainment for $PM_{10}$. The project site is under the jurisdiction of the Maricopa County Air Quality Department (MCAQD).

## 3. FACILITY DESCRIPTION:

a. GENERAL PLANT DESCRIPTION:

Arizona Public Service (APS) owns and operates the WPPP. The WPPP is located in Phoenix, Arizona, and has been in continuous operation since 1930. The Plant is located in an attainment area for Carbon Monoxide (CO) and Sulfur Dioxide ($SO_2$). The area is in marginal non-attainment for the 8 hour ozone standards in which $NO_x$ and VOC are used as surrogates for the formation of ozone. The area also has been designated as a serious non-attainment area for particulate matter less than 10 microns ($PM_{10}$).

The current power generating units include five combined cycle (CC) units, and two simple-cycle combustion turbines (CT). The power generating units are supported by three cooling towers, and one auxiliary boiler.

All power generating units at the WPPP will use Pipeline Natural Gas as sole fuel as part of this permit renewal. Pipeline Natural Gas is obtained from the El Paso Natural Gas Company and is delivered at a city gate just east of the property. The WPPP power generating units serve several functions for APS. The power generating units can be used to meet local and system load demands and can be used for grid voltage control. Accordingly, the units are operated on as as-needed basis, 24 hours per day throughout the year.

b. COMBINED CYCLE UNITS (5):

The combined cycle units use a combination of combustion and steam turbines to generate electrical power. Compressed air is used in conjunction with fuel combustion to drive the combustion turbines. Waste heat from the combustion turbine is used to produce steam in a heat recovery steam generator (HRSG). The HRSG may or may not be equipped with auxiliary duct burners. Steam from the HRSG is used to drive a steam turbine (ST). This utilization of waste heat increases the efficiency of the combined cycles. The five combined cycle units at the WPPP are designated as CC1, CC2, CC3, CC4, and CC5 (A and B). CC5 is a two-on-one combined cycle. This designates a power block consisting of two combustion turbines and one steam generator. CC5A and CC5B designate the use of dual combustion turbines in CC5. There are continuous emission monitoring systems (CEMS) at the emission points of CC3, CC4, CC5A and CC5B.

COMBINED CYCLE UNITS 1, 2, AND 3

SCC Code: 2-01-002-01 (Natural gas)

CC1 was placed in commercial operation June 20, 1976. CC2 was placed in commercial operation June 19, 1976. CC3 was placed in commercial operation June 19, 1976. Each of the CC's have a nominal

rating of 85 megawatts (MW) and up to an electrical output to 97 MW during the colder months of the year. The combined cycle units (CC1, CC2 & CC3) consist of the following major equipment:

Combustion Turbine - A General Electric model 7001C turbine with a 17 stage compressor and a 3 stage turbine section rated at 57 MW and drives an electrical generator.

Steam Turbine - The GE steam turbine is a single flow, straight condensing, non-reheat, and non-extraction unit rated at 28 MW and is also used to drive the same electrical generator.

Heat Recovery Steam Generator (HRSG) - This GE unit is an extended-tube type, forced circulation, steam generator which uses heat from the gas turbine exhaust to convert water into steam for driving the steam turbine. Steam is produced in three stages in the economizer, evaporator, and superheater. The CC3 HRSG was replaced with an HRSG built by Volt-NIM. The new HRSG incorporates a selective catalytic reduction (SCR) system to lower $NO_x$ emissions. The CC1, CC2 and CC3 HRSGs are not equipped with auxiliary duct burners.

COMBINED CYCLE UNIT 4

SCC Code: 2-01-002-01 (Natural gas)

CC4 was placed in commercial operation in June 2001, has a rated nominal capacity of 125 MW, and consists of the following major equipment:

Combustion Turbine - A General Electric model 7EA turbine. The turbine is designed with a 17-stage compressor and a 3-stage turbine, and has a nominal rating of 80 MW. The CC4 combustion turbine is also equipped with a dry low-$NO_x$ combustion system.

Steam Turbine - The CC4 steam turbine is a 14 stage Dresser–Rand steam turbine. The steam turbine is a single flow, straight condensing, non-reheat, non-extraction unit with a nominal rating of 45 MW.

Heat Recovery Steam Generator (HRSG) - The CC4 HRSG was built by Foster Wheeler and is designed to produce 68,000 lb/hr steam at 113 psig. The HRSG is an extended-tube type, forced circulation, steam generator which uses heat from the gas turbine exhaust to convert water into steam for driving the steam turbine. The CC4 HRSG is also equipped with an oxidation catalyst to reduce carbon monoxide.

COMBINED CYCLE UNIT NO. 5

SCC Code: 2-01-002-01 (Natural gas)

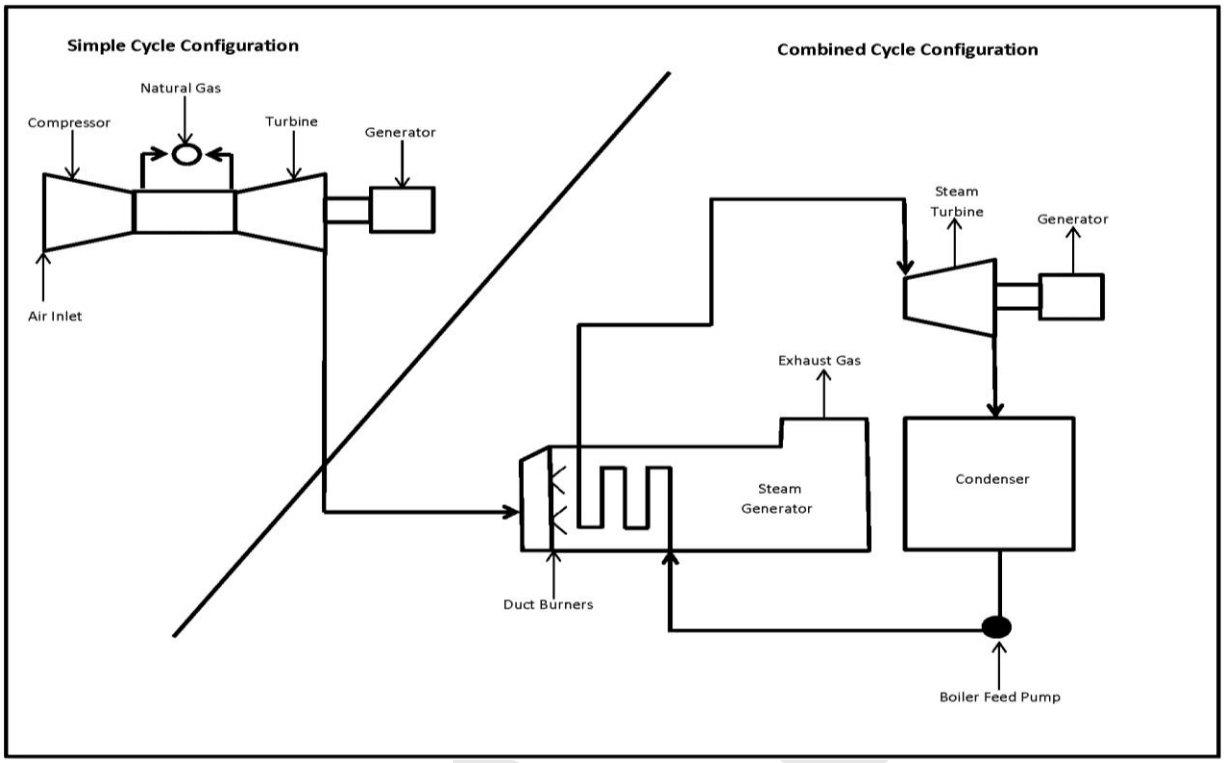
CC5 was place into commercial operation in August 2003. It has a nominal rating of 530 MW. CC5 is a two-on-one design, which means the combined cycle unit consists of two combustion turbines (CC5A and CC5B), and one steam turbine. Each combustion turbine is equipped with separate and independent HRSGs, and can be operated separately or simultaneously. CC5 does not have the capability to combust fuel oil.CC5 consists of the following major equipment:

Combustion Turbine - Twin Siemens Westinghouse model 501F, combustion turbines with dry low-$NO_x$ combustion controls. The combustion turbines have a nominal rating of 175 MW each.

Steam Turbine - The CC5 steam turbine is a Siemens Westinghouse single flow, straight condensing, non-reheat, and non-extraction unit with a nominal rating of 180 MW.

Heat Recovery Steam Generator (HRSG) - Each combustion turbine is equipped with separate HRSGs manufactured by Kawasaki-VNI. The HRSGs are an extended-tube type, forced circulation, steam generator which uses heat from the gas turbine exhaust to convert water into steam for driving the steam turbine. Each CC5 HRSG is also equipped with an SCR to reduce nitrogen oxide emissions and oxidation catalyst to reduce carbon monoxide emissions Each CC5 HRSG is equipped with a 245 MMBtu/hr auxiliary duct burner.

**Figure 1: Simple/Combined Cycle Configurations:**




c. SIMPLE CYCLE COMBUSTION TURBINES (2)

SCC Code: 2-01-002-01 (Natural gas)

CT 1 was placed into commercial operation May 1972. CT 2 was placed into commercial operation in July 1973. These simple cycle combustion turbines consist of a high efficiency axial compressor, a combustion chamber and a reaction type turbine. The turbine is coupled to and drives an air cooled generator. Each CT has a nominal generating capability of 55 MW and consists of the following major equipment:

Combustion Turbine - A Westinghouse model W-501-AA turbine with a 17 stage compressor and a 4 stage turbine section is used to drive a generator. The CTs directly convert the heat from burning fuel into mechanical energy within a single assembly; none of the waste heat from the combustion turbine is recovered.

Auxiliary Equipment - Associated equipment includes: Fuel system for natural gas, starting system, digital computer control system, etc.

d. COOLING TOWERS (3)

Because the combined cycle units use a steam turbine to produce a portion of the power, a cooling tower is required for condensing steam back to a liquid. One cooling tower supplies circulating water to the condensers on CC1, CC2, and CC3. CC4 and CC5 have separate and independent cooling towers.

COMBINED CYCLES 1, 2, and 3 COOLING TOWER

One cooling tower is used to provide circulating water to the three combined cycle condensers. This 6 cell, crossflow, induced draft tower manufactured by the Marley Co. has a drift rate of 0.001 percent, 6 fan stacks, and 3 circulating water pumps (30,000 gallons per minute, (gpm), each) located outside of the cold water basin. These pump water to the condensers and back to the distribution basins located at the top of the tower.

CC4 COOLING TOWER

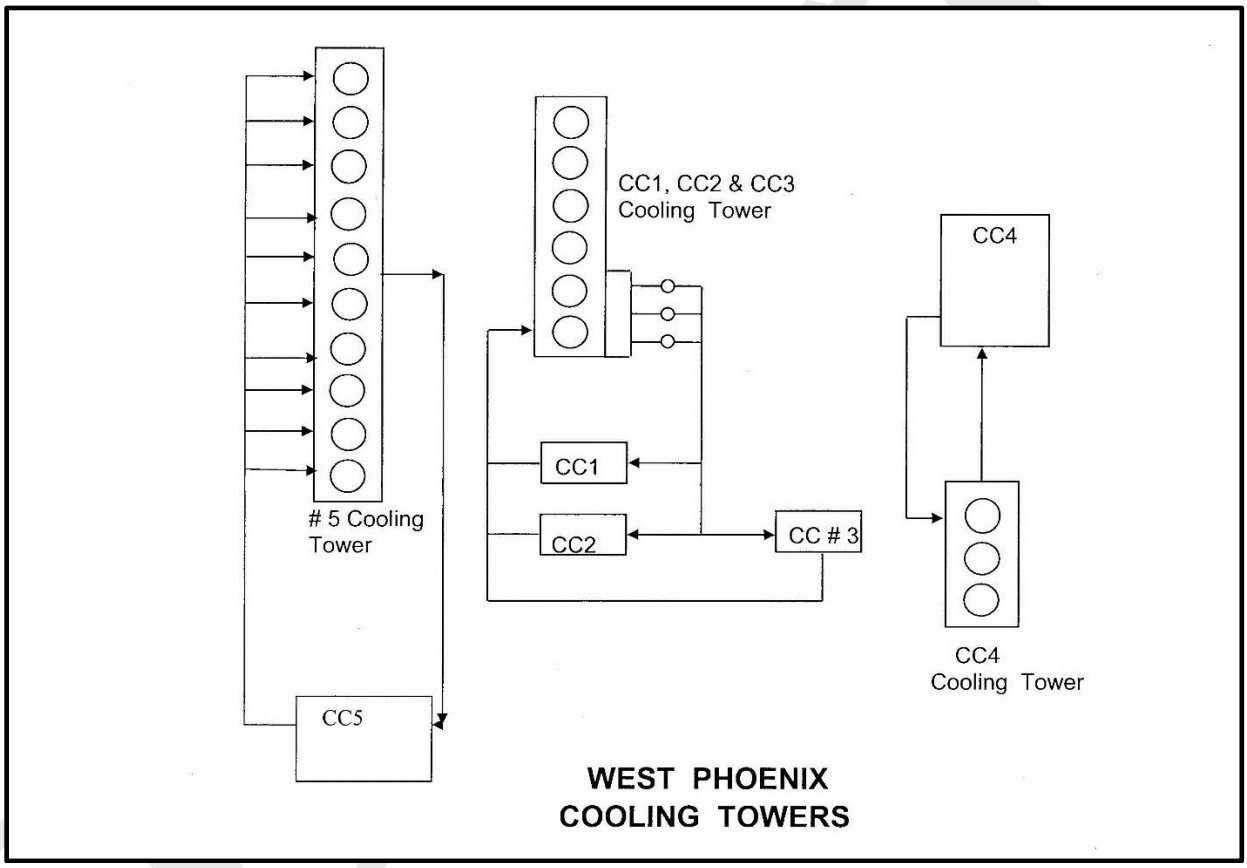
The CC4 cooling tower is used to provide circulating water to the #4 combined cycle condenser. The cooling tower is a 3 cell, crossflow, induced draft tower with a flow rate of 42,000 gpm. The drift

efficiency is rated at 0.0005 percent. Makeup water to the tower is supplied by wells located on the plant site. The cooling tower blowdown is directed to a brine concentrator.

CC5 COOLING TOWER

The CC5 cooling tower is used to provide circulating water to the #5 combined cycle condenser. This cooling tower is a 10 cell, crossflow, induced draft tower. The flow rate for the CC5 tower is 140,000 gpm. The towers are equipped with high efficiency drift eliminators capable of controlling the drift rate to 0.0005 percent. During periods when CC5 is in hot standby, one or more of the circulating water pumps may be operating to recirculate the cooling tower water. Makeup water to the tower is supplied by wells located on the plant site. The cooling tower blowdown is directed to a brine concentrator.

**Figure 2: Cooling Towers Configuration:**




e. CLAYTON AUXILIARY BOILER:

The auxiliary boiler located at CC5 is manufactured by Clayton model EG304-1-LNB. The boiler's heat input is rated at 12.5 MMBtu/hr. The boiler is fired by natural gas and is equipped with low $NO_x$ burners. The Clayton boiler provides auxiliary steam for the brine concentrator when CC5A and CC5B are not in operation. (Serial no. 23643, Date of manufacture – June 9, 1998)

## 4. AIR POLLUTION CONTROL EQUIPMENT:

West Phoenix emission units incorporate the use of both combustion and post combustion controls to reduce and limit the amount of pollutants emitted. Combustion controls include the use of pipeline quality natural gas and pollution control equipment such as dry low-$NO_x$ (DLN) burners to limit production of nitrogen oxides. Post combustion controls include the use of selective catalytic reduction (SCR) systems to control $NO_x$ emissions and oxidation reduction catalyst to reduce carbon monoxide emissions.

Identification, Description, and Location of Control Equipment:

a. West Phoenix combined cycles CC4 and CC5 are equipped with DLN burners which fine tunes the ratio of air to fuel in the combustor through various stages of combustion as the load increases. The intent is

to limit the fuel/air ratio to a fuel lean environment which decreases the flame temperature to limit thermal $NO_x$ production.

b. CC3 and CC5 are equipped with an SCR to reduce post combustion $NO_x$ emissions. Each SCR system consists of a catalyst and an ammonia injection system. The catalysts are located in the HRSGs, in the area where the temperature is in the ideal range for the catalyst-assisted reaction during normal operation.

c. CC4 and CC5 are also equipped with oxidation catalyst to reduce CO emissions. CO can be formed during any incomplete combustion of the fuel. The oxidation catalyst, along with excess air, converts the CO into carbon dioxide thereby reducing the CO emission.

## 5. PERMIT HISTORY:

APS was issued its Title V permit for the WPPP on June 30, 2002 by the Maricopa County Environmental Services Department (MCESD). Table 1 shows the history of revisions to the permit since then.

**Table 1: APS WPPP Permit History**

| Approval Date | Revision Number | Type | Reason for Revision |
|---|---|---|---|
| June 30, 2000 | S99-023 | Significant Revision | Installation of new units CC4 and CC5 and installation of a $NO_x$ SCR system on CC3. |
| June 30, 2002 | | Permit Issuance | Permit issuance using current numbering system. |
| June 11, 2003 | 6-27-02-01 | Minor | The revision was to correct information previously submitted for Significant Revision S99-023 and to revise testing requirements on unit CC3 while combusting fuel oil. The heat input rate capacity of CC3, CO emission rate for CC3, and startup/shutdown $SO_2$ rates for CC4 and CC5 were increased as part of the changes to S99-023. |
| June 19, 2003 | 6-19-03-01 | Minor | Added auxiliary boiler |
| June 13, 2007 | 1.0.0.0 | Renewal | Permit renewal |
| November 21, 2008 | 1.0.1.0 | Minor | Update dust control plan as required by Rule 310. |
| November 28, 2011 | 2.0.0.0 | Renewal | Permit Renewal and Significant Revision to increase the CO limits on CC3 from 360 to 440 lbs/hr. |
| September 24, 2013 | 2.1.0.0 | Significant Revision | Permit Revision to change CO limits on CT 5A and 5B from a one hour average to a three hour average. The Babcock & Wilcox auxiliary boilers have been removed. |
| TBD | 3.0.0.0 | Renewal | Permit renewal. |

## 6. ALTERNATE OPERATING SCENARIOS:

There are no alternate operating scenarios at the West Phoenix Power Plant.

The CTs combust pipeline natural gas to produce electricity. The CTs may be operated simultaneously or one at a time at a capacity factor of 0 -100% each. Excess heat from the CTs is captured in the HRSG and used to create steam to drive the STs. At times when additional heat is required to obtain the full benefit of CC5's STs, duct burners may be operated.

## 7. PREVENTATIVE MAINTENANCE SCHEDULE:

Preventative maintenance is scheduled to ensure the proper functioning of the major equipment. The typical schedule at the West Phoenix facility is as follows:

**Table 2: Preventative Maintenance Schedule**

| Combined Cycle Units | Outage | Frequency |
|---|---|---|

| | | |
|---|---|---|
| 1) Combustor basket and blade inspection | 2-3 days | Annual |
| 2) Combustor inspection | 4-6 weeks | Annual |
| 3) Hot gas path inspection | 8 weeks | 3 years |
| 4) Major overhaul | 16 weeks | 6 years |
| Combustion Turbines | | |
| 1) Combustor basket and blade inspection | 2-3 days | Annual |
| 2) Combustor inspection | 4-6 weeks | 5 years |
| 3) Hot gas path inspection | 8 weeks | 10 years |
| 4) Major Overhaul | 16 weeks | 20 years |

## 8. PERMIT RENEWAL REQUESTED CHANGES:

APS is not requesting to add or modify any existing equipment with this renewal.

APS is requesting the following changes to the permit:

Permit Condition 1.a.iii.4)

The maximum short-term $NO_x$ emissions from the duct burners on CC4 and CC5 shall be limited to 0.20 lb/MMBtu at all times.

Comment: CC4 is no longer equipped with duct burner.

Table 3. BACT/LAER Allowable Emissions

APS is requesting that the last row of the table be removed since CC4 is no longer equipped with duct burners.

County: Accepted both changes above to remove references to CC4 duct burners.

Permit Condition 1.d.i

The maximum short-term $NO_x$ emissions from CC1 and CC2 during periods of normal operation shall not exceed 155 ppmvdc calculated as nitrogen dioxide when burning gaseous fossil fuel.

Comment: Add 'dc' to ensure it is understood that measurement is in parts per million by volume dry, corrected to 15% oxygen.

County: Accepted this change and added ppmvdc to the definition section.

Permit Condition 2.a.i.2)

If at any time a fuel sulfur analysis indicates noncompliance with the fuel sulfur limit of Pipeline Natural Gas, the Permittee shall notify the Administrator and Control Officer ~~of such excess emissions~~ within one week of the analysis and shall follow the procedures in 40 CFR Part 75, Appendix D. Section 2.3.1.4 for additional monitoring.

Comment: This would not be considered an excess emission. The plant would simply have to use calculated emission factor instead of the default .0006 lb $SO_2$/MMBtu.

County: Accepted this change as this is not an excess emission and took out the requirement to notify the Administrator.

Permit Condition 3.a.i

Combustion Turbine: The Permittee shall use operational practices for combustion turbines that ensure good combustion control. For purposes of this condition, "Good combustion control for combustion turbines shall mean that the temperature spread across the combustion burners during steady state operations is no greater than 100 °F." If a valid temperature spread of greater than 100 °F is observed across the burners, corrective action shall be taken within three hours to either (1) reduce the output of the units until the spread is less than 100 °F or (2) shutdown the unit until the problem causing the temperature imbalance is corrected. The temperature spread across the combustion burners during startup and shut down conditions shall not be subject to the maximum 100°F condition.

Comments: Temperature spread across burners is inconsistent when the unit is not operating during steady state because of inconsistent cooling. Language was added to clarify that condition does not apply during startup or shutdown.

County: Accepted this change.

Permit Condition 3.a.ii

CC5 Auxiliary Boiler (Clayton): The Permittee shall have established initial optimal baseline concentrations for $NO_x$ and CO utilizing the initial design burner specifications or manufacturer's recommendations to ensure good combustion practices. Tune the unit in accordance with good combustion practices or a manufacturer's procedure, if applicable, and as required by Rule 323. Tuning the unit may include the following but only as required by County Rule 323:

1) ~~Inspect the burner system and~~ Clean and replace any components of the burner as necessary to minimize emission of $NO_x$ and CO.

2) ~~Inspect the burner chamber for areas of impingement and remove if necessary.~~

3) Inspect flame pattern and make adjustments as necessary to optimize the flame pattern.

4) Inspect the system controlling the air-to-fuel ratio and ensure that it is correctly calibrated and functioning properly.

5) Measure the $NO_x$ and the CO concentration of the effluent stream after each adjustment was made with a handheld portable monitor to ensure optimal baseline concentrations are maintained.

Comment: Due to the design of the boiler and the ultra-low emission burner system, combustion chamber inspection, burner inspection, and inspection of the flame pattern cannot be complete. Documentation from Clayton has been provided to the agency during compliance inspection.

County: Changes were made and a note was added to the permit for 3).

Permit Condition 3.b.ii

Combustion Monitors: To monitor for good combustion the Permittee shall install and maintain combustion monitors on Combustion Turbines. The Permittee shall ~~daily~~ record temperature spread across the combustion burners for each Combustion Turbine except CC3, CC4, and CC5 during steady state operations. The Permittee shall keep record of any corrective actions taken in a case the temperature spread was greater than 100 °F during steady state operations. The temperature spread across the combustion burners during startup and shut down conditions shall not be subject to the maximum 100°F condition.

Comment: Language updated to clarify when recordkeeping of temperature spread is required.

County: These changes are reasonable and were accepted.

Table 5a. Stack Performance Test Requirements for the Combined Cycle Units 3, 4, and 5

Add EPA Method 320 to test Method column for Ammonia.

Comment: This condition has been approved at Redhawk Generating Station and improves consistency between plant requirements.

County: This change was accepted.

Permit Condition 4.a.ii.3)

The maximum temperature of the oxidation catalyst shall not exceed 1000 ºF as measured at the catalytic oxidizer inlet or the maximum temperature in the currently approved version of the O&M plan. The approved oxidation catalyst temperature range is ~~600~~ 350 - 1000 ºF during normal operations.

Comment: Updated to reflect value from the approved Operations and Maintenance Plan.

County: This change was accepted.

Permit Condition 5.a.i.1)

Daily zero and span calibration drifts according to 40 CFR 60.13(d). Note that daily zero, span and Quality Assurance activities are not required on any calendar day in which no fuel is combusted in the unit for which the CEMS is monitoring or if a malfunction of the CEMS occurs preventing the calibration to be performed in which case a daily calibration is required to be conducted as soon as the CEMS has been repaired and placed back in service.

Comment: A malfunction of the CEMS prevented the daily calibration to occur. When this was reviewed by the department, it was determined that it was not a violation of the permit or standard. APS is requesting that language is added to the permit to clarify what is required if a malfunction of the CEMS occurs. This language is from the recently approved Redhawk Power Plant Title V Permit that was negotiated with MCAQD earlier this year.

County: This change was made to the permit. The wording in the Redhawk permit was used to be more consistent between the two permits.

Permit Condition 5.a.v.

The Permittee shall ensure that all calibration gases (including zero gases) are certified and current at all times. The certification of zero air gases is unlimited and there is no expiration date for their certification.

Comment: This language helps to clarify that the certification of zero gas does not expire. Documentation related to this has been submitted to the agency during compliance inspections.

County: This is correct and the language added.

Permit Condition 5.a.vi.

The Permittee shall re-calibrate any CEMS after any maintenance activity that could affect the system calibration and shall re-certify, for the $NO_x$ and $O_2$ or $CO_2$ diluent CEMS, as required by and within the time periods required by 40 CFR 75.20(b) whenever the Permittee makes a replacement, modification, or change that may significantly affect the ability of the system to accurately measure or record emissions.

Comment: Language added to clarify requirement.

County: This is consistent with the regulations, so the language was added.

Permit Condition 7.d

d. In addition to the information provided in the Compliance Certification, the Permittee shall submit the following information at a minimum in the Monitoring Report.

i. ~~Hours of the operation and amount of fuel burned each hour for each combustion turbine, duct burner, and auxiliary boiler.~~ A summary of the hours of operation for each combustion turbine, duct burner and auxiliary boiler.

~~ii. Electrical energy output of each Combustion Turbine for each hour of operation.~~

iii Dates on which visible emissions observations were taken, the test method used, and the results of the observations;

iv. Fuel supplier certification or other documentation as detailed in Permit Condition 2.a.ix. regarding sulfur content for all fuel combusted;

~~v. Continuous Emissions Monitoring data related to the emission limits contained in this permit, calibrations, quality assurance, performance demonstrations, and certifications for the reporting period.~~

~~vi. Stack emissions test results related to emission limits and/or operational requirements in this Permit.~~

~~vii. Cooling tower inspection log and results of conductivity and TDS monitoring.~~

~~viii. Odor log.~~

~~ix. Good combustion monitoring records for Combustion Turbines including the records required by County Rule 322 §501.6.~~

x. Any other records and reports required by any Permit Condition contained in this Permit.

Comment: The items listed above are reviewed during the annual Title V inspection and do not need to be submitted in their entirety. This requirement language has been changed to match the requirements agreed upon in the recently approved Redhawk Title V permit. This will reduce extensive paperwork submittal and man hours on these semi-annual reports. The most current submittal of the compliance certification and monitoring plan for West Phoenix Power Plant was 888 pages in length.

County: The facility County inspector agreed that this was not necessary to be in the compliance Certification, so it was removed.

Table 6. Calculated Startup/Shutdown Emissions
Change lb/hr rate for CC3 to 440.

Comment: Correction made to reflect value found in Table 2a.
Equipment List Updates

1. Manufacture of Simple Cycle 1 and 2 were manufactured by Westinghouse
2. CC3 SCR was replaced and is manufactured by Ceram
3. CC5 oxidation catalyst is manufactured by Johnson Matthey
4. Cooling Tower 1, 2, and 3 is manufactured by PVC Cellular
5. Cooling Tower 5 is manufactured by Marley and is model TU12C
6. Self-contained abrasive blasting cabinet has exhaust
7. Bioventing systems no longer at facility
8. Facility no longer has a solvent cleaning station

County: These changes were made to the permit and equipment list.

County Rule 310 for Dust Generating Operations requirements were added to the permit in Conditions 10 through 18.

**9. ACID RAIN PERMIT APPLICATION:**

APS has submitted the required Acid Rain Renewal Application with their renewal application. Units CC4, CC5A, and CC5B will hold allowances in accordance with 40 CFR 72.9(c)(1).

**10. MODELING:**

No modeling was necessary for this permit renewal.

**11. CONCLUSION:**

Based on the information supplied by APS, and on the analyses conducted by the Maricopa County Air Quality Department, MCAQD has concluded that the requested Permit Renewal is consistent with Federal, State, and County regulations and rules and will not cause or contribute to a violation of any federal ambient air quality standard, will not cause any Arizona Ambient Air Quality Guidelines to be exceeded, and will not cause additional adverse air quality impacts.

Therefore, MCAQD proposes to issue the Permit Renewal subject to the proposed permit conditions.