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52-001

July 21, 1992

NOTE TO: Chet Poslusny, DAR, NRR

FROM: Robert Palla, PRAB, DREP, NRR RPalla

SUBJECT: ADDITIONAL INFORMATION NEEDED FOR CLOSURE OF PRA ISSUES

I have enclosed a fax I sent to Jack Duncan, GE, on July 20, 1992 regarding clarification/additional information needed for closure of Level 2 PRA issues. This information is needed in order to complete the SER supplement.

Enclosure: As stated

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Clarification/Additional Information Needed For Closure Of Level 2 PRA Issues

DCH

1. The Level 1 analysis does not consider depressurization of sequences in accident classes IB-1, IB-2, and IB-3, yet the Level 2 analysis (Table 1, CEB-92-39) reports that the bulk of these sequences are depressurized. Provide supporting analyses and/or revised Level 1 event trees which demonstrate that these sequences will in fact be depressurized. Identify and discuss the specific guidance provided to the operator in the EPGs for these sequences.

2. Provide justification that the reactor depressurization system is highly reliable during seismic events, and will assure a very low absolute frequency of high pressure reactor vessel failures in seismic events. This should include discussion of: (1) the impact of SRV discharge pipe failures on the ability to depressurize (indicated to be a concern in draft Section 19E.2.3.3.4), and (2) quantitative estimates of the availability of wetwell sprays in these events.

Supression Pool Bypass

1. Quantification of the failure probability of vacuum breakers in the pool bypass CET/DET is based on vacuum breaker operating data collected over a ten year period. It is our understanding that this includes surveillance (stroke) test data as well as leak rate test data, and is used to quantify several branches in the DET. Please provide a summary of the operating data, e.g., summary tables showing the component operating time, number of tests of each type, failures to open, failures to reclose, failures of leak rate tests.

2. Provide additional discussion of the criteria and rationale for excluding failures to open and failures of local leak rate tests from the database. It would appear that valves which fail to open during a surveillance test (perhaps due to binding on the shaft) might still open during an accident if the differential pressures are greater than used during the surveillance test. They would then be likely to stick open. Valves which fail to pass local leak rate tests even though their indicator switch indicates "closed" may be a precursor to binding on the shaft, and may exhibit a similar tendency to fail to reclose. Given these uncertainties, and the lack of data on vacuum breaker performance under actual accident conditions, provide an assessment of the effect of retaining these failures in the database on the probability of a stuck open vacuum breaker (event VB) and the probability of vacuum breaker leaks (event VB LEAK).

COPS

1. Section X.4.1 provides a comparison of sequences with and without COPS. This assessment is insufficient to fully resolve the issue regarding net risk impact of COPS (O-14). Specifically, the net risk impact of COPS, and the effect of suppression pool bypass, CCI, etc. on this result cannot easily be ascertained by comparing results from MAAP calculations with and without COPS. Rather, the net risk impact should be assessed based on considering the impact of the system on the CET results, i.e., by assessing the risk profile or CET end states with and without COPS. In this way, any effects that the system would have on shifting releases from one release category to another, or any interactions between phenomena/events would be accounted for. The information provided in Section X.4.1 of CEB-92-X should be supplemented in this regard to resolve the issue.

2. Provide a breakdown of the frequency of containment venting in terms of time to vent, e.g., the frequency of venting early (such as < 12h), intermediate (such as 12-24h), and late (such as >24h).

Passive Flooder System

1. Provide the assessment of net risk impact of the passive flooder system identified in O-15. As discussed above for COPS, net risk impact should be assessed using the modified CETs/DETs as the basis for demonstrating how the design feature influences the risk profile for the ABWR

2. In the ITAAC submittal (June 30, 1992), the minimum acceptable passive flooder flow rate is indicated to be 10.5 l/sec per valve. Based on the analyses presented in Section X.4.2.1 of CEB-92-X, the expected flow rate for each valve under accident conditions, using Bernoulli's equation, is approximately 11.0 l/sec. Because the minimum acceptable flow rate is very close to the maximum theoretical flow rate possible under accident conditions, lodging of the teflon disc in the valve, or small amounts of fusible material/alloy remaining in the valve after actuation may cause the valve flow to be unacceptably low. Furthermore, the analyses in Section X.4.2 suggest that 8 valves would be required to remove all the decay heat available at the time they would be actuated. (This is based on all of the core participating, but also does not include heat from exothermic reactions in the debris bed.) In view of the fact that a significant number of the valves would be required to operate in order to fulfil the system function, and the uncertainty in individual valve operability, the probability of successful passive flooder operation assumed in the PRA (0.999) appears overly optimistic. In this regard, please provide an assessment of the impact of reduced passive flooder system reliability on the ABWR risk profile. A recommended approach for addressing this concern is to requantify the CETs/DETs assuming lower probabilities of

successful system operation.

PRA Input to Severe Accident Closure Chapter

1. Provide a sequence-by-sequence comparison of accident frequency between the ABWR and operating BWRs, and an explanation of specific reasons for differences. To the extent possible, this discussion should indicate the specific impact of the plant features (which account for the difference) on key PRA models or assumptions.

2. Provide estimates of CCFP for the ABWR based on the revised CETs/DETs. Also provide separate estimates of CCFP for alternative definitions of containment failure, e.g., CCFP if containment venting after 12h, 18h, 24h is considered a success.

3. Provide a breakout and discussion of the contribution/effect of key Level 2 issues on CCFP and risk. Specifically address what the PRA results say about the importance of the individual issues/phenomena, including DCH, pool bypass, and CCI. Quantitative rather than qualitative arguments should be used. This information may be embedded in the recent GE submittals, but a more concise and focussed discussion of the role of these issues in the ABWR risk profile is needed.

Credit for Firewater Addition

1. Considerable credit is taken for recovery of core damage in-vessel for certain subclasses (e.g., IB-2, ID, and IIID), however, the bases for the assigned probabilities is vague. Specifically, it is not clear how much of the credit is due to: (1) recovery of AC power, (2) recovery of previously failed systems, or (3) use of previously unavailable systems such as fire water. For each accident subclass, please identify the specific systems being credited, and the credit taken for each, so as to support the probability values used in the analysis.

2. Clarify how the use of firewater was treated in the revised PRA. (It is our understanding that no credit has been taken for severe accident prevention (i.e., in the Level 1 analysis), and that credit is taken only in the Level 2 analysis.)

3. Provide references to SSAR sections or GE submittals in which details regarding use of the AC-independent fire water addition systems are provided. This should include specific human actions required to connect the diesel-driven pumps and the fire trucks, locations that these actions would be taken, emergency procedures guiding these actions, necessary spool pieces, tools, etc. and design details such as pump head curves, pressure capacity of fire hose/piping, and in-line check valves to assure that rapid RCS pressurization will not

result in a breach of the injection path.

Modelling of Operator Actions in the Level 2 Analysis

1. Provide references to specific sections of the EPGs and SSAR which address the following:
    A. operator actions in response to failure of SRV discharge line in seismic events,
    B. operator actions following rupture disc opening,
    C. operation of drywell sprays as alluded to on page 19E.2-11 of draft Section 19E.2.2,
    D. operation of wetwell sprays alluded to in insert to June 4, 1992 GE markup of Section 19E.2.3.3.4.(1),
    E. hookup of diesel-driven fire sprays, and fire truck for core/spray injection, and
    F. operator response to RWCU line breaks alluded to in Insert 3 to June 4, 1992 GE markup of Section 19E.2.3.3.3.(4).

Level 2 Results

1. Figure 2 in CEB-92-39 appears to play a key role in integrating the results of the individual CETs for each accident subclass/PDS, and establishing frequencies for each release class/case in the Level 3 analysis. However, the submittal provides no discussion of the role of this figure, how it was developed, and how it is used to support the frequencies of the various releases in the Level 3 analysis. A detailed discussion of this figure and how it is used is needed.

2. Provide a description of the process used to assign release characteristics to each of the end states of Figure 2 in CEB-92-39 is needed, and to group these releases for subsequent Level 3 analysis. Also identify: (1) the accident sequence group assigned to each of the 53 end states/STC#s, and (2) the frequencies assigned to each accident in Table 1-1 of the updated ABWR consequence analysis (June 30, 1992 fax from J. Duncan).

3. Based on our initial review, it appears that core concrete interactions should be included as a top event in Figure 2. Provide justification for not including it.

4. The treatment of Class 2 accidents in the Level 2 analysis is limited to the information presented in Figure 9 in CEB-92-39. This figure is not discussed in the text, and the bases for the branch point probabilities are not presented. Furthermore, several of the probability values appear extremely optimistic. In particular, the assumption that continued core cooling is assured after rupture disc actuation does not acknowledge the potential for failure of injection due to decreased NPSH and the potential for random failure during the mission time. The assumption that gross

containment failure leads to loss of core cooling with a probability of only 0.001 is also extremely optimistic given that containment failure can affect long term operability via radiation and temperature effects and access, as well as the two concerns noted above. In view of the importance of this event tree in virtually eliminating Class 2 sequences, a detailed discussion of the Class 2 analysis is needed, along with justification for the probability values assumed.

5. In the various CETs in CEB-92-39, the top event dealing with active injection to the lower drywell (LDWI) appears to assume that injection via firewater sprays (branch "FW SPRAY") assures that water will be added to the lower drywell. As a result, the potential for failure of the passive flooder system is not assessed in the subsequent branch. This treatment is inconsistent with our understanding that the lower drywell will only be flooded after a significant amount of water is added with this system, and only after a significant delay. Please address this apparent inconsistency.

6. In CEB-92-39, accident subclass Ib2-1 is discussed in several locations in the text and is depicted in Figure 16. However, it is our understanding (based on information on page 1 of that submittal) that an event tree for this event was not developed based on its low frequency. Thus, the split fraction information for this subclass presented in the submittal (e.g. on page 3 of the submittal) appears irrelevant. Please clarify this.

7. In CEB-92-3 , significant credit is taken for recovery of RHR prior to fission product release, however, little information or bases are provided for the values selected. Please identify: (1) the actions to restore RHR that are credited in the analysis, and (2) the measures that are assumed to be taken by the COL applicant prior to the accident to assure that these actions can in fact be implemented. Such measures would include accident management measures, storage of spare parts, installation of flanges or cross-connect capabilities, etc. The time available to implement these actions, and the accessibility to the necessary areas in the reactor building should be explicitly addressed for each accident subclass.

Revised MAAP Calculations

1. In CEB-92-X and previous communications, GE indicated that the probability of a flooded lower drywell cavity at the time of reactor vessel failure is extremely low because the firewater system would need to inject for about 11h in order to overflow the suppression pool into the lower drywell. However, in the revised MAAP analyses provided in draft Section 19E.2.2 the reactor cavity is calculated to be flooded in cases NSRC-PF-R-N and SBRC-PF-R-N. Please provide a discussion which reconciles this conflicting information. Also provide a

quantitative estimate of the probability of a flooded cavity at the time of reactor vessel failure based on the revised PRA.

2. With regard to Figure 19E.2-6E, please provide an explanation for the lower drywell water mass increasing over a 10h period (apparently due to suppression pool overflow), while suppression pool mass continues to decrease.

3. Provide the rationale for establishing the time of drywell spray initiation. In some cases analyzed, sprays are not considered to be started until 2h after reactor vessel failure. Discuss the reasons for this delay.

3. Provide a detailed chronology of the "FS" cases which are identified in Table 19E.2-16 but not discussed in the text. Along with other events of significance, please include the time to: suppression pool overflow, lower drywell dryout, passive flooder opening, drywell spray start and stop, and firewater start and stop.

4. The reactor vessel failure times in the revised MAAP calculations appears to be delayed about 1 hour relative to the times predicted in the original calculations, however, no explanation for this change is presented. Please discuss the reasons for these differences.

5. The release fractions for similar accidents are much lower in the revised MAAP calculations than in the original calculations, e.g., the CsI release fraction for LCHP-PF-P-M is decreased from 0.39 in the original analysis to 0.088 in the revised analysis, and releases for other cases are decreased from <1E-5 in the original analyses to <1E-7 in the revised analyses. Please discuss the reasons for these differences.

6. The source terms predicted by MAAP for vented sequences are far lower than predicted by other code calculations. This may be a result of models/assumptions regarding suppression pool scrubbing. In view of the importance of this release class, provide an assessment of the impact that higher release fractions for these sequences would have on the ABWR risk profile, and compliance of the design with the ALWR design goal regarding 25rem dose at the boundary. This will be a critical issue in the staff's review.

LOCAs Outside Containment

1. An insert to June 4, 1992 GE markup of Section 19E.2.3.3.3.(4) indicates that potential bypass through the drywell purge exhaust and the inerting lines is (will be) included in the containment event trees. However, the June 30, 1992 submittal on suppression pool bypass (Section X.3.3 of CEB-92-X) addresses only pool bypass via the vacuum breakers. Please

identify the schedule for completing the CET analysis of the additional two bypass paths.

2. The same insert states that the table in Section 19E.2.3.3.4.(1) will be modified to represent probabilities at 0.6g. To our knowledge, this also has not yet been submitted.

Level 3 Analysis

1. The warning times used in the analysis (0.8h for essentially all ABWR sequences) appear unrealistic in view of the fact that in certain accidents, the event classification (emergency action level) will not be escalated to the point that evacuation would be recommended until late in the accident. In this regard, provide justification for the warning time used for each accident sequence on which the various Level 3 cases were based. Discuss the consistency of these estimates with the estimated times at which evacuation recommendations would be made based on emergency action levels.

ITAACs for Level 2 Design Features

1. A more in-depth assessment of Level 2 PRA inputs to ITAAC is required. Based on a quick (and incomplete) staff assessment, a number of risk-significant features are missing from GE's June 30, 1992 ITAAC submittal. For example, ITAAC should be provided to assure the following:
   - there are no unforeseen changes to the plant design (such as water ingression paths or increased CST volumes) that would render the lower drywell flooded at the time of reactor vessel breach in dominant severe accident sequences,
   - the proper concrete type (basaltic concrete) has been used in construction of the lower drywell, and
   - solid catwalk/decking is installed below each vacuum breaker, and is sufficient in dimension to completely shield each vacuum breaker from pool froth impact loads so as to reduce the potential for containment bypass.

2. The ITAAC for the COPS rupture disc and the passive flooder valves need to be expanded to include a commitment to a component testing activity sufficient to assure that the high reliability assumed in the PRA for these components (0.99 and 0.999 probability of successful operation, respectively) is valid. This type of assurance is needed prior to plant startup, thus the RAP should not be viewed as the sole vehicle for confirming the reliability of these components. For the flooder valve, the number of unique alloy mixtures that will be used for the thermal plug, and the number of valves of each type should be specified.

3. The ITAAC for the passive flooder valves needs to be expanded to specify/describe the environmental conditions under which

the tests would be performed (e.g., water and surrounding atmosphere pressure and temperature), and the test configuration to assure that important heat transfer boundary conditions are properly reflected (e.g., heat transfer to water in the connected pipe, radiation shape factors, and wall effects).