NRR-PMDAPEm Resource

From: ERICKSON, JEFFREY S <JERICKS@entergy.com>
Sent: Tuesday, June 21, 2016 1:03 PM
To: Hughey, John
Cc: Hardy, Jeffery A
Subject: [External_Sender] Palisades Frazil Ice Discussion
Attachments: Frazil Ice Discussion.pdf

John,

As requested, attached is a discussion that addresses the potential for frazil ice formation during a beyond-design-basis-external-event at the Palisades Nuclear Plant.

Please let me know if you need any additional information.

Thanks,

Jeff Erickson
Regulatory Assurance
Palisades Nuclear Plant
269-764-2375

Hearing Identifier: NRR_PMDA
Email Number: 2913

Mail Envelope Properties (AACFD50AA516704FAADD585E0320491732790A30)

Subject: [External_Sender] Palisades Frazil Ice Discussion
Sent Date: 6/21/2016 1:02:32 PM
Received Date: 6/21/2016 1:02:48 PM
From: ERICKSON, JEFFREY S

Created By: JERICKS@entergy.com

Recipients:
"Hardy, Jeffery A" <jhardy@entergy.com>
Tracking Status: None
"Hughey, John" <John.Hughey@nrc.gov>
Tracking Status: None

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Files	**Size**	**Date & Time**
MESSAGE	336	6/21/2016 1:02:48 PM
Frazil Ice Discussion.pdf	12112	

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Priority: Standard
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Expiration Date:
Recipients Received:

Palisades Nuclear Plant 6/21/16
Entergy Nuclear Operations, Inc.

Response to NRC Request for Frazil Ice Information

Frazil ice is a surface and sub-surface phenomena associated with large, open bodies of water under extremely cold, windy, and turbulent conditions. These conditions result in emulsified ice crystals forming in the subcooled surface and subsurface of the water. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," states that the potential for frazil ice formation during a beyond-design-basis-external-event (BDBEE) should be addressed by licensees in their response to NRC Order EA-12-049.

The Palisades Nuclear Plant draws water from Lake Michigan. The water enters an intake crib in the lake, passes through a buried intake line (about 3000 feet in length), and then empties into the plant's intake structure. At the intake structure, the line divides into two flow paths, one entering the north and the other entering the south intake structure bays, and then passes through trash racks and traveling screens in the bays. Two dilution water pumps and one diesel fire pump take suction from this portion of the intake structure. Water supplying the service water pumps and the remaining fire water pumps flows from the two intake bays through sluice gates into the service water pump intake bay.

During a BDBEE, the FLEX pumps are deployed in Phases 2 and 3 to take suction from the north or the south intake structure bay, at a location immediately upstream of the trash racks and traveling screens, outside the screen house. Some of the water drawn by the Phase 2 FLEX pump is recirculated back into the bay. Water can also be recirculated during Phase 3 FLEX pump operation as well.

Frazil ice is not considered to be a hazard to FLEX equipment deployed during a BDBEE for the following reasons:

- The intake crib, intake line, and intake structure were originally designed for the much larger flow rates required to support once-through condenser cooling. The once-through cooling was later converted to a closed loop cooling tower design early in the plant's life. As a result, the capacity of the plant's intake from Lake Michigan greatly exceeds the combined capacity of all the pumps that use the lake as a source of water and results in much lower flow velocities in the intake system. This inhibits the formation of frazil ice at the intake crib and in the intake structure.

- Upon the loss of power during the BDBEE, the service water, dilution water, and fire water pumps would all be stopped, greatly reducing the flow of the colder lake water into the intake structure bays and further lowering the probability of water containing entrained frazil ice crystals migrating into the bays.

- With the drastically reduced water flow from the lake upon a loss of power, the water velocity from the intake crib into the intake structure bays would be extremely slow, such that turbulent conditions within the intake structure bays would not exist. Moreover, the low flow conditions in the bays would, under subcooled conditions, likely result in the formation of a surface ice layer. The surface ice layer would prevent the mixing of supercooled surface water with the water below, preventing the formation of emulsified ice crystals in the subsurface of the water.

- During normal operations, plant procedures direct the operators to take actions to prevent frazil ice formation in the intake structure whenever frazil ice conditions exist. The actions normally involve diverting warm water from the circulating water mixing bay to the intake structure, in the vicinity of the suction of the FLEX pumps. Therefore, if the conditions for frazil ice formation exist at the start of a DBDEE event, the temperature of the water in the intake structure would be above freezing. Since frazil ice formation requires supercooled water, the initial BDBEE conditions, in which warm water recirculation would be in service, would inhibit the formation of frazil ice in the intake structure bay.

- As stated above, some of the water drawn by the Phase 2 FLEX pump is recirculated back into an intake structure bay. Water can also be recirculated during Phase 3 FLEX pump operation as well. This water would be at a slightly elevated temperature, due to pump heat, and would warm the water in the vicinity of the FLEX pump suction.