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NewYork Power Authority

October 27, 1989
JPN-89-70

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

Subject: James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
Generic Letter 89-16
Installation of a Hardened Wetwell Vent

References:
1. NRC Generic Letter 89-16 dated September 1, 1989, James G. Parlow to NYPA regarding the same subject.
2. NYPA letter, J. C. Brons to NRC, dated January 12, 1988 (JPN-88-001/IPN-88-001) regarding revisions to comments on NUREG-1150.
3. NYPA letter, J. C. Brons to NRC dated September 28, 1987 (JPN-87-051/IPN-87-045) regarding comments on draft NUREG-1150.

Dear Sir:

The Authority has reviewed Generic Letter 89-16 (Reference 1). This letter and its attachments satisfy the staff's request that each Mark I licensee inform the NRC of its plans to install a hardened containment vent. For the reasons outlined below and further detailed in Attachment 1, the Authority will not volunteer to install a hardened vent at FitzPatrick at this time.

First, the NRC staff has not justified why this issue should be given unique or special treatment. Rather, it should be resolved in the same way other SECY-89-017 issues are being resolved - as part of the IPE/PRA (Individual Plant Evaluation/Probabilistic Risk Assessment) currently in progress.

Second, the Authority's current analyses, together with the unique circumstances and features of the FitzPatrick plant, do not justify installation of a hardened wetwell vent for the TW sequence. The Generic Letter inappropriately prescribes a generic modification for a clearly plant-specific severe accident issue.

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Third, SECY-89-017 (upon which Generic Letter 89-16 is based) contradicts both itself and other NRC-sponsored studies on several technical points.

Integration in IPE/PRA Program

The NRC staff has not adequately demonstrated why the hardened vent issue should be resolved independent of IPE/PRA programs. The other "potential Mark I improvements" mentioned in SECY-89-017 were subsumed into the IPE process "to account for possible unique design differences that may bear on the necessity and nature of specific safety improvements." Studies prepared for the NRC make it very clear that a containment vent is equally plant-specific. NUREG-5225, "An Overview of BWR Mark-1 Containment Venting Risk Implications," Addendum 1 states:

> "...Applying the Peach Bottom results to other plants requires careful consideration. The sequence frequencies, local population density, evacuation plans, and plant unique features could have a significant impact on the results." [Executive Summary]

The analyses and justifications referred to in the Generic Letter and SECY-89-017 do not consider several relevant issues, alternative approaches or near-term improvements that significantly reduce the frequency and consequences of severe accidents. Other modifications or procedural changes with greater benefits and lower costs, should be considered before deciding on a hardened vent.

The Authority has significant experience developing and using PRAs. One of the first utility-sponsored PRAs was completed almost ten years ago for our Indian Point 3 Nuclear Power Plant as part of the Zion/Indian Point PRA studies. The Authority also has significant experience in the analysis of severe accidents having independently prepared and submitted extensive comments on NUREG-1150, "Reactor Risk Reference Document," (References 2 and 3).

The Authoirty's previous experience indicates that PRAs are systematic, scientific tools for identifying cost-effective changes to improve safety at commercial nuclear power plants. We fully expect to gain insights into those structures, systems and components that contribute most significantly to risk when the FitzPatrick IPE/PRA is completed. Any decision to install a hardened vent before an IPE/PRA has been completed is premature and only serves to undermine the IPE process. While the Authority may eventually determine that some type of vent at FitzPatrick is useful, such a choice should only be made in the context of the larger IPE/PRA analysis.

Severe Accident Analyses

The 45 days allotted by the Generic Letter for a response was insufficient to fully develop and evaluate a hardened vent or the multitude of alternate approaches and mitigating features not considered by the staff. In the limited amount of time available, the Authority has developed a position paper which summarizes some of these points, a copy of which is included as Attachment I. This paper also identifies several inconsistencies in the approach prescribed by the Generic Letter and SECY-89-017.

Hardened Vent Cost Estimate

Attachment II is the Authority's preliminary cost estimate for installation of a hardened vent based on the description included in Generic Letter 89-16. Because only 45 days was allotted to respond to the Generic Letter, the Authority reserves the right to revise the estimate.

Should you or your staff have any questions regarding the Authority's plans or position, please contact Ms. S. M. Toth of my staff.

Very truly yours,

for John C. Brons
Executive Vice President
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Attachment 1 to JPN-89-070

Response to USNRC Generic Letter No. 89-16
"Installation of a Hardened Wetwell Vent"

New York Power Authority
James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333

Table of Contents

I. SUMMARY

The Authority will not volunteer to install a hardened vent at FitzPatrick at this time. This position is based on several points.

First, the NRC staff has not justified why this issue should be given unique or special treatment. Rather, it should be resolved in the same way other SECY-89-017 (Reference 4) issues are being resolved - as part of the IPE/PRA (Individual Plant Evaluation/Probabilistic Risk Assessment) currently in progress. Any decision to install a hardened wetwell vent at FitzPatrick should not be made until after the completion of a plant specific IPE/PRA.

Second, the Authority's current analyses, together with the unique circumstances and features of the FitzPatrick plant, do not justify installation of a hardened wetwell vent for the TW sequence. The Generic Letter inappropriately prescribes a generic modification for a decidedly plant-specific severe accident issue.

Third, SECY-89-017 (upon which Generic Letter 89-16 is based) contradicts both itself and other NRC sponsored studies on several technical points.

This paper develops these and other issues related to severe accidents and containment venting.

II. BASES

Various potential Mark I enhancements are discussed in SECY-89-017. As stated in Generic Letter 89-16 (Reference 1), all SECY-89-017 Mark I enhancements, except for the hardened vent, are to be evaluated as part of the IPE/PRA program. These other potential enhancements are to be subsumed into the IPE/PRA process because a plant specific analysis must be performed to account for possible design differences among various nuclear power plants that may bear on the necessity and nature of specific safety improvements. However, as stated in NRC NUREGs, the use of a hardened vent also requires a plant specific analysis. Applying the same logic leads to the conclusion that the hardened vent should also be examined after the IPEs are completed. There is nothing distinctive about the hardened vent, compared to other suggested enhancements, that justifies a different course of action.

This recommendation is consistent with earlier ACRS recommendations, conclusions drawn by the CRGR (Reference 5), and Addendum I of NUREG/CR-5225 "An Overview of BWR Mark I Containment Venting Risk Implications," (Reference 6). This NRC report concluded in its Executive Summary:

> "Applying the Peach Bottom results to other plants requires careful consideration. The sequence frequencies, local population density, evacuation plans, and unique plant features could have a significant impact on the results."

Therefore, the hardened vent, like other Mark I enhancements, requires plant and site specific considerations and should be treated in a consistent manner; i.e., folded into the IPE/PRA process.

Generic Letter 89-16 did not establish the need to move with urgency to install a hardened vent. In fact, SECY 88-206 (Reference 7), reaffirmed that the risks from BWR Mark I's are low. More recently, the June, 1989 issue of NUREG-1150, "Severe Accident Risks: An Assessment for Five U. S. Nuclear Power Plants" (Reference 8), displayed very low risks for its reference Mark I plant, Peach Bottom. These low risks were achieved in spite of Peach Bottom's relatively high 50 mile population and without dependence on a hardened vent.

Originally, the Commission set out to establish a more balanced approach between accident prevention and mitigation. This philosophy was the regulatory underpinning for the Containment Performance Improvement Program. Since BWRs already have low core melt frequencies, emphasis has been placed upon reducing the likelihood of drywell shell failure assuming core melt conditions had occurred, i.e. mitigation. Drywell shell failure is identified in NUREG-1150 as the principle containment failure mode in Mark I plants. Yet, given a core melt situation, venting is ineffective in reducing the probability of shell failure. Consequently, the hardened vent strategy put forth in Generic Letter 89-16 is inconsistent with the original purpose of the Containment Performance Improvement Program.

The actual risk reduction potential of a hardened vent primarily depends upon the frequency of the TW sequence (loss of long term decay heat removal). In SECY-89-017, a wide range of TW sequence frequencies was displayed. The FitzPatrick TW sequence frequency will not be known until its IPE/PRA is completed. Therefore, a precise cost/benefit analysis of a hardened vent cannot be done for FitzPatrick at this time. However, there are numerous indications that it will not be cost beneficial.

Many of the benefits claimed for the hardened vent depend upon the operation of other plant equipment. For example, unless emergency core cooling pump suction is aligned to an alternative source of water, venting in some accident sequences could terminate vessel injection and accelerate core damage. Successful vent operation, therefore, requires consideration of other plant specific features beyond the hardened vent itself. The risk reduction value of a hardened vent is also reduced if other potential plant enhancements lower accident frequencies or severity. To design a hardened vent early without even knowing the baseline TW sequence frequency, is unjustified. A hardened vent designed without knowledge of other plant systems is poor practice. Knowledge of the potential risk reduction of other enhancements should be a prerequisite.

III. REVIEW OF SECY-89-017

The recommendation to fold the hardened vent decision into the IPE/PRA process is also based, in part, on our review of SECY-89-017, the Mark I Containment Improvement Program. Our review concluded that the technical and economic justification for a hardened vent at the James A. FitzPatrick plant was not provided in that document.

Our review of SECY-89-017 raises questions in two broad categories: Cost/benefit analyses and alternatives to hardened vents. These categories are examined below.

III.A Cost/Benefit Analyses

III.A.1 Basic Equation

The basic equation used to calculate the cost/benefit ratio in SECY-89-017 is in error. SECY-89-017 provides the following formula:

$$Cost\ Benefit = \frac{Averted\ Exposure}{(Installation\ Cost - Averted\ Onsite\ Costs)}$$

Should *Installation Cost* equal the *Averted Onsite Costs*, the *Cost Benefit*, by this equation, would become infinite. Even when these two factors are not quite equal, the *Cost Benefit* ratio is driven by how close they are and becomes insensitive to the *Averted Exposure* or the absolute magnitudes of the *Installation Cost* and the *Averted Onsite Costs*. Therefore, this equation is improperly formulated.

This equation has been recently reviewed by the Electric Power Research Institute, EPRI, in its draft report, NSAC 143, "Questionable Techniques Used In Cost-Benefit Analyses of Nuclear Safety Enhancements," September 1989, (Reference 9) and found to be inappropriate.

III.A.2 Present Worth Analyses

Information from the same EPRI draft report indicates that the benefit portion of SECY-89-017's health effects cost/benefit analysis may have been overestimated by about a factor of 2.5. Since health effects dominate SECY-89-017's benefit figures, it is crucial to calculate this figure correctly.

The EPRI document advances the argument that any future expense, including future health effect costs, must account for the time value of money. Note that the EPRI analysis does not discount health effect costs themselves. Rather, such costs are treated as a constant potential expense that may occur at any time within the assumed remaining 25 years of plant life. Standard accounting practice for a potential fixed expense yields a time weighted present worth factor of 2.5 for a 25 year period and a 10% discount rate.

Even though health effects costs are themselves not discounted with time, an investment today to handle a potential future expense of any kind must utilize present worth processes. It appears that the SECY document did not adequately account for the time value of money and, therefore, overestimates health effect benefits by about a factor of 2.5.

III.A.3 TW Sequence Person-Rem Figures

The person-rems associated with the SECY's TW sequence may be too high by a factor of about 3 to 4. Using the person-rem figures on page 10 of SECY-89-017, there are 1330-210 = 1120 person-rems/RY associated with TW sequences at Peach Bottom when such sequences have a frequency of 10^{-4}/RY. Dividing this person-rem number by the frequency, one obtains a value of 1.12×10^{7} person-rems/release. However, using source terms developed in BMI-2104 (Reference 10) for TW sequences and matching these source terms to person-rem data for Peach Bottom from NUREG-1150[1], yields 2.87×10^{6} to 3.62×10^{6} person-rems. Thus, earlier analyses of the Peach Bottom site with source terms associated with TW sequences result in fewer person-rems by about a factor of 3 to 4.

Similarly, the Peach Bottom person-rems for ATWS sequences appear to be about a factor of 4 too high in this SECY.

III.A.4 Population Effects

SECY-89-017 does not properly account for site-to-site population differences which directly affect the number of person-rems per release. For example, the 50 mile radius population for Peach Bottom is about 4.1×10^{6} people. At the FitzPatrick plant, the 50 mile radius population is only about 0.84×10^{6} people or about one-fifth of the 50 mile population of the Peach Bottom site. Based on information in NUREG/CR-2239, "Technical Guidance for Siting Criteria Development" (Reference 11), this smaller population at FitzPatrick should reduce the FitzPatrick person-rems/TW sequence release to about 40% of the Peach Bottom figure. Page 21 of Enclosure 4 (Regulatory Analysis) of SECY-89-017 discusses the effect of population differences on risk. It is acknowledged that less populated sites may result in risk reductions of about a factor of five. The SECY then addresses the possibility that the lower station blackout (SBO) frequencies at Peach Bottom may offset that plants' higher population. The SECY also discusses potential circumstances where both higher population and high SBO frequencies may coexist. However, the SECY is silent on combinations where both SBO frequencies and population densities are low and therefore the cost/benefit ratio would be below the SECY generated numbers. Yet, subject to the Authority's IPE/PRA results, this is likely to be the FitzPatrick situation.

1/ See Peach Bottom source terms bins, Volume 2, Appendix E, NUREG-1150, draft for comment, February, 1987. 2.87×10^{6} person-rems corresponds to a CRAC 2 calculation while 3.62×10^{6} person-rems is a MACCS calculation. The BMI source term is composed of 0.048I, 0.045Cs, and 0.15 TE.

III.A.5 Net Risk Analyses

To comprehensively evaluate the cost/benefit ratio of a hardened vent, one must consider both the potential benefits and the detriments of this plant modification. Examples of this logic can be seen in Tables 2, 3 of NUREG/CR-5225, attached. Note that venting can both increase and decrease risks. In actual plant specific analyses, numerical values would replace the greater than and less than symbols, sequence-by-sequence. These numerical values would be weighted by their sequence frequencies and then summed to determine the net risk. These numerical values would also be affected by the particular vent design and operation. For example, early venting may result in releasing a larger amount of noble gases than delayed venting. SECY-89-017 does not particularly address net risks, nor could it. Such an evaluation requires a specific plant analysis.

Part of a net risk analysis includes an accounting of the exposure of plant personnel while installing plant modifications.

It does not appear that exposure of plant personnel was accounted for in the SECY's cost/benefit analysis. Much of present plant personnel exposure occurs during outages and maintenance. Using national BWR exposure values, if plant personnel were exposed to a one time ten percent increase over normal exposure levels because of installing a hardened vent, this would be 51 person-rems (See Figure 1, "Collective Radiation Exposure - BWR Average." Using FitzPatrick-specific data, a comparable figure would be approximately 80 person-rems.) If the frequency of the sequence that this fix was to modify was initially 10^{-5}/RY and twenty-five years of plant life remained, this onsite exposure is equivalent to about 290,000 person-rems of offsite exposure, at a plant capacity factor of 0.70. Therefore, SECY-89-017 is incomplete without an analysis of the onsite exposure due to installing these proposed modifications. If 1.4×10^6 person-rems approximates a TW sequence release at the FitzPatrick site[2], onsite exposure would be equal to about 20% of this figure, based on the above assumed exposure rates and sequence frequency.

Part of the justification offered for the hardened vent is the SECY-89-017 argument that venting lowers the containment backpressure on the ADS valves. With lower containment backpressure, the ADS can then open, which would lower the reactor pressure. This, in turn, could allow a diesel driven fire pump to deliver adequate amounts of water to cool the core. This sequence of events may be appropriate for certain types of ADS designs, but it may not be universally true. Mark I ADS valves fall into a number of categories, e.g. two stage valves, three stage valves and electromatic valves. The relationship between containment pressure and ADS valve operability depends on the type of valve. For three stage valves, as was apparently used in SECY-89-017, once the valve closes the increasing reactor system pressure will oppose reopening and only a large enough decrease in containment pressure will cause the valve to reopen. With such a configuration, venting would be useful in opening the valve. With a two stage valve, once the ADS valve closes it can reopen if either the reactor pressure increases or if the containment pressure decreases. Consequently, containment venting is not required to open two stage valves.

2/ The figure of 1.4×10^6 person-rems is derived from using the Peach Bottom TW sequence MACCS value of 3.62×10^6 person-rems and correcting for the smaller FitzPatrick population.

Therefore, the hardened vent "credit" given in SECY-89-017 for assisting the ADS operation would only be applicable to that subset of Mark I plants that have three stage valves. FitzPatrick uses two stage ADS valves. Furthermore, if there are diesel driven fire pump water delivery concerns, these can be addressed in a variety of ways such as adding a booster pump, changing over to two stage ADS valves, etc. This potential pump delivery concern does not mandate the use of hardened vents for its resolution.

Part of the credit SECY-89-017 assigns to hardened vents is for ATWS sequences. Such credit may be unjustified. For many ATWS sequences, the vent flow area required to prevent containment over-pressurization would be much larger than one used to cope with just decay heat as in a TW sequence. It appears that the Boston Edison design referenced by Generic Letter 89-16 would be limited to TW type sequences. A vent capable of handling ATWS sequences would be considerably larger and more expensive that the estimates referred to in SECY-89-017 and Generic Letter 89-16. Therefore, there seems to be an inconsistency in the ATWS risk reduction credit given to hardened vents and the associated designs and costs. Futhermore, application of the ATWS rule has minimized the risk reduction potential for vents for such sequences.

There are other complications between ATWS sequences and venting that needs to be resolved. If a TW based vent design does not provide sufficient containment pressure relief during certain ATWS events and if venting has little impact on preventing drywell shell attack upon reactor vessel failure, the risk reduction potential in ATWS sequences is quite limited. On the other hand, concerns have been raised that if these plants were vented during ATWS sequences, core damage could occur because of induced NPSH problems. Previous analyses of certain ATWS sequences show that venting might induce a core melt situation. Independent analyses of the Brown's Ferry and FitzPatrick plants show that certain ATWS sequences go through a period of power oscillation and then settle down to thermal equilibrium, without core damage. Both of these plants use two stage ADS valves. Other plants with three stage ADS valves in similar ATWS events are predicted to lead to core damage, independent of vent operation. SECY-89-017 does not discriminate between plants with different ADS valve configurations and, thereby, can increase risks due to certain ATWS events for two stage ADS valve plants. This example underscores the importance of individual plant examinations and the jeopardy of imposing generic fixes.

The initiation of venting is symptom based. In an ATWS sequence, high containment pressures, enough to initiate venting, could occur much more quickly than in a TW sequence because of the much greater energy generated in ATWS. Present EPGs (Emergency Procedure Guidelines) for venting Mark I's minimize the likelihood of NPSH problems, but are largely based on TW sequences. The adequacy of these EPGs to prevent NPSH problems in ATWS sequences may have to be reviewed. This infers that application of venting to ATWS sequences may require considerable study prior to starting any design or construction effort.

SECY-89-017 identifies a number of benefits to ADS operation, such as lowering the likelihood of prompt containment failure upon reactor vessel failure. One major ADS benefit was overlooked. Operation of the ADS prior to reactor vessel failure has been investigated for Peach Bottom station blackout sequences. ADS operation significantly cools the reactor internal surfaces and this ,in turn, results in the volatile radionuclides released from the fuel being trapped on these cooler surfaces. One such Authority analysis of the Peach Bottom plant showed about a factor of 10 reduction in the source term when the ADS was used. To the extent that ADS operation reduces the source term in various sequences, the risk reduction potential of other plant modifications, such as vents, is reduced. SECY-89-017 did not account for this additional ADS benefit and, therefore, overrated the benefit of hardened vents.

There is another overlap between ADS benefits and venting benefits. One of the potential benefits of hardened vents is a reduced likelihood of prompt containment failure upon reactor vessel failure, provided that venting is initiated early in the accident sequence. Since venting provides a low containment pressure, the sum of initial containment pressure and the containment pressure spike caused by a reactor vessel failure would be below the ultimate failure pressure of the containment. However, SECY-89-017 acknowledges that the ADS could accomplish the same thing. The containment pressure spike at the moment of reactor vessel failure is reduced because of the earlier energy transfer from the reactor to the suppression pool via the ADS. ADS operation is like "internal venting," i.e., it causes lower peak containment pressures but without the early release of noble gases.

Therefore, if a utility decides to maximize the use of the ADS in its severe accident management program, the benefits of hardened venting are decreased. However, the process outlined in Generic Letter 89-16, which separates the venting issue from other potential Mark I enhancements, complicates matters. This separation process leads to overestimates of the worth of venting.

Perhaps the most extreme example of overlapping between the hardened vent and other potential plant modifications is the impact of containment sprays. As SECY-89-017 points out, sprays would reduce the airborne concentration of fission products in the drywell, would retard or prevent core-concrete interactions and would reduce the likelihood of drywell shell failure. Sprays may also reduce containment pressure prior to reactor vessel failure, if initiated early enough. This would, like venting and ADS operation, reduce the probability of a prompt containment overpressure. As discussed later, sprays could also be used in TW sequences to add water from other sources to the suppression pool via the downcomers, thereby extending the time for recovery because of the additional heat capacity. Therefore, sprays accomplish many of the same risk reduction benefits of vents and some (e.g., reduced probability of drywell shell failure) that venting does not. SECY-89-017's person-rem analyses did not account for the spray system's ability to prevent and/or mitigate many severe accidents, especially if backed up by a diesel driven pump. By ignoring the potential benefits of the containment sprays, the risk reduction potential of vents is overrated.

III.A.6 Summary

The process of accelerating hardened venting in advance of other plant enhancements leads to overrating the risk reduction potential of venting. The process of designing vents prior to IPE/PRA completion can lead to inferior results. Finally, Generic Letter 89-16 cannot be properly implemented since accident frequencies would be unknown. Therefore, the NRC cannot provide a plant specific cost/benefit analysis of hardened vents without completion of a plant specific IPE/PRA.

III.B Alternatives to Hardened Vents

III.B.1 Overview

In this section alternatives to hardened vents are discussed. Based on the person-rem figures provided in SECY-89-017[3] TW sequences represent about 77 to 84% of the risk reduction potential for the various accident sequences that were examined. SECY-89-017 suggests the use of a hardened vent to minimize the frequency of TW sequences. However, there are a number of ways to reduce the risk potential of TW sequences, including the use of the hardened vent. If alternatives to a hardened vent are elected to reduce TW sequences' risk potential, the residual risks of the ATWS and station blackout sequences are too small to justify a hard pipe vent. Indeed, recent steps taken to reduce ATWS frequency and the station blackout rule probably result in even fewer person-rems for these accidents than were assumed in SECY-89-017.

The TW sequences, therefore, are central to justifying a hardened vent. If these sequences have a low base line frequency or if these sequences are minimized by alternative means, then hardened vents are not justified.

As long as electric power is available, as it is for the TW sequences, it is very likely that loss of containment integrity and core damage can be prevented, without reliance on a hardened vent.

The Authority's position is influenced by the fact that there are many ways to cool a BWR plant. This fact has already manifested itself by the low calculated core melt frequencies that these plants typically have. In TW sequences, electric power is available which greatly increases the number of operable systems relative to the more serious station blackout sequences. TW sequences evolve very slowly, giving the operator long periods of time to take corrective action. In fact, if TW sequence plant recovery cannot be accomplished in a BWR with all of its heat removal pathways, with electric power available, and with a very slowly evolving accident, then serious questions arise about the overall value of operators during severe accident conditions and the usefulness of the whole severe accident management program.

In the very unlikely event that a TW sequence does lead to a core melt, the releases of radioactive material to the environment could be minimized by containment sprays.

Because both a low probability of having a TW sequence core melt is expected, especially when alternatives to a hardened vent are used, and very small source terms should result if containment sprays are operated, FitzPatrick TW sequences are not expected to be risk significant.

3/ Page 10, SECY-89-017

III.B.2 First Steps

Well before hardened vents would be considered at FitzPatrick, several steps would be taken. The first step is to determine what the TW sequence frequencies are. This activity is now in motion as part of the FitzPatrick IPE/PRA. Assuming that the TW sequence frequencies are too high, a number of additional steps may be taken to minimize TW sequence initiation and/or to maximize recovery in a timely manner. Just such an approach is described in the draft EPRI report, "Severe Accident Prevention: Reducing BWR Condenser Isolations," EPRI RP 2420-22, May 1989 (Reference 12). This report is under review at the Authority to assess its usefulness to the FitzPatrick plant.

III.B.3 Alternative Means

If, after applying the suggestions in the above EPRI report, it was determined that the TW sequence frequencies were still too high, the use of alternative means to establish a pathway to an ultimate heat sink would be investigated. Several utilities are individually examining such alternatives and a number of member utilities of the BWROG have sponsored studies by the General Electric Company on such alternatives.

Under investigation at this time are:

(1) Opening of the main steam isolation valves,

(2) Removing heat through the main steam isolation valve drain lines,

(3) Removing heat through the reactor water cleanup system,

(4) Flooding the wetwell torus up to the drywell/wetwell vacuum breakers, and

(5) Combinations of the above.

Item (4) does not establish a pathway to an ultimate heat sink, but the additional heat capacity extends the time to recover from this accident prior to core damage. One way of increasing the suppression pool's heat capacity is to operate the drywell sprays. This would also reduce the source term, should there be a core melt, minimize core/concrete interactions, and reduce the likelihood of drywell shell failure.

Other alternatives to a hardened vent not yet under active review are:

(6) Heat removal through the drywell coolers

(7) Mass and heat removal through the torus drain line

(8) Mass and heat removal through drains from any system that takes suction from the suppression pool (e.g., the RHR system)

(9) Heat losses through the torus surface itself, possibly enhanced with fire hose sprays, and,

(10) Low pressure venting (venting without exceeding pressure boundaries).

As more utilities turn their attention to alternatives to hardened vents, other success paths may be identified.

Initial calculations of those heat removal paths under active review are very encouraging. Note that it is not necessary for a single alternative to be capable of eliminating the TW sequences. Since the containment pressure rise rate is very gradual in TW sequences, particularly if the pool's heat capacity has been increased, containment pressure equilibrium may be achieved by the sum of two or more alternatives.

III.B.4 FitzPatrick Specific Studies

The Authority has actively participated in the BWROG/GE effort on these alternative pathways. Furthermore, the Authority is examining the application of the GE report specifically to the FitzPatrick plant. Initial reviews of the FitzPatrick reactor water cleanup system and use of the FitzPatrick MSIV drain lines indicate that heat removal with a combination of these two systems is close to matching a decay heat rate of 1% of full power. The Authority is also in the early stages of examining the mass and heat removal capabilities of the torus drain lines, RHR drain lines and other systems that take suction from the suppression pool.

III.B.5 Summary

The FitzPatrick IPE/PRA may show that this plant already has a low overall TW sequence frequency. If not, there may be opportunities to lower the frequency of TW sequence initiation and further opportunities to recover from such sequences, once initiated. Should all this still prove to be inadequate, a variety of alternative decay heat removal means appear to be feasible for FitzPatrick, based on plant specific studies now underway.

In the very unlikely event that a TW sequence induced core melt does occur, the consequences of such an accident could be minimized by using the containment spray system. In the event that normal drywell sprays are inoperative, backup diesel driven sprays might be used.

In view of all this, it appears that the TW sequences for FitzPatrick will prove to be an unimportant risk contributor and the hardened vent unjustified. In any case, the decision should be made upon completion of the IPE/PRA process.

IV. REFERENCES

1. NRC Generic Letter 89-16 dated September 1, 1989, James G. Parlow to NYPA regarding the same subject.

2. NYPA letter, J. C. Brons to NRC, dated January 12, 1988 (JPN-88-001/IPN-88-001) regarding revisions to comments on NUREG-1150.

3. NYPA letter, J. C. Brons to NRC dated September 28, 1987 (JPN-87-051/IPN-87-045) regarding comments on draft NUREG-1150.

4. SECY-89-017, Mark I Containment Improvement Program, dated January 23, 1989.

5. NRC January 5, 1989 memorandum, Edward L Jordan to V. Stello, regarding minutes of CRGR Meeting No. 152.

6. Addendum I to NUREG/CR-5225, EGG-2548, " An Overview of BWR Mark-1 Containment Venting Risk Implications; An Evaluation of Potential Mark-1 Containment Improvements."

7. SECY 88-206, dated July 15, 1988

8. NUREG-1150, June 1989 issue, "Severe Accident Risks: An Assessment for Five U. S. Nuclear Power Plants."

9. NSAC 143, "Questionable Techniques Used in Cost-Benefit Analyses of Nuclear Safety Enhancements," September 1989.

10. BMI-2104

11. NUREG/CR-2239, "Technical Guidance for Siting Criteria Development"

12. EPRI Report EPRI RP 2420-22 "Severe Accident Prevention: Reducing BWR Condenser Isolations," May 1989.

V. TABLES AND FIGURES

Table 1.

Risk Comparisons of Station Blackout Scenarios With Various Venting Systems from NUREG/CR-5225

Qualitative Change in Risk Relative to a Nonventing Scenario

			Hard Pipe Vent System					
	Duct Vent System		With a Rupture Disk		Without a Rupture Disk		With Filter System	
Accident End State	Early	Late	Early	Late	Early	Late	Early	Late
Vessel failure with early liner melt-through	NC	NA	NC	NA	NC	NA	NC	NA
Vessel failure with early containment overpressure failure	<	NA	NC	NA	<	NA	<	NA
Recovery without vessel or containment failure	>	NA	NC	NA	>	NA	>	NA
Recovery with vessel failure and without containment failure	>	>	>	>	>	>	>	>
Vessel Failure and late drywell containment failure	<	<	<	<	<	<	<	<

Legend:

Early - Initiate venting before vessel failure and leave open. (The rupture disk will not open until vessel failure).

Late - Initiate venting after vessel failure.

< - Venting consequences are expected to be lesser than(<) the nonventing consequences.

> - Venting consequences are expected to be greater than (>) the nonventing consequences.

NC - No change in risk.

NA - Not available, venting would not be initiated at this time.

Table 2.

Risk Comparisons of ATWS and TW Scenarios With Various Venting Systems from NUREG/5225

Qualitative Change in Risk Relative to a Nonventing Scenario

Parameter	Duct Vent System	Hard Pipe Vent System: With a Rupture Disk	Hard Pipe Vent System: Without a Rupture Disk	Hard Pipe Vent System: With Filter System
Containment failure venting scenarios				
With alternate injection	<	<	<	<
Without alternate injection and with early liner melt-through	NC	NC	NC	NC
Without alternate injection and without early liner melt-through	<	<	<	<
No containment failure venting scenarios				
With alternate injection	NC	NC	NC	NC
Without alternate injection	>	>	>	>

Legend:

< - Venting consequences are expected to be lesser than (<) the nonventing consequences.

> - Venting consequences are expected to be greater than (>) the nonventing consequences.

NC - No change in risk.

Collective Radiation Exposure
BWR Average

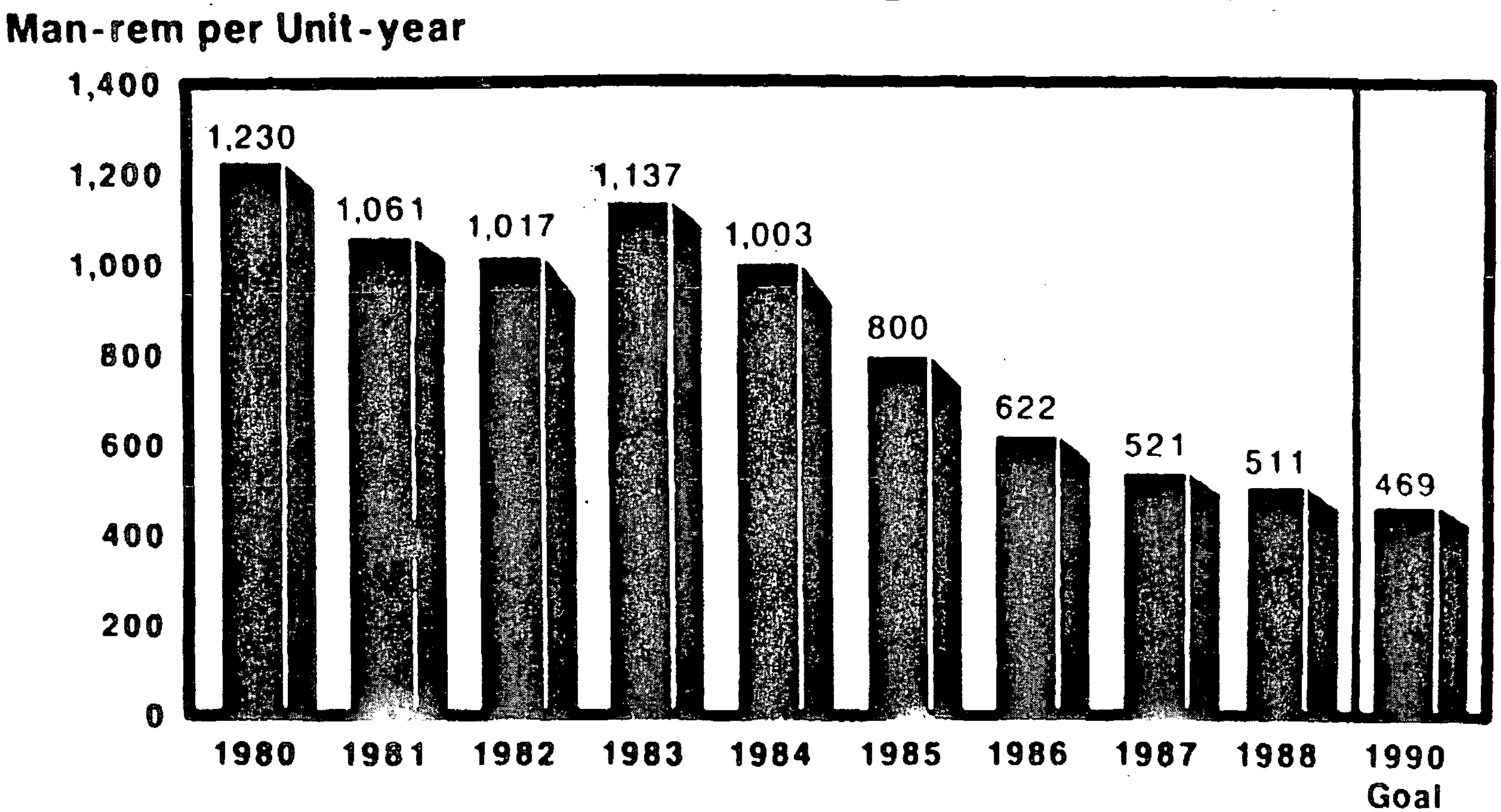

Figure 1.

New York Power Authority

Cost Estimate for the Installation of a Hardened Vent at the James A. FitzPatrick Nuclear Power Plant

Introduction

A preliminary estimate of the installation costs for a hardened vent described in Generic Letter 89-16 and SECY-89-017 has been prepared. Because of the short amount of time allotted to prepare the estimate, it is not comprehensive and therefore should not be considered final. Accordingly, the Authority reserves the right to revise this estimate.

Conceptual Design

This estimate was based on a conceptual design similar to the design outlined in the Generic Letter and implemented by the Boston Edison Company at Pilgrim. It assumes that existing structures, systems and components will be used to the maximum extent possible.

The existing containment Vent and Purge penetrations were assumed to be the connection to the containment atmosphere. Piping from the torus penetration to the SBGT (Stand-By Gas Treatment) filter train and from the filter train to the plant stack is already "hard" piping with a design pressure of 150 psig. The SBGT filter trains and transition pieces (located outside of secondary containment in the SBGT room) are "soft" ductwork with a design pressure of approximately 1 psig.

Essential features of the conceptual design include:

- New 12 inch, seismic class I, 150 psig, piping and supports necessary to bypass SBGT filter trains. (A 12 inch nominal pipe size was selected to match the larger of the two limiting pipe sections upstream of the SBGT filters.

- A new isolation valve and rupture disk to isolate the SBGT bypass from the SBGT.

- Modifications to existing valves (including containment isolation valves, and SBGT valves) to assure operability at severe accident pressures and temperatures.

- SBGT piping support modifications to assure operability at severe accident pressures and temperature.

- Additional controls and control logic modifications to operate new equipment. Controls were assumed to be located in the main control room.

- Addition of a new, higher range plant stack radiation monitor to detect the release.
- AC power to new electrical equipment.
- DC power to new and existing equipment for the AC independent option.

Costs included in this estimate include: engineering, design, material, and installation. The base estimate (non-AC-independent option) assumed the availability of AC power. Both estimates include a 25% contingency.

This estimate does not consider costs associated with radiation exposure, health physics support, anticontamination clothing, licensing costs for technical specification changes, writing or rewriting operating procedures or staff training. Additional costs and unforeseen problems can only increase the total cost. The estimate also does not include replacement power costs. If this modification is the on the critical path for an outage, an increase of $500,000.00 per additional outage day due to lost revenue/replacement power costs would be added.

Results

Base Estimate = $680,000.00

Incremental cost for
AC-independent design = $ 70,000.00