

Ultimate Heat Sink Fish Mortality and Vegetation Evaluation

REASON FOR EVALUATION/SCOPE:

During the Nuclear Regulatory Commission (NRC) Triennial Heat Sink inspection, the lead NRC inspector questioned whether adequate documentation of the effects of fish mortality due to high lake temperature was considered (IR 1390774). In particular, for scenarios where high lake temperatures begin causing fish mortality, the Updated Final Safety Analysis Report (UFSAR) defines the basis of the shad net installation as being present to protect the plant intake from a shad run. The design of the shad net and continuous inspection/maintenance program of the net is credited as preventing common mode failures such as aging, and blockages such as algae growth. It is stated that the fish are prevented from perishing due to the low water velocity through the net which enables them to swim away and stay in motion instead of stagnating or blocking the net or downstream screens.

The UFSAR basis (Section 2.5.5.2.5, CSCS Pond Flume Failure Analysis) is built on the assumption that the fish are alive. In the Design Basis Accident (DBA) event scenario where a protracted fish kill is in progress, and the dike were to fail and the lake begins draining, the question to be answered is if the credited Core Standby Cooling System (CSCS) cooling pond volume would be unavailable for plant cooling due to the accumulation of dead fish in the CSCS pond at the shad net barrier.

The current documented reviews do not detail the dynamics of multiple effects which could be present in a scenario such as this. Although fish kills would largely consist of fish floating to the water surface, if large populations of them were at the bottom of the CSCS pond due to it being the deepest portion of the lake, evaluations need to establish whether they would be in jeopardy of staying submerged or sinking due to acute temperatures thus causing significant blockage that isolates the Ultimate Heat Sink (UHS) from the CSCS intake.

The purpose of this evaluation is to assess the effects of fish mortality and vegetation on the shad net and UHS functions and assumptions in the station UFSAR.

DETAILED EVALUATION:

A formal evaluation to assess the potential impact fish could have on the shad net and the effective UHS volume during accident conditions was performed by an outside engineering consulting firm, URS Corporation. This document is provided as Attachment A in this evaluation and is summarized in this evaluation.

The objectives of this report were to evaluate if the volume of fish could potentially impair the water supply intended to cool the core during a DBA by limiting water flow through the shad net; if the volume of fish would reduce the effective UHS volume to a capacity that would reduce the ability to appropriately dissipate heat; and to provide an

opinion on the effectiveness of the inspection/maintenance strategy developed by Exelon to keep the shad net in continuous and reliable operation.

This evaluation uses design inputs from Calculation L-002457, Rev. 7 (Reference 3). This calculation has not been approved for implementation pending NRC License Amendment Request approval. While the data contained within the calculation has not been approved by the NRC, it bounds both the current and proposed licensing bases for the UHS and therefore its use is conservative.

Fish Quantification

Abundance and size composition within LaSalle Lake was estimated using several sources as discussed in the report (Attachment A) and summarized as follows: Illinois Department of Natural Resources (IDNR) stocking data, IDNR Creel data from 2007 recreational fishing season, and published literature on species growth rates and densities in similar US lakes. Approximately 16 million juvenile and adult fish were estimated to reside within LaSalle Lake. The majority of the total is gizzard and threadfin shad. Recreational fish comprise approximately 20 percent of the total population due to stocking and natural reproduction.

UHS Effective Volume

Based on the expected flow rates and velocities during and after a dike failure event, no fish avoidance response is expected. The fish behavior during and after the dike break will primarily be influenced by the dropping water level causing fish to seek refuge in deeper portions of the lake including the UHS and potentially the borrow pits. Approximately 10 percent of the total fish population within the lake is assumed to take refuge within the UHS after a dike failure which equates to approximately 1.6 million fish with composition and life stages of the fish to be proportional to the overall lake data. Using an average weight per fish of 0.1 pounds and fish density equal to water (based on 1-year old shad characteristics, the most abundant fish type present), the total estimated volume of fish is less than 0.1 acre-feet and less than 0.1 percent of the total effective UHS volume. Therefore, the quantity of fish seeking refuge within the UHS during a dike break does not impact the UHS effective volume.

Shad Net Loading

The primary loads on the shad net anchors include the cable, net, buoys weights, and supports (above and below the waterline). Under normal conditions, the cable is pre-tensioned to 12 kips and the double-drum buoys provide the necessary buoyancy to support the cable and net weight along the length of the Shad net. Under accident conditions, the UHS waterline drops from 700 feet to 690 feet and is only 5 feet deep at the shad net area. Under this condition, the horizontal pre-tensioned cable would need to support the vertical loads of the double-drum buoy, cable, and net. An evaluation based on available data showed that the total load due to the cable, net and buoys

would be less than the cable rating/specification of 103.4 kips. Fish buildup along the shad net would increase the horizontal force on the net. The estimated resultant hydrostatic load per foot is less than 1 kip/ft. Based on the shad net vendor's experience with commercial fishing nets, the net is capable of withstanding this load. Therefore, loading on the shad net components from the drop in water level and fish loading will not result in an increased likelihood of failure.

Maintenance Strategy for Fish Kill in DBA

As previously discussed, approximately 10 percent (1.6 million fish) of the total fish population within the lake will seek refuge in the UHS following a dike breach. A breach concurrent with a DBA will result in thermal loading of the UHS causing the fish to begin to experience thermal stress. During the 30 day coping period following the accident, it is expected that the majority of the fish within the UHS will succumb to thermal stress. As fish begin to perish, different species of fish will float and/or sink at different decomposition periods. Since the water velocities through the net are low, little movement of the floating dead fish is expected.

However, under specific meteorological conditions (winds from east to west) floating fish have the potential to build up on the east face of the shad net. In order to cope with this issue, a maintenance strategy has been developed which uses monitoring and maintenance measures that will reduce the number of floating fish within the UHS to minimize the effects on the shad net. This strategy is documented in SEAG 12-000247 (Reference 4). In order to take credit for the strategy, it must be proceduralized. AT 1390774-05 will determine what procedures require revision and initiate actions to implement the revisions.

Effects of Vegetation on Shad Net and UHS

The primary source of vegetation that is experienced on the shad net is algae. Algae grow on the shad net with peak growth during the spring and fall months. This algae is filamentous and can be power sprayed off the nets. During peak algae growth season, the shad net is inspected and cleaned daily. Algae growth is typically not experienced during the winter and summer months. With proper maintenance, the impact of algae on the shad net is mitigated.

Based on observations from the shad net maintenance crew, other types of vegetation impacting the net is rare. While leaves, logs, hydrilla and other debris occasionally appear along the net, the debris does not present a significant level of blockage to affect the performance of the net. This debris also does not damage the net at the waterline. Therefore, aquatic debris does not present a significant threat to the shad net.

The UHS was excavated entirely in the Wedron silty clay till materials (UFSAR Section 2.5.5.2.7, CSCS Pond Turbidity). This clay has a highly plastic nature and does not go into suspension during normal and accident conditions. Because of the nature of UHS

bottom, aquatic vegetation is not found growing within the UHS bottom. This is based on observations by the shad net maintenance crew, the Underwater Construction divers performing maintenance at the Lake Screen House and intake flume, and Ocean Surveys contractors performing hydrographic surveys of the UHS bottom. The only source of vegetation comes from plants growing along the waterline of the lake itself. Therefore, aquatic vegetation growing within the UHS bottom is not a concern to the operation of the UHS in normal or accident conditions.

CONCLUSION/FINDINGS:

An evaluation of the effects of fish and vegetation on the shad net was performed. The evaluation found that the quantity of fish seeking refuge within the UHS would have a negligible affect to the UHS effective volume. The shad net components are capable of withstanding the associated forces acting on the components during a dike break and fish kill event. A maintenance strategy has been developed to monitor and remove the dead floating fish from the UHS during the coping period following a dike breach and DBA. While vegetation in the form of algae can create blockage within the shad net, frequent regular inspection/maintenance during peak growth season mitigates the effects of the algae. Other aquatic debris such as leaves, logs, hydrilla does not accumulate in quantities that impact the shad net performance.

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REFERENCES:

1. LaSalle Issue Report (IR) 1390774, NRC Triennial Inspection Issue – UHS Fish Mortality
2. LaSalle Updated Final Safety Analysis Report, Rev. 19
3. Calculation L-002457, Rev. 7, LaSalle County Station Ultimate Heat Sink Analysis (Implementation pending NRC License Amendment Request Approval)
4. SEAG 12-000247, Transmittal of Information for UHS Fish Mortality Evaluation, Exelon Maintenance Strategy for Fish Kill in DBA, dated September 7, 2012