From: Ballinger, Amy [aballinger@STPEGS.COM]
Sent: Wednesday, August 20, 2008 11:11 AM
To: Adrian Muniz; Belkys Sosa; George Wunder; Loren Plisco; Raj Anand; Rocky Foster; Tekia Govan; Tom Tai
Subject: Impact of The Redesigned Ultimate Heat Sink on STP 3 & 4 Review
Attachments: UHS letter _ABR-AE-08000051_ r8_signed.pdf

Good Morning,

This email contains a courtesy electronic copy of the letter submitted to the NRC entitled "Impact of The Redesigned Ultimate Heat Sink on STP 3 & 4 Review" with attachments. The official paper copy was sent via UPS today according to the letter addressee lists.

If you have any questions, please contact Coley Chappell at (361) 972-4745 or Bill Mookhoek at (361) 972-7274

Amy Ballinger
STP Units 3 & 4
Licensing Specialist
Phone: (361)972-4644
Fax: (361) 972-4751

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From: Ballinger, Amy

Created By: aballinger@STPEGS.COM

Recipients:
"Adrian Muniz" <Adrian.Muniz@nrc.gov>
Tracking Status: None
"Belkys Sosa" <Belkys.Sosa@nrc.gov>
Tracking Status: None
"George Wunder" <George.Wunder@nrc.gov>
Tracking Status: None
"Loren Plisco" <Loren.Plisco@nrc.gov>
Tracking Status: None
"Raj Anand" <Raj.Anand@nrc.gov>
Tracking Status: None
"Rocky Foster" <Rocky.Foster@nrc.gov>
Tracking Status: None
"Tekia Govan" <Tekia.Govan@nrc.gov>
Tracking Status: None
"Tom Tai" <Tom.Tai@nrc.gov>
Tracking Status: None

Post Office: exgmb1.CORP.STPEGS.NET

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Nuclear Operating Company

South Texas Project Electric Generating Station 4000 Avenue F – Suite A Bay City, Texas 77414

August 19, 2008
ABR-AE-08000051

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville MD 20852-2738

South Texas Project
Units 3 and 4
Docket Nos. 52-012 and 52-013
Impact of the Redesigned Ultimate Heat Sink on STP 3 & 4 COLA Review

References:

1. Letter, M. A. McBurnett to Document Control Desk, "Submittal of Combined License Application Revision 1," dated January 31, 2008 (ML080700399)

2. Letter, D. B. Matthews to M. A. McBurnett, "Staff review of the Combined License Application for South Texas Project, Units 3 and 4," dated January 30, 2008 (ML 080230721)

The Ultimate Heat Sink (UHS) is being redesigned from the description in the Combined License Application (COLA) Part 2 Section 9.2.5, included in Reference 1. The redesign replaces the single, large structure UHS that supplied both units with an UHS design featuring separate, stand alone structures for each unit. The purpose of this letter is to explain the reasons this redesign should not adversely affect the ongoing NRC reviews of Chapter 2 of the Final Safety Analysis Report (FSAR) for South Texas Project (STP) Units 3 and 4, in accordance with Reference 2.

The decision to change the design of the UHS was made based on our fundamental commitments to improving safety and the environment. The factors involved were:

(1) As noted by the NRC during their initial site visit, the single structure contained a "common wall" separating the basin between each unit's respective equipment. Further evaluation disclosed that this configuration involved a potential common mode failure (of the common wall) that could affect each unit's capability for long term cooling. While a remote threat, changing to individual cooling towers eliminates this issue, and contributes to a small positive safety benefit.

(2) The single UHS had been located to the northwest of Unit 4. Our environmental report notes that this area is under evaluation as 0.2 acres of potential wetland (this determination has not been made to date). However, moving the UHSs to the south of each unit makes this issue moot. The new locations are in a previously established construction/laydown area for Units 1 and 2 and will have no environmental impact.

(3) Moving the structures, as discussed with NRC's Office of Nuclear Security and Incident Response (NSIR), also improves security (the details of which are Security Sensitive Information and not for public disclosure pursuant to NRC regulations).

Accordingly, the new UHS configuration was reviewed and approved by South Texas Project Nuclear Operating Company (STPNOC) on April 23, 2008. STPNOC evaluated the redesign of the UHS to assess the impact on information previously submitted in the COLA. The following conclusions are based on a comparison between the proposed redesign and relocation of the UHS and the design submitted in COLA Revision 1, specifically in the following areas related to Chapter 2 of the FSAR:

Atmospheric Dispersion Parameters (χ/Q)

In order to conservatively calculate the maximum χ/Q values, the beneficial effects of structures and other mechanisms that may enhance dispersion, such as the vapor plume released by the UHSs, were ignored, as described in Attachment 1, Section 4.1.2, on page 11. As a result of this conservative methodology, the design and location of the UHSs will not affect the site meteorological data, the physical configuration of the release points and receptor locations, or dispersion patterns. Consequently, the χ/Q values, including the Control Room values, are not changed by the redesign and relocation of the STP Units 3 & 4 UHSs.

Flooding Analyses

As shown in Attachment 1, Section 4.2.2, pages 13 and 14, Site flooding events and associated maximum water levels are not significantly affected, nor are the redesigned UHS structures affected differently, by site flooding events, except in the event of a postulated Main Cooling Reservoir (MCR) breach as described in FSAR Section 2.4S.4. The relocation of the UHS basins, the first safety-related structure to be impacted by the water from a MCR breach, results in increased flood levels (on the order of one foot, less than a 10% change) on the south (upstream) side of the UHS basins. No increase to the maximum water level is expected in the power block area. There are no access points on the south side of the redesigned UHS. These results are within the maximum water level and flooding conditions that the UHS and other safety-related facilities are designed to withstand. Placing the UHSs between the MCR and the Reactor Buildings acts as a first-impact flood-wave buffer and has a small, positive improvement on the effect of a MCR breach on the Reactor Buildings.

<u>Groundwater Analyses</u>

The assessment of the impact of the redesign and relocation of the UHSs is described in Attachment 2. The redesign of the UHSs has no effect on the docketed information on groundwater. Descriptions of groundwater flow directions and subsurface pathways are not affected, and impact on aquifer flows is expected to be negligible. The groundwater analyses are not adversely affected.

Based on these conclusions, as discussed in our public meeting with the NRC on July 23, 2008, we believe the reviews made by NRC staff to date on Chapter 2 of the FSAR should not be adversely affected by this change.

The STP 3 & 4 Engineering, Procurement, and Construction (EPC) team has reviewed these issues and produced two reports that are provided as attachments to this letter.

There are no commitments in this letter.

Should you have any questions, please contact me at (361) 972-4626, or Bill Mookhoek at (361) 972-7274.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on August 19, 2008

Gregory T. Gibson
Manager, Regulatory Affairs
South Texas Project Units 3 & 4

<u>Attachments</u>:

1. "South Texas Project Units 3 & 4 Impact of the Ultimate Heat Sink Redesign on χ/Q and Flooding Analyses," Revision 1, Project 12188-043 Report SL-ER-2008-0001, Prepared by Sargent & Lundy, dated July 25, 2008.

2. "Impact of UHS Relocation & Slurry Wall Construction on Groundwater," Revision 0, White Paper A3SC-P-SP-50003, Prepared by Fluor, dated June 13, 2008.

cc: w/o attachment except*

(paper copy)

Director, Office of New Reactors
U. S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Regional Administrator, Region IV
U. S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 400
Arlington, Texas 76011-8064

Richard A. Ratliff
Bureau of Radiation Control
Texas Department of State Health Services
1100 West 49th Street
Austin, TX 78756-3189

C. M. Canady
City of Austin
Electric Utility Department
721 Barton Springs Road
Austin, TX 78704

*Steven P. Frantz, Esquire
A. H. Gutterman, Esquire
Morgan, Lewis & Bockius LLP
1111 Pennsylvania Ave. NW
Washington D.C. 20004

*George F. Wunder
Two White Flint North
11545 Rockville Pike
Rockville, MD 20852

(electronic copy)

*George F. Wunder
Loren R. Plisco
U. S. Nuclear Regulatory Commission

Brad Porlier
Steve Winn
Eddy Daniels
NRG South Texas 3/4 LLC

Jon C. Wood, Esquire
Cox Smith Matthews

J. J. Nesrsta
R. K. Temple
Kevin Pollo
L. D. Blaylock
CPS Energy

South Texas Project Units 3 & 4 Impact of the Ultimate Heat Sink Redesign on χ/Q and Flooding Analyses

Prepared by

Project 12188-043

Report SL-ER-2008-0001

Revision 1
July 25, 2008

S&L File No. 6.03

Issue Summary

Revision 1

Prepared By:	W.J. Johnson	7/25/08 **Date**
Prepared By:	G. Komanduri	7/25/08 **Date**
Prepared By:	J. Moslemian	7/25/08 **Date**
Reviewed By:	B.J. Andrews	7-25-2008 **Date**
Reviewed By:	R.W. Hooks	7-25-2008 **Date**
Approved By:	M. J. Shewski	7/25/08 **Date**

Issue Summary

Original Issue Revision 0

Prepared By:	W.J. Johnson	06/20/08 **Date**
Prepared By:	G. Komanduri	06/20/08 **Date**
Prepared By:	J. Moslemian	6/20/08 **Date**
Reviewed By:	B.J. Andrews	June 20, 2008 **Date**
Reviewed By:	R.W. Hooks	06/20/2008 **Date**
Approved By:	M. J. Shewski	6/20/2008 **Date**

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1.0 PURPOSE/OBJECTIVE

1.2 Purpose

The South Texas Project (STP) Units 3 & 4 Ultimate Heat Sinks (UHSs) are being redesigned and relocated instead of using the design presented in Revision 1 of the STP Units 3 & 4 of the Final Safety Analysis Report [Reference 6.1]. The purpose of this report is to provide information on how the redesign of the STP Units 3 & 4 UHSs may impact the calculation of the site's χ/Q values and affect site flooding.

1.3 Objective

This report will explain how the redesigned STP Units 3 & 4 UHSs may impact the following:

1. The calculation of the χ/Q values for the site,
2. The site flooding, and
3. How the redesigned UHS may be affected by a site flood

This report also provides information on the redesign of the UHS.

2.0 SUMMARY OF REDESIGNED UHS

2.1 The redesigned STP Units 3 & 4 UHSs will have a separate UHS for each unit. The two sinks will not be cross-tied; thus, STP Unit 3 can not receive cooling water from the STP Unit 4 UHS, and vice versa.

2.2 The STP Units 3 & 4 UHSs will be separate, stand alone structures that are not an integral part of the Reactor or Turbine Buildings of the units or the other unit's UHS or the existing STP Unit's 1 & 2 UHS.

2.3 Each STP Units 3 & 4 UHS will be composed of three divisions of cooling water supply and return in conformance with the ABWR Design Control Document (DCD). Each division will have two fans for cooling the water that is being returned to the basin(s), two 50 percent reactor service water (RSW) pumps, spray nozzles, associated piping and valves.

2.4 Each STP Units 3 & 4 RSW system division utilizing the UHS will be physically and electrically separated.

2.5 Emergency power will be supplied to the fans, pumps, valves and controls for the RSW system.

2.6 The UHS mechanical draft cooling tower complex will have Seismic Category I structures and components that are also designed to withstand other natural phenomena (freezing, tornadoes, hurricanes, floods, tsunami, seiches, etc.), site-related events (accidents), and a reasonably probable combination of natural phenomena and/or site-related events, as required by regulation.

2.7 Only two of the three divisions of the RSW system and associated mechanical draft cooling towers are needed to supply adequate cooling to the unit during the postulated 30 day post-accident scenario.

2.8 Each unit's UHS will consist of a single 100 percent water basin that will have at least a 30 day supply of water to cope with an accident (LOCA) without credit taken for make-up.

2.9 The makeup water to the UHS basins will be from onsite wells and/or the onsite Main Cooling Reservoir (MCR).

2.10 Adequate NPSH will be provided for the RSW pumps.

3.0 BACKGROUND

Section 4.1 of Revision 0 of the ABWR Tier 1 Design Control Document [Reference 6.2] states that:

> "The Ultimate Heat Sink (UHS) removes the heat load of the Reactor Service Water (RSW) System during [~~of~~] plant operation. The UHS is not within the Certified Design. The UHS will meet the following requirements:
>
> (1) Provide cooling water to the RSW System for normal plant operation and to permit safe shutdown and cooldown of the plant and maintain the plant in a safe shutdown condition for design basis events.
>
> (2) Makeup water for the UHS shall not be required for at least 30 days following a design basis accident.
>
> (3) Any active safety-related system, structure, or components within the UHS shall have three divisions powered by their respective Class 1E divisions. Each division shall be physically separated and electrically independent of the other divisions."

3.1 Docketed UHS Design (As described in COLA, Revision 1)

Section 9.2.5 of Revision 1 of the STP Units 3 & 4 FSAR [Reference 6.1] provides the conceptual design information for the previously considered UHS. Attachment A to this report shows the location of the STP Units 3 & 4 UHSs proposed at that time. This UHS water storage basin was to be a common structure for both the STP Units 3 & 4. The basin had a dividing wall, creating a dedicated compartment for each unit. Thus, the inventory was not shared between STP Units 3 & 4.

The UHS water storage basin was to be a Seismic Category I cylindrical structure (106.7-meter internal diameter and 17.1-meter-tall with 1.52-meter-thick wall) built partially below grade and sized for a water volume sufficient to meet the cooling requirements for 30 days following a design basis accident (DBA) with no makeup water and without exceeding the design basis temperature and chemistry limits. The docketed (as described in COLA, Revision 1) UHS basin was to be split by a 1.22-meter-thick divider wall into two symmetric compartments, one compartment dedicated to each unit.

To accommodate normal water level fluctuations because of evaporation, makeup water was to be available from two sources. The primary source of makeup water was to be well water and the backup source was to be water from the Main Cooling Reservoir (MCR). The makeup water was to be controlled by the level in the UHS basin. Blowdown lines were to be used to control the chemistry of the water stored in the UHS basin. In the event of maximum precipitation, the basin water level was to be maintained within the limits by discharging the excess water through the blowdown lines to the MCR.

The RSW Pump House for each Units 3 & 4 were to be contiguous with the UHS water storage basin and were to house the RSW system pumps and associated piping and valves. These STP Units 3 & 4 RSW Pump Houses were to be located diametrically opposed to each other. Each pump was to be located in its own bay.

The pump intake structure was to be designed to provide adequate submergence and net positive suction head (NPSH) for the pumps. The intake floor was to be 2.13 meters below the water storage basin floor and was to be transitioned at a slope of 26°.

The docketed (as described in COLA, Revision 1) electrical equipment room of each division was to be located in the RSW Pump House below the respective RSW pump room and above the respective mechanical equipment room.

HVAC equipment was designed to maintain suitable room conditions for proper operation of the RSW pumps and electrical equipment as described below:

- Ventilation of the RSW pump rooms was to be provided by a dedicated, thermostatically controlled ventilation system that removes the heat generated by the RSW pump motor and other equipment in the RSW pump rooms. The system for each pump room was to be comprised of two dual speed wall-mounted propeller exhaust fans. Each fan was to be rated at 50 percent of total room air flow capacity. The exhaust fans are controlled by dual-temperature sensors for staging fans and controlling ambient air intake louver positions in each pump room. The ventilation inlet/exhaust openings in the RSW Pump House structure were to be protected against tornado-generated missiles.
- The RSW pump rooms were to be heated by thermostatically controlled electric unit heaters sized to maintain the minimum design winter temperature.
- The air temperature in the electrical equipment rooms associated with the RSW Pump House was to be controlled by the HVAC packaged air conditioning unit in each room. RSW was to be used to cool the water-cooled condenser of each air conditioning unit. The RSW used for cooling was to be returned to the UHS basin.

3.2 Proposed Redesign of UHSs for STP Units 3 & 4

The redesign of the STP Units 3 & 4 UHSs will not affect the function of the UHSs to assure a supply of cooling water that is credited for dissipating reactor decay heat and essential station heat loads after a normal reactor shutdown or a shutdown following an accident or transient, including a loss-of-coolant accident (LOCA).

The redesign of the STP Units 3 & 4 UHSs proposes two separate, stand alone structures. Attachment B shows the layout and dimensions of the proposed STP Units 3 & 4 UHSs and adjacent RSW Pump Houses. The original single cylindrical STP Units 3 & 4 UHS structure, which was northwest of STP Unit 4, has been changed to two rectangular structures that are to be located south of the Reactor Buildings for each unit. Each unit's UHS will consist of a single 100 percent water basin that will have at least a 30 day supply of water to cope with an accident (LOCA) without credit taken for make-up.

The UHS mechanical draft cooling tower complexes will have Seismic Category I structures and components that are also designed to withstand other natural phenomena (freezing, tornadoes, hurricanes, floods, tsunami, seiches, etc.), site-related events (accidents), and a reasonably probable combination of natural phenomena and/or site-related events as required by regulation.

For the redesigned STP Units 3 & 4 UHS, adequate NPSH is provided for the RSW pumps, as for the docketed pump designs, except that horizontal pumps are to be utilized, instead of the vertical pumps.

The scheme for makeup water to the UHS basins and blowdown to the Main Cooling Reservoir (MCR) is unchanged from the docketed concept.

The function of the HVAC equipment to maintain suitable room conditions for proper operation of the RSW pumps and electrical equipment was not changed in the redesign of the STP Units 3 & 4 UHSs.

4.0 EVALUATION

4.1 Atmospheric Dispersion Parameter (χ/Q) Values

4.1.1 Docketed χ/Q (As described in COLA, Revision 1)

Atmospheric dispersion parameter (χ/Q) values are used in the calculation of radiation doses due to releases from the plant. The values of χ/Q are determined from historical meteorological data collected on the site.

There are three sets of χ/Q values, as discussed below, that are presented in Sections 2.3S.4 and 2.3S.5 of the COLA [Reference 6.1].

Short Term χ/Q Values at the Site Boundary

These χ/Q values are calculated using the computer code PAVAN [Reference 6.3]. A ground level release is assumed, but the Exclusion Area Boundary (EAB) and Low Population Zone (LPZ) are far enough away that building wake effects are ignored. All other mechanisms that could enhance dispersion are ignored to conservatively maximize χ/Q values. For example, the vapor plume that may be released from the UHS is not considered since it increases atmospheric turbulence and therefore increases dispersion. So there are two sets of data that are needed to perform the PAVAN calculations. The first is meteorological data, which is in the form of a three way joint frequency table (JFT). Chapter 2 of the COLA contains an extensive description of a three year set of meteorological tower data for the years 1998, 1999 and 2000, including a three way JFT (COLA Table 2.3S-10). The meteorological data is collected by the meteorological tower, which is located on the eastern STP site boundary. The meteorological tower is far enough from the proposed location of the UHS that the UHS will have no effect on meteorological measurements, and, therefore will not affect the meteorological data that may be used for determining χ/Q values. The other set of data is the distances to the EAB and LPZ in each of sixteen direction sectors. The EAB and LPZ are defined in relation to STP Units 1 & 2, so the distances from Units 3 & 4 vary for each direction sector. The resulting minimum distances are summarized in Table 2.3S-22. The change in the design of the UHS will not change the location of the release points and will therefore not change the EAB and LPZ distances.

Control Room χ/Q Values

These χ/Q values are calculated using the computer code ARCON96 [Reference 6.4]. The meteorological data used by ARCON96 is a set of hourly readings, rather than a JFT, and is described in the COLA as being based on the same three year period as the JFT. As described above, the design and location of the UHS will not affect the meteorological data used for determining χ/Q values. The other type of data used in the ARCON96 calculation describes the relationship between the release point and receptor location. The parameters involved are the height of the release point, the height of the receptor, the distance from the receptor to the release point, and the azimuthal direction from the receptor to the release point. There are two release points identified in the COLA (the stack and the Turbine Building truck doors), and there are three receptor locations (Control Room intake "B", Control Room intake "C", and the Technical Support Center (TSC)). The change in the design of the UHS will not change the locations of the release points or the receptors and therefore will not change the ARCON96 input parameters.

Long Term (Annual Average) χ/Q and D/Q Values

These χ/Q and D/Q values are calculated using the computer code XOQDOQ [Reference 6.5]. The input to this code is similar to the input to PAVAN. The meteorological data is input as a JFT, which would be the same one used in PAVAN. The χ/Q and D/Q values are calculated at a set of standard distances out to 50 miles in each direction sector. There is also a set of sensitive locations (e.g., the nearest resident), which are identified in the COLA and are referenced back to the STP Units 1 & 2 Offsite Dose Calculation Manual (ODCM). The resulting χ/Q and D/Q values, which are documented in Tables 2.3S-28 and 29, are not based on any parameters that are affected by the design of the UHS.

4.1.2 χ/Q Assessment Due to the Redesigned UHS

As can be seen from the information provided in Section 4.1.1, the location of the UHS has no effect on the χ/Q values provided in the COLA for STP Units 3 & 4. This is because the methodology used to calculate the χ/Q values does not consider most structures on the site in order to conservatively maximize χ/Q values. Other mechanisms that may enhance dispersion, such as the vapor plume released by the UHSs, are also conservatively ignored. The main input parameters to the χ/Q calculation fall into two categories.

The first major set of inputs is the meteorological data, which is based on several years of historical data collected by the STP Units 1 & 2 meteorological tower. The meteorological tower is located close to the site boundary on the east side of the plant, so the locations of the redesigned UHSs are such that they do not affect the meteorological tower.

The second set of data describes the location of the release point and the locations of receptors under consideration. For example, the offsite χ/Q values, which are determined in accordance with Regulatory Guide 1.145, consider releases from the plant vent and dose points at the Exclusion Area Boundary (EAB) and Low Population Zone (LPZ).

Since the releases at STP are considered ground level releases, the only inputs to the calculation are the distances to the EAB and LPZ in each of 16 direction sectors. For routine releases, the distances are based on specific locations of interest or standard distances from the plant. There is one additional parameter that is used to take advantage of building wake effects. The cross sectional area of the building from which the release takes place (or the nearest adjacent building) is entered and used to provide some initial dispersion caused by the wake of the building (Reactor or Turbine Building depending on the release point). All other structures are ignored.

A similar approach is used for Control Room χ/Q values. In accordance with Regulatory Guide 1.194, the only inputs used in the calculation using the computer code ARCON96 are the meteorological data and the data that describes the relationship between the release point and the intake for the Control Room or Technical Support Center. Since no credit is taken for structures on the site when calculating χ/Q values, the location of the UHS will not affect the χ/Q values provided in the COLA.

Since the design and the location of the UHSs will not affect either the site meteorological data or the physical configuration of the release points and the receptor locations, the χ/Q values will not be affected by the redesign, including relocation, of the STP Units 3 & 4 UHSs.

4.2 Site Flooding

4.2.1 Docketed Site Flooding Information (As described in COLA, Revision 1)

The site flooding is governed by the postulated breach of the Main Cooling Reservoir (MCR). The critical safety-related flood levels resulting from a postulated instantaneous breach of the MCR embankment are discussed in Subsection 2.4S.4 of Revision 1 of the STP Units 3 & 4 FSAR. Calculations show a maximum flood water level at the safety-related facilities, including the power block and the UHS, to be Elevation 47.6 ft. MSL, which is designated as the Design-Basis Flood elevation. Specific elevations of safety-related structures and plant flood protection measures are discussed in Subsections 2.4S.2 and 2.4S.10 of Revision 1 of the STP Units 3 & 4 FSAR.

With the docketed design (as described in COLA, Revision 1), the RSW Pump Houses are located at the UHS tower basin. The lowest elevation associated with the entrances or openings of these safety-related structures is the RSW Pump House roof slab elevation that is at 50 ft. MSL, below which the UHS basin and associated RSW Pump Houses are water tight. Flooding of these structures is therefore precluded, and the structures are designed to withstand the static and dynamic effects of the flood.

4.2.2 Impact on Site Flooding due to the Proposed UHS Relocation for STP Units 3 & 4

The following is an evaluation of the consequences of relocating/redesigning the UHS for STP Units 3 & 4. The proposed relocation will place the UHS basins directly south of their respective Reactor Buildings for STP Units 3 and 4. Specifically, this evaluation addresses the impacts of this redesign/relocation on site flooding.

The existing STP Units 1 & 2 are located approximately 400 feet north of the northern MCR embankment and have a grade elevation of 28 ft. MSL [All elevations are referred to NGVD (National Geodetic Vertical Datum) 29]. The proposed STP Units 3 & 4 will be located approximately 2,000 feet north of the northern MCR embankment, west of STP Units 1 & 2. STP Units 3 & 4 will have a nominal plant grade elevation of 34 ft. MSL. The ground floor elevation of safety-related buildings is Elevation 35 ft. MSL. Site grade north of the northern MCR embankment ranges from 27 ft. MSL to 29 ft. MSL.

The following site flooding considerations are reviewed to determine the impact, if any, of the redesign/relocation of the UHS will have on the site flooding.

1. Probable Maximum Flood (PMF) in Colorado River
2. Local Probable Maximum Precipitation (PMP) at the site
3. Domino failure of upstream dams on Colorado River
4. Breach of the MCR dike
5. Probable Maximum Hurricane (PMH) flooding
6. Probable Maximum Tsunami (PMT) flooding

Based on a review of the STP Units 3 & 4 FSAR [Reference 6.1], flooding due to two of these events, local PMP at the site and breach of the MCR dike, result in water levels above the plant grade elevation.

The effects of STP Units 3 & 4 UHSs relocation on site flooding are evaluated as discussed in the following paragraphs:

1. **Probable Maximum Flood (PMF):**

   The PMF in the Colorado River results in a still water level at the site of 26.3 feet according to Section 2.4.3.5.3.2 of the STP Units 3 & 4 FSAR [Reference 6.1]. The PMF water level is below the site grade, and has no affect on the relocated STP Units 3 & 4 UHSs. Conversely, the relocation of the STP Units 3 & 4 UHSs will not affect the PMF water level at the site.

2. **Local Probable Maximum Precipitation (PMP):**

   The maximum water level within the power block area resulting from the local PMP event is 36.6 ft. MSL (Section 2.4.2.3.5, STP Units 3 & 4 FSAR). Because the accumulation of flood waters during the local PMP is relatively gradual and because the area of the UHS is a very small fraction of the flooded area, the relocation of the STP Units 3 & 4 UHS basins will not appreciably affect the maximum water level near the safety-related structures, system and components (SSC). The water level upstream of the STP Units 3 & 4 UHS basins may be affected by a very small amount depending on the flow path of the PMP runoff. However, this water level is lower than the maximum water level established for a MCR dike breach and hence the governing water level for flood protection is due to the MCR dike breach.

3. **Domino Failure of Upstream Dams on the Colorado River**

   The maximum water level near the site due to domino failure of upstream dams on the Colorado River is 28.6 ft. MSL. This water level is below the site grade, and will not affect the relocated STP Units 3 & 4 UHSs. The relocation of the STP Units 3 & 4 UHSs will not affect this maximum water level due to the failure of upstream dams.

4. **MCR Dike Breach:**

   Parameters assumed for the MCR breach analysis for Revision 1 of the COLA (see STP Units 3 & 4 FSAR Section 2.4S.4) were:

   - Bottom elevation of MCR assumed uniform at Elevation 20 ft. MSL although the bottom elevation actually varies from 16 ft. in the south to 28 ft. at the northern end
   - Initial reservoir water level Elevation 50.74 ft. MSL corresponding to the ½ PMP on top of the normal maximum operating water level of 49 ft. MSL
   - Velocity in the reservoir is zero
   - Embankment Crest Elevation 65.75 ft. MSL.

   The analysis considered a breach on the northern MCR embankment of 4,757 feet wide, centered on the centerline between STP Unit 3 and Unit 4. The seismic-induced breach is assumed to be coincident with the one-half local PMP event, creating an initial reservoir water level of 50.74 ft. MSL (equivalent to the one-half PMP on top of the normal maximum operating level). The postulated MCR breach analysis predicted a maximum water surface elevation of 47.6 ft. MSL.

The flood wave resulting from the breach propagates north toward the power block area of STP Units 3 and 4. The STP Units 3 & 4 UHS relocation sets the basins in the direct path of the flood wave, making the STP Units 3 & 4 UHSs the first safety-related structure to be impacted by the wall of water. The flood levels at the STP Units 3 & 4 UHS basin will be affected because the basins are relocated to a position that is closer to the MCR and consequently would locally increase flood levels on the upstream side of the UHS basins.

Flow Velocity downstream of the Breach:

The flow velocity downstream of the breach is estimated as follows. The peak flow through the abrupt breach can be estimated using the following equation [Reference 6.6]:

$$Q_{\max} = \frac{8}{27}\sqrt{g}K^{0.25}W_b D_b^{1.5}$$

Where:
Q_{max} = peak discharge in cubic feet per second (cfs)
g = gravitational constant, 32.2 feet per second squared
K = constant assumed to be 1
W_b = width of the breach, 4,757 feet
D_b = depth of water above the breach in feet, 24.74 feet

The existing site grade elevation north of the MCR breach location varies from 27' to 29' MSL. Therefore, the crest of the breach is conservatively assumed to be at Elevation 26 ft. MSL for this evaluation, which creates a depth of breach of 24.74 feet. Under these conditions, the peak discharge from the MCR breach is approximately 963,295 cfs. Considering the aforementioned breach dimensions (4,757 feet wide and 24.74 feet high), the estimated velocity of the flood water is approximately 8.2 ft/sec [V=Q/A= 963,295 cfs / (4,757 ft x 24.74 ft) = 8.19 ft/sec]. STP Units 3 & 4 FSAR Figure 2.4S.4-21 shows the height of the flood level at the power block at approximately 13.6 feet above grade, based on the plant grade elevation of 34 ft. MSL. The peak flow rate near the power block would be smaller than what was calculated above at the breach location because the flow width will be larger and part of the flow would flow away to the west and east. Therefore, assuming that water at a velocity of 8.2 ft/sec impacts the walls of the STP Units 3 & 4 UHSs, the localized rise in water level would be of the order of one foot [Increase = V^2 / 2g = $(8.2 \text{ ft/sec})^2$ / (2 x 32.2 ft/sec^2) = 1 ft].

If it is assumed that the breach bottom is at EL 20', as per Revision 1 of the COLA, the depth of breach would be 30.74' and the corresponding peak discharge from the breach would be 1,334,183 cfs. The estimated velocity of the flood water is approximately 9.1 ft/sec [V = Q/A = 1334183cfs / (4757 ft x 30.74 ft) = 9.1 ft/sec]. The increase in water level upstream of UHS would be approximately 1.3' [Increase = $V^2$2 / 2g = $(9.1 \text{ ft/sec})^2$ / (2 x 32.2 ft/sec^2) = 1.3 ft].

The STP Units 3 & 4 UHSs relocation could potentially affect the other safety-related structures in the power block area. The relocation situates the STP Units 3 & 4 UHS basins directly between the MCR and the STP Units 3 &4 power block, creating an obstruction that could result in potentially lower flood levels for the safety-related buildings downstream of the UHSs in the power block.

The effect of the relocation of the STP Units 3 & 4 UHS basins on site flooding is as follows:

- No increase to the maximum water level (47.6 ft. MSL) is expected in the power block area.
- Flood levels on the upstream side of the UHS basins could increase on the order of one foot.

The maximum water level will be confirmed in a reanalysis of the postulated MCR dike breach using a two dimensional (2-D) flow model. The analysis will include the effects of sedimentation and erosion on the STP Units 3 & 4 SSCs.

5. Probable Maximum Hurricane (PMH) Surge Flooding

The maximum water level at the site due to PMH surge is estimated as 31.1 ft. MSL. This water level is below the site grade, and will not affect the relocated STP Units 3 & 4 UHSs. Conversely, the relocation of the STP Units 3 & 4 UHSs will not affect the PMH surge water level at the site.

6. Probable Maximum Tsunami (PMT) Flooding

The maximum water level at the site due to PMT is estimated as 16.3ft. MSL. This water level is below the site grade, and will not affect the relocated STP Units 3 & 4 UHSs. The relocation of the STP Units 3 & 4 UHSs will not affect the PMT water level at the site.

4.3 Site Flooding Effects on the Redesigned UHS

4.3.1 Docketed Flood Protection (As described in COLA, Revision 1)

Section 2.4S.10 of Revision 1 of the STP Units 3 & 4 FSAR [Reference 6.1] states that, the design basis flood (DBF) elevation in the STP Units 3 & 4 power block area is at Elevation 47.6 ft. mean sea level (MSL), or NGVD 29. Therefore, all safety-related facilities require flood protection measures up to at least Elevation 47.6 ft. MSL. The DBF elevation is determined by assessing a number of different flooding scenarios as a result of man made structures and various types of meteorological and hydrological events presented in Subsection 2.4S.2 of the STP Units 3 & 4 FSAR. The DBF for the STP Units 3 & 4 site is the result of the MCR embankment breach (non-seismic Category 1 embankment), and it is discussed in detail in Subsection 2.4S.4 STP Units 3 & 4 FSAR. STP Units 3 & 4 safety-related facilities are the Reactor Building, Control Building, and the Ultimate Heat Sink (UHS) storage basin, cooling towers, and reactor service water (RSW) Pump Houses. The Reactor and Control Buildings are located in the power block area of the site. The UHS and RSW Pump Houses were to be located on the west side of STP Unit 4. Site grade elevations in the STP Units 3 & 4 power block area range from 32 ft. MSL to 36.6 ft. MSL. Thus, the Reactor and Control Buildings are subject to flooding and require flood protection. The surrounding local grade elevation for the UHS and RSW Pump Houses was to be at approximately 30 ft. MSL; and thus, these facilities would also be subject to flooding. The UHS water storage basin, cooling towers and RSW Pump Houses were to be water tight below Elevation 50 ft. MSL. The access doors to the RSW Pump Houses were to be located at Elevation 50 ft. MSL, which is above the DBF level. Thus, all safety-related equipment associated with the UHS, cooling towers, and RSW Pump Houses were to be protected from flooding.

Safety-related facilities are designed to withstand the combination of flooding conditions and wave run up, including both static and dynamic flooding forces, associated with the flooding events.

A MCR embankment breach could result in significant erosion of earth material in the area of the breach. If this were to occur in the STP Units 3 & 4 power block area, the foundations for the safety-related facilities are deep enough to withstand the erosive forces of the MCR embankment breach and would not be affected. The safety-related facility foundation depths range from approximately Elevation -48.5 ft. MSL for the Reactor Building to approximately Elevation -9 ft. MSL for the docketed UHS Pump House.

In addition to structural protection against static, dynamic, and erosion flood forces, the safety-related facilities must remain free from flooding and intrusion of water into areas that contain safety-related equipment. All safety-related facilities are designed to be water tight at or below Elevation 47.6 ft. MSL. All water tight doors and hatches are normally closed under administrative controls and open outward. All ventilation openings are located above Elevation 47.6 ft. MSL.

A MCR embankment breach near the STP Units 3 & 4 power block area would not provide sufficient time for implementation of emergency operating procedures or flood warning systems. Since all water tight doors and hatches are to remain in a closed position, no emergency operating procedures or plant Technical Specifications (plant shutdown) are required for implementation of flood protection measures.

4.3.2 Flood Protection for the Proposed Relocation of the STP Units 3 & 4 UHSs

As presented in Section 4.2.2, above, flood levels on the upstream side of the UHS basins could increase on the order of one foot. The redesigned UHS basins, cooling towers, and RSW Pump Houses are water tight below Elevation 50 ft. MSL. The access doors to the RSW Pump Houses are located at Elevation 50.0 ft MSL. Thus, all safety-related equipment associated with the redesigned UHS basins, cooling towers, and the RSW Pump Houses are protected from flooding.

Safety-related facilities are designed to withstand the flooding conditions, including both static and dynamic flooding forces, associated with the maximum water level.

A MCR embankment breach could result in significant erosion of soil material from the breached dike and local erosion of ground material in the area of the breach. If this were to occur in the STP Units 3 & 4 UHS area, the foundations for the facilities are deep enough to withstand the erosive forces of the flow from the MCR embankment breach and would not be affected. The foundation depths range from approximately Elevation 4 ft. MSL for the UHS basins to approximately Elevation -32 ft. MSL for the RSW Pump House.

The redesigned UHS basins and RSW Pump Houses are designed to resist flotation, collapse, and permanent lateral displacement due to action of flood loads. The UHS basins and the RSW Pump Houses have been evaluated for the effects of flood loading (hydrostatic and hydrodynamic) and debris on the 6-feet thick above-grade walls exposed to the maximum water level. These evaluations have been performed in accordance with the provisions of ASCE 07-05, Chapter 5 for flood loads [Reference 6.7]. Wave run up is not considered due to limited fetch length and the relatively short duration of flood inundation.

5.0 CONCLUSIONS

The locations of the two redesigned UHSs have no effect on the χ/Q values provided in the docketed COLA (Revision 1) for STP Units 3 & 4.

The two redesigned STP Units 3 & 4 UHSs have no significant effect on site flooding. A reanalysis of the effects of a postulated MCR dike breach, including effects of sedimentation and erosion, on the SSCs of STP Units 3 & 4 is planned using a two dimensional (2-D) flow model, to confirm the maximum water levels.

The two redesigned STP Units 3 & 4 UHSs and RSW Pump Houses are designed for the static and dynamic flooding forces associated with the maximum water level.

The maximum water surface elevation at the power block area and the UHS area will be reconfirmed by a reanalysis of a postulated MCR breach.

6.0 REFERENCES

6.1 South Texas Project Units 3 & 4, "Final Safety Analysis Report," Revision 1

6.2 Design Control Document (DCD) for the Advanced Boiling Water Reactor (ABWR), U.S. NRC Docket No. 52-001, Revision 0

6.3 Bander, T.J., "PAVAN: An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations," NUREG/CR-2858, Revision 0, Pacific Northwest National Laboratory, Richland, WA, November 1982

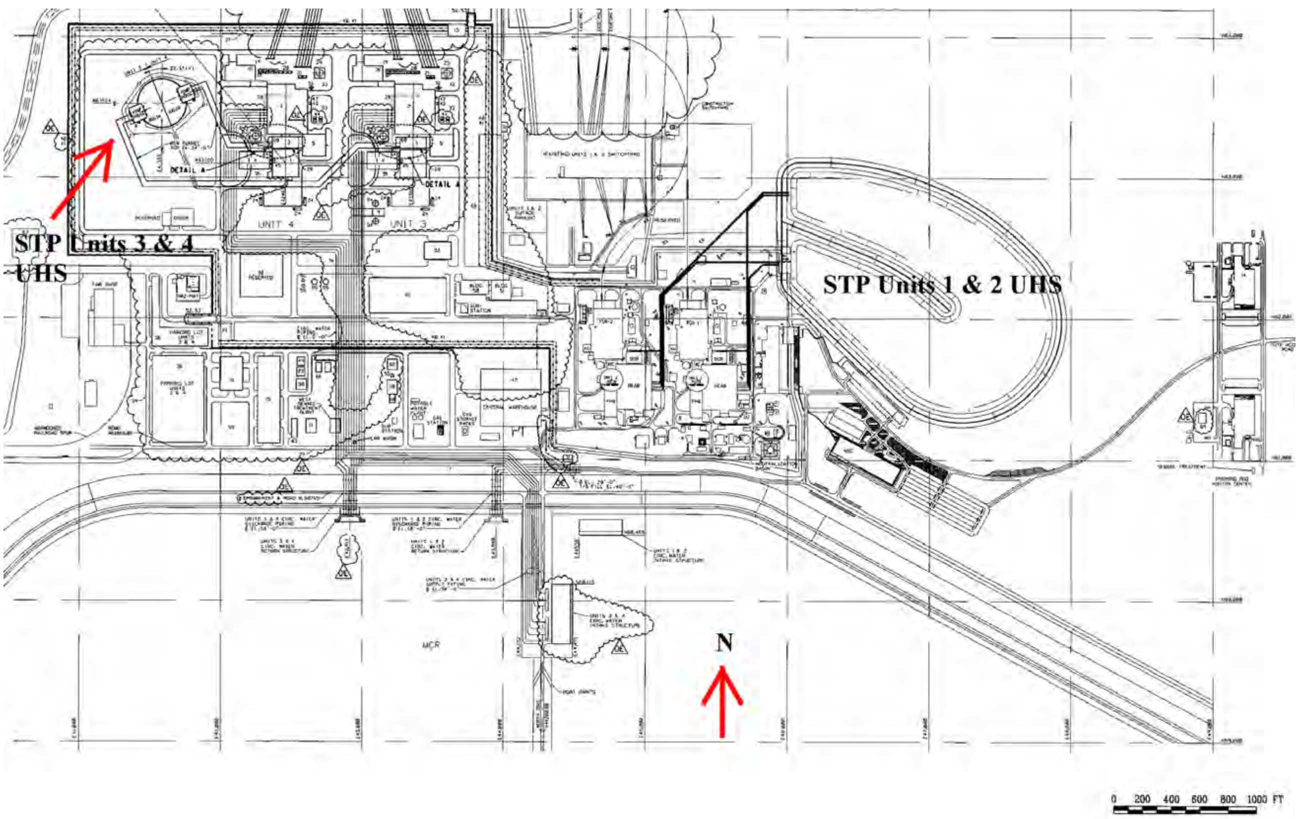
6.4 Ramsdell, J. V., Jr., and C. A. Simonen, "Atmospheric Relative Concentrations in Building Wakes," NUREG/CR-6331, Revision 1, Pacific Northwest National Laboratory, Richland, WA, May 1997

6.5 Sagendorf, J.F., J.T. Goll, and W.F. Sandusky, "XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations," NUREG/CR-2919, Revision 0, Pacific Northwest National Laboratory, Richland, WA, September 1982

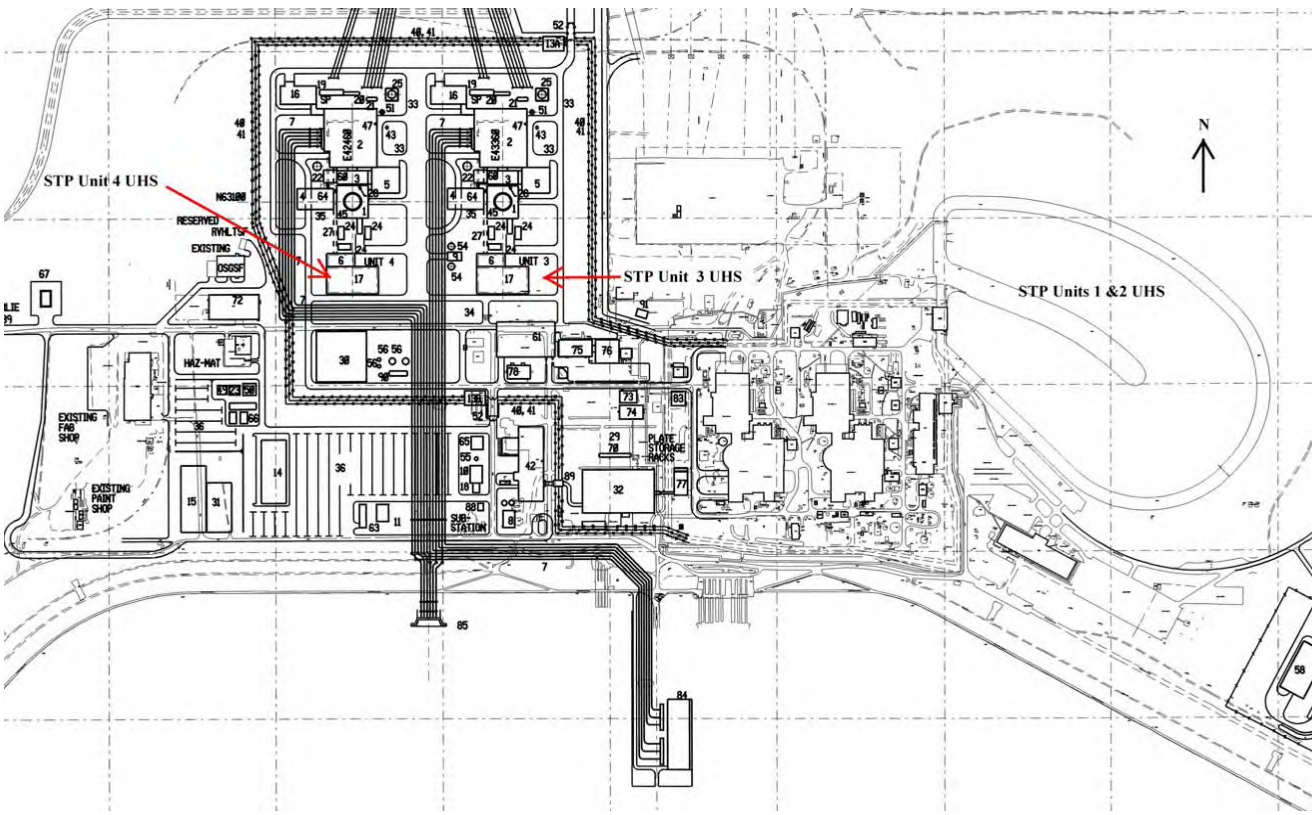
6.6 Engineering and Design - Hydrologic Engineering Requirements for Reservoirs, EM-1110-2-1420, U.S. Army Corps of Engineers, October 1997

6.7 American Society of Civil Engineers, "Minimum Design Loads for Buildings and Other Structures," ASCE Standard ASCE/SEI 7-05, Including Supplement No. 1

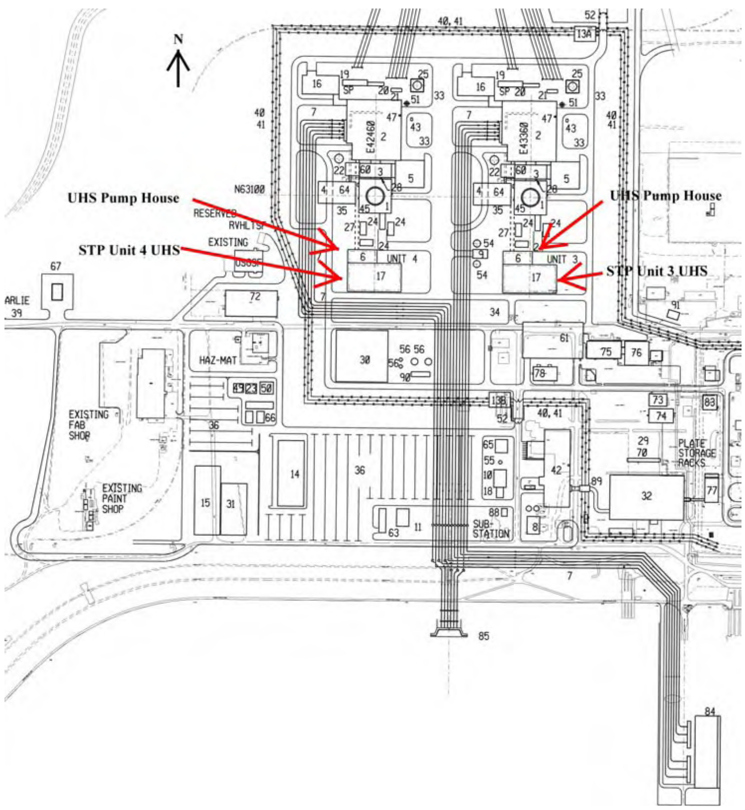
Attachment A – Docketed STP Units 3 & 4 UHS Design (As described in COLA, Revision 1)



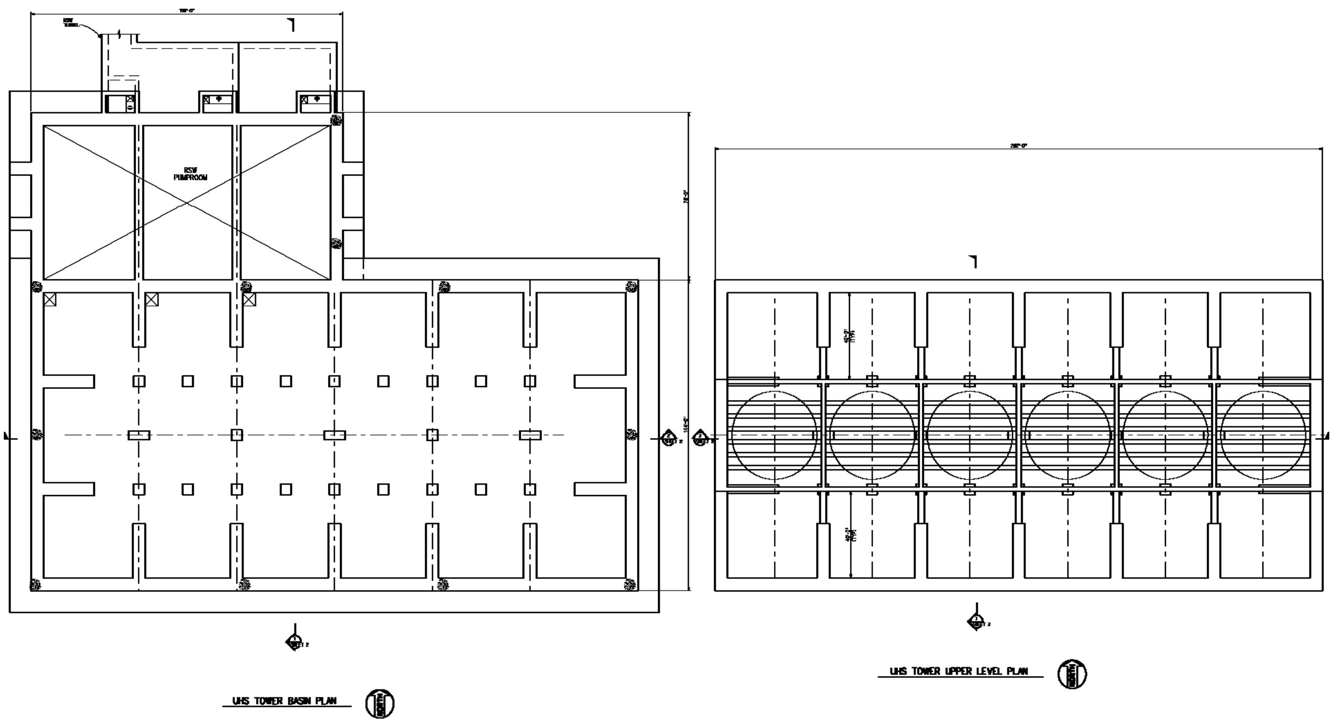
Attachment B – Conceptual STP Units 3 & 4 UHS Redesign (Figure B-1 Site Layout)



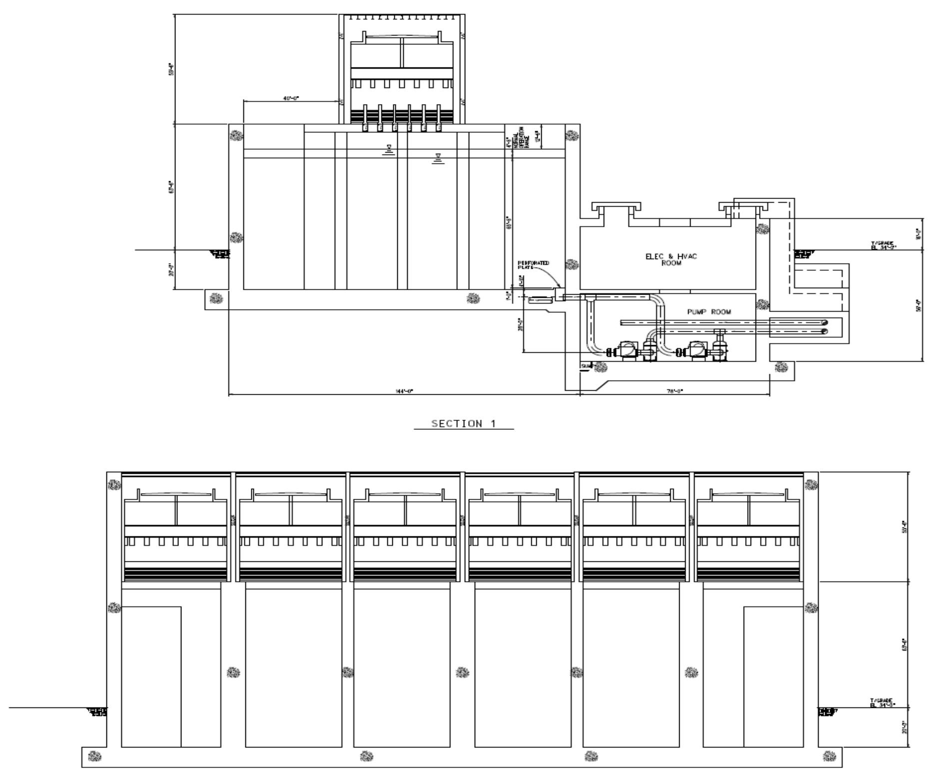
Attachment B – Conceptual STP Units 3 & 4 UHS Redesign (Figure B-2 Site Layout)



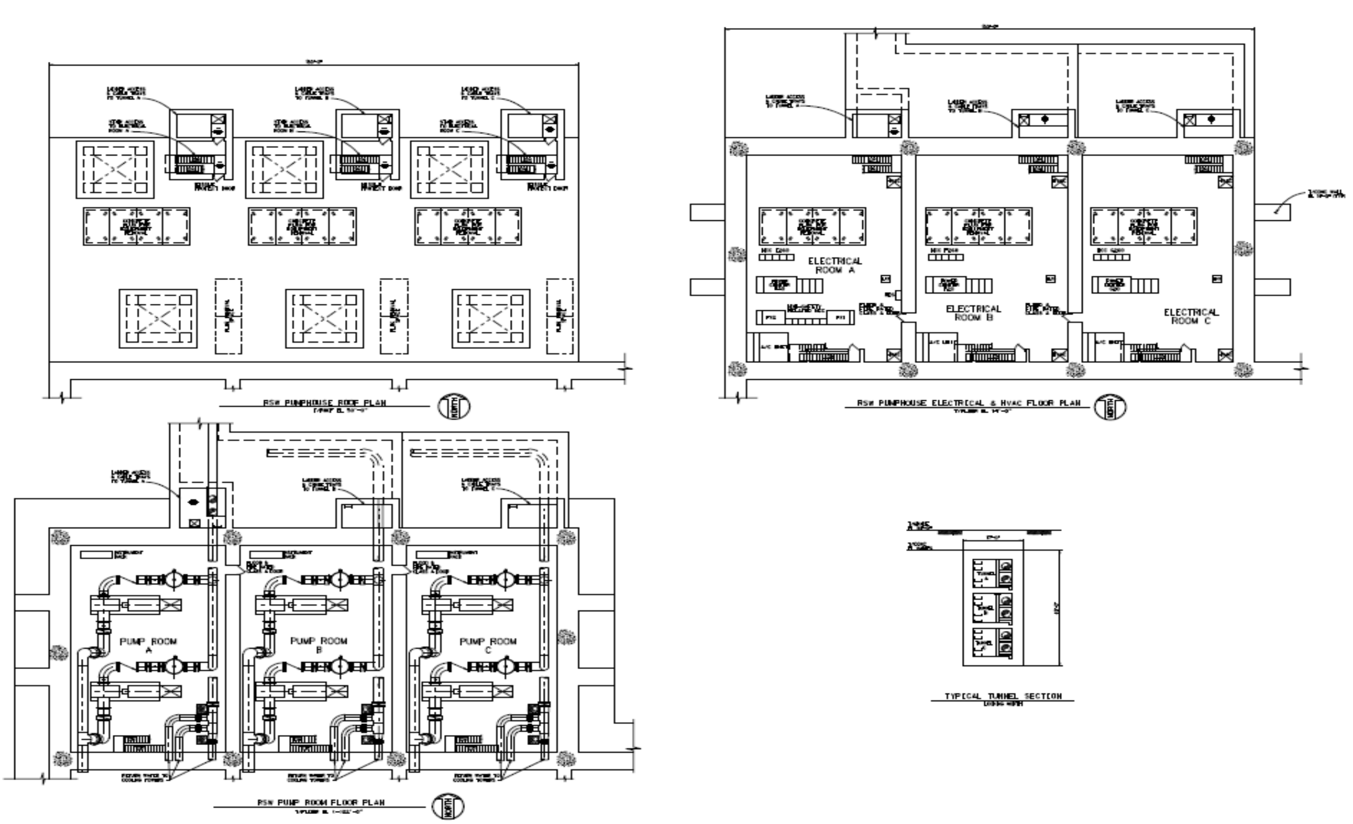
Attachment B – Conceptual STP Units 3 & 4 UHS Redesign (Figure B-3 UHS Tower Basin Plan)



Attachment B – Conceptual STP Units 3 & 4 UHS Redesign (Figure B-4 UHS Tower Sections)



Attachment B – Conceptual STP Units 3 & 4 UHS Redesign (Figure B-5 UHS Pump House & Tunnel Plans & Sections)



A42

Impact of UHS Relocation & Slurry Wall Construction on Groundwater

☐ Safety-Related ☒ Non-Safety Related

ASME: ☐ Section III
☐ Section XI

1	8/6/08	Richard Hall	Collin Palmer (J. Mele, telcom)	William G Culp
Ø	6/13/08	J. Mele	T. Williams	W.Culp
Rev.No.	Date	Prepared By	Reviewed By	Approved By

Impact of UHS Relocation and Slurry Wall on Groundwater

Purpose / Objective

This white paper discusses the docketed site groundwater information and the potential impact of the redesigned Ultimate Heat Sink (UHS) and slurry wall on the docketed description. The effect of STP Units 3&4 on groundwater is evaluated in Rev 1 of the STP Units 3&4 FSAR, Section 2.4S, with one large UHS basin located northwest of Unit 4. This white paper discusses the separation of the UHS into two UHS structures, one for each unit, located approximately 300 ft. south of the respective reactor building and the addition of a slurry wall around the STP 3&4 excavation.

Background

This white paper summarizes the extent of the FSAR evaluation and provides recommendations on how to answer the NRC question: "How does the re-design of the UHS and the addition of a slurry wall affect groundwater?" Bechtel provided the original input to the COLA as summarized below.

The slurry wall was proposed in June 2008 by S&B as the recommended means of lowering the water level in the excavation; this will not cause any change in the groundwater levels outside the slurry wall. The slurry wall will surround the excavation and extend to a depth of approximately 125 ft. below grade. The slurry wall teminates in a clay layer wall and cuts off the flow of groundwater into the excavation during excavation and construction. Groundwater monitoring wells will be installed near the slurry wall.

This slurry wall will be left in place after construction, but it will be breached near the surface after final grading of STP Unit 3&4 and before operation of STP Unit 3 so that the groundwater level is never higher than 5 ft. below the surface. This is consistent with the assumption in the certified design DCD.

Assessment

Section 2.4S.12, Groundwater, includes general discussions that are unaffected by the UHS. Section 2.4S.12.2.2, Groundwater Flow Directions, describes the upper shallow aquifer groundwater flow in the vicinity of STP Units 3&4 as generally towards the southeast and southerly around the west side of the MCR. The deep aquifer flows are northerly towards wells. The MCR is described as the dominant feature. There is no mention of the UHS. The addition of the slurry wall does not change these overall flow directions and the MCR remains the dominant feature.

The STP Units 1&2 production well depths are between 600 and 700 ft below the ground surface; no pumping is allowed within 4000 ft. of STP Units 1&2 (FSAR 2.4S.12.1.6) to minimize the potential for subsidence resulting from lowering of the deep aquifer zone "potentiometric" head. The slurry "cutoff" wall is located 1500 ft. from STP Units 1&2 but the location and design effectively eliminate changes in shallow or deep groundwater levels outside the slurry wall. The production well depth is below the slurry wall and dewatering pump depth, and there will be no deep aquifer water withdrawal by the dewatering pumps.

Section 2.4S.12.3, Subsurface Pathways, addresses pathways for offsite exposure resulting from an accidental radioactive liquid release. This FSAR section describes a surface water pathway to the STP Units 1&2 Essential Cooling Pond. This pathway is unaffected by the UHS move or the addition of the slurry wall. Similarly, a release to the lower shallow aquifer is not in any way hindered by the old or new UHS in terms of the analysis.

Impact of UHS Relocation and Slurry Wall on Groundwater

Figure 2.4S.12-21 Conceptual Hydrologic Cross Section shows a diagram of the upper shallow and lower shallow aquifer. The dimension of the UHS is small compared to the section cut and the redesigned UHS is in line with the Reactor Building in a North-South direction, so from an area standpoint, the redesigned UHS could be expected to have little impact in any North-South flow. The slurry wall is deeper and larger than the UHS and encompasses the plant area. The effect of the slurry wall on the local shallow aquifer flow is deemed to be negligible because water is not being withdrawn any where near the outside of the slurry wall in any significant quantity.

The slurry wall would detain the migration of any plant release in the groundwater pathway to the environment. It is conservative to not take any credit for this detention assuming that there is no dewatering to recharge wells outside the slurry wall after the start-up of STP Units 3&4. Any analysis would need to take into account the operating strategy for dewatering pumps and the configuration of the dewatering system.

The dimensions of the slurry wall are insignificant for regional groundwater flow. The sand layers are deep and will provide ample flow paths around the slurry wall. Figure 2.4S.12-26, Contour Maps of Hydraulic Conductivity from Slug Tests in the Shallow Aquifer, is conservative in terms of pathways to the environment since the slurry wall would provide additional detention for which credit is not taken in the transport analysis.

Section 2.4S.12.3.1, Exposure Point and Pathway Evaluation, describes the evaluation of an accidental release of liquid effluent to groundwater or surface water via the groundwater pathway. The calculation uses a diffusion model that is unaffected by any intervening structures. Therefore, the redesign of the UHS and the presence of the slurry wall will only reduce the offsite consequences from those previously submitted.

Conclusion

The redesigned UHS and slurry wall do not adversely affect the groundwater analyses and the regulatory review of the FSAR with respect to groundwater should continue.