Task II.E.4: Containment Design (Rev. 2)

The objective of this task was to improve the reliability and capability of nuclear power plant containment structures to reduce the radiological consequences and risk to the public from design basis events and degraded-core and core-melt accidents.

ITEM II.E.4.1: DEDICATED PENETRATIONS

This item was clarified in NUREG-0737,[1] requirements were issued, and MPA F-18 was established by DL/NRR for implementation purposes.

ITEM II.E.4.2: ISOLATION DEPENDABILITY

This item was clarified in NUREG-0737,[2] requirements were issued, and MPA F-19 was established by DL/NRR for implementation purposes.

ITEM II.E.4.3: INTEGRITY CHECK

DESCRIPTION

Historical Background

In this TMI Action Plan[3] item, a requirement was proposed for the performance of a feasibility study to evaluate the need and possible methods for performing a periodic or continuous test to detect unknown gross openings in the containment structure. A prime example of the type of operational error this issue was directed at was the incident at Palisades where the reactor was operated for about 1.5 years while the containment isolation valves in a purge system bypass line were unknowingly locked in the open position.

Safety Significance

Should a LOCA resulting in major fuel damage occur in a plant that has an undetected breach in the containment building, severe offsite exposure would be expected.

Possible Solutions

Systems which can continuously monitor containment pressure, temperature, in-flow or outflow of fluids, and alarm upon abnormal conditions could be provided for in some containment designs such as inerted BWR MARK I and II containments, sub-atmospheric containments, and possibly some PWR dry containments which operate with a small positive differential containment pressure with respect to atmospheric pressure. Most PWR dry containments might require a system which can produce a small positive pressure in the containment periodically, perhaps quarterly, and perform a gross containment leak rate test to assure the plant is not operated for an extended time period with an undetected breach of containment integrity.

PRIORITY DETERMINATION

Frequency Estimate

Using known incidents in which breaches in containment integrity were revealed (mostly during the

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[1] NUREG-0737, "Clarification of TMI Action Plan Requirements," U.S. Nuclear Regulatory Commission, November 1980, (Supplement 1) January 1983.
[2] NUREG-0737, "Clarification of TMI Action Plan Requirements," U.S. Nuclear Regulatory Commission, November 1980, (Supplement 1) January 1983.
[3] NUREG-0660, "NRC Action Plan Developed as a Result of the TMI-2 Accident," U.S. Nuclear Regulatory Commission, May 1980, (Rev. 1) August 1980.

containment integrated leak rate testing required by 10 CFR 50, Appendix J), estimates of the duration of the breached condition, and the average number of plants in operation, an estimate of the expected frequency of an undetected breach in containment integrity was derived. The Palisades incident and three other incidents (in the five years prior to this evaluation) in which holes were detected in the containment liner were considered. The estimated frequency of an undetected breach in containment integrity was determined to be 1.1 x 10^{-2}/RY. The unavailability of containment due to a breach of containment integrity was also estimated to be about 10^{-2} year/RY, assuming in two instances the breach remained undetected for about 1.5 years, in another instance the breach was undetected for one year, and the remaining one was detected immediately.

From WASH-1400,[4] the dominant risk sequences which are affected by containment isolation (or integrity) failure are those which result in Category 4, 5, and 8 releases for PWRs and a Category 4 release for BWRs. These are all scenarios in which the containment failure mode is containment isolation failure. Since the WASH-1400[5] containment isolation failure frequency did not include contribution from undetected breach of containment integrity, the frequencies of the dominant scenarios from these categories were adjusted to include the additional probability of undetected breach of containment integrity. The base case risk was then calculated using the adjusted frequencies and the dose equivalent factors from Table D.1 of NUREG/CR-2800[6] for the affected scenarios for both PWRs and BWRs.

An estimate was then made of the potential effects of the above possible solutions in reducing the expected extent of containment unavailability as a result of undetected breach of containment integrity. Breaching of containment integrity is almost always found during containment integrated leakage rate tests which are performed about every 3.5 years. Continuous or quarterly testing will assure early detection of operational error resulting in breach of containment integrity. It was estimated that systems like those assumed could reduce the expected unavailability of containment due to breach of containment integrity events to 1.6 x 10^{-3}/demand. It was assumed that the frequency of unknown containment integrity violations was 1.1 x 10^{-2}/RY, as determined above, and that the average duration of such events (including detection and correction time) was 3 days for plants having continuous detection means and 1.5 months for plants utilizing periodic detection means. It was conservatively assumed that all breaches of containment integrity will be found by periodic testing. Using this new unavailability, the base case risk was adjusted to represent the expected risk at PWRs and BWRs following implementation of the solution.

Consequence Estimate

The difference between the base case risk and the adjusted risk represented the potential risk reduction which that be gained by the resolution of the issue. The potential risk reduction was found to be 10.1 man-rem/RY for PWRs and 6.1 man-rem/RY for BWRs. With an expected population of 95 PWRs and 48 BWRs and an expected average remaining life of 28 years/plant (Table C.1, NUREG/CR-2800),[7] the total expected public risk reduction from resolution of this issue was calculated to be 3.5 x 10^4 man-rem. The average public risk reduction was estimated to be 3.5 x 10^2 man-rem/plant. Resolution of this issue was not expected to affect the frequency of core-melt events.

Cost Estimate

Industry Cost: The population of 143 reactors was divided into two groups. One group represented those

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[4] WASH-1400 (NUREG-75/014), "Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," U.S. Atomic Energy Commission, October 1975.
[5] WASH-1400 (NUREG-75/014), "Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," U.S. Atomic Energy Commission, October 1975.
[6] NUREG/CR-2800, "Guidelines for Nuclear Power Plant Safety Issue Prioritization Information Development," U.S. Nuclear Regulatory Commission, February 1983, (Supplement 1) May 1983, (Supplement 2) December 1983, (Supplement 3) September 1985, (Supplement 4) July 1986, (Supplement 5) July 1996.
[7] NUREG/CR-2800, "Guidelines for Nuclear Power Plant Safety Issue Prioritization Information Development," U.S. Nuclear Regulatory Commission, February 1983, (Supplement 1) May 1983, (Supplement 2) December 1983, (Supplement 3) September 1985, (Supplement 4) July 1986, (Supplement 5) July 1996.

plants which, because of specific containment design features, may find it relatively easy to develop and install a continuous monitoring system. Plants with BWR MARK I and II inerted containments, subatmospheric containments, and PWR dry containments which normally operate with a small positive containment pressure would be expected to fall into this group. It was found that about 56 plants might fit into this group. It was expected that these plants might require a control room alarm, some containment pressure and/or temperature instruments to augment existing capacity, a flow measuring device, and a software routine which may be suitable for operation on the plant computer. This equipment was not expected to be safety grade as it would have no post-accident function. We estimated this equipment, installed, to cost about $80,000/plant. Operation, maintenance, and repair costs for the system were estimated at $20,000/RY. This resulted in a total cost for the 56 plants of $36M.

The remaining plants (87) were felt to be more suitable for a periodic test system which might pressurize the containment to a small positive pressure and check containment integrity by performing a low pressure leak rate test. These plants would be expected to require quite a bit more special pressure and temperature instrumentation than needed for a continuous monitoring type system. In addition, a high volume compressor would be needed. A program suitable for operation on the plant computer would also be required for data reduction and analysis. We estimate that such a system, installed, would cost about $250,000. Maintenance and operation of this system was estimated at $40,000/RY. This resulted in a total plant cost for these 87 plants of $121M. Thus, the total expected industry cost was $157M.

NRC Cost: Resolution of the issue and implementation of the solution were expected to require the following:

(a) Data collection, analysis, and definition of the expected frequency of breach of containment - 1 man-year

(b) Preliminary design of containment integrity test methods, systems, and equipment - 3 man-years

(c) Cost analysis - 0.5 man-year

(d) Development of NRC requirements, review and approval, issuance of order to licensees - 2.5 man-years

(e) Review of licensee implementation - 0.05 man-year/plant

(f) Surveillance of test results of all operating plants - 0.5 man-year/year.

At the rate of $100,000/man-year for all NRC and consultant manpower, the estimated cost was about $2.84M.

Total Cost: The total industry and NRC cost associated with the possible solution was $(157 + 2.84)M or $159.84M.

Value/Impact Assessment

Based on an estimated public risk reduction of 35,000 man-rem and a cost of $159.84M for a possible solution, the value/impact score was given by:

$$S = \frac{35{,}000 \text{ man-rem}}{\$159.84\text{M}}$$

$$= 220 \ \frac{\text{man-rem}}{\$\text{M}}$$

CONCLUSION

A value/impact score of 220 man-rem/$M was indicative of a medium priority ranking (see Appendix C). However, the evaluation of expected frequency for undetected breach of containment integrity performed for this effort indicated an unexpectedly high frequency (1.1×10^{-2}/RY). This exceeded the safety goal maximum probability for loss of a layer of "defense-in-depth" (i.e., the containment). For this reason, the issue was pursued on a high priority basis with the first order of business to be the establishment (as

accurately as possible) of the expected frequency of undetected breach of containment integrity and the expected unavailability of containment and their uncertainty bounds.

The staff concluded its review of the issue and the results were presented in NUREG-1273[8] which included a review of relevant LERs, the sensitivity of offsite dose to the containment leakage rate, and an assessment of potential methods for continuous monitoring of containment integrity.

All relevant LERs from April 1965 through May 1983 were reviewed to evaluate occurrences of suspected containment isolation failure; LERs are required to be submitted when the measured leakage exceeds the TS limits (0.6 of allowable containment leakage). This study indicated that reportable occurrences were divided about equally for BWRs and PWRs (~2/RY), and that only 16% of the reportable events were for components (mainly valves) located in systems that could provide a direct air path outside of containment (assuming failure of the second isolation valve). In addition, less than 5% of the events could be characterized as large or very large leaks (more than ten times allowable) within direct air pathways, and only a few could be considered as extended undetected breaches in the containment building. The probability of an undetected direct open air path in a BWR containment was estimated to be about 0.1 for small leaks to 0.001 for large leaks. For PWRs, the comparable probabilities were about 0.3 and 0.07.

A study of the potential risk as a function of containment leakage rate was provided in NUREG/CR-4330.[9] These analyses indicate that containment leakage provides only a small contribution (1 to 2 man-rem/RY) to the total exposure from postulated design basis accidents. Therefore, increasing the containment leakage up to a factor of 10 results in only a very small increase in total risk. Thus, containment leakage rate was not found to be an important contributor to the total risk on a probabilistic basis.

Item II.E.4.3 deals with containment leakage during postulated (i.e., design basis) accidents and does not address the issue of containment integrity and associated radiation consequences during severe accidents. This last issue is being addressed as part of implementation of the Commission's policy on severe accidents and, more specifically, in the Individual Plant Examination (IPE) and Containment Performance Improvement (CPI) programs. Thus, this issue was RESOLVED with no new requirements.[10]

ITEM II.E.4.4: PURGING

The primary purpose of this item is to reevaluate the acceptability of purging/ venting nuclear power plant containments during the reactor operating modes of startup, power operation, hot standby, and hot shutdown. The five parts of this item are listed below.

ITEM II.E.4.4(1): ISSUE LETTER TO LICENSEES REQUESTING LIMITED PURGING

DESCRIPTION

A number of events occurred over a span of several years during and prior to 1978 that were directly related to containment purging during normal plant operation. Some of these events raised questions relating to automatic isolation of the purge penetrations which are used during power operation. Instances occurred at Millstone-2 where intermittent containment purge operations were conducted with the safety actuation isolation signals to both in-board and out-board containment isolation valves in the purge system inlet and outlet lines manually overridden and inoperable. Other instances occurred at Salem-1 where venting of the containment through the containment ventilation system valves to reduce pressure was conducted. In certain instances, this venting occurred with the containment high particulate radiation monitor isolation signal to the purge and pressure vacuum relief valves overridden.

These events raised concerns relative to potential failures affecting the purge penetration valves which

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[8] NUREG-1273, "Technical Findings and Regulatory Analysis for Generic Safety Issue II.E.4.3, `Containment Integrity Check,'" U.S. Nuclear Regulatory Commission, April 1988.
[9] NUREG/CR-4330, "Review of Light Water Reactor Regulatory Requirements," U.S. Nuclear Regulatory Commission, (Vol. 1) April 1986, (Vol. 2) June 1986.
[10] Memorandum for V. Stello from E. Beckjord, "Resolution of Generic Safety Issue II.E.4.3, `Containment Integrity Check,'" March 22, 1988. [8809150125]

could lead to a degradation in containment integrity and, for PWRs, a degradation in ECCS performance because of insufficient containment back pressure. In order to reduce the probability of these potential accident scenarios, the NRC was to issue letters to licensees of operating plants requesting limited purging of containment and justification for additional purging.

CONCLUSION

NRR issued a letter[11] to all licensees of operating plants on November 28, 1978 (Docket No. 50-348) requiring compliance with specific requests enclosed with that letter. This issue was RESOLVED with the issuance of the letter to the licensees.

ITEM II.E.4.4(2): ISSUE LETTER TO LICENSEES REQUESTING INFORMATION ON ISOLATION VALVE

DESCRIPTION

By letter dated November 28, 1978,[12] [see Item II.E.4.4(1)] the NRC requested all licensees of operating reactors to respond to generic concerns about containment purging or venting during normal plant operation. The generic concerns were two-fold:

(1) Events occurred where licensees overrode or bypassed the safety actuation isolation signals to the containment isolation valves. These events were determined to be abnormal occurrences and reported to Congress in January 1979.

(2) Licensing reviews required tests or analyses to show that containment purge or vent valves would shut without degrading containment integrity during the dynamic loads of a design basis LOCA.

The staff visited several plants, met with some licensees, and held telephone conferences with many other licensees and valve manufacturers. As a result of these meetings and conferences and in light of the new information gained, the NRC determined that an interim commitment from all licensees of operating plants was warranted.

CONCLUSION

NRR issued a letter[13] with an interim position to all licensees of operating reactors requesting compliance with the specific items of the position. Thus, the issue was RESOLVED and requirements were issued.

ITEM II.E.4.4(3): ISSUE LETTER TO LICENSEES ON VALVE OPERABILITY

DESCRIPTION

By letter dated November 28, 1978,[14] NRC requested all licensees of operating reactors to respond to generic concerns about containment purging and venting during normal plant operation. As a result of the review of licensee responses to this letter, NRC learned that at least three valve vendors reported that their valves may not close against ascending differential pressure and the resulting dynamic loading of the design basis LOCA. For plants utilizing valves from these manufacturers, it was determined that the containment integrity could be sufficiently assured by maintaining the valves in the closed position or by restricting the angular opening of the valves whenever primary containment integrity is required. NRC is to issue guidelines to all affected licensees in order to ensure operability of purge and vent valves.

CONCLUSION

NRR issued a letter[15] to all licensees of operating plants requesting compliance with the specific

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[11] Letter to Alabama Power Company from U.S. Nuclear Regulatory Commission, "Containment Purging During Normal Plant Operation," November 28, 1978. [7812140364]
[12] Letter to Alabama Power Company from U.S. Nuclear Regulatory Commission, "Containment Purging During Normal Plant Operation," November 28, 1978. [7812140364]
[13] Letter to Nebraska Public Power District from U.S. Nuclear Regulatory Commission, "Containment Purging and Venting during Normal Operation," October 22, 1979. [7911190034]
[14] Letter to Alabama Power Company from U.S. Nuclear Regulatory Commission, "Containment Purging During Normal Plant Operation," November 28, 1978. [7812140364]
[15] Letter to All Light Water Reactors from U.S. Nuclear Regulatory Commission, "Containment Purging

guidelines enclosed with that letter. All licensees that utilized valves identified by the three manufacturers as having potential closure problems were required to either maintain the valves closed or install devices to limit the opening angle at all times when containment integrity is required, until such time that full opening was justified to the NRC. This issue was RESOLVED with the issuance of the letter to the licensees.

ITEM II.E.4.4(4): EVALUATE PURGING AND VENTING DURING NORMAL OPERATION

Items II.E.4.4(4) and II.E.4.4(5) were combined and evaluated together.

DESCRIPTION

Historical Background

This TMI Action Plan[16] item required NRR to generically evaluate the radiological consequences of containment purging of nuclear power plants while in the power operation mode. Item II.E.4.4(5) established a requirement for NRR to utilize the results of the radiological evolution from Item II.E.4.4(4) and other efforts already completed to reevaluate current NRC requirements established in SRP[17] Section 6.2.4 and the associated BTP CSB/6-4. Item II.E.4.4(5) anticipated a need to require modification of the current requirements on the use of purge systems of nuclear power plants. Therefore, Items II.E.4.4(4) and II.E.4.4(5) were combined and evaluated together.

Safety Significance

Should a LOCA occur during a period in which the containment building is being purged while the plant is operating at power, radiation releases will occur. If the purge system containment isolation valves meet the closure requirements of BTP/CSB 6-4, the containment purge system should be closed prior to any LOCA- induced fuel damage and releases to the public would be small. However, if the LOCA resulted in major fuel damage and the containment purge system is not isolated (due to isolation valve or signal failures), releases and, therefore, public exposure would be large.

Possible Solution

A possible solution to further reduce the probability of failure to isolate the purge system was to limit the use of the purge system when RCS temperatures are greater than 2000F. The imposition of limits on the use of purge systems which have containment isolation valves meeting the staff's operability requirements for active valves (BTP/CSB 6-4) has been considered from time to time but as yet has not been implemented. A few of the older operating plants require either very frequent or even continuous purging to control containment temperature and/or pressure. If containment purge system use were limited to some small fraction of the time (1% to 10%) that the plant is in operating modes 1-4, these plants would either have to shut down to purge or modify the plant to add larger containment cooling or pressure control systems. In addition, a few plants which require frequent entry by operators to perform safety-related surveillance and maintenance would find it necessary to add containment air filtration systems to reduce operator exposures in order that plant shutdowns not be incurred to purge the containment prior to an entry, if use of the purge system is drastically limited.

PRIORITY DETERMINATION

Assumptions

It was assumed that the solution would entail some limit on the use of purge systems. Using existing knowledge of operating practices at the time of this evaluation, it was estimated that, of the 72 operating plants, 25 inerted BWRs and 8 PWRs with sub-atmospheric containments did not purge during plant

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and Venting During Normal Operation—Guidelines for Valve Operability," September 27, 1979. [9705190209]

[16] NUREG-0660, "NRC Action Plan Developed as a Result of the TMI-2 Accident," U.S. Nuclear Regulatory Commission, May 1980, (Rev. 1) August 1980.

[17] NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, (1st Ed.) November 1975, (2nd Ed.) March 1980, (3rd Ed.) July 1981.

operation. There were about 20 to 22 newer PWRs with dry containments that purged very little (~1% to 5% or less). This leaves 17 PWRs which we assumed purge continuously. Of these 17 plants, we assumed that 7 (about 10% of all operating plants) need to purge continuously for containment temperature or pressure control (violation of current requirements). We assumed that the remaining 10 plants purge continuously because they have no containment air filtration systems and thus purge frequently or continuously for the purpose of maintaining operating personnel exposure as low as possible. If low percentage use limits are placed on containment purge systems, it was assumed that the group of 7 plants would be required to purchase and install containment pressure and temperature control systems and suffer replacement power costs during plant shutdowns to purge until these systems are installed. The group of 10 plants was assumed to have to purchase and install filtration systems for containment air, but were not assumed to encounter plant shutdown and replacement power costs prior to installation. It was instead assumed that higher in-plant personnel exposures were incurred until the modifications were completed.

Frequency Estimate

Use of the containment purge system during plant power operation will result in two distinct scenarios by which significant radiation release to the environment would be expected. The two scenarios are: (1) LOCA with core- melt and the containment purge system fails to isolate; and (2) successfully mitigated LOCA but the containment purge system fails to isolate. In early 1981, SPEB/DST/NRR evaluated[18] three different positions regarding the use of containment purge systems during plant operation. This report developed best estimates of the frequency of accident scenarios which might result while the containment purge system is in use. This study showed the expected frequency of the two scenarios above to be 4 x 10^{-9}/RY (Scenario 1) and 7 x 10^{-8}/RY (Scenario 2). These frequencies were for an assumed purge usage of 20% of plant operating time. In this analysis, the above values were adjusted to determine the expected frequency of the scenarios as a function of purge limit (from 0% to 100%).

Consequence Estimate

WASH-1400[19] PWR Release Category 4 represents the offsite consequences of core melt events in which the containment is not isolated. In this scenario, a 4-inch penetration was assumed to be open resulting in atmospheric releases. Most PWR purge system penetrations are large (24" to 60" in diameter). We assumed a 40" diameter purge line. We ratioed the releases by the square of the ratio of the diameter of the purge line to the diameter of the unisolated line in the WASH-140016 PWR-4 event. In this case, the ratioed consequence would have exceeded the consequence of the PWR-1 event (early overpressure failure of containment with energetic release of the greatest fission product inventory). We, therefore, limited the release for core-melt scenarios in which the containment is not isolated to that for the PWR-1 event. This resulted in a calculated dose of 5.4 x 10^6 man-rem/event (Table D.1, NUREG/CR-2800),[20] assuming a core-melt LOCA in which the purge system fails to isolate (Scenario 1), midwest-type meteorology, and a uniform population density of 340 people/ square-mile.

The same ratioing technique of the dose resulting from a PWR-8 release was used to determine an expected dose for the mitigated LOCA in which the containment is not isolated (Scenario 2). For this event, the offsite dose was found to be 2.3 x 10^5 man-rem/event.

The expected frequencies of the two scenarios were multiplied by the dose consequence of the appropriate scenario and summed. This resulted in an averted public risk, assuming the base case in which there is no limit on purge system use (100% limit), of 0.106 man-rem/RY for the case in which there is no use of the purge system allowed (0% limit). When applied to the 17 plants for their average expected remaining life (25 yrs), this results in a maximum total averted public risk of 46 man-rem for a

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[18] Memorandum for L. Rubenstein from M. Ernst, "Proposed Position Regarding Containment Purge/ Vent Systems," April 17, 1981. [8105260251]

[19] WASH-1400 (NUREG-75/014), "Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," U.S. Atomic Energy Commission, October 1975.

[20] NUREG/CR-2800, "Guidelines for Nuclear Power Plant Safety Issue Prioritization Information Development," U.S. Nuclear Regulatory Commission, February 1983, (Supplement 1) May 1983, (Supplement 2) December 1983, (Supplement 3) September 1985, (Supplement 4) July 1986, (Supplement 5) July 1996.

0% limit on the use of purge systems during plant power operation. Averted total public risk varies linearly from nothing, when 100% use of purge systems is allowed, to the maximum (46 man-rem), when no purging is allowed. The maximum potential total risk reduction afforded by a complete ban on the use of purge systems while the plant is in PWR operating modes 1 through 4 (about 46 man-rem) represents less than 0.02% of the total plant risk as determined by WASH-1400.[21] The average public risk averted per plant if a 0% purge limit is imposed is 0.32 man-rem/reactor.

Cost Estimate

Industry Cost: Costs were limited to the 17 plants that were expected to purge frequently or continuously and were estimated to cover both the cost of containment pressure and temperature control systems or filtration systems, as appropriate. The cost of replacement power at $300,000/day was also estimated for the 7 plants which were assumed to require pressure and temperature control system additions. In the analysis, we assumed that the affected plants could purge for 1 day and then operate for 3 days before containment purging would be required again. We estimated the cost of a pressure/temperature control system addition to be $2.5M and a filtration system addition to be $1M. Industry costs were calculated as a function of containment purge limit. Due to the above assumption on the amount of purge versus non-purge operation attainable, there are no industry costs between 25% and 100% of the purge limit. Different ratios of purge to non-purge time would alter the purge limit at which negligible industry cost would be reached.

NRC Cost: We estimated a total of 19.5 man-years of staff and consultant effort to do the following: study purge system use, operational data, and designs; prepare preliminary design of potential plant modifications; perform cost analysis; develop, review, and approve new requirements and issue orders; review licensee responses to orders, including plant modifications when proposed; and perform yearly surveillance of plant purge system usage. At $100,000/man-year, these efforts were estimated to be about $2M.

Value/Impact Assessment

The value/impact score as a function of containment purge limit increases slightly to about 0.4 man-rem/$M in the purge limit range of zero to 25%. At 25%, a maximum value/impact score of 17 man-rem/$M was found. The value/impact score decreases as the purge limit is increased from 25% to 100%.

Other Considerations

The value/impact score as a function of purge limit varied from low category to the drop category. The value/ impact score calculated is a direct function of the probability of the failure of the containment purge system isolation valve (large butterfly valve) to close. The best estimate value for failure to close (which was used in the prior SPEB study) was conservatively chosen to be 3×10^{-3} /demand. WASH-1400[22] found the mean failure rate of all qualified safety system valves (including butterfly valves) to be 3×10^{-4}/demand. If the failure rate of containment purge system isolation valves were found to be much greater than the value assumed in these studies (i.e., on the order of 10^{-1}/demand), the public risk associated with containment purging during power operations would be greatly increased. The public risk due to containment purging during plant operations, instead of being less than 1% of total plant risk, could be large enough to become a dominant risk factor. In that case, action to reduce the public risk from purging of plants during power operation would probably be warranted. The resolution of the issue might take the form of increased reliability requirements for active purge system isolation valves, strict limits on the use of purge system during normal plant operation, or a combination of both approaches. This analysis indicates that, if the isolation valve failure rate is high at all plants, the more attractive means to reduce risk would be to improve the valve reliability.

CONCLUSION

The value/impact score indicated a low priority ranking for Items II.E.4.4(4) and II.E.4.4(5) (see Appendix

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[21] WASH-1400 (NUREG-75/014), "Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," U.S. Atomic Energy Commission, October 1975.
[22] WASH-1400 (NUREG-75/014), "Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," U.S. Atomic Energy Commission, October 1975.

C). The key to a better risk/benefit insight to the value of further changes in criteria for the use of containment purge systems centered around the failure rate of the large butterfly valves utilized as containment isolation valves.

At the time prioritization of Items II.E.4.4(4) and II.E.4.4(5) was initiated, work was not yet completed on these items. Since that time, AEB/DSI/NRR[23] and CSB/DSI/NRR[24] reported that the efforts called for by these items were completed and the EDO was informed.[25] Thus, these issues were RESOLVED.[26]

ITEM II.E.4.4(5): ISSUE MODIFIED PURGING AND VENTING REQUIREMENT

This item was evaluated in Item II.E.4.4(4) above and was determined to have a low priority ranking. However, all required action was completed as described in Item II.E.4.4(4) above. Thus, this issue was RESOLVED.[27]

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[23] Memorandum for T. Speis from R. Houston, "Containment Venting and Purging—Completion of TMI Action Plan Item II.E.4.4(4)," March 3, 1982. [8401170023, 8203240149]
[24] Memorandum for R. Mattson from T. Speis, "Containment Purge and Venting—Completion of TMI Action Plan Item II.E.4.4(5)," April 9, 1982. [8204260021]
[25] Memorandum for W. Dircks from R. Mattson, "Status Report on Containment Purge Evaluations," May 13, 1982. [8401170021]
[26] Memorandum for W. Minners from R. Mattson, "Schedules for Resolving and Completing Generic Issues," January 21, 1983. [8301260532]
[27] Memorandum for W. Dircks from R. Mattson, "Status Report on Containment Purge Evaluations," May 13, 1982. [8401170021]