Pacific Gas and Electric Company
Power Generation
Fossil Plant Construction

Colusa Generating Station Project
915 Highland Pointe Drive
Suite 130
Roseville, CA 95678

DOCKET
06-AFC-9C
DATE Nov 4 2008
RECD. Nov 4 2008

November 4, 2008

Mr. Dale Rundquist
California Energy Commission
1516 Ninth Street, MS-2000
Sacramento, CA 95814

Subject: Colusa Generating Station Project (06-AFC-9C)
Response to Data Requests 1-17 Related to PG&E's License Petition Amendment

Dear Mr. Rundquist:

Enclosed are Pacific Gas and Electric Company's responses to the California Energy Commission Staff's Data Requests 1-17 that were issued on October 17, 2008. The responses address Staff's questions in the technical areas of air quality and soil and water resources. If you have any questions regarding this information, please contact Andrea Grenier at (916) 780-1171.

Sincerely,

Jon Maring, Senior Director
New Generation

Enclosures

cc: Scott Galati, Galati & Blek LLP
Andrea Grenier, Grenier & Associates, Inc.
Steve Hill, Sierra Research
Jerry Salamy, CH2MHill

Colusa Generating Station

(06-AFC-9C)

Data Responses

(Responses to Data Requests 1 though 17)

Submitted to

California Energy Commission

Submitted by

Pacific Gas and Electric Company

November 2008

With Assistance from

CH2MHILL
2485 Natomas Park Drive
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Contents

Introduction

Attached are Pacific Gas and Electric Company's responses to the California Energy Commission (CEC) staff's Data Requests (DRs) 1 through 17 related to PG&E's License Petition Amendment which was submitted to the CEC on August 14, 2008. DRs 1-15 relate to air quality and DRs 16 & 17 relate to soil and water resources. The attached responses are presented in the same order as the CEC staff presented them and are keyed to the Data Request numbers (1 through 17). New or revised graphics or tables are numbered in reference to the Data Request number. For example, the first table used in response to Data Request 15 would be numbered Table 15-1. The first figure used in response to Data Request 15 would be Figure 15-1, and so on.

Air Quality (1-15)

Background

The requested annual emission revisions to Condition of Certification **AQ-26** for NOx, SOx, CO and VOC, while close, do not match the emissions totals shown in the Appendix 3.1-1 emission calculations. Additionally, the revisions in the hourly emissions are not reflected in the requested changes to the Conditions of Certification. Staff needs this discrepancy corrected.

Data Request

1. Please either correct the requested annual emission revisions in Condition of Certification **AQ-26** or correct the emission calculations provided in Appendix 3.1-1, and describe how these corrections were made, so that there is no discrepancies in the two provided annual emission values.

Response: The revised Condition of Certification AQ-26 is presented below which is consistent with the emission calculations presented in Appendix 3.1-1 of the Amendment.

AQ-26 The total emissions from the Colusa Power Plant shall not exceed the limits established below.

Quarterly and Annual Estimated Combustion Emissions from CGS Facility					
Pollutant	1st Quarter Emissions (tons)	2nd Quarter Emissions (tons)	3rd Quarter Emissions (tons)	4th Quarter Emissions (tons)	Annual Emissions (tons)
NO_X	45.57	43.58	51.30	44.26	184.71
CO	55.08	53.28	109.19	54.69	272.24
VOC	12.40	11.74	12.50	11.87	48.51
PM10	25.54	25.78	26.02	26.02	103.34
SO_2	4.04	3.83	3.86	3.86	15.49

Verification: The project owner shall submit to the CPM and APCO plant emissions data demonstrating compliance with this condition as part of the Quarterly Operation Reports (**AQ-22**).

Data Request

2. Please confirm numerically that the project's obtained emission reduction credits will cover any and all annual emission increases from the facility-wide annual emission limits currently allowed in **AQ-26** (annual VOC emissions are shown to have a minor increase in Appendix 3.1-1).

Response: Table 2-1 presents a comparison of the CGS emissions to the quantity of ERCs being purchased. As shown in Table 2-1, PG&E is purchasing a surplus of VOC, SO_2 and

PM_{10} ERCs, but is showing a deficit of NOx ERCs. PG&E is proposing to use VOC ERCs to mitigate NOx emissions at a ratio of 1.4:1, which is the offset ratio that was approved in the original Conditions of Certification.

The elimination of the auxiliary boiler, emergency generator, and fire pump resulted in a net reduction (including the new water bath heater emissions) in NOx emissions of 3.4 tons per year and a net increase in VOC emissions of 0.74 tons per year. The reduction in the CTG PM_{10} emission rate results in a reduction of PM_{10} emissions of 38.9 tons per year.

Table 2-2 presents a comparison of ozone and PM10 precursor emissions ERCs versus CGS emissions, which shows that the annual ozone precursor ERCs are being purchased in quantities greater than the expected CGS emissions.

PG&E will surrender sufficient credits from the purchased offsets to meet District offset requirements, and to mitigate all project annual emissions (except for NOx) at a 1:1 ratio. Mitigation for NOx will be achieved, in part, by NOx offsets; the shortfall will be mitigated by the surrender of VOC offsets at a ratio of 1.4:1.

The offsets purchased exceed the offsets to be surrendered. Once the required offsets are provided, PG&E will retain the remaining credits, in the amount of 8.96 TPY VOC and 0.04 TPY SO2.

TABLE 2-1
Comparison of PG&E CGS Emissions and ERCs being purchased

Pollutant	1st Quarter Emissions (tons)	2nd Quarter Emissions (tons)	3rd Quarter Emissions (tons)	4th Quarter Emissions (tons)	Annual Emissions (tons)
CGS NO_X	45.57	43.58	51.3	44.26	184.71
NOx ERCs Provided	28.79	27.41	23.36	29.93	109.50
CGS VOC	12.4	11.74	12.5	11.87	48.51
VOC ERCs Provided	52.58	52.19	51.91	53.47	210.15
CGS PM_{10}	25.54	25.78	26.02	26.02	103.34
PM_{10} ERCs Provided	30.26	28.16	21.97	31.58	111.96
CGS SO_2	4.04	3.83	3.86	3.86	15.49
SO_2 ERCs Provided	4.65	3.96	1.93	5.12	15.66

TABLE 2-2
PG&E CGS Non-Attainment Pollutant ERC Liability Comparison

Pollutant	1st Quarter Emissions (tons)	2nd Quarter Emissions (tons)	3rd Quarter Emissions (tons)	4th Quarter Emissions (tons)	Annual Emissions (tons)
CGS Ozone Precursors Emissions	57.97	55.32	63.8	56.13	233.22
Ozone Precursor ERCs	78.56	77.34	74.36	80.47	310.73
CGS PM_{10} Precursor Emissions	29.58	29.61	29.88	29.88	118.83
PM_{10} Precursor ERCs Provided	34.89	32.10	23.88	36.68	127.56

Data Request

3. Please identify why the changes to the NOx, SOx, CO, and VOC hourly emissions, as identified in Table 3.1-1, and daily emissions were not shown in the requested change to Condition of Certification **AQ-25**, and if that was an error of omission please provide a correction to the request change in this condition.

Response: Condition of Certification AQ-25 only addresses the turbine/heat recovery steam generator (CTG/HRSG) emissions and expected hourly changes identified in Table 3.1-1 of the Amendment only specifies a change to CTG/HRSG PM_{10}. As shown Table 3.1-1 of the Amendment, no changes to the combustion turbine/heat recovery steam generator NOx, CO, VOC, or SO2 emission rates are expected, and therefore no changes to NOx, CO, VOC, or SO_2 emissions in AQ-25 are warranted.

Background

Amendment 1 indicates a significant reduction in PM10 emissions from the gas turbines, an action originally recommended by staff early during the siting process of the project. However, while the hourly, daily, and annual emissions are shown to drop substantially in Appendix 3.1-1, the annual reductions are not described in Section 3.1 and are not identified as a requested change to Condition of Certification **AQ-26** or the emission offset conditions **AQ-SC7** and **AQ-27**.

Staff expects that if there is ever to be a request to reduce the PM_{10} offsets due to the turbine PM_{10} emission reduction, that action would be handled with this amendment request, so a request to change the offset package should be made now based on this identified emission reduction, or not at all. Staff needs additional information regarding the reduction in the annual PM_{10} emissions and the ultimate ramifications to the conditions of certification.

Data Request

4. Please identify why the significant annual emissions reduction for PM10, as identified in Appendix 3.1-1, were not carried forward in Section 3.1 or in the requested revision to the conditions of certification provided in Appendix 4 of the amendment request.

Response: PG&E is currently exploring the possibility with the Colusa County Air Pollution Control District's (CCAPCD) of lowering its PM_{10} ERC liability to address the reduction in turbine PM_{10} emissions. If the CCAPCD approves the modifications to the project's PM_{10} ERC package, PG&E will submit the CCAPCD's modifications to AQ-27 to the CPM for approval under the authority granted in AQ-SC6 and AQ-SC7. Since the CCAPCD has not approved an alternate PM_{10} ERC package at this time, PG&E is requesting this amendment be processed to allow construction to continue without waiting for modifications to AQ-27, which are uncertain at this time. PG&E would also like to point out that sufficient ERCs to mitigate the CGS's PM10 liability were identified during the licensing of the project as noted in the Air Quality Appendix of the CGS Final Decision.

Data Request

5. Please identify if the PM10 offset requirement of **AQ-SC7** and **AQ-27** will be requested to be amended due to the significant gas turbine PM10 emission reductions that are requested as part of this amendment, and if so please:

a. Provide requested revisions to the conditions of certification; and

Response: See Response to Data Request 4 above.

b. identify the specific emission reduction credits (ERCs), shown in the Appendix to **AQ-SC7**, that are now proposed to be used to offset the PM10 emissions (Staff's preference is to use the stationary source ERCs first, and the agricultural burn cessation credits second).

Response: See Response to Data Request 4 above.

Major Equipment Removal Questions

BACKGROUND

The amendment request removes several pieces of operating equipment (auxiliary boiler, emergency generator engine, and fire pump engine) formerly considered necessary for safe and efficient site operation. Staff needs additional description to show that this equipment can be removed without causing significant air quality impacts.

Data Request

6. The use of the auxiliary boiler was originally described as necessary to limit start-up emissions for the facility, so staff is concerned that removal of the auxiliary boiler could increase the maximum hourly emissions or maximum duration and total emissions of the gas turbine start-ups. Please provide additional description, of PG&E's operating experience with 7F turbines, that supports the contention that the auxiliary boiler is not necessary and that its removal would not cause an increase in start-up emissions or durations.

Response: As shown at pp. 11-12 of the Colusa County Air Pollution Control District's (CCAPCD) Final Determination of Compliance (FDOC), the original estimates of startup emissions (by the project's prior owner) were as follows:

Estimated Emission Rates for One Gas Turbine During Startup and Shutdown (from FDOC)

	Cold Startup		Warm Startup		Hot Startup		Shutdown	
	270 minutes		180 minutes		90 minutes		30 minutes	
Pollutant	Lbs/hr	Lbs/event	Lbs/hr	Lbs/event	Lbs/hr	Lbs/event	Lbs/hr	Lbs/event
NOx	333.3	779.1	152.0	456.2	249.9	259.9	115.0	115.0
CO	373.6	1355.6	370.3	790.5	429.6	679.6	483.5	483.5
VOC	27.7	106.7	27.7	47.4	27.7	38.0	23.9	23.9
SOx	2.0	5.05	2.0	2.88	2.0	1.66	1.0	1.0
PM_{10}	12.0	48.8	12.0	30.8	12.0	12.8	6.0	6.0

As suggested by the CEC staff, elimination of the auxiliary boiler will, in fact, extend the startup times for CGS, particularly during the infrequent cold starts expected at the plant. Based on discussions with equipment suppliers, PG&E estimates that cold starts may be extended by up to 45 minutes beyond the times previously expected. This would increase the length of a cold start from the 4.5 hours estimated by the project's prior owner, to up to 5.25 hours. This longer duration is not inconsistent with cold start times reviewed and approved by the CEC for other F-class turbine projects.1 (See, for example, the 360 minute startup duration recently approved for the Russell City Energy Center's cold starts.)

The auxiliary boiler would also have been used to shorten warm and hot startups. However, PG&E believes that the startup durations proposed by the previous owner (180 minutes for warm starts, and 90 minutes for hot starts) are sufficiently conservative regardless of whether an auxiliary boiler is used or not. As a result, PG&E does not believe that changes to the limits on the duration of warm or hot starts are necessary (nor are changes to the mass emission limits for these startup events.)

The second aspect of the CEC staff's question relates to emissions during startups, and whether the increased startup duration (particularly for cold starts) would result in increased emissions. In theory, the longer startup durations will result in increased emissions for NOx and CO (and, potentially, VOC). No increase in emissions would be expected for SOx and PM_{10}, as startup emissions for those pollutants are generally the same as, or lower than, emissions during routine operations. As shown in the January 15, 2008 petition to amend the Commission's Decision in the case of PG&E's Gateway Generating Station, PG&E believes that, during a cold start, NOx emissions would be not more than 160 lbs/hr, and not more than 600 lbs/event during a six hour cold start. For CO, PG&E

[1] Although the staff's question requested information regarding startups with General Electric 7FA combustion turbines, the duration of a cold start is largely a function of the equipment downstream of the combustion turbine, such as the heat recovery steam generator and steam turbine, and plant cooling system. Thus, data from all comparable F-class turbines is relevant to answering the question regarding startup duration.

believes that, during a cold start, CO emissions would be not more than 900 lbs/hr, and not more than 5400 lbs/event during a six hour cold start. VOC emissions are expected to be not more than 16 lbs/hr, and not more than 96 lbs/event for a six hour cold start.

With the exception of the CO values, the expected worst case emission rates are less than the current permit limits for CGS and, as a result, PG&E sees no reason to amend these conditions. With respect to CO emissions, actual data from sixteen startups of combined cycle units with F-class turbines in California showed a maximum hourly CO emission rate of 130 lbs/hr, and 420 lbs/start. (These data are from source test reports that have been previously submitted to the CEC Staff by the respective project owners.) These numbers are well below the current permit limits for CGS. Although PG&E might prefer to have higher CO limits, consistent with those proposed for Gateway, given the fact that emissions during startups are not guaranteed by equipment vendors, PG&E believes that the available data supports the current CGS emission limits even in the absence of an auxiliary boiler.

Data Request

7. Please provide more information regarding the potential for simultaneous outages for the two redundant 230-kV transmission lines and the 12-kV distribution line, such as the catastrophic power outage that occurred over the northeastern United States in 2003.

Response: Auxiliary power to Colusa Power Plant comes from two sources. One is the 230 kV line, and one from the 12 kV line. Colusa Plant is connected to Delevan substation which loops four (4) 230 kV lines from North to South. On this basis alone, supporting the auxiliary power required for the plant can come from 8 lines, 4 from the North, and 4 from the South, not including the 12 kV from Cortina substation which takes power from the 4 lines on the South side.

Data Request

8. The emergency engine was originally described in the project's AFC as required during extended utility outages for the safe shutdown of the CTGs, HRSGs and STG. In the event of a catastrophic outage please identify how safe shutdown of these units and shutdown emissions would be ensured.

Response: The emergency diesel generator was originally included to provide power to the plant's critical electrical bus. The critical bus power is supplied from the plant's uninterruptible power supply (UPS) which powers those components necessary for a safe plant shut down and allows for an expedited return to service when normal power supply is restored. Components necessary for a safe plant shut down include the continuous emissions monitoring system, gas and steam turbine lube oil systems, turbine turning gear motors, the control room distributive control system, and plant emergency lighting. The UPS is normally powered from plant supply which also continuously supplies and charges the UPS batteries. When the normal power feed to the UPS is lost, the batteries provide the necessary electrical supply (without interruption) to the critical bus for two hours after loss of the primary electrical power supply. This time is sufficient to ensure an orderly plant shutdown.

New Equipment - Emission Control Technology

BACKGROUND

The amendment requests the addition of two new polluting equipment items, the Wet Surface Air Condenser (WSAC) and the natural gas water bath heater, but does not provide any information about emission controls for either item. Staff needs additional information about the emission controls proposed for these new equipment items.

Data Request

9. Please describe the emission controls proposed for the WSAC.

Response: The WSAC will include drift eliminators with a control efficiency of 0.005 percent of the recirculation rate. The WSAC design does not allow for the addition of additional fill to increase the drift elimination efficiency.

Data Request

10. Please describe the emission controls proposed for the water bath heater.

Response: The water bath heater will include low NOx burners capable to achieving a NOx concentration of 30 parts per million by volume dry (ppmvd) corrected to 3 percent oxygen and a CO concentration of 100 ppmvd corrected to 3 percent oxygen.

BACKGROUND

The emission calculations presented in Appendix 3.1-1 of the amendment request for the new equipment items do not provide enough information to determine the basis of the hourly emissions determined for the WSAC or the water bath heater. Staff needs additional information regarding the emission assumptions for these two new equipment items.

Data Request

11. Please provide the basis and calculations for the hourly PM10 emissions from the WSAC as identified in Appendix 3.1-1, including the water spray rate, assumed mist fraction (with reference source), and the local water quality data used to determine the operating total dissolved solids (TDS) level.

Response: The WSAC PM10 emissions are based on a TDS of 200 parts per million, a recirculation rate of 8,000 gallons per minute (based on a water spray of 1,960 gpm per cell and 4 cells), a drift elimination rate of 0.005 percent, and 6 cycles of concentration.

Data Request

12. Please provide the emission concentration basis used to determine the hourly emissions from the water gas heater as identified in Appendix 3.1-1, including any relevant burner based emission factors/emission concentration limits.

Response: Table 12-1 presents the emission concentrations and rates used in calculating the hourly emission rates for the water bath heater. The emission concentrations were back calculated from the emission rates presented in Table 12-1.

TABLE 12-1
PG&E CGS Water Bath Emission Concentrations

Pollutant	Ppmvd @ 3% Oxygen	Pounds/MMBtu
NOx	30	0.039
CO	100	0.079
SO_2	--	0.003
VOC	--	0.003
PM_{10}	--	0.003

Laws, Ordinances, Regulations and Standards

BACKGROUND

The amendment request does not fully describe the LORS applicable to the amendment request and compliance with the LORS. Staff needs additional information to fully analyze the requested changes to the facility.

Data Request

13. Please identify the LORS that are applicable to the WSAC and the water bath heater, such as Colusa County Air Pollution Control District (CCAPCD) permitting requirements, and describe compliance with those LORS.

Response: The WSAC and water bath heater are subject to the same CCAPCD LORS as were analyzed during the licensing proceeding, including the CCAPCD's Regulation III – Permits. As discussed below, PG&E has consulted with the CCAPCD and is preparing a request to modify the Authority to Construct permit (Determination of Compliance) and will submit a copy of the request to the CCAPCD and CEC by November 7, 2008. The WSAC will further be required to comply with the CCAPCD Appendix A Regulation for Chromate Treated Cooling Towers, which requires notifying the CCAPCD about the installation of a cooling tower, prohibiting the addition of any hexavalent chromium-containing compounds to the cooling tower circulating water, maintaining the hexavalent chromium concentration in the cooling tower circulating water to less than 0.15 milligrams per liter, testing the circulating water to determine the concentration of hexavalent chromium every six months, maintaining records of any tests for two years, and submitting records to the CCACPD when requested. PG&E will not use any chromium-based cooling tower additives (as demonstrated by the MSDS submitted as Appendix 3.12 of the Amendment), and does not expect that the WSAC will be constructed with any chromium treated materials. Therefore, PG&E expect to comply with applicable CCAPCD LORS.

Air Quality Permits

BACKGROUND

This facility requires both CCAPCD and U.S. EPA air quality permits. The amendment request provides no information regarding the impact of the requested changes to these permits. This is particularly critical for the CCAPCD permit because the requested revisions to the conditions of certification impact CCAPCD permit conditions. Staff needs additional information regarding the actions taken to modify these permits.

Data Request

14. Please identify the steps taken to modify the CCAPCD air quality permit.

Response: PG&E has been in discussions with CCAPCD (represented by Mr. Les Fife) regarding modification of the air permit. Based on these discussions, PG&E is in the process of preparing this request to modify the air permit and will submit it to the CCAPCD (with copies to the CEC) by November 11, 2008.

Data Request

15. Please identify the steps taken to modify the U.S. EPA air quality permit.

Response: PG&E has been in discussions with U.S. EPA Region IX (Ms. Shaheerah Kelly – 415- 947-4156) regarding modification of the PSD permit. Based on these discussions, U.S. EPA does not believe that the proposed changes represent a major modification to a major source, and has suggested that PG&E submit a formal request to modify the PSD permit. PG&E is in the process of preparing this request and will submit it to the U.S. EPA (with copies to the CEC and Colusa County Air Pollution Control District) by November 11, 2008.

Soil & Water (16 & 17)

BACKGROUND

PG&E proposes to add a wet surface air cooler (WSAC) that would provide greater cooling capability for all lubricating oil . A natural gas water bath heating system is added to heat up the gas to prevent condensation. In the petition, PG&E estimates that operation of the WSAC system will have an annual water consumption of 21-AF. The additional consumption of 21-AF to the expected annual CGS consumption of 130-AF brings the revised CGS annual water consumption to 151-AF.

PG&E's water supply agreement with the Glenn-Colusa Irrigation District provides for a maximum annual delivery of 180-AF for CGS operation, which is the maximum annual water consumption per Condition of Certification **SOIL & WATER-7**. The annual consumption of 21-AF seems to be reasonable but PG&E provides no supporting text or tables supporting this consumption.

PG&E has provided a revised water balance diagram as Figure 2-4 that includes the WSAC system but did not provide a water balance table that identifies the flow rates corresponding to the processes shown on Figure 2-4. Additionally, the natural gas water bath heating system is not shown on the water balance diagram and its flow rate and annual water consumption are not identified.

Data Request

16(a). Please provide: discussion of the average and maximum water consumption for the WSAC and the natural gas water bath heating systems that includes a table showing the average and maximum flow rates in gallons per minute and corresponding annual consumption in acre-feet.

Response: Table 16-1 presents the WSAC maximum make-up water flow rate in gallons per minute and annual average water requirements in acre-feet. An average flow rate is not expected as the WSAC will be operated only during warm ambient conditions. However, to estimate the annual average water requirement, PG&E assumed the WSAC is operated at the maximum make-up water flow rate for 80 percent of the year.

The water bath heater does not use water on a continuous basis. The heater consists of a vessel containing a water/glycol mixture and heat transfer piping. Natural gas is combusted in one set of heat transfer piping and the natural gas being heated is passing through another set of heat transfer piping. The heat of combustion heats the water/glycol mixture, which heats the natural gas.

TABLE 16-1
WSAC Water Use

	Maximum Water Use Gallons/Minute	Annual Average Water Use Acre-Feet/Year
WSAC	108	2.32

16(b). Please provide: water balance diagram(s) that shows the flow distribution to the WSAC and the natural gas water bath heating systems and a table that identifies the flow rates for the processes shown on the diagram(s).

Response: Figures 16-1a and 16-1b presents a water balance diagram for the CGS project, showing the flow rates for all water consuming equipment.

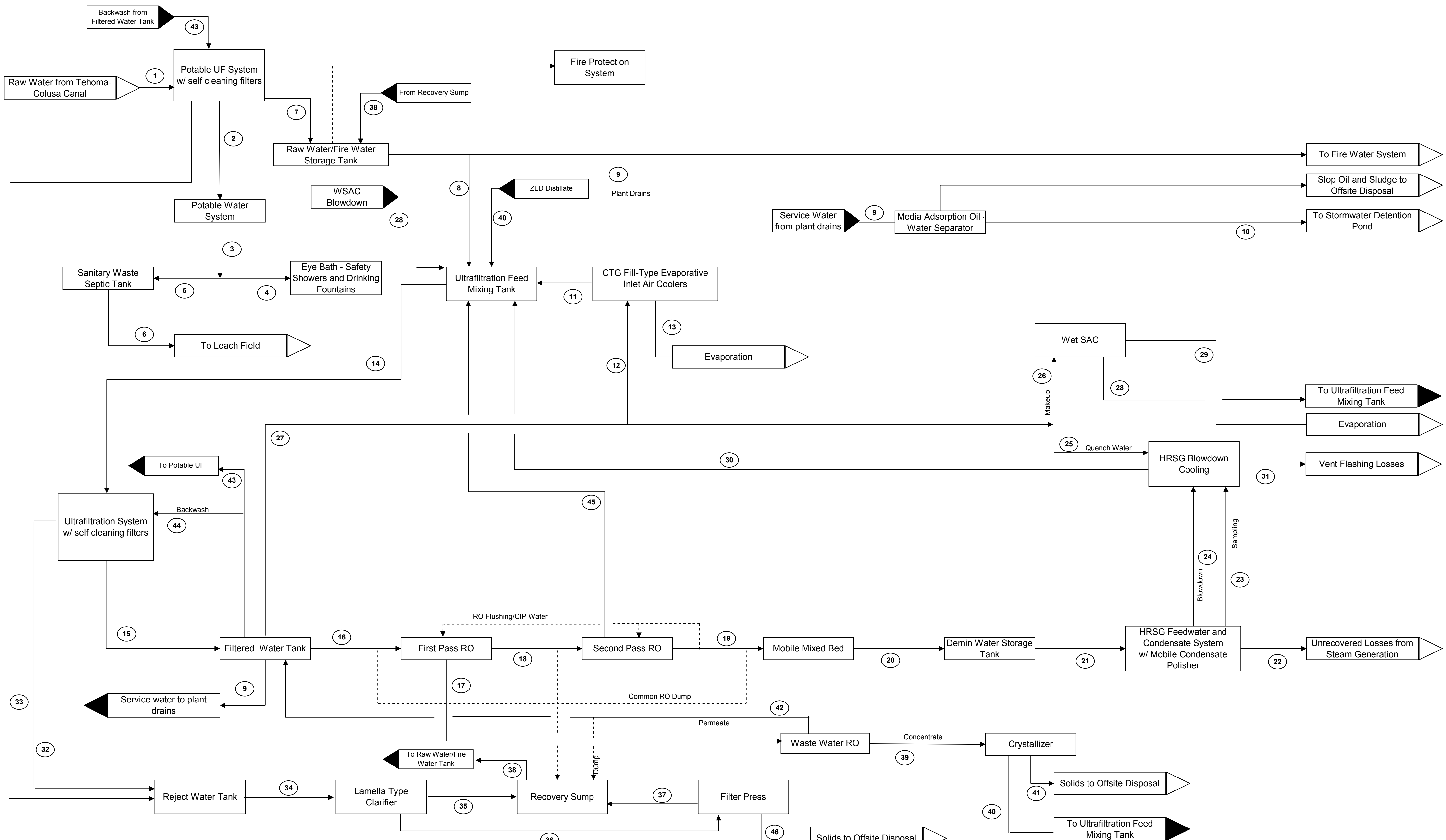
BACKGROUND

Condition of Certification **SOIL & WATER-10** prohibits surface or subsurface disposal of process wastewater and requires a narrative of the redundant or backup wastewater disposal method to be implemented during periods of ZLD system shutdown or maintenance. The water balance diagram, Figure 2-4 in PG&E's petition, includes a backup wastewater discharge cell shown with dashed lines. Staff assumes this is an emergency backup system, but no descriptive text or disposal process was included in the amendment petition.

Data Request

17. Please provide a description of the emergency wastewater discharge system, including its proposed location on the CGS site, and its potential impacts to soil and water resources.

Response: PG&E has developed two options for disposing of wastewater during zero liquid discharge (ZLD) system outages. The first is to discharge wastewater to the fire water sump and after the ZLD system is operational, process the wastewater (in the fire water sump) in the ZLD system for disposal. Alternatively, wastewater would be stored in temporary tankage and again process by the ZLD system when functional. The temporary tankage would be stored just north of the fire water pump house (item 24 on Amendment Figure 2-1), located near the southwestern corner of the project site.



Source: WorleyParsons LTD, Drawing COLS-1-SK-021-305-001C, 09/27/08

FIGURE 16-1A
COLUSA GENERATING STATION WATER BALANCE

COLUSA GENERATING STATION
PACIFIC GAS AND ELECTRIC

CH2MHILL

ES022008013SAC figure_16_1a.ai 10.30.08 tdaus

Rev	Date	By	Checked	Rev	Date	By	Checked	Rev
C	8/27/2008	MLC	SJR					
	Case (Heat Balance Case)	Duct Burning Status	Evaporative Cooler Status	Temperature °F	Relative Humidity (%)	Wet Bulb Temperature °F	Main Steam Flow at HRSG (pph)	% Occurrence
	A (1155)	Off	Off	**59**	**60.0**	**51.56**	**912018**	20%
	B (1189)	On	On	**94**	**25.4**	**67.96**	**1752972**	30%
	C (1159)	On	Off	**59**	**60.0**	**51.46**	**1764925**	20%
	E (1195)	Off	On	**114**	**20.0**	**77.81**	**901359**	
	(1199)	On	On	**114**	**20.0**	**77.81**	**1178258**	30%

Values are daily average values in gpm unless otherwise noted

Stream No.	Stream Description	Case A @ 2% HRSG blowdown	Case C @ 2% HRSG blowdown	Case B Full Wet SAC	Case E Full Wet SAC	1199 Full Wet SAC	**Startup** Case A
1	Influent from Canal	35	53	216	224	229	155
2	Potable Water Makeup	5	5	5	5	5	5
3	Potable Water Effluent	5	5	5	5	5	5
4	Eye Wash/Safety Shower Flow	1	1	1	1	1	1
5	Sanitary Waste to Septic System	4	4	4	4	4	4
6	Septic Waste to Leach Field	4	4	4	4	4	4
7	Potable UF effluent to Raw water tank	26	43	190	196	201	135
8	Ultrafiltration Feed Mixing Tank Makeup	48	82	265	260	270	205
9	Plant Washwater	10	10	10	10	10	10
10	Oil Water Separator Effluent to Stormwater	10	10	10	10	10	10
11	CTG Air Cooler Blowdown	0	0	14	19	19	0
12	CTG Air Cooler Makeup	0	0	86	116	116	0
13	CTG Air Cooler Evaporation	0	0	72	97	96	0
14	Ultrafiltration System Makeup	196	362	575	443	496	582
15	Ultrafiltration Product	176	326	517	399	446	524
16	1st Pass RO Makeup	67	122	122	66	84	156
17	1st Pass RO Reject	17	31	30	17	21	39
18	1st Pass RO Permeate	50	92	91	50	63	117
19	2nd Pass RO Permeate	45	83	82	45	57	105
20	Demineralized Water to storage Tank	45	83	82	45	57	105
21	Cycle Makeup	45	83	82	45	57	105
22	HRSG Unrecovered Losses	4	7	7	4	5	9
23	Sampling Losses	5	5	5	5	5	5
24	HRSG Blowdown	36	71	70	36	47	91
25	Quench Water	109	212	210	108	141	273
26	WSAC Makeup	0	0	108	108	108	108
27	Filtered Water From Tank	119	222	414	342	375	391
28	WSAC Blowdown	0	0	18	18	18	18
29	WSAC Evaporation			90	90	90	90
30	HRSG Quenched Blowdown	136	259	257	135	175	333
31	Vent Flashing Losses	15	28	28	14	19	36
32	Ultrafilter Reject to Reject Tank	20	36	57	44	50	58
33	Potable UF Reject to Reject Tank	3	5	22	22	23	16
34	Lamella Clarifier Makeup	23	41	79	67	73	74
35	Lamella Clarifier Product Water	21	37	71	60	65	66
36	Lamella Clarifier Bottoms to Filter Press	2	4	8	7	7	7
37	Filterpress return to recovery sump	1	2	4	3	4	4
38	Recovery Sump Return to Raw Water Tank	22	39	75	63	69	70
39	ZLD Feed	7	12	12	7	8	16
40	ZLD Distillate to UF Mixing Tank	6	12	12	6	8	15
41	Solids to offsite disposal	0	1	1	0	0	1
42	WW RO Permeate to Filtered Water Tank	10	18	18	10	13	23
43	Potable UF Backwash	0	0	0	0	0	0
44	UF Backwash	0	0	0	0	0	0
45	2nd Pass RO Reject	5	9	9	5	6	12
46	Water leaving with Solids from filter press	1	2	4	3	4	4
	Yearly Average Total Make-up (acre-ft/year)	46	60	192	198	202	143

Operating Conditions:

16 hrs/day
6 days/week
2 hrs/startup/day

Assumptions:

Evap Cooler/ WSAC COC	6
Clarifier Bottoms, (% influent)	10%
1st Pass RO Reject (% influent)	25%
2nd Pass RO Reject (% influent)	10%
ZLD Distillate(% influent)	95%
Unrecovered losses (% HRSG BD)	10%
Blowdown flash (% HRSG BD)	40%
ZLD Steam requirement (% Evaporator influent flow)	65%
Sanitary Waste (gpm)	4
Eye Wash/Safety Shower Flow (gpm)	1
Sampling Losses (gpm)	5
Plant Washwater (gpm)	10
WSAC Evaporation (gpm)	90
Percent HRSG BD	2%
UF Reject	10%
Startup BD	5%
WWRO Reject (% influent)	40%

OVERALL AVERAGE YEARLY TOTAL MAKE UP:

139 acre-ft/year

Determined using full WSAC for Cases B and 1199 for 30% of the year respectively.

The remainder was determined with Cases A and C for 20% of the year respectively with no wet cooling.

FIGURE 16-1B
COLUSA GENERATING STATION
WATER BALANCE
COLUSA GENERATING STATION
PACIFIC GAS AND ELECTRIC

Source: WorleyParsons LTD, Drawing COLS-1-SK-021-305-001C, 09/27/08

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