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FVY 87-68


REPLY TO
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June 25, 1987

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attn: Office of Nuclear Reactor Regulation
Mr. Steven A. Varga, Director
Division of Reactor Projects I/II

References:
a) License No. DPR-28 (Docket No. 50-271)
b) Letter, VYNPC to USNRC, FVY 86-81, dated 9/9/86
c) Letter, USNRC to VYNPC, NVY 86-218, dated 10/24/86
d) Letter, VYNPC to USNRC, FVY 86-117, dated 12/19/86
e) Letter, VYNPC to USNRC, FVY 86-122, dated 12/19/86
f) Letter, VYNPC to USNRC, FVY 87-18, dated 2/5/87
g) Report, "Mark I Containment Severe Accident Analysis," prepared for the BWR Owner's Group by CB&I, dated 4/87
h) Letter, USNRC to VYNPC, NVY 87-70, dated 5/1/87

Dear Sir:

Subject: Vermont Yankee Containment Safety Initiatives - Status Update and Design Description

The purpose of this letter is to provide you with a status report and summary of design engineering information developed to date regarding Vermont Yankee's Containment Safety Initiatives, as requested in your letter of May 1, 1987 [Reference h)]. In our letter of February 5, 1987 [Reference f)], we outlined two major areas of pursuit related to potential containment safety improvements for which Vermont Yankee was applying the resources necessary to obtain sufficient design information to allow decisions to be made with respect to modifications. This effort has culminated in a better understanding of the impacts and potential benefits of the most frequently discussed systems for dealing with the potential consequences of a range of severe accidents; enhanced containment spray capability and enhanced containment wetwell venting capability.

In conjunction with these efforts, we have been carefully monitoring recent NRC and industry studies of severe accident events and possible modifications to mitigate the consequences. Although the results are still preliminary and undergoing industry review, no potential modification that has an obvious risk reduction has been identified. We will, however, continue to evaluate these efforts and pursue any appropriate modifications that offer a significant improvement to containment safety.

The following is a description of our current understanding of the containment spray and containment vent issues, a summary of our plant-specific evaluation of each, and our current plans.



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Containment Spray

Vermont Yankee's original design incorporates a Containment Spray System utilizing two spray ring headers in the drywell supplied by the RHR System in the containment spray mode. This system is operable with both the off-site power grid available or with no off-site power via the on-site emergency power systems. This concept is typical of BWR designs. Atypical for Vermont Yankee, however, is the installed capability to supply one containment spray header from the Diesel Fire System as a backup in the remote case when no off-site or on-site power is available (Station Blackout). This condition, no ac power available, is often used to characterize a range of scenarios which, if other failures are assumed, could be postulated to result in damage to the reactor core. If the total loss of power is sustained for a long period, i.e., greater than six hours, the Alternate Containment Spray System could become an important system for cooling the core as well as protecting the integrity of the containment itself.

Vermont Yankee has identified three basic objectives for the Alternate Containment Spray System, which could be applied to mitigating the effects of beyond design bases events or severe accidents.

o Containment Temperature and Pressure Control

For severe accident sequences where all decay heat removal capability is lost, the torus will eventually boil and containment pressurization results. Sprays that effectively condense the steam in the drywell will reduce pressure and temperature to preserve containment integrity. This is a major benefit in station blackout scenarios and even scenarios where reactor level control is being maintained.

Since only the heat transfer necessary to quench the drywell steam is necessary, a very low flow rate would be required. Existing spray pattern should be sufficient to provide adequate heat transfer surface area.

o Core Debris Cooling

Once core cooling has been lost, and the scenario is presumed to continue to core melt and vessel breach, the core debris will collect on the drywell floor (under the pedestal area).

Containment spray could be utilized to cool the core debris on the drywell floor, thus providing decay heat removal from the debris and ensuring solidification of the material.

o Fission Product Scrubbing

If all severe accident management strategy fails to maintain drywell integrity, yet containment sprays are available, they would be able to provide some fission product scrubbing prior to leakage from drywell.

In order that the Alternate Containment Spray System is used most effectively and is available for scenarios when it may be desirable, changes have already been implemented to the emergency operating procedures at Vermont Yankee which provide the alignment of systems for this mode of containment spray. Operator training in these augmented procedures has been completed to ensure that Operations personnel are fully cognizant of the situations and scenarios for which this system would provide benefits as well as aware of the installed flexibility of the Containment Spray and Alternate Containment Spray Systems.

Based on the recent reviews of the Alternate Containment Spray System, it is apparent that, by providing an additional emergency supply of backup power, this system could be aligned at any time from outside of the Reactor Building and, hence, away from any potentially significant radiation hazards. The current industry studies indicate that this one modification will provide a significant reduction in containment failure probability, assuming a core melt accident. Accordingly, Vermont Yankee has completed work on a conceptual design which provides this other level of backup emergency power from an additional installed on-site diesel generator set which is completely independent of the plant. This design would provide remote operability from the Control Room in the unlikely event of a station blackout for the following system valves:

- MOV-10-26A, RHR Outboard Containment Spray Valve
- MOV-10-31A, RHR Inboard Containment Spray Valve
- MOV-10-38A, RHR Suppression Chamber Spray Valve
- MOV-10-39A, RHR Suppression Chamber Spray Valve
- MOV-10-183, Outboard RHR to Service Water Intertie Isolation Valve
- MOV-10-184, Inboard RHR to Service Water Intertie Isolation Valve

As can be seen, the ability to operate these valves from an additional power source would greatly enhance the capability of the drywell (containment) spray and the torus (suppression chamber) spray to function in the unlikely event they were required.

In addition to the spray capability, this design would also allow MOV-10-25A and MOV-10-27A, LPCI injection valves, to be powered from the additional power source. This would ensure the capability to use the diesel fire pump for vessel injection and direct core cooling, potentially eliminating any core damage during a sustained long-term station blackout.

Another important benefit which can be realized from this design change is the added flexibility to potentially power other components if required. For example, the capability is provided to supply an additional ac power source to the spare battery charger, thus creating the capability to charge any of the station batteries in a station blackout scenario. This provides an extended capability to run important equipment such as the RCIC and HPCI systems for long-term core cooling and inventory control if normal or emergency ac sources cannot be restored.

The operating procedures associated with the above operations have also been evaluated and have been judged to be well within the capabilities of the on-shift Operations personnel if the alignments described were required to be made.

These design changes, as well as the operating procedures required to provide the guidance necessary to accomplish the functions described, have also been evaluated for potential risk reduction and possible reduction in the overall containment failure probability reported in the Vermont Yankee Containment Safety Study provided by Reference b). The addition of the remote operability of the containment spray and vessel injection capability above has been conservatively estimated to cut in half the already small probability of containment failure under the circumstances where a core melt has occurred. As previously described, these modifications would also reduce the overall probability of several accident sequences which could lead to core damage or melting.

Based on these benefits and with the previous concurrence by R. Bernero, NRC, Vermont Yankee has committed to proceed with the design modifications necessary to accomplish these changes. Development of the design packages, equipment procurement, and operating procedure changes will proceed on a schedule which will allow installation and additional training to occur during the refueling outage, presently scheduled to start on February 4, 1989.

Containment Vent

The present design of the Vermont Yankee plant incorporates various systems for pressure control of the atmosphere in the primary containment. These systems include a variety of systems which could be used to reduce the pressure in the containment to maintain design conditions. Over the past year, concerns have been raised about the integrity of the containment structure for a range of severe accidents which can be be postulated to go beyond the design bases for the plant. The idea has been proposed by the NRC and others that pressure control by venting may be one way to reduce the probabilty of a containment failure following a severe accident. To objectively evaluate severe accident venting, Vermont Yankee has divided the issue into four parts:

1. Traditional Definition of Containment;
2. Design of the Vermont Yankee Containment Structure;
3. Typical Severe Accident Vent Design; and
4. Consequences of Severe Accident Venting.

10CFR50, Appendix A, Criterion 16 - Containment design states in part: "Reactor containment...shall be provided to establish an essentially leaktight barrier against the uncontrolled release of radioactivity to the environment...." It is this definition that has guided reactor designers and engineers and has produced the philosophy in the U.S. that the containment is the ulimate barrier against the release of fission products to the environment following an accident which damages the reactor core. This philosophy has produced containments that are designed and maintained "essentially leaktight," which isolate mechanically to the fullest extent possible in the event of an accident, which are of sufficient strength to contain all of the fission products, gases, and steam produced by a wide range of analyzed accidents and provide the necessary radiation shielding to minimize or eliminate the radiological consequences to on-site and off-site populations.

Consistent with this philosophy, the Vermont Yankee containment was designed to withstand an accident pressure of 56 psig which was greater than all past and presently analyzed accidents. With the recent concerns focusing in part on the ultimate strength of the primary containment, analysis has been performed [Reference g)] by Chicago Bridge & Iron Company, under the direction of the BWR Owner's Group, to predict the additional margin which exists to contain an accident environment over and above the design pressure. This report concludes, for the reference plant, that "based upon these results, it is estimated that a breach of containment is not likely until the internal pressure reaches or exceeds 159 psig, and the failure is expected to occur in the upper portion of the torus shell." Similarly, a simpler analysis performed for the Vermont Yankee Containment Safety Study [Reference b)] concluded that, based on geometry and structural capabilities of the containment shell, a reasonable aproximation of failure pressure would be 135 psig with failure predicted to occur in the torus air space (upper portion of the torus shell).

The capability to withstand pressures of this magnitude clearly precludes failure of the containment for a wide range of accidents even beyond the design bases. The question remains, however, that for postulated, perhaps non-mechanistic, accident pressures above the ultimate failure pressure: Is venting the containment a prudent option?

To assist in answering this question, Vermont Yankee has completed the conceptual design of a containment vent which would provide a reliable and controllable vent path from the containment wetwell. The vent studied would consist of a six-inch steel line originating at an unused penetration in the torus air space. A six-inch air-operated gate valve, manually operated from outside of the Reactor Building, would be used to provide control of the vent and tight resealing upon closure if the vent were used. To minimize any adverse impact on existing plant design up to existing design pressure, i.e., new failure modes, a rupture disc set above design pressure would be installed downstream of the new valve. This would ensure that the vent would not change the consequences of/or create any new accidents within the existing design bases of the plant. Several termination points for the vent have been evaluated for mechanical considerations including routes to the vent stack and up the side of the Reactor Building.

The actual equipment design issues associated with the containment vent have been evaluated and judged to be solvable. It is the consequences of the use of such a vent which remain and present the largest uncertainties to Vermont Yankee's ultimate decision to proceed with any modifications. As discussed, we consider this type of vent to be a significant departure from conventional containment design philosophy and, as such, must be approached with care to be sure that the consequences are fully evaluated. The analytical techniques and assumptions which could provide this certainty are currently being developed and debated at and by the National Labs, the NRC and the utility industry. Therefore, proceeding with equipment modifications before Vermont Yankee has concluded that an overall improvement in safety will result is not a prudent course of action.

Vermont Yankee will continue to support and follow the various efforts in progress aimed at resolving the containment venting issues. We feel that, at this time, establishing a schedule for installing the type of vent described above is premature. We are, however, establishing a target date of January 1988 for a thorough re-review of containment vent design and implementation issues. We will notify you of the results of our review by March 1, 1988. This will allow the evaluation of significant work now in progress to be assessed for applicability to Vermont Yankee.

We trust that this information is of assistance regarding your ongoing reviews of these issues and in accordance with your letter of May 1, 1987 [Reference h)], which requested our updated plans and design details for our containment safety initiative. Should you have any questions or require additional information concerning these matters, please contact us.

Very truly yours,

VERMONT YANKEE NUCLEAR POWER CORPORATION

Warren P. Murphy

Warren P. Murphy
Vice President and
Manager of Operations