Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

June 23, 2010

R. William Borchardt, Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Indian Point Unit 2 Cruising Down Davis-Besse Boulevard

Dear Mr. Borchardt:

A recent Nuclear Regulatory Commission inspection report[1] for Indian Point Unit 2 (IP-2) contains many items that closely resemble conditions at Davis-Besse prior to the belated discovery of the football-sized hole in its reactor vessel head. The purpose of this letter is to call your attention to those parallels. This letter is not a request per 10 CFR 2.206 for the NRC to take enforcement action to resolve the many clear safety problems identified at IP-2. Rather, it is our expectation that after reading this letter and seeking confirmation from the NRC staff, you will initiate whatever measures are needed to remedy these problems before IP-2 conducts another refueling outage. It would be replicating the inadequate licensee management and ineffective regulatory oversight factoring into the Davis-Besse near-miss to conduct another refueling outage at IP-2 the way outages have been conducted since 1993. We trust that you will not knowingly permit those egregious errors to be repeated.

THE PROBLEMS NRC IDENTIFIED

NRC inspectors chronicled the recurring leakage of borated water from the reactor refueling cavity at IP-2 into the lower elevations of the reactor containment building. According to the NRC's inspection report, refueling cavity leak rates of between 2 and 10 gallons per minute have been repeatedly entered in the corrective action program dating back to 1993. Despite these numerous corrective action program entries, the licensee has not yet "*evaluated the impact of reactor refueling cavity water leakage on the dissimilar metal welds between the stainless steel liner and the carbon steel studs*" nor has the licensee evaluated "*the effects of the leakage … with regard to liner attachment welds and carbon steel hardware.*"

The NRC's inspection report stated that the licensee "*previously attempted to repair this leakage by applying various chemically bonded coatings to the stainless steel liner in various prospective leak locations. The coatings have not proven effective in stopping the leakage*."

[1] NRC Inspection Report 05000247/201002 dated May 13, 2010. Available in ADAMS under ML101330214.

www.ucsusa.org
Two Brattle Square · Cambridge, MA 02238-9105 · TEL: 617.547.5552 · FAX: 617.864.9405
1825 K Street NW · Suite 800 · Washington, DC 20006-1232 · TEL: 202.223.6133 · FAX: 202.223.6162
2397 Shattuck Avenue · Suite 203 · Berkeley, CA 94704-1567 · TEL: 510.843.1872 · FAX: 510.843.3785
One North LaSalle Street · Suite 1904 · Chicago, IL 60602-4064 · TEL: 312.578.1750 · FAX: 312.578.1751

The NRC's inspection report stated that the licensee initiated a corrective action report in 2000 about the dissimilar metal weld between the stainless steel liner of the refueling cavity and the carbon steel studs, but closed that report "*without taking documented corrective action*."

The NRC's inspection report 'accepts' this condition on this stated basis:

> *The inspectors acknowledge that the leakage only occurs for approximately two weeks every other year, when the refueling cavity is flooded with water. For the remaining period of each operating cycle, this area is dry and area conditions should not be conducive to corrosion.*

THE PARALLELS WITH DAVIS-BESSE

For many refueling outages prior to the discovery of the football-sized hole in spring 2002, Davis-Besse had experienced considerable problems with boric acid corrosion on the reactor vessel head. It was attributed to leakage downward from the bolted flange connections for the control rod drive mechanism nozzles. That licensee repeatedly planned to modify the service platform above the reactor vessel head to facilitate inspections and cleaning of the head, but repeatedly deferred that modification for schedule and budget reasons. Likewise, that licensee opted not to modify the bolted CRDM nozzle flange connections for welded connections that other licensees adopted. This licensee repeatedly failed to satisfy regulatory requirements to (a) remove all boric acid accumulations and inspect the underlying surfaces for corrosion damage and (b) evaluate safety-related components affected by boric acid for margin reductions. Many corrective action program entries about recurring leakage of borated water and its consequences were either closed without any actions taken or closed after inadequate corrective actions were taken.

At Davis-Besse, borated water leaked from CRDM nozzle flanges so often that this abnormal condition became the norm. At IP-2, borated water leaking from the "leakproof membrane"[2] has become the routine refueling outage configuration.

> The refueling canal connects the reactor cavity with the fuel transport tube to the spent fuel pool. The floor and walls of the canal are concrete, with wall and shielding water providing the equivalent of 6-ft of concrete.
>
> The refueling canal floor is 5-ft thick. The concrete walls and floor are lined with 0.25-in. thick stainless steel plate. The linings provide a leakproof membrane that is resistant to abrasion and damage during fuel handling operation.

At Davis-Besse, modifications proposed to facilitate inspecting and cleaning the reactor vessel head were repeatedly deferred. At IP-2, permanent resolution of the leaking refueling cavity liner has been repeatedly postponed.

[2] The boxed text was extracted from Section 5.1.2.1 of the Indian Point Unit 2 Updated Final Safety Analysis Report submitted to the NRC in July 2001 – eight years after leakage through the membrane was entered into the corrective action program.

At Davis-Besse, NRC inspectors were handed the infamous red photo in spring 2000 showing clear evidence of reactor vessel head degradation yet meekly filed it away without taking action. At IP-2, NRC inspectors formed an equally clear picture of unsafe conditions yet wrote it off despite knowledge that the leakage may be degrading carbon steel supports and no assessment of this potential degradation has ever been performed.

At Davis-Besse, inspections of the CRDM nozzles in spring 2002 due to the discovery of a problem at Oconee in spring 2001 finally found the football-sized hole in the reactor vessel head and triggered the resolution of that problem, its consequences, and its contributing causes. At IP-2, no such stroke of luck has yet prompted the resolution of this longstanding safety problem.

THE REAL AND POTENTIAL CONSEQUENCES OF THE PROBLEMS

The recurring leakage of borated water from the refueling cavity at IP-2 raises five related but distinct consequences:

1. Inadequate leak rate monitoring during refueling and inadequate administrative controls covering appropriate response to increasing leak rate trends.

2. Increased probability for leak-before-break event.

3. Damage to equipment inside containment from boric acid/borated water and inadequate scope of boric acid corrosion control program.

4. Potential impairment of proper control of containment water pH following a loss of coolant accident.

5. Inadequate corrective action program.

Each of these five consequences are described in greater detail in the following sections.

Inadequate Leak Rate Monitoring During Refueling

Section 3.4.13 within the technical specifications for IP-2 covers leakage into the reactor containment. These technical specifications limit leakage from identified sources to 10 gallons per minute and leakage from unidentified sources to only 1 gallon per minute. But these requirements are only applicable in MODES 1, 2, 3, and 4 while refueling is defined as MODE 6. Likewise, whereas technical specification section 3.4.15 requires the containment leakage detection instrumentation to be operable, these requirements only apply during MODES 1, 2, 3, and 4. The leakage detection instrumentation is not required to be operable during refueling.

Section 3.9, Refueling Operations, of the technical specifications neither limits leakage during refueling nor even requires leakage to be monitored during refueling.

The NRC's inspection report stated that borated water has been routinely leaking through the refueling cavity liner at rates between 2 and 10 gallons per minute during refueling outages since 1993.

- What if cavity liner leakage rapidly increased from 5 gpm to >50 gpm during a future refueling outage? With no governing technical specification requirement – and we reasonably presume no applicable administrative control – when would workers take appropriate steps to respond to deteriorating plant conditions?

- What if cavity liner leakage rapidly increased from 2 gpm to >200 gpm during a future refueling outage when the leak detection instrumentation is all out of service, as allowed by technical specifications, for maintenance and inspections? What parameter would clue workers into the need to respond to this deteriorating plant condition?

The design and licensing bases for IP-2 clearly and unequivocally do not allow any leakage through the refueling cavity liner. Operation within the design and licensing bases would preclude the leak rate limit and monitoring issues identified above. Repetitive operation outside the design and licensing bases invoke these issues.

Indian Point Unit 2 has been flying blind during refueling outages conducted since 1993 by having leakage through the refueling cavity liner but without regulatory requirements and administrative controls to (a) require the leakage to be monitored, and (b) limit the leak rate at an acceptable level.

<u>Increased Probability for Leak-Before-Break Event</u>

As noted in the NRC inspection report, Section 9.5.1.4 in the Updated Final Safety Analysis Report for IP-2 states:

> The reactor cavity, refueling canal and spent fuel storage pit are reinforced concrete structures with a seam-welded stainless steel plate liner. These structures are designed to withstand the anticipated earthquake loadings as seismic Class I structures so that the liner prevents leakage even in the event the reinforced concrete develops cracks.

The liner has a safety-related function of preventing leakage following a seismic event. When the liner is leaking between 2 and 10 gallons per minute <u>before</u> a seismic event, it is virtually impossible for this safety-related function to be satisfied <u>after</u> a seismic event. It seems more likely that the forces applied during the seismic event could significantly increase the pre-existing leak rate.

In April 2010, industry representatives appeared before the NRC's Chairman and Commissioners urging them to allow credit to be taken for leak-before-break – the fanciful notion that licensees will respond to indications of unacceptable leakage and take appropriate steps to prevent the ensuing catastrophic break. This case at IP-2 is but another example of the industry not backing up its leak-before-break rhetoric with action. Knowing about leakage for nearly two decades without (a) evaluating potential consequences and (b) correcting the problem essentially begs for the break to happen.

Inadequate Scope of Boric Acid Corrosion Control Program

More than two decades ago, the NRC required the IP-2 licensee to develop and implement a boric acid corrosion control program for carbon steel components within the reactor pressure boundary.[3]

More than fifteen years before that mandate, the Atomic Energy Commission notified[4] the IP-2 licensee about damage to the reactor vessel head of a foreign reactor caused by leakage of borated water.

This warning and mandate applied to damage caused by borated water leaking from the reactor coolant system, the primary loop of a pressurized water reactor. This warning and mandate did not apply to borated water leaking from the refueling cavity liner. But components within the containment building really cannot distinguish between being wetted by borated water from the reactor coolant system and borated water from the refueling cavity. The borated water leaking from the reactor coolant system at Davis-Besse damaged more than carbon steel components within the reactor pressure boundary. The metal coils of the fan coolers inside containment at Davis-Besse were replaced due to boric acid degradation.

The leakage of between 2 and 10 gallons per minute for approximately two weeks during the nine refueling outages at IP-2 since 1993 means that 362,880 to 1,814,400 gallons of borated water leaked into containment. The NRC's inspection report documented that the licensee has not yet evaluated carbon steel components known to be in the proximity of and likely to be in the path of this borated water.

The scope of the boric acid corrosion control program is limited to leakage from the reactor coolant system and its potential adverse impact on carbon steel components within the reactor pressure boundary. The limited-scope boric acid corrosion control program provides little to no

[3] Nuclear Regulatory Commission Generic Letter No. 88-05 dated March 17, 1988, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants."

[4] Atomic Energy Commission letter dated February 9, 1972, to William J. Cahill, Jr., Vice President – Consolidated Edison Company. Available in the NRC's Public Document Room under Accession No. 8111100305.

protection for equipment exposed to and potentially damaged by borated water leaking from the refueling cavity liner.

If the licensee persists in operating IP-2 with refueling cavity liner leakage, it should expand the scope of its boric acid corrosion control program to address components in the path of this water.

Potential Impairment of Post-Accident Containment Water pH

More than five years ago, the NRC alerted[5] the IP-2 licensee to another consequence of borated water leakage into containment – the potential impairment of containment water pH control following an accident. For both equipment protection and to limit the amount of gaseous radioactive iodine within containment (and therefore, available for release to the atmosphere), the pH of the water in the containment sump is controlled. Because the water spilling into containment from a broken pipe is borated, materials are pre-staged inside containment to balance that acidic tendency and achieve the desired pH range.

Until recently, tri-sodium phosphate (TSP) in powder form was installed in the Indian Point Unit 2 containment for pH control. Sodium tetraborate is now used for that purpose. The license amendment authorizing this material change required at least 8,096 pounds of sodium tetraborate to be available inside containment. That amount was reported to provide a 41 percent margin for the desired pH range based on the amount of boric acid deposited into containment in the first 30 days following an accident.[6]

The recurring leakage of between 2 and 10 gallons per minute of borated water (approximately 2,700 parts per million boron concentration) for two weeks during the nine refueling outages since 1993 deposited between 362,880 and 1,814,400 gallons in containment. That water contained between 8,203 and 41,016 pounds of boron. If only two percent of that water evaporated and left boron, likely in the form of boric acid, behind, that means there’s 164 to 820 pounds of boron pre-existing inside containment and ready to adversely affect pH control after an accident. If ten percent of that water evaporated, there’s 820 to 4,102 pounds of boron unaccounted for inside containment.

The calculation[7] that determined the amount of sodium tetraborate for proper pH control is not publicly available. We are therefore unable to assess the potential impact of pre-existing boron inside containment on post-accident pH control.

[5] Nuclear Regulatory Commission Information Notice 2004-21 dated November 24, 2004, “Additional Adverse Effect of Boric Acid Leakage: Potential Impact on Post-Accident Coolant pH.”
[6] Nuclear Regulatory Commission Amendment No. 253 to the Indian Point Unit 2 Operating License dated February 7, 2008.
[7] Entergy Calculation IP-CALC-07-00129.

Inadequate Corrective Action Program

The known leakage of between 2 and 10 gallons per minute of borated water through the "leakproof membrane" of the refueling cavity liner during nine refueling outages conducted since 1993 despite numerous attempts to patch it should be nominated for the worst corrective action program performance in history. This constitutes the repetitive failures or sustained incompetence that makes for great case studies of how NOT to conduct corrective actions.

It also represents fertile ground for numerous violations of the quality assurance regulatory requirements contained in 10 CFR 50 Appendix B.

Not only has this license repeatedly failed to plug leaks in a supposedly "leakproof membrane," it has also failed to evaluate the direct consequences of that known leakage.

The corrective action program at IP-2 is clearly deficient and thus in violation of federal regulations.

THE BOTTOM LINE

The NRC has documented serious safety problems involving improperly evaluated, recurring leakage of borated water from the refueling water cavity at IP-2. Should this problem remain unresolved during future refueling outages and escalate into an accident, it will serve as a starting point for the Congressional post-event inquiries formed to assign blame.

This NRC inspection report could also serve as a foundation for the regulatory steps needed to compel this recalcitrant licensee into truly and properly fixing the problems. This would stop Indian Point Unit 2's movement down the Davis-Besse path and prevent an otherwise nearly inevitable bad outcome.

UCS trusts you will direct the NRC staff to undertake those regulatory steps and stop the downward slide at IP-2.

Sincerely,

David Lochbaum
Director, Nuclear Safety Project
PO Box 15316
Chattanooga, TN 37415
(423) 468-9272, office
(423) 488-8318, cell