Union of Concerned Scientists

Citizens and Scientists for Environmental Solutions

July 15, 2002

Mr. John A. Grobe, Chairman
Davis-Besse 0350 Panel
United States Nuclear Regulatory Commission
801 Warrenville Road
Lisle, IL 60532-4351

Mr. Edwin M. Hackett, Assistant Team Leader
Davis-Besse Reactor Vessel Head Degradation Lesson-Learned Task Force
United States Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: SEEKING THE (W)HOLE STORY OF DAVIS-BESSE

Dear Mr. Grobe and Mr. Hackett:

The Union of Concerned Scientists continues to attempt to understand factors contributing to the near-miss loss-of-coolant accident at Davis-Besse. Our efforts raised additional questions, including some directly tied to the safe restart of the reactor. For example, we reviewed information about potential containment vessel damage being dismissed by FirstEnergy in an eerily similar way to how the company, and the NRC, overlooked many warning signs of potential reactor vessel head damage. The questions and their background are detailed in the attachment.

Please note that at least one of these questions raises generic safety concerns that may affect operating nuclear power plants other than Davis-Besse. A relatively minor reactor coolant system leak resulted in the containment radiation filters being clogged on a daily basis, essentially disabling this vital monitoring function. A design basis accident, such as a loss of coolant accident, would likely put far more particulate matter into the containment atmosphere. An accident could therefore fail the monitoring instrumentation just when it is needed most. It raises the question of whether any plant is really in compliance with General Design Criterion 4.

Our reviews continue to suggest that FirstEnergy failed to fully evaluate the safety significance of non-conforming conditions at Davis-Besse and that NRC inspectors repeatedly accepted incomplete evaluations. UCS joined fourteen other local, regional, and national organizations in petitioning the NRC to have an independent verification team assess conditions at Davis-Besse. As time goes by without any substantive response from the NRC, we see more and more reason why independent verification is desperately needed. There is a vast difference between the 0350 Panel process as implemented for D C Cook and the same process currently being implemented for Davis-Besse. At the 0350 Panel meetings on D C Cook, the public learned the detailed results from far-ranging investigations by the company and the NRC. At the 0350 Panel meetings on Davis-Besse, the public is treated to a mind-numbing chorus by company officials promising better days ahead. There is pitifully little information being released that suggests yet alone demonstrates that the company is backing its words with actions.

Washington Office: 1707 H Street NW Suite 600 • Washington DC 20006-3919 • 202-223-6133 • FAX: 202-223-6162
Cambridge Headquarters: Two Brattle Square • Cambridge MA 02238-9105 • 617-547-5552 • FAX: 617-864-9405
California Office: 2397 Shattuck Avenue Suite 203 • Berkeley CA 94704-1567 • 510-843-1872 • FAX: 510-843-3785

The NRC should expeditiously grant the petition and get the independent verification team to the site as soon as possible. UCS realizes that neither of you has a ballot in the decision-making process regarding this important matter, but perhaps you could pass along the reminder to the "paper-rock-scissor" gang at headquarters.

Sincerely,

David Lochbaum
Nuclear Safety Engineer
Washington Office

Containment Radiation Filters

The NRC and FirstEnergy attribute the extensive damage to the reactor vessel head at Davis-Besse to "missed opportunities." Few commentators have missed the opportunity to cite the frequent filter changes for the containment radiation monitors as compelling evidence of the "missed opportunities."

In 1999, workers at Davis-Besse knew something wasn't right. They were entering the containment almost daily with the reactor at power in order to replace the filters on radiation monitors:

> "The performance of the Containment Radiation Monitors, RE4597AA and RE4597BA has degraded due to repetitive low sample flow conditions. The cause of the low sample flow is due to a buildup of material on the particulate filter. The particulate matter is primarily an iron oxide powder but the source is unknown."
>
> and
>
> "Subsequent filter changes were required every 24-48 hours."[1]

Davis-Besse began operating in 1977 and operated for over two decades without daily visitations to the containment monitors. Knowing something was wrong but not knowing exactly what, workers sent some of the filters to an offsite laboratory for analysis:

> "Several filters from the CTMT [containment] radiation monitors and a sample from the White Bird used for CTMT pressure releases were sent to Southwest Research Institute (SRI) for analysis as part of the RE4597AA/BA action plan. Per telecon with Dr. Richard Page of SRI, the analysis was completed on 7/29 with the following results:
>
> > "The RE 4579BA filter from 7/3/99 contained primarily Iron Oxide (10-100 microns with some smaller particles down to 1 micron). There was also some measurable Chlorine. The Iron Oxide particles had a granular appearance indicating the source is from corrosion.
> >
> > "The RE 4597BA filter form 7/9/99 also had three darker spots on it which were analyzed to contain potassium and chlorine. A sample from the white bird filter also contained iron oxide. No Boron was detected, however, Dr. Page indicated there would have to be a large quantity of Boron on the filter to detect it."[2]

Thus, workers learned three years ago that particulates caused by corrosion of something inside containment made of iron were clogging the containment radiation monitor filters. And NRC inspectors knew it, too:

> "Subsequent to the outage, low flow rates have been routinely occurring in the containment atmosphere particulate and gaseous radiation monitoring system. The plant staff has been aggressive in attempting to identify the reasons for this phenomenon, but the frequent filter changes required to address the low flow conditions have been a distraction to plant personnel."[3]

---

[1] FirstEnergy, Condition Report 1999-1300, July 30, 1999.
[2] FirstEnergy, Condition Report 1999-1300, July 30, 1999.
[3] Letter dated March 31, 2000, from Thomas J. Kozak, Chief - Reactor Projects Branch 4, Nuclear Regulatory Commission, to Guy G. Campbell, Vice President - Nuclear, FirstEnergy Nuclear Operating Company, "Plant Performance Review - Davis Besse," enclosure page 12, item 1.

What did FirstEnergy do about this "distraction" to their workers? At least two things:

1. "This TM [temporary modification] will install four portable HEPA filtration units in containment and a portable air sampler.

   "This change is intended to reduce the particulate concentration in the containment atmosphere. The particulate material, is clogging the filters for the containment radiation monitors, RE4597AA and RE4597BA, which results in a low flow condition every 24 to 48 hours. Normal filter change interval is weekly or even monthly.

   "This TM is intended to reduce the particulate concentration in the containment atmosphere. The availability of the Containment Radiation Monitors will increase once the particulate concentration is reduced."[4]

2. "The inspectors reviewed the following temporary modifications to verify they did not affect the safety functions of important safety systems. The inspectors reviewed the temporary modifications and the associated 10 CFR 50.59 screenings against the system design basis documentation, including the USAR and TSs to determine if there was any effect on system operability or availability and to verify temporary modification consistency with plant documentation and procedures:

   - Bypassing the charcoal filters on Radiation Elements RE 4597AB/BA"[5]

Unable to figure out the source of the corrosion particles, workers essentially installed four vacuum cleaners inside containment under the first temporary modification in an attempt to remove the stuff in the air. Their hope was that the radiation monitor filters would clog less frequently if there was less stuff in the air.

The second temporary modification appears to have dealt with the stuff in the air by routing the air around the charcoal filters so the stuff won't clog the filters. In essence, a backup in case the four temporary vacuum cleaners did not work.

Unfortunately, the problem plaguing the containment radiation monitor filters may have been more than merely "distracting." It seems the radiation monitors in question have a role other than providing a daily exercise regime for workers. Operators at Davis-Besse rely on formal emergency procedures when responding to events. For example, they use the following procedure when unusually high radiation levels are detected inside containment:

---

[4] Letter dated November 9, 2000, from Guy G. Campbell, Vice President - Nuclear, FirstEnergy, to Nuclear Regulatory Commission, "10 CFR 50.59 Report of Facility Changes, Tests and Experiments."

[5] Letter dated December 11, 2001, from Christine A. Lipa, Chief - Reactor Projects Branch 4, Nuclear Regulatory Commission, to Guy G. Campbell, Vice President - Nuclear, FirstEnergy Nuclear Operating Company, " Davis-Besse Nuclear Power Station NRC Inspection Report 50-346/01-13," page 8.

"Table of Emergency Action Level Conditions"[6]

Condition	Indication(s)	Emergency Classification
Abnormal containment radiation and temperature	Both of the following: 1. Containment radiation level corresponds to an Alert as determined from the Containment Radiation EAL Plot on page 20 or 21 2. Containment average air temperature indicates >170°F (TI1356, 1357, 1358)	Alert RA-EP-01700 All modes
High containment radiation, pressure and temperature	1. Containment radiation level corresponds to an Site Area Emergency as determined from the Containment Radiation EAL Plot on page 20 or 21 2. Containment average air temperature indicates >200°F (TI1356, 1357, 1358)	Site Area Emergency RA-EP-01800 All modes

Alert and Site Area Emergency are the middle two of four classifications NRC uses for emergencies at US nuclear plants. This procedure directs the operators to use the Containment Radiation EAL [emergency action level] Plot on page 20 or 21 to determine if conditions warrant an Alert or Site Area Emergency classification. Upon turning to page 21, the operators find:

> "The curves represent readings for monitors RE 4597AA or BB, Containment Atmosphere Radiation Detector. The procedure for their use is as follows:
>
> > "1. Determine the time after reactor shutdown [0 to 35 hour scale]
> >
> > "2. Determine the RE 4597AB or BB Channel 1 or 2 radiation reading
> >
> > "3. Find the point on the figure where these two numbers intersect
> >
> > "4. Read the classification level of the line immediately below this point. This is the classification [Alert, Site Area Emergency, General Emergency] to use in correlation to the "Abnormal Containment Atmosphere" section of in the Emergency Action Levels."[7]

Obviously, if clogged filters disable containment radiation monitors RE 4597AA/BB, the operators are deprived of information needed to determine the Containment Radiation Emergency Action Level using the curves on page 21. They might move from "distracted" to "distraught."

The paperwork showed workers replacing the clogged filters on the containment radiation monitors as often as every 24 hours. Thus, if the accident began the moment after workers replaced the filters and the stuff in the air remained constant, the operators would likely lose input from the monitors about 24 hours

[6] FirstEnergy, Emergency Plan Implementing Procedure RA-EP-01500 RO C3, "Emergency Classification," May 1, 1995, page 18.
[7] FirstEnergy, Emergency Plan Implementing Procedure RA-EP-01500 RO C3, "Emergency Classification," May 1, 1995, page 21, "Containment Radiation EAL Plot."

later. And with high radiation readings inside containment, workers would not be able to perform their daily task of replacing the filters. The emergency procedures carry the event out to 35 hours, but the required information would be lost before that time.

It must also be recognized that the containment radiation monitors were failing on a daily basis due to stuff in the air from a very, very small reactor coolant system leak (typically less than 0.1 gallons per minute from 1998 through 2002 for an estimated total of approximately 300,000 gallons). That leak reportedly corroded/eroded about 70 pounds of carbon steel from the reactor vessel head. If such a small leak can create atmospheric conditions inside containment that fail the containment radiation monitors every 24 hours due to clogged filters, is it not only credible but highly probable that a reactor coolant system pipe break or steam line break inside containment (i.e., the initiating event for the accident invoking the emergency procedures) would put even more stuff in the air? In other words, would the containment radiation monitors fail even faster under accident conditions? After all, General Design Criterion 4 in Appendix A to 10 CFR Part 50 requires:

> *Criterion 4 -- Environmental and dynamic effects design bases. Structures, systems, and components important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents. These structures, systems, and components shall be appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit. However, dynamic effects associated with postulated pipe ruptures in nuclear power units may be excluded from the design basis when analyses reviewed and approved by the Commission demonstrate that the probability of fluid system piping rupture is extremely low under conditions consistent with the design basis for the piping.*

"Stuff in the air" is as much an environmental condition associated with postulated accidents, including loss-of-coolant accidents, as temperature, pressure, and humidity. The slow leak of 300,000 gallons from 1998 to 2002 created atmospheric conditions inside containment that disabled the containment radiation monitors on a daily basis. A postulated loss of coolant accident would jet more than 300,000 gallons into containment in mere minutes. It seems entirely plausible that the physical violence inside containment associated with an assault might put considerably more stuff in the air. The force of the water released inside containment can blow insulation off piping, "steam clean" concrete, and shake the entire building to its very foundation. If the resulting haze clogged the containment radiation monitor filters, workers would not have the luxury of making an entry to replace them. It therefore seems likely that instrumentation[8] needed by the operators to monitor conditions inside containment following an accident would fail if the accident happened.

UCS-15[9] **Could the operators have faithfully executed the plant's emergency procedures when the containment radiation monitors had a mean-time-between-failure of only 24 hours?**

UCS-16 **Did the operability justifications/evaluations performed for the condition report and the associated temporary modifications—which all concluded the safety function of the containment radiation monitors—properly consider the ability**

[8] UCS trusts that NRC will not improperly narrow the focus of this concern to just RE 4597AA/BB but will evaluate the potential challenge to all radiation monitors inside containment.
[9] Questioning numbering continues from prior UCS letters dated July 3, 2002, and June 12, 2002.

of the monitors to operate in the atmospheric conditions following an accident?

UCS-17a **Does FirstEnergy have a formal engineering calculation and/or analysis of non-radioactive particulate matter in the containment atmosphere f ollowing design basis accidents?**

UCS-17b **If no such calculation or analysis exists, how can the plant be assured of operating within its design bases with respect to 10 CFR 50, Appendix A, GDC 4?**

UCS-18 **Is the NRC confident that containment radiation monitors and other components inside the containments of US nuclear power plants will not be impaired by stuff in the air resulting from postulated design basis accidents?**

In a post-script on containment radiation monitors, filter clogging of RE 4597AA/BB was not the only problem encountered in 1999. FirstEnergy made another modification that fateful year:

> "Safety Evaluation Summary for MOD 99-0050 (SE 99-0045)
>
> "The containment atmosphere sample lines leading to the Normal Range Particulate Radiation Skid have had a history of condensing and collecting sample moisture in the line lower points, resulting in its removal from service to facilitate draining of the moisture."[10]

It appears that the subject sample lines experienced excessive moisture and resulting condensation during a period of time when boric acid was wafting throughout containment. The reactor vessel head demonstrated the dire consequences when moisture and boric acid crystals mix. Did boric acid also enter the moisture-laden sample lines?

UCS-19 **Has the extent-of-condition assessment conducted by FirstEnergy included verification that the containment atmosphere sample lines leadings to the Normal Range Particulate Radiation Skid are free from boric acid corrosion?**

[10] Letter dated November 9, 2000, from Guy G. Campbell, Vice President - Nuclear, FirstEnergy, to Nuclear Regulatory Commission, "10 CFR 50.59 Report of Facility Changes, Tests and Experiments."

Containment Vessel Damage: Reactor Vessel Head Damage déjà vu?

As has been widely reported, the extensive reactor vessel head damage at Davis-Besse occurred over a period of years despite several opportunities to detect and correct it. The same thing may now be happening to the steel containment vessel at Davis-Besse:

> "During the 12th Refueling Outage, water seepage was noted through a Thiokol sealant barrier at the interface of the outside surface of the Containment Vessel and the concrete surface in the base of the Annulus. Access to the steel Containment Vessel below this point is not available as it is encased in concrete. This condition was documented in Davis-Besse Condition Report 2000-0709."[11]

FirstEnergy accepted the non-conforming condition on the following basis:

> "The moisture sealing properties of the Thiokol sealant have been reduced allowing water to seep out at the interface of the outside surface of the steel Containment Vessel and the concrete surface in the base of the annulus. This area is below the groundwater table and it is believed that the source of the water is groundwater. In order for the groundwater to arrive in the annulus, it must travel through a breach in the waterproof membrane that surround the containment foundation, travel through at least 3'-6" of concrete, and then travel along the concrete/Containment Vessel interface until is reaches the surface. This path reduces the hydrostatic head of the groundwater (at approximately 570 ft.), causing the water to appear as a very small seepage in a few locations at the annulus floor (elevation 562.5 ft.)."
>
> and
>
> "The presence of water between the concrete foundation and the Containment Vessel in the inaccessible areas will not degrade the Containment Vessel any more than the exposed areas based on the following. The area that is most susceptible to corrosion is at the surface of the concrete and Containment Vessel where there is continuous moisture, moving or flowing water, and plenty of oxygen. A visual examination of this area noted that there was no noticeable differences between the area at the concrete to Containment Vessel interface and the areas immediately above the interface. This condition would bound any inaccessible areas embedded in concrete."
>
> and
>
> "Microbiological Induced Corrosion (MIC) is not considered as a corrosion mechanism. Groundwater is not a likely source of MIC due to the lack of airborne or waterborne organisms. The location of the between the Containment Vessel and concrete foundation does not provide a ready food source for MIC to occur. Should MIC be occurring, it would be evident at the area of the seal where the water is open to the air. As the visual examination of this area revealed that there was no noticeable differences between the areas at the concrete to Containment Vessel interface and the areas immediately above the interface, MIC does not appear to be occurring."[12]

---

[11] Letter dated August 22, 2000, from Guy G. Campbell, Vice President - Nuclear, FirstEnergy, to Nuclear Regulatory Commission, "Inservice Inspection Summary Report of Twelfth Refueling Outage Activities for the Davis-Besse Nuclear Power Station - Unit 1, page 11.

[12] Letter dated August 22, 2000, from Guy G. Campbell, Vice President - Nuclear, FirstEnergy, to Nuclear Regulatory Commission, "Inservice Inspection Summary Report of Twelfth Refueling Outage Activities for the Davis-Besse Nuclear Power Station - Unit 1, page 11.

FirstEnergy may have concluded that groundwater lacks airborne or waterborne organisms out of convenience rather than science. Their dismissal of groundwater as a possible source of MIC seems to directly contradict information they received from, of all places, the NRC:

> "MIC is a form of corrosive action that occurs as a direct, or indirect, result of living organisms in contact with the materials of construction. **Microorganisms have been observed in a variety of environments including soils, sediment, natural fresh water (e.g., wells, rivers, lakes), brackish and sea water, as well as oil and other natural petroleum products**. Many species may form synergistic cross feeding support systems with other bacteria, fungi, algaes and the like to enhance survival under the most adverse conditions. They have been known to tolerate a wide-range of temperatures (-10 to 90C), pH values of 0 to 10.5, oxygen concentrations from zero to almost 100 percent O2 and extreme hydrostatic pressure. There are six different classifications of microorganisms containing over 30 species that can be a problem, depending on the geographic location and the environmental conditions."[13] [emphasis added]

There are many disturbing similarities between the reactor vessel head and the containment vessel:

Issue	Reactor Head	Containment Vessel
Barrier failure	Borated water leaked past (a) CRDM flanges and (b) CRDM nozzles to reach unprotected carbon steel head	Groundwater (maybe) leaked past "waterproof" membrane and concrete to reach formerly protected steel vessel
Inspection failure	Repeated deferral of modification to service platform prevented effective inspections	Concrete prevented effective inspections
Potential problem identification	Workers wrote Condition Reports on boric acid deposits on reactor head and associated clogging of containment radiation monitor filters	Workers wrote Condition Report on water reaching containment vessel
Potential problem analysis	Workers visually examined some parts of boric acid covered reactor vessel head and proclaimed it acceptable. Workers sent filter samples to offsite lab, but misdiagnosed results	Workers visually examined the exposed part of the containment vessel and proclaimed it acceptable. Workers avoided the misdiagnosis step by not even analyzing the groundwater
Potential problem "resolution"	Workers deluded themselves into believing that dry boric acid was benign boric acid	Workers deluded themselves that untreated groundwater at Davis-Besse, unlike untreated groundwater elsewhere on the planet, cannot contain harmful microorganisms
Company's view of NRC guidance on matter	Establish boric acid control program to placate NRC, but don't follow it to save money	Ignore NRC guidance documents altogether
NRC stance	Whatever the company says is fine with us — no independent evaluations	Whatever the company says is fine with us — no independent evaluations

Has FirstEnergy dismissed MIC-causing groundwater without rigorous evaluation much as they dismissed boric acid corrosion of the reactor vessel head on the mere supposition, unsubstantiated by actual inspections, that dry boric acid is benign?

[13] Nuclear Regulatory Commission, Information Notice No. 85-30 dated April 19, 1985, "Microbiologically Induced Corrosion of Containment Service Water System."

Their dismissal of the potential threat from groundwater also flies in the face of conventional corrosion industry practice and knowledge. For example:

> "**All untreated water from natural sources**, and particularly sea water, contains millions of invisible micro-organisms in every litre."[14] [emphasis added]

Companies around the globe are spending lots and lots of money to treat water to guard against MIC, but FirstEnergy is confident that untreated water of uncertain origin getting through a degraded barrier and contacting vulnerable steel that cannot be inspected will not result in MIC damage. Miracle or mistake? The NRC should make sure before the plant is restarted.

Even if by some miracle Davis-Besse's containment vessel is not being attacked by MIC, it appears that FirstEnergy did not fully evaluate the potential consequences of the non-conforming condition. The company supposed that groundwater is flowing through an impaired waterproofing membrane and passing through the concrete portion of the containment to contact the steel containment vessel. Their ensuing evaluation appeared to exclusively focus on potential damage to the steel containment vessel from stuff in the water. But what about potential damage to the concrete itself? After all, the company stated its belief that groundwater is flowing through the breach in the waterproof membrane and also through the concrete. As the NRC notified plant owners, including FirstEnergy, just five years ago:

> "The MNPS-3 [Millstone Nuclear Power Station Unit 3] licensee, Northeast Nuclear Energy Company (NNECO), identified the issue of cement erosion from the porous concrete drainage system in 1987 upon examination of the accumulated sludge in the two lower drain sumps in the ESF Building. The licensee's efforts to follow up on and resolve this concern are documented in NRC Inspection Reports 50-423/94-11 (accession number 9406060281) and 50-423/96-04 (accession number 9606180450), dated May 27, 1994, and June 6, 1996, respectively. The main concern is the adequacy of the eroded porous media to transfer the containment loads to the bedrock. The unexpected erosion of the high-alumina cement also gave rise to another concern regarding a potential for interaction between the concrete of the foundation basemat that contains Portland cement and the high-alumina cement of the subfoundation in the presence of underground water."[15]

Davis-Besse may not be as vulnerable to concrete erosion because only a handful of plants used high-alumina cement, but they still have the obligation to consider the potential and take all appropriate action. FirstEnergy seems to have failed, once again, to fully evaluate the potential consequences of a non-conforming condition.

UCS-20a **Will the NRC require FirstEnergy to actually inspect the containment vessel to determine, with certainty replacing supposition. that it is not be damaged by contact to groundwater caused by a non-conforming condition ?**

UCS-20b **If not, will the NRC's MIC man (i.e., Mr. James Davis) independently evaluate the potential for MIC damage to the steel containment vessel before restart?**

UCS-21a **Did FirstEnergy evaluate the potential for containment concrete erosion from the non-conforming groundwater flow?**

---

[14] http://www.agma.co.uk/corrosion/microbio.html

[15] Nuclear Regulatory Commission, Information Notice 97-11, dated March 21, 1997, Cement Erosion From Containment Subfoundations at Nuclear Power Plants.

UCS-21b **If not, will NRC require FirstEnergy to complete such an evaluation before restart?**

RC-262: RC-2 déjà vu?

In 1999, workers at Davis-Besse discovered valve RC-2 in a severely degraded condition. RC-2 is a normally-closed, motor-operated valve located on the 2½-inch diameter pressurizer spray pipe inside the reactor containment structure. This pipe connects to the reactor coolant system (RCS) cold leg between reactor coolant pump 1-2-2 and the reactor pressure vessel.[16] Operators in the control room can remotely open RC-2 during plant operation to allow relatively cool borated water to spray into the to portion of the pressurizer, reducing its pressure.

NRC inspectors examined the repairs to RC-2 and reported:

> "Once the licensee determined that boric acid corrosion (BAC) was the most likely cause for the missing nuts on RC-2, a thorough evaluation of the condition was conducted and extensive, effective corrective actions were developed. The inspectors noted a much greater sensitivity to the effects of BAC on plant equipment and a recognition that some plant maintenance practices required improvement, more oversight, and more assessment."[17]
>
> and
>
> "The engineering plan to address the extent of condition for the two missing nuts on pressurizer spray valve RC-2 was comprehensive and detailed. The licensee completed the extent of condition review during the recent mid-cycle outage. Additionally, the licensee demonstrated a heightened sensitivity to boric acid corrosion effects on plant equipment."[18]

While the damage to RC-2 occurred at a time when FirstEnergy believes at least one CRDM nozzle was leaking borated water into containment, it is more likely that the damage to RC-2 was due to boric acid from the borated water flowing through the valve itself. In any event, boric acid was determined by FirstEnergy and accepted by NRC as having damaged RC-2.

RC-262 is a normally-closed, manually-operated valve on the 2½-inch diameter pressurizer spray bypass pipe inside the reactor containment structure. This pipe serves as a bypass line around RC-2.[19] If RC-2 fails to open, operators can manually open RC-262 to allow relatively cool borated water to spray into the to portion of the pressurizer, reducing its pressure.

Thus, RC-2 and RC-262 are exposed to virtually identical service conditions (i.e., borated water at essentially the same pressure and temperature).

In 2000, workers at Davis-Besse discovered valve RC-262 in a severely degraded condition. The NRC examined the temporary repairs to RC-262 and reported:

---

[16] Davis-Besse Nuclear Power Station, Drawing ISID2-030A, Rev. 9, "Inservice Inspection Diagram Reactor Coolant System."

[17] Letter dated March 31, 2000, from Thomas J. Kozak, Chief - Reactor Projects Branch 4, Nuclear Regulatory Commission, to Guy G. Campbell, Vice President - Nuclear, FirstEnergy Nuclear Operating Company, "Plant Performance Review - Davis Besse," enclosure page 8, item 3.

[18] Letter dated March 31, 2000, from Thomas J. Kozak, Chief - Reactor Projects Branch 4, Nuclear Regulatory Commission, to Guy G. Campbell, Vice President - Nuclear, FirstEnergy Nuclear Operating Company, "Plant Performance Review - Davis Besse," enclosure page 12, item 3

[19] Davis-Besse Nuclear Power Station, Drawing ISID2-030A, Rev. 9, "Inservice Inspection Diagram Reactor Coolant System."

> "The inspectors reviewed Temporary Modification 00-0026, which injected leak sealant material into pressurizer spray bypass valve RC-262, to verify that it did not affect the safety functions of important safety systems. The inspectors reviewed the temporary modification and the associated 10 CFR 50.59 screening against the system design basis documentation, including the Updated Safety Analysis Report and Technical Specifications to verify that the modification did not affect system operability/availability (other documents reviewed: DB-OP-02513, DB-MM-09067)."[20]

"Leak sealant material" functions like "stop-leak" poured into a car radiator. It plugs cracks and holes in valve bodies. But what caused the damage to valve RC-262? Was it boric acid, as had apparently damaged sister valve RC-2 a few months earlier? If boric acid contributed to the damage, wouldn't the NRC's conclusion about RC-2 also apply to RC-262 (at least the part about prompt discovery)?

> "The inspector determined that the licensee's boric acid control program was adequately documented. However, a weakness was identified in the program concerning the verification of materials subjected to boric acid corrosion which contributed to the failure to promptly identify that the RC-2 valve components were not as specified in its design document."[21]

If boric acid was not responsible for the damage to RC-262, then it means that two valves suffered severe damage from separate causes. Aging management programs are supposed to monitor the condition of important structures and components, such as these two valves, and repair or replacement them before failure. Yet neither aging mechanism was detected in time to prevent serious degradation.

UCS-22 **What really caused the damage to RC-262?**

UCS-23a **If boric acid was a root cause, should NRC inspectors have evaluated the temporary modification in context of RC-2 damage?**

UCS-23b **If boric acid was a root cause, doesn't the back-to-back damage to RC-2 and RC-262 suggest that FirstEnergy's extent-of-condition and problem resolution processes are flawed?**

UCS-24 **If boric acid was not a root cause, doesn't it strongly suggest that FirstEnergy's inservice inspection, preventative maintenance, and aging management programs are flawed?**

UCS-25 **When NRC inspectors examine an incident, are they formally trained and instructed to test the licensee's theory by reviewing plant-specific and industry experience?**

---

[20] Letter dated September 5, 2000, from Thomas J. Kozak, Chief - Reactor Projects Branch 4, Nuclear Regulatory Commission, to Guy G. Campbell, Vice President - Nuclear, FirstEnergy Nuclear Operating Company, "Davis-Besse Nuclear Power Station - NRC Inspection Report 50-346-00-09(DRP)," page 7.

[21] Letter dated March 31, 2000, from Thomas J. Kozak, Chief - Reactor Projects Branch 4, Nuclear Regulatory Commission, to Guy G. Campbell, Vice President - Nuclear, FirstEnergy Nuclear Operating Company, "Plant Performance Review - Davis Besse," enclosure page 12, item 4.

GSI-191

UCS had repeatedly questioned whether the emergency systems at Davis-Besse could have reliably mitigated the loss-of-coolant accident that would have occurred had the stainless steel cladding on the damaged reactor vessel head failed. To date, those questions remain unanswered. An unresolved NRC generic safety issue (GSI-191) involves material and debris inside containment potentially clogging the containment sump screen and disabling the low pressure recirculation phase of the accident. A recent study by Los Alamos National Laboratory for the NRC estimated a 56 percent to 82 percent chance of containment sump failure at operating pressurized water reactors, Davis-Besse included. The study masked the plant identifications, so the public cannot determine whether how vulnerable Davis-Besse is to this problem.

In 1999, NRC inspectors discovered that FirstEnergy had not been properly controlling the installation of insulation inside containment at Davis-Besse for the prior eleven (11) years—coincidentally, perhaps, the same period that FirstEnergy had not been properly controlling boric acid corrosion inside containment at Davis-Besse:

> "The inspectors concluded that in 1988, the licensee failed to evaluate whether the installation of NUKON insulation in containment could cause the emergency core cooling system (ECCS) pumps and containment spray pumps to not be able to perform their design function during a loss-of-coolant accident (LOCA). The root cause was that specification M-197N gave unrestricted approval for the use of NUKON insulation in containment without requiring that specific evaluations be performed to determine how much material could migrate and clog the ECCS emergency sump pump during a LOCA. This was a Non-Cited Violation of design control."[22]

Even if one assumes, for whatever reason, that FirstEnergy will flawlessly adhere to all regulatory requirements for all future insulation applications within the Davis-Besse containment, it is not apparent that FirstEnergy or the NRC went back and reviewed insulation applications between 1988 and 1999. If that's the case, there could be one or more undetected insulation miscues lying in wait to clog the containment sumps.

UCS-26 **Did FirstEnergy perform an extent-of-condition assessment for its containment insulation specification problem?**

UCS-27a **If so, has NRC independently verified its completeness and accuracy?**

UCS-27b **If not, how can NRC be assured that Davis-Besse is not unduly vulnerable to GSI-191 related safety problems?**

[22] Letter dated March 31, 2000, from Thomas J. Kozak, Chief - Reactor Projects Branch 4, Nuclear Regulatory Commission, to Guy G. Campbell, Vice President - Nuclear, FirstEnergy Nuclear Operating Company, "Plant Performance Review - Davis Besse," enclosure page 13, item 1.

Hydrostatic Test of What?

FirstEnergy submitted a summary report to the NRC of its inspection activities at Davis-Besse during 12RFO.[23] Page 75 of this report stated that the company performed a hydrostatic test of the reactor vessel penetrations and welds on June 5, 2000. The company's final root cause report for the reactor vessel damage estimated that CRDM nozzle #3 cracked through-wall around 1996 and has leaked reactor coolant water since then.

If CRDM nozzle #3 has been cracked through-wall since 1996, one wonders why a hydrostatic test performed of reactor vessel penetrations and welds in 2000 did not identify any leakage. Cameras installed for the hydrostatic test and focused on the CRDM nozzles, for example, should have revealed any leakage. But cameras were not installed and leakage was not detected. What good is a test for leaks that fails to find leaks?

UCS-28a **Should the hydrostatic test in 2000 have identified leakage from CRDM nozzle #3?**

UCS-28b **If not, should the NRC require licensees to revise hydrostatic testing procedures so they can find leakage?**

[23] Letter dated August 22, 2000, from Guy G. Campbell, Vice President - Nuclear, FirstEnergy, to Nuclear Regulatory Commission, "Inservice Inspection Summary Report of Twelfth Refueling Outage Activities for the Davis-Besse Nuclear Power Station - Unit 1.

Condition Reports

The majority of the "missed opportunities" to discover the reactor vessel head damage before it nearly created a loss-of-coolant accident resulted from improper evaluation and/or dispositioning of condition reports written by workers at Davis-Besse. Last year, NRC inspectors performed an audit of the corrective action process at the plant. Included in that audit was a focused look at condition reports:

> "The inspectors reviewed a selected sample of condition reports associated with Davis-Besse's permanent plant modifications and 10 CFR 50.59 program to verify that the licensee had an appropriate threshold for identifying issues and to verify the effectiveness of corrective actions for the identified issues."
>
> and
>
> "No findings of significance were identified."[24]

The condition reports sampled by the inspectors were listed on pages 7 and 8. There were 19 condition reports listed. Thus it would appear that NRC inspectors examined 19 condition reports and concluded that FirstEnergy had the proper threshold for initiating condition reports and an effective process for processing condition reports.

But that conclusion seems to be in direct conflict with other NRC findings. On the very same page where they listed the 19 condition reports reviewed, the inspectors listed eight (8) condition reports that were initiated as a direct result of the NRC audit:

01-3425	Temporary Procedure Change Canceled but Regulatory Applicability Determination and Screen Data Base Was Not Revised
01-3416	New Motor Information Not Incorporated into Vendor Manual M-516-73 for Main Lube Oil Pump on the Make-up Pumps
01-3418	Overload Heater Rating for Main Lube Oil Pumps MP371B and MP372B Are Incorrect in Design Documents
01-3438	Makeup Pump DC Lube Oil Pump Was Not Properly Sized for Cold Weather Lube Oil Viscosities
01-3439	Resolution of Differences Between Vendor Supplied Motor and Design Specifications Was Not Documented
01-3443	Increased Load on Load Center L57D1 Was Updated on Design Drawings and in the Updated Safety Analysis Report, but not Included in the Plant's Electrical Load Monitoring System Calculation
01-3444	Insufficient Justification for Change in Code Allowable Value Used in Framatone Stress Calculation
01-3452	The Documentation/Justification for Two Safety Reviews Did Not Provide Enough Detail to Sufficiently Answer the Question on Change to the Facility[25]

[24] Letter dated January 16, 2002, from John M. Jacobson, Chief - Mechanical Engineering Branch, Nuclear Regulatory Commission, to Howard Bergendahl, Vice President - Nuclear, FirstEnergy Nuclear Operating Company, "Davis-Besse Nuclear Power Station NRC Inspection Report 50-346/01-14," page 5.

[25] Letter dated January 16, 2002, from John M. Jacobson, Chief - Mechanical Engineering Branch, Nuclear Regulatory Commission, to Howard Bergendahl, Vice President - Nuclear, FirstEnergy Nuclear Operating Company, "Davis-Besse Nuclear Power Station NRC Inspection Report 50-346/01-14," page 5.

If the threshold for initiating condition reports was proper, as NRC asserted, shouldn't workers have written at least one or two of these eight condition reports instead of waiting for NRC inspectors to point out the need? That so many condition reports had to be written due to findings by NRC inspectors during the audit strongly suggests that either workers cannot find problems or that workers can find problems but do not document their findings in condition reports. Neither explanation is consistent with the NRC's conclusion that Davis-Besse has an acceptable corrective action program. What acceptance criterion did the NRC inspectors apply in this case—as long as fewer condition reports are written than read, all is well?

UCS-29a **Does the NRC believe that forcing a company to write 8 condition reports really indicates a proper threshold for condition reports?**

UCS-29b **If so, why?**