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V. S. BOYER
SR. VICE PRESIDENT
NUCLEAR POWER

January 25, 1983

Docket Nos. 50-352
50-353

Mr. Darrell G. Eisenhut
Division of Licensing
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Limerick Generating Station - BNL Draft Report of the LGS-PRA (NUREG/CR-3028, dated October 1982)

Ref: Ltr., V. S. Boyer to D. G. Eisenhut, dated December 22, 1982

Dear Mr. Eisenhut:

In accordance with the commitment made in the referenced letter, enclosed are our detailed comments on the subject report. We will be pleased to amplify or discuss these comments with your staff or BNL at their convenience.

We thank you for your cooperation in this matter.

Sincerely,

V. S. Boyer

B001

Encl.

Copy to (see attached list)

cc: Judge Lawrence Brenner
Judge Richard F. Cole
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Docket and Service Section

ATTACHMENT TO LETTER

V. S. BOYER TO D. G. EISENHUT, 1-25-83

SUMMARY COMMENTS ON BNL DRAFT REPORT
NUREG/CR-3028 OCTOBER, 1982

There are a number of statements made in the BNL report which do not accurately portray the Limerick Plant or are not properly justified. The following are items which are inappropriate relative to Limerick and are judged to have the most significance with regard to the quantitative evaluation of risk:

1. Initiator frequencies were modified by BNL. The choice of significantly higher initiator frequencies than those used in the LGS PRA is not supported in the draft report, is inconsistent with other published PRA studies, and is judged to be inappropriate. The specific transient initiator frequencies which were increased without adequate justification are: loss of offsite power, turbine trip and IORV.

2. System unavailabilities of HPCI and ADS/Reactor Depressurization were increased by a significant amount. These apparently arbitrary increases have large impacts on the calculated core melt frequency. Detailed comments are included in the Attachment.

3. The conditional probability of a common mode failure of the diesels was not taken from the event tree function evaluation. The value used in the BNL draft is not the value suggested in the LGS-PRA, and is not supported by data.

4. The calculation of the Class II accident sequence frequencies appears to be in error, i.e. overestimates the frequency. See detailed comments in the Attachment, particularly on sequences TEW, TTQW, TIQW, and TTPW.

5. The calculational model of CRAC was found to be the dominant contributor to the difference in the consequences as calculated by BNL. Brookhaven's approach to evacuation goes beyond the original intent of the LGS-PRA, that is, to follow the WASH-1400 analysis approach.

The remainder of the attachment addresses a page by page commentary on the BNL draft report. Within the detailed commentary are explicit concerns associated with the above major contributors to differences between the BNL and PECo evaluations.

ATTACHMENT TO LETTER

V. S. BOYER TO D. G. EISENHUT, 1-25-83

COMMENTS ON BNL DRAFT REPORT
NUREG/CR-3028 OCTOBER, 1982

PAGE	COMMENT
iii abstract	Third sentence; The BNL re-evaluation as presented is not comparable with the LGS-PRA or WASH-1400 due to changes in methods; particularly the treatment of initiator frequency and evacuation parameters.
xx	Second paragraph, Revision 4 and 5 of the LGS-PRA were not substantive revisions of the study. They were in response to NRC Requests for Additional Information (RAI).
xxi	Item B. The statement that the LGS-PRA "can be upgraded" does not address the nature of the study as a WASH-1400 comparison. Most "upgrades" proposed by the report are extensions beyond the scope of WASH-1400.
	Item C. If the report and its contained re-evaluation are not a "full reassessment" of the LGS-PRA as a comparison to WASH-1400, a clarifying statement should be made as to what the BNL re-evaluation represents.
xxi/xxii	Item E. This item seems to imply that the LGS-PRA was not a balanced assessment of accident sequences. Further, the LGS-PRA is characterized as "not sufficently realistic". The specific reasons for these beliefs and an unambiguous statement as to conservatism or non-conservatism should be made if possible.
xxii	Table; The values from the Limerick study should be 2.4 x 10^{-6} for acutes and 3.6 x 10^{-4} for latents. The units on latents should be (per year/year). The values from WASH-1400 for BWR core melt are 3.0 x 10^{-5} for acutes and 7 x 10^{-4} for latents.

xxii Last paragraph and top of next page; These factors on core melt do not appear to be in the order of impact. This comment seems inappropriate in view of the fact that the BNL quantification does not demonstrate that the identified dependencies contribute appreciably to the calculated core melt frequency or ex-plant consequences. In other words, it seems more appropriate to characterize the dependencies identified by BNL not as a primary contributor to the differences in quantification but rather as a minor contributor.

Bottom of page, last sentence; This statement is incorrect in that sequences involving failure of ADS are additive to sequences involving failure of LPCI. Therefore, neglect of this commonality, if it proved to be significant, would result in double counting of failures in the LGS analysis (ie. an incorrect high estimate of the core melt frequency would result).

xxiii Third paragraph; The limited purpose of the use of the BNL siting model is not clearly stated. The degree to which the use of a non-WASH-1400 approach impacts the results and an adequate justification for doing so should be stated. Such a statement should appear wherever and whenever the results of BNL's calculations are shown in conjunction with those from the LGS-PRA and particularly when comparisons are explicitly performed.

Table; The point estimate value for latents should correspond to the value of 5.7×10^{-3} given in the table on the previous page (xxii).

1-3 Top paragraph, last sentence, item 3); Does the phrase "best estimates of the risk indices" describe the BNL re-evaluation? If so, see comments on page iii, xxi, xxii, and xxiii.

2-3 Item 2.1.2; The implication that the use of realistic criteria is improper is incorrect. The entire PRA is meant to represent a realistic assessment of risk within the scope and methodology of WASH-1400 and must be based on realistic success criteria.

2-5 Top paragraph, second sentence; A generic GE analysis in NEDO 24708 demonstrates BWR response with only RCIC and an SORV.

It is recognized that there eventually will be a decrease in reactor pressure below the RCIC operating range, i.e. less than 100 PSI. At this time the low pressure systems are required. However, the low pressure system reliability is sufficiently high that a low pressure system failure during these sequences does not contribute significantly to core melt frequency.

2-15 Table 2.3, Frontline Systems; Manual Actuation of SRV's should be included for Safety Function 4) with an (*) indicating no credit taken.

3-8 First paragraph, second sentence; The term "less conservative" needs further clarification. With respect to what?

Second paragraph; We concur with the BNL statement that a more detailed and realistic analysis was performed in the LGS-PRA compared to the RSS. See comment on page 2-3, Item 2.1.2.

3-9 Top of page; Statement as to Q/W dependencies is incorrect. The dependence of the PCS on the availability of the MSIV's and feedwater is explicitly identified as an important dependence. See comments on pages 5-11 through 5-13.

3-9/10 Last line/first line; The statement that the LGS-PRA "neglected potentially important dependencies" should be clarified. All significant known dependencies were treated in the quantification of the event trees. The values at the event tree branches were modified from the values on the System Level Fault Trees. All values on the event tree branches are conditional probabilities and should be multiplied directly.

3-11 Item 3.5, second paragraph; There are no relevant air system dependencies for HPCI, RCIC, RHR, ESW, NSW, or RHRSW. Most of these systems contain no air operated components. In the others failure is in the safe mode. Air system dependencies for ADS are fully modeled.

3-12 Mid-page. This discussion of failure rates seems inconsistent with BNL's approach to initiator frequencies. See comments on Section 4.

3-13 Section 3.5.1; The discussion of the modifications made to the SLFT's was supplemented on 11/29/82 by BNL with specific comments and numerical values. Due to the proprietary nature of the SLFT's the response to the above discussion will be provided at a later date. Based on the results as depicted in Table 5.6 (page 5-60) specific comments will be made on page 5-60 only where a significant change occurs.

3-21 Fourth and fifth sentences; The referenced Tables, 3.1 and 3.2, are not dependence matrices. The reference should be changed to Tables 3.3 and 3.4 respectively.

3-49 Table 3.4; The AC power arrangement for the PCIG compressors is non-Class IE.

4-1/2 Item 4.1.2; Discussion of BNL assessment of initiator frequencies is hampered by the unavailability of reference 4-4. While the theory behind the method is generally viewed as acceptable practice, the specific implementation by BNL appears to yield results which are inconsistent with a simple approach and good engineering judgement. Further comments will be possible when the information requested in the reference letter is made available.

4-3 Item 4.1.3, first and second paragraphs; The lack of comment or critique of the LGS-PRA data and methods for this initiator is viewed as a significant shortcoming of the BNL report given the substitutions made by BNL.

Third paragraph; A precise statement as to the purpose of the BNL assessment is needed. Are the results BNL's best estimate for Limerick?

Item 4.1.4. The issue of the loss of offsite power recovery was discussed in the reference letter. Section 4.1.4 should be written with consideration of the information provided in the reference letter.

4-6 Item 4.2.2, Fourth paragraph: The value of 1.08×10^{-3} is correct throughout the report. The information in Appendix A is incorrect. A copy of the corrections for page A-100 of the PRA was provided in the reference letter.

4-7 Item 4.3.1, first paragraph, item 1); No dedicated operator was assumed in the model. The data from Swain was specifically identified as appropriate for operator response without a dedicated operator. The analysis is consistent with actual plant operation at Peach Bottom.

4-7/8 Item 4.3.1, second paragraph, item 2); The BWR Emergency Procedures Guidelines (EPG) and the PECo procedures require reactor depressurization for nearly all shutdowns. Depressurized shutdowns represent approximately 97% of all reactor trips. Therefore, the operation is a normal operator function. The BNL assertion is incorrect.

The majority of comments on depressurization seem to indicate that the reviewers believe that the only way to manually depressurize the reactor is to activate the ADS. In fact, manual depressurization as well as pressure control at high pressure may be performed by manual actuation of one or more of the nine Non-ADS SRV's. This is the method recommended in the Emergency Procedures Guidelines developed by the BWR Owners Group in cases where the turbine bypass is unavailable.

4-8 Item 3); The concept of manual depressurization is well established, included in operator training, and well practiced during plant operation. The BNL statement is incorrect.

First paragraph; We believe this paragraph should be reviewed based on the foregoing arguments.

Item 4.3.2; ATWS procedures for use at Limerick are not fully developed. The PRA representation was the thinking at the time

the PRA was performed. Within the framework of the LGS-PRA assumptions and methods, the value used provided the best balance for ATWS risk. As pointed out by BNL it is recognized that this may be an important operator response which could affect offsite consequences.

4-9 Item 4.3.3, last sentence; The need to restructure the operator training program is not obvious. The existing structure was not presented as part of the LGS-PRA.

4-12 Table 4.2; Value for LGS at 20 hours is .0003 not .03 as shown. Value at 1/2 hour is 0.74 not 0.66. See Table A.6.3.

5-2 Top paragraph, first sentence; Stated more accurately, the functional fault trees are representative of the combinations of failures which could disable a function or multiple functions. System fault trees were combined according to the logic of the functional level trees. In selected cases where WAMCUT had been previously run to demonstrate minimal system dependencies or when the top event as shown in the SLFT's could be combined under the appropriate gate in WAMBAM, then and only then were the system unavailabilities substituted into the functional fault tree. The principal example of this is the HPCI and RCIC combination which were combined in WAMBAM under an AND gate.

Fourth paragraph; In the third sentence, the term "early core damage" is not a descriptive term for Class III accidents. Class III represents a set of accident sequences which are characterized by a saturated or nearly saturated suppression pool coupled with high containment pressure all occurring prior to core melt conditions.

5-3 Last paragraph, second sentence; It is agreed that the contribution of Classes II and IV are treated conservatively. The statement that the PRA neglected containment leakage is incorrect. The conservatism is due to the fact that the accident sequence frequency evaluations were rounded upward.

Last paragraph, last sentence; The numerical errors referred to were identified in a telecon with BNL on 11/29/82.

5-4 Item 1), mid-page; The support system dependencies are included in the evaluation of frontline systems. In addition multiple frontline systems requiring the same support systems were evaluated quantitatively to verify that the support system contribution affecting multiple systems was small compared with the combination of the total calculated system unreliabilities appearing on the event trees.

Third paragraph, first sentence; The sequence dependencies noted by BNL and which are asserted to have significant impact on calculated frequency of core melt were each treated in the LGS PRA in the following manners:

AC Power Dependence: Following a plant transient (i.e. scram), there is a possiblity that offsite power could be lost and the diesels fail to start. An evaluation was performed to ensure that such sequences were not dominant contributors to core melt.

The evaluation is considered a conservative estimate of the impact because of the use of the value of 10^{-3} per demand for the loss of offsite power following a transient. Based on data to date the value for nuclear plants is calculated approximately as $2x10^{-4}$ per demand. This would reduce the contribution to core melt from $6.5x10^{-7}$ per reactor year by a factor of 5 to approximately $1.3x10^{-7}$ per reactor year or less than 1% of the calculated core melt frequency. Either estimate represents a small increase in core melt frequency.

Service Water: The LGS service water system has a large measure of redundancy built into it. Nevertheless, there may be remote instances of common mode failure that could disable these multi-leg systems. The LGS evaluation identified the common mode failure of all service water as approximately 10^{-8} per demand.

DC Power Dependence: LGS has four independent DC Class IE power systems. Each DC division is energized by its own battery and chargers. There are no bus ties between divisions.

Third paragraph, second sentence; All functions (branches) in the event trees were multiplied but the function quantifications were not calculated independently. The supporting document "Quantification of Limerick PRA Event Tree Functions" provides the dependency evaluations and explanations.

5-5 Item 2), top of page; These dependencies have been evaluated and are either explicitly included in the PRA (eg. QW dependence) or were found to be negligible (eg. common use of the CST). The other dependencies are similar, that is, while the system or component may contribute to the unavailabiltiy of more than one system, the calculated combined system failures are significantly higher than the common mode contribution cited by BNL from other sources.

5-7 Item 5.2.1.1; While it is true that all four trains of Class IE DC power and four Class IE AC Trains and offsite power are included in the ADS fault tree, these are not all necessary for a successful ADS. In fact only one train is required for ADS and only one DC train is required for depressurization.

5-10 Last paragraph, fourth and sixth sentences; In analyzing the Feedwater (TF) CDFT, the value of $6.28x10^{-6}$ cannot be obtained from Table 5.4. If $6.28x10^{-6}$ is the correct value, all sequences which are a part of that number should be listed.

5-11 to 5-13 The event tree quantification in Section 3.4 is composed of an initiator frequency and conditional probabilities. The conditional probabilities are derived such that they are sequence dependent. That is, the conditional probability is dependent upon the events which have occurred up to that point.

The dependence of the power conversion system on the availability of the MSIV's and feedwater is explicitly identified as an important dependence (Section 3.4 and Functional Fault tree of W). The event tree quantification clearly indicates that the conditional probabilities are determined based upon the precondition established by the accident sequence. Specifically, in the case of Q and W the power conversion system is

penalized since the MSIV's may be required to be reopened.

While it is true that there are some hardware unavailabilities which will affect both, the models are necessarily different since a minimal FW/PCS arrangement is required for containment heat removal.

5-17 Items c) and d); The response to these comments are highly dependent upon the plant specific procedures implemented at Limerick for symptoms related to reactivity, level, and containment control.

The PRA was conservatively formulated in each of the areas cited by BNL given the systems availability and the assumed operating procedures. The LGS-PRA evaluation is consistent with the human error modeling performed on the PRA.

The assumed operating procedure used in the quantification of these event functions is the following:

> If, following a turbine trip or isolation event, any three adjacent control rods fail to insert and power is indicated above 3%, perform the following:
>
> 1. Inject SLC immediately.
> 2. Control water level between Level 1 and Level 2.
> 3. Prevent ADS by using a manual inhibit switch.
>
> Using these assumed procedures and the assumption of thorough simulator training for its implementation, the quantification is consistent with NUREG/CR-1278.

It should be noted that the value of ADS inhibit used in the LGS PRA has a large uncertainty associated with it. However, the following aspects of the LGS-PRA mitigate the impact of possible misestimation of the ADS inhibit reliability:

1) The conditional probability of being in the situation of receiving an ADS signal is conservatively estimated for the dominant sequence.

2) The Class IV source term is extremely conservative.

5-21/5-22 Last paragraph/top of page; The identified dependencies are overestimated as indicated in the previous responses. The other BNL modifications need further explanation and the initiator frequency should be reviewed for consistency with other PRA work.

5-31 The functional fault tree for High Pressure Injection Functions indicates that EAC or ARC alone will fail HPCI and RCIC. ARC alone cannot fail any system. The intention was probably to have an "AND" gate rather then an "OR" gate.

5-39 All class designations depicted in the CDFT will cause a large LOCA. The large LOCA initiator, A, should be "ANDED" with orgate1 to obtain the correct result.

5-40 The Core Damage Fault Tree (CDFT) for Medium LOCA should have the following items changed; the "O" under andgate2 should be a "Q". Under Class II events, the andgate2 should be changed to an andgate7.

5-41 The CDFT for the small LOCA initiator is composed entirely of orgates. In effect, any system failure would cause a small LOCA. This is incorrect. The following orgates should be changed to andgates; orgate1, orgate3, and orgate4.

5-58 The cutset probabilities listed in Table 5.3, Feedwater Transient CDFT Cutsets, do not correspond to the BNL numbers listed in Table 5.17.

The functional fault tree for the containment heat removal functions (W) uses only the hardware failure of the RHR system (RHRH) but the cutsets listed in Table 5.3 show a function "RHRHUBPB". Is this function an "AND" or an "OR" combination between RHR hardware and another component (or function)?

5-59 Table 5.4 Feedwater Transient CDFT Cutsets with Support Systems could be one of two things; it could be Turbine Trip (TT) Cutsets with the wrong title or it could be the Feedwater Transient (TF) table with the wrong initiator. A clarification should be provided.

5-68 Table 5.19 provides a summary of Class II sequences which appears to be in error in the total, which is inconsistent with the total quoted in Table 5.16 [i.e. $6.5x10^{-6}$ (Table 5.19) vs. $8.7x10^{-6}$ (Table 5.16)]. In addition, TFQW appears twice in Table 5.19 and it appears TTQW is left off the Table 5.19.

The following comments are applicable to the Class II dominant sequences quoted in Table 5.19 of the BNL report:

1) Some sequences have been identified by BNL as missing from this table, i.e. TT (WSW).

2) BNL (PAPAZAGLOU) in discussions with PECo. (GIBBON), WLA (BURNS), and NRC (COFFMAN) on December 9, 1982 indicated that TEW was in error and should be a factor of at least 4 less than cited in Table 5.19. The removal of this error has the effect of reducing the Class II frequency by approximately 35%.

3) The IORV sequences have an initiator which is too high by a factor of 4.4.

4) TTPW sequence has an initiator which is too high by a factor of 2.1.

5) TM(WSW) appears to be erroneously included in Class II sequences. This may be double counting since this identical sequence also appears in Class I. It is inappropriate to double count such sequences.

Table 5.18 provides the summary of the BNL frequencies for Class I.

The principal contributors to the BNL calculated increase in core melt frequency for Class I sequences are the following: (1) BNL changes to increase the initiators frequency [TE (X4), TT (X2.1), TI (X4.5)], (2) BNL assertion that HPCI unavailability is higher (X1.7); (3) BNL assertion that ADS/depressurization has a higher conditional failure probability (X3); (4) BNL use of an incorrect value for the diesel common mode failure probability (X1.8).

5-71 Second paragraph; It should be noted that the listings of the WAMCUT cutsets do not give any consideration to the required number of trains that must be used to accomplish a real cutset to the system. This can lead to false indications on the criticality of a component. For example, in the Electric Power System, the loss of 4Kv bus (EBSD11DWI) is listed as the highest order cutset with a probability of $2x10^{-5}$. This however, refers to only one of four busses and would cause the loss of only one train of AC. In other cases (RCIC for one) the cutset actually fails the entire system. This should be clarified somewhere, either by words in the text or by notes in each table.

5-71/5-72
5-75/5-76 The references in the text do not always agree with those in the tables. For example:

in LPCI	text	DHU102DXZI
	table	DHU102DXI
in RHR	text	DTM1
	table	DTM12

Since the addition or deletion of one character can make the designation mean something else, all references must agree.

6-8/6-29 Second paragraph, second last sentence; This statement should be revised in light of the discussion in Section 7.3.1 and mid-page on page 7-103 to the effect that LOCA changes made by BNL "did not significantly alter total risk."

6-9 Item 6.2.2.1; The BNL restructured trees for C2 and C4 are reasonable but are unrealistically applied due to the following:

1) The probabilities assigned to in-vessel and ex-vessel steam explosions are very conservative.

2) The release fractions for steam explosions as represented by OXRE, which was unmodified by BNL, do not consider the amount of material which could be involved in the oxidation reaction for the assigned probabilities.

3) The comments made by BNL do not reflect the fact that partial oxidation releases were added in the LGS-PRA to non-OXRE release fractions.

Based on the meeting discussions between PECo, NRC and BNL, on December 15, 1982, it is our understanding that BNL recognizes these inconsistencies. The probability of a steam explosion event will be re-evaluated vis-a-vis the magnitude of the core material involved in the oxidation process.

6-20/24 Item 6.2.2.4.2; Sandia experiments and analyses of steam explosions indicate that the RSS assessment is very conservative. Best estimate value for in-vessel and ex-vessel steam explosions (given that the containment is already failed) is approximately $5x10^{-3}$ (*). RSSMAP of Grand Gulf used a probability of 10^{-4} for in-vessel steam explosions given a high pressure reactor vessel environment; and 10^{-2} for low pressure environment failing the containment. It should be noted also that experimental data indicate that steam explosions in high pressure environments (invessel) are not likely.

(*) SAND 80-2132 "Probability of Containment Failure Due to Steam Explosions Following Core Meltdown in LWR" Corradini, et al., June, 1981.

7-7/8 The Brookhaven report presents a discussion for another core debris dispersal mode following RPV bottom head failure as an "alternative scenario". This scenario is not intended to be an alternative to the scenario analyzed in the PRA. It should be noted in the text that the described mode of core debris dispersal could potentially occur if the corium behaves as a slurry following vessel failure. This was presented in response to an NRC request. The context of presenting this scenario in the BNL report as an alternative scenario to the PRA scenarios is incorrect.

7-13 First paragraph, middle of page; The CORRAL calculations include a gap release mechanism which was explicitly modeled. Tables of best estimate core release fractions presented in Section 3.4 of the LGS PRA include the gap release mechanism.

7-25 Figure 7.2; This figure presents a comparison of the PRA and BNL calculated pressure-time history. The BNL pressure trace for the same scenario is very different, and no discussion is presented in this section to explain the apparent differences due to the models used. It needs to be emphasized that the calculational tools have model differences which could result in these diverging results.

7-28 Last paragraph, second sentence; Although the heat content of the La group is higher, only approximately 1% of the La FP's are released from the fuel during meltdown. It is not totally clear how this alone could result in the high containment temperatures shown in Figure 7.3b for the case where the pool is effectively bypassed (DCF=1). This would obviously lead to an early containment failure since the containment pressure would likewise be higher.

7-30/33 Table 7.14; The footnote implies some discrepancy in the prediction of the vessel failure timing in the LGS-PRA. Comparison of the timing for the BNL calculations of TWLP, TWLP', TWLP² and TWHP shown in the table indicates that the failure times range from 0.1 to 6.7 hours. The TW modeling options described in the text by BNL do not explain this wide range in the timing for vessel head

failure. The footnote should be reworded such that it is not limited to the LGS-PRA calculations only.

7-37 Last paragraph; This statement is true as indicated in extensive reviews of the MARCH code. In addition, when the oxide layer is solid, it is also initially predicted by INTER to be the bottom layer. In this case, the heat transfer is neglected and the vertical penetration is negligible until the oxide layer becomes molten (due to the lower melting point from addition of other oxides). Almost shortly thereafter, the two layers switch and the metal layer becomes the bottom layer. The vertical penetration rates are then determined by the higher heat transfer rates from the metal layer. This is apparent in Figure 7-10 which compares the concrete penetration for the LGS PRA and BNL calculations of the Class IV accident sequence.

The INCOR (INTER) model is not constrained in the same manner as the MARCH. For the case where the containment is not failed, this difference in the modeling assumptions could lead to corresponding difference in the pressurization rates.

7-43 Fourth and fifth sentences, second highlight under section 7.2.2.1; The specific modeling assumptions of BNL in the fission product transport calculations during this time period need to be clarified. By merely displacing the timing of the vaporization release relative to vessel head failure, the corresponding thermodynamic conditions and more importantly, the fluid flows from the drywell to the wetwell would not be modeled correctly. Therefore, the fission products may not be predicted to flow through the wetwell pool and be attenuated, before accumulating in the suppression pool chamber. This could impact the magnitude of release at containment failure.

7-44 Top of page; The LGS PRA used a DF of 10 for both I_2 and particulates for saturated pools. This is conservative considering that the pool does not become saturated for the Class I accident sequence. Based on discussions during the meeting on December 15, 1982, the DF values used by BNL were inferred from the text in the LGS-PRA. A statement in Appendix

D (p. D-8) following a discussion on subcooled pools contributed to this error in BNL's understanding of what was done in the PRA. The data available at the time of the LGS PRA suggest DF values greater than 10 are possible for saturated pools. The basis for the LGS values have been extensively discussed in the response to the BNL questions on Appendix D with the reference documented.

First paragraph; The basis for adding the 10% oxidation release into the drywell air space via the downcomers is not stated in the BNL analysis. This scenario would not be realistic if we consider that the steam explosion would likely be triggered when the molten corium impacts the pool bottom (Appendix H). This could disperse the fragmented debris into the suppression pool chamber, releasing the fission products into the wetwell air space.

The LGS PRA fission product transport CORRAL model depicted the latter scenario. Thus, the last sentence in the paragraph is in error. The discussion in Appendix D on oxidation release states that the wetwell atmosphere as well as the suppression pool are the oxidation release source compartment. This may have contributed to this error in the BNL comment.

7-51 Last paragraph; BNL states that the LGS-PRA modeled the RPV as a separate compartment in which the FPs could settle and/or plateout. The LGS-PRA did not give credit to in-vessel plateout and settling in the CORRAL analysis. This statement is not correct.

7-54 The BNL reference to p. 3-123 of the LGS PRA would indicate that no plant specific calculations were performed for the C4 sequences. The C4 sequence considering the γ, γ' and γ'' containment failure modes was explicitly analyzed for releases using CORRAL.

7-58/59/60 First sentence, top of page; The referenced tables, 7.23 and 7.24, show the effects of the CRAC code calculation differences. The BNL/PRA ratios range from 1.7 to 2.8 for the latents and 10 to 90 for the acutes. The acute fatalities are significantly affected by the evacuation model used by BNL thus, the latent effects will be used as a measure of

the CRAC code differences. One parameter that could directly impact the results is the LGS PRA CRAC code dispersion parameters. Other parameters, such as the shielding factors also contribute to this difference.

Second paragraph, Section 7.2.3.2; The text definition of the warning time described in this section does not agree with all the values shown in Table 7.25. The Class IV accident sequence shows an inconsistency in time of release and warning time which could significantly impact the results (The value is also physically unrealistic). Based on discussions during the meeting of December 15, 1982, it is understood that this warning time was in error in the BNL draft.

7-61/64/65 Second paragraph, first sentence; The two tables, 7.26 and 7.27, present a good comparison of the consequences using the same calculational model (CRAC) and therefore, provide a direct measure of the effect of the releases in the consequence calculations. Brookhaven adopted the LGS PRA steam explosion source terms without any modification. The latent fatalities BNL to LGS ratio vary from 0.4 to 1.7 for the various release categories with the OXRE unchanged. The BNL assessment of the OPREL releases is reduced if the suppression pool is not assumed to flash at containment failure. (This is a very conservative assumption in the LGS PRA, which was not assumed by BNL in the risk calculations). The acute fatalities are all higher in the BNL audit calculations. At most a factor of 2.2 is noted in the C4 γ' case.

7-62 Table 7.25; A generic response to this comparison may be summarized as follows. The difference between BNL and LGS source terms are generally more significant in the aerosol release fractions. The elemental iodines are comparable. This could be explained by the more conservative assessment by BNL of the scrubbing effectiveness of saturated pools with respect to the aerosols.

7-81 Paragraph preceeding section 7.3.3; This is a favorable remark by Brookhaven concerning one of the conservative assumptions made in the LGS PRA on sequence binning. The Class IV sequence probability decreases (approximately 48% per table on p. 7-81) because of the shift

from Class IV to Class III of accident event sequences involving the high pressure ECCS systems. This is tempered by the BNL assessment of the probability of the other sequences under Class IV (net increase of 2.9 of Class IV is noted).

Last paragraph, last sentence; The amount of FP retained in the RPV is approximated by the H_2 which remains in the vessel at the end of the meltdown.

This value (70%) is considered high when it is compared to the INCOR calculations for Limerick. The primary system would still blowdown through the SRV's after core melt during the vessel head attack. The coolant is displaced following core slump, and film boiling at the corium-water interface would provide the driving force for the FP's until the head fails. Therefore, the corresponding fission products retained in the RPV would be less than the 70% used by BNL.

7-92 First paragraph, third sentence; In discussions with BNL, apparently, the main concern in this scenario is the resulting pressurization rates which can occur could pose as a threat to containment. Extrapolating from the discussions of core-coolant interactions in Appendix H, the pressurization could be rate limited as well. Therefore, this case may not be worse than the early release to the suppression pool. Again, the core-concrete interaction could be precluded and vaporization release of fission products would not occur.

7-98/99 Second paragraph, Table 7.46; The calculations described are for the different heights at which the meteorological data was obtained at Limerick. The variation shows a drop of latent effects (3%) when the elevated weather data set is used. It was noted in discussions with BNL reviewers that the use of the 175 ft. tower data for OXRE (as was done for the PRA) could reduce the BNL calculated values for the early effects. The effect is expected to be more dramatic than the 3% due to the threshold effects of doses. It is our understanding that this will be performed in the final BNL report risk calculations.