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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
Additional Information on the External Events Analysis for
the South Texas Project Probabilistic Safety Assessment

Reference: 1) Letter ST-HL-AE-4238 from W. J. Jump to Document Control Desk dated October 21, 1992.

The purpose of this letter is to supplement the information provided by the above referenced correspondence regarding the external events analysis included in the South Texas Project (STP) Probabilistic Safety Assessment (PSA). Attachment 1 provides the basis for concluding that the possibility of flooding caused by gravity draining of the Essential Cooling Pond (ECP) and the Main Cooling Reservoir (MCR) through connecting systems and effecting safety systems is negligible.

If you should have any questions, please contact A. W. Harrison at (512) 972-7298.

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Attachment 1: Evaluation of Flooding Caused by Water From ECP and MCR

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Attachment 1

Evaluation of Flooding Caused by Water From ECP and MCR

Comment: **It is not clear whether the licensee has considered sources other than pipe breaks in the internal flood analysis. Along with other potential flooding sources, the potential for flooding caused by water from the ECP or MCR flowing freely by gravity in the event of valve failures in the connecting lines should be examined.**

Response: The possibility of internal flooding events caused by valve failures which would allow water to drain freely by gravity from the ECP (Essential Cooling Pond) or MCR (Main Cooling Reservoir) and which would result in a core damage event are considered negligible at STPEGS (less than 1×10^{-7}). The potential for internal flooding of the plant from systems connecting to the ECP (the Essential Cooling Water System, ECWS) or MCR (the Circulating Water System, CWS) has been reviewed as a result of previous lessons learned (e.g., the Oconee PRA).

However, as a result of this comment and in view of the potential for conditions to have changed since the prior review a number of years ago, the potential for this condition to occur was reconsidered. Although the design and operation of the systems connecting to the ECP and the MCR have changed to some extent since last reviewed, the conclusions previously reached remain valid.

Discussion:

The possibility of internal flooding events caused by valve failures which would allow water to drain freely by gravity from the ECP (Essential Cooling Pond) or MCR (Main Cooling Reservior) and which would result in a core damage event are considered negligible at STPEGS. The potential for internal flooding of the plant from systems connecting to the ECP (the Essential Cooling Water System, ECWS) or MCR (the Circulating Water System, CWS) has been reviewed as a result of previous lessons learned (e.g., the Oconee PRA). However, as a result of this comment and in view of the potential for conditions to have changed since last reviewed, the conclusions were reconsidered.

First, note that the design basis flood at STPEGS is the flood level attained as a result of the instantaneous breach of the MCR embankment, and, as indicated in Section 13 of the PSA, all safety systems are designed to function under this condition. The CWS provides cooling to the condenser (and other equipment) which is located in the Turbine Building, a non-safety structure containing non-safety components which would be expected to flood under design basis flood conditions and which is considered unavailable during a design basis flooding event. Similarly, an internal flooding event involving the CWS (and hence the MCR) would affect only the Turbine Building, and would not affect plant safety or safety related equipment.

Next, it should be noted that the ECP is below nominal plant grade. The equipment served directly by the 30" large-bore ECWS piping is above grade, as is most of the other equipment served by essential cooling water, which is provided by substantially smaller diameter piping from the main 30" header.

Finally, note that both the ECP and the MCR are surrounded by embankments with the respective ECWS or CWS supply and return piping rising above the level of the reservoir as it enters or leaves the reservoir. The ECWS and CWS pumps each take suction substantially below the respective reservoir's surface with a motor-operated pump discharge isolation valve immediately down-stream from the pump and above the reservoir's surface. These discharge MOVs are automatically closed when the respective pump is secured. The CWS pump discharge valve is located inside the MCR embankment at the MCR intake structure. The ECWS pump discharge valve is located inside the ECW intake structure on the ECP embankment.

<u>Essential Cooling Pond:</u>

As noted in Section 13 of the STP PSA, the normal operating level of the ECP is between Elevation 25.6 feet and Elevation 26.0 feet; the minimum operating level is at 25.5' and the maximum operating level is at 26.0' (UFSAR Section 9.2.6.2). The natural ground surface in the vicinity of the ECP is approximately 26'. Plant grade is at Elevation 28.0 feet.

The minimum available submergence of the ECW pumps in the ECP is 10.0 feet, with the pump casing rising vertically into the intake building and discharging horizontally into the 30" piping header (above grade). Upon pump start, a 10 second delay is provided before the discharge MOV starts to open in order to allow removal of the accumulated air in the pump column through a pump column vent (Reference 1). This reduces the potential of water hammer in the ECWS piping. Upon pump trip, the discharge MOV automatically closes after a two minute delay.[1]

The ECWS provides cooling to the Standby Diesel Generators (SDG) in the Diesel Generator Building, and to the Essential Chilled Water System (ECHS) and the Component Cooling Water System Heat Exchangers (CCWS HX) in the Mechanical Auxiliary Building (MAB). From the ECW Intake Structure, three independent trains of large bore (30") pipe for each unit descend below grade, travel to the respective unit's MAB, and return below grade to the ECW Discharge Structure, where each train ascends above grade to discharge to the open air above the ECP.

Three independent trains of 10" piping connect to the underground ECWS supply header to provide cooling to the SDGs. One of each of these 10" lines rises above grade in each of three physically separated compartments in the Diesel Generator Building (DGB) to provide cooling to the respective SDG, and then returns underground to the respective 30" ECWS return header for discharge into the ECP.

The 30" ECWS piping enters the MAB below grade and ascends above grade to the CCW heat exchangers on the Ele. 26' level of the MAB. From this location the piping descends below grade and returns to the ECWS Discharge Structure.

[1] Whereas the pump and ECW piping upstream of the motor-operated discharge isolation valve were considered to drain down during a period of reversed flow, thus precluding the possibility of flow from the ECW by gravity, changes have been implemented in the system to prevent or reduce the potential for water hammer which may allow the system to remain water solid (Reference 1).

Since the SDG and the CCW HX cubicles are at or above the level of the ECW pumps, the potential for water to drain and to impact this equipment is considered negligible. In addition, no valves were identified which, if failed, would result in a direct path to the cubicles. In the case of the SDGs, only one SDG would be impacted if such a failure were to occur.

On the 10' level of the MAB, each ECW train has a 4" blowdown valve which, when in use, provides a path to blow down the ECWS from the ECW return header to the ECW sump. This water is then transferred to the CWS and eventually to the MCR. The purpose of this blowdown is to maintain the ECP at a maximum level of 26', the conditions for which occur infrequently (makeup is required much more frequently). Each blowdown valve is air operated fail-close controlled by a solenoid powered by class 1E DC, each from a separate channel.

There are manual valves in the blowdown lines which allow manual isolation. Up to two sump pumps, either of which is capable of removing blowdown from one ECW line, are automatically actuated on high sump water level and are powered by non-safety power.[2]

Any possible gravity draining of ECP cooling water into the ECW sump would require a very unlikely set of conditions (estimated to occur at less than 10^{-7} per year). If these conditions occurred and went undetected for a substantial period of time (on the order of four hours or more), which is unlikely, previously analyzed flood levels in the MAB would have to be exceeded before essential equipment would be affected. Additional failures would be required for core damage to occur.

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[2] As a result of this review, a revision to a plant procedure has been initiated to assure that plant operators are aware of the potential for flooding if ECW blowdown is in progress and non-safety power is lost.

Assuming that the train is filled, conditions would require that the ECW pump discharge valve fail to close, that the blowdown line be in use, that the blowdown valve fail to close, that both sump pumps fail to operate, and that operators fail to manually isolate the blowdown line. In addition, flow resistance through the pump impeller, a spring-closed 30" check valve, the self-cleaning strainer located in the ECW intake structure, and the CCW HX tubes must be ignored.

No valves have been identified associated with the essential chillers which could fail providing a direct path to the chiller cubicles on the 10' level of the MEAB.

Note: Numerous pressure relief lines of size 1" and 1-1/2" with pressure relief valves which drain to the ECW sump are not included in this discussion. There is also a 2" drain line on the CCW HX which drains to the ECW sump which is likewise not discussed here. The relief lines are primarily associated with the CCW HXs and the Essential Chillers. The relief lines are considered too small to represent a significant hazard, especially since the relief valves are rarely if ever demanded. The drain line is not considered a hazard because of its size, location and function.

<u>Main Cooling Reservoir:</u>

The MCR and the CWS perform no safety functions. The CWS supplies cooling water from the MCR to the main condenser for removing rejected heat from the steam cycle during normal power generation, hot standby, cooldown, startup, and shutdown. The system also discharges the heated water back to the MCR. The CWS provides a path for returning open-loop auxiliary cooling water from the TGB to the MCR. The CWS also provides a path to discharge ECW blowdown to the MCR (see Reference 2).

The CWS for each unit consists of four 25-percent vertical, single-stage propeller pumps which take suction from the MCR via a common intake structure for Units 1 and 2. Vertical pumps were selected in order to avoid penetration of the embankment of the MCR below the water level. The MCR was initially designed to support four units with a surface area of 7000 acres at a nominal water level at 49'. With two units located on the STPEGS site, the water level in the reservoir is maintained between 40' and 45'.

The CW pumps provide cooling water to the generating units through eight 96" diameter pre-cast concrete pipe lines (four supply lines per unit). A motor-operated butterfly valve is installed in each pump discharge supply line. Water jet pumps are installed immediately downstream of the valves to remove air, which subsequently allows complete filling of the pump discharge lines prior to pump startup. A two-level air vent system upstream of the pump discharge valve allows venting of the air in the pump column at startup. The pump is started against a "closed" discharge valve after priming the system on the condenser side of the valve in order to avoid water hammer. A timing device is interlocked with the pump motor breaker which starts the valve opening 10 seconds after the breaker closes. The 10 second delay permits enough air to escape via the column venting system to avoid air problems and/or water hammer problems downstream. When the pumps are secured, the stop signal automatically initiates closure of the discharge valve.

The eight supply lines pass over the reservoir embankment and then combine into two 138" diameter pipes that each feed a manifold in the respective TGB. The manifold in each TGB supplies cooling water to the condenser by way of six 84" diameter lines from each condenser outlet water box. The discharge manifold for each generating unit splits into two 138" diameter lines returning water to the reservoir at the discharge structure. The four 138" diameter lines (two lines per generating unit) pass over the reservoir embankment enroute to the discharge structure. A sealing weir is located at the discharge structure to maintain the effective discharge level at 35 feet MSL, and thereby maintain a siphon on the system in the event of low reservoir level. The minimum operating level of the MCR (for a two-unit plant) is elevation 25.5' MSL. The design of the CW pumps, pump intake structure, and the CWS discharge structure is based on this minimum level.

Flooding of safety-related equipment from the MCR through the CWS is not considered possible. All safety-related equipment, including electrical cables and pipe chases, are protected against the probable maximum flood by flood-proof structures. There are no passageways, pipe chases, or cable-ways from the TGB to areas containing safety-related equipment that are below plant design flood level. The design flood level from external sources is much higher than the flood level which could be caused by failure of a valve or pipe break in the CWS.

References

1. Design Basis Document, Essential Cooling Water System, Document Number 5R289MB1006.

2. Design Basis Document, Circulating Water System, Document Number 9T229MB1052.