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Attention: Richard W. Borchardt, Director
Standardization Project Directorate

Subject: Response to the Reference 1 Letter

References:

1. Letter, M. Malloy (NRC) to P. W. Marriott (GE), *REQUESTS FOR ADDITIONAL INFORMATION REGARDING THE TEST PROGRAM FOR THE GE NUCLEAR ENERGY (GE) SIMPLIFIED BOILING WATER REACTOR (SBWR) (Q900.82-Q900.95)*, dated September 16, 1994.
2. Letter, T. R. McIntyre (GE) to R. W. Borchardt (NRC), Same Subject, dated September 26, 1994.

The enclosure to this letter contains responses to Requests for Additional Information (RAIs) 900.82, 900.84 - 900.86, 900.88 - 900.90, and 900.92, which were enclosures to the Reference 1 letter. The responses to the remaining RAIs from the Reference 1 letter were transmitted earlier by Reference 2.

Sincerely,

R. Asamoto, Acting Manager
Advanced Plant Technologies

Enclosures: Responses to RAIs 900.82, 900.84 - 900.86, 900.88 - 900.90 and 900.92.

cc: P. A. Boehnert (ACRS)
R. W. Hasselberg (NRC)
M. Malloy (NRC)

RAI Number: 900.82

Question:

Provide a description and discussion of interactions expected to occur between the suppression pool and the Passive Containment Cooling System (PCCS) during PCCS purging. This includes both short-term and long-term interactions, possible instabilities in the main vent lines, and effects of suppression pool stratification.

GE Response:

The GE response to RAI 900.78 discusses the overall system behavior of the SBWR Passive Containment Cooling System (PCCS), including how flows between the drywell and wetwell are divided between the main vent system, and PCCS. This response will address the specific effects involved in PCC venting, main vent interactions and suppression pool stratification.

Short-term, the drywell is purged of noncondensible gases during the blowdown period of the transient. Drywell gases, initially high in non-condensibles and then increasing in steam content as non-condensibles are purged, are vented through both the main LOCA vents and PCCS, as described in RAI 900.78. The flow through the PCCS during the early part of the blowdown is nearly all noncondensible gases, which are released through a vent-exit sparger located about a meter below the pool surface. During the initial blowdown, the noncondensible gases expelled at the PCC vent are expected to form a large bubble, similar to a SRV discharge bubble, mixing the pool above the vent exit. After the initial purge of noncondensible gases, the steam which follows will be mostly condensed by the PCCS. Any carry-through of steam will be condensed in the pool at the sparger.

Later, any noncondensible gas that enters the PCCS is forced through the PCCS vent line and into the wetwell by the pressure difference between the drywell and wetwell. This gas will be cooled to the saturation temperature in the PCCS tubes, so it may be cooler than the suppression pool. The flow of noncondensibles through the PCCS vent is calculated to be quite low and intermittent, following an event which releases noncondensibles into the drywell. The gas is expected to be released by the vent-exit sparger and bubble to the surface, mixing the pool around the vent exit. No adverse interactions are expected, and the gas release below the surface should promote mixing of the surface layer of the pool.

With respect to interactions between the main LOCA vents and the PCCS vents, this is predicted to occur only during the blowdown period. The PCCS carries a small fraction of the blowdown flow, less than ten percent. There is a large difference in the flow impedance between the two flow paths, so instabilities between the two paths would not be expected. Flow continues through both paths as long as the drywell-to-wetwell pressure difference is large enough to

overcome the elevation head in the main vents. For most breaks this continues until the GDCS flow temporarily stops the steam production and lowers the drywell pressure. The lower drywell pressure closes both the main vents and the PCCS vents. After the decay heat overcomes the GDCS subcooling and steam production resumes, the drywell pressurization is only sufficient to establish flow through the PCCS heat exchanger and the PCCS assumes the decay heat load. The main vents do not reopen. By this time, the noncondensibles have been nearly all purged, and unless there is vacuum breaker cycling during the GDCS period, the PCCS vent has only the drywell residual noncondensibles left to purge. Under SSAR assumptions, at one hour into the LOCA scenario, drywell nitrogen content will be in the neighborhood of 5%. This residual gas will be slowly purged following PCC restart.

Suppression pool stratification is established early in the transient. It is important because the pool surface layer effects both the drywell and wetwell pressures, as described in RAI 900.78. The stratification pattern will depend on how the blowdown flow is transferred to the pool. Pressure suppression tests indicate that steam condensed in the pool heats the pool layer above the point of steam entry. To estimate pool stratification, flow through the horizontal vents is used to calculate the temperature rise of the pool water above the vent. Similar calculations are done for flow through the SRVs during the blowdown. After the main vent flow has stopped, the flow through the PCCS vent is used to calculate the heat-up of the layer of pool water above the PCCS vent exit. Very little heat is returned to the pool through the PCCS vents, so pool heating due to PCCS vent discharge in the long term phase of the LOCA transient is very small. Venting of noncondensibles during any phase of the LOCA transient promotes pool mixing and reduces pool stratification. During the early blowdown period, pool swell and noncondensible venting are expected to mix the pool. Stratification patterns as, described above, result from extended periods of steam condensation, and are conservative for use in estimating the pool surface layer temperature.

RAI Number: 900.84

Question:

Discuss how the helium tests in GIRAFFE will be used to support SBWR modeling. The discussion should include a full description of the test, including instrumentation used, and should also address the issue of adequate helium concentration. In light of the past problems in obtaining information from Toshiba, the staff also needs assurance that all relevant information that might be requested as part of the review of the test will be provided promptly and completely.

GE Response:

The GE response to RAI 900.67 contains the requested information on test conditions, instrumentation, and helium concentration for the GIRAFFE HELIUM test Program. Parameters of interest in the data/analysis comparisons will be drywell and wetwell pressures, and PCC flow rates. Post-test TRACG analysis results will be forwarded to NRC soon after they are completed.

While the GIRAFFE HELIUM program will yield valuable data for TRACG qualification, the primary purpose of these tests is to demonstrate effective performance of the PCCS system in the presence of lighter-than-steam non-condensable gas mixtures.

GE will assign an engineer to the GIRAFFE HELIUM test program, who will also be responsible for data transmittals as requested by the NRC. As the GIRAFFE HELIUM test program is defined, the documentation will be forwarded to NRC as we are doing for the PANDA and PANTHERS test programs.

RAI Number: 900.85

Question:

Provide details of the additional analyses of the GIST tests performed with TRACG, and delineate clearly which test parameters are pertinent to code qualification for the SBWR.

GE Response:

The following additional GIST tests will be evaluated with TRACG

TEST #	EVENT*	CASE
B03	MSLB	Low suppression pool level
A01	BDLB	Base case
A03	BDLB	Max. GDCS flow area
A05	BDLB	CRD flow
D01A	NB	Base case
D02	NB	Max. GDCS flow area
D04	NB	Pressurized wetwell

* MSLB = Main Steam Line Break
BDLB = Bottom Drain Line Break
NB = No Break

The specific conditions for each of these tests can be found in Appendix A of the "SBWR Test and Analysis Program Description", NEDO-32391.

Although no new GIST-related qualification needs were identified as a result of the Test and Analysis Program these additional analyses will be performed in order to assure that TRACG is qualified over the widest possible range of conditions. The key parameters to be compared with TRACG predictions are GDCS flowrate, GDCS initiation time, and RPV pressure.

RAI Number: 900.86

Question:

Discuss treatment of back pressure in the PANDA vent line.

GE Response:

For most of the PCCS operation, the backpressure in the three PCCS vent lines at PANDA will be equal to the sum of the pressure in the wetwell airspace and the submergence of the vent in the suppression pool. The pressure in the vent line at the exit is also equal to the drywell pressure less the pressure loss of the PCCS. When the drywell pressure drops to below the wetwell pressure and the vacuum breakers open, the pressure in the PCCS vents will also decrease accordingly. Since containment pressures and the vent submergence at PANDA are typical to that of the SBWR, the backpressure will be similar to that which would occur in the SBWR during a postulated LOCA.

RAI Number: 900.88

Question:

Provide studies or explicit reference to data concerning heat losses for PANTHERS, PANDA, and GIST and, as appropriate, discuss the effects of heat losses on test results.

GE Response:

The explicit reference to data concerning heat losses for PANDA and PANTHERS are provided in the response to RAI 900.79 submitted by GE MFN No. 113-94, dated September 26, 1994. The GIST heat loss situation is discussed in Section 2.4 of "Response to NRC Findings on GIST", submitted by MFN No. 235-93 on December 16, 1993.

RAI Number: 900.89

Question:

Provide details or reference to details of initial conditions for isolation condenser (IC) operation for tests in PANDA in which the IC will be operated.

GE Response:

As noted earlier, GE is considering changes to the PANDA test matrix, as described in NEDC-32391P, in response to staff comments from the meeting on August 18, 1994. In NEDC-32391P, Table A.3-5b, PANDA test M6 is defined as being a repeat of test M3, but with isolation condenser operation. We are currently considering operation of the isolation condenser in tests M8 and M9 as well.

We are currently evaluating the exact initial conditions for these tests, as part of our pre-test analysis program. Test M3 will utilize initial conditions equivalent to approximately SSAR conditions at 1 hour into the LOCA scenario. These conditions are:

Table 1
Approximate Initial Conditions
PANDA Test M3
(SBWR - SSAR Assumptions @ 1 Hr Post LOCA)

Parameter	Value
RPV Pressure (kPa)	300
Steam Flow Rate (Kg/Sec)	0.03
RPV Level (m)	8.0
Drywell Pressure (kPa)	296
Nitrogen Partial Pressure (kPa)	12
Steam Partial Pressure (kPa)	284
Wetwell Pressure (kPa)	286
Suppression Pool Temperature (° C)	77
PCC Pool Temperature (° C)	100
GDCS Pool Temperature (° C)	100
GDCS Pool Level	Same as absolute level in RPV

RAI No. 900.89 (continued)

The specific initial conditions for use in Tests M5 through M9 have not yet been set, but all will be variations about this norm. NEDC-32391P, Appendix C presented the results of several TRACG studies that investigated the perturbations in system performance when non-safety systems such as the IC were in operation. In Section C.3 it was determined that the effect of IC operation is to slightly lower the RPV water level for the Main Steam Line Break case, but that the system pressure was set by ADS and containment system performance. In Section C.4 it is explained that the effect of the IC on containment system performance is to remove approximately as much energy as was removed by the PCCS, resulting in a slightly lower suppression pool temperature and wetwell pressure. Consequently, when initial conditions for test M6 are established, it is anticipated that they will not be much different from those selected for M3. These test conditions will be established Spring of 1995.

As noted above, GE is considering addition of IC operation to tests M8 and M9. If this is done, test M8 will use nominal initial conditions the same as test M6. RAI 900.73 addressed the start time for the "early start" tests M7 and M9. At 10 minutes into the LOCA scenario, the RPV is essentially depressurized, and its pressure is not substantially different from the values given in Table 1. Since less steam will have purged through the drywell, the drywell air content will be higher than in Table 1, and both wetwell and drywell pressures slightly less than in this scenario.

RAI Number: 900.90

Question:

Consider including IC operation as one of the parameters in PANDA Test M9.

GE Response:

GE is considering including IC operation as one of the parameters in PANDA Test M9 (see response to RAI 900.89, above).

RAI Number: 900.92

Question:

Provide a detailed scaling analysis of the PANDA facility covering the "early" parts of the accident scenarios for which testing in PANDA is now planned, demonstrating applicability of PANDA data to SBWR behavior.

GE Response:

The PANDA facility is scaled very well for its original intended purpose of simulating the long-term PCCS phase of a main steam line break. It does not have sufficient heat input or GDCS volume capabilities to fully simulate the SBWR transients prior to one hour after scram. The specific differences are described in RAI response 900.73. As indicated in the RAI the now planned M7 and M9 tests will be used to simulate the conditions starting at approximately 10 min after scram. Therefore, some compromises will have to be made on how to best simulate the desired effects in these tests. The specific initial conditions for these tests have not been determined yet. A detailed scaling analyses of the early phases of these tests will be performed when the specifics of how these tests will be run are determined.