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MEMO

2 pages sent via fax (717) 232-6802

Attorney Work Product

TO: Lee Swartz
FROM: Arnie Gundersen

Subject: Post Accident Containment Leakage

In reviewing the report of Dr. Sinovy V. Reytblatt on containment leakage at TMI, it is obvious that the containment system failed. In the report, prepared December 17, 1995 as part of the TMI litigation punitive damages portion of the case, Dr. Reytblatt concluded "... that a plausible release of up to 8 to 12 percent of volatiles may have occurred due to the unavailability of the containment system at the time of (sic) accident." (p.19)

Dr. Reytblatt used a containment pressure versus time curve to support his conclusion. The containment pressure versus time curve showed that the containment was at 2 to 4 pounds of positive pressure until a hydrogen detonation occurred at approximately 1:55 PM. Pressure rapidly decayed after hitting a peak of <u>at least</u> 28 pounds per square inch gauge (PSIG). Dr. Reytblatt's analysis included leakage before and after the detonation.

I concur with Dr. Reytblatt's analysis and conclusion. I also believe it is important to document the other operating data from the plant that indicated leakage of radioactivity after the hydrogen detonation. Specifically:

1. Exhibit B, Figure 2.27 of the Report by John A. Daniel showed that an area radiation monitor (HP-R-234) located in the Service Building Access Corridor recorded a five-fold increase in radiation. This five-fold increase in radiation occurred at precisely the same time as the detonation and followed four-hours of consistently decreasing radiation levels.
2. Figure 3.2 of Daniel's review of Webb's analysis showed that the strip chart for radiation monitor (HP-R-3240) failed shortly before 2PM and started operating with <u>off-scale readings</u> at approximately 3PM. Radiation levels

increased by at least a factor of 10 during this one-hour time span.

Webb thought that this may have been due to the blowout but the fact that it occurred simultaneously with the containment spike makes it more likely that this 10-fold increase in radiation is due to a containment breach. Blowout occurred after 3PM.

3. Daniel's Figure 2.2 for the Letdown Process Monitor (MU-R-720H) in the Auxiliary Building showed an increase from 40,000 Counts Per Minute (CPM) at 2PM to 85,000 CPM at 3PM. It should be noted that this particular monitor was shielded by four-inches of lead and most of the radiation was extremely weak Gammas and Betas. Considering the amount of shielding around this monitor, a two-fold increase in radiation after detonation is very significant.
4. Since all effluent monitors were already off-scale prior to the detonation, they cannot be relied upon to corroborate or deny the theory that the containment was leaking.

The simultaneous increase in these three radiation monitors at the same time as the hydrogen detonation corroborates that the containment leakage increased dramatically after detonation. This substantiates Dr. Rytblatt's non-linear leakage hypotheses.

Estimates of the radioactivity inside the containment vary and I do not know if the Plaintiff has an agreed upon value. However, Figure 4.4 of Daniel's Report indicated that 56.2 percent of only XE-133 was released to the containment. Daniel also indicated that 154 million curies were available. Using Daniel's values, this indicates that 86.5 million curies of only XE 133 were in the containment. Referring to the midpoint of Dr. Reytblatt's leak rates (8 to 12 percent) of 10 percent indicates that 8.6 Million Curies of XE-133 were released from the containment.

Figure 4.2 of Daniel's report indicated that the total fission products released from the fuel to the containment were approximately 130,000,000 (130 Million) Curies inside the containment at noon on the day of the accident. Again using Dr. Reytblatt's midpoint leakage, it is indicated that 13,000,000 (13 Million) total Curies escaped into the environment.

Clearly, containment leakage was a significant contributor to offsite exposures on the day of the accident and is easily quantifiable. Additionally there are numerous other potential release paths, like the steam generators, the make-up tank, waste gas decay tanks, leakage from the waste gas header, and a failed rupture disk on an auxiliary building sump tank.

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Feb.13, 1996

To: Dave Lockbaum/ Kim Stevens
From: Arnie Gundersen
Subject: Forensic Evidence to Support Blowout

There is one piece of forensic evidence to support the Blowout theory which to my knowledge is not yet in evidence. Specifically, the condition of the makeup demineralizers after the accident indicates that they were subjected to extreme temperature which could only have been caused by hot gases passing over them.

GPU Technical Plan TPO/TMI-072 (Bates 000600618 5) states in its appendix on page A-2 that "The estimated maximum temperature experienced by the resins in the makeup and purification system was 360 degrees Fahrenheit." Note however that the makeup system had relief valves set for 80 psi. The saturation temperature of steam at 80 psia is 312 degrees; at 80 psig it is 324 degrees. Therefore, steam and water could not have been responsible for heating the resin to 360 degrees. We are certain that water entered the demineralizers after 7PM on the day of the accident and the system remained in use with water in it after that time. We can conclude that the demineralizers were damaged by temperatures of 360 degrees prior to 7PM on the first day of the accident.

There can be two causes for this high temperature. The first is that uranium and radioactive fission products trapped in the resin caused it to overheat. However, the uranium was deposited in the resins when the reactor coolant pumps were restarted on the evening of the accident, when the system was full of water. The demineralizer held 2,746 pounds of water, with 4 pounds of uranium stuck to the resin. Compared to full power, the decay heat from uranium 15 hours after shutdown is one half of one percent. There is no way that four pounds of uranium could generate enough heat to boil dry the demineralizer with 2746 pounds of water in an open system. Page A-2 of the report states that researchers could only model the resin degradation using a combination of radiation and heating, and not radiation alone.

The other alternative is that there was a blowout. The "A" demineralizer had a "crust over the resin" which was difficult to penetrate with a sample probe. Page A-6 also states that "The "A" demineralizer resin has a crusted appearance and severe channeling exists." The presence of a crust at the top of the resin indicates that it was subjected to a sudden flux of high temperature gas. The crust cannot be explained by radiational heating or radiation damage, since the radiation profile of the vessel(Figure 2-2) shows most of the radiation was concentrated in the middle. In addition, had the temperature gradually risen from uniform radiational heating of the entire resin, no surface crust would have developed. The severe channeling was then due to hot gases causing the entire resin to contract, not homogeneously, but in clumps, much the same way a down comforter dries in a hot air dryer.

I conclude on the basis of forensic evidence that sometime before 7 PM on the first day of the accident, the makeup system and its demineralizer were subjected to hot gases from a blowout.

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To: Larry Burnham, Lee Swartz, Dave Lochbaum, Paul Blanch,Norm Aamodt

From: Arnie Gundersen Date: 3/3/96

Subject: Major Discrepancy between Daniel and Akers data which may increase exposures to support Plaintiff's claims

Below is a comparison of Krypton isotopes from Daniel's1992 Report and Akers' 1995 Report. Attached also are the complete tables from each report. On Friday March 1,1996, Paul Blanch noticed the major discrepancy between the two reports for Krypton 83M. Akers value for Kr83M is 1000 times bigger than any other volatile isotope. It is unlikely that Akers made a typographical error in Table A3, because the moles of Kr83M in that table are also very large. It is possible that Daniel "forgot" that Kr83M is a daughter of other fission products.

If Akers is correct, the public received an enormous exposure from the short lived Kr83M on the first day of the accident, from the steam generator leak and just from gas stripped from the reactor coolant by the Letdown/Makeup system which was released up the plant stack. If just one tenth of one per cent of Akers Kr83M was released by the 8 AM Steam Generator leak, this alone would be a 10,000,000 curie release. Akers value for Kr83M supports Lochbaum's assertion that releases were substantially greater than 10,000,000 curies.

We need to get Akers' value of Kr83M into the record to repudiate Daniel and to support Lochbaum's contention. Since we caught the difference after we deposed Daniel (whoops!), our best approach might be to bring it up in our direct examination of Lochbaum this week. I leave that for the legal minds to figure out.

COMPARISON OF KRYPTON ISOTOPIC INVENTORIES AT SHUTDOWN

ISOTOPE	Daniel's 1992 Report TABLE 3.2 (curies)	Akers 1995 Report TABLE A3 (curies)
Kr83M	11,040,000	9,900,000,000
Kr85M	26,450,000	25,000,000
Kr85	962,800	967,000
Kr87	50,890,000	49,600,000
Kr88	72,050,000	70,000,000
Kr89	92,770,000	NA

COMPARISON OF DANIEL'S 1992 AND 1996 NOBLE GAS RELEASES

Location of Radioactivity	1992 Percent Radioactivity		1992 Curies[1] Radioactivity	1996 Percent Radioactivity	1996 Curies Radioactivity
Core		30.0 %	52,000,000	36%	63,000,000
Containment	(.56 x .7)	39.2%	68,000,000	52%	91,000,000
Reactor Coolant	(.12 x .7)	8.4%	14,000,000	0%	0
Aux. Bldg.	(.22 x .7)	15.4%	26,950,000	0%	0
Environment	(.10 x .7)	7.0%	12,000,000	12%	21,000,000
TOTAL		100%		100%	

[1]Based on a total noble gas inventory of 175,000,000 curies of noble gas present on April 29, 1979