HYD-31 Response

HYD-31 Information Needs:

Please make available for reference and demonstration waste concentration, predicted dilutions, and concentrations at various distances from the discharge point for all plant discharge to water-bodies.

Action:

A table summarizing information on the estimated concentration of chemicals in the effluent stream after treatment in the blowdown treatment facility along with a narrative explanation of the process will be made available in a referenceable form.

Response:

A water chemistry analysis was used to estimate the analyte concentrations for a 2.4-cycle blow-down discharge into Lake Granbury to evaluate the anticipated water quality at the effluent discharge point for the Combined Operating License (COL) Application as a part of the Environmental Report for Comanche Peak Nuclear Power Plant (CPNPP). This analysis included using the tabulated quarterly monitoring data for surface water (SW) samples collected in year 2007 from Lake Granbury. This data was used to determine the mean and maximum concentrations for each analyte. The estimation included:

1) Compiling the Lake Granbury quarterly data (Sampling Locations LG 101 through LG 109) into a Spreadsheet.

2) Converting *non-detect* values and reporting the appropriate value for statistical analyses as follows:
   a) For results reported BELOW the detection limits:
      i. ½ of the reporting limit or ½ of the screening limit, whichever was smaller, was used in the calculation for each analyte.
   b) For results reported ABOVE the detection limits:
      i. The detected value was used in the calculation for each analyte.

3) Using Excel "AVERAGE" and "MAX" functions to determine the MEAN and MAX concentrations for each analyte over the four quarterly sampling events.

4) Using the calculated MEAN and MAX concentrations to determine the MEAN and MAX analyte concentrations after a 2.4-cycle concentration (performed in this calculation) for the Low Flow of Lake Granbury.

5) Using the calculated MEAN and MAX concentrations to determine the MEAN and MAX analyte concentrations after a 2.4-cycle concentration (performed in this calculation) for the Annual Mean Flow of Lake Granbury.

6) ER Table 3.6-1 was used to summarize the chemicals expected to be added to the system and the concentrations of the chemicals were estimated.

7) The final concentrations were compared to the Texas Commission on Environmental Quality (TCEQ) Criteria for Specific Metals in Water for Protection of Aquatic Life, Texas Surface Water Quality Standards (TSWQS), Human Health Criteria in Water, Screening Levels for Nutrient Parameters and

the CPNPP Texas Pollutant Discharge Elimination System (TPDES) permit.

Therefore, this estimation has three parts as follows:

1) Part 1: To estimate the 2.4-cycle effluent concentration for the MEAN concentration and the MAX concentration of each analyte.

2) Part 2: To estimate the analyte concentration (both MEAN and MAX) after the 2.4-cycle effluent has been diluted into Lake Granbury during Low Flow and Annual Mean Flow.

3) Part 3: To estimate the total concentration of the added chemicals present in the effluent discharge.

The results are provided on the attached spreadsheet.

During this estimation, the following conclusions were derived:

- Most of the mean and maximum trace metals concentrations are below the TCEQ Criteria for Specific Metals in Water for Protection of Aquatic Life.
- No samples had a selenium concentration reported above the detection limits; however, selenium was estimated to exceed the TCEQ Criteria for Specific Metals in Water for Protection of Aquatic Life after ½ the detection limit was calculated and used in the 2.4-cycle cooling tower operation concentration for both the mean and maximum concentrations when mixed with Lake Granbury at low flow. Selenium is estimated to be reduced to concentrations below the TCEQ Criteria for Specific Metals in Water for Protection of Aquatic Life when mixed with Lake Granbury during the annual mean flow for both mean and maximum concentrations.
- Chlorides are not estimated to exceed the Texas Surface Water Quality Standards (TSWQS) for Lake Granbury as a result of the 2.4-cycle cooling tower operation for the mean concentration but are estimated to exceed the TSWQS for the maximum concentration, and both the mean and maximum concentrations when diluted by Lake Granbury at low flow. Chlorides are expected to be reduced to concentrations less than the TSWQS when mixed with Lake Granbury during the annual mean flow for both mean and maximum concentrations.
- The concentration of total dissolved solids (TDS) is estimated to exceed the TSWQS for Lake Granbury for maximum concentrations as a result of the 2.4-cycle cooling tower operation and when mixed with Lake Granbury at low flow and annual mean flow.
- Sulfates are only estimated to exceed the TSWQS for Lake Granbury at maximum concentration when diluted by Lake Granbury at low flow.

To further describe the 2.4-cycle blow-down estimation, the follow assumptions were made:

HYD-31 Response

The appropriate calculation is the EPA's Simple Dilution Model Equation:

$$C_{is} = \frac{L/OD * CF}{FF + SF}$$

Where:

C_{is} = in-stream pollutant concentration (µg/L)
L = facility pollutant loading (lbs/yr)
OD = facility operations (days/yr)
FF = facility flow (MG/Day)
SF = stream flow (MG/Day)
CF = conversion factor 120 (µg MG/L lbs) = 0.2642 (gal/L) * 0.4536 (kg/lbs) * 10^3 (µg MG/kg gal)

The units are the units provided by the EPA. To use this equation to calculate the concentration at dilution, these units were not used and the following assumptions apply:

- The EPA's simple stream model equation is an appropriate estimate of analyte concentration after dilution and does not account for fate or transport within the stream.
- Accounts for no existing analyte concentrations at the dilution point (therefore, the statistical MEAN and statistical MAX are factored back [see modified equation]).
- L/OD = is the loading rate and is equivalent to analyte concentration (mg/L or ug/L) times the Plant Discharge Rate (PDR) (L/sec).
- FF = PDR (L/sec).
- SF = Low Flow, or the Annual Mean Flow (L/sec).
- The equation can be modified to account for conversion factors discussed above and to account for the existing concentrations in Lake Granbury at the dilution point.

Design inputs include the following:

mg/L = milligrams per liter
cfs = cubic feet per second
gpm = gallons per minute
MG/Day = million gallons per day
L/sec = liters per second
ppm = parts per million, milligrams per liter
ppb = parts per billion, micrograms per liter

- The statistical MEAN and statistical MAX concentration for each analyte reported from the water quality monitoring locations from Lake Granbury.
- Plant Discharge Rate (PDR) = 26,100 gpm.
- Low Flow of Lake Granbury = 28 cfs.
- Annual Mean Flow of Lake Granbury = 1031 cfs.
- The statistical MEAN and statistical MAX calculated from quarterly

monitoring data collected at certain locations from Lake Granbury.
- ER Table 3.6-1 concentrations in waste stream.

The following were converted to L/sec

Gallons per minute (gpm)	Cubic feet per second (cfs)	Liters per second (L/sec)
26,100	58.15	1646.65
	28 (low flow)	792.87
	1031 (monthly average flow)	29,194.67

For Part 1:
The statistical MEAN and statistical MAX concentration for each analyte on the attached spreadsheet was multiplied by 2.4.

For Example:

The statistical MAX concentration (AC_{max}) for Total Alkalinity is 141 mg/L.
2.4-cycle concentration = AC_{max}*2.4
= 141 mg/L*2.4
= **338 mg/L**

For Part 2:
To estimate the analyte concentration as a result of dilution in Lake Granbury, use the EPA's simple dilution stream model that does not account for fate or transport and factor the analyte concentration (AC) measured in Lake Granbury back into the equation:

$$C_{dilution} = \frac{L/OD + AC_{mean} \text{ or } AC_{max}}{FF + SF}$$

Where:
- $C_{dilution}$ = in-stream pollutant concentration at the discharge point
- L/OD = facility loading rate in mass/time (mg/sec or ug/sec).
- FF = facility flow (L/sec).
- SF = stream flow (L/sec).
- AC_{max} = Statistical MAX analyte concentration in Lake Granbury at the dilution point.
- AC_{mean} = Statistical MEAN analyte concentration in Lake Granbury at the dilution point.

For example:

L/OD = Cycle Mean or Max Concentration * PDR
Max Total Alkalinity concentration in 2.4-cycle effluent = 338 mg/L
FF = PDR = 1646.65 L/sec
SF at Low Flow = 792.87 L/sec

AC_{max} = 141 mg/L

$$C_{dilution} = \frac{338\ mg/L * 1646.65\ L/sec}{792.87\ L/sec + 1646.65\ L/sec} + 141\ mg/L$$
$$= 228\ mg/L + 141\ mg/L$$
$$= \mathbf{369\ mg/L}$$

For Part 3:

To estimate the total concentration of the chemical additive in the effluent discharge, add the concentration listed for each system's waste stream. If the concentration in the waste stream is reported in ER Table 3.6-1 as a less-than value, then the less-than value is used as the concentration in the effluent.

$$SC_{tot} = SC_{cws} + SC_{esw}$$

Where:

- SC_{tot} = total concentration of the additive chemical after each system
- SC_{cws} = concentration of the additive chemical after the CWS system
- SC_{esw} = concentration of the additive chemical after the ESW system

For example:

Total concentration of Biocide/sodium hypochlorite in the effluent discharge

SC_{cws} = 0.2 ppm
SC_{esw} = <0.2 ppm
SC_{tot} = 0.2 ppm + 0.2 ppm
= **0.4 ppm**

The values of the estimated analyte concentrations for a 2.4-cycle blow-down discharge into Lake Granbury are presented on the attached spreadsheet.

Stacy H. Burgess

Signature

4/14/2009

Date

4th Quarter Dilution Table

Category		Total Alkalinity mg/L	Total Arsenic mg/L	Total Barium mg/L	Bicarbonate Alkalinity mg/L	Total Boron mg/L	Total Cadmium mg/L	Total Calcium mg/L	Carbonate Alkalinity mg/L	Chloride mg/L	Chlorophyll a mg/m³	Total Chromium mg/L	Fecal Coliform col/100mL	Total Coliform col/100mL	Total Copper mg/L	Hardness, $CaCO_3$ mg/L	Total Iron mg/L	Total Lead mg/L	Total Magnesium mg/L	Total Manganese mg/L	Dissolved Mercury mg/L	Total Mercury mg/L	Total Nickel mg/L	Nitrate as N mg/L	Nitrite mg/L	Orthophosphate mg/L	Total Phosphorous mg/L	Total Potassium mg/L	Total Selenium mg/L	Silica mg/L
		COMPOUNDS MEASURED IN LAKE GRANBURY																												
[1] Criteria for Specific Metals in Water for Protection of Aquatic Life			0.19				0.0021					0.373			0.027			0.008				0.0013	0.338						0.005	
Human Health Criteria in Water			0.05	2			0.005					0.1						0.00498				0.0000122		10					0.05	
Screening Levels for Nutrient Parameters											0.0267													0.37			0.2			
[1] TSWQS for Lake Granbury										1000																				
CPNPP TPDES													400		1		1													
Values calculated from quarterly monitoring at stations in Lake Granbury	Mean Concentration	132	0.003	0.112	120	1.925	0.0005	71.7	5	296	40.542	0.003	152	6851	0.009	245	0.47	0.003	15.6	0.038	0.0001	0.0001	0.003	0.08	0.2	0.24	0.186	6.30	0.003	13.8
	Max Concentration	141	0.003	0.164	164	2.500	0.0005	99.7	5	594	260.000	0.003	1100	25000	0.018	347	2.16	0.003	23.7	0.163	0.0001	0.0001	0.003	0.19	0.5	4.40	2.460	7.30	0.003	18.3
[2] Concentration of chemicals added to the system and factored into the effluent	Low	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	High	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2.4 -Cycle Concentration [3]	Mean concentration	317	0.006	0.268	289	4.619	0.0012	172.2	12	711	97.300	0.006	364	16442	0.022	588	1.12	0.006	37.4	0.091	0.0002	0.0002	0.006	0.20	0.4	0.58	0.447	15.13	0.006	33.1
	Max concentration	338	0.006	0.394	394	6.000	0.0012	239.3	12	1426	624.000	0.006	2640	60000	0.043	833	5.18	0.006	56.9	0.391	0.0002	0.0002	0.006	0.44	1.2	10.56	5.904	17.52	0.006	43.9
Diluted Effluent at Low Flow	Mean concentration	346	0.007	0.293	315	5.043	0.0013	188.0	13	776	106.218	0.007	398	17949	0.024	642	1.22	0.007	40.9	0.099	0.0003	0.0003	0.007	0.22	0.4	0.63	0.488	16.51	0.007	36.1
	Max concentration	369	0.007	0.430	430	6.550	0.0013	261.2	13	1556	681.193	0.007	2882	65499	0.047	909	5.66	0.007	62.1	0.427	0.0003	0.0003	0.007	0.48	1.3	11.53	6.445	19.13	0.007	47.9
Diluted Effluent at Annual Mean Flow	Mean concentration	149	0.003	0.126	136	2.171	0.0006	80.9	6	334	45.737	0.003	171	7729	0.010	277	0.53	0.003	17.6	0.043	0.0001	0.0001	0.003	0.09	0.2	0.27	0.210	7.11	0.003	15.6
	Max concentration	159	0.003	0.185	185	2.820	0.0006	112.5	6	670	293.316	0.003	1241	28203	0.020	391	2.44	0.003	26.7	0.184	0.0001	0.0001	0.003	0.21	0.6	4.96	2.775	8.24	0.003	20.6

cfs = cubic feet per second
L/sec = liters per second
CPNPP - Comanche Peak Nuclear Power Plant
TPDES - Texas Pollution Discharge Elimination Standard
TSWQS - Texas Surface Water Quality Standard

MEAN and MAX Concentrations - Calculated based on quarterly monitoring data from Lake Granbury. For values reported as nondetects, 1/2 of the analytical reporting limit or 1/2 the screening level, whichever was smaller, was used in calculating the mean and max concentration for each analyte, based on Draft 2008 Guidance for Assessing and Reporting Surface Water Quality in Texas (December 21, 2007) (pg 37).

Additive - chemicals that will be added to system(s) and will not undergo cycle concentration. Additives with chemical concentrations estimated to be below the detection limit were reported at the detection limit. Additives that are added intermittently are not included in the dilution calculation.

"--" - Not evaluated for that compound

Notes:
(1) Screening Levels Used as the Primary Screening Level.
(2) Concentration of additives are not increased by the number of cycles.
(3) The Mean or Max analyte concentration is increased by the number of cycles
** Amount to be determined by TPDES permit

Equation for Diluted Effluent Concentrations

$$EC = \frac{\text{Cycle Mean/Max Concentration} * PDR}{PDR + FR} * \text{Mean/Max Concentration}$$

This is not intended to be a scientific model after discharge into Lake Granbury and does not account for fate and transport processes.

HIGHLIGHTED ANALYTES REPRESENT AN EXCEEDENCE OF THE CORRESPONDING REGULATORY LEVEL

For Screening Level:
The default screening level used was the Aquatic Life Criteria or TSWQS Criteria. If neither was provided, then the screening level for Nutrient Parameters was used. If the Nutrient Parameters criteria was not provided then the Human Health Criteria was used or the TPDES criteria.

 # Cycle Concentration 2.4
1 cfs = 448.8312 gpm
1 cfs = 28.31685 L/sec

Low Flow	gpm	cfs	L/sec
Plant Discharge Rate (PDR) =	26100	58.15	1646.65
Flow Rate (FR) =		28	792.87

Annual Mean Flow	gpm	cfs	L/sec
Plant Discharge Rate (PDR) =	26100	58.15	1646.65
Flow Rate (FR) =		1031	29194.67

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4th Quarter Dilution Table

Category		Total Silver mg/L	Total Sodium mg/L	Fecal Streptococci col/100mL	Sulfate mg/L	Total Dissolved Solids mg/L	Total Kjeldahl Nitrogen mg/L	Turbidity NTU	Total Zinc mg/L	COMPOUNDS ADDED TO THE SYSTEM: Sodium Hypochlorite ppm	pH/Lsi adjustment Sulfuric Acid ppm	Corrosion Inhibitor Proprietary Orthophosphate & Phosphonate ppm	OTHER POTENTIAL DISCHARGE COMPOUNDS (see note below): Biochemical Oxygen Demand mg/L	Chemical Oxygen Demand mg/L	Total Suspended Solids mg/L	Ammonia Nitrogen mg/L	pH	Temperature deg C
[1] Criteria for Specific Metals in Water for Protection of Aquatic Life									0.225									
Human Health Criteria in Water																		
Screening Levels for Nutrient Parameters																0.11		
[1] TSWQS for Lake Granbury					600	2500											6.5-9.0	
CPNPP TPDES						4000							45		45			
Values calculated from quarterly monitoring at stations in Lake Granbury	Mean Concentration	0.001	195	7	121.6	1012	0.490	42.3	0.012				2.7	24.0	54.7	0.149	8.03	63.71
	Max Concentration	0.001	368	80	232.0	7010	0.920	350.0	0.024				7.7	65.0	672.0	0.520	8.44	83.78
[2] Concentration of chemicals added to the system and factored into the effluent	Low	--	--	--	--	--	--	--	--	0.2	2.2	**						
	High	--	--	--	--	--	--	--	--	0.2	2.2	**						
2.4 -Cycle Concentration [3]	Mean concentration	0.001	467	18	291.8	2429	1.177	101.6	0.029				--	--	--	--	--	--
	Max concentration	0.001	883	192	556.8	16824	2.208	840.0	0.058				--	--	--	--	--	--
Diluted Effluent at Low Flow	Mean concentration	0.001	510	20	318.6	2652	1.285	110.9	0.032	0.135	1.48498	**	--	--	--	--	--	--
	Max concentration	0.001	964	210	607.8	18366	2.410	917.0	0.063	0.135	1.48498	**	--	--	--	--	--	--
Diluted Effluent at Annual Mean Flow	Mean concentration	0.001	220	8	137.2	1142	0.553	47.8	0.014	0.01068	0.11746	**	--	--	--	--	--	--
	Max concentration	0.001	415	90	261.7	7908	1.038	394.8	0.027	0.01068	0.11746	**	--	--	--	--	--	--

These chemicals are not considered to increase by the number of cycles and will be affected by the chemicals added to the system.

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L/sec = liters per second
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TSWQS - Texas Surface Water Quality Standard

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Equation for Diluted Effluent Concentrations

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HIGHLIGHTED ANALYTES REPRESENT AN EXCEEDENCE OF THE CORRESPONDING REGULATORY LEVEL

For Screening Level:
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