Water Quality and Quantity Impacts from Proposed South Texas Plant Expansion

Submitted to:
SEED Coalition
1303 San Antonio Street; Suite 100
Austin, Texas 78701

by:
Lauren Ross, Ph. D., P. E.

Glenrose Engineering, Inc.
P. O. Box 1948
Austin, Texas 78767-1948
Telephone: 512/326-8880
Facsimile: 512/326-8881
www.glenrose.com

D Lauren Ross
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Introduction

This report presents an analysis of water quality and quantity impacts from the proposed addition of two nuclear powered generating plants at the existing South Texas Project. The analysis is based on information about the proposed expansion as presented in Combined License Application Section 3 - Environmental Report; and on published information regarding environmental conditions in the vicinity of the existing plant and proposed expansion.

The following is a summary of contentions regarding the proposed expansion:

- **Increasing Levels of Groundwater Tritium.** The Environmental Report fails to predict or evaluate the effects of increasing groundwater tritium concentrations.
- **Insufficient TPDES Permit Effluent Limits.** The proposed Texas Pollution Discharge Elimination Permit fails to establish necessary effluent limits for the range of toxic and harmful chemicals that have been documented to be present or are possibly present in the power plant effluent.
- **Reliance on Dilution to Achieve Discharge Standards.** The Environmental Report discusses the importance of dilution of nuclear power plant wastewater to meet discharge standards, but neglects to evaluate the relationship between a slightly larger effective Main Cooling Reservoir volume and the additional waste loads from doubling the electrical generation capacity.
- **Unregulated Wastewater Discharge.** A regulatory loophole has allowed a primary discharge of wastewater from the existing facility to be unregulated. The proposed expansion would be operated under the same regulatory framework. The harm caused by this regulatory failure will be magnified by the proposed addition of two additional nuclear powered generating plants.
- **Unevaluated Reduction in Groundwater Supply for Adjacent Landowners.** The Environmental Report fails to provide adequate information regarding the effect of the expansion on the availability of groundwater from the regional Gulf Coast Aquifer. A determination of key information necessary for an analysis of impact is deferred to a later detailed engineering phase. Information provided in the Environmental Report

underestimates the predicted effect of the proposed expansion on groundwater availability to wells on adjacent property.

- **Unevaluated Reduction in Surface Water Flow.** The Environmental Report fails to evaluate the effect of Colorado River withdrawals of up to 48% of the river flow on the river and estuary resources. The Environmental Report fails to demonstrate the availability of necessary surface water from the Colorado River during drought conditions. The Environmental Report also fails to evaluate the effect of increased groundwater withdrawals on flow in adjacent streams and rivers including the Colorado River.

Information to support each of these contentions is presented below.

Background

The proposed STP 3 & 4 nuclear powered generating plants would be constructed on a 12,220-acre site in Matagorda County currently occupied by two nuclear powered generating plants. The plants would be constructed using Advanced Boiling Water Reactor technology with a closed-loop water cooling system. The closed-loop cooling system would cycle water through the existing 7,000-acre Main Cooling Reservoir (MCR). A summary of plant characteristics and water use is provided in Table 1.

Water would be used at the proposed plant expansion in much the same way that water is used for the two existing nuclear powered generating plants. The largest use of water is forced evaporation from the MCR to cool the steam electrical generation process. Heat from the existing STP 1&2 plants currently evaporates an average 37,100 acre feet of water from the MCR per year. The two proposed plants would increase forced evaporation by an additional 37,400 acre-feet per year.

The capacity of the MCR is 202,600 acre-feet at a water elevation of 49 feet mean sea level.[1] Water elevation in the MCR currently fluctuates from a low of 25.5 feet mean sea level to a maximum level of 47 feet mean sea level. The maximum water elevation in the basin would be

[1] Environmental Report, page 2.3.1-12.

increased to 49 feet mean sea level to accommodate the cooling requirements of the two proposed additional nuclear generating plants.

Water that is lost from the MCR is replaced from two sources. When water in the Colorado River at the plant intake is sufficiently fresh, it is pumped into the reservoir. The estimated average Colorado River withdrawal matches the average forced evaporation rate.

When Colorado River flow is low, water from Matagorda Bay estuaries flow up river past the plant intake. Under low flow conditions river water at the plant intake is too saline to be used for power plant purposes. Evaporation drops the level in the MCR until fresh Colorado River water is available to fill it again.

The other source of water into the MCR is facility wastewater. Wastewater discharged into the MCR include metal cleaning wastewater, blowdown from cooling towers and the Ultimate Heat Sink basin, laboratory wastewater, sanitary wastewater, wet scrubber air pollution control systems, ion exchange water treatment systems, boiler blowdown, floor drains and wastewater from an oil/water separator.

When the concentration of total dissolved solids in the MCR is sufficiently high, water is blown down from this reservoir back into the Colorado River under the authorization of a Texas Pollution Discharge Elimination Permit. With operation of the two existing nuclear power plants, there has been little need, however, for blowdown. There has been no discharge from the MCR to the Colorado River since March 1997.[2]

Instead of discharging to the Colorado River, an estimated 5,700 acre-feet per year, or 3,530 gallons per minute are lost from the bottom of the unlined MCR.[3] Relief wells in the embankment around the pond pump 68% of this leached MCR water from the underlying shallow aquifer and discharge that water into a surface drainage ditch that surrounds the reservoir.

[2] STP Nuclear Operating Company TPDES Permit No. WQ0001908000 Fact Sheet and Executive Director's Preliminary Decision, page 2.
[3] Environmental Report §2.3.1.

Table 1. Summary of Current and Proposed Water Use

System	STP 1&2	STP 3&4	STP 1, 2, 3 &4	Source
Infrastructure				
Advanced Boiling Water Reactor	√	√		
Power rating per unit (MWt)	3,853	3,926		
Net electrical output (Mwe)	1,250	1,300		
Main condenser heat sink	MCR	MCR		
Ultimate Heat Sink (UHS) basin		one each		
Mechanical draft cooling tower		one each		
MCR Volume (acre-feet)	188,600	14,000	202,600	
MCR forced evaporation (acre-feet/yr)	37,100	37,400	74,500	
MCR forced evaporation (gpm)	22,983	23,169	46,152	
Surface Water Use	Used for MCR makeup, backup makeup for Ultimate Heat Sink			
Normal Colorado River withdrawal to replace MCR water loss (gpm)		23,170	42,604	
Peak 48-hour Colorado River Withdrawal (gpm)		23,427	44,779	
Permitted Colorado River withdrawal (acre-ft/yr)			102,000	
Permitted Colorado River withdrawal (gpm)			62,234	
Backup water right during drought conditions (acre-ft/yr)	20,000		40,000	§5.2.1
Groundwater Use	Used for condensate water makeup, UHS basin water makeup, potable water, radwaste, fire protection			
Average groundwater use (gpm)	798	1,242	2,040	§5.2.1; §10.4-2 Discrepancy: 1077
Maximum groundwater use during outages (gpm)		4,108		§5.2.1; §10.4-2 Discrepancy: 3935; p. 5.2-5 Descripancy: 4,115
UHS average makeup (gpm)		885		
UHS average maximum makeup (gpm)		3,203		
UHS blowdown, filter backwash, etc. to MCR (gpm)		550		
UHS consumption (gpm)		566		
Currently permitted (gpm)			1,860	
Currently permitted (acre-ft/yr)			3,000	§2.3.1, page 22
Demineralized Water Demand				
Normal demineralized water demand (gpm)	200	200		
Estimated emergency demineralized water demand (gpm)	800	800		
Provided maximum demineralized flow capacity (gpm)			500	

In addition to water that is withdrawn from the Colorado River, the existing STP 1&2 units pump an average of 789 gallons per minute of water from the underlying Gulf Coast Chicot Aquifer. The addition of two nuclear powered generators would increase the average groundwater pumped by 1,242 gallons per minute to a total of 2040 gallons per minute. During emergency conditions, the estimated maximum groundwater needed for STP 3&4 is 4,108 gallons per minute.[4]

The current groundwater pumping permit, issued by the Coastal Plains Groundwater Conservation District, allows a maximum pumping amount of 3,000 acre-feet per year, or 1,860 gallons per minute. This permitted amount is 180 gallons per minute less than the estimated average amount needed to operate all four proposed nuclear power generating plants under normal operating conditions. Groundwater is used as the source water for demineralized water, as makeup water for the Ultimate Heat Sink basin, for potable and sanitary purposes, to process radwaste, and for fire protection.

Contentions

Each of the contentions in this report regarding the proposed STP nuclear power plant expansion is discussed in the following sections.

Unevaluated Increasing Levels of Groundwater Tritium

A radioactive material that is present in the water that is discharged from the facility is tritium. Tritium is a radioactive isotope of hydrogen containing one proton and two neutrons. Tritium emits low-energy beta radiation which can be dangerous if it is inhaled, ingested, or absorbed through pores in the skin. U.S. Environmental Protection Agency safe drinking water limits for tritium are 20,000 picoCuries per liter.

Tritium has been detected in two of the pressure relief wells that collect water leaking from the unlined bottom of the MCR. [5] Concentrations of tritium have increased in both wells over the original monitoring levels. Tritium concentration changes are illustrated in Figures 1 and 2.

[4] Environmental Report §5.2.1.
[5] Environmental Report Table 2.3.3-6, page 2.3.3-19-20.

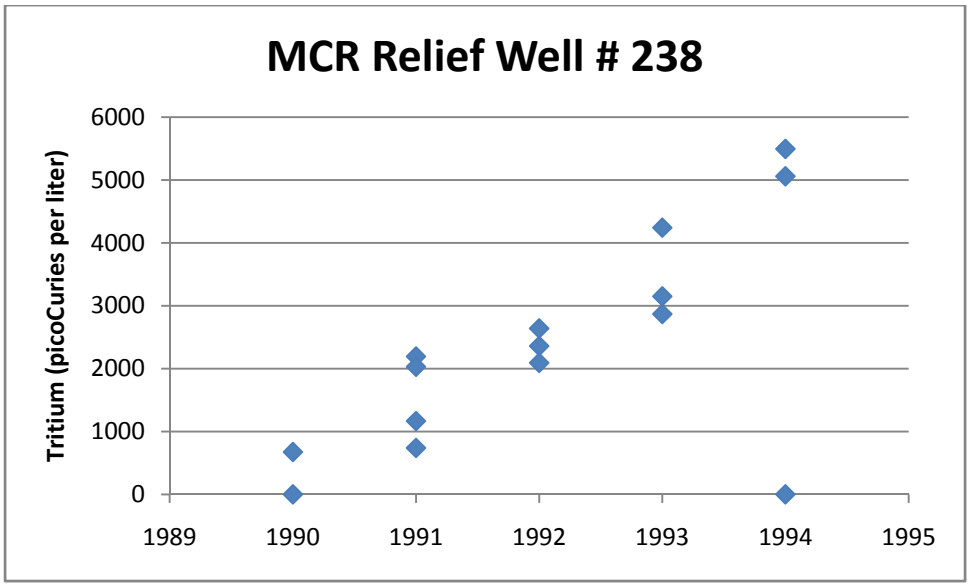

Figure 1. Tritium Concentrations in Relief Well #238

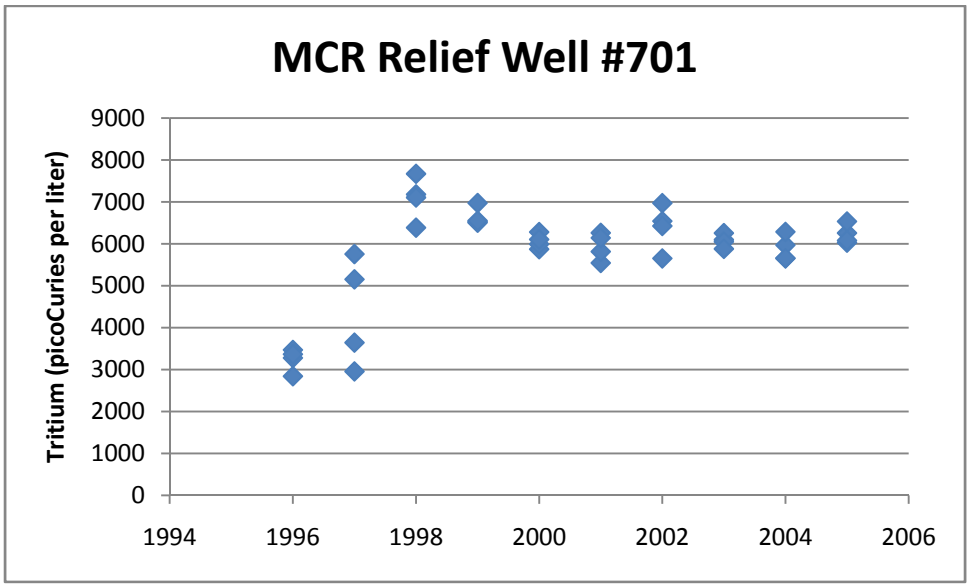

Figure 2. Tritium Concentrations in Relief Well #701

With the addition of two proposed nuclear power generating stations, tritium concentrations in MCR and in the wastewater that is leaking through its unlined bottom are likely to increase. The Environmental Report fails to consider this increase, evaluate its magnitude, or propose any measures to mitigate potential damage to adjacent water and its users.

Insufficient TPDES Permit Effluent Limits

Wastewater discharges from the STP facility are regulated by a Texas Pollution Discharge Elimination System (TPDES) permit issued by the Texas Commission on Environmental Quality. The existing permit[6] regulates the outfalls and parameters listed in Table 2.

Table 2. TPDES Permit Effluent Limits

Outfall	Proposed Effluent Limits (Daily Average)	Wastewater	Volume	Receiving Water
001	Flow (report) Colorado River Flow (report) Temperature (95°F) Total Residual chlorine (0.05 mg/l daily maximum) pH (6 min., 9 max.)	Low volume waste (Outfalls 101 and 201), metal cleaning waste, recirculated cooling water, cooling reservoir blowdown	Daily Average: 144 MGD Daily Maximum: 200 MGD	Colorado River Tidal Segment 1401
101	Flow (report) TSS (30 mg/l) Oil & Grease (15 mg/l)	Low volume waste commingled with previously monitored metal cleaning waste	Flow variable	Into MCR
201	Flow (report) TSS (30 mg/l) Oil & Grease (15 mg/l)	Low volume waste from oily waste treatment system and stormwater	Flow variable	Into MCR
401	Flow (report) BOD5 (20 mg/l) TSS (20 mg/l) Total Residual chlorine (1.0 mg/l)	Sanitary sewage, car wash water, air conditioning condensate and HVAC cooling tower blowdown wastewater	Continuous and flow variable	Into MCR
501	Flow (report) Total iron (1.0 mg/l) Total copper (0.5 mg/l)	Metal cleaning waste	Intermittent and flow variable	Into waste stream to Outfall 101
601	Flow (report) BOD5 (20 mg/l) TSS (20 mg/l) Total Residual chlorine (1.0 mg/l)	Treated sanitary sewage, air conditioner condensate, HVAC cooling tower blowdown	Continuous and flow variable	Into MCR

These permit terms fail to capture parameters of significant concern associated with the proposed wastewater discharges. In particular, the permit does not address concentrations of radionuclides

[6] TPDES Permit No. WQ0001908000 (TX 0064947).

like tritium that have been measured in MCR blowdown at concentrations as high as 17,410 picoCuries per liter.[7]

The permit also does not require monitoring for total dissolved solids or specific conductance, even though the specific conductance (a measure of total dissolved solids) of the MCR water is the condition that determines whether blowdown is necessary.[8] The permit does not limit either the concentration or mass of metals other than iron or copper that would be expected in metal cleaning waste. The only limit on organic or hydrocarbon waste is a limit on oil and grease, which is an insensitive and imprecise measure of many chemicals of concern potentially present in the reactor wastewater.

Biocides, anti-scalants, sulfuric acid, sodium hexametaphosphate, and sodium hydroxide are added by STP to condition the water for either circulation or makeup uses. The Environmental Report states:[9]

> *"Biocides or chemical additives would be from those approved by the U.S. Environmental Protection Agency or the state of Texas, and the volume and concentration of each constituent discharged to the environment would meet the requirements established in the Texas Pollution Discharge Elimination system (TPDES) permit."*

This statement demonstrates the applicant's reliance upon effluent limits in the TPDES permit to provide environmental protection for a range of chemicals that are not addressed by the permit limits. Specifically neither sulfur nor sodium limits are placed on the wastewater discharges. In addition to these chemicals, approved biocides and chemical additives might encompass a range of constituents well beyond these monitored or regulated within the TPDES permit.

STP also uses compliance with the TPDES discharge permit to justify radioactive discharges, even though the terms of the permit ignore radioactive characteristics:

[7] Environmental Report Table 2.3.3-5, page 2.3.3-18.
[8] Environmental Report, page 2.3.3-1.
[9] Environmental Report, page 3.6-1.

"All discharges of radioactive effluents have been associated with routine permitted releases and permitted beneficial land application activities."[10]

Reliance upon Dilution to Achieve Discharge Standards

The Environmental Report specifically states that the facility relies upon a dilution factor of 10 to meet the discharge standards:

"Because of dilution, the anticipated impact on water quality or aquatic biota is SMALL and will not be within previously permitted levels."[11]

The primary source of dilution is 202,600 acre-feet of storage in the MCR. This storage volume will change by only 14,000 acre-feet (7.4%) with an increase in the maximum elevation from 47 to 49 feet.

The Environmental Report provides no quantification of the change in waste discharge loads from the proposed addition of two nuclear reactor power plants. It also fails to address the consequences of these load increases into a system with only a small change in the dilution factor. Without this information it is impossible to assess potential environmental impacts of the proposed expansion.

Unregulated Wastewater Discharge

An estimated 5,700 acre-feet per year leaks through the unlined bottom of the MCR into the underlying Gulf Coast Chicot Aquifer and approximately 68% of the leaked water is recovered by pumping pressure relief wells and discharging the pumped water into surface water drainage.[12] Leaked water from the MCR that isn't removed by the relief wells migrates underground to seep into adjacent surface water bodies, into pumped wells, or into the Gulf of Mexico estuary system. This process is described in the Environmental Report as follows:

[10] Industry Groundwater Protection Initiative Questionnaire, http://adamswebsearch2.nrc.gov/nrcws/nrcdoccontent.aspx?Library=PU_ADAMS^PBNTAD01&LogonID=4824443c2c210bb0639c9eff218687ce&DocID=062400034, April 19, 2009.
[11] Environmental Report page 10.1.2.3; underlined word may be typographical error.
[12] Environmental Report page 2.3.1-12.

"In reality, some water returns to the Colorado River as groundwater flow as the water seeps from the MCR and infiltrates the upper shallow portion of the groundwater system beneath the MCR. The water then flows toward the Colorado River where it discharges. Water from the MCR is also released through the pressure relief wells located in the above-grade dike surrounding the MCR. Water from these relief wells is discharged to a surface water ditch that surrounds the MCR and flows away from the reservoir through the STP site's natural drainage features."[13]

Given that all other permitted plant outfalls flow into the MCR and that there has been no MCR discharge through Outfall 001 since March 1997, this leaked water through the bottom of the MCR has been the single significant wastewater discharge for the entire facility for more than 12 years.

Water in some of the relief wells demonstrates concentrations of radioactive tritium and potentially conveys any of the wastewater characteristics that would be regulated were the discharge to occur through Outfall 001.

The TPDES permit authorizes discharges from the reservoir relief wells, reservoir spillway gate leakage, condenser box drainage, groundwater monitoring wells, and process monitoring instrumentation to the Colorado River, the West Branch of the Colorado River, to Little Robbins, Slough, and the East Fork of Little Robbins Slough without any qualifications or restrictions.[14]

Failure to monitor and regulate leakage through the MCR reservoir bottom constitutes a failure to protect groundwater and surface water from plant operations. Given that the proposed plant expansion will operate with the same wastewater process system and within the identical permitting environment as the existing facility, it is reasonable to believe that this failure to regulate discharge will extend to operation of the facility expansion. Because of the increased contaminant loads from the added generation capacity, the consequences of failure to regulate the facility to protect groundwater and surface water from MCR leakage will be direr.

[13] Environmental Report page 5.2-2.
[14] STP Nuclear Operating Company TPDES Permit No. WQ0001908000, Other Requirements No. 3 page 2.

Unevaluated Reduction in Surface Water Flow

Surface water in the vicinity of the South Texas Project nuclear power generating plants will be affected in two different ways by the proposed construction of two additional nuclear generating plants. One way is that additional water must be withdrawn from the Colorado River to replace water that is evaporated from the MCR to provide necessary cooling for power generation. The water required to replace evaporated water would be about 74,500 acre-feet per year for the four generating plants.

Water from the Colorado River can only be withdrawn when river flow is sufficient to flush saline water from the estuary tidal zone past the plant intake structure. Under low flow conditions the saline quality of the river water is unacceptable for power plant use. South Texas Project has a backup water right for drought conditions of 40,000 acre-feet per year for all four nuclear generating plants. The Environmental Report fails to discuss, however, whether the backup volume can be delivered reliably to this downstream location on the Colorado River at a sufficient flow to be useable during drought conditions. Current drought conditions, illustrated in Figure 3,[15] are classified as exceptional by the U. S. Drought Mitigation Center.

The Environmental Report fails to discuss the environmental affects during conditions when water withdrawal for the nuclear power plants is a significant fraction of the total river flow. From January 1, 2001 through September 30, 2006 there were 69 days when withdrawal was equal to or greater than one quarter of the entire river flow. River flow rates and withdrawal rates for these days is presented in Table 3. On September 16, 2001, the withdrawal was 509 cubic feet per second while the average river flow on that day was 1070 cfs. The STP plant took 48% of the total river flow. The occurrence of days when the percentage of flow withdrawn is a significant fraction of the total river flow would occur more frequently with a doubling of the surface water demand to cool two additional nuclear power generating stations.

This increase in withdrawal and its implications for the environmental health of the Colorado River estuary are not evaluated in the Environmental Report.

[15] Figure from http://drought.unl.edu/dm/DM_state.htm?TX,S, April 21, 2009.

Table 3. STP Withdrawal and Colorado River Flow When Withdrawl is a Significant Proportion of Flow

Date	STP Withdrawal (cfs)	Colorado River Flow (cfs)	Proportion of Flow Withdrawn	Date	STP Withdrawal (cfs)	Colorado River Flow (cfs)	Proportion of Flow Withdrawn
9/16/2001	509	1070	48%	5/9/2004	360	1200	30%
10/19/2004	600	1430	42%	7/1/2002	600	2000	30%
4/17/2004	582	1470	40%	6/26/2006	280	941	30%
5/7/2004	597	1550	39%	10/22/2004	360	1210	30%
10/18/2004	600	1590	38%	7/25/2005	300	1020	29%
4/8/2004	577	1530	38%	3/27/2004	233	796	29%
6/4/2006	540	1440	38%	6/25/2006	336	1150	29%
9/15/2001	600	1600	38%	7/2/2002	600	2070	29%
10/31/2004	600	1600	38%	10/20/2004	362	1260	29%
5/8/2004	446	1220	37%	10/21/2004	360	1260	29%
10/15/2002	534	1480	36%	5/6/2004	600	2110	28%
6/24/2006	509	1430	36%	4/6/2004	600	2130	28%
6/5/2006	457	1290	35%	4/9/2004	360	1280	28%
5/12/2006	540	1540	35%	4/15/2004	600	2160	28%
4/4/2006	248	718	35%	6/21/2006	540	1950	28%
7/30/2006	386	1140	34%	1/9/2001	600	2170	28%
10/30/2004	600	1780	34%	7/12/2006	269	998	27%
4/16/2004	600	1810	33%	1/8/2001	600	2240	27%
6/3/2006	540	1630	33%	10/14/2005	300	1130	27%
4/18/2004	381	1160	33%	4/17/2002	300	1140	26%
10/17/2004	600	1850	32%	10/15/2005	300	1140	26%
10/17/2002	409	1270	32%	9/27/2001	303	1160	26%
7/10/2006	540	1680	32%	4/16/2002	300	1150	26%
4/3/2006	314	993	32%	4/13/2002	540	2070	26%
4/30/2004	600	1900	32%	5/11/2006	540	2070	26%
6/2/2006	540	1730	31%	4/7/2004	600	2300	26%
4/2/2006	458	1470	31%	4/27/2006	211	824	26%
5/10/2004	360	1160	31%	10/29/2004	600	2350	26%
10/24/2004	360	1160	31%	7/8/2006	540	2120	25%
10/25/2004	360	1160	31%	9/14/2001	600	2360	25%
7/11/2006	405	1310	31%	4/19/2004	248	982	25%
10/16/2002	480	1570	31%	4/14/2002	381	1510	25%
5/13/2006	308	1010	30%	9/25/2006	300	1190	25%
10/23/2004	360	1190	30%	9/30/2006	236	937	25%
9/17/2001	270	897	30%				

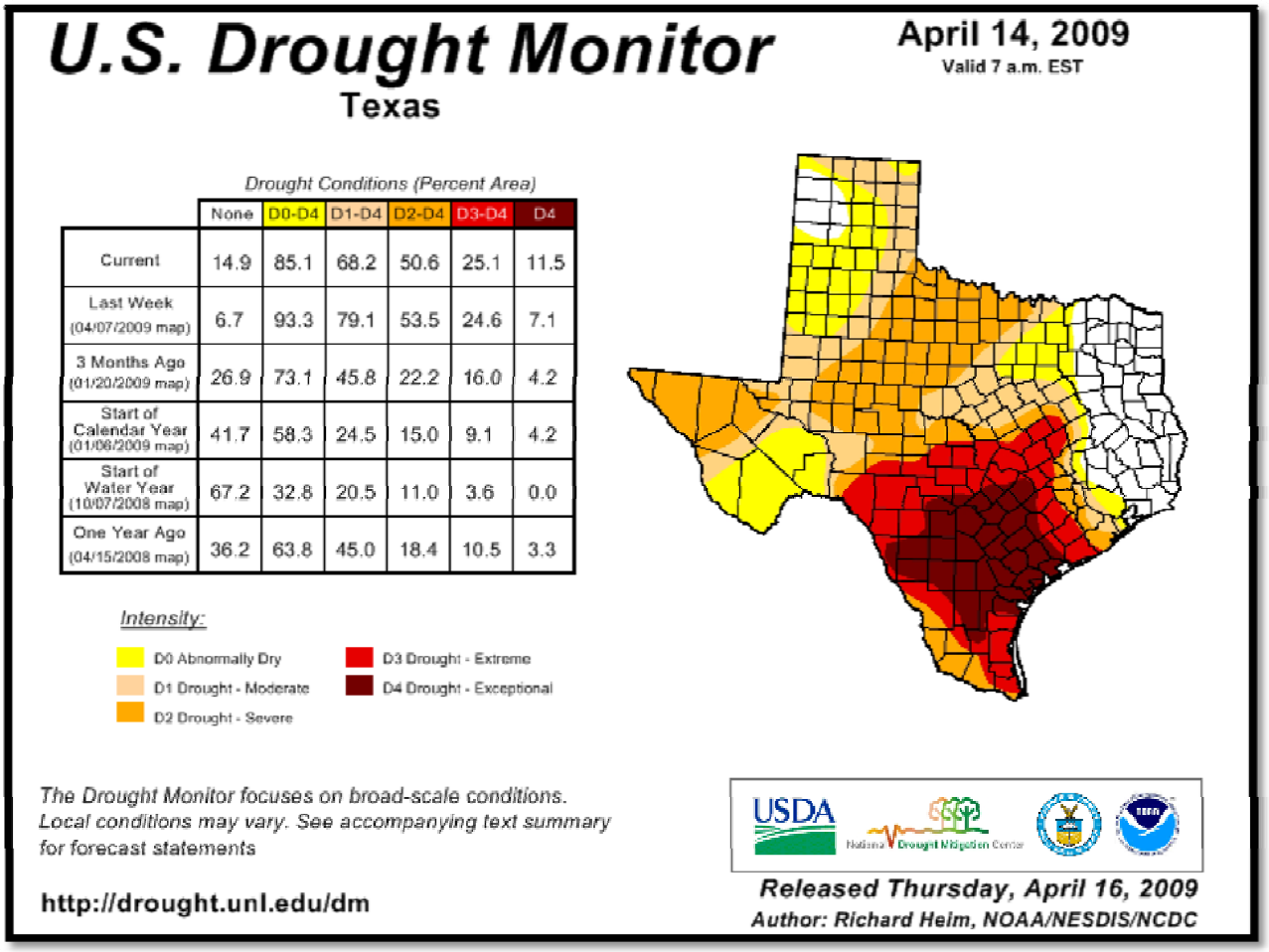

Figure 3. Current Drought Conditions in Texas

In addition to direct withdrawals from the Colorado River, the proposed nuclear power plant expansion will reduce surface water flows, including flows in the Colorado River, by lowering the groundwater table through pumping. An estimated 43% of the Central Gulf Coast Aquifer discharge supplements stream flow, including the Colorado River.[16] Increased pumping to meet the water needs of the proposed nuclear power plant expansion will decrease aquifer contributions to surface water flow. The magnitude of this stream flow reduction, its

[16] Groundwater Availability Model of the Central Gulf Coast Aquifer System: Numerical Simulations through 1999, Texas Water Development Board, September 27, 2004.

environmental implications, and possible mitigation have not been evaluated in the Environmental Report.

Unevaluated Reduction in Groundwater Supply for Adjacent Landowners

Groundwater withdrawal from the underlying Gulf Coast Chicot Aquifer is used to meet every important STP nuclear power plant water need other than primary cooling. Groundwater feeds the demineralized water system and is used to make condensate water, to fill the Ultimate Heat Sink basins, for potable and sanitary purposes, to process radwaste, and for fire protection. Estimated groundwater use would more than double from an average of 798 gallons per minute for the existing facility over the last five years, to a projected level of 2040 gallons per minute for all four nuclear power generating plants. The current permit allows an average pumping rate of 1,860 gallons per minute.

The applicant proposes to postpone an analysis of groundwater availability until after the permit is issued: *"A detailed evaluation of groundwater availability and estimates of aquifer drawdown, water conservation measures, and identification of alternative sources, if practicable, will be addressed as part of the detailed engineering for STP 3 & 4."*[17]

The question of the availability of the necessary groundwater supply is an important question that should be addressed prior to detailed engineering.

Furthermore, the Environmental Report predicts the effects of the proposed pumping on groundwater levels in a hypothetical well 2,500 feet from the STP wells. The predicted drop in the groundwater levels considers, however, only the difference between the existing and the currently permitted use. Furthermore, the predicted drop in groundwater levels is not based on the actual projected needs for the two additional power plants, but only on the permitted pumping rate.

Predicted groundwater level drawdown in the hypothetical adjacent well for different scenarios is presented in Table 4. This table is based upon identical assumptions, equations, and parameter estimates as those in the Environmental Report Table 5.2-2. It extends the table, however, to consider the estimated groundwater needs of the proposed expansion, rather than the lower

[17] Environmental Report, page 2.3.1-22.

pumping amount that it currently permitted. Using assumed aquifer parameters in Table 5.2.2, the Environmental Report underestimates lowering of the groundwater table from the proposed expansion by about 10 feet at the end of 10 years. Combining groundwater use for both the existing and proposed nuclear power generating plants, the total drawdown at an adjacent well is estimated to be 72 feet.

Table 4. Predicted Groundwater Level Drops Associated with Proposed Plant Expansion

Theis nonequilibrium well equation					
s=[Q/4(3.14)T](W(u))	**Table 5.2-2 Case 1**	**Table 5.2-2 Case 1**	**Table 5.2-2 Parameters w/ Currently Average Pumping**	**Table 5.2-2 Parameters w/ Total Currently Permitted Pumping**	**Table 5.2-2 Parameters w/ Proposed Permitted Pumping**
Q: pumping rate (gpm)	1062	1062	798	1860	2040
Q: pumping rate (cf/day)	204,449	204,449	153,626	358,075	392,727
T: transmissivity (sf/day)	4444	4444	4444	4444	4444
t: time since pumping started (days)	3650	3650	3650	3650	3650
S: coefficient of storage	0.00076	0.00022	0.00022	0.00022	0.00022
r: distance to pumping well (ft)	2500	2500	2500	2500	2500
$u=r^2S/4Tt$	7.3209E-05	2.1192E-05	2.1192E-05	2.1192E-05	2.1192E-05
W(u) = Theis well function; $u \leq 1$	8.9450	10.1847	10.1847	10.1847	10.1847
W(u) = Theis well function; $u > 1$					
s: drawdown (ft)	32.8	37.3	28.0	65.3	71.7