Union of Concerned Scientists

May 23, 2001

Mr. Hubert J. Miller
Regional Administrator
United States Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406-1415

SUBJECT: LOSS OF SPENT FUEL POOL COOLING EVENT AT INDIAN POINT 3

Dear Mr. Miller:

The loss of spent fuel pool cooling during refueling at Indian Point 3 on May 8, 2001, raises several safety questions that we hope will be addressed in the NRC's special inspection report.

The NRC reported that the temperature of the spent fuel pool water rose four degrees to 155°F before cooling was restored.[1] That implies the initial temperature was 151°F. It is my understanding that workers completed fully offloading the reactor core into the spent fuel pool less than 48 hours prior to the event and that the backup spent fuel pool cooling system was functioning in place of the normal fuel pool cooling system.

Conducting a refueling outage such that the plant's entire decay heat load is placed into a relatively small volume with limited heat removal capability and virtually no backups appears both imprudent and illegal.

I have worked as a reactor engineer on the refueling floor at both the Browns Ferry and Hope Creek nuclear plants when temporary cooling problems caused the pool water to heat up to nearly 110°F. The sauna-like conditions on the refueling floor were an extreme challenge to workers and equipment. I know first-hand that my attention-to-detail suffered when I was riding the refueling platform in radiation protection clothing and sweating profusely. I also know from first-hand experience that had my personal comfort not been an issue, it was still very difficult to peer through 25 feet of water and read the fuel assembly serial numbers when there was so much turbulence in the water at the elevated temperature. It was much easier to verify assembly identification numbers and orientation when the pool temperature was around 85 to 90°F as it normally was at Browns Ferry and Hope Creek.

[1] Nuclear Regulatory Commission, News Release No. I-01-025, "NRC to Conduct Special Inspection at IP3 to Look into Loss of Spent Fuel Cooling," May 11, 2001, and Nuclear Regulatory Commission, Preliminary Notification of Event or Unusual Occurrence PNO-I-01-013, "Indian Point 3 - Loss of Spent Fuel Pool Cooling Special Inspection," May 10, 2001.

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How did Indian Point 3 get into this situation? The nuclear safety evaluation prepared by the plant's owner for the backup spent fuel pool cooling system (NSE 98-3-019 SFPC, Rev. 4) stated:

> This modification installed a permanent and independent Back-up Spent Fuel Pool Cooling System (BSFPCS). This system is capable of operation during all plant modes and provides the means to cool the SFP [spent fuel pool] for a limited time period while the existing cooling system is not available due to maintenance. ... The physical design of the BSFPCS and the high degree of its independence from existing plant system precludes it from increasing the possibility or consequences of any accident or malfunction discussed in the SAR [safety analysis report]. There are no unreviewed safety questions.[2]

I challenge the veracity of this conclusion. Worker performance is unquestionably reduced when they function in a building with the spent fuel pool water at such an avoidably high temperature. The NRC has established that worker errors cause most loss of fuel pool cooling events:

> The dominant cause of the actual loss of SFP cooling events [over the 12-year period reviewed] was loss of electrical power to the SFP cooling pumps. ... The primary causes appeared to be human error and administrative problems in 22 of the 39 events.[3]

Thus, the backup spent fuel pool cooling system at Indian Point 3 most certainly DOES increase the possibility of accidents discussed in the safety analysis report because it adversely affects human performance, a dominant contributor in the cause of those accidents. This is a violation of 10 CFR 50.59 because the NRC did not approve the change in advance as required by the regulation.

Your inspectors have already documented worker problems caused by elevated spent fuel pool temperature at Indian Point 3 during the 1999 refueling outage:

> However, the unavailability of the fan cooler units due to emergent service water repairs and the higher humidity and reactor coolant temperature from the less efficient backup spent fuel pool cooling system were not accounted for in the outage planning, or were not well integrated into the on-going radiation protection work activities. The overall containment building air temperature was much higher than initially expected and caused personnel to wipe excessive perspiration from their facial areas while working. Also, the high temperature imposed heat stress avoidance requirements on some work. In order to avoid employee heat stress, the health physics department had to make a conscious choice to relax some of the protective clothing requirements (e.g., allowing single layer rather than double layer clothing in highly contaminated areas). The inspector noted that the licensee's anticipation and response to higher temperatures in the containment building was slow and at times ineffective, as evidenced by the high number of facial contaminations. Also, the licensee's corrective action guidance after the first large number of contaminations did not prevent additional contaminations during the reactor cavity decontamination.[4]

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[2] Letter dated December 27, 2000, from Robert J. Barrett, Vice President, Operations—IP3, Entergy Nuclear Northeast, to Nuclear Regulatory Commission, "Indian Point 3 Nuclear Power Plant Code of Federal Regulations 10 CFR 50.59 Annual Report of Changes, Texts, and Experiments."

[3] J. G. Ibarra, W. R. Jones, G. F. Lanik, H. L. Ornstein, and S. V. Pullani, Nuclear Regulatory Commission, "Operating Experience Feedback Report Assessment of Spent Fuel Cooling," NUEG-1275 Vol. 12, February 1997.

[4] Section R1.1, Radiological Controls - External and Internal Exposure, NRC Integrated Inspection 50-286/99-098, December 8, 1999.

The problems during the 1999 refueling outage might be excused because they were unexpected. The excuse, however lame, disappears altogether for the 2001 refueling outage. Deliberately conducting a refueling outage knowing that the spent fuel pool water temperature will rise to nearly 150°F displays a callous disregard for safety. It clearly demonstrates that management is willing to expose workers to increased risk of both heat stress and radiological contamination. There's simply no reason to put workers in harm's way, except for greed. The plant's owner could have easily avoided the elevated temperature in the spent fuel pool by numerous ways including (a) waiting until later in the outage to fully offload the reactor core, (b) upgrading the heat removal capability of the backup spent fuel pool cooling system, or (c) not taking the normal fuel pool cooling system out of service until later in the refueling outage. But all of these options cost money, so they were discarded in favor of putting workers at increased risk.

Entergy's economy plan also put members of the public at increased risk. The time-to-boil for the spent fuel pool water was approximately 12 hours, based on the information reported by the NRC. The time-to-boil would obviously have been less than 12 hours immediately after the last fuel assembly was offloaded from the reactor core to the spent fuel pool. The NRC has looked at the consequences of loss of spent fuel pool cooling events:

> An extended loss of SFP [spent fuel pool] cooling would result in heat up and boil off of SFP coolant inventory and the eventual uncovery of the stored fuel in the unlikely event that no corrective actions were taken. This would result in high levels of radiation in the SFP area and having to prohibit personnel access to the area. Clad failure and radiation release would be the final outcome.[5]

The folks at Indian Point 3 have evaluated a loss of spent fuel pool cooling event when the entire reactor core is offloaded, as it was on May 8th:

> The maximum pool bulk temperature resulting from [the full core discharge scenario] was 200°F. ... For this case, 49.2 minutes are available to reestablish pool cooling before bulk boiling occurs.[6]

The NRC reported that it took workers 50 minutes to reestablish pool cooling.[7] But rather than quibble over 0.8 minutes, I'd prefer to focus in on the plant's capability to recover from a loss of spent fuel pool cooling event. The spent fuel pit skimmer pump's design temperature is only 200°F.[8] As the fuel pool temperature approached boiling, how reliably will this pump operate above its design temperature?

There's also the question of station blackout. Federal regulations require:

> Each light-water-cooled nuclear power plant licensed to operate must be able to withstand for a specified duration and recover from a station blackout.[9]

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[5] J. G. Ibarra, W. R. Jones, G. F. Lanik, H. L. Ornstein, and S. V. Pullani, Nuclear Regulatory Commission, "Operating Experience Feedback Report Assessment of Spent Fuel Cooling," NUEG-1275 Vol. 12, February 1997.

[6] Page 9.3-14 of the Indian Point 3 Updated Final Safety Analysis Report, Rev. 3, June 2000.

[7] Nuclear Regulatory Commission, News Release No. I-01-025, "NRC to Conduct Special Inspection at IP3 to Look into Loss of Spent Fuel Cooling," May 11, 2001, and Nuclear Regulatory Commission, Preliminary Notification of Event or Unusual Occurrence PNO-I-01-013, "Indian Point 3 - Loss of Spent Fuel Pool Cooling Special Inspection," May 10, 2001.

[8] Table 9.3-3 of the Indian Point 3 Updated Final Safety Analysis Report, Rev. 4, June 2000.

[9] Title 10 of the Code of Federal Regulations, §50.63 Loss of all alternating current power (available on the world wide web at http://www.nrc.gov/NRC/CFR/PART050/part050-0063.html).

Station blackout is defined in the regulations as follows:

> Station blackout means the complete loss of alternating current (ac) electric power to the essential and nonessential switchgear buses in a nuclear power plant (i.e., loss of offsite electric power system concurrent with turbine trip and unavailability of the onsite emergency ac power system). Station blackout does not include the loss of available ac power to buses fed by station batteries through inverters or by alternate ac sources as defined in this section, nor does it assume a concurrent single failure or design basis accident. At single unit sites, any emergency ac power source(s) in excess of the number required to meet minimum redundancy requirements (i.e., single failure) for safe shutdown (non-DBA) is assumed to be available and may be designated as an alternate power source(s) provided the applicable requirements are met. At multi-unit sites, where the combination of emergency ac power sources exceeds the minimum redundancy requirements for safe shutdown (non-DBA) of all units, the remaining emergency ac power sources may be used as alternate ac power sources provided they meet the applicable requirements. If these criteria are not met, station blackout must be assumed on all the units.[10]

According to the NRC, the station blackout duration for Indian Point 3 is eight (8) hours.[11] Because the equipment needed to cool the spent fuel pool—both the normal system and its backup—require alternating current (ac) electric power to operate, it appears that workers at Indian Point 3 could not possibly reestablish cooling in 49.2 minutes, or 50 minutes, or 90 minutes, or even 300 minutes if a station blackout lasted up to 8 hours (480 minutes). Are procedures in place to direct workers at Indian Point 3 in event of a station blackout event during refueling?

This question has more than academic importance. When Indian Point 3 is running, its operating license requires two independent connections to its offsite electrical grid and all three emergency diesel generators to be operable.[12] However, when Indian Point 3 is refueling, only one connection to its electrical grid and only one diesel generator is required to be operable.[13] The probability of a station blackout occurring are therefore greater during refueling because fewer than half of the alternating current sources are required to be available. Again, the NRC has already reached this conclusion:

> Despite the relatively small fraction of an operating cycle that each unit at SSES [Susquehanna Steam Electric Station] was assumed to be in a refueling outage, the sequences occurring during refueling outage periods that were examined dominated the near-boiling frequency. Two factors contributed to this result: the relatively shorter time to reach boiling after a loss of SFP cooling because of the practice of conducting full-core off-loads at SSES and the practice of removing systems associated with the outage unit that contribute to SFP decay heat removal capability from service for maintenance during refueling outages.[14]

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[10] Title 10 of the Code of Federal Regulations, §50.2 Definitions (available on the world wide web at http://www.nrc.gov/NRC/CFR/PART050/part050-0002.html).

[11] William S. Raughley, Nuclear Regulatory Commission, "Final Report - Regulatory Effectiveness of the Station Blackout Rule," ADAMS Accession No. ML 003741781, 2001.

[12] Technical Specification 3.8.1 of the Improved Technical Specifications for Indian Point 3 (ADAMS Accession No. ML0037513130).

[13] Technical Specification 3.8.1 of the Improved Technical Specifications for Indian Point 3 (ADAMS Accession No. ML0037513130).

[14] Nuclear Regulatory Commission, Information Notice No. 98-38, Supplement 1, "Potential Loss of Spent Fuel Pool Cooling after a Loss-of-Coolant Accident of a Loss of Offsite Power," August 24, 1995.

The NRC reminded plant owners about the importance of written contingency plans for loss of power during refueling nearly a decade ago following two near-misses:

> These events [at Turkey Point in November 1990 and at Indian Point 2 in March 1991] illustrate the benefits of carefully planning equipment outages during shutdown. Before each event, the [plant owners] has made additional power sources available to augment normal supplies. Furthermore, the [plant owners] had developed written procedures to address anticipated equipment failures. These efforts allowed operating personnel to have adequate time to perform deliberate, well informed actions and minimized the safety concerns associated with each event.[15]

Have workers at Indian Point 3 developed procedures for coping with a station blackout during refueling when the entire reactor core is offloaded into the spent fuel pool? Have they developed procedures for responding to a failure of the backup spent fuel pool cooling system when the normal cooling system is unavailable due to maintenance?

I hope to find the answers to these important safety questions in the report issued by the NRC's inspection team and in the enforcement action(s) taken against the plant owner for its violation(s) of 10 CFR 50.59.

Sincerely,

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[15] Nuclear Regulatory Commission, Information Notice No. 91-68, "Careful Planning Significantly Reduces the Potential Adverse Impacts of Loss of Offsite Power Events During Shutdown," October 28, 1991.