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INDIANA MICHIGAN POWER

November 8, 1999

C1199-15
10 CFR 50.4

Docket Nos.: 50-315
50-316

U.S. Nuclear Regulatory Commission
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Washington, DC 20555-0001

Donald C. Cook Nuclear Plant Units 1 and 2
REVIEW OF PRELIMINARY ACCIDENT SEQUENCE PRECURSOR
ANALYSIS OF OPERATIONAL CONDITION

Indiana Michigan Power Company (I&M), the Licensee for Donald C. Cook Nuclear Plant (CNP), Units 1 and 2, is providing a response to the referenced letter. The staff's letter focused on the circumstances presented in Licensee Event Report (LER) 316/98-005, "Interim LER - Potential for High Energy Line Break to Degrade Component Cooling Water [CCW] System," and its accident sequence precursor (ASP) analysis conclusion that the postulated event described in the LER results in a significant increase to the core damage frequency (CDF) for CNP. The staff's letter was officially received on October 7, 1999. This response is being provided within the 30-day comment period in accordance with the provisions of the staff letter and 10 CFR 50.4(d).

LER 316/98-005 was submitted in accordance with 10 CFR 50.73 to report that a postulated crack in a Unit 2 main steam line could degrade the ability of the CCW pumps to perform their design function. As part of the NRC's ASP Program, the potential event described in this LER was selected for analysis. The staff's preliminary ASP analysis of the potential event focused on the three piping runs, namely two main steam lines and one feedwater line, that run vertically and behind three corresponding CCW pump room doors, and the effect of a postulated pipe rupture in one of these lines on CDF. The staff's ASP analysis resulted in a postulated increase to the CNP overall CDF probability of 1.3×10^{-5}, which is above the ASP significance threshold of 1×10^{-6}.

I&M's review of the ASP analysis concludes that the staff's inclusion of the two heater drain line rupture events to establish a feedwater break probability was overly conservative and that the percentage of piping situated near the doors is

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more realistically 1 percent of the applicable high energy line piping instead of the 5 percent assumed by the staff. A re-analysis incorporating these changes in the modeling assumptions results in a change in CDF of 9.0×10^{-7}. I&M requests consideration of the information contained herein to support a revision to the staff's conclusion.

Attachment 1 provides a detailed response to the analysis presented in the September 27, 1999, letter. Attachment 2 provides an event tree incorporating revised modeling assumptions and presents I&M's conclusion for CDF.

The computations and assumptions contained herein have been reviewed and verified. However, they have not been performed as formal calculations in accordance with station procedures. They do not constitute changes, directly or indirectly, in the CNP licensing and design bases documentation.

Should you have any questions, please contact Mr. Robert C. Godley, Director of Regulatory Affairs, at (616) 466-2698.

Sincerely,

M. W. Rencheck
Vice President

\dms

Attachments

c: J. E. Dyer
MDEQ - DW & RPD, w/o attachments
NRC Resident Inspector
R. Whale, w/o attachments

Reference: Letter from NRC to I&M dated September 27, 1999, "Review of Preliminary Accident Sequence Precursor [ASP] Analysis of Operational Condition at Donald C. Cook Nuclear Plant, Units 1 and 2"

ATTACHMENT 1 TO C1199-15

LICENSEE REVIEW OF PRELIMINARY ACCIDENT SEQUENCE PRECURSOR ANALYSIS

Overview

Indiana Michigan Power Company (I&M), the Licensee for Donald C. Cook Nuclear Plant (CNP), Units 1 and 2, is providing a response to the NRC staff's letter, "Review of Preliminary Accident Sequence Precursor [ASP] Analysis of Operational Condition at Donald C. Cook Nuclear Plant, Units 1 and 2," dated September 27, 1999. The staff's letter focused on the circumstances presented in Licensee Event Report (LER) 316/98-005, "Interim LER - Potential for High Energy Line Break [HELB] to Degrade Component Cooling Water [CCW] System," and its conclusion that the postulated event described in the LER results in a significant increase to the core damage frequency (CDF) for CNP. The staff's letter was officially received on October 7, 1999. This response is being provided within the 30-day comment period in accordance with the provisions of the staff letter and 10 CFR 50.4(d).

LER 316/98-005 was submitted in accordance with 10 CFR 50.73 to report that a postulated crack in a Unit 2 main steam line could degrade the ability of the CCW pumps to perform their design function. The potential event described in this LER was selected for analysis as part of the NRC's ASP Program. The staff's preliminary ASP analysis of the potential event focused on the three piping runs, namely two main steam lines and one feedwater line that run vertically and behind three corresponding CCW pump room doors, and the effect of a postulated pipe rupture in one of these lines on CDF. The staff's ASP analysis resulted in a postulated increase to the CNP overall CDF probability of 1.3×10^{-5}, which is above the ASP significance threshold of 1×10^{-6}.

I&M's review of the ASP analysis concludes that the staff's inclusion of the two heater drain line rupture events to establish a feedwater break probability was overly conservative and that the percentage of piping situated near the doors is more realistically 1 percent of the applicable high energy line piping instead of the 5 percent assumed by the staff. A re-analysis incorporating these changes to the modeling assumptions results in a change in CDF of 9.0×10^{-7}.

Attachment 2 provides an event tree analysis performed with the alternate modeling assumptions showing the derivation of the change in CDF of 9.0×10^{-7}.

The staff's letter outlined a response format. The following discussion addresses each point of this guidance:

- "Does the 'Event Description' section accurately describe the event as it occurred?"

The staff's ASP analysis was not performed on an event that actually occurred. The analysis was based on a postulated event as described in LER 316/98-005. The ASP analysis Event Description section accurately reflects the postulated event described in the LER abstract.

- "Does the 'Additional Event-Related Information' section provide accurate additional information concerning the configuration of the plant and the operation of and procedures associated with relevant systems?"

  The additional event-related information appears to accurately reflect the plant configuration and the potential steam escape paths. Additionally, I&M has confirmed the preliminary conclusion that there are no high stress piping segments in this area that are vulnerable to cracks or breaks and that these portions of piping are not susceptible to erosion/corrosion (E/C) effects.

- "Does the 'Modeling Assumptions' section accurately describe the modeling done for the event? Is the modeling of the event appropriate for the events that occurred or that had the potential to occur under the event conditions? This also includes assumptions regarding the likelihood of equipment recovery."

  Based on a review of the NRC assessment and the technical issues surrounding the assessment, I&M has determined that the NRC's calculated change in CDF for this postulated event is more than an order of magnitude too high. The discussion presented below details assessment areas that warrant reconsideration.

  <u>Feedwater Piping Failure Probability</u>

  I&M has determined that the NRC's assumed feedwater (FW) line break probability is at least a factor of ten too high. It is, in fact, a factor of ten higher than the break probability assumed in the CNP probabilistic risk-assessment (PRA) performed in response to Generic Letter (GL) 88-20, "Independent Plant Examination" (3.4×10^{-4} versus 2.3×10^{-3}).

  The frequency used in the NRC assessment for the FW line break is influenced by two FW break or crack incidents over 729 critical reactor years. These incidents occurred in piping where E/C was the cause of the rupture. Specifically, a review of the events referenced in the NRC ASP analysis showed that the selected events occurred in an 8-inch schedule 40 drain line (normally 470 psig at 463 degrees F) from the first stage reheater drain tank to a FW heater (Millstone LER 336/91-012) and 6-inch schedule 40 moisture separator drain tank pump discharge line (nominal wall thickness 0.280 inch and normally 600 psig) (Millstone LER 423/90-030). These piping sections were downstream of control valves and under significantly different temperature, pressure and flow characteristics than the 20-inch

schedule 80, nominal wall thickness 1.031-inch, FW line (normally 1025.8 psig at 421 degrees F) in question. It can be demonstrated that the conditions for E/C are not present in the CNP FW piping near the CCW pump room doors.

The consideration of these two events at Millstone and their impact on the FW piping failure frequency should be removed from the ASP analysis. These events occurred in piping geometries that are not representative of the feedwater piping in question and were in locations that are not considered part of the FW system at CNP. Removal of these two events from the analysis would cause the frequency for rupture of the subject main FW line to be identical to that of the two main steam lines in the vicinity of the CCW pump room doors. This results in a decrease in the change to the CDF by about a factor of three. The initiating event frequency would be reduced from 2.8×10^{-3} to 9.5×10^{-4}, and an end state CDF probability would be reduced by the same factor, from 1.3×10^{-5} to 4.5×10^{-6}.

Additionally, the I&M investigation in progress for CNP's LER 315/98-005 has uncovered an analysis conducted in mid-1994 that focused on potential FW and main steam line HELB events and their effects on the CCW pump room doors and the CCW pumps. This analysis, which was based on the CNP Updated Final Safety Analysis Report; NRC GL 87-11, "Relaxation in Arbitrary Intermediate Rupture Requirements"; and NUREG-0800, "Standard Review Plan," Sections 3.6.1 and 3.6.2, determined that "it is not necessary to assume HELB pipe breaks or leakage cracks at any intermediate location along the [subject FW and MSL] vertical piping runs due to the low level of stress in the piping." I&M has determined that this conclusion remains valid. Also, the FW line in question has been evaluated in accordance with the CNP flow accelerated corrosion program and it was determined that the FW line in front of the CCW doors is not susceptible to E/C effects.

The following supports the above finding of a lower frequency of FW line failure:

1. The piping near the doors is a straight run of piping far enough away from any fittings or other sources of flow disturbance. This geometry is not expected to produce eddies or other abnormal velocity profiles normally associated with erosion flow streams.
2. The piping in this area has been seismically analyzed and shown to be in a low stress state. The stress values are below the values contained in NUREG-0800, Section 3.6.2 for postulation of either a break or a crack.
3. The velocity and single phase nature of the fluid associated with this section of main FW piping is not conducive to piping erosion.
4. FW is a chemically treated fluid, which is purposely maintained at low oxygen content. This creates an unlikely environment for general corrosion. Corrosion is much more likely to be a concern in areas of flow stagnation, such as vent or drain connections. No such connections exist in the FW piping in the vicinity of the doors.

These considerations alleviate the need to consider MSL and FW line breaks in this area.

Percentage of Incident Piping

I&M has determined that the NRC's value of 5 percent assigned to the percentage of high-energy line (HEL) piping present in front of the doors that can impact the CCW pumps is overly conservative. The percentage calculated by the staff was based on approximately 2,000 linear feet of HEL piping for Unit 2 with 60 to 90 feet of this piping situated near the CCW pump room doors. I&M conducted further evaluations of the piping systems and concluded that the 60 to 90 feet of HEL piping situated near the doors correlates to less than 1 percent of the overall amount of the MSL and FW piping systems. Field walkdowns showed that there is over 20,000 feet of HEL piping on Unit 2. Specifically, the MSL and FW HEL comprises 11,000 feet of this piping and the balance represents piping from other systems like extraction steam, condensate, and high pressure drain lines. Incorporating a reduction of the HEL piping percentage from 5 percent to 1 percent in the staff's assessment would reduce the end state CDF from 1.3×10^{-5} to 2.6×10^{-6}.

Effect of Reducing FW Break Frequency and Affected Piping Percentage

Combining the changes to the two modeling assumptions in the NRC assessment (i.e., an equal probability for the FW and MSL break and that the piping segments that can impact the CCW pumps conservatively represents 1 percent of the HEL) results in a CDF of 9.0×10^{-7}, as presented in Attachment 2.

Other Modeling Assumptions Not Credited

There are additional modeling assumptions applicable to the postulated scenario that were not credited in the I&M re-analysis:

1. A crack is postulated to occur in these MSL and FW piping runs directly in front of the doors. This is consistent with the NRC GL on the consequences of postulated piping failure (the "Giambusso letter"), dated December 18, 1972, requirements for the consideration of a critical crack in the worst location. However, the impingement pressures from a resulting crack jet would be negligible since the doors are located beyond 10 diameters from the piping. This distance is important because the length of 10 pipe diameters is an accepted cut-off for impingement effects established in NUREG/CR-2913, "Two Phase Jet Loads." The crack is modeled as a pipe break with the piping diameter equivalent to the critical crack area (i.e., crack area = 1/2 the piping diameter x 1/2 the piping thickness). Additionally, the use of the NUREG to establish an impingement zone of influence for a crack is conservative since the flow from a crack would normally be disbursed in a more diffused pattern than would be expected from a jet emanating from a circular break.

Thus, when pipe break in this area is eliminated (as discussed above) and a worst case crack is postulated, the CCW pump room doors would not fail. In this case, the CCW pump room would not be subjected to a harsh environment and the CCW pumps would not fail.

2. A more realistic view of the length of piping that would have sufficient influence on the doors to result in degradation to the CCW pumps would be 10-foot runs centered on the 5-foot, 9-inch tall doors. This would result in a total of 30 feet of piping for consideration rather than the 90 feet used in the ASP analysis and would result in a piping percentage reduction from 1 percent to approximately 0.33 percent of the HEL piping. This, in conjunction with the MSL and FW line break probability being equal, would result in a sequence CDF of 3.0×10^{-7}.

3. Additionally, in order for the postulated crack to present a threat to the doors and, subsequently, the CCW pumps, the crack must be oriented such that it is within an incident angle that is directly facing the doors. Using an overly conservative incident angle that includes all 180 degrees of the piping circumference facing the door would still reduce the probability of a crack in the piping in front of the doors by fifty percent.

Conclusions

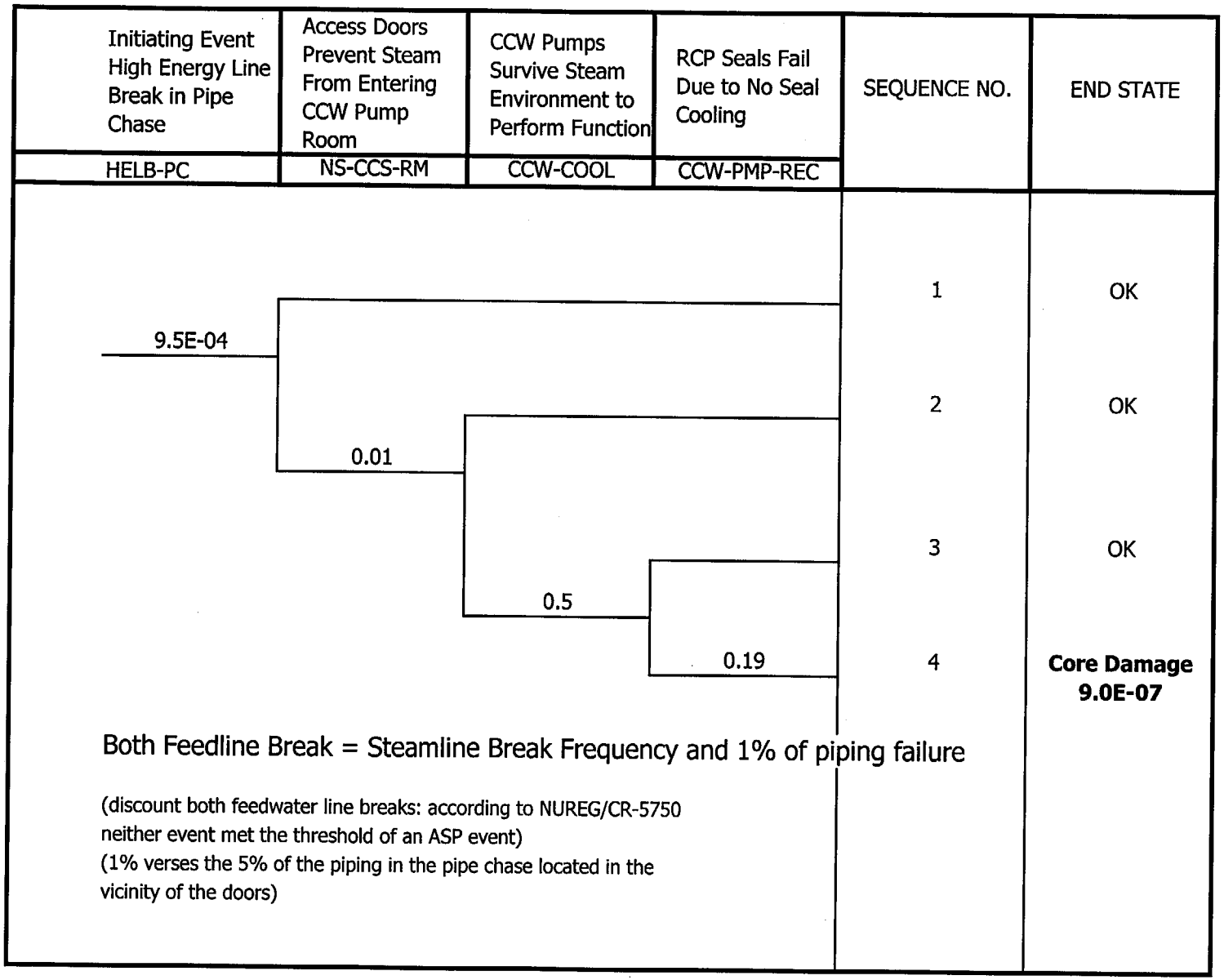
The direct probability of CCW pump degradation/failure due to a line break in general, and a feedwater break in particular, is considered to be greater than a factor of ten lower than established in the NRC assessment. This is primarily due to the staff assumption of the feedwater break probability of 2.3×10^{-3} that was based on two Millstone events that I&M considers to be overly conservative for this study. As shown above and in Attachment 2, incorporating changes to the two modeling assumptions in the NRC preliminary assessment (i.e., an equal probability for the FW and MSL break and that the piping segments that can impact the CCW pumps conservatively represents 1 percent of the HEL) results in a CDF of 9.0×10^{-7}. The additional considerations discussed above further reduce the end state CDF below the 1.0×10^{-6} criterion for a significant ASP analysis result.

ATTACHMENT 2 TO C1199-15

LICENSEE REVIEW OF PRELIMINARY
ACCIDENT SEQUENCE PRECURSOR ANALYSIS

EVENT TREE

Event Tree


Initiating Event High Energy Line Break in Pipe Chase
Access Doors Prevent Steam From Entering CCW Pump Room
CCW Pumps Survive Steam Environment to Perform Function
RCP Seals Fail Due to No Seal Cooling
SEQUENCE NO.
END STATE
HELB-PC
NS-CCS-RM
CCW-COOL
CCW-PMP-REC
9.5E-04
0.01
0.5
0.19
1
OK
2
OK
3
OK
4
Core Damage
9.0E-07
Both Feedline Break = Steamline Break Frequency and 1% of piping failure
(discount both feedwater line breaks: according to NUREG/CR-5750
neither event met the threshold of an ASP event)
(1% verses the 5% of the piping in the pipe chase located in the
vicinity of the doors)