October 29, 1982

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
THE CLEVELAND ELECTRIC	)	Docket Nos. 50-440
ILLUMINATING COMPANY, ET AL.	)	50-441
	)	
(Perry Nuclear Power Plant,	)	
Units 1 and 2)	)	

APPLICANTS' ANSWER TO OHIO CITIZENS FOR RESPONSIBLE ENERGY FIFTH SET OF INTERROGATORIES TO APPLICANTS

Applicants for their answers to Ohio Citizens for Responsible Energy ("OCRE") Fifth Set of Interrogatories to Applicants, dated September 13, 1982, state as follows:

All documents supplied to OCRE for inspection will be produced at Perry Nuclear Power Plant ("PNPP"). Arrangements to examine the documents can be made by contacting Mr. Ronald Wiley of The Cleveland Electric Illuminating Company at (216) 259-3737. Applicants will provide copies of any of the produced documents, or portions thereof, which OCRE requests, at Applicants' cost of duplication. Arrangements for obtaining copies can be made with Mr. Wiley.

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Applicants' counsel and Ms. Susan Hiatt, OCRE's interim representative, conferred by telephone on October 26, 1982, regarding Applicants' objections to OCRE's interrrogatories. Applicants' counsel and Ms. Hiatt were unable to agree on the scope of Issue #8.

RESPONSES

5-1. What do Applicants consider to be the equivalent of a TMI-2 accident at Perry? Provide the probability of its occurrence and a thorough description of its consequences, including fuel failure modes, effect on containment integrity, and off-site doses to the public at 2, 5, 10 and 50 miles from PNPP.

Response:

Applicants do not believe that there is a credible BWR/6 accident scenario equivalent to the TMI-2 scenario.

The TMI-2 accident was a small break loss-of-coolant accident ("LOCA") that was not recognized by the plant operators. The accident was complicated by a series of equipment failures and operator errors which combined to produce severe damage to the plant. A comparison of the major complications at TMI-2 with the BWR/6 design demonstrates that there are unique features and characteristics of the BWR/6 which will protect against and mitigate the type of accident scenario that occurred at TMI-2.

The TMI-2 accident began with a loss of feedwater and unavailability of auxiliary feedwater. These events combined to deprive the reactor of its heat sink. The Mark III containment used in PNPP has a large suppression pool inside the containment which provides a passive heat sink for primary system energy during a LOCA. This heat sink capacity is sufficient to accommodate stored thermal energy and decay heat from the reactor for several hours with the reactor isolated from its normal heat sink.[1/]

The TMI-2 event became a small break LOCA when a power operated primary relief valve stuck open, resulting in the overpressurization of its quench tank, discharge of primary system water to the containment, and activation of the Emergency Core Cooling System ("ECCS"). The functional equivalent of a power operated primary relief valve for the BWR/6 is the Safety Relief Valve ("SRV"). The SRVs open to relieve pressure increases that occur during expected transients and during certain accident conditions. Each SRV is piped to the large suppression pool. Since the SRVs are designed for routine use in BWRs, the isolation with "stuck

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1/ In addition, the BWR/6 has a High Pressure Core Spray ("HPCS") system and a Reactor Core Isolation Cooling ("RCIC") system to maintain the vessel water level automatically. The primary water source for both systems is the condensate storage tank. The operator thus is not required to do anything with the water level in the vessel. Consequently, a TMI-2 type initiation event for a BWR/6 is no more than a transient occurrence that interrupts reactor operation.

open" valve is a design transient that is considered in standard plant and containment analyses. The containment would not be significantly pressurized by SRV blowdown. Automatic initiation of the makeup systems would maintain the reactor water level. There would be no TMI-2 type complications arising from SRV actuation and subsequent failure to close; such an event would be only a minor transient at PNPP.

The TMI-2 operators were misled into believing that the reactor core was sufficiently covered. This failure was caused by their reliance on the pressurizer level, which gave an indirect and ambiguous measure of the water level in the reactor. At PNPP, however, the water level in the reactor vessel is measured continuously and directly using multiple and redundant instrumentation. The reactor water level also is displayed redundantly in the control room at the reactor control console and other control room locations in full view of the operator.

The TMI-2 operators did not recognize, and, therefore, did not respond promptly to the existence of boiling in the reactor. Boiling, however, is the normal mode of BWR operation. Water is circulated directly through the reactor core where it boils to produce saturated steam which is separated from recirculation water, dried in the top of the vessel, and directed to the steam turbine generator. Because boiling is normal in BWRs, no operator action is required by boiling in the reactor.

The noncondensible gases (predominantly hydrogen) trapped in the TMI-2 vessel inhibited natural circulation cooling. Significant amounts of noncondensible gases cannot be formed in the PNPP vessel for any credible accident because a number of BWR unique features would prevent the core temperatures from reaching the level required for hydrogen generation by metal-water reaction. However, if any noncondensible gases should form inside the PNPP vessel, the gases could be vented either through the SRVs or through the vessel dome vent line. Furthermore, because any noncondensible gases which might form would rise to the top of the vessel along with the steam that is generated in the core, natural circulation cooling in PNPP would not be inhibited by noncondensible gases. During reactor shutdown conditions, any small amounts of noncondensible gases that might form would be swept with the steam either to the condenser (via the turbine bypass valve) or to the suppression pool (via the SRVs). The reactor vessel head also can be remotely vented to the drywell from the control room. Thus, the formation of noncondensible gases would not hinder natural circulation during an abnormal event or hamper eventual recovery of the core.

Natural circulation at TMI-2 was interrupted by voids resulting from boiling and noncondensible gases trapped in the primary system. As clearly noted, neither boiling nor noncondensible gases are obstacles to natural circulation cooling at

PNPP. Moreover, strong natural circulation internal to the reactor vessel is a significant inherent feature of the PNPP reactors, which are capable of operating at significant power under natural circulation conditions while retaining core cooling margins.

With the reactor shut down, natural circulation mechanisms provide adequate core cooling to maintain temperatures at all points in the core well below the temperatures necessary for hydrogen generation, as long as the core is covered. For an accident of the type experienced at TMI-2, maintenance of natural circulation at the PNPP units would occur automatically and would not require operator action.

The TMI-2 reactor was maintained partially pressurized following the accident because of concern over boiling in the reactor and possible core uncovery due to expansion of the noncondensible gas bubble. Because the PNPP units are designed for boiling and provide for venting of noncondensible gases, they can be depressurized safely during an emergency. Depressurization through the SRVs to the suppression pool can be initiated either automatically or manually.

Partial uncovering of the core at TMI-2 led to inadequate core cooling and resulted in core damage. The PNPP reactors are designed with multiple water sources and injection delivery systems to maintain adequate core cooling. The diverse and redundant water supply capability to the PNPP reactor vessels is due in part to the direct cycle BWR design, in which normal pumping systems (feedwater, control rod drive cooling, and RCIC) provide makeup water to the reactor vessel. In addition, ECCS assures adequate cooling during an emergency via HPCS, Low Pressure Coolant Injection ("LPCI"), and Low Pressure Core Spray ("LPCS"). These systems include the capability to spray the core from above and refill it from below at both high and low pressure. A brief description of each of the primary makeup systems follows.

RCIC is initiated automatically when the water level in the reactor vessel drops below a preselected level. RCIC supplies makeup water from the condensate storage tank (primary source), the suppression pool, or, following manual operator action, from the steam condensed in the residual heat removal system ("RHR") heat exchangers. Through these sources, RCIC maintains sufficient makeup water in the vessel to cool the core. It then maintains the reactor in safe standby condition or allows for complete plant shutdown.

HPCS is a high pressure system that provides core cooling by spraying water over the fuel assemblies and makeup water in the unlikely event of loss of reactor coolant inventory. The system permits the plant to shut down while maintaining sufficient reactor vessel water inventory. Operation of the system is initiated automatically from signals indicating low reactor water level or high drywell pressure. The HPCS pump supplies makeup water from the condensate storage tank or the suppression pool.

LPCI is a low pressure system designed to restore and maintain the water level in the reactor vessel after a LOCA so that the core is sufficiently cooled to prevent fuel cladding heat up. The three LPCI pumps are initiated automatically by either high drywell pressure or low reactor water level, and inject at low vessel pressure. Water is supplied to the vessel from the suppression pool. The system continues to operate until it is manually stopped by the operator.

LPCS is a second low pressure system designed to prevent fuel cladding heat up in the event the core is uncovered by a LOCA. The cooling is accomplished by directing jets of water over the fuel assemblies from spray nozzles mounted on a ring above the reactor core. The LPCS pump is initiated automatically on low reactor water level or high drywell pressure, and injects at low vessel pressure. Water is supplied to the vessel from the suppression pool. The system continues to operate until it is manually stopped by the operator.

These systems (HPCS, RCIC, LPCI, and LPCS), together with the inherent natural circulation, provide very large decay heat removal capability and ensure that the core temperatures will be maintained for any credible BWR accident well below the levels required for hydrogen generation by metal-water reaction.

The accident at TMI-2 released radiation to the environment because of incomplete containment isolation and containment bypass leakage. The Mark III primary containment isolates when the ECCS initiates. In addition, the Mark III containment provides suppression pool "scrubbing" of potential fission product releases as well as a secondary containment with engineered safeguard leakage filtration systems.

These comparisons demonstrate that there is no credible BWR/6 accident scenario equivalent to the accident that occurred at TMI-2.

5-2. Give the percent elemental composition of the Zircaloy fuel rod cladding used in Perry.

Response:

The General Electric Company Zircaloy fuel rod tubing meets the following elemental composition envelope:

Element	Weight %
Tin	1.20 - 1.70
Iron*	0.07 - 0.20
Chromium*	0.05 - 0.15
Nickel*	0.03 - 0.08
Oxygen	0.07 - 0.15
Zirconium	Balance

* The iron, chromium and nickel combined have a weight % ranging from 0.18 to 0.38.

5-3. Give the following dimensions of the fuel rod cladding used in PNPP:

(a) mass
(b) volume
(c) surface area (outside and inside of cladding)
(d) length of fuel rods
(e) thickness of cladding
(f) diameter (outside) of cladding

Response:

Items (d) through (f) are contained in PNPP FSAR Chapter 4, Table 4.2-4. Using the theoretical Zircaloy clad density of 6.55 grams/cubic centimeter, the mass of the fuel rod cladding is 74,567 pounds weight. The volume of the fuel rod cladding is 315,400 cubic inches. The surface area of the fuel rod cladding is 10,556,000 square inches outside and 9,157,000 square inches inside.

5-4. Give the model, type, and manufacturer of the recombiners. Provide all manufacturer's data and specifications.

Response:

The PNPP recombiners are supplied by Westinghouse Electric Corporation in accordance with Gilbert Associates, Inc. Specification SP-628-4549-00. The Specification will be supplied for examination at PNPP. They are Model B, natural convection, flameless, thermal reactor-type hydrogen oxygen recombiners to form water vapor.

5-5. Section 6.2.5.2.3 of the FSAR states that the recombiners are "100% capacity." Explain what is meant by this.

Response:

"100% capacity" means that for any design basis accident, one hydrogen recombiner operating at a minimum capacity of 100 scfm will be able to maintain the hydrogen concentration below 4% by volume.

5-6. At what range of H_2 concentrations (in volume-%) are the recombiners effective in reducing the H_2 concentration below flammable limits?

Response:

The recombiners are effective up to a hydrogen concentration of 4% by volume in containment in maintaining hydrogen concentration below the lower flammable limit of 4%.

5-7. At what concentration of H_2 (volume-%) would the recombiners become an ignition hazard?

Response:

The level of hydrogen concentration necessary to achieve a burn ranges from 4% to 8% by volume. If the recombiners were on at that hydrogen concentration, they could cause a hydrogen burn.

5-8. Would the recombiners be turned off if this concentration is reached? If not, why not?

Response:

To the extent that hydrogen concentrations above 4% by volume could be generated, Applicants' symptom oriented procedures will preclude the recombiners from being turned on. However, there are no credible accident scenarios that can generate hydrogen concentrations above 4% by volume.

5-9. Would the recombiners ever be turned off if the H_2 concentration exceeded a certain value? At what value?

Response:

See Applicants' Response to Interrogatory #5-8, supra.

5-10. Provide all details of the Perry distributed igniter system, including type and manufacturer of glow plugs, with all data and specifications, lifetime of the glow plugs, and whether they are qualified for the environment expected (post-LOCA), including suppression pool loads.

Response:

The requested information is contained in Applicants' "Preliminary Report on the Hydrogen Control System," and the manufacturer's procurement specifications. The Report and the specifications will be supplied for examination at PNPP.

5-11. Are the igniters manually or automatically operated?

Response:

The igniters are manually initiated.

5-12. Produce all plant operating procedures/guidelines pertaining to the hydrogen control systems, including the analyzers, mixers, recombiners, igniters, and back-up purge.

Response:

The procedures still are being developed.

5-13. What parts of the hydrogen control system would be used concurrently. E.g., would the mixers and recombiners be operated along with the igniters?

Response:

The parts of the control systems that may be used concurrently will be dealt with in the procedures that still are being developed.

5-14. At what range of H_2 concentrations (volume-%) are the igniters effective in reducing the H_2 concentration below flammable limits?

Response:

The igniters will induce combustion when hydrogen concentration reaches a range of 4% to 8% by volume, with an oxygen concentration of at least 5% by volume. Hydrogen will continue to burn until all oxygen or hydrogen is consumed.

5-15. At what concentration of H_2 would the igniters become an ignition hazard such that they could trigger an explosion which could threaten containment integrity?

Response:

The hydrogen igniters are designed to burn hydrogen at low concentrations to prevent a large concentration of hydrogen from developing, thus precluding any detonations and threat to containment integrity.

5-16. Would the igniters be turned off if this concentration is reached? If not, why not?

Response:

Because the igniters will burn off the hydrogen at low concentrations, see Applicants' Response to Interrogatory #5-15, *supra*, hydrogen concentrations that could threaten containment integrity would not be reached. There thus is no need to turn off the igniters.

5-17. Would the igniters ever be turned off if the H_2 concentration exceeded a certain value? At what value?

Response:

See Applicants' Responses to Interrogatories #5-15 and #5-16, *supra*.

5-18. Describe the expected operational characteristics of the igniter system. What pressure and temperature transients will be experienced by the containment and the equipment therein? Is the controlled hydrogen ignition expected to be cyclic?

Response:

A study presently is underway which will establish the pressure and temperature conditions resulting from a controlled hydrogen burn. A controlled hydrogen burn is expected to be cyclic.

5-19. No Interrogatory.

5-20. Is the equipment in the containment subject to such conditions qualified for repeated pressure pulses and temperature transients? Document all such qualification.

Response:

A study presently is underway which will demonstrate that the components inside the containment will survive the pressure and temperature conditions resulting from a controlled hydrogen burn.

5-21. Would cyclic pressure pulses produced by the controlled hydrogen ignition damage any valves/components between the wetwell and drywell (e.g., vacuum breakers and H_2 mixing system), thereby allowing bypass of the suppression pool? Provide documented studies showing this would not happen.

Response:

A study presently is underway to determine the magnitude of the pressure pulses produced by a controlled hydrogen burn. The effect of the pressure pulses on various components in the containment will be evaluated in light of the results of the study.

5-22. Can individual glow plugs be controlled separately? Or are all energized simultaneously, with no individual control?

Response:

The igniters are energized simultaneously.

5-23. Provide documentation showing that all parts of the hydrogen control system meet GDC 41 to 10 CFR Part 50, pertaining to redundancy in components and power supply.

Response:

Compliance of Applicants' Hydrogen Control System, the distributed igniter system (see § 2 of Applicants' "Preliminary Report on the Hydrogen Control System"), with GDC 41 is discussed in Applicants' "Preliminary Report on the Hydrogen Control System." The Report will be supplied for examination at PNPP.

5-24. Demonstrate that the hydrogen control system meets GDC 42 to 10 CFR Part 50.

Response:

Compliance of Applicants' distributed igniter system with GDC 42 is discussed in Applicants' "Preliminary Report on the Hydrogen Control System." The Report will be supplied for examination at PNPP.

5-25. Demonstrate that the hydrogen control system and PNPP procedures will meet GDC 43 to 10 CFR Part 50.

Response:

Compliance of Applicants' distributed igniter system and procedures with GDC 43 is discussed in Applicants' "Preliminary Report on the Hydrogen Control System." The Report will be supplied for examination at PNPP.

5-26. How quickly could hydrogen generation cause an explosive mixture in the drywell and containment (answer for both) following:

(a) an accident Applicants condider to be the equivalent of a TMI-2 accident for Perry;

(b) what Applicants consider to be the worst-case accident in terms of H_2 generation for Perry;

(c) the following accident sequences as defined in NUREG/CR-1659 Volume 4 (RSS Methodology applied to Grand Gulf):

(1) AI

(2) AE

(3) AC

(4) SI

(5) SC

(6) SE

(7) T_1PQI

(8) T_1PQE

(9) $T_{23}PQI$

(10) $T_{23}PQE$

(11) T_1QW

(12) T_1QUV

(13) T_1C

(14) T_1QUW

(15) $T_{23}C$

(16) $T_{23}QW$

(17) $T_{23}QUW$

(18) $T_{23}QUV$

Response:

(a) As stated in Applicants' Response to Interrogatory #5-1, supra, if a BWR such as PNPP were subjected to event initiating conditions analogous to those of the TMI-2 accident, no metal-water reaction would occur. Although a small amount of hydrogen might be generated by radiolysis, the amount would be negligible and far below ignition levels. Thus, for conditions analogous to the accident initiating events at TMI-2, neither flammable nor explosive hydrogen mixtures would be formed in the containment or the drywell.

(b) The worst case design basis accident scenario in terms of hydrogen generation is a design basis LOCA. For a design basis LOCA, the hydrogen control equipment for the standard BWR plant (recombiners) is designed to prevent the formation of an explosive or even flammable mixture in the containment or the drywell. However, Applicants object to part (b) of the Interrogatory as irrelevant and beyond the scope of Issue #8 because the design basis LOCA scenario is not analogous to the accident initiating conditions at TMI-2. See objection to part (c) below.

(c) Because none of the postulated sequences are analogous to the accident initiating conditions at TMI-2, Applicants object to part (c) of the Interrogatory as irrelevant and beyond the scope of Issue #8. See 10 C.F.R. § 2.740(b)(1); see generally Cleveland Electric Illuminating Co. (Perry Nuclear Power Plant, Units 1 and 2), ALAB-675, slip op. at 19 ("the contention is predicated on the assumption of a TMI-2 type accident"). Applicants also object to part (c) of the Interrogatory on the ground that such analyses have not been conducted for PNPP, and Applicants are under no obligation to conduct such analyses in response to a discovery request.

5-27. What do Applicants consider to be the worst-case accident in terms of H_2 generation at Perry? Provide the probability of its occurrence and a thorough description of its consequences, including fuel failure modes, effect on containment integrity, and off-site doses to the public at 2, 5, 10, and 50 miles from Perry.

Response:

The design basis LOCA is considered to be the worst case design basis accident in terms of hydrogen production. The probability of a design basis LOCA is 1×10^{-4}. The consequences of a design basis LOCA, including fuel failure modes, effect on containment integrity, and off-site doses, are discussed in PNPP FSAR § 15.6.5. However, Applicants object to the Interrogatory as irrelevant and beyond the scope of Issue #8. See Applicants' objections to parts (b) and (c) of Interrogatory #5-26, supra.

5-28. Describe all sources of ignition within the drywell and containment. Include in this assessment all components of the H_2 control system.

Response:

Any components that can produce sparks, such as electrically operated valves, electric motors, and switches, theoretically could serve to ignite hydrogen within the drywell and the containment. The distributed igniters, however, will preclude such components from serving as ignition sources. The placement of the igniters and the fact that the igniters will ignite hydrogen at relatively low concentrations will insure that the igniters, and not other components, will serve as the hydrogen ignition source.

5-29. Provide a diagram of the PNPP containment (including drywell) showing locations of the recombiners, glow plug igniters, mixer components, and analyzer sampler areas.

Response:

The Combustible Gas Control System components are located on the following drawings:

Component	Tag No.	Drawing	Location
Hydrogen Recombiners	M51D001A M51D001B	D-304-831 D-304-831	CO/16-644 CO/13-644
Drywell Mixing System	M51C001A	D-304-831	CO/16-644
Compressors	M51C001B	D-304-831	CO/13-644
Hydrogen Analyzer	H51P022A	E-001-032	AXD/AX3-620
Panels	H51P022B	E-001-043	IBC/IB3-654

These drawings will be supplied for examination at PNPP.

The locations of the glow plug igniters are described in Applicants' "Preliminary Report On the Hydrogen Control System." Appropriate drawings are being prepared. The Report and the drawings will be supplied for examination at PNPP.

5-30. Does the analyzer have the ability to map the H_2 concentration in the containment, as recommended in NUREG/CR-1561, p. 134?

Response:

As described in PNPP FSAR § 6.2.5.2.1, each redundant hydrogen analyzer in PNPP is piped to four sample points. These sample points are considered to be representative of the containment and drywell regions. Thus, the hydrogen detection system monitors hydrogen concentration throughout the containment.

5-31. Does the analyzer meet the criteria of IEEE Standards 323, 334, and 344? Demonstrate this compliance.

Response:

The hydrogen analyzers have been qualified to IEEE 323 and 344, as stated in PNPP FSAR § 6.2.5.2.1. Documentation is available in Comsip, Inc. Qualification Report #1035-1, Dec. 1980. The Report will be supplied for examination at PNPP.

Because IEEE 334 deals with class 1E motors, and no such motors are contained in the hydrogen analyzer, IEEE 334 is not directly applicable. However, the motors used in the analyzer are qualified to the environments they will be subjected to, as set forth in the above cited manufacturer's qualification report.

5-32. FSAR Section 6.2.5.2.1 states that delaying the start of the H_2 analysis until 15-60 minutes following the LOCA will avoid exposing the analyzer to severe sample conditions. Are the analyzers designed to withstand such conditions? If not, why not? What assurance is there that the severe conditions will not persist beyond 15-60 minutes after the LOCA?

Response:

As stated in PNPP FSAR § 6.2.5.2.1, the analyzers are designed and qualified to withstand maximum LOCA conditions. The analyzers are fully capable of functioning under maximum LOCA conditions should such conditions exist when the analyzers are initiated. Therefore, no assurance is needed that severe conditions will not persist beyond 15-60 minutes after a LOCA.

5-33. What judgements will be made by operators as to when in the 15-60 minute period following the LOCA to start the H_2 analysis? Upon what will these judgements be based?

Response:

The operating procedures still are being developed.

5-34. Describe in detail how the samples are brought to the analyzers. Are any manual actions needed?

Response:

PNPP FSAR § 6.2.5.5 describes in detail the actions required to place the hydrogen analyzers in operation.

5-35. How long is the time period from initiation of the H_2 analysis to obtaining results?

Response:

The hydrogen analyzers are operated in a standby mode during normal plant operation, thereby obviating warmup when hydrogen analysis is initiated. Thus, the only delay in obtaining results is transport time of the sample. Based on design conditions, the sample transport time for the longest sample line is less than one minute.

5-36. Does the "grab sample" technique permit continuous monitoring of the containment atmosphere? If not, at what intervals are samples taken? How are these intervals decided upon?

Response:

The "grab sample" technique does not provide continuous monitoring of the containment atmosphere. However, the

PNPP hydrogen analyzers do not use the "grab sample" technique. The PNPP hydrogen analyzers provide continuous analysis of a selected point or automatically sequence sample points. Because continuous analysis is used, there are no intervals between taking samples.

5-37. Demonstrate that the Perry H_2 analyzer has met all 9 criteria listed on p. 195 of Volume 2 of NUREG/CR-2017.

Response:

As described in PNPP FSAR § 6.2.5.2.1, the hydrogen analyzers in PNPP are the thermal conductivity type. Table 1 on page 200 of NUREG/CR-2017 indicates that the thermal conductivity type hydrogen detector meets characteristics 1 through 6 and 8 and 9. With respect to characteristic 7 (radiation), the analyzer has been tested and successfully qualified for PNPP, as documented in Comsip, Inc. Qualification Report No. 1035-1, December 1980. The report documents that radiation has no detrimental effects. The report will be supplied for examination at PNPP.

5-38. Provide all manufacturer's data and specifications for the H_2 analyzer system.

Response:

The hydrogen analyzers manufacturer's data and specifications are available in:

1) Comsip, Inc. Instruction Manual.
2) Comsip, Inc. Qualification Report No. 1035-1.
3) Comsip, Inc. Drawing 063720.
4) Comsip, Inc. Drawings 063701 and 063702.

These documents will be supplied for examination at PNPP.

5-39. How many repeat measurements are made of H_2 concentration before the operators will accept the results as valid?

Response:

The operators will accept all hydrogen measurements as valid unless the validity of the measurements is disproved by at least two independent indications.

5-40. Have Applicants considered any other types of analyzer (sampler-detector) systems, e.g., acoustic or fluidic oscillator detectors? If so, provide all conclusions as to why these systems are not used at Perry.

Response:

No.

5-41. For containment H_2 concentrations above 4 volume-%, would the mixers accelerate combustion by providing a uniformly combustible atmosphere in the containment? If so, is the mixing system shut off when the H_2 concentration reaches a certain value? At what value?

Response:

The mixers are designed to inhibit combustion by preventing the formation of localized concentrations of hydrogen. The mixing of the containment atmosphere to obtain a more uniform atmosphere does not "accelerate" combustion. Applicants have no plans to shut off the mixers at a certain H_2 concentration level.

5-42. Provide offsite radiation doses (whole body and thyroid) to the public at 2, 5, 10, and 50 miles from PNPP resulting from containment purge following each of the accidents listed in interrogatory 5-26.

Response:

Because virtually no hydrogen would be produced if a BWR such as PNPP were subjected to event initiating conditions analogous to those of the TMI-2 accident, there would be no containment purge for such an "accident."

As for the design basis LOCA, the off-site doses resulting from a purge using the backup hydrogen purge system are described in PNPP FSAR Table 15.6-5. However, Applicants object to this portion of the Interrogatory as irrelevant and beyond the scope of Issue #8. See Applicants' objection to part (b) of Interrogatory #5-26, supra.

As for the postulated accident sequences of part (c) of Interrogatory #5-26, Applicants object to this portion of the Interrogatory as irrelevant and beyond the scope of Issue #8. See Applicants' objection to part (c) of Interrogatory #5-26, supra. Applicants also object because no such analyses have been conducted for PNPP, and Applicants are under no obligation to perform such analyses in response to a discovery request.

5-43. Have Applicants considered other hydrogen control measures (e.g., containment inerting, post-accident inerting, halon suppressents [sic] in the containment atmosphere, use of sodium metavanadate ($NaVO_3$) in the coolant to inhibit H_2 production from the radiolysis of water) for Perry? List all measures which were considered and indicate why they were not chosen.

Response:

The other hydrogen control measures that were considered, and the reasons they were not chosen, are discussed in Appendix A to Applicants' "Preliminary Report on the Hydrogen Control System." The Report will be supplied for examination at PNPP.

5-44. SECY-80-107A contains view-graphs presented by General Electric to the NRC which state that containment inerting, hydrogen ignition, recombiners, and purging are all impractical for significant rates of H_2 production. Do Applicants agree? If not, why not?

Response:

For the reasons set forth in Applicants' "Preliminary Report on the Hydrogen Control System," Applicants believe that distributed igniters adequately control hydrogen generated as the result of degraded core conditions. The Report will be supplied for examination at PNPP.

5-45. The NRC has stated that hydrogen control methods that do not involve burning provide protection for a wider spectrum of accidents than do those that involve burning. 46 FR 62282. Do Applicants agree? If not, why not?

Response:

Applicants have no basis for agreeing or disagreeing with the referenced statement since the NRC has never clarified which hydrogen control methods (other than burning) are being referred to, and what is meant by "a wider spectrum of accidents."

5-46. NUREG/CR-1561 at 12 states that recombiners are inadequate for controlling hydrogen generated by metal-water reactions. Do Applicants agree? If not, why not?

Response:

The referenced sentences read in full as follows:

> [The recombiners] are primarily intended to handle the radiolytic generation of hydrogen. For accidents in which the core has been uncovered and metal-water reactions are occurring, the recombiners would be inadequate.

Applicants agree with the above quoted statement.

5-47. Could the ignition of hydrogen by the glow plugs produce missiles that could damage the containment or any equipment therein? Provide documentation showing that this could not happen.

Response:

A study presently is underway to determine containment pressure and temperature conditions resulting from a controlled hydrogen burn. Whether missiles could be generated by the distributed igniters will be reviewed in light of the results of the study.

5-48. What methods do Applicants intend to use for the removal of the heat of combustion from containment when using the igniters and recombiners?

Response:

Applicants intend to use the containment sprays and the natural heat sinks within the containment for removal of the heat generated by a controlled hydrogen burn.

5-49. Have Applicants performed any analyses of the type which would be required by the proposed rule, "Interim Requirements Related to Hydrogen Control," 46 FR 62281, December 23, 1981? Produce all such analyses.

Response:

The proposed rule lists three analyses which shall be performed: an evaluation of the consequences of large amounts of hydrogen generated after the start of an accident, including consideration of hydrogen control measures as appropriate; an analysis justifying the selection of the chosen hydrogen control system; and, an analysis showing that containment structural integrity will be maintained. See 45 Fed. Reg. 62285 (Dec. 23, 1981). Applicants have performed the second of the three analyses as to PNPP. See Applicants' "Preliminary Report on the Hydrogen Control System." The Report will be supplied for examination at PNPP. The Report also contains part of the third analysis as to PNPP. Studies presently are underway to do the first analysis as to PNPP and complete the third analysis as to PNPP.

5-50. Describe the design of the high point vents required for the reactor coolant system by 10 CFR 50.44(c)(3)(iii). Provide diagrams, as appropriate. Into what area would the gases released by the vents enter and/or accumulate?

Response:

The design of the high point vents is described in PNPP FSAR Appendix 1A, Item No. II.B.1., at pages 1A-38 - 1A-40. A diagram can be found in PNPP FSAR Figure 5.1-3. The vents discharge to the drywell.

5-51. What is the ultimate strength of the Mark III containment? Of the drywell?

Response:

The ultimate strength of the Mark III containment is set forth in Applicants' interim report, "Ultimate Structural Capacity of Mark III Containments." The Report will be supplied for examination at PNPP. Although the precise ultimate capacity of the drywell structure has not been calculated, because the design strength of the drywell structure is substantially greater than the design strength of the containment, the ultimate strength of the drywell structure is greater than the ultimate strength of the containment.

5-52. Has the assessment of containment strength considered both static and dynamic loads? List all assumptions made in this evaluation.

Response:

The ultimate containment strength has been assessed for both static and dynamic loads. The assumptions underlying both analyses are discussed in Applicants' interim report, "Ultimate Structural Capacity of Mark III Containments." The Report will be supplied for examination at PNPP.

5-53. Has the assessment of containment strength considered containment penetrations as possible points of rupture? If not, why not?

Response:

Applicants' interim report, "Ultimate Structural Capacity of Mark III Containment," recognizes that containment penetrations could serve as possible points of rupture. The final ultimate capacity study presently underway will provide a more detailed assessment of containment penetrations as possible points of rupture.

5-54. Is the assessment of containment strength based on any experimental data? Produce all studies supporting the containment analysis.

Response:

Although the assessment of the containment strength is in the form of an analytical model, various inputs in the model -- such as manufacturers' specifications and industry codes -- are themselves based on experimental data. In this regard, see the references listed on page 12 of Applicants' interim report, "Ultimate Structural Capacity of Mark III Containments." The Report will be supplied for examination at PNPP.

5-55. Could overpressure from hydrogen production alone (no explosion) be sufficient to rupture the containment? Provide documentation showing that this could not happen.

Response:

As stated in Applicants' Response to Interrogatory #5-1, if a BWR such as PNPP were subjected to event initiating conditions analogous to those of the TMI-2 accident, no metal-water reaction would occur. Although a negligible amount of hydrogen might be produced, it would be so insignificant that it could not possibly rupture the containment. Applicants object to the Interrogatory to the extent that it seeks information going beyond the scope of Issue #8. See Applicants' objections to parts (b) and (c) of Interrogatory #5-26.

5-56. Describe the pressure and temperature transients which would be experienced by the containment from the complete combustion of the following concentrations of hydrogen (vol-%, assume abundant oxygen):

(a) 4%
(b) 6%
(c) 9%
(d) 12%
(e) 18%
(f) 24%
(g) 33%

Response:

A study presently is underway which will determine the containment pressure and temperature conditions resulting from a controlled hydrogen burn at PNPP. The study will not, however, deal with each of the discrete hydrogen volume percentages requested by the Interrogatory. Applicants object to the Interrogatory on ground that they are under no obligation to perform such analyses in response to a discovery request. Applicants will, however, supply the study for examination at PNPP when the study has been completed.

5-57. Are the results given above based on any experimental data or studies specific to either the Perry or the generic Mark III containment? Produce all such studies.

Response:

The requested information will be provided when the study referenced in Applicants' Response to Interrogatory #5-56, <u>supra</u>, has been completed.

5-58. List any assumptions made in the preparation of such studies, e.g., regarding the quenching effects of steam/humidity or the effect of containment structures and equipment on flame fronts.

Response:

The requested information will be provided when the study references in Applicants' Response to Interrogatory #5-56, supra, has been completed.

5-59. What is the capacity, in scfm, of the mixers?

Response:

Each unit has a mixing system, which has two redundant motor driven compressors with an air flow rate of 500 scfm per compressor.

5-60. Would blowdown through the suppression pool, either through the safety-relief valves or through overpressure in the drywell (e.g., large break in drywell) exceed the capacity of the mixers? Provide documentation that this would not happen.

Response:

Blowdown through the suppression pool would not exceed the capacity of a compressor in the mixing system. A prototype drywell purge compressor has been tested under LOCA conditions to insure operation following a LOCA. See PNPP FSAR § 6.2.5.2.2.

5-61. Would direct leakage from the drywell to the containment (bypassing the suppression pool) exceed the capacity of the mixers? Provide documentation showing that this could not happen.

Response:

No. There only is negligible bypass leakage from drywell to containment. See PNPP FSAR § 6.2.1.1.5.

5-62. From what area in the containment do the recombiners take suction? Could direct drywell-to-containment leakage dissipate hydrogen outside this region? Provide documentation showing that this could not happen.

Response:

As shown in drawing D-304-831, see Applicants' Response to Interrogatory #5-29, supra, the recombiners are located in the containment on elevation 644 feet at column lines 13 and 16. An analysis presently is underway which will answer the remainder of the Interrogatory.

5-63. What pressure head does the mixer compressor create?

Response:

The outlet pressure of the compressor is a function of inlet pressure and capacity. The outlet pressure is 20.82 psia for normal start-up.

5-64. Would the drywell-to-containment differential pressure ever be great enough (e.g., after upper pool dump) that the mixer compressor head is insufficient to clear the upper suppression pool vents? Provide documentation showing that this could not happen.

Response:

An analysis presently is underway which will answer the Interrogatory.

5-65. Would the recombiner exhausts product [sic] "hot spots" which could adversely affect the containment or equipment therein? Provide documentation showing that this would not happen.

Response:

An analysis presently is underway which will answer the Interrogatory.

5-66. Are the analyzers capable of measuring hydrogen concentration in a steam atmosphere? Up to what volume-% steam?

Response:

The analyzers are designed to accommodate water in the sample stream and were tested satisfactorily with 100% saturated steam in the sample atmosphere.

5-67. Is there any interlock in the circuitry for starting the recombiners or igniters which requires that the containment spray be operating first?

Response:

No.

5-68. Do Applicants intend to initiate H_2 control only after LOCAs and not transient accidents? If so, justify this in light of the fact that transient sequences are significant contributors to the risk of containment failure due to hydrogen explosions (see Table 5-4 of NUREG/CR-1659, Volume 4).

Response:

The procedures for activating the igniters still are being developed. The procedures, however, will be symptom based and not event oriented.

5-69. List all documents relied upon in answering the above interrogatories, and list the persons responsible for the answers, along with their professional qualifications.

Response:

The only document relied upon other than those cited in the foregoing Interrogatories and Responses is NRC Regulatory Guide 1.7, "Control of Combustible Gas Concentrations In Containment Following a Loss-of-Coolant Accident" (Rev. 2, 1978).

Resumes for the following persons will be supplied for examination at PNPP:

Ms. Eileen Buzzelli

Mr. Bradley W. Shaffer

Mr. Roger W. Alley

Mr. John D. Metzger

Mr. Robert T. Getty.

Respectfully submitted,

SHAW, PITTMAN, POTTS & TROWBRIDGE

By: [signature]

Jay E. Silberg, P.C.
Robert L. Willmore

Counsel for Applicants

1800 M Street, N.W.
Washington, D.C. 20036
(202) 822-1000

Dated: October 29, 1982

AFFIDAVIT

STATE OF CALIFORNIA)
SS:
COUNTY OF SANTA CLARA)

BRADLEY W. SHAFFER, being duly sworn, deposes and says: That he is an Engineer in the Emergency Core Cooling Systems Organization of General Electric Company and that the facts set forth in the foregoing Applicants' Answer to Ohio Citizens for Responsible Energy Interrogatories 5-1, 5-2, 5-3, 5-26, 5-27, 5-55 and 5-69 (Issue #8), dated September 13, 1982, are true and correct to the best of his knowledge, information and belief.

Bradley W. Shaffer

Subscribed and sworn to before me on this 29th day of October, 1982.

Ruthe M. Kinnamon
NOTARY PUBLIC, STATE OF CALIFORNIA

OFFICIAL SEAL
RUTHE M KINNAMON
NOTARY PUBLIC - CALIFORNIA
SANTA CLARA COUNTY
My comm. expires APR 26, 19[illegible]
175 Curtner Avenue, San Jose, CA 95125

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

CLEVELAND, OHIO

Eileen M. Buzzelli, being duly sworn according to law, deposes that she is Licensing Engineer, of The Cleveland Electric Illuminating Company and that the facts set forth in the foregoing Applicants' Answers to Ohio Citizens for Responsible Energy Interrogatories 5-7 through 5-13, 5-16 through 5-18, 5-20, 5-21, 5-23 through 5-25, 5-33, 5-39 through 5-47, 5-49, 5-50, 5-56 through 5-58, 5-68 and 5-69 dated September 13, 1982, are true and correct to the best of her knowledge, information and belief.

Eileen M. Buzzelli

Sworn to and subscribed before

me this 29.th day of October 1982

____________________.

Joanne [illegible]

JOANNE [illegible], Notary Public
State of Ohio - Lake County
My comm. exp. Nov. 12, 1983

STATE OF PENNSYLVANIA

COUNTY OF BERKS

AFFIDAVIT

J. D. Metzger, being duly sworn according to law, deposes and says that he is Nuclear Engineer - Mechanical, Perry Project, of Gilbert Associates, Inc. and that the facts set forth in the foregoing Applicants' Answers to Ohio Citizens for Responsible Energy Interrogatories 5-4, 5-5, 5-6, 5-14, 5-15, 5-22, 5-28 5-29, 5-48, 5-59, 5-60, 5-61, 5-62, 5-63, 5-64, 5-65, 5-67 and 5-69 dated September 13, 1982, are true and correct to the best of his knowledge, information and belief.

[signature]

Sworn to and subscribed before me this 29th day of October 1982.

[signature]

IRMA L. FINN
Notary Public, Reading, Berks Co.
My Commission Expires August 20, 1983

STATE OF PENNSYLVANIA

COUNTY OF BERKS

AFFIDAVIT

R. T. Getty, being duly sworn according to Law, deposes and says that he is Lead System Instrument and Control Engineer, Perry Project, of Gilbert Associates, Inc. and that the facts set forth in the foregoing Applicants' Answers to Ohio Citizens for Responsible Energy Interrogatories 5-30, 5-31, 5-32, 5-34, 5-35, 5-36, 5-37, 5-38 5-66, and 5-69 dated September 13, 1982, are true and correct to the best of his knowledge, information and belief.

Robert T. Getty

Sworn to and subscribed
before me this 29th day
of October 1982.

Irma L. Finn

IRMA L. FINN
Notary Public, Reading, Berks Co.
My Commission Expires August 20, 1983

STATE OF PENNSYLVANIA

COUNTY OF BERKS

AFFIDAVIT

R. W. Alley, being duly sworn according to law, deposes and says that he is Project Structural Engineer, Perry Project, of Gilbert Associates, Inc. and that the facts set forth in the foregoing Applicants' Answers to Ohio Citizens for Responsible Energy Interrogatories 5-51, 5-52, 5-53, 5-54 and 5-69 dated September 13, 1982, are true and correct to the best of his knowledge, information and belief.

Roger W. Alley

Sworn to and subscribed
before me this 29th day
of October 1982.

Irma L. Finn

IRMA L. FINN
Notary Public, Reading, Berks Co.
My Commission Expires August 20, 1983

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
THE CLEVELAND ELECTRIC ILLUMINATING COMPANY, ET AL.	))	Docket Nos. 50-440 50-441
	)	
(Perry Nuclear Power Plant, Units 1 and 2)	))	

CERTIFICATE OF SERVICE

This is to certify that copies of the foregoing "Applicants' Answer to Ohio Citizens For Responsible Energy Fifth Set of Interrogatories to Applicants," were served by deposit in the U.S. Mail, First Class, postage prepaid, this 29th day of October, 1982, to all those on the attached Service List.

Robert L. Willmore

Dated: October 29, 1982

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of THE CLEVELAND ELECTRIC ILLUMINATING COMPANY (Perry Nuclear Power Plant, Units 1 and 2)	)))))))	Docket Nos. 50-440 50-441

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