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Docket Nos. 50-295
and 50-304

Mr. George T. Klopp
Commonwealth Edison Company
Post Office Box 767
Chicago, Illinois 60690

Dear Mr. Klopp:

The enclosed meeting agenda outlines the items to be discussed during a meeting to be held on January 28th and 29th between the NRC staff and Commonwealth Edison Company. A compilation of specific questions is also enclosed. We request that you be prepared to address these questions at the meeting.

Sincerely,

/S/

Thomas M. Novak, Assistant Director
for Operating Reactors
Division of Licensing

Enclosures: As stated

cc: See next page

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PROPOSED AGENDA

Meeting with Commonwealth Edison on the Zion Probabilistic Safety Study: Sections 2, 3, 4, 5, 6, 9.

Thursday, January 28, 1982

P-118, Bethesda, Maryland

I	8:30	Opening Remarks ... NRC Staff
II	8:45	Overview of the relationship between the containment event trees (Section 2), phenomenology (Section 3) and transient analysis (Section 4) for the hydrogen-burn containment failure mode. (Include description of propagation of uncertainties.) ... Commonwealth Edison
III	9:30	Plant description: Details of physical plant. ... Commonwealth Edison
	10:30-10:45	BREAK
IV	10:45	Hydrogen Production: In Vessel a. Accident Progression Description b. Phenomenology of Zr/H_2O interaction ... ... Commonwealth Edison
	12:00	LUNCH
V	1:00 pm	Hydrogen Production: Ex Vessel a. Accident Progress description b. Phenomenology of Fe/H_2O interaction (role of concrete and quenching) ... ... Commonwealth Edison
VI	2:00	Hydrogen release (to containment), migration, burning and ESF and containment loading a. Sequence of events b. Phenomenology: Flame temperature criteria; deinerting c. Load analysis: Pressure, temperature, local pressure/temperature effects ... ... Commonwealth Edison
	4:00-4:15	BREAK
VII	4:15-5:00	Hydrogen Wrap up ... Staff and Commonwealth Edison

Friday, January 29, 1982

P-118, Bethesda, Maryland

VIII	8:30 am	Role of corium, water, and concrete interactions in accident progressions; steam explosions (ex-vessel), quenching, debris-bed coolability, core-concrete interactions.
		... Commonwealth Edison
	10:00-10:15	BREAK
IX	10:15	Details of Vessel Failure Analysis
		...Commonwealth Edison
X	11:15	Leakage of fission products prior to structural failure: Why not consider a problem.
		...Commonwealth Edison
	12:00	LUNCH
XI	1:00	Containment Failure Analysis
		...Commonwealth Edison
XII	2:00	Misc. Topics and general discussion
		...Staff and Commonwealth Edison
XIII	3:00	Summaries and Adjournment
		...Staff and Commonwealth Edison

SPECIFIC QUESTIONS/ISSUES THAT SHOULD BE
ADDRESSED AT THE ZION PROBABILISTIC SAFETY STUDY
MEETING OF
JANUARY 28, 29, 1982

(The numbering of questions here is consistent with the numbering of the agenda items.)

III. Plant Description

III-1. Provide details of the obstructions and irregularities in the reactor cavity that might affect the proposed sweepout model coolability considerations and basemat penetration evaluations, such as the sump and the instrument tubes.

III-2. Provide best estimates of the water depths in the reactor cavity at vessel failure for the dominant accident sequences.

III-3. Describe what pieces of equipment or system components, if any, are located within the line-of-sight solid angle from the instrument tunnel.

III-4. Describe the location and relation of fans, filters, cooling coils and ductwork for the containment fan coolers. Will the system continue to function if the filters are clogged?

III-5. Describe the geometric features of rooms, cells or general regions into which hydrogen could be introduced.

IV. Hydrogen Production : In Vessel

IV-1. Discuss hydrogen production from all sources (in-vessel) including the probability of producing those amounts that deviate from your best estimate.

IV-2. Concerning the core heatup, dryout, and initial melting stage of the in-vessel accident progression, you assert that the core heatup and melting evolution is incoherent and results in only small amounts of hydrogen being produced. Based on our assessment of flow velocities and flow patterns and core heat transfer, we believe that a much more coherent heatup, oxidation and meltdown will occur. Considering this, address the following:

(a) justify "oxygen starvation and hydrogen blanketing" under the turbulent conditions that will be present in the core region (e.g. you estimate several centimeters per second steam flow (p. 3.1-16) while we estimate several meters per second).

(b) do you consider natural convection processes in the core region which would tend to cool the hotter portions and heatup the cooler and thus tend to produce a more coherent heatup and meltdown.

(c) how do you account for the heat source from Zr/H2O reaction which could possibly reduce the incoherence by adding heat to the core periphery where the core is not steam starved?

IV-3. During core slumping in-vessel we would expect larger amounts of steel to be present in the corium mix (in addition to larger amounts of molten fuel). Explain how you determined the amount of steel present in the mix which enters the lower head?

IV-4. We estimate a large amount of hydrogen is being produced as the core slumps into the vessel head. A portion of your argument that only small amounts of additional hydrogen are produced is that the particle sizes will be large and that hydrogen blanketing will occur -- both minimizing hydrogen production. Further justify this assessment in light of corium fragmentation experiments (which have yielded very small particles) and the non-prototypic (quiescent) characteristics of "hydrogen blanketing" experiments.

IV-5. In your study, the oxidation of zirconium prior to core slumping is estimated most probably to fall within the range 20-40% of the core cladding. Best estimates of the TMI oxidation however range from 40 to 60%. We believe this latter estimate should be given considerable weight in such estimates. We would like your description of how much weight you have given to these estimates.

IV-6. RE: Section 3.1.1.3. In this section you make a case for in-vessel coolability. For the various sequences considered what probability do you assign to the possibility of coolability (containment event tree mode "H") and how does it affect final conclusions.

V. Hydrogen Production: Ex-Vessel

V-1. Discuss hydrogen production from all sources (ex-vessel) including the probability of producing those amounts that deviate from your best estimate.

V-2 Describe in detail the physical progression and final disposition of the 50% of core material not involved in the vessel failure and cavity dynamics described in Section 3. In particular describe the hydrogen production from this mass of core material.

V-3. Your description of the effect of fuel ejected from the vessel assumes that the concrete is a rather benign material. On the contrary, experiments indicate a vigorous gas evolution from the concrete which could alter your postulated well behaved flow and interaction patterns in the cavity. What is your assessment of the effect of this concrete outgassing, in particular as it relates to the subsequent accident progression and the hydrogen and carbon monoxide production.

V-4. Summarize the amount of metals (wt % and total mass) in the corium entering the cavity for the various cases considered.

V-5. What is the effect of the instrument tube and supporting steel obstructions on the blow out from the cavity.

V-6. In your analysis, vessel penetration times are relatively short. We would assume that because of this, there would be solid components in the ejected corium. Yet your analysis of the removal of material from the cavity assumes a fluid form. Explain this apparent inconsistency.

V-7. We note that the models for fuel sweepout from the reactor cavity appear to be based on failure of the reactor vessel at 2500 psi, as in a TMLB accident. Nevertheless, the sweepout models developed are applied to accidents where the failure occurs as low as a few hundred pounds per square inch. We are told that experiments on the behavior of molten fuel at pressures up to 100 psi have shown no such sweepout. If there is evidence to validate your sweepout models at high pressure or its extrapolation to low pressure, it would be helpful.

VI. Hydrogen Burning

VI-1. In order to enable the staff to place the issue of hydrogen (and carbon monoxide) burning into an appropriate perspective, provide us with the probabilities you assigned to those classes and bounding cases that result in vigorous hydrogen burns as listed in the Tables 4.3.1, 2, 3, 4, 5 and 6.

VI-2. Discuss the flame temperature criterion. In particular explain how the "H2 Burn Probabilities" and the times above and below the FTC were determined. Explain your position that this criterion is conservative since it appears to preclude the accumulation of mixtures that permit detonation phenomena.

VI-3. Discuss how, if at all, you included in the ZPSS the potential for large burns resulting from restoration of containment cooling at a point when large quantities of hydrogen are present in the containment.

VI-4. You use a single-volume containment model and assume a homogeneous mix of hydrogen. We are concerned that insufficient attention has been given in the analysis to non-uniform effects including non uniform distributions of hydrogen in the containment which could lead to the possibility of damaging detonations in local regions (damaging to ESF and to the containment itself). Please elaborate on these matters.

VIII. Core/Water/Concrete Interactions

VIII-1 Quenching of the debris depends on the ability to supply coolant and to extract heat. Most of the analyses in the PRA consider only the limitation of providing coolant (see for example pp. 3.2-13 and 3.2-14). Explain how potential formation of a crust over the debris and the resulting reduction in the ability to extract heat will alter any conclusion on quench rate, steam-inerting of containment, and hydrogen generation.

Further, explain how a potential crust over the debris will alter the arguments for core debris expulsion from the cavity - in particular entrainment and flow up out of the cavity.

VIII-2. Analyses of basemat penetration are based on penetrating the entire 9 foot basemat. Explain how penetration of the two foot thick basemat below the reactor cavity sump will be prevented and how earlier penetration of this section will alter risk.

VIII-3 Gas evolution due to core debris concrete interactions is evaluated only during discharge and some long-term interactions. What gas evolution would be associated with other steps of the dynamic dispersal described in the PRA? Examples of these steps are flow of debris up the key-way walls and restriction of concrete attack to twice the area of the jet. Consider also the experimentally demonstrated fact that flowing materials erode concrete more rapidly than a nonflowing pool.

VIII-4. Explain why debris bed stratification by particle size and its well-known inhibition of coolability was not considered in assessing the coolability of fragmented core debris.

Also, coolability is quite dependent on the packing efficiencies of the particulate. A 60% efficiency is assumed throughout the analysis. It is known the distributed particle-size masses can pack more efficiently than this. Explain how the conclusion of permanent coolability of fragmented core debris might be changed if packing efficiency were increased to 75%.

IX Vessel Failure

IX-1 What are the ramifications of multiple instrument tube failures (say 12 to 24) on the accident progression? Consider the steam explosion potential when large amounts of water are present in the cavity.

IX-2 Be prepared to discuss the ZPSS analysis of the vessel failure mode considering such items as the uniform temperature assumption, the role of crusts and plugging, nonuniform wall fluxes, steel ablation, and the composition of the corium attacking the vessel.

IX-3 What probability do you associate with the scenario where the core barrel fails and the molten pool and core support plate fall into the plenum? What are the vessel failure implications?

XI Containment Failure Analysis

XI-1 In your analysis the section of the cylinder at the junction with the foundation mat has not been considered on the ground that the effects of loading at this discontinuity is self-limiting. Explain what you mean by self-limiting.

XI-2 If self-limiting involves cracking of concrete, yielding of reinforcing steel and steel liner, how can you know that the integrity, structural as well as leaktightness, of the containment is insured without making any analysis of this portion of the containment.

XI-3 Indicate whether the steel liner strain values obtained in experiments are based on uniaxial or biaxial tension tests. If based on uniaxial tensile tests, how can such test data be applied to the steel liner which is under biaxial tension?