Doerflein, Lawrence

From: Vaidya, Bhalchandra
Sent: Friday, May 18, 2012 3:26 PM
To: Lee, Samson; Vaidya, Bhalchandra; Bickett, Brice; Doerflein, Lawrence; Jennerich, Matthew; Dennig, Robert; Ulses, Anthony; MorganButler, Kimyata; Fretz, Robert; (b)(7)(C) Eul, Ryan; Richards, Karen; Safford, Carrie; Monninger, John; McIntyre, David; Collins, Timothy; Scott, Catherine; Albert, Michelle; Cook, William; Thadani, Mohan; Russell, Andrea; McCarver, Sammy; Lemoncelli, Mauri
Cc: Wilson, George
Subject: G10120172, 2.206 Petition; PRB Meeting of May 17, 2012 to make Initial Recommendation to accept or reject
Attachments: Dec 6, 1991 Document.pdf; Aug 14.1992 Document.pdf

Folks,

Subsequent to our discussion in the PRB meeting on May 17, 2012, I have had more conversations with Mohan Thadani, who was the PM for the GL 89-16. The following points would help to clarify the claims of the Petitioners with respect to the NRC efforts during the GL 89-16 process as well as Post-Fukushima Events:

(1) Contrary to our discussion, GL 89-16 addresses all contents of "Vent Products," such as Steam, Hydrogen, Nitrogen, etc. This is mainly because the BWROG criteria that were used to evaluate the licensees' responses, included Hydrogen concerns (In addition to Sept 28, 1992 NRC Approval, I am providing two more documents from ADAMS Archive for your information). GL 89-16 was part of the NRC's program to enhance the Containment Performance in response to "Beyond Design Basis Accidents, namely SBO TW Sequence," in addition to the Design Basis Accidents. Therefore, the Petitioners' claim that the NRC's evaluation of the licensee's GL 89-16 responses being "improper," "in-adequate," "faulty," etc., is not correct. Whether, the modification to Vent system were installed, or not, FitzPatrick was found to meet the performance requirements per BWROG Criteria.

(2) After Fukushima Accident, the NRC through the near term task force (NTTF), and Japan Lessons Learned Directorate (JLD), has issued the Hardened Vent Order to achieve the "Reliable" Vent System to address the performance issues on the Vent System, all constituents of the Vent Product. The Hardened Vent Order has a prescribed time line for completion, which will require a 10 CFR 50.90 process that allows for public Participation. FitzPatrick is no different from the other 24 odd BWR, MARK I plants. Therefore, the Petitioners' claim that Fukushima event makes the FitzPatrick Vent System unreliable, undependable is true only for "Fukushima Type Event," and is no different than other 24 odd BWR, MARK I plants. The Commission has established the process to resolve the issue for all BWR, MARK I Plants for Fukushima type of events, including FitzPatrick.

With the above discussion, I believe that the Table in the Final PRB Notes of our meeting yesterday, May 17, 2012, should indicate "reject" or "no" for all items.

If you believe that we need another meeting to discuss this more, let me know and Andrea and I will make arrangement for the meeting.

Thanks,

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Vaidya, Bhalchandra | Thursday, May 17, 2012

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New York Power Authority

Ralph E. Beedle

December 6, 1991
JPN-91-065

U.S. Nuclear Regulatory Commission
Attn.: Document Control Desk
Mail Station P1-137
Washington, D.C. 20555

Subject: James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
Hardened Wetwell Vent Capability for the James A. FitzPatrick Nuclear Power Plant

Reference:
1. NRC Generic Letter 89-16, "Installation of a Hardened Wetwell Vent," dated September 1, 1989.
2. NRC letter, S. A. Varga to J. C. Brons, "Installation of a Hardened Vent Capability at the James A. FitzPatrick Nuclear Power Plant," dated January 24, 1991.

Dear Sir:

Generic Letter 89-16 (Reference 1) requested that utilities with BWR Mark I containments volunteer to install a hardened wetwell vent system. The Authority's response to this Generic Letter requested that the decision whether to modify the existing FitzPatrick plant hardened wetwell vent be deferred until after completing the FitzPatrick Individual Plant Examination (IPE) which was then under development. The NRC concurred and requested that the Authority submit its final position regarding the Boiling Water Reactor Owners Group (BWROG) hardened vent design criteria within 60 days of completing the FitzPatrick IPE (Reference 2). In addition, the NRC requested that the Authority use the results of the IPE to re-examine venting procedures and training of operators.

This letter contains the Authority's response to Reference 2. Attached is an evaluation of venting during severe accidents at the FitzPatrick plant. It includes the Authority's final position regarding the BWROG hardened vent criteria and a re-examination of venting procedures and training. In addition, it describes insights the Authority gained from performing the IPE and the status of investigations into accident management strategies associated with severe accidents.

The Authority concludes that the current design of the FitzPatrick hardened wetwell vent meets Generic Letter 89-16 by providing a reliable venting capability with significant scrubbing of fission products during specific severe accident conditions. The evaluation also concludes that several procedural changes associated with the operation of the vent

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equipment may be beneficial as accident management strategies. These venting strategies include:

- Venting until the containment pressure is reduced to near atmospheric pressure; and,

- Initiating the vent early, i.e., venting under certain circumstances prior to the containment pressure reaching the currently established vent pressure.

Implementation of these procedural enhancements would require changes to the currently approved emergency procedure guidelines and emergency operating procedures. The Authority will bring these issues to the attention to the BWROG for generic consideration. When these changes are approved by the BWROG and NRC, the Authority will provide the NRC with an implementation schedule.

If you have any questions, please contact Mr. J. A. Gray, Jr.

Very truly yours,

Ralph E. Beedle
Executive Vice President
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Hardened Wetwell Vent Capability for the James A. FitzPatrick Nuclear Power Plant

I. Background

Generic Letter 89-16 (Reference 1) requested that utilities with BWR Mark I containments volunteer to install a hardened wetwell vent system. The Authority response (Reference 3) stated that any decision whether or not to modify FitzPatrick's existing hardened wetwell vent design should be deferred until after completing the FitzPatrick Individual Plant Examination (IPE), then being developed in accordance with NRC Generic Letter 88-20. The Authority provided a significant amount of additional information (References 6, 8, 9, and 11) to support this position. The NRC concurred and requested that the Authority submit within 60 days of the completion of the FitzPatrick IPE, its final position on the Boiling Water Reactor Owners Group (BWROG) hardened vent criteria (Reference 10). In addition, the NRC requested that the Authority use the results of the IPE to reexamine the venting procedures and training of operators. On September 13, 1991, the New York Power Authority provided the James A. FitzPatrick Nuclear Power Plant Individual Plant Examination to the NRC (Reference 11).

This attachment provides the Authority's detailed response to Reference 10. Section II describes several insights concerning post-accident venting. These insights were gained from performing the IPE and from performing other severe accident studies and evaluations. The Authority's detailed evaluation of the FitzPatrick vent design to the BWROG hardened wetwell vent design criteria is provided in Section III. Section IV discusses issues associated with venting procedures and training. The status of investigations into certain accident management strategies associated with venting and station blackout events, is contained in Section V.

As detailed in References 6 and 9, the FitzPatrick plant already has a hardened vent. The vent piping originates at the primary containment suppression chamber air space and terminates at the inlet to the standby gas treatment system (SGTS), which is located in a separate structure adjacent to the reactor building. All of the vent piping is rated for 150 psig internal pressure. Because the FitzPatrick plant already has a hardened wetwell vent, the remaining vent-related issues are mostly related to the need, if any, for modifying the existing venting procedures or adding new vent equipment to meet the BWROG vent design criteria. The need for, and the nature of such additional venting procedures and equipment has been determined from insights gained from the FitzPatrick plant IPE and other severe accident analyses.

II. Severe Accident (TW and SBO) Venting Insights

TW Sequence Definition

In TW accident sequences, a plant transient causes the reactor to trip. The reactor is automatically shutdown with reactor water level maintained above the reactor core, providing core cooling by using one or more plant systems (e.g., condensate, HPCI, RCIC, LPCI, core spray, etc.). However, normal means of decay heat removal (e.g., steam dump through the turbine bypass valves, RHR shutdown cooling, RHR suppression pool cooling, and RHR LPCI or containment spray injection through an RHR heat exchanger) are all unavailable. Instead, decay heat is transferred to the suppression pool by steam flow through one or more safety/relief valves (SRV). This heats up the suppression pool, and when pool temperature, in conjunction with reactor pressure, approaches the heat capacity temperature limit (HCTL) curve, the operator manually depressurizes the reactor by opening additional SRVs. The suppression pool absorbs this additional heat and continues to condense the steam generated from decay heat. When the water temperature approaches 212°F, the suppression pool can no longer condense all of the steam being added through the SRVs. Steam then evolves from the surface of the suppression pool into the containment atmosphere. Eventually this begins to pressurize the containment. After approximately 20 hours, the containment pressure approaches 44 psig, which is the FitzPatrick primary containment pressure limit (PCPL). The emergency operating procedures (EOPs) then direct the operators to vent the containment to maintain pressure below the PCPL.

Wetwell venting at this time prevents the containment from overpressurizing, while providing a stable, long term decay heat removal pathway (the steam generated off the suppression pool is directed to the environment). The release to the environment from TW venting would be slightly contaminated steam mixed with the inventory of nitrogen gas which was initially in the containment. When one of the normal decay heat removal pathways is restored, the TW accident is over. The vent is then closed with the plant remaining in a stable cold shutdown condition.

If the containment is not vented, then pressure continues to rise. When the containment pressure rises to within 50 psi of the containment instrument nitrogen pressure (or at approximately 70 psig), the SRVs close due to insufficient dp across their air actuators and the reactor repressurizes. If the high pressure coolant injection (HPCI) system is not available, then all coolant injection to the reactor ceases. Reactor water level then drops due to boil-off and core damage follows. The containment continues to pressurize from gases generated from metal-water reactions within the reactor and, following reactor vessel failure, from core-concrete reactions within the drywell. When the pressure within the containment exceeds its failure pressure, structural failure occurs. With HPCI available, core cooling is maintained as the reactor repressurizes. However, this does not prevent containment from overpressurizing from steam generated off the suppression pool. HPCI is then assumed to fail with the other ECCS systems when the containment fails as described below, and core damage follows.

The sudden depressurization of the containment upon its failure has several effects: Some of the water in the suppression pool flashes to steam, and with reduced containment pressure, the SRVs may reopen, depressurizing the reactor. Suppression pool flashing reduces the net positive suction head (NPSH) available to the emergency core cooling system (ECCS) pumps taking suction from the suppression pool and may cause them to fail from cavitation. If these pumps do not fail from reduced NPSH, then the IPE assumes that all ECCS pumps (RHR, Core Spray, and HPCI) fail from environmental effects (temperature/humidity) due to steam released from a rupture or leak of the suppression pool. Since one or more of these pumps were providing cooling water to the reactor, core damage would follow.

SBO Sequence Definition

In a long term station blackout (SBO) all sources of AC electrical power are unavailable. The reactor is automatically shutdown and the steam driven HPCI and RCIC systems maintain water level above the reactor core. As with the TW sequences, decay heat is transferred to the suppression pool by steam flow through the SRVs and the containment eventually pressurizes. Since the HPCI and RCIC turbines are dependent upon DC control power, depletion of the station batteries after about eight hours leads to their failure. Once HPCI and RCIC fail, the water inventory in the reactor boils away and core damage begins. The onset of core damage occurs approximately 13 hours into the SBO. At this time, the containment pressure is significantly below the PCPL vent setpoint pressure of 44 psig.

A. IPE Insights - TW Sequences

The FitzPatrick IPE was used to estimate the risk reduction associated with successful venting of the wetwell airspace for the TW accident sequences. This is shown by comparing the total core damage frequency (CDF) with and without venting. Based on the FitzPatrick IPE, we find:

CDF, without venting = 2.72 E-5/yr.
CDF, with venting = 1.92 E-6/yr.

The total core damage frequency is reduced by a factor of 14 due to venting during TW sequences. This factor of 14 is conservative because it assumes that all overpressurizations of the containment from TW sequences lead to a loss of core cooling. Nevertheless, venting during TW sequences is an important mitigating action.

For FitzPatrick, the dominant TW sequences are those that result from a nonrecoverable loss of either of the two 4160 VAC emergency busses (10500 or 10600). Loss of either of these busses results in having three of the four RHR pumps functionally unavailable for decay heat removal. The RHR and RHR service water (RHRSW) pumps are organized and powered as follows:

Division A	Division B
RHR pump A (10500)	RHR pump B (10500)
RHR pump C (10600)	RHR pump D (10600)
RHRSW pump A&C (10500)	RHRSW pump B&D (10600)

To provide decay heat removal, at least one RHR and one RHRSW pump from the same division must function. Given a loss of a single emergency bus, both RHRSW pumps from one division as well as one RHR pump from the other division lose power, leaving only one RHR pump and two RHRSW pumps available for decay heat removal. Random failure of that one remaining RHR pump leads to a loss of decay heat removal, i.e. a TW accident sequence.

Since loss of an emergency bus is the dominant TW event initiator, in all likelihood, the vent would have to be manually operated. This is because valves in the vent path are powered or controlled from both emergency busses. Loss of either 4160 VAC emergency bus require that at least some of the valve manipulations would be performed manually. In addition, if offsite power is also lost, then the wetwell vent containment isolation valves, 27AOV-117 and 118, would have to be manually opened due to loss of the instrument air system. (These valves are designed to close upon loss of instrument air.) All of the valves in the vent path are located within the reactor building and accessible depending on radiological conditions within the building. Since the PCPL pressure is reached only after 20 hours into the TW event, the IPE determined that sufficient time is available to predict that venting would be neccesssary and carry out all manual actions necessary to establish the vent path prior to the containment reaching the PCPL.

B. Other, Non-IPE Insights - TW Sequences

The Authority looked at venting at containment pressures below the EOP specified vent pressure to see if this affects the risks associated with TW. Early venting might cause RHR and core spray pumps to cavitate from reduced NPSH due to flashing within the suppression pool. Flashing couldn't occur until the pool temperature is above 212°F. Analyses indicate that it would take approximately ten hours for the suppression pool to approach 212°F. Venting prior to 10 hours into a TW sequence does not result in pool flashing and should not cause an NPSH concern.

After 10 hours into a TW event, the core spray and RHR pumps might fail from cavitation upon venting. However, the IPE assumes that the RHR and core spray pumps will fail upon venting anyways, with core cooling only available through alternative means such as the condensate, condensate booster, condensate transfer, RHRSW, and fire pumps. Low pressure venting could only accelerate this effect. The potential earlier loss of the core spray or RHR systems due to early venting would not alter IPE calculated core damage frequencies.

If the HPCI or RCIC systems were being used for core cooling, they would be unaffected by early venting. These systems initially take their suction from the condensate storage tanks and their suction auto-swap to the suppression pool is required to be inhibited by procedure. Early, low pressure venting does not increase IPE calculated TW risk.

C. IPE Insights - Long Term SBO Sequences

The FitzPatrick IPE did not take credit for using the hardened wetwell vent during SBO sequences. Based on the EOPs, the operators would not vent until the containment pressure approached the PCPL. Studies performed as part of the IPE project show that SBO core damage following battery depletion occurs 13 hours after the SBO began. This is significantly less than the 20 hours necessary to reach the PCPL venting pressure. At the time of reactor vessel breach, a containment pressure spike may occur. Then containment pressurization would continue at an accelerated pace from the gasses evolved from core-concrete interactions and will eventually reach the PCPL pressure. However, once core damage occurs the operators lose access to the reactor building, and cannot manually open the vent path.

The IPE confirmed the previous analyses which supported the FitzPatrick 10 CFR 50.63 SBO coping duration. As noted above, core damage does not occur until 13 hours into an SBO, whereas under 10 CFR 50.63, the FitzPatrick plant is required to be able to withstand an SBO of four hours duration.

D. Other, Non-IPE Insights - Long Term SBO Sequences

If new equipment such as a small engine driven source of DC power is installed and venting occurs during a postulated SBO, the SBO is essentially converted into a TW sequence by providing long term core cooling with the HPCI or RCIC systems and decay heat removal to the atmosphere with the vent. (See Section V.) In this scenario, venting is identical to that described for the TW with the exception that all valves would have to be manually operated. In this situation core damage frequency from an SBO would be reduced.

As noted earlier, core damage during an SBO occurs long before the containment reaches the PCPL vent pressure. The Authority investigated the possibility of opening the wetwell vent early during an SBO - before core damage occurs. In this scenario, the containment is vented significantly below the PCPL pressure. The HPCI and RCIC pumps, which draw their water from the condensate storage tanks, would be unaffected by venting. Early venting does not prevent nor postpone core damage, since core damage follows directly from station batteries depletion. However, once core damage occurs, the previously opened wetwell vent could scrub the evolved gasses in the suppression pool and reduce the amount of fission products released from the containment. Without the vent, the containment would eventually fail, releasing the fission products without the benefit of scrubbing. Therefore, initiating the vent at a lower containment pressure during an SBO would reduce the severity of the release to the environment.

E. Potential Vent Modifications

The Authority has identified several possible hardware modifications to the FitzPatrick plant which may help mitigate core damage during SBO and TW sequences. These modifications are unrelated to wetwell vent operation and are discussed as accident management stragegies in Section V.

The potential to identify cost beneficial modifications to the vent itself is small. Vent modifications considered include providing dedicated motive power (AC power and/or compressed air) for the normally closed valves in the vent pathway, and providing a hard piped bypass around the SGTS filter trains. There are several reasons why these vent modifications are not cost beneficial.

(1) The mean core damage frequency at FitzPatrick due to SBO sequences is already relatively low at 1.75 E-6/yr. (Reference 11, FitzPatrick IPE, Table 1.4.5.1). Consequently, the economic value of reducing this frequency is also low. This is demonstrated by comparison to an earlier NRC analysis of venting at the FitzPatrick plant (Reference 5). This NRC analysis assumed 25 more years of FitzPatrick operation and calculated 1637 person-rems averted as a result of reducing the FitzPatrick core damage frequency by 4.5 E-5/yr. Using a simple ratio of core damage frequencies, the person-rems averted by eliminating SBO sequences at the FitzPatrick plant would be:

$$\frac{1.75\ E\text{-}6\ (1637)}{4.5\ E\text{-}5} = 63.7 \text{ person rems averted}$$

At $1,000 per person rem averted, only about $64,000 would be justified for the cost of modifying the FitzPatrick plant to reduce SBO offsite health and property risks to zero.

This justifiable expenditure is less than 10% of the $680,000 the Authority estimated to provide a hard pipe bypass around the FitzPatrick Standby Gas Treatment System (SGTS) filter trains (Reference 3). Although the cost of providing dedicated power supplies to the vent valves has not been determined, it will most likely also exceed $64,000. However, neither of the modifications reduce the CDF, their benefits only reduce, but not eliminate the offsite dose. Therefore, their benefits are considerably less than $64,000.

(2) Based upon expert opinion, the two dominant containment failure modes during long term SBO sequences are direct liner attack from the core debris and rapid containment overpressurization at the time of reactor vessel breach. (Reference 11, FitzPatrick IPE, Section 4.7). Should containment structural integrity be lost by either of these mechanisms, wetwell venting would be ineffective (i.e., fission products would escape from the containment through the breach caused by the failure rather than be scrubbed by the wetwell vent).

(3) Several accident management strategies based upon insights gained from the FitzPatrick IPE are under review. (See Section V.) Should any of these strategies prove to be technically feasible and cost beneficial, it will be considered for implementation. If implemented, the frequency of SBO sequences leading to a core

melt would be reduced. These strategies would also reduce the cost benefit of modifying the vent to cope with SBO conditions.

Based on the above, hardware modifications to the FitzPatrick hardened vent to cope with SBO sequences are not justified.

III. Evaluation of the FitzPatrick Plant to the BWROG Design Criteria

In Reference 10, the NRC compared the FitzPatrick plant's existing vent capability to the BWROG hardened wetwell vent design criteria. The NRC concluded that the existing FitzPatrick vent design satisfies several of these criteria and may have acceptable deviations from several others. The following information provides the Authority's final position regarding each of the BWROG criteria.

BWROG Criterion (a)

The vent shall be sized such that under conditions of (1) constant heat input at a rate equal to one percent of rated thermal power (unless lower limit justified by analysis), and (2) containment pressure equal to the primary containment pressure limit (PCPL), the exhaust flow through the vent is sufficient to prevent the containment pressure from increasing.

NYPA Response to Criterion (a)

The Authority compared the FitzPatrick wetwell vent configuration to the NRC approved design for Boston Edison's Pilgrim Plant. The Pilgrim plant is rated at 1998 MWth and has a limiting vent diameter of 8 inches (approximately 50 in^2). The FitzPatrick plant is rated at 2436 MWth and has a limiting vent area through a set of parallel 6 and 12 inch valves (27MOV-121 and 120) comprising a total cross section area of over 140 in^2. The limiting FitzPatrick vent flow area is over 2 3/4 times the size of Pilgrim's, and the limiting flow area per MWth is over 2 1/4 times greater than that of the Pilgrim design. However, the FitzPatrick 18 inch wetwell vent containment isolation valves, 27AOV-117 and 118 are blocked from opening beyond 50° (Ref. Technical Specification 3.7.D). Nevertheless, the wetwell vent should be capable of passing steam flows corresponding to greater than 24.36 MWth (one percent of rated thermal power). The Authority will confirm the minimum heat removal capability of the hardened wetwell vent by formal calculation.

Since the NRC considers the Pilgrim design to be acceptable, the FitzPatrick design, being proportionally larger, should also be acceptable. In addition, the NRC concluded in Reference 10 that the suppression chamber vent path was acceptable for satisfying Criterion (a) when using the main suppression chamber vent containment isolation valves (27AOV-117 and 118).

This criterion is fully met.

BWROG Criterion (b)

The hardened vent shall be capable of operating up to the PCPL. It shall not compromise the existing containment design basis.

BWROG Criterion (f)

The hard vent path shall be capable of withstanding, without loss of functional capability, expected venting conditions associated with the TW Sequence.

NYPA Response to Criteria (b) and (f)

With the exception of the Standby Gas Treatment System (SGTS) room, the vent path from the primary containment to the environment has a design pressure rating of 150 psig, which is greater than the design pressure rating of the containment and significantly greater than the PCPL pressure of 44 psig. The PCPL pressure of 44 psig is less than the 56 psig design pressure of the containment due to limitations on the closing capability of the containment vent isolation valves.

The Authority analyzed the SGTS and determined that the inlet transition pieces are capable of withstanding an internal pressure of approximately 1/2 psig. The SGTS filter train enclosures are rated for an internal pressure of a few psig. At the pressures expected to be encountered during TW venting, the transition pieces may rupture and, possibly, the SGTS enclosure as well. The vent effluent would then enter the SGTS room and, once the room is slightly pressurized, would be relieved through a set of double doors that open to the environment. The functional requirement of the wetwell vent (i.e., to remove decay heat from the containment and provide a scrubbed vent path) would not be compromised. In Reference 10, the NRC concluded that this vent flow path, including damage to the SGTS, could be an acceptable deviation from this criterion.

Based on the IPE, the Authority concludes that loss of the SGTS is an acceptable consequence of severe accident venting. Nevertheless, the Authority is investigating the possibility of opening the SGTS charcoal filter access doors and the SGTS room door to the environment prior to venting. This action would make the SGTS inoperable, thereby eliminating the required secondary containment differential pressure and, consequently, making the secondary containment inoperable as well. But this action may reduce the damage to the SGTS during severe accident venting. This procedural action will be investigated further. If the Authority determines that these actions will prevent SGTS damage during venting and allow the SGTS to be returned to service following venting, then it will be considered for inclusion in the venting procedure.

The FitzPatrick vent design is an acceptable deviation from criteria (b) and (f).

BWROG Criterion (c)

The hardened vent shall be designed to operate during conditions associated with the TW sequence. The need for station blackout venting will be addressed during the IPE.

NYPA Response to Criterion (c)

Venting During the TW Sequence:

The capability of the FitzPatrick hardened vent to operate during postulated TW sequences is discussed in the responses to criteria (a), (b) and (f). The FitzPatrick hardened vent should be capable of removing at least one percent of the rated thermal power and of withstanding the anticipated pressures for the section of the vent path within the reactor building.

Operation of the valves in the vent flow path has been demonstrated since the same flow path is used to depressurize the suppression chamber following primary containment integrated leakage rate tests (ILRT). During both ILRT and TW venting operation, the containment is initially at high pressure (44 psig for TW and 45 psig for ILRT). The flow path for both modes of operations is virtually identical, initially through a 2 inch bypass line around the 18 inch containment isolation valves, 27AOV-117 and 118, and later through the larger valves. The only significant difference is that during TW venting, the 2 inch bypass line may not be sufficient to depressurize the containment and the transition to the larger valves would occur sooner. This procedure is successfully employed during an ILRT and should also work for venting during a TW event.

The FitzPatrick hardened vent satisfies flow rate, pressure retention and operability requirements during TW sequences.

Venting During the Station Blackout (SBO) Sequence:

The SBO sequences require essentially the same heat removal rates and pressure retention capabilities as do the TW sequences. The valve operations for venting during SBO must be done manually due to the lack of motive power to the valves (AC and compressed air). All of these valves are located in the reactor building and could be accessed during SBO prior to onset of core damage. The effectiveness, or need for venting during an SBO, as opposed to the capability to vent, is discussed in Sections II and V.

This criterion is fully met.

BWROG Criterion (d)

The hardened vent shall include a means to prevent inadvertent actuation.

NYPA Response to Criterion (d)

The NRC's review of this criterion (Reference 10) correctly stated that "to prevent inadvertent actuation of the vent, the plant relies on operator training and adherence to the EOPs." It is highly unlikely that an operator would deviate from the EOPs. The actions necessary to initiate the vent are significantly more complicated than merely turning a control switch. Venting the containment requires an exact sequence of manipulations involving six valves within the containment vent and purge system. These valves are operated from the primary containment panel in the relay room, not from the control room. And in the most likely TW sequences (loss of emergency bus 10500 or 10600), venting would require manual operation of many of these valves in the reactor building.

In addition, drywell pressure and possibly high containment radiation instrumentation would be generating continuous containment isolation signals to the vent isolation valves. These signals would have to be bypassed as directed by the venting procedure F-AOP-... Leaving the control room to operate valve controls in the relay room, to bypass containment isolation signals, or to manually reposition valves during a severe accident would occur only under the specific direction of the Shift Supervisor or the Emergency Director.

Inadvertent actuation during an SBO is even less likely than during a TW event. In SBO sequences, every valve manipulation would have to be performed manually. Therefore, it is highly unlikely that inadvertent vent actuation would take place during an SBO. For more detailed information, see the FitzPatrick IPE, Appendix E.

The Authority has determined that inadvertent actuation of the FitzPatrick hardened vent is highly unlikely. Existing procedure and training provide an adequate means to prevent inadvertent vent actuation.

This criterion is fully met.

BWROG Criterion (e)

The vent path up to and including the second containment isolation barrier shall be designed consistent with the design basis of the plant.

NYPA Response to Criterion (e)

The hardened vent path uses the currently installed suppression chamber purge exhaust containment penetration. The containment isolation provisions for this penetration meet the design basis of the FitzPatrick plant. The NRC also concluded in Reference 10 that the existing FitzPatrick design satisfies Criterion (e).

This criterion is fully met.

BWROG Criterion (g)

Radiation monitoring shall be provided to alert control room operators of radioactive releases during venting.

NYPA Response to Criterion (g)

The currently installed post accident sampling system (PASS) has the capability to sample the wetwell atmosphere for the presence of radionuclides such as noble gases and iodines. This system is designed for the environmental conditions associated with accidents and would be available during TW events. The FitzPatrick vent procedure calls for its use stating, "If time permits, the Radiological and Environmental Services Departments should analyze the containment atmosphere prior to venting to aid in formulation of protective action recommendations."

As discussed previously, TW accident sequences evolve slowly, providing ample time to draw and analyze a PASS sample of the wetwell atmosphere prior to venting. By sampling from the wetwell atmosphere, the PASS system will analyze the actual gasses that will be released from the wetwell vent. Therefore, accurate venting source terms can be determined. Once venting has begun the operators will know what is being released and additional samples can be drawn as necessary to determine if the radiological content of the vent effluent has changed.

In addition, the PASS system is designed to sample the drywell atmosphere and suppression pool water for radioactive liquids, gasses, and disolved gasses. The drywell PASS sample, in addition to other accident qualified containment radiation detection instrumentation, can be used to assess the radiological consequences of venting. Since the drywell atmosphere has not been scrubbed through the suppression pool, these radiological assessments would give conservative indications of what would be released from the wetwell vent.

There are conditions under which operators are directed to vent the drywell directly (See Section IV.) Under these conditions, the drywell PASS sample together with containment radiation monitoring instrumentation would provide direct indication of the radioactivity associated with drywell venting.

The Authority considers the installed radiation detection and sampling systems adequate for TW venting. Since operation of the PASS requires AC power, it would not be available under SBO conditions.

Assuming an AC independent dedicated venting radiation monitoring system were to be installed, it would have little accident mitigation/management function. Only during those rare, long term SBO sequences leading to core damage where early, low pressure wetwell venting is employed (contrary to current emergency procedures), and the containment does not fail from other SBO phenomena, could significant radiation be detected in the vent path.

Even if a dedicated vent monitor detected radioactive materials passing through the vent, this would not be the basis for any operator action. The operators are instructed to vent regardless of radiation releases. In addition, the vent cannot be manually isolated during the release because of the high radiation levels expected within the reactor building. Therefore, a dedicated vent radiation monitor would not serve any useful operational purpose.

In the most likely, long evolving TW and SBO accident sequences, emergency response decisions and recommendations to County and State agencies for sheltering or evacuation of the public, would be based on conservative radiological estimates prior to venting. The actual dose rates and radiological assessments made during venting would not have any effect on the previous decision and recommendations for public protective actions. Radiation monitoring needs associated with offsite emergency responses are met by currently installed sampling systems, instrumentation and offsite monitoring capabilities.

A AC independent dedicated vent radiation monitoring system serves no useful purpose in the decisions to open or close the vent nor in decisions related to offsite responses. The existing radiation monitoring capability at the FitzPatrick plant is sufficient for venting during both TW and SBO events.

The FitzPatrick vent design is an acceptable deviation from criterion (g).

BWROG Criterion (h)

The hardened vent design shall ensure that no ignition sources are present in the pathway.

NYPA Response to Criterion (h)

Hydrogen and other combustible gases would not be generated during venting under TW conditions because core damage would not have occured. Therefore, the presence of ignition sources are unimportant during TW.

Combustible gases such as hydrogen or carbon monoxide are generated only during core damage events such as SBO. Not only are SBO sequences unlikely, but by their very nature they minimize concerns about equipment being energized (ignition sources) in the vent path including the SGTS room. Once AC power is restored, accident mitigation activities would reduce or eliminate combustible gas generation.

In letters previously provided the NRC on the hardened vent (References 6 and 9), the Authority noted that:

- Combustion within the vent piping and SGTS room is unlikely due to high steam concentrations.
- Even if combustion were to occur, it is unlikely to cause structural failure of the SGTS room, particularly failure of the 2 foot thick reinforced concrete common wall between the SGTS room and the reactor building, and
- Even if the SGTS room failed structurally, it would be unlikely that this failure would propagate such that the primary containment would also fail.

The alternate action would be to install a hard pipe bypass around the SGTS at an estimated cost of $680,000 (Reference 3) Since combustion in the existing vent path is not risk significant, the Authority does not plan to modify the FitzPatrick vent design to reduce ignition sources

The FitzPatrick vent design is an acceptable deviation from criterion (h)

IV. Examination of Venting Procedures and Training

In Section 2 0 of the Enclosure to Reference 10, the NRC concluded that:

(1) operators are untrained regarding venting consequences and do not expect a rupture in the SBGT portion of the venting pathway;
(2) operators are not familiar with other methods expec[illegible]d to be employed to stretch out the time to reach containment failure pressure and other decay heat removal pathways.
(3) present simulator scenarios involving loss of decay heat removal sequences do not result in containment venting; and
(4) procedural guidance is not provided to determine when to secure venting once it has been started

In addition, the procedures do not clearly indicate the conditions which would require use of the drywell, suppression chamber, or both, vent paths Also, F-AOP-35 contains human factors weaknesses which could prove detrimental to operator use of the procedure

With respect to issue (1), the more general issue is operator training in the various severe accident insights and phenomena revealed through the IPE process Recommendations for operator training with respect to the results of the IPE have been identified and are being integrated into the operator training program. Included with this training will be training in severe accident phenomena such as the consequences of venting during severe accidents.

Item (2) is more appropriately handled under the accident management program which is being coordinated by utilities through NUMARC and the NRC. In any event, both TW and SBO sequences evolve slowly and, even without employing other methods of heat removal, require approximately 20 hours to reach the PCPL pressure. This provides ample time for operator action. The IPE did not consider means of extending the time to reach the PCPL or containment failure pressure or alternate methods of heat removal necessary. Successful operation of the FitzPatrick vent resolves any concern about reaching containment failure pressure, eliminating the need to providing measures to stretch out the time to reach this pressure.

With regard to present simulator scenarios in Item (3), the FitzPatrick simulator cannot simulate TW sequences which require venting. The FitzPatrick simulator is designed to meet the requirements of ANSI/ANS-3.5-1985, "Nuclear Power Plant Simulators for Use in Operator Training" which has very specific requirements for the capabilities of the simulator and for validation of simulator models. Operators are not simulator trained with unvalidated simulator models because modeling inaccuracies may mislead them. The simulator suppression pool temperature model has not been validated for beyond design basis events (above approximately 120°F), such as would be generated by long term TW sequences. This limitation is of little significance for scenarios which evolve slowly, especially where emergency procedures are available and operators well trained. In addition, the actual valve manipulations to effect venting cannot be performed in the simulator because the vent valve control switches are not located in the control room and, therefore, are not provided in the simulator. Operators are fully classroom trained on those portions of the EOPs which represent beyond design basis events.

With respect to item (4), F-AOP-35 was significantly revised, providing more detailed instructions and improving human factors considerations, subsequent to the NRC's visit to the FitzPatrick plant (Reference 8) and their review of the procedure. The revised format of F-AOP-35 should alleviate the human factors weaknesses noted by the NRC.

F-AOP-35 directs operators to vent "only as necessary to reduce and maintain Primary Containment pressure below the Primary Containment Pressure Limit. A pressure control band should be chosen such that offsite radiological consequences are expected to be minimized." This procedure could be revised further to provide more specific guidance in selecting the limits of the pressure control band. However, such guidance would have to account for differing pressurization rates from many postulated accident sequences and would be very cumbersome and would not improve vent operation.

The Authority is investigating whether this procedure should be modified to direct the operator to continue venting until the containment has been depressurized to near atmospheric pressure instead of using a pressure control band. There are only minimal adverse radiological consequences in the TW sequence by allowing the vent to remain open until near atmospheric conditions are reached in the containment. In SBO or other core damage events, this approach has a number of potential benefits. Terminating venting at a low containment pressure is discussed further in Section V.

F-AOP-35 is very specific on when the venting of the suppression chamber or drywell shall be conducted. This procedure states, "A Primary Containment vent path taking its suction on the Torus airspace is preferred due to an expected decrease in radioactive release rate due to pool scrubbing of fission products." If the suppression pool water level is above 28.5 feet (just below the height of the vent penetration), then the procedure requires that venting be conducted directly from the drywell, regardless of the radiological consequences. There are no conditions under which simultaneous venting from both the suppression chamber and the drywell would be required. Furthermore, the flow limiting valves in the vent path are common to both the suppression chamber and drywell vent paths. Opening both paths simultaneously does not increase the limiting flow area and should not significantly increase the overall vent flow rate.

V. Accident Management Strategies

The Authority is currently examining several accident management strategies. Neither the feasibility nor the cost effectiveness of these strategies have been determined. However, preliminary analyses indicate that should these strategies be implemented, the risk significance of SBO sequences could be lowered by a factor of about 4 to 6.

One accident management strategy is to provide a small engine driven generator to supply 600 VAC power to one or both battery chargers or to supply 125 VDC power directly to one or both DC systems. The FitzPatrick IPE verified that SBO sequences lead to core damage due to inability to maintain core cooling once DC power is exhausted. Use of an additional electric generator could extend the availability of DC power and prevent core damage.

Another IPE insight is to install a crosstie between the fire protection system and the emergency service water system (ESW). This will allow one or both of the diesel driven fire pumps to supply cooling water to one or more of the jacket water cooling heat exchangers on the four emergency diesel generators (EDGs). Based on the FitzPatrick IPE, loss of ESW was a major contributor to EDG unavailability. When at least one EDG becomes functional, core cooling would be possible through use of the core spray system or the LPCI mode of RHR, thereby terminating the SBO.

A single operating diesel generator can power an RHR service water pump and all necessary auxiliary equipment in addition to the RHR and core spray pumps to provide simultaneous core cooling and containment heat removal. With an EDG providing AC power, there is no need to initiate the vent, and if the vent is already open, there is AC power to close it. Three modes of ECCS system operation can provide the heat removal path from the reactor core to the ultimate heat sink (Lake Ontario) using a single EDG, shutdown cooling, suppression pool cooling, and containment spray through an RHR heat exchanger.

In shutdown cooling mode, an RHR pump circulates reactor coolant through an RHR heat exchanger and then back to the reactor vessel. In suppression pool cooling mode, an RHR pump circulates water from the suppression pool through an RHR heat exchanger and then back to the suppression pool. In containment spray mode, an RHR pump circulates water from the suppression pool through an RHR heat exchanger and then through the containment spray headers. The water then collects on the floor of the drywell and spills back into the suppression pool through the downcomers. These last two modes require using the core spray system to provide core cooling. In all three of these modes, an RHRSW pump provides cooling water from Lake Ontario to the tube side of the RHR heat exchanger and returns the heated water back to the lake.

Another IPE insight is the use of the existing fire protection system crosstie to the RHRSW to provide cooling water flow to an RHR heat exchanger instead of using the RHRSW pumps. The crosstie was originally installed to provide cooling water to the reactor core during SBO conditions. This new use of the crosstie would mitigate certain TW sequences where an RHR pump is available, but the corresponding RHRSW pumps are not. This strategy can be implemented through simple procedure changes since all necessary crosstie hardware have been previously installed and only new valve manipulations are required.

The Authority plans to bring several other venting strategies to the attention of the BWROG for generic consideration prior to any decision to implement on a plant specific basis. Two of these strategies are early (low pressure) venting during SBO and venting the containment to near atmospheric pressure instead of maintaining containment pressure just below the PCPL. These strategies were mentioned previously and are described in greater detail below.

The first strategy involves manual opening of the vent valves prior to the containment pressure reaching the PCPL during an SBO if loss of core cooling is imminent. Due to the long time between loss of core cooling and core damage during SBO sequences, there should be sufficient time to manually open the vent valves. This would not significantly increase risks, and could be useful in SBO sequences if the containment does not fail early from other SBO phenomena (e.g., direct drywell liner attack). In fact, venting in SBO sequences may also reduce the probability of early containment failure from postulated containment pressure spikes at the time of reactor vessel failure. Regardless of when the vent is opened, the suppression pool would be available to scrub radionuclides from the vent effluent. Therefore, the release to the environment would not be adversely affected by initiating the vent at a lower containment pressure during SBO. If this strategy were not implemented, then adherence to the current EOPs and postulated radiological conditions would prohibit any vent operation during an SBO.

The second strategy is to modify vent operation such that instead of maintaining a containment pressure control band, the vent would remain open until the containment is fully depressurized. This mode of vent operation would apply to TW sequences where core cooling is provided throughout the vent operation. If early venting during SBO is implemented as described above, then once core damage has occurred the vent could not be reclosed due to radiological conditions within the reactor building. Nevertheless, there are significant benefits to maintaining the vent open during both TW and SBO. Maintaining the vent open will:

- Reduce the number of operator actions and vent valve manipulations. There would be no concern that the vent could not be reclosed, and if reclosed, that it could not be reopened as would be necessary to maintain a pressure control band. This improves the reliability of the vent.

- Purge most combustible gases from the containment.

- Minimize the driving force (pressure difference between the containment and the atmosphere) for fission product release through other openings in the containment.

- Cool the containment and reactor vessel surfaces to retain radionuclides. And,

- Scrub all vent effluent through the suppression pool to trap the maximum amount of radionuclides.

VI. Conclusion

The existing FitzPatrick hardened wetwell vent is adequate to meet the accident conditions associated with TW and SBO conditions. It meets many of the BWROG design criteria and represents an acceptable deviation from the remainder. The hardware modifications needed to fully meet the BWROG design criteria are not necessary to ensure that the vent performs its decay heat removal and scrubbing functions and would not produce significant public benefits.

Procedures and operator training with respect to vent operation are adequate and the Authority is fully confident that plant operators will use the existing hardened wetwell vent when plant conditions dictate.

The hardware modifications associated with the accident management strategies described in Section V are unrelated to the hardened wetwell vent and would be preventive in nature. These strategies are currently being evaluated, with the fire protection to ESW crosstie modification expected to be installed in the near future. Accident management procedural changes which have the potential to improve the operation of the vent will be brought to the attention to the BWROG for generic consideration. When these operational changes are approved by the BWROG and NRC, the Authority will provide the NRC with an implementation schedule.

VII. References

1. NRC Generic Letter 89-16, "Installation of a Hardened Wetwell Vent," dated September 1, 1989.

2. NRC memo, B.W. Sheron to A.C. Thadani, "Reduction in Risk from the Addition of Hardened Vents in BWR Mark I Reactors," dated October 19, 1989.

3. NYPA letter, J.C. Brons to the NRC, (JPN-89-070) providing the Authority's initial response to Generic Letter 89-16, dated October 27, 1989.

4. NRC memo, W. Minners to A.C. Thadani, "Draft Environmental Assessment and Plant-Specific Regulatory Analysis for Installation of Hardened Vents in BWRs With Mark I Containments," dated January 8, 1990.

5. NRC letter, T.E. Murley to J.C. Brons, "Staff's Backfit Analysis for James A. FitzPatrick Nuclear Power Plant Regarding Installation of a Hardened Wetwell Vent," dated June 15, 1990.

6. NYPA letter, J.C. Brons to the NRC, (JPN-90-055) providing the Authority's comments on the NRC's Hardened Vent Backfit Analysis, dated July 25, 1990.

7. NRC letter, D.E. LaBarge to J.C. Brons, "Topics for Discussion During Planned Site Visit to Address the Hardened Wetwell Vent at the FitzPatrick Nuclear Power Plant," dated August 17, 1990.

8. NRC staff visit to the FitzPatrick plant to gain further insight into the design of the FitzPatrick Wetwell Vent Path, held on August 22, 1990.

9. NYPA letter, J.C. Brons to the NRC, (JPN-90-061) providing two supplementary Authority's analyses to the NRC staff, "Radiological Benefits of an Elevated Release" and "Combustion Analysis," dated September 7, 1990.

10. NRC letter, S.A. Varga to J.C. Brons, "Installation of a Hardened Vent Capability at the James A. FitzPatrick Nuclear Power Plant," dated January 24, 1991.

11. NYPA letter, J.C. Brons to the NRC, (JPN-91-048) providing the completed Level I and Level II IPE for the James A. FitzPatrick Nuclear Power Plant, dated September 13, 1991.

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New York Power Authority

Ralph E. Beedle

August 14, 1992
JPN-92-045

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Washington, D.C. 20555

SUBJECT: James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
Hardened Wetwell Vent Capability

Reference: NRC letter, R. A. Plasse to R. E. Beedle, "Request for Additional Information - Hardened Wetwell Vent Capability for the James A. FitzPatrick Nuclear Power Plant (TAC No. M82364)," dated July 2, 1992.

Dear Sir:

In a May 19, 1992 conference call with the NRC staff, the Authority agreed to provide additional information regarding the FitzPatrick wetwell vent design. The referenced letter details the specific information requested by the NRC in order to resolve the outstanding concerns of Generic Letter 89-16 for the FitzPatrick plant. This letter provides the Authority's response to these three concerns.

1) Perform the calculation to confirm the minimum heat removal capability of the hardened vent and provide the results to the NRC staff.

Response:

This calculation has been performed. The calculation determined that one percent decay heat (24.36 MW) produces 25.183 lbm/sec of steam at 44 psig (the PCPL pressure) by evaporation from the suppression pool, at a rate of 269.964 ft^3/sec. This is the volumetric flow rate of the vent necessary to prevent one percent decay heat from causing pressure to continue to increase within the containment. Assuming a vent effluent of pure nitrogen (the initial gas contained in the wetwell), a vent mass flow rate of 44.21 lbm/sec is required. Although the actual vent effluent would be a mixture of nitrogen and other gases, primarily steam, the higher density of nitrogen leads to conservative results in this calculation.

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The venting procedure directs venting through parallel 6 and 12 inch lines. This parallel path, as well as each individual path, were evaluated for their ability to pass the required flow rate. Venting through the 6 inch line alone is capable of passing 17 lbm/sec, which is insufficient for reducing the containment pressure. The 12 inch line alone is capable of passing 71 lbm/sec, which is significantly greater than the 44.2 lbm/sec required. The combined flow through both lines is 78 lbm/sec. The calculation concludes that venting through the combined flow path or only through the 12 inch line is sufficient to remove one percent decay heat. Therefore, the FitzPatrick design fully meets the BWROG hardened wetwell vent heat removal design criteria.

Because the vent path can pass significantly more flow than required (approximately 60% margin for venting through the 12 inch line alone) ample vent capacity is available to support the planned 4% power uprate. This will be formally documented

2) The vent path at FitzPatrick for the wetwell may include up to 7 different valves. Assurance of vent operation is vital to the success of the hardened vent operation. Provide confirmation that the valves used in the vent path are capable of operation up to the PCPL (44 psig)

Response.

The operability of the wetwell vent containment isolation valves (27AOV-117 and 118) were factored into the determination of the primary containment pressure limit (PCPL). These large diameter butterfly valves required modification of the shaft to disk pin to ensure their ability to open and close against a differential pressure of 44 psig (the PCPL).

The small diameter containment isolation bypass valves (27MOV-117 and 123) have design pressures in excess of the PCPL. 27MOV-117 is designed to operate against a differential pressure of 56 psig, the primary containment design pressure. 27MOV-123 was originally designed for a PWR primary coolant system application with a design differential pressure of 1621 psig. These two valves are opened to depressurize the containment following conduct of the primary containment integrated leakage rate test (PCILRT) from an initial pressure of 45 psig. Therefore, their ability to open from a pressure in excess of the PCPL is periodically demonstrated.

The parallel 6 and 12 inch valves further downstream in the vent path (27MOV-121 and 120) were designed to operate aagainst a differential pressure of 10" W.G. The mandatory opening sequence for the vent valves requires these valves to be opened before the containment isolation valves to ensure that the valves which can handle the PCPL pressure are opened last.

The only other valve in the vent path is one of the standby gas treatment system (SGTS) inlet isolation valves (01-125MOV-14A, B). Since the vent procedure requires one train of the SGTS to be in service prior to venting, this valve will already be open prior to opening any of the other valves in the vent path and will not be exposed to significant differential pressure.

Therefore, the FitzPatrick design meets the BWROG hardened wetwell vent criteria of being capable of operating up to the PCPL.

3) PASNY must demonstrate how the existing equipment meets the intent of the criteria for providing radiation monitoring equipment. A discussion should be provided in timing, sensitivity, and ranges of the installed equipment. During the May 1992 conference call, PASNY indicated that this information has been provided in response to NUREG 0737 and would be summarized to fulfill the needs of this criteria.

Response:

The existing containment high range radiation monitor (CHRM) and post accident sampling system (PASS) can be used to assess the radiological consequences of venting. These two monitoring systems [illegible]e installed specifically to assess severe accident conditions and will be operable under the environmental conditions expected to be present when venting is required.

The CHRM provides indication in the control room of the gamma radiation dose rate in the drywell. The location of the CHRM detectors, 27RE 104A and B was requested by the NRC in the May 19 conference call. 27RE 104A is [illegible] the south quadrant of the drywell at elevation 290'4" and 27RE 104B is located at the east quadrant at elevation 288'4". These elevations place the CHRM detectors in the spherical section of the drywell, 10 and 8 feet respectively above the equator line. These detectors had been previously repositioned to more accurately monitor the radiological conditions within the drywell. The Authority has determined that a severe accident source term of 100% noble gas and 25% halogen airborne plus 50% halogen and 1% fission product in liquid form will result in a CHRM reading of approximately 10[illegible] R/hr immediately after plant shutdown. This is well within the CHRM measurement range of 1 to 10[illegible] R/hr.

The PASS system takes direct samples of the drywell atmosphere, wetwell atmosphere, reactor coolant and suppression pool for laboratory analysis. The time it takes from making the decision to operate PASS until the sample analysis is completed is within the three hour criterion of NUREG 0737. This duration is primarily a result of administrative controls, including pre-job ALARA reviews and briefings, not the actual sample collection and analysis time.

The results of PASS analyses and CHRM readings can be used to estimate core damage and fission product sources using Emergency Plan Implementing Procedure EAP 44, "Core Damage Estimation." One of the ten core damage categories is determined based upon the results of the analysis. In addition, offsite dose can be estimated directly from the CHRM readings using Emergency Plan Implementing Procedure EAP 4, "Dose Assessment [illegible]." In this calculation, the CHRM reading is correlated [illegible] concentration (C[illegible] in the containment atmosphere. Then, dividing by the vent flow rate (cc/sec) and considering the scrubbing effects of the suppression pool, a release rate (Ci/sec) can be determined. Once field readings are obtained, the release rate can be refined by back calculation. This accident monitoring equipment meets the intent of the BWROG criteria to provide radiation monitoring of the vent effluent.

If you have any questions, please contact Mr. J. A. Gray, Jr.

Very truly yours,

Ralph E. Beedle
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