

**Cox, Mark**

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**Sent:** Tuesday, September 13, 2005 7:02 PM  
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**Cc:** Schwartz, Geoffrey  
**Subject:** U2 south pool wall update  
  
**Attachments:** U2SPFSouthWallIndicationR2091305.doc; U2SFPWallODMI.doc

For Communications Department: We have found hairline cracks, typical of those which form during concrete curing, in the Unit 2 spent fuel pool south wall. Several have evidence of a slight amount of moisture. The wall has been evaluated by structural engineers and is sound. The source of the moisture is under investigation by a full time multi-discipline team, following a detailed action plan.

For the leadership team:

The lower moist crack that we found yesterday (at about 61.5 foot elevation, 3 feet below the first moist crack) was covered with plastic for 24 hours, allowing us to capture about 12 mL of water. Initial analysis indicated the presence of low level Cs-137 and a boron concentration of approximately 1200 ppm. The upper crack (the first one) visually now appears almost dry. Full test results (including Tritium) of soil and the 12 mL sample are expected to be available tomorrow. All visually accessible areas of the pool wall have been inspected (south wall in the FSB loading bay, east wall outside and adjacent to the MOB, west wall in the Pipe Pen, and west wall between the VC, FSB and PAB). In the Pipe Pen where the west wall is visible we found dry hairline cracks at about the same elevation as the south wall (64.5 foot) with white streaks. The white material is being analyzed. After all radiochemistry analysis is complete we will develop initial conclusions and further recommendations for discussion with Senior Management.

The ODMI has been reviewed with the Shift Manager and final signatures should be gained tomorrow. We reviewed the Action Plan and ODMI with an engineer from JAF who has been involved in the recent JAF pool leakage issue. He concurred with our approach and methodology.



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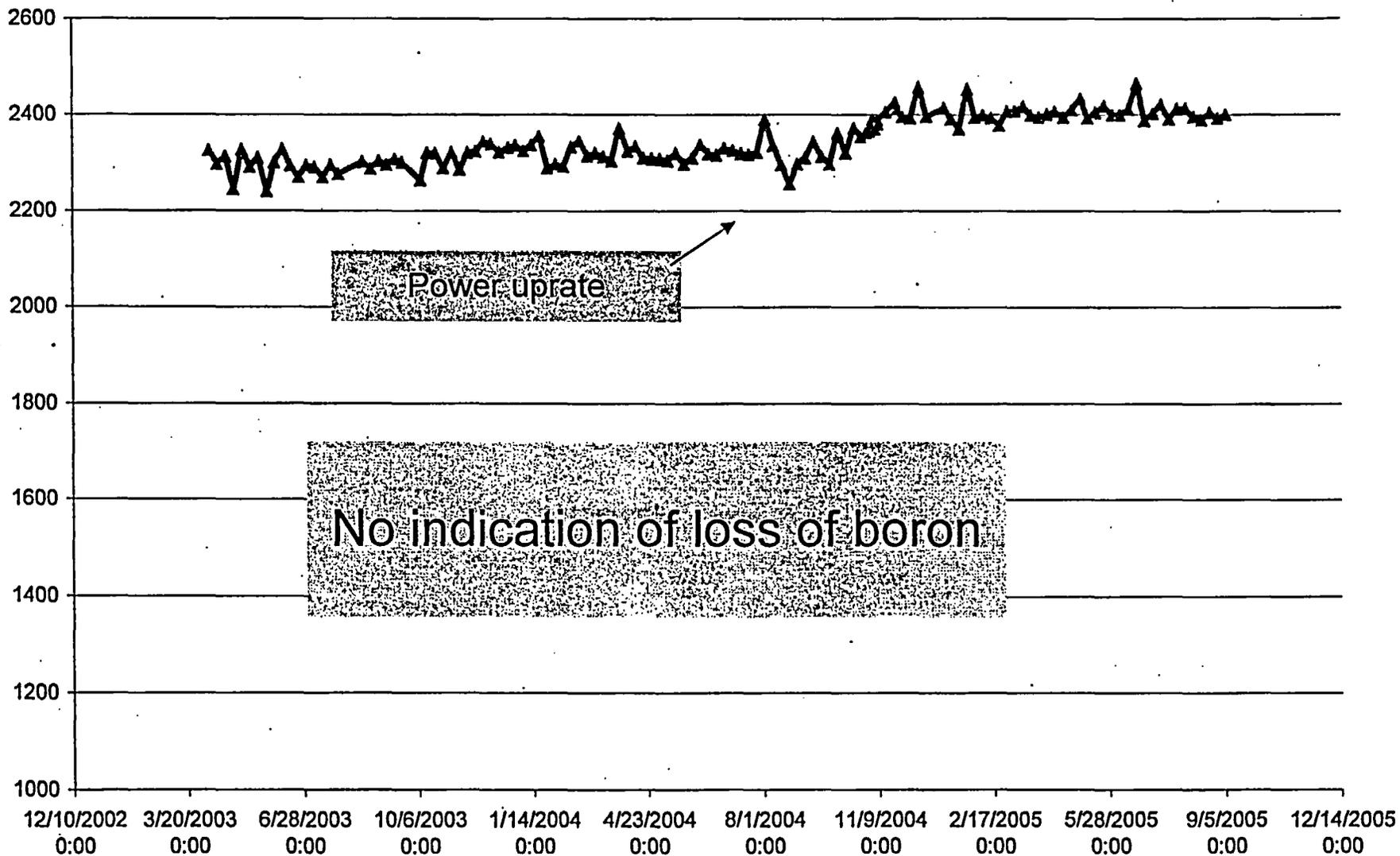
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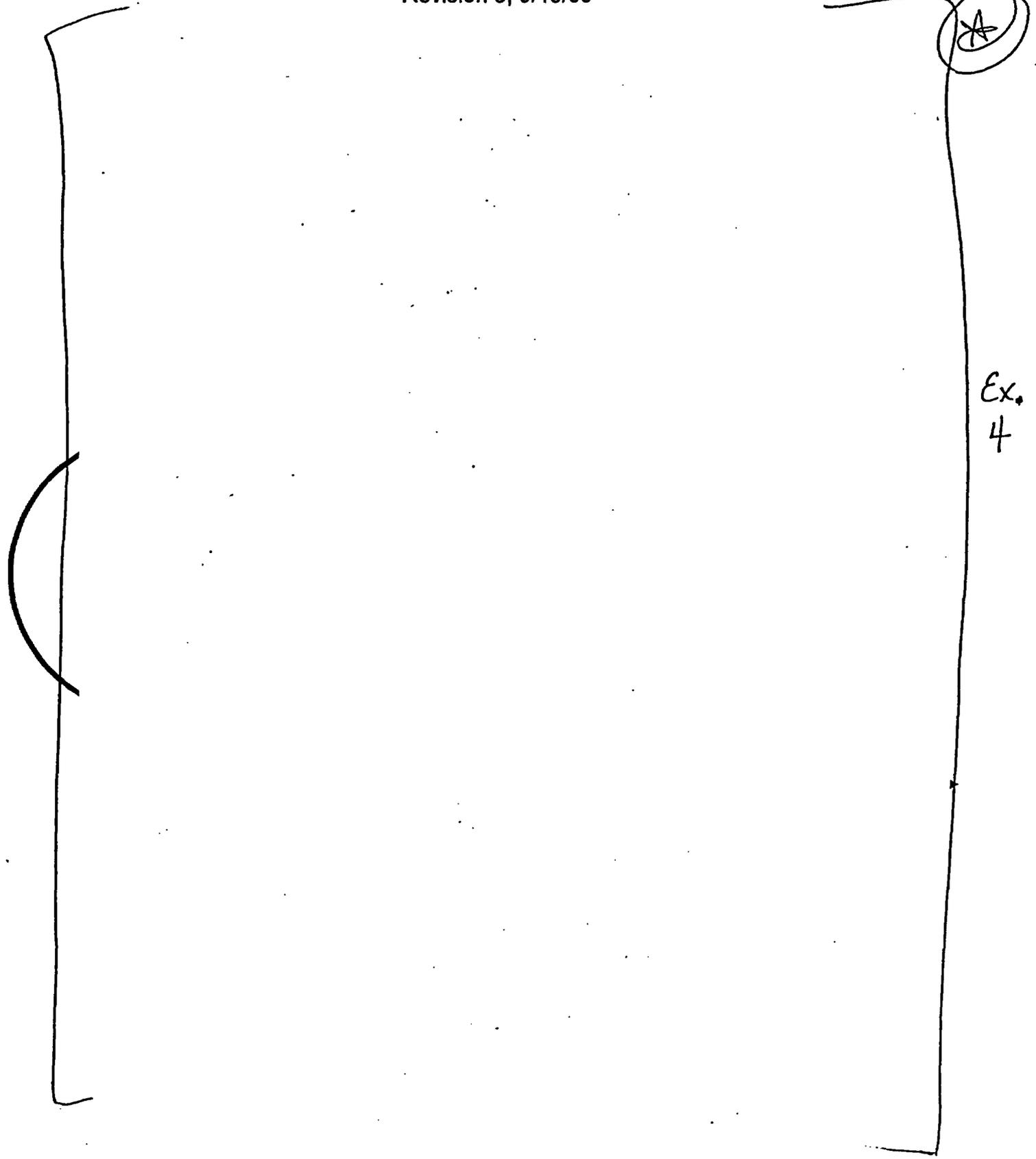
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# U2 SFP





Hairline Crack in IPEC Unit 2 Spent Fuel Pool South Wall  
Revision 3, 9/13/05



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Background

IPEC is in the process of implementing dry cask storage capability for Unit 2. This requires that the Fuel Storage Building (FSB) loading bay floor be removed and replaced with a significantly more substantial structure. The original floor has been removed, and excavation of soil and rock in the loading bay is in progress. During removal of loose soil and rocks in the north area of the loading bay (along the SFP south wall), approximately horizontal cracks were exposed at an elevation of approximately 65 feet, and an approximately vertical crack above. The cracks are very narrow (less than 1/64-inch wide). One of the cracks, on the west side of the south SFP wall, has moisture in and near it.

SFP wall structure

In the area of the crack,

The cracks have been visually inspected by an IPEC civil/structural engineer, and the IPEC Supervisor of Civil/Mechanical Engineering. The condition is typical of cracking due to shrinkage during post-construction concrete curing. The moisture in and around one of the cracks is very slight, essentially a film which is not dripping or beading. The moisture has been analyzed and found to contain trace amounts of Cesium 134 and 137, Cobalt-60, and Boron. The Boron concentration is about 6 to 15 times less than the concentration in the SFP, and the ratio of Cesium-134 to 137 indicate the activity is about 6 to 10 years old. The crack has calcium stains emanating from it, as is expected when moisture leaches through concrete, and no visual evidence of steel corrosion products (rust). Due to the thickness of the SFP wall, amount of steel reinforcement, and lack of evidence that the small amounts of moisture and boron have caused corrosion of the reinforcing rods, there is reasonable assurance that the SFP wall is structurally sound and capable of performing it's intended function.

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Potential sources of moisture

The moisture in and around the crack could be from one or a combination of several sources.

- 1. A leak, either active or in the past, through the SFP stainless steel liner, and leach through the wall into the crack.
  - a. The Unit 2 SFP does not have a leak detection system. Usually such a system consists of a drain path

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[ (Unit 3 has such a  
leak detection system). The Unit 2 [

Ex. 4

] An active leak, depending on its age and volume, could be determined when it develops by a change in frequency of pool water make-up and/or a change in pool boron concentration. A discussion with Unit 2 licensed operators indicated the frequency of make-up has not changed, other than that expected due to seasonal changes in pool water evaporation rate, and as a separate attachment to this paper, a trend graph of boron concentration in Unit 2 SFP is attached indicating no unexpected/unexplained loss of boron. However, due to the lack of a leak detection system, and the large volume of pool water normally lost due to evaporation, a small liner leak could go undetected.

- b. Based on isotopic ratios and radionuclide type, the existence of radionuclides such as Cesium and Tritium in the moisture could provide an indicator of whether there is an active leak, or whether the moisture source could have been from a since-repaired liner leak. Soil and moisture samples are being collected and will be sent to a laboratory for analysis which can detect the presence of Tritium.
2. Contamination of the soil in the FSB loading bay, above and adjacent to the moist crack, and subsequent entry of contaminated liquid into the crack due to hydraulic pressure from the loading bay side.

### Historical information

1. In the northeast area of the SFP stainless steel liner at about the 89 foot level, a small hole occurred during a 1990 pool re-racking project. The damage was discovered in 1992 when boron powder was found on the SFP east exterior wall. During subsequent radiological recovery and repair of the hole, outside soil adjacent to the SFP east wall was found to contain Antimony-124 and 125, and Cesium-137. Approximately 100 55-gallon barrels of soil, down to a depth of eight feet below grade (72 foot level) required remediation. The leakage through the hole in the pool liner was estimated to have been 20-30 gallons per day, which was unnoticed due to the much large volume of normal evaporative loss from the pool.
2. The original loading bay floor had a drain system (see attached elevation sketch), above and adjacent to the area of the moist crack, which was piped through the wall separating the FSB loading bay and SFP heat exchanger room to a sump in the heat exchanger room. When the floor was removed in 2004 for the dry cask storage modifications, the drain pipe was found to be cracked, and the wall penetration through which the drain

pipe was installed was found to be unsealed. Discussions with personnel who were working at Unit 2 at the time indicated that in years past, the level in the sump rose above the drain pipe penetration. This, along with the cracked pipe, resulted in contamination of the soil beneath the floor. Contamination of this soil, primarily in the northwest area of the loading bay, was found and remediated during excavation in 2004 and 2005 for the dry cask storage project.

3. From 2003 through 2005, various activities associated with the dry cask storage project in the area above and adjacent to the crack required the use of water as a dust-inhibiting and cooling measure, which was allowed to drain into the FSB loading bay soil. These activities included core-boring, saw cutting of the original loading bay floor, and excavation. Six core-bore samples, to a depth of greater than 20 feet, were taken in the FSB loading bay (four cores), and FSB access roadway (2 cores) in 2003 during the dry cask storage engineering study activities.

### **Industry operating experience**

In September 2002 the Salem nuclear plant found evidence of contaminated water leaking through a wall and onto the floor of the auxiliary building. This leak was found as a follow-up to unexpected shoe contaminations. There were other leaks through walls and penetrations that appeared to be originating from the Unit 1 SFP. It was determined that the tell-tale drains for the SFP were plugged with debris, so there was a build up of hydrostatic pressure between the liner and concrete wall. This caused the leakage to find alternative through-wall paths. When these drains were cleaned, the leakage flowed to a collection system, essentially terminating the through wall leakage. The pool leakage was then identified via the drain system. This pool leakage occurred for an indeterminate time.

Salem conducted sampling and analysis of the environment surrounding Unit 1 FSB, in a phased approach, to identify potential release of the water outside the building confines. On February 6, 2003, Salem found tritium (H-3) contamination in close proximity to the Unit 1 FSB. By now the tell-tale drains were functioning, so the through wall leakage had stopped. Salem reviewed other spills that could have contributed to the tritium contamination.

Salem performed test core borings in various site locations and initially identified five areas with varying tritium contamination levels. 37 well locations were installed around the site to better characterize the extent of contamination, and 30 of the areas found some tritium contamination. There were no locations that found tritium in unrestricted-access areas

## **Action Plan**

The following actions (see next page) are being implemented to aid in determining the source of moisture, potential amount and extent of related soil contamination, conclusions, and remediation/repair plan and schedule.

1. The IPEC Manager of Dry Cask Storage (G. Schwartz, x6684) has overall responsibility for executing this plan, updating it, and keeping senior management, NRC, and Unit 2 Shift Manager informed daily. The IPEC Director of Special Projects (D. Mayer, x5521, who has responsibility for Health Physics Department) will assist.
2. (Manager of Dry Cask Storage) Issue Condition Report and submit Operability Evaluation information to Shift Manager; develop and issue ODMI. CR-IP2-2005-03557 included Operability Evaluation). ODMI drafted and in review cycle, expect final issue by 9/15/05.
3. (Radiological Waste Department) Take radiological samples at damp crack, and take dirt samples from where excavation material was placed. Results (ND = None Detected):

Sample Date-time	Location	Type	Co-60 uCi	Cs-134 uCi	Cs-137 uCi
9/1/05 10:00 AM	N. Wall at leak	Large Area Smear	ND	3.03E-07	1.92E-03
9/1/05 10:12 AM	N. Wall at leak	Large Area Smear	ND	6.24E-04	4.64E-03
9/1/05 12:00 PM	N. Wall at leak	Large Area Smear	ND	ND	1.68E-03
9/1/05 2:00 PM	N. Wall at leak	Scraping of wall	2.22E-03	5.06E-03	8.07E-02
9/2/05 1:30 PM	N. Wall at leak	Large Area Smear	ND	ND	1.17E-03
9/2/05 1:30 PM	N. Wall at leak	Large Area Smear	ND	ND	1.17E-03
9/7/05 1:00 PM1	Outside MOB Dirt on Hill area	Dirt	ND	ND	8.75E-08
9/7/05 1:00 PM2	Outside MOB Dirt on Hill area	Dirt	ND	ND	ND
9/7/05 1:00 PM3	Outside MOB Dirt on Hill area	Dirt	ND	ND	1.03E-07
9/7/05 1:00 PM4	Outside MOB Dirt on Hill area	Dirt	ND	ND	5.61E-07
9/8/05 10:00 AM4	Outside MOB Dirt on Hill area Re-sample	Dirt	ND	ND	2.18E-07

4. (Civil-structural Engineering) Determine rebar location in relation to cracks, using a rebar detection device. Completed 9-7-05. Rebar is [ ] to cracks.
5. (Radiological Waste Department/Civil-structural Engineering) Hand-drill (small diameter bit) several inches into the SFP wall in the area of the moist crack and analyze drill-bit finds for contamination. Completed 9-7-05. Finds appeared to be damp in first several inches of depth, then appeared to be dry. Results:

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Sample of Hole Drilled In North FSB Wall	pH	Co-60 uCi/gm	Cs-134uCi/gm	Cs-137 uCi/gm	Iron ppm	Boron ppm
Base line	11.74	ND	ND	ND	96	159
First 2" (0-2") of crack	10.7	8.31E-05	2.65E-05	1.65E-03	628	72

Second 2" (2-4") of crack	11.46	4.04E-05	1.39E-05	8.46E-04	640	56
Third 2" (4-6") of crack	11.75	1.02E-05	ND	1.27E-04	3285	28
Fourth 2" (6-8") of crack	11.79	ND	ND	1.75E-05	60	226

6. (Radiological Waste Department) Place a plastic covering over the moist crack to attempt to capture of a larger volume of liquid for radiochemistry analysis. Plastic installed 9-7-05 and left in place 24 hours. Collected approximately 2 mL of liquid, which was insufficient for Tritium detection. Plastic reinstalled and left over weekend of 9/10 to 9/11/05, with moisture collected still insufficient. See #19 below.
7. (Chemistry Department) Sample the soil beneath the area of the crack for H-3. Sample collected, sent off-site to laboratory for Tritium analysis 9/9/05 - results expected by 9/14/05 or earlier. Other analysis results:

Sample Date	Location		Co-60 uCi/gm	Cs-134 uCi/gm	Cs-137 uCi/gm
9/6/2005	Against North Wall below Leak	Dirt	1.05E-05	3.98E-06	2.92E-04
9/6/2005	1 ft from N. Wall Below Leak	Dirt	1.15E-06	ND	1.61E-05
9/6/2005	2 ft from N. Wall Below Leak	Dirt	2.42E-07	ND	5.07E-07
9/6/2005	3 ft from N. Wall Below Leak	Dirt	ND	ND	1.19E-07
9/8/2005	Against North Wall below Leak 1 ft depth	Dirt	5.90E-06	3.54E-06	1.63E-04
9/8/2005	1 ft from N. Wall Below Leak 1 ft depth	Dirt	1.19E-06	1.82E-07	1.09E-05
9/8/2005	2 ft from N. Wall Below Leak 1 ft depth	Dirt	ND	ND	9.44E-08
9/8/2005	Against North Wall below Leak 2 ft depth	Dirt	1.38E-05	1.43E-05	6.00E-04
9/8/2005	2 ft from N. Wall Below Leak 2 ft depth	Dirt	ND	ND	ND

8. (Chemistry Department) Scrape material from an unaffected area of the SFP wall and test for boron content. Used dry finds from drilling (see above table).
9. (Civil/structural Engineering) Determine the typical level of boron in clean concrete. Attempted, no information available.
10. (Civil/structural Engineering) Determine expected corrosion rates for steel reinforcing rods subjected to an environment containing boron. See #12 below.

11. (Licensing Department) Gather historical written records on SFP stainless steel liner damage and SFP sump overflows. Some Liner damage information recovered, including Calculation CGX-00006 (Structural Evaluation of Unit 2 Fuel Pool Wall) and Technical Report ME-3802 (Evaluation of Spent Fuel Pool Walls - IP2 NPP). These are considered bounding for the current situation in terms of wall and rebar structural integrity. No information on sump overflows (other than tribal knowledge) has been recovered.
12. (Civil/structural Engineering) Arrange a ground-penetrating radar (GPR) inspection (or other methodology) of the crack to determine (if possible) crack depth. GPR determined not feasible. Two 4-inch diameter cores, [ ] were taken 9-8-05 in the area of the moist crack. One appeared to be dry on 9-8-05 and it is presumed this was affected by boring bit heating. 24 hours later on 9-9-05 it was damp. The rebar exhibits normal surface oxidation. Visual inspection on 9/12/05 and 9/13/05 appears to indicate moisture is lessening.
13. (Chemistry Department) Determine if a Unit 2 Spent Fuel Pool Integrity Evaluation from Tritium Measurement, was performed, similar to that performed for Unit 3. Not performed for Unit 2. TBD whether to perform this, as it requires a lengthy period of data collection.
14. (Radiological Waste Department) Gather radiological results of test core borings accomplished for dry cask storage inside FSB loading bay (4) and in FSB loading bay access road in 2003. Completed. Low-level surface contamination was found consisting of Cs-134, Cs-137, Co-58 and Co-60.
15. (Manager of Dry Cask Storage) Bring in expert structural engineer from ABS Consulting with past experience in SFP leakage. Arrived 9/12/05.
16. Conduct Challenge Meeting with IPEC management. Completed 9/12/05.
17. Contact JAF to obtain input based upon recent experience with leaking Spent Fuel Pool liner. Conference call conducted with JAF 9/13/05. Discussed conditions and status of IPEC issue, and draft ODMI. No additional recommended actions were suggested.
18. Inspect other accessible exterior areas of SFP wall. Other accessible areas in addition to the south wall include the west wall in the pipe penetration space ("Pipe Pen"), the west wall in between the FSB, VC and PAB, and the east wall outside adjacent to the MOB (where the 1990-92 leak was discovered). The east wall has no evidence of a problem subsequent to the 1990-92 leak. The west wall in the Pipe Pen has some cracking and dry white streaking with no evidence of moisture. The white material will be sampled for radiochemistry by 9/14/05. The west wall in between the FSB, VC and PAB has some shrinkage cracking but no evidence of moisture.
19. (Manager of Dry Cask Storage) Issue final version of this paper with conclusions and physical actions (as deemed necessary, such as repairs, test wells, etc.) and schedule. Target 9-23-05.

#### Summary as of 9/13/05

Due to the thickness of the SFP wall, amount of steel reinforcement, small volume of moisture and boron impingement on the reinforcing rods, there is reasonable assurance that the SFP wall is structurally sound and capable of performing its intended function. This is additionally supported by the bounding calculation and study referred to above.

The data collected so far is inconclusive in regard to source of the moisture in the cracks. The next key event is full results soil and liquid radiochemistry testing including for Tritium, expected by 9/14/05.

Some soil and rock was removed 9/12/05 beneath the area of the moist crack for sampling purposes and another moist crack was observed below the first one. The upper (first) crack is at approximately 64.5 foot elevation and the second crack is approximately three feet below the first. The lower crack characteristics (hairline, roughly horizontal, length, moisture) observed is very similar to the upper crack. Visual inspection of the (upper) crack at 64.5 foot elevation indicates the amount of moisture, compared to last week, is declining (as of 9/13/05 it appears nearly dry). A plastic covering was placed over the upper moist crack on 9/9/05, and on 9/12/05 very little liquid was found in the plastic (not enough for meaningful radiochemistry analysis). However, a plastic was placed over the lower moist crack for 24 hours collected about 12 mL of water, which is being analyzed with results expected 9/14/05.

Attachments (See Rev.1 issue of this paper dated 9/9/05)

Elevation sketches (2)  
Moist crack photograph  
Unit 2 SFP Boron graph  
Core bores photograph  
Draft ODMI