

May 13, 1985

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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Before the Atomic Safety and Licensing Board

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In the Matter of)
)
THE CLEVELAND ELECTRIC)
ILLUMINATING COMPANY, ET AL.)
)
(Perry Nuclear Power Plant,)
Units 1 and 2))

OFFICE OF SECRETARY
DOCKETING & SERVICE
BRANCH

Docket Nos. 50-440 OL
50-441 OL

APPLICANTS' PROPOSED FINDINGS OF FACT
AND CONCLUSIONS OF LAW IN THE FORM
OF A PARTIAL INITIAL DECISION
(EMERGENCY PLANNING AND TDI DIESEL GENERATORS)

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Pursuant to 10 C.F.R. § 2.754(a)(1), The Cleveland Electric Illuminating Company ("CEI"), acting for itself and as agent for Duquesne Light Company, Ohio Edison Company, Pennsylvania Power Company, and The Toledo Edison Company (collectively referred to herein as "Applicants"), submits in the form of a partial initial decision Applicants' proposed findings of fact and conclusions of law relating to Issue No. 1 (emergency planning) and Issue No. 16 (TDI diesel generators) in this proceeding. The proposed findings of fact and conclusions of law follow the form prescribed by the Atomic Safety and Licensing Board (the "Board").^{1/}

^{1/} Memorandum and Order (Proposed Findings and Conclusions) (April 18, 1985).

OPINION

I. HISTORY OF THE CASE

This is the second partial initial decision in this contested proceeding on the application for operating licenses for the Perry Nuclear Power Plant ("PNPP").^{2/} The application is for the operation of two boiling water nuclear reactors ("BWRs"), Units 1 and 2, at the Perry site in Lake County, Ohio, located approximately 35 miles northeast of Cleveland on Lake Erie.

Applicants filed their operating license application for PNPP with the NRC on June 26, 1980. In February 1981, the NRC published a Federal Register Notice of "Receipt of Application for Facility Operating Licenses, Consideration of Issuance of Facility Operating Licenses, and Opportunity for Hearing."^{3/} This notice provided an opportunity for any person whose interest might be affected by the proceeding to request a hearing and file a petition for leave to intervene. Several intervenor groups and individuals filed petitions in response to the Federal Register notice.

^{2/} A somewhat more extended description of the history of the case is provided here because the Board's first partial initial decision, LBP-83-77, 18 N.R.C. 1365 (1983), did not set forth a detailed description of the background of this proceeding.

^{3/} 46 Fed. Reg. 12372 (February 13, 1981).

By order dated April 9, 1981,^{4/} the Board made initial determinations concerning party status and scheduled a special prehearing conference pursuant to 10 C.F.R. § 2.751a. The Board convened the special prehearing conference in Painesville, Ohio on June 2-3, 1981, and thereafter issued a special prehearing conference order on party status, contentions and discovery.^{5/} Party status was granted to Intervenor Ohio Citizens for Responsible Energy ("OCRE"), Tod J. Kenney,^{6/} and a number of other individuals and groups consolidated as Sunflower Alliance, Inc., et al. ("Sunflower"). LBP-81-24 at 177.^{7/} The Lake County Board of Commissioners and The Lake County Disaster Services Agency ("DSA") were admitted as non-party participants pursuant to 10 C.F.R. § 2.715(c). LBP-81-24 at 177.^{8/} Subsequently, the Ashtabula County

^{4/} Memorandum and Order (Scheduling Prehearing Conference Regarding Petitions for Intervention), LBP-81-24, 14 N.R.C. 235 (1981).

^{5/} Special Prehearing Conference Memorandum and Order Concerning Party Status, Motions to Dismiss and to Stay, the Admissibility of Contentions, and the Adoption of Special Discovery Procedures, LBP-81-24, 14 N.R.C. 175 (1981).

^{6/} Mr. Kenney was later dismissed as a party. Memorandum and Order (Concerning Motion to Dismiss) (April 8, 1982).

^{7/} See Memorandum and Order (Concerning The Status of Ashtabula County and Objections to the Special Prehearing Conference Order, LBP-81-35, 14 N.R.C. 682, 687 (1981) (clarifying Sunflower's consolidated status).

^{8/} See LBP-81-35 at 687 (clarifying non-party status of Lake County Commissioners and Lake County DSA).

Commissioners and Ashtabula County DSA petitioned for and were granted admission as non-party participants under § 2.715(c). LBP-81-35 at 688.

The Board in its special prehearing conference order admitted seven issues to the proceeding. LBP-81-24 at 232-33. In addition, nine late-filed contentions have been admitted in the course of the proceeding. Of the sixteen issues admitted, three have been dismissed pursuant to Commission rule-making or policy statement,^{9/} and nine have been summarily disposed of as the result of motions by Applicants and the NRC Staff ("Staff").^{10/}

^{9/} Those issues were: Issue No. 6 (automatic standby liquid control system): Memorandum and Order (Denying Motion for Summary Disposition on OCRE Issue No. 6 and Dismissing the Contention), LBP-84-40, 20 N.R.C. 1181 (1984); Issue No. 10 (psychological stress): Memorandum and Order (Concerning Psychological Stress Contention), LBP-82-53A, 16 N.R.C. 208 (1982); Issue No. 2 (financial qualifications): Memorandum and Order (Concerning Motion to Dismiss Financial Qualifications Contention) (April 28, 1982).

^{10/} Those issues were: Issue No. 15 (steam erosion): Memorandum and Order (Motions) (March 13, 1985) ("March 13, 1985 Memorandum and Order") and Memorandum and Order (Motions for Summary Disposition of Issues 1, 15 and 16) (April 9, 1985) ("April 9, 1985 Memorandum and Order") (providing explanation of earlier order); Issue No. 14 (in-core thermocouples): Memorandum and Order (Motion for Summary Disposition on In-Core Thermocouples, Issue 14) (February 27, 1985); Issue No. 13 (turbine missiles): Memorandum and Order (Summary Disposition of Turbine Missile Issue), LBP-83-46, 18 N.R.C. 218 (1983); Issue No. 9 (polymer degradation): Tr. 827-28 (Prehearing Telephone Conference of May 9, 1983) and Memorandum and Order (Polymer Degradation: Summary Disposition), LBP-83-18, 17 N.R.C. 501 (1983); Issues No. 4 (emergency core cooling sys-

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Issue No. 3 (quality assurance) was the subject of the first phase of the evidentiary hearing on May 24-27, 1983 in Painesville. On December 2, 1983, the Board issued a partial initial decision which concluded in favor of Applicants. Partial Initial Decision (Quality Assurance Contention), LBP-83-77, 18 N.R.C. 1365 (1983). That partial initial decision was affirmed by the Appeal Board.11/

The second phase of the hearing, which is the subject of this partial initial decision, concerned Issues No. 1 (emergency planning) and No. 16 (TDI diesel generators). Direct testimony was filed on March 25, 1985. The hearing was held on April 9-12, 1985 in Perry, Ohio. The Board received limited appearances pursuant to 10 C.F.R. § 2.715(a) during an evening session on April 11, 1985.12/

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tem), No. 11 (environmental impact statement cost-benefit balance) and No. 12 (economic costs of serious accidents): Memorandum and Order (Concerning Summary Disposition), LBP-82-119, 16 N.R.C. 2063 (1982); Issues No. 5 (scram discharge volume piping) and No. 7 (Asiatic clams): Memorandum and Order (Concerning Summary Disposition: Quality Assurance, Corbicula and Scram Discharge Volume Contentions), LBP-82-114, 16 N.R.C. 1909 (1982).

11/ ALAB-802, 21 N.R.C. _____ (March 26, 1985).

12/ The Board also granted an unscheduled limited appearance on April 12, 1985. Tr. 2907-11.

The third phase of the evidentiary hearing, which was held on April 30 through May 3, 1985, addressed Issue No. 8 (hydrogen control) and will be the subject of a subsequent partial initial decision.

The decisional record of the proceeding for the second phase consists of the testimony and exhibits filed by the parties, and the other evidence contained in the transcripts of the hearing.^{13/} In preparing our decision, we reviewed and considered the entire record and the proposed findings of fact and conclusions of law submitted by the parties. Those proposed findings and conclusions that are not incorporated directly or by inference in this partial initial decision are rejected as being unsupported by the record of the case or as being unnecessary to the rendering of this decision.

This Board's jurisdiction is limited to a determination of findings of fact and conclusions of law on matters put into controversy by the parties to the proceeding or found by the Board to involve a serious safety, environmental, or common defense and security question.^{14/} The Board has made no such

^{13/} Appendix A to this partial initial decision identifies, by witness, the location of written testimony in the transcript. Appendix B lists the exhibits identified, indicates the Board's ruling on any offer of an exhibit into evidence, and identifies the location of admitted exhibits in the transcript.

^{14/} 10 C.F.R. § 2.760a. See Houston Lighting and Power Co. (South Texas Project, Units 1 and 2), LBP-81-54, 14 N.R.C. 918, 922-23 & n.4 (1981).

additional determinations in this case.

II. CONTENTIONS

A. Issue No. 1: Emergency Planning

1. Background and Introduction

In the special prehearing conference order, the Board admitted a broad emergency planning contention, Issue No. 1, which stated:

Applicants' emergency evacuation plans do not demonstrate that they provide reasonable assurance that adequate protective measures can and will be taken in the event of an emergency.

LBP-81-24 at 189, as modified by LBP-81-35 at 686.15/ The Board in admitting this broad contention noted that "state and local emergency plans . . . have not yet been completed . . ." for the plume exposure pathway Emergency Planning Zone ("EPZ") for PNPP. LBP-81-24 at 189.

After well-developed offsite plans had been available for some time, and following extensive discovery, Applicants (with the support of the Staff) moved for a Board order requiring

^{15/} The Board subsequently noted that the words "State and local" should be substituted for the word "Applicants'" in the wording of the contention. Memorandum and Order (Particularization of Emergency Planning Contention), LBP-84-28, 20 N.R.C. 129, 130 n.1 (1984).

particularization of the broad contention. The Board granted Applicants' motion, directing Intervenor Sunflower^{16/} to "specify in a written filing the specific inadequacies alleged to exist in the draft local and State emergency plans" LBP-84-28, 20 N.R.C. at 132.

Sunflower responded to the Board's order by filing a number of what it termed "particularized objections" to the State, County and onsite emergency plans. Based on Sunflower's filing, Applicants, with the support of the Staff, moved to dismiss Issue No. 1 from the proceeding. The Board denied Applicants' motion, and reworded and admitted as contentions 18 of Sunflower's "objections."^{17/} Summary disposition motions on all of the admitted contentions subsequently were filed by Applicants (and supported by the Staff), and were granted with respect to nine of the contentions as well as parts of two others.^{18/}

^{16/} Sunflower was designated lead intervenor on the emergency planning issue in the Board's Memorandum and Order (Concerning Redesignation of Lead Intervenor) (October 13, 1981).

^{17/} Memorandum and Order (Admissibility of Contentions on Emergency Plans and Motion to Dismiss) (January 10, 1985) ("January 10, 1985 Memorandum and Order"). The Board expressly rejected all allegations of the proposed contentions not included in the contentions as framed by the Board. *Id.* at 5.

^{18/} March 13, 1985 Memorandum and Order. *See* April 9, 1985 Memorandum and Order.

Summary disposition of the following contentions was

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The following seven contentions and parts of two contentions on emergency planning remained at issue for the hearing:

Contention A: State and local comments on
Evacuation Time Estimate study

Contention J: Incomplete Emergency Action
Levels

Contention M: Independent radiation monitoring
systems

Contention P: Hospitals

Contention Q: Letters of agreement for school
buses

Contention U: Handling contaminated property at
reception centers

Contention Z: Bus driver protection

Contention BB: FEMA Interim Report

Contention CC: SER resolution items

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granted in full: Contention B (evacuation route impediments; evacuation of onsite construction workers; consideration of low or no power operation during extreme inclement weather); Contention C (legal authority and role of County Commissioners); Contention G (availability of potassium iodide for emergency workers and the public); Contention H (radiation exposure limits and respirators for emergency workers); Contention I (evacuation beyond 5 miles); Contention O (reentry and recovery of property); Contention DD (location of the Emergency Operations Facility); Contention GG (communication with people who do not use radios or televisions); Contention JJ (availability of back-up power for evacuation).

Those contentions on which summary disposition was granted in part are discussed infra.

The texts of these contentions are provided in the discussions of individual contentions, infra.

The evidentiary record for the emergency planning contentions includes the written and/or oral testimony of eight witnesses for Applicants, one witness for the Staff, one witness for the Federal Emergency Management Agency ("FEMA"), and two witnesses for Sunflower.

Addressing the contentions (A, J and CC) relating to the adequacy of the PNPP onsite plan ("PNPP Plan") on behalf of the Staff was Mr. Donald J. Perrotti. As an Emergency Preparedness Specialist in the Emergency Preparedness Branch, Division of Emergency Preparedness and Engineering Response, Office of Inspection and Enforcement of the NRC, Mr. Perrotti is responsible for review and evaluation of radiological emergency response plans, including the PNPP Plan, submitted by reactor applicants and licensees. Testimony of Donald J. Perrotti Regarding Emergency Plan Issues, ff. Tr. 3111 (hereinafter "Perrotti"), at 1, Attachment at 1.

Addressing the contentions (A, M, P, Q, U, Z and BB) relating to the adequacy of the State and County emergency plans on behalf of FEMA was Mr. Robert O. Shapiro. Mr. Shapiro is an Emergency Management Specialist in the Technological Hazards Branch, Natural and Technological Hazards Division of FEMA, Region V. He is responsible for the review and

evaluation of State and County radiological emergency response plans, including the plans of the State of Ohio and the three counties - Lake, Ashtabula and Geauga - which are partially within the PNPP plume exposure pathway EPZ. Testimony of Robert O. Shapiro, Federal Emergency Management Agency Regarding Emergency Planning Contentions A, M, P, Q, U, Z, BB, ff. Tr. 3111 (hereinafter "Shapiro"), at 1-2, Attachment at 1.

Addressing the nine emergency planning contentions for Applicants was a series of witnesses. Those witnesses are identified infra in the discussion of specific contentions.

Sunflower's witnesses were Dr. Ernest J. Sternglass and Dr. Robert L. McTrusty. Dr. McTrusty, whose pre-filed written testimony addressed Contention P, is an obstetrician/gynecologist, and was identified as chairman of the Ashtabula County Medical Center Disaster Committee. Testimony of Dr. Robert L. McTrusty, Chairman, Ashtabula County Medical Center Disaster Committee, ff. Tr. 3149 (hereinafter "McTrusty"), at 1. Dr. McTrusty was unable to appear at the hearing due to scheduling difficulties, and his written testimony was received into evidence without cross-examination by stipulation of the parties. See Tr. 3148-49.

Dr. Sternglass' testimony addressed Contentions J, M, P and Z. Dr. Sternglass is Professor Emeritus of Radiological Physics, University of Pittsburgh School of Medicine,

Department of Radiology. Testimony by Dr. Ernest J. Sternglass, ff. Tr. 2566 (hereinafter "Sternglass"),19/ at 1. Dr. Sternglass has testified over the years before numerous legislative, administrative and other bodies on the health effects of low levels of radiation. Sternglass at 2; Tr. 2596 (Sternglass). Applicants' counsel cross-examined Dr. Sternglass at length concerning the findings of various groups with respect to Dr. Sternglass' views, including the National Academy of Science Advisory Committee on the Biological Effects of Ionizing Radiations, the United States Environmental Protection Agency, the Committee on Environmental Hazards of the American Academy of Pediatrics, the Health Physics Society, and the NRC. See Tr. 2596-2645 (Sternglass).

It appears from the record that Dr. Sternglass' theories on radiation health effects have been rejected by virtually every scientific group and governmental body to which he has presented them. More importantly for our purposes, the consensus of the scientific community seems to be that Dr. Sternglass' work is fundamentally characterized by the selective and biased use of data. See, e.g., App. Ex. 1-1, ff. Tr. 2602, at 178;20/ App. Ex. 1-4, ff. Tr. 2618, at 2;21/

19/ The Board ordered the words "Summary of," which appear in the original, stricken from the title of Dr. Sternglass' testimony. Tr. 2564.

20/ "It is clear that the correlations presented in support of the hypothesis depend on arbitrary selection of data supporting

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App. Ex. 1-5, ff. Tr. 2620;22/ App. Ex. 1-6, ff. Tr. 2622;23/
App. Ex. 1-7, ff. Tr. 2625, at 1;24/ App. Ex. 1-8, ff. Tr.
2627, at 2-3.25/

(Continued)

the hypothesis and the ignoring of those that do not. In several regards, the data used by Sternglass appear to be in error." Report of the Advisory Committee on the Biological Effects of Ionizing Radiations, National Academy of Sciences (1972).

21/ ". . . Dr. Sternglass has brought together a series of data interpretations which seem plausible on casual review, even to technical people. However, on closer look it becomes readily apparent that this report has many misinterpretations which tax even the experts to clarify." Letter to Christopher J. Dodd, House of Representatives, from Douglas M. Costle, Administrator, U.S. EPA (August 9, 1978).

22/ "Dr. Sternglass has been presenting similar reports for the last 10 years which, on careful analyses, have been shown by a number of reputable scientists to be based on a highly selective and very biased use of mortality data. In every case we have found that Dr. Sternglass only uses data which support his pronounced views which are usually directed against nuclear power." Letter to James C. Cleveland, House of Representatives, from W.D. Rowe, Deputy Assistant Administrator of Radiation Programs, U.S. EPA (August 2, 1978).

23/ ". . . Dr. Sternglass tends to select that data he uses and does not subject his statements to peer review." Letter to Bo Lindell, National Institute of Radiation Protection, Stockholm, from William A. Wills, Director, Criteria & Standards Division, Office of Radiation Programs, U.S. EPA (February 7, 1980).

24/ "He has selected data to prepare his hypothesis without considering the far more extensive data that do not support it." Committee Statement of Committee on Environmental Hazards, American Academy of Pediatrics (1970).

25/ "At the core of the phenomenon appears to be Dr. Sternglass' careful selection of only that data he finds will support the conclusions he wishes to reach. Toward that

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The Appeal Board has concluded the following about Dr. Sternglass:

. . . Dr. Sternglass' statistical methodology and selective sampling techniques are not scientifically credible and indeed raise serious questions as to whether his presentation is consistent with even a moderate degree of scientific responsibility.

Trustees of Columbia University in the City of New York, ALAB-50, 4 A.E.C. 849, 862 (1972), aff'd sub nom. Morningside Renewal Council, Inc. v. A.E.C., 842 F. 2d 234 (2d Cir. 1973), cert. denied, 417 U.S. 951 (1974). The United States Court of Appeals of the Third Circuit also has criticized "the questionable nature of many of the assumptions relied upon by Dr. Sternglass and the resulting imprecision of his calculations . . . " Punnett v. Carter, 621 F.2d 578, 586 (1980). See id. at 583-86. Dr. Sternglass' methodology and conclusions similarly have been rejected in Tennessee Valley Authority (Hartsville Nuclear Plant, Units 1A, 2A, 1B, and 2B),

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end he apparently has no qualms in changing facts such as which way the wind blows and making water flow upstream; or corroborating as supporting references his own previous papers; or ignoring the protests of other scientists whose research he sometimes cites; or displaying no apparent interest in the mass of scientific opinion which rejects his methods of research and findings as bunk and pseudo-science; and when being questioned, invariably changing the subject or always displaying 'new data.' " Statement of Dade W. Moeller, President, Health Physics Society (1971).

ALAB-463, 7 N.R.C. 341, 349-51 (1978); Long Island Lighting Co. (Shoreham Nuclear Power Station, Unit 1), ALAB-156, 6 A.E.C. 831, 850 (1973); Duquesne Light Co. (Beaver Valley Power Station, Unit No. 2), LBP-74-25, 7 A.E.C. 711, 719-20 (1974); Toledo Edison Co. (Davis-Besse Nuclear Power Station), 3 Atomic Energy Law Reporter (CCH) 17735-30, 17735-38 to -43 (1973); Consumers Power Company (Midland Plant, Units 1 and 2), LBP-72-34, 5 A.E.C. 214, 226 (1972), aff'd in relevant part, ALAB-123, 6 A.E.C. 331, 344-45 (1973); Toledo Edison Company (Davis-Besse Nuclear Power Station), 4 A.E.C. 571, 584-85 (1971). See Carolina Power & Light Co. (Shearon Harris Nuclear Plant, Units 1 and 2), LBP-84-15, 19 N.R.C. 837, 838-39, 843-44 (1984); LBP-84-7, 19 N.R.C. 432, 438 (1984).

Dr. Sternglass' response to what he acknowledges to be widespread rejection of his views is that there is a deliberate "coverup" or "conspiracy" on the part of governmental agencies and established scientific groups to suppress information which supports those views. See, e.g., Tr. 2613-15, 2634-35, 2654. We agree that "[s]uch a vast 'conspiracy' at all levels of government and in industry and science is too big to swallow by any reasonable person." App. Ex. 1-8 (Statement of Dade W. Moeller, President, Health Physics Society, at 6.

The Board, based on its consideration of this body of criticism, concludes that Dr. Sternglass' credibility has been

seriously impeached. Consequently, the Board believes that the testimony of Dr. Sternglass should be accorded no weight in deciding the contentions addressed by his testimony.

2. Contention A: State and Local Comments on ETE Study

The portion of Contention A which was not summarily disposed of concerns the issue of obtaining comments from state and local officials on evacuation time estimates. See Finding 1.

Applicants' witness on Contention A was Mr. Scott T. McCandless of HMM Associates, Inc. Mr. McCandless was Principal-in-Charge of the evacuation time estimate study prepared by HMM for the PNPP plume exposure pathway EPZ. That study is entitled "Evacuation Time Estimates For Areas Near The Perry Nuclear Power Plant" (the "ETE"). Applicants' Direct Testimony of Scott T. McCandless on Issue No. 1 - Contention A, ff. Tr. 2791 (hereinafter "McCandless"), at 1. Mr. McCandless has supervised or otherwise participated in evacuation time estimates for numerous other nuclear power plants as well, and has extensive experience in the general areas of emergency planning and transportation planning. Statement of Qualifications of Scott T. McCandless, ff. Tr. 2790; Tr. 2793-94 (McCandless).

Appendix 4 to NUREG-0654/FEMA-REP-1, "Criteria For Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants" (Rev. 1, November 1980), sets forth the regulatory acceptance criteria for evacuation time estimate studies. Appendix 4 provides, in relevant part, that review of the draft ETE by the principal organizations (State and local) involved in emergency response for the site shall be solicited and comments resulting from such review included with the submittal of the ETE. Finding 2.

The testimony presented by the witnesses for Applicants, FEMA and the Staff^{26/} clearly established that the ETE has been reviewed by the State of Ohio and the three counties,^{27/} and that the resulting comments were included with the submittal of the February 1985 revision of the ETE to the NRC. Findings 3-7. Each of the principal response organizations has subsequently expressed concurrence with the changes made to the ETE as a result of its comments. Finding 7.

The Board agrees with the Staff's and FEMA's conclusion that Applicants have complied with the regulatory guidance applicable to this contention. See Finding 8. Nothing in

^{26/} Sunflower submitted no direct testimony on Contention A.

^{27/} Indeed, offsite emergency planning/response officials have played an important role in the development of the PNPP ETE. Thus, the participation of these officials has gone far beyond a mere "review" of the ETE. Finding 3.

Sunflower's cross-examination of Applicants', FEMA's or the Staff's witnesses provides a basis for questioning that conclusion.

3. Contention J: Incomplete EALs

This contention was based on the incomplete status of several Emergency Action Levels ("EALs") in Table 4-1 of Revision 3 of the PNPP Plan, dated April 23, 1984. EALs describe specific plant conditions at which one of the four Emergency Classifications (Unusual Event, Alert, Site Area Emergency, General Emergency) are to be declared. Finding 10.

Applicants' witness on Contention J was Mr. Daniel D. Hulbert, Emergency Planning Coordinator, Perry Plant Technical Department, CEI. Mr. Hulbert is responsible for developing, maintaining, and evaluating the PNPP Plan. His responsibilities include the development of EAL indications. Applicants' Direct Testimony of Daniel D. Hulbert on Issue No. 1 - Contention J, ff. Tr. 2965 (hereinafter "Hulbert (Contention J)"), at 1.

Of the over 200 individual EAL indications in Revision 3 of the PNPP Plan, only 13 were incomplete. In each case, the value to be included later was not available at the time Revision 3 was issued, because the value could only be determined after the detailed technical data became available. However, in every case a comparable value was specified. Findings 11-12.

For each of these 13, either the "missing" values have now been developed based upon additional detailed information which became available after Revision 3 was issued, or alternate indications have been selected. In all cases, these have been included in Revision 4 to the PNPP Plan, which was issued in February 1985. Finding 13.

Nevertheless, Sunflower's witness, Dr. Sternglass, maintained that the 13 EALs still are "incomplete." First, according to Dr. Sternglass, Applicants have not provided a sufficiently detailed technical basis for the evaluation of the EALs which now have been supplied. Sternglass at 3-4. Yet Sunflower's counsel failed to cross-examine Mr. Hulbert concerning the detailed technical basis for the 13 EALs. See Tr. 2966-76 (Hulbert). Moreover, Mr. Perrotti testified that the Staff's review to date of Applicants' emergency classification and action level scheme shows that Applicants' emergency plan is adequate in this regard. Finding 14.

Dr. Sternglass argued, second, that the EALs are "incomplete" because "existing regulations" require that nomograms^{28/} be developed which address a range of possible EALs, and because such nomograms are not included in the PNPP Plan. Sternglass at 4-5. See Finding 15.

^{28/} Dr. Sternglass' testimony actually read "monograms" instead of "nomograms." Sternglass at 4. Dr. Sternglass appeared confused about the difference between a monogram and a nomogram. Tr. 2647-48 (Sternglass).

In fact, nomograms are not required by any regulation, but were merely recommended in an EPA Manual. The EPA Manual went on to say that other "shortcut" dose projection methods may have been developed that are just as accurate as nomograms; and these methods should be used if appropriate. Finding 15. Nomograms have become obsolete since the EPA Manual was written. Nomograms are not a useful tool because they require a number of assumptions, are good for only a limited number of cases, and are typically difficult to read and interpret. The current method of dose projection, which is used by Applicants, is a computer-based system which uses real time data from in-plant monitors and meteorological data for rapid dose assessment calculations. This method is far superior to nomograms for use during an emergency. Finding 16. The Board finds, based on the testimony, that there is no regulatory requirement to use nomograms, and that Applicants' dose projection method is an adequate and preferable alternative.

Third and finally, Dr. Sternglass asserted that Applicants' information on the EALs is "incomplete" because Applicants' emergency plan contains a wrong assumption concerning the sensitivity of the fetus to radioactive iodine. Specifically, Dr. Sternglass objected to Footnote 3 of Table 6-2 of the PNPP Plan, entitled "Guidelines for Protection Against Ingestion of Contamination," which indicates that the sensitivity of the newborn infant is considered to bound that of the fetus

with respect to the effects of ingestion of Iodine-131. Sternglass at 5; Tr. 2651 (Sternglass). Footnote 3 of Table 6-2 is taken from federal Food and Drug Administration recommendations for ingestion pathway protective action guides ("PAGs"). Finding 17.

There is no connection between protective action guides for the ingestion pathway and EALs, nor was Dr. Sternglass able to show such a relationship. Finding 18. See Tr. 2650-52 (Sternglass). Because the Board finds that no relationship was established between Table 6-2 of the PNPP Plan and the EALs, it is not necessary to reach Dr. Sternglass' arguments concerning possible differences between fetal and newborn sensitivity to radioiodine. Licensing Boards are restricted to adjudicating only those matters raised by the contentions. See supra p. 6 and note 14. In view of Dr. Sternglass' lack of credibility, as discussed supra, the Board in any event would not have found those arguments persuasive.^{29/}

In conclusion, the Board finds that Applicants' EALs in Table 4-1 of the PNPP Plan are complete. Further, no evidence was adduced by Sunflower which could provide a basis for questioning the adequacy of the 13 previously incomplete EALs.

^{29/} See Duquesne Light Co. (Beaver Valley Power Station, Unit No. 2), supra, 7 A.E.C. at 718-20, 742. The licensing board in Beaver Valley concluded, contrary to testimony by Dr. Sternglass, that "young children represent the most critical portion of the population with respect to environmental exposure from radioiodine and not the infant in utero."

4. Contention M: Independent Radiation Monitoring Systems

Contention M states that Independent Radiation Data Monitoring Systems should be installed within the PNPP plume exposure pathway EPZ. Sunflower's argument is that each of the three counties within the plume exposure pathway EPZ should have fixed radiation monitors, meteorological equipment and telemetering equipment.

Applicants presented two witnesses on this contention -. Mr. Richard R. Bowers and Mr. Kenneth B. Cole. Mr. Bowers is CEI's Corporate Health Physicist, with 30 years of health physics experience. He has technical overview responsibilities for both CEI's operational health physics program and engineering health physics program. Applicants' Direct Testimony of Richard R. Bowers on Issue No. 1 - Contention M, ff. Tr. 2914 (hereinafter "Bowers"), at 1; Tr. 2915 (Bowers). See Statement of Qualifications of Richard R. Bowers, ff. Tr. 2913. Mr. Bowers also has been a technical advisor for some time to Lake County regarding the County's development of an independent monitoring capability. Tr. 2932-33, 2956-57 (Bowers).

Mr. Cole is Nuclear Operations Officer for the ODSA. He supervises the three sections of ODSA which deal with radiological matters for the State of Ohio. Those matters include, among other things, response to accidents involving radiological materials, and training of emergency response

workers to conduct radiological monitoring. Professional Qualifications of Kenneth B. Cole, ff. Tr. 2834, at 1.

There is no regulatory requirement or guidance that each jurisdiction within the plume exposure pathway EPZ have independent radiation monitoring systems. NUREG-0654 states that each emergency planning organization shall describe the monitoring capability on which it will rely. Finding 20. The State and County plans for the PNPP plume exposure pathway EPZ meet this criterion. Finding 31.

Nor is there any regulatory requirement or guidance which states that any independent off-site monitoring which may be provided must be a fixed system. Finding 21. Mobile monitoring teams in fact provide the most effective, as well as efficient, method to track and measure offsite doses. Finding 22. The principal advantage of mobile teams is that mobile teams, unlike stationary monitors, are able to locate and take measurements at the centerline of the radioactive plume, which is necessary for meaningful dose measurements and extrapolations. A dose measurement at a particular fixed monitor cannot be extrapolated to project the doses at other locations, because there is no way to know whether the monitor happens to be located at the centerline of the plume. Although a fixed monitoring system would give instantaneous readouts, the data would be of questionable value. For this reason, even a fixed

monitoring system in combination with mobile monitoring would not have any advantage over mobile monitoring. Finding 23.

In addition, mobile monitoring teams are more cost-effective than stationary monitoring systems. FEMA recommends mobile monitoring teams and rejects stationary systems for this reason. Finding 24. The cost for installation and operation of a stationary system for PNPP would be substantial. Approximately 100 fixed monitoring locations would be needed. Finding 25. A fixed monitoring system would not replace either the CEI or State monitoring teams, the PNPP in-plant effluent monitors, or the State, CEI or NRC thermoluminescent dosimeters. Finding 26. Although Sunflower's witness, Dr. Sternglass, argued that the cost of a fixed monitoring system would constitute only a small fraction of the total cost of the plant (Sternglass at 9), the Board finds this comparison inappropriate. Almost any expenditure could be justified by comparing it to the total cost of the plant.

There will be multiple, independent radiation monitoring systems operating within the PNPP plume exposure pathway EPZ in the event of an accident at the Plant. The State of Ohio will field three fully trained and equipped mobile survey teams in the event of a radiological emergency at PNPP to provide independent monitoring assessments. Finding 27.^{30/} Team members

^{30/} In addition, the local ODSA representative for Lake County has the ability to conduct field monitoring if necessary. Finding 27.

are identified and placed on "alert" at an Unusual Event, and are dispatched at the Alert emergency stage. The response team supervisor is dispatched by helicopter to the site area to perform an aerial survey. The helicopter's response time to the PNPP site is about one hour and 15 minutes, and the field teams are in place 3 to 3 1/2 hours after they are dispatched. Finding 28.

The State monitoring teams obtain radiation readings for the State's Dose Assessment Group in the State Emergency Operations Center ("EOC") in Columbus. The information received from the monitoring teams is fed into a dedicated computer system in the State EOC which plots the plume and identifies plume parameters. Field monitoring teams are directed by the response team supervisor operating out of the State communications van. The supervisor is in direct communication with the State EOC, the County EOCs, the PNPP Emergency Operations Facility ("EOF"), and the State monitoring teams. Findings 29-30.

The State of Ohio's field monitoring teams have demonstrated their ability to perform accident assessment during eight emergency planning exercises, including the November 1984 exercise for PNPP. All three counties within the PNPP plume exposure pathway EPZ rely on the State's field monitoring capabilities. Finding 31.

Independent monitoring assessment also will be provided by Lake County, which will maintain two fully trained and equipped monitoring teams for response to a radiation emergency at PNPP. Each team will consist of two Lake County Health District employees who will be trained to perform both radiation and airborne activity surveys. For each team, two additional trained personnel will be available as backups. Finding 32.

The Lake County monitoring teams will be activated at the Alert emergency stage. It is estimated that the teams can be dispatched and in place within 1.0 to 1.5 hours during normal working hours, and within 1.5 and 2.0 hours during off-work hours, after declaration of an Alert. The teams will communicate with the County EOC, and will perform surveys as directed by the County Radiological Officer in the EOC. Finding 33.

In addition to the State and Lake County, the Department of Energy, the U.S. EPA, and the NRC all have radiation field monitoring capability in the event of an accident at PNPP. A central location for consolidating and coordinating all field data - the Federal Radiological Monitoring and Assessment Center - would be set up by DOE and would relay information to the State and County EOCs, the EOF and FEMA. Finding 34.

The PNPP Plan calls for two CEI radiation monitoring teams to be dispatched at an Alert, and a third team to be dispatched at a Site Area Emergency, to monitor the actual conditions

downwind of the plant. Additional teams may be organized as the situation warrants. Finding 35.

The CEI teams will provide field monitoring capabilities prior to the deployment of the State and County teams. Depending on the time of day and site staffing, teams can be dispatched and in place within 30 to 45 minutes after declaration of an Alert. Finding 36.

Dr. Sternglass argued that a report on the Three Mile Island accident demonstrates the drawbacks of relying on mobile monitoring methods such as car-mounted or helicopter-mounted instruments. Sternglass at 7-8. However, Dr. Sternglass was unable to show that the TMI report addresses car-mounted equipment. See Tr. 2667-69, 2709 (Sternglass). He also failed to show that the TMI report documents cases of missed releases or inaccurate measurements when helicopters were actually flying. See Tr. 2669-71 (Sternglass).

Dr. Sternglass, despite his lack of familiarity with the PNPP area^{31/}, offered his general opinion that mobile detectors mounted on land vehicles are handicapped by inaccessability to areas like railroad tracks, wooded areas, and bodies of water. Sternglass at 8. However, there is an excellent network of roads in the vicinity of PNPP which allows effective tracking

^{31/} See Tr. 2692 (Sternglass).

of the plume. Finding 37. Releases over Lake Erie which returned to land would be tracked by Applicants' computerized dose projection system and could be detected by mobile teams along the shore or by DOE helicopters. Finding 38.

The Board notes that there are also two fixed independent radiation monitoring systems in place around PNPP. The State of Ohio and the NRC both have thermoluminescent dosimeter ("TLD") monitors arranged in rings within the plume exposure pathway EPZ. The TLD monitors measure the doses from accidents, as well as any doses from normal plant operation, if any measurable doses are produced. These fixed systems are in addition to the TLD monitors placed and maintained by CEI throughout the EPZ. Although these devices cannot give instantaneous indications, they would be valuable to measure the doses during an accident. They could be changed during an accident to evaluate doses during various stages of the accident. Finding 39.

In conclusion, there is no regulatory requirement for fixed, off-site independent radiation monitoring systems. It was unrefuted that a fixed system for PNPP would be less effective, and more costly, than the mobile monitoring teams which will be used. Further, the mobile monitoring teams of the State of Ohio and Lake County, the DOE, NRC and EPA mobile teams, and the fixed TLD monitors maintained by the State and

the NRC, will provide independent radiation monitoring around PNPP. Thus, there is reasonable assurance that the public health and safety will be protected in the event of a radiological accident at PNPP.

5. Contention P: Hospitals

This contention concerns the capability of hospital medical services to handle contaminated injured or exposed persons if a radiological accident were to occur at PNPP. See Finding 40.

Applicants' witnesses on Contention P were Dr. Roger E. Linnemann and Dr. Deborah Hankins. As Vice Chairman and Chief Medical Officer of the Radiation Management Corporation ("RMC"), Dr. Linnemann is responsible for the training which RMC has provided to hospitals in the area surrounding PNPP. He also is Clinical Associate Professor of Radiology, University of Pennsylvania School of Medicine, and Visiting Associate Professor of Clinical Radiology, Northwestern University Medical School. Applicants' Direct Testimony of Roger E. Linnemann on Issue No. 1 - Contention P, ff. Tr. 2980 (hereinafter "Linnemann"), at 1-2. Dr. Linnemann has actual experience treating contaminated injured and exposed patients, and has published numerous articles on the ability of hospitals to treat such patients. See Professional Qualifications of Roger E. Linnemann, ff. Tr. 2978; Tr. 2991, 2992, 3027 (Linnemann).

Dr. Hankins, who has a Ph.D. in Nuclear Engineering, is Principal Engineer, Systems Engineering, The General Electric Company ("GE"). She has 13 years of nuclear experience (including experience as a senior reactor operator) and has published widely in technical journals, including several articles on severe accident issues. Resume attached to Rebuttal Testimony on NUREG/CR-2239, ff. Tr. 3158 (hereinafter "Hankins"); Tr. 3167-71 (Hankins).

The Commission's emergency planning regulations require that "[a]rrangements are made for medical services for contaminated injured individuals." 10 C.F.R. § 50.47(b)(12). NUREG-0654 provides that each emergency planning organization should arrange for local and backup hospital and medical services for such individuals, and should provide assurance that persons providing these services are adequately trained. Finding 41. The Commission has interpreted 10 C.F.R. § 50.47(b)(12) to include radiation exposed as well as contaminated injured persons. Southern California Edison Co. (San Onofre Nuclear Generating Station, Units 2 and 3), CLI-83-10, 17 N.R.C. 528, 530 (1983). The United States Court of Appeals for the District of Columbia Circuit recently has ruled that "arrangements" for medical services for contaminated injured and exposed members of the general public (as for on-site emergency workers) require more than "a simple list of treatment facilities already in place. . . ." GUARD v. United States

Nuclear Regulatory Commission, 753 F.2d 1144, 1146 (D.C. Cir. 1985). For the reasons stated below, the Board finds that satisfactory arrangements consistent with the GUARD decision have been made for hospital medical services in an emergency at PNPP.

Radiation injuries result from either exposure to radiation or contamination by radioactive particles. In the case of radiation exposure, the patient is not radioactive and presents no hazard to response personnel. In the case of contamination, an exposure hazard remains until loose radioactive particles adhering to the body are removed. However, radioactive decontamination is easy to detect and is easily accomplished by removing contaminated clothes and bathing the affected area. The emergency plans call for people who are contaminated and not injured to go to relocation centers other than hospitals.

Finding 42.

The characteristics of radiation injury make it one of the easiest medical emergencies to handle. Radiation injuries are seldom if ever life threatening, and their consequences unfold predictably over a period of time. No special equipment is needed for treatment of radiation injuries or disposal of any contaminated materials. Finding 43.

Should a patient be exposed and otherwise injured, the patient can be handled as any other injured patient, and no

special emergency facilities are needed. Finding 44. If the patient is contaminated and otherwise injured, procedures are implemented to reduce exposure and control the spread of any contamination. However, these procedures are not unique to radiation injury cases; similar steps are taken for chemical contamination or septic cases. Finding 45.

Dr. Linnemann testified that it is unlikely that an accident at a nuclear plant would require a large number of hospital beds. In his substantial experience at 25 nuclear power plant sites, only two cases involved multiple injuries - in each case involving two employees each. Finding 46. Dr. Linnemann further testified that even an accident with substantial offsite release of radiation would not likely result in large numbers of traumatic casualties, nor would it result in the levels of radiation exposure necessary for an individual offsite to require hospitalization. Findings 47-48. At most, hospital emergency rooms might have to deal with a few cases where someone is incidentally injured and, at the same time, slightly contaminated or exposed. Finding 48. Dr. Hankins' testimony showed that a core-melt accident at PNPP would produce offsite doses less than 25 rem even at distances as close as one mile from the Plant. Finding 54. An exposure of approximately 150 rem over a period of a few hours would be necessary for an individual to require hospitalization. Finding 48.

Sunflower's witnesses, Dr. Sternglass and Dr. McTrusty, presented a strikingly different picture of the consequences of a serious accident at PNPP. Dr. McTrusty in his testimony cited a Sandia National Laboratories study, NUREG/CR-2239, "Technical Guidance for Siting Criteria Development" (November 1982) ("Sandia Siting Study") for the proposition that a worst-case accident scenario for PNPP would involve 5,500 early deaths within 60 days, 180,000 radiation induced injuries, and 14,000 cases of malignancy. McTrusty at 3.32/ Similarly, Dr. Sternglass cited studies which he claimed show that a severe nuclear accident could result in hundreds to thousands of individuals receiving whole body doses in the range of 100 to 1000 rads, who would require hundreds to thousands of highly specialized hospital facilities. Sternglass at 13-15.

The Sandia Siting Study is not an appropriate source of the number of fatalities and injuries from an accident at PNPP. First, the study does not represent the risk of a severe nuclear power plant accident for any particular site. Consistent with its purpose, which was to provide technical guidance to the NRC to support rulemaking for the siting of power reactors, the study makes generic assumptions with respect to both

32/ These numbers are not found in the Sandia Siting Study, but appear to be numbers that were publicized by a Congressional subcommittee based on background calculations of extremely low probability events which were made in connection with the study. Hankins at 1-2.

probability and consequences. Finding 49. Other NRC decisions have recognized that the Sandia Siting Study does not represent realistic, site-specific risks. See Duke Power Company (Catawba Nuclear Station, Units 1 and 2), LBP-84-37, 20 N.R.C. 933, 982 (1984); Boston Edison Company (Pilgrim Nuclear Power Station), DD-84-5, 19 N.R.C. 542, 550 (1984).

Second, the severe consequences reported in the Sandia Siting Study were not based upon the PNPP design. The PNPP design is substantially different from the design assumed in the study. Finding 50. The largest calculated consequences in the study were based on an assumed siting source term (SST 1) which is an estimate of the largest possible release of fission products from a pressurized water reactor assuming worst case conditions. The SST 1 release is not a credible source term for a BWR/6 - Mark III design such as PNPP for two basic reasons. First the PNPP design features multiple structural barriers to fission product release. Second, the Mark III pressure suppression containment provides effective filtration, or scrubbing, of potential releases from the containment. Taking these mitigating design features into account drastically reduces the projected consequences of a core-melt accident at PNPP to zero early fatalities and few if any injuries requiring emergency care. Findings 51-53.

A GE evaluation of the consequences of a core melt accident at PNPP shows that even at distances as close as one mile from the plant, a core melt accident produces low doses (less than 25 rem) when PNPP specific fission product releases are coupled with the PNPP site specific features. Finding 54. GE estimated the probability of such a core-melt accident at PNPP to be one in 200,000 per reactor year. Id.

Dr. Sternglass admitted under cross-examination that the studies he cited (and on which his predictions of hundreds to thousands of radiation injuries were solely based) were not based upon the PNPP design, nor did they take into account the specific design features of the PNPP containment. Tr. 2685-90 (Sternglass). Dr. Sternglass himself was unaware of the type of containment used at PNPP. Tr. 2686 (Sternglass). Earlier studies, such as the ones cited by Dr. Sternglass which predicted large accident releases, ignored the features incorporated in the PNPP containment. See Hankins at 6.

Based on the above considerations, the Board concludes that it is reasonable to assume that the medical responsibilities of a major accident at PNPP would be the treatment of a few incidentally injured and contaminated or exposed plant workers, and possibly a few incidentally injured and contaminated or exposed members of the public.

These cases could readily be handled by present medical resources. The county emergency plans identify Lake County Memorial Hospital East, Lake County Memorial Hospital West, Geauga Community Hospital and Ashtabula County Medical Center as the local hospitals designated to handle members of the general public who may have radiation injuries. Letters of agreement with all of these hospitals are being obtained. Finding 55. The PNPP Plan designates Lake County Memorial Hospital East as the hospital to receive highly-contaminated-injured persons from on-site for initial treatment and decontamination. Id. Extensive training has been provided by RMC, as well as the State of Ohio, to personnel of all these hospitals. Finding 56.

Dr. McTrusty's testimony questioned the ability of the Ashtabula County Medical Center ("ACMC") to handle exposed or contaminated injured persons from an accident at PNPP on two grounds. First, Dr. McTrusty made a general assertion that ACMC has inadequate medical resources for "treatment of radiation contamination" of even "minimal numbers" of persons. McTrusty at 3. Dr. McTrusty's testimony gives no indication that he has any experience or expertise in evaluating or treating radiation injuries.^{33/} As discussed above, no special

^{33/} As noted supra, Dr. McTrusty was not able to appear at the hearing due to scheduling difficulties. His testimony was stipulated into evidence without cross-examination.

emergency facilities or equipment are needed for treatment of radiation exposure. Further, Dr. Linnemann testified, based on his personal visits to ACMC, that the hospital does have adequate facilities, equipment and supplies for handling contaminated injured patients. Finding 58. All four local hospitals, including ACMC, are well prepared to handle such patients. Finding 57. We find Dr. Linnemann's expert, detailed testimony persuasive.

Further, the November 28, 1984 emergency exercise demonstrated the ACMC emergency room staff's knowledge of proper decontamination procedures. Although FEMA found certain equipment items unavailable to ACMC emergency room personnel during the exercise, the principal piece of equipment which was unavailable - a decontamination table container with a water collection system - has now been provided to ACMC. Finding 59.

Dr. McTrusty's second point was that he was personally aware (based on interviewing "various" emergency room personnel at some unspecified point in time) of only two hours of training given such personnel at ACMC. McTrusty at 3-4. According to Dr. Linnemann, however, ACMC personnel received eight hours of training from RMC as well as 16 hours from the State. Finding 56. The Board finds no reason to question the credibility of Dr. Linnemann's testimony. In addition, the ACMC emergency room staff demonstrated its preparedness to

handle contaminated injured persons in a recent incident at the hospital. See Finding 60. We conclude that ACMC does have adequate medical resources and training to handle contaminated and injured individuals if there were an accident at PNPP.

We also find that even in the unlikely event of multiple contaminated and injured personnel, the four local support hospitals would be able to handle the increased numbers. Since hospitals already have procedures to handle mass casualty situations these can easily be applied to handle multiple injured contaminated patients. Finding 61.

In addition to these four local hospitals, there are some 26 hospitals in the counties around the plume exposure pathway EPZ which can receive and care for radiological accident cases. These hospitals have diagnostic and/or therapeutic radioisotope facilities and are thus already capable of handling radiologically contaminated and injured patients. In addition, the hospitals are accredited by the Joint Commission on Accreditation of Hospitals, which requires that they have procedures to deal with the emergency management of individuals who have actual or suspected exposure to radiation or who are radioactively contaminated. Finding 62. All hospitals have written disaster plans which provide for emergency patient overflow from the hospitals to be handled by other hospitals. Finding 63.

The Board finds that the four local support hospitals for PNPP have adequate medical resources and training to handle the number of persons which could reasonably be expected to require hospital care in the event of accident at the plant. The Board concludes that the PNPP, State and County emergency plans provide adequate arrangements for hospital medical services, including assistance to injured and contaminated or exposed individuals, in the event of an accident at PNPP.

6. Contention Q: Letters of Agreement for School Buses

Contention Q concerns the issue of formal letters of agreement for the use of school buses with schools outside of the plume exposure pathway EPZ. See Finding 64.

Applicants' witness was Mr. John W. Baer. As Project Manager for Emergency Management Services, Energy Consultants, Mr. Baer manages Energy Consultants' activities in support of the offsite radiological emergency preparedness programs for Lake, Ashtabula and Geauga Counties. Applicants' Direct Testimony of John Baer on Issue No. 1 - Contention Q, ff. Tr. 3047 (hereinafter "Baer (Contention Q)"), at 1; Statement of Qualifications of John Baer, ff. Tr. 3047, at 1.

Letters of agreement will be obtained by the Lake, Ashtabula and Geauga County Disaster Service Agencies from each of the school districts outside the plume exposure pathway EPZ

for PNPP designated to supply school buses to support an evacuation of the plume exposure pathway EPZ. It is anticipated that these letters will be obtained before fuel load. Finding 65.

The letters currently are under development. School district officials in all the school districts involved have been informed that letters will be sought. The letters of agreement are scheduled to follow arrangements being made between CEI and the school districts for the provision of radios for the buses. Finding 66.

There is no reason to believe that the letters of agreement with school districts outside the PNPP plume exposure pathway EPZ will not be obtained in a timely fashion. The Board finds that there is reasonable assurance that the letters will be obtained prior to operation of PNPP above five percent power. 34/

34/ In any event, letters of agreement are not necessary to demonstrate reasonable assurance that emergency plans can be implemented. Philadelphia Electric Co. (Limerick Generating Station, Units 1 and 2, LBP-85-14, 21 N.R.C. _____ (May 2, 1985), slip op. at 240.

7. Contention U: Handling Contaminated Property at Reception Center

Contention U states Sunflower's claim that reception centers do not have the means or facilities to handle contaminated property. Applicants' direct testimony on this contention was presented by Mr. Baer. His qualifications are discussed supra under Contention Q. Applicants also presented rebuttal testimony by Mr. John Wills, who is Resident Radiological Analyst for ODSA. Tr. 3200 (Wills).

The radiological emergency response plans and procedures for Lake, Ashtabula, and Geauga Counties provide for monitoring, decontamination, and isolation of vehicles and property at reception centers. Standard action levels have been established among the three counties for decontamination, including decontamination of property such as personal clothing, vehicles and other surfaces. Findings 68-69.

These provisions of the plans are supported by Standard Operating Procedures ("SOPs"). The Ashtabula County Decontamination SOP and individual fire department SOPs for Lake and Geauga Counties provide guidance to fire department personnel, who are responsible for monitoring and decontamination at reception centers, on the handling of property and vehicles. The SOPs provide directions for monitoring and decontamination of vehicles, and provide that vehicles that cannot be

decontaminated will be impounded. Personal property found to be contaminated will be sealed in plastic bags for disposal. Findings 70-71.

Approximately 554 fire department personnel have been, or will be, trained on decontamination procedures. This is more than twice the number needed to conduct monitoring and decontamination activities at all reception centers. The training includes specific instruction for handling contaminated property and vehicles. Finding 72.

Emergency kits containing equipment and supplies for monitoring, decontamination, and handling of property and vehicles currently are being assembled. Some kits are now in place, and kits are scheduled to be in place for all reception centers prior to fuel load. Specific instructions will be provided with the kits directing where contaminated vehicles will be impounded and where contaminated property will be temporarily stored at each reception center. Findings 73-74.

The reception centers designated in the Lake, Ashtabula and Geauga Plans are public education institutions; therefore adequate facilities are available - i.e., parking lots and recreation fields - for isolating vehicles that require decontamination. Finding 75. Access to these areas would be restricted if contamination reached a preestablished limit. Id.

The Board finds that the plans and procedures are in place for handling contaminated property at reception centers. Sunflower's cross-examination of Applicants' and FEMA's witnesses uncovered no reason to question the adequacy of those arrangements. There is reasonable assurance that reception centers have the means and facilities for handling contaminated property in the event of an accident at PNPP.

8. Contention Z: Bus Driver Protection

Contention Z asserts that the emergency plans do not provide decontamination protection for bus drivers during an emergency. Sunflower believes that bus drivers, in addition to the dosimeters they will have, should also be provided with protective gear such as respirators and goggles. Applicants' witnesses for Contention Z were Mr. Baer, and Mr. Wills, who offered rebuttal testimony.

There is no regulatory requirement and no regulatory guidance that calls for bus drivers to be provided with protective gear such as respirators and goggles. NRC regulations require that there be means for controlling radiation exposures to emergency workers. Guidance in NUREG-0654 describes provisions for supplying dosimetry to emergency workers. Finding 77. Although the State of Ohio requires that respiratory equipment must be provided to emergency workers under certain circumstances, that requirement is being revised to eliminate the

need for respiratory equipment for bus drivers. Finding 78. In any event, about 550 respirators are available for offsite emergency workers. Finding 79.

The county emergency plans provide for the distribution of personnel dosimetry, both self-reading and permanent record types, to those bus drivers who will be serving as emergency workers. Dosimeters are reliable radiation detection devices. Finding 80. Each bus driver will wear dosimetry equipment at all times. Training in the use of dosimetry has been and will continue to be provided to bus drivers. Finding 81.

SOPs for each school district require that bus drivers read their dosimeters and record their readings at least once an hour. If the bus driver's self-reading dosimeter indicates any radiation exposure, the procedures call for him to report to a monitoring and decontamination station outside the plume exposure pathway EPZ for monitoring and, if needed, decontamination. Upon completion of a mission or shift, each bus driver is required to turn in his or her dosimetry to be checked and recorded. Dosimetry records are forwarded to the county EOC and retained. Finding 82.

Mr. Shapiro in his testimony pointed out that FEMA found the Saybrook Fire Station in Ashtabula County inadequate for decontamination of emergency workers during the November 28, 1984 emergency exercise for PNPP. However, the Ashtabula Plan

includes two other facilities for decontamination of emergency workers in that county. Ashtabula County also has committed to make the necessary improvements to Saybrook or seek an alternate facility. Finding 83. The Board finds that the exercise deficiency concerning the Saybrook Station does not substantially affect the resolution of this contention and, in any event, is being adequately addressed.

In addition to the above, there are several other factors that reduce the chance of bus drivers being exposed to any radiation hazard.

First, emergency response plans have been written so that an evacuation can be completed before the release of significant radioactivity occurs. Finding 84.

Second, bus drivers will spend less time inside the plume exposure pathway EPZ than most other emergency workers, i.e., bus drivers leave the risk area as soon as their buses are loaded. Finding 85. Dr. Sternglass in his testimony claimed that bus drivers would have to make repeated trips into contaminated areas. Sternglass at 16. On cross-examination, however, he acknowledged that he did not know the school population for the PNPP plume exposure pathway EPZ, or the number of buses required to evacuate that population, and thus could not say for certain whether bus drivers would have to make repeated trips. See Tr. 2693-95 (Sternglass). (Indeed, Dr. Sternglass

admitted that he did not even know the names of the three counties within the EPZ. See Tr. 2692 (Sternglass)). In fact, there are sufficient buses in the three counties to evacuate everyone needing transportation, including school students, in a single trip. Finding 86.

Third, every bus will have a radio, which will allow prompt receipt or transmission of pertinent information, including radiological information. Radiation information from radiological monitoring teams can be relayed to bus drivers. Findings 87-88. Thus, Dr. Sternglass' testimony that dosimeters do not provide adequate protection for bus drivers because "they do not tell them in which direction to drive [sic] to reduce the exposure rate" is completely irrelevant. Dr. Sternglass did not examine the communications systems of the three counties to see that there is an ability to communicate with bus drivers. See Tr. 2692-93 (Sternglass).

Dr. Sternglass also alluded to the possible existence in an emergency of "highly contaminated areas" and "lethal levels" of radiation to which bus drivers might be exposed. Sternglass at 16. The evidence presented on Contention P showed that offsite radiation doses sufficient to require hospital emergency care, let alone "lethal" doses, are highly unlikely even in a severe accident at PNPP. See, e.g., Finding 54.

Finally, Dr. Sternglass claimed that the availability of respirators to female bus drivers would reduce the potential exposures to developing fetuses which, according to Dr. Sternglass, are particularly sensitive to radioiodine. Sternglass at 17. In light of the Board's discussion, supra, concerning Dr. Sternglass' credibility, it is unnecessary to further address the merits of Dr. Sternglass' theories on fetal sensitivity.

The Board concludes that, in light of the information and procedures in the emergency response plans providing for the proper dosimetry, exposure control recordkeeping, and monitoring and decontamination services, as well as the other factors discussed above, bus drivers are well protected. There is no need for bus drivers to have goggles, protective clothing or respirators.

9. Contention BB: FEMA Interim Report

Sunflower's Contention BB alleges that the offsite emergency plans for PNPP are inadequate due to the planning deficiencies set forth in FEMA's Interim Report on Offsite Radiological Emergency Planning for the Perry Nuclear Power Station, dated January 10, 1984 ("FEMA Interim Report"). Applicants' witness on this contention was Mr. Baer.

The FEMA Interim Report concluded that "there is reasonable assurance that the plans are adequate and capable of being implemented in the event of an accident at the site." Finding 90.

The FEMA Interim Report reflects the review by the FEMA Regional Assistance Committee ("RAC") of draft Ashtabula, Geauga and Lake County Emergency Plans submitted for review by the State of Ohio on March 17, 1983, and the schedule of corrections to the RAC review received by FEMA from the State on August 30, 1983. As reflected in the FEMA Interim Report, more than half of the planning deficiencies identified by the RAC were corrected and the corrective actions accepted by FEMA in the Interim Report itself. A subsequent submittal of corrections to be made to the county plans was made by the State to FEMA on March 29, 1984. Finding 91.

Each of the county plans was revised to reflect corrective actions made in direct response to the planning deficiencies noted in the FEMA Interim Report. Finding 92. All planning deficiencies listed in the Interim Report have been corrected or are being addressed. Finding 93. The few items still being addressed primarily involve Applicants' emergency information material. Finding 94. The emergency information handbook will be distributed prior to fuel load. Id. The NRC has reviewed Applicants' emergency information handbook and determined that it complies with NUREG-0654. Id.

The Board finds that each of the planning deficiencies listed in the Interim Report has been, or is being, resolved. These resolutions further support FEMA's conclusion that the county plans are adequate. Sunflower's cross-examination of Applicants', the Staff's and FEMA's witnesses elicited no support for Sunflower's claim that the planning deficiencies noted in the FEMA Interim Report indicate that the county plans are inadequate.

10. Contention CC: SER Resolution Items

Contention CC asserts that the resolution items set forth by the Staff in Supplement 4 of its Safety Evaluation Report Related to the Operation of the Perry Nuclear Power Plant, Units 1 and 2, NUREG-0887 (February 1984) ("SSER 4"), pages 13-1 to 13-22, are uncorrected deficiencies in Applicants' emergency plan. The referenced pages in SSER 4 set forth the Staff's evaluation of the PNPP Plan (through Revision 2), and identified 35 items which required resolution. Finding 95.

Applicants' witness for Contention CC was Mr. Hulbert. His qualifications are discussed supra under Contention J. Sunflower declined to conduct cross-examination on Contention CC. Neither did Sunflower present any direct testimony on this contention.

On April 28, 1984, CEI transmitted to the Staff Revision 3 to the PNPP Plan, as well as a cross-reference between the resolution items in SSER 4 and where in Revision 3 those items had been resolved. On August 20, 1984 and October 29, 1984, CEI provided to the Staff additional clarification of changes to the PNPP Plan which related to resolution items in SSER 4 and which were being incorporated in Revision 4 to the PNPP Plan. On February 20, 1985, CEI transmitted to the Staff Revision 4 to the PNPP Plan. This revision incorporated the information from the August 20 and October 29, 1984 correspondence identified above. Finding 96.

The information contained in Revisions 3 and 4 and the identified correspondence demonstrate that all the emergency planning resolution items in SSER 4 have been resolved. Finding 97. The evidence is undisputed, and the Board so finds, that these resolution items are not uncorrected deficiencies in the PNPP Plan.

B. Issue No. 16: TDI Diesel Generators

1. Background and Introduction

Issue No. 16 concerns the ability of the four Transamerica Delaval, Inc. ("TDI") diesel generators in place at PNPP to reliably generate emergency onsite power.

Intervenors Sunflower and OCRE filed separate diesel generator contentions. Both Applicants and the Staff opposed admission of the contentions. Neither Sunflower's nor OCRE's original contention concerning the PNPP diesel generators was admitted by the Board.^{35/}

OCRE subsequently filed a motion to resubmit its contention on the diesel generators. This motion was opposed by Applicants and the Staff. The Staff subsequently re-examined its position, in light of new information, and later supported the admission of OCRE's late-filed diesel generator contention.

The contention was admitted in this proceeding on December 23, 1983, with OCRE as the lead intervenor.^{36/} As admitted by the Board, Issue No. 16 states:

Applicant has not demonstrated that it can reliably generate emergency on-site power by relying on four Transamerica Delaval diesel generators, two for each of its Perry units.

The Board's basis for admitting Issue No. 16 was the number of deficiencies reported via Deficiency Analysis Reports ("DARs") on the PNPP TDI diesel generators which raised design,

^{35/} See LBP-81-24 at 222-24.

^{36/} The Board simplified the contention resubmitted by OCRE. Memorandum and Order (New Contention on Diesel Generators), LBP-83-80, 18 N.R.C. 1404 (1983).

as well as manufacturing concerns, and cracks in the crankshafts in the TDI diesel generators installed at the Shoreham Nuclear Power Station ("Shoreham").^{37/}

Briefs on NRC regulations and guidance applicable to Issue No. 16 were submitted by OCRE, the Staff, and Applicants. Reply briefs were thereafter filed by OCRE and Applicants.

Discovery on this issue closed on June 1, 1984. It included three sets of interrogatories to the Applicants by OCRE and one set of interrogatories and request for production of documents to OCRE from Applicants. On January 7, 1985, OCRE filed a motion to reopen discovery on Issue No. 16 along with another set of interrogatories to Applicants. Applicants voluntarily responded to the new set of interrogatories and provided the majority of the documents requested.

On February 5, 1985, Applicants filed a motion for summary disposition of Issue No. 16. Applicants' motion was supported by the Staff and opposed by OCRE. After considering the filings of the parties, the Board denied Applicants' summary disposition motion.^{38/} The Board indicated that its decision was governed by the technical complexity of the issue.

^{37/} See LBP-83-80 at 1405-07.

^{38/} March 13, 1985 Memorandum and Order. See April 9, 1985 Memorandum and Order.

On February 11, 1985, OCRE filed a motion to have Mr. George Eley, an individual who had testified on behalf of intervenors in the Shoreham proceedings on TDI diesel generators, appointed as a Board witness in this proceeding. OCRE justified its request by citing its inability to pay Mr. Eley's fees and expenses. After considering the opposing filings of the other parties, the Board denied this motion.^{39/} OCRE subsequently filed a motion for directed certification of the Board's decision on March 16, 1985. This motion was opposed by both Applicants and the Staff. The Atomic Safety and Licensing Appeal Board refused to delay the evidentiary hearing on Issue No. 16,^{40/} as OCRE had requested, and subsequently denied OCRE's motion,^{41/} agreeing with Applicants and the Staff that the standard for interlocutory review had not been met.

Pre-filed written testimony on the diesel generator issue was submitted by Applicants and the Staff. OCRE filed no testimony. OCRE filed a motion to strike portions of Applicants' and the Staff's testimony on April 1, 1985. This motion was subsequently denied, as to Applicants (Tr. 2170), and withdrawn, as to the Staff (Tr. 2281).

^{39/} March 13, 1985 Memorandum and Order. See Memorandum and Order (Motion for Appointment of Board Witnesses) (March 26, 1985) (explaining the Board's decision).

^{40/} Order (April 2, 1985).

^{41/} ALAB-805, 21 N.R.C. ____ (April 10, 1985).

Applicants' witnesses at the evidentiary hearing on Issue No. 16 were Edward C. Christiansen, John C. Kammeyer, and Charles D. Wood, III. Edward C. Christiansen is the Senior Design Engineer at PNPP responsible for the Electrical Unit of the Nuclear Construction Engineering Section. His responsibilities include the coordination of engineering and licensing activities involved with the diesel generators and associated standby power facilities at PNPP. Mr. Christiansen acted as CEI's technical representative to the TDI Diesel Generator Owners Group ("Owners Group").

John C. Kammeyer is an employee of Stone & Webster Engineering Corporation who is currently acting as the Assistant Head of the Site Engineering Office at Shoreham. Over the last five years his responsibilities at Shoreham have provided him with extensive experience in the resolution of problems and technical issues involving TDI diesel generators. Mr. Kammeyer served as the Owners Group Program Manager and had the overall responsibility for implementation of the Owners Group Design Review/Quality Revalidation Program for TDI diesel generators in nuclear service.

Charles D. Wood, III is the Vice President of the Engines, Emissions, and Vehicle Research Division of Southwest Research Institute ("SwRI") which was employed by Applicants to independently review the Owners Group analyses of sixteen engine

components exhibiting potentially generic problems (Phase I of the Owners Group Program). Mr. Wood has nearly 30 years of engineering experience with extensive work involving different types of diesel engines. Mr. Wood is the author of numerous publications concerning diesel engines and holds a number of patents.

The Staff's witnesses were Dr. Carl H. Berlinger, Drew Persinko, Dr. David A. Dingee, Howard M. Hardy, Adam J. Henriksen, Dr. Spencer H. Bush, and B. J. Kirkwood. Dr. Carl H. Berlinger is a member of the NRC Staff, currently acting as the NRC TDI Diesel Generator Project Group Manager. Dr. Berlinger holds a PhD in mechanical engineering and has nearly 12 years experience with the NRC in the Systems Integration, Licensing, and Operating Reactors Divisions.

Mr. Drew Persinko is also a member of the NRC Staff employed as an Integrated Assessment Project Manager in the Licensing Division. Mr Persinko is a member of the TDI Diesel Generator Project Group. As such, he has been responsible for Staff review of the TDI diesel generators at PNPP and Comanche Peak, and has assisted in the reviews at a number of other plants.

Dr. David A. Dingee is employed by Pacific Northwest Laboratory ("PNL") and is currently serving as Deputy Project Manager on the Assessment of Diesel Engine Reliability/Operability

project being conducted for the NRC Staff. Dr. Dingee holds a PhD in physics.

Howard M. Hardy, Adam J. Henriksen, Dr. Spencer H. Bush and B. J. Kirkwood are all employed as engineering consultants to PNL. Mr. Hardy is a specialist in engine dynamic vibration analyses and has worked extensively with medium to large diesel and gas engines. Messrs. Henriksen and Kirkwood have a considerable amount of experience in diesel engine applications and contributed extensively to the technical evaluation of the PNPP engines' reliability/operability. Dr. Bush holds a PhD in metallurgy.

OCRE presented no direct testimony, but cross-examined both Applicants' and the Staff's witnesses.

2. Reliability of the TDI Diesel Generators

The primary focus of the Board's decision on Issue No. 16 is on the measures taken by Applicants to revalidate their TDI diesel generators^{42/} in light of the design and manufacturing problems associated with TDI units at other plants (particularly at Shoreham). The Board has concluded that Applicants have

^{42/} The PNPP diesel generators are DSRV-16-4 engines. Finding 100. These are TDI R-4 model engines, having 16 cylinders arranged in two banks in a V-type engine block, as opposed to TDI's DSR-48 which is an inline, 8-cylinder engine design. Id.

adequately addressed the concerns raised by OCRE as to the reliability of the TDI diesel generators in place at PNPP and have demonstrated that these engines are capable of performing their intended safety-related functions.

This conclusion is based on a review of the TDI Diesel Generator Owners Group Program and Applicants' implementation thereof (including the Phase I and Phase II component reviews and the engine tear-down and revalidation performed on both Unit 1 diesel generators), and Applicants' commitment to perform the same type of program for the Unit 2 diesel generators. The successful torsionograph testing of both Unit 1 engines further supports this decision. The Board also considered the extensive testing being performed on the diesel generators prior to plant operation. The Board has noted Applicants' commitment to perform the maintenance and surveillance recommendations of the Owners Group as well as those of SwRI and PNL. This commitment provides additional assurance of the TDI diesel generators' operability and reliability in the future.

Accordingly, the Board has concluded that Applicants have satisfactorily answered the concerns raised under Issue No. 16 and that there remains no outstanding issue as to the reliability of the TDI diesel generators in place at PNPP.

a. The TDI Diesel Generator Owners Group Program

Twelve U.S. utilities (including CEI) with TDI diesel generators participated in the TDI Diesel Generator Owners Group Program. Finding 101. The Owners Group Program utilized a combination of design reviews, quality revalidations, engine tests, and component inspections to assess the adequacy of the PNPP TDI diesel generators. Id. The Owners Group Program did not rely on TDI's quality assurance program. Finding 102. Rather, the Owners Group Program, as implemented at PNPP, revalidated the diesel generators on-site. Id.

i. The Sixteen Phase I Components

One of the Owners Group's first tasks was to assemble experience data pertinent to TDI engines. Finding 103. Using this database, sixteen components were identified as exhibiting potentially generic problems; these components were singled out for a detailed design review in the Phase I effort. Id.^{43/}

The Owners Group reports on these "Phase I components" were reviewed by PNL for the NRC Staff. Finding 104. Applicants also employed an independent engineering consulting firm,

^{43/} These sixteen components were the turbocharger, engine base and bearing caps, crankshaft, cylinder block, cylinder head studs, connecting rods, connecting rod bearing shells, pistons, air start valve capscrews, cylinder heads, fuel oil injection tubing, pushrods, rocker arm capscrews, jacket water pump, wiring and termination, and cylinder liner. Finding 103.

SwRI, to review, evaluate, and independently verify the Owners Group methodology, results and conclusions, as reflected in each of the Phase I reports. Finding 105.44/ Based on their review, both PNL and SwRI concluded that the Phase I components in the PNPP engines will adequately perform their intended function.45/ Findings 104, 105. The Board concurs with Applicants, Staff, and their consultants, and finds that the Owners Group evaluation of the sixteen Phase I components has demonstrated their suitability for use in nuclear applications.

In its response to Applicants' motion for summary disposition OCRE focused on nine of the sixteen Phase I components.46/ It is, therefore, appropriate for the Board to focus its discussion on these same components.

44/ The Board finds both the pre-filed and oral testimony of the SwRI and PNL witnesses credible and unrefuted by OCRE.

45/ PNL considers the PNPP crankshaft adequate provided its review of the torsigraph testing conducted at PNPP confirms the favorable results reported by Applicants. Finding 104. PNL's interim basis for adjudging the crankshafts to be reliable is the torsigraph testing previously conducted at TDI, the fact that the Owners Group analytical calculations confirmed the prior test results so closely, and the favorable results of torsigraph testing at other plants. Finding 122.

46/ The nine components singled out by OCRE were the crankshaft, cylinder heads, engine base and bearing caps, turbocharger, cylinder block, cylinder liner, pistons, connecting rods, and connecting rod bearing shells. At the hearing, OCRE focused its cross-examination on the first six of these components.

Crankshaft. As previously noted, cracks in the crankshafts in the TDI diesel generators installed at Shoreham provided one of the bases for admitting OCRE's diesel generator contention in this proceeding. Problems experienced with the Shoreham crankshafts were also the reason for including the crankshaft in the group of components subjected to a detailed design review by the Owners Group. Finding 112. The PNPP DSRV-16-4 engines are different from the DSR-48 engines installed at Shoreham and also have a larger (13" x 13") crankshaft than the crankshafts (13" x 11") which cracked at Shoreham. Findings 100, 112. Both the Owners Group and SwRI concluded that the PNPP crankshafts are adequate for their intended service provided appropriate maintenance, inspection and surveillance recommendations are followed. Finding 122. Because PNPP is committed to implementing these recommendations, the Board also finds the PNPP crankshafts suitable for their intended service. Id.

The Owners Group analysis of the crankshaft confirmed prior analysis and torsigraph testing at TDI which had indicated that the PNPP crankshafts met the recommendations of the Diesel Engine Manufacturers Association ("DEMA"). Findings 112, 113, 114. Torsigraph testing of both of the PNPP Unit 1 engines has verified this fact. Finding 114. The Board finds DEMA to be an appropriate, conservative standard for adjudging the adequacy of the PNPP crankshafts. Finding 113. It concurs

with the NRC Staff that the rules of the European ship classification societies are not appropriate for stationary diesels. Finding 119. The Board finds that although the PNPP crankshaft has a fourth order critical speed (436 rpm) which is close to the engines' operating speed (450 rpm), the DEMA standards have been met by a significant margin. Id. PNPP's performance specification for the engines was even more stringent than the DEMA requirements. Finding 113. That performance specification has been met. Id. The Board notes, with approval, the steps taken at PNPP to limit the engines' speed range so steady operation of the engines below 450 rpm is minimized. Finding 115.

PNPP's simulation and investigation of the effect of radial cylinder imbalance on crankshaft stresses (during the torsigraph testing), as well as its commitment to regularly monitor cylinder firing pressures and exhaust temperatures, adequately responds to OCRE's concerns regarding cylinder imbalance. Findings 119, 120. The Board does not agree that cylinder imbalance will present a problem for engine operation, as OCRE suggests.

The problems experienced with the San Onofre Nuclear Power Station ("San Onofre") crankshaft, which were raised by OCRE at the hearing, are irrelevant to PNPP. Finding 117. San Onofre has a DSRV-20 engine and a crankshaft significantly different

from the PNPP crankshaft Id. The situation at San Onofre (where the engine passes through three critical speeds in close proximity) is unique, and has not been observed in any of the other TDI engines. Id.

The Board concludes that Applicants have adequately addressed other crankshaft concerns manifested during Owners Group recommended inspections (e.g., machining marks in the oil holes) and the problems identified by regulatory reporting programs (e.g., the crack in the crankshaft oil hole plug recently reported per 10 C.F.R. Part 21). Findings 116, 118. PNPP's response to the aforementioned incidents demonstrates its commitment to perform whatever corrective action is necessary to assure the continued reliability and operability of its engines.

Cylinder Block and Liner. At the hearing, OCRE raised a number of questions with regard to the Owners Group evaluation of the cylinder block, particularly its inspection requirements. PNPP has performed a 100 percent inspection of the cylinder block tops and liner landings on each of its engines and has found no evidence of any cracking of the block tops (as occurred at Shoreham and elsewhere). Findings 123, 127. Applicants' and Staff's witnesses' testimony concerning the low probability of crack propagation in the blocks (even during a Loss of Offsite Power/Loss of Coolant Accident ("LOOP/LOCA"))

was unrefuted by OCRE. Finding 129. Abnormal microstructure was a problem with one of the Shoreham blocks which cracked. Finding 130. The blocks at PNPP have been inspected and reported to have normal microstructure (typical Class 40 grey cast iron). Id. The Board, therefore, finds that the Owners Group recommended inspection intervals for the block are sufficient to identify any deleterious cracking prior to its presenting a problem for engine operation and concludes that the cylinder blocks at PNPP are acceptable. Findings 126-129.

The Board approves of steps taken at PNPP to reduce the possibility of block cracking by reducing liner proudness. Finding 131. The Board finds the PNL testimony concerning the consequences of liner to block fretting convincing and does not believe it will affect operation of the PNPP diesels. Id.

Connecting Rods. The PNPP connecting rods are supplied with 1-1/2" bolts which provide a greater material section, and reduce stress levels, in the master rod box. Finding 132. The design in use at Perry does not have the failure history associated with the connecting rod assemblies produced with 1-7/8" bolts. Id.

OCRE questioned the Owners Group's failure to perform an evaluation of the buckling strength of V-engine connecting rods, such as those at PNPP. Both the Staff and its consultants testified that such an analysis was unnecessary in light

of the absence of problems with buckling of these rods. Finding 133. The Board finds the testimony particularly persuasive in light of both PNL's and SwRI's review of the Owners Group evaluation of this component. Findings 104, 105. The Board, therefore, concurs with Applicants and the NRC Staff that the connecting rods are suitable for their intended service at PNPP. Finding 134.

Connecting Rod Bearing Shells. Connecting rod bearing shells were reviewed as a Phase I component due to cracked bearing shells at Shoreham. Finding 135. The larger (1/4" x 45 degree) chamfer at Shoreham which caused the cracking has been replaced by a smaller (1/6" x 45 degree) design, which is utilized at PNPP. Id. OCRE conducted no cross-examination concerning the bearing shells.

The connecting rod bearings at PNPP have been inspected, per Owners Group requirements, and found to meet the Owners Group criteria for acceptance. Finding 136. The bearing shells have a fatigue life of 38,000 hours of full load operation. Finding 135. The Board finds Applicants and the NRC Staff's testimony concerning this component credible and unrefuted by OCRE and, therefore, finds that the connecting rod bearing shells in place at PNPP are adequate for their intended service.

Pistons. The PNPP engines have AE pistons which are structurally stronger than the AF pistons which exhibited cracking at Shoreham. Finding 137. OCRE conducted no cross-examination concerning the pistons. The PNPP AE piston skirts have been confirmed to satisfy Owners Group acceptance criteria. Finding 138. Applicants and the NRC Staff have concluded that they will perform satisfactorily. Id. No evidence has been presented by OCRE to indicate otherwise. The Board, therefore, finds that the AE pistons in place at PNPP are adequate for their intended service.

Cylinder Heads. Cylinder heads were evaluated by the Owners Group as a Phase I component due to cracking observed in a number of locations on the head. Finding 157. At the hearing, OCRE expressed concern that the PNPP cylinder heads might be subject to valve seat cracking. The cylinder heads in place at PNPP have all been stress-relieved and welded to meet new requirements and are, therefore, not subject to this problem. Finding 158. The PNPP cylinder heads also meet minimum fire deck thickness requirements and do not have through-wall weld repairs performed on one side only, a condition considered detrimental by PNL due to the stress concentration associated with such a repair. Findings 159, 160. The Board notes with approval PNPP's plans to air-roll its engines after all operations and before all planned starts as an additional precaution against water leakage into the cylinders caused by possible

cracking in the cylinder heads. Finding 161. The Board concurs with Applicants and the NRC Staff that the cylinder heads in place at PNPP are adequate. Finding 162.

Engine Base and Bearing Caps. The engine base and bearing caps assembly was included among the Phase I components due to cracking observed in DSR-4 inline engines, a nut pocket failure in a DSRV-16-4 engine, and through-bolt failures on a DSR-46 engine. Finding 163. At the hearing, OCRE indicated concern with the Owners Group inspection requirements for this component because those requirements do not include materials verification. To ensure that the engine base is fabricated from acceptable material, the Owners Group requires inspection of the most critical bearing saddle and the most highly-loaded bearing cap, routine maintenance, and visual inspections at each outage. Finding 164. PNPP completed these inspections and routinely performs the required maintenance, including visual inspections of every bearing saddle area. Finding 165. During the inspection, minor casting flaws common to the type of casting involved were discovered but were too small to necessitate removal. Id. The Board, therefore, agrees with Applicants and the NRC Staff that the base, bearing caps, and associated bolting are adequate for their intended service. Finding 166.

Turbocharger. The turbochargers were included among the Phase I components because of a number of failures. Finding 167. While vane failures may occur on the PNPP turbochargers in the future, the history of turbochargers in nuclear service reveals that none has suffered severe damage and some have not even evidenced any damage as a result of vane breakage. Finding 169.

Because vane cracking cannot be detected by visual or liquid penetrant inspections, the PNPP turbochargers will be subjected to stringent maintenance and surveillance to identify any problem at an early stage. Finding 170. The Board feels that the increased maintenance and surveillance to be implemented at PNPP is acceptable, and, therefore, finds that the PNPP turbochargers are adequate for their intended service.

Seven Remaining Phase I Components. The remaining Phase I components (the pushrods, rocker arm capscrews, fuel oil injection tubing, wiring and termination, jacket water pump, cylinder head studs, air start valve capscrews), all received detailed design reviews by the Owners Group. Findings 141, 143, 145, 147, 149, 152, 155. In some instances, SwRI performed an additional analysis or varied the parameters in an Owners Group analysis to reflect conditions at PNPP. Findings 141, 155. In all cases, the Owners Group and SwRI concluded that the component utilized at PNPP would satisfactorily perform its intended

function. Findings 141, 144, 146, 148, 151, 154, 156. OCRE adduced no evidence to the contrary. The Board, therefore, finds that each of the aforementioned components will satisfactorily perform its intended function at PNPP.

ii. The Phase II Design Review/Quality Revalidation Program

Phase II of the Owners Group Program examined components of the PNPP engines which were not evaluated in Phase I. Finding 106. These components have not had a history of problems. Id. As selected by a technical committee, 171 components on the PNPP engines were reviewed in the Phase II Design Review/Quality Revalidation ("DR/QR") program. Id. The DR/QR program is based on a "lead" engine - "following" engine concept, with the lead engine for PNPP being a DSRV-16-4 engine at Comanche Peak Steam Electric Station ("Comanche Peak"). Finding 107. The Comanche Peak lead engine was subjected to an extensive evaluation and detailed component review by the Owners Group.^{47/} Id. Results of this investigation dictated the follow-up inspections to be performed at PNPP. Id. The Board finds the lead engine approach to qualification of following engines to be a valid and appropriate technique.

^{47/} A full, pre-operational test program has been conducted on the DSRV-16-4 engines at Comanche Peak. Finding 178. Over 100 hours of operation have been logged on these engines. Id. Over 1600 hours have been logged on the DSRV-16-4 engines at Catawba. Id.

At the hearing, Applicants' witnesses responded to concerns expressed by OCRE regarding the lack of quality revalidation on various PNPP engine components. Finding 108. The Board agrees with the Owners Group that quality revalidation of every component on the PNPP engines is unnecessary. Where the physical inspection of a component was required on the lead engine at Comanche Peak, the same inspection was performed on the PNPP engines. Id. The Board agrees with the NRC Staff's characterization of the Owners Group DR/QR program as an "excellent revalidation program". Finding 106.

iii. Engine Teardown and Reassembly

In the third phase of the Owners Group Program, the PNPP Unit 1 engines were completely disassembled, inspected, and reassembled under PNPP's quality control and quality assurance program. Finding 110. Replacement of components and routine maintenance on the engines were also performed during this time. Id.

iv. Engine Maintenance and Surveillance

The final phase of the Owners Group program is ongoing at PNPP. Finding 111. It involves the implementation of a comprehensive set of maintenance and surveillance recommendations. Id. The maintenance and surveillance program being implemented at PNPP will guarantee that the engines meet General Design

Criteria ("GDC") 17 throughout the life of the plant. Id.
This conclusion is buttressed by the fact that PNPP has also agreed to implement each of the maintenance and surveillance recommendations made by PNL and SwRI. Id.

The Board finds that the revalidation of the PNPP Unit 1 engines was complete in scope and has been satisfactorily performed. Applicants have demonstrated that any inadequacies associated with the TDI quality assurance program do not affect the reliability of the PNPP TDI diesel generators. Finding 102.

Applicants have adequately addressed each of the items highlighted by the NRC Staff in its prefiled testimony.^{48/} For example, the NRC Staff indicated that it would like additional information on OCRE's previously expressed concern regarding the sufficiency of the contact between the engine base and chocks. Finding 173. As explained by Applicants' witnesses at the hearing, PNPP's architect/engineer established an inspection requirement of 85% surface contact for all heavy machinery installations. Id. An engineering evaluation was required and conducted at PNPP for chock plates with less than 85% contact. Id. In all cases, the contact exceeded TDI's minimum

^{48/} In its prefiled testimony, the Staff responded to concerns raised in OCRE's response to Applicants' motion for summary disposition.

requirements; hot and cold crankshaft deflection measurements at PNPP have confirmed that TDI's criteria have been met. Id.

b. Engine Testing

The Board believes that the testing to be performed on the diesels prior to and during plant operation, as well as between outages, will permit the identification and correction of any minor operational problems which occur in the diesel generators in the future. Finding 175. As noted by one of Applicants' witnesses, random failure of components on the PNPP diesels is still a possibility. Finding 186. Given the complexity of these engines, the Board does not find this unexpected. The Board believes that the comprehensive program conducted by the Owners Group has significantly reduced the likelihood of such an occurrence. Id.

As of the time of the hearing, the Unit 1 engines had run for a total of approximately 20 hours without a hardware-related incident. Finding 177. This operation, coupled with the successful testing and hundreds of hours of operation accumulated on other DSRV-16-4 engines, supports the reliability of DSRV-16-4's. Finding 178. The Board finds additional assurance of the reliability of the PNPP diesels in the Owners Group study which indicated that the TDI diesel engines are extremely reliable in starting, and fall well within Regulatory Guide 1.108 requirements. Finding 180. The Board agrees with

Applicants and the NRC Staff that operation of the PNPP engines for 10^7 cycles prior to plant operation is unnecessary.

Finding 179.

The PNPP TDI diesel generators are rated for continuous operation at 7,000 kw, with a short-term overload rating of 7,700 kw. Finding 100. In an accident situation, the most highly-loaded PNPP engine would be subjected to a maximum load of 5,634 kw, only 82% of the engines' nameplate rating. Finding 181. The PNPP engines, therefore, have more than adequate design capacity to handle the most severe design basis accident loading. Id.

3. Summary and Conclusion

The Board finds that Applicants have established that the Unit 1 diesel generators will perform reliably. The Unit 2 diesels will also be subjected to all phases of the Owners Group Program as carried out for Unit 1.^{49/} Finding 185. The Unit 2 diesels will undergo the same preoperational testing. Id. The Board, therefore, finds that Applicants have successfully demonstrated that PNPP can reliably generate emergency on-site power with the TDI diesel generators installed at both PNPP Units.

^{49/} The Board recognizes that it may be appropriate to modify maintenance and inspection requirements, as well as some testing requirements for the Unit 2 engines, as additional operational experience is obtained. Finding 185.

FINDINGS OF FACT

I. CONTENTIONS

A. Issue No. 1: Emergency Planning

1. Contention A: State and Local Comments on ETE Study

1. Sunflower's Contention A as admitted by the Board stated:

Evacuation time estimates have not been reviewed by State or local organizations and adverse weather conditions have not been considered.

January 10, 1985 Memorandum and Order at 6. The Board granted Applicants' motion for summary disposition of Contention A "except as to the issue of obtaining published comments from state and local officials on evacuation time estimates. . . ." March 13, 1985 Memorandum and Order at 1. See April 9, 1985 Memorandum and Order at 3.

2. Appendix 4 to NUREG-0654 sets forth the regulatory acceptance criteria for evacuation time estimate studies. Appendix 4 provides, in relevant part:

A review of the draft submitted by the principal organizations (State and local) involved in emergency response for the site shall be solicited and comments resulting from such review included with the submittal.

NUREG-0654 at page 4-10. See Shapiro at 3; Perrotti at 3.

3. Offsite emergency planning/response officials have played an important role in the development of the ETE for the PNPP plume exposure pathway EPZ (e.g., in the determination of preparation and mobilization times, and vehicle occupancy rates). McCandless at 2. See Perrotti at 2. Thus, the participation of these officials has gone far beyond a mere "review" of the ETE. McCandless at 2.

4. The evacuation time estimate study for the PNPP plume exposure pathway EPZ was prepared by HMM Associates, Inc. Before beginning work on the Perry ETE, on October 3 and 4, 1983, HMM personnel met individually with representatives of each of the three counties (including the DSA Directors for Geauga, Ashtabula, and Lake Counties), to present the basic methodology of the ETE and to discuss the general input data and assumptions for the computer simulation model to be used in developing the ETE. The model output (evacuation time estimates, average travel speeds, queue lengths, etc.) was also described. In addition, the time/weather condition scenarios to be modeled were discussed. All meeting participants were in agreement with the information presented, and future meetings with the officials were scheduled for their review of the validity of the area-specific input data and assumptions for the PNPP plume exposure pathway EPZ. Id. at 1-3.

5. On October 17 and 18, 1983, HMM personnel again met with the officials (including the DSA Directors) of the three counties, to review the area-specific data and assumptions for use in the ETE. The data and assumptions discussed included matters such as evacuation area boundaries, evacuation routes, and adverse weather conditions to be modeled. All those in attendance at the meetings concurred in the results to date, as well as the proposed plans and procedures for continued work on the ETE. Id. at 3.

6. On March 9, 1984, copies of the March 1984 draft of the ETE were provided to the DSA Directors and Sheriffs of each of the three counties, and to the Ohio Disaster Services Agency ("OSDA") in Columbus, for review and comment. McCandless at 3; Shapiro at 3 and Attachment 1. The agencies' comments (see Shapiro, Attachments 2-5) have been reflected in the February 1985 revision of the ETE, which is included in Revision 4 of the PNPP Plan as Appendix D. McCandless at 3. The comments were submitted to the NRC on February 20, 1985 with the submission of Revision 4 of the PNPP Plan. McCandless at 3; Perrotti at 2; Tr. 2823-24 (McCandless), 3112-13 (Shapiro).

7. On March 20, 1985, HMM met again with the three County DSA Directors, who expressed concurrence with the changes made as the result of their comments. Tr. 2809 (McCandless). The County Engineers for Lake, Ashtabula and Geauga Counties

also were present at that meeting, and they also concurred with the revised ETE. Tr. 2795-97 (McCandless). The ODSA also has concurred with the changes made as the result of its comments. Tr. 2896-97 (Cole).

8. Thus, the ETE has been reviewed by the principal state and local organizations and the comments of the officials involved have been included with the submittal of the ETE to the NRC. Both FEMA's and the Staff's witnesses concluded that Applicants have complied with NUREG-0654 as it relates to this contention. See Perrotti at 3; Shapiro at 3; Tr. 3112-13 (Shapiro).

2. Contention J: Incomplete EALs

9. Contention J states:

Emergency action level indicators are
imcomplete in Applicant's emergency plan.

January 10, 1985 Memorandum and Order at 6.

10. EALs describe specific plant conditions at which one of the four Emergency Classifications (Unusual Event, Alert, Site Area Emergency, General Emergency) are to be declared. Table 4-1 of the PNPP Plan, Rev. 3 (April 23, 1984) set forth more than 200 individual EAL indications. Hulbert (Contention J) at 2.

11. Of the over 200 EALs, 13 were "incomplete" in Revision 3 of the PNPP Plan. In each case, the value to be included later was not available at the time Revision 3 of the Plan was issued, because the value could only be determined after the detailed technical data became available. Id.

12. In each of the 13 cases where a value was to be added later, a comparable value was specified. For example, Table 4.1, EAL § I.3.a(1) stated:

Off-gas pretreatment process radiation monitor high alarm with indication of (1) increase of (later) mrem/hr in 30 min. (equiv. to 100,000 uCi/sec).

Id.

13. In each of the 13 cases in Revision 3, either the "missing" values have now been developed based upon additional detailed information which became available after Revision 3 was issued, or alternate indications have been selected. In all cases, these have been included in Revision 4 to the PNPP Plan, which was issued in February 1985. There are no incomplete EALs. Id. at 2-3; Perrotti at 3-4.

14. Based on the Staff's review to date of Applicants' emergency classification and action level scheme, the Staff concludes that Applicants' emergency plan satisfies the applicable regulatory requirements and guidance. Perrotti at 4.

15. A nomogram is a graphic device which contains a series of assumptions and possible variables. Tr. 2648 (Sternglass). Nomograms can be developed which address a range of possible EALs for different situations during an emergency. See Sternglass at 4. The use of nomograms for this purpose is not required by any regulation. Nomograms are recommended in the EPA's Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, at 5.15. Tr. 2648-50, 2701-04 (Sternglass). However, the EPA Manual states that other "shortcut" dose projection methods may have been developed that are just as accurate as nomograms; and these methods should be used if appropriate. Tr. 2703, 2728 (Sternglass).

16. Nomograms have become obsolete since the EPA Manual was written. Nomograms are not a useful tool because they require a number of assumptions, are good for only a limited number of cases, and are typically difficult to read and interpret. The current method of dose projection, which is used by Applicants, is a computer-based system which uses real time data from in-plant monitors and meteorological data for rapid dose assessment calculations. This method is far superior to nomograms for use during an emergency. Tr. 2971-73 (Hulbert).

17. Footnote 3 of Table 6-2 of the PNPP Plan, entitled "Guidelines for Protection Against Ingestion of Contamination," is taken from a Food and Drug Administration Federal Register

Notice containing recommendations for ingestion pathway protective action guides. 47 Fed. Reg. 47073, 47081 at n. 1, 47082 (1982). See Tr. 2654-55 (Sternglass).

18. There is no relationship between ingestion pathway protective action guides, as found in Table 6-2 of the PNPP Plan, and EALs. See Tr. 2970 (Hulbert).

3. Contention M: Independent Radiation Monitoring System

19. Sunflower's Contention M alleges:

Independent Data Monitoring Systems should be installed within all counties in the Emergency Planning Zone (EPZ).

January 10, 1985 Memorandum and Order at 6.

20. There is no regulatory requirement or guidance that each jurisdiction within the plume exposure pathway EPZ have independent radiation monitoring systems. Bowers at 2.

NUREG-0654, Criterion H.7 (p. 54) says that

[e]ach organization, where appropriate, shall provide for off-site radiological monitoring equipment in the vicinity of the nuclear facility.

(Emphasis added.) NUREG-0654, Criterion I.7 (p. 57) states that

[e]ach organization shall describe the capability and resources for field monitoring within the plume exposure pathway Emergency Planning Zone which are an intrinsic part of the concept of operation of the facility.

(Emphasis added.) This criterion does not require that each organization have its own capability, but rather that each organization describe the monitoring capability on which it will rely. Bowers at 2.

21. There also is no regulatory requirement or guidance which states that any independent off-site monitoring which may be provided must be a fixed system. Bowers at 2; Tr. 3136 (Shapiro).

22. Mobile monitoring teams provide the most effective, as well as efficient, method to track and measure offsite doses. Bowers at 4. Mobile survey teams can move to the area where meteorological conditions (both wind speed and direction) indicate the plume is located, and make measurements to define the precise plume location and the radiation levels associated with it. The mobile survey teams can use instruments to measure the whole body dose rate directly, and can take special air samples to evaluate radioiodine concentrations. As the plume moves, the survey teams can follow it. Data from these actual field measurements are fed back into the dose projection models to make the projections and assessments more accurate. Id. at 3; Tr. 2929-30, 2932 (Bowers).

23. The principal advantage of mobile teams is that mobile teams, unlike stationary monitors, are able to locate and take measurements at the centerline of the radioactive plume,

which is necessary for meaningful dose measurements and extrapolations. A dose measurement at a particular fixed monitor cannot be extrapolated to project the doses at other locations, because there is no way to know whether the monitor happens to be located at the centerline of the plume. Tr. 2927-32 (Bowers). Thus, although a fixed monitoring system would give instantaneous readouts, the data is of questionable value. Tr. 2930 (Bowers). For this reason, even a fixed monitoring system in combination with mobile monitoring would not provide any advantages over mobile monitoring for purposes of dose projection. Tr. 2928 (Bowers).

24. Mobile monitoring teams are more cost-effective than stationary monitoring systems. FEMA-REP-2, Guidance on Off-Site Emergency Radiation Measurement Systems (September 1980), recommends mobile monitoring teams and rejects stationary systems because of the large numbers of sophisticated detectors and the telemetry necessary for such systems. Bowers at 2-4.

25. The cost for installation and operation of a fixed monitoring system at PNPP would be substantial. Approximately 100 fixed monitoring locations would be needed. Bowers at 3. The cost of hardware - including radiation detection equipment, air sampling equipment, telemetering equipment, meteorological equipment, and a central computer - and installation of the

equipment would be about \$2,635,000. In addition, there would be significant costs associated with ongoing maintenance such as calibration. Tr. 2916-19 (Bowers).

26. A fixed monitoring system would not replace any of the following dose assessment methods to be used at PNPP: the CEI and State of Ohio monitoring teams, the PNPP in-plant effluent monitors, or the State, CEI and NRC TLDs. Tr. 2958 (Bowers).

27. The State of Ohio will field three fully trained and equipped mobile survey teams in the event of a radiological emergency at PNPP. Cole at 1-2; Tr. 2845 (Cole). These State teams provide independent monitoring assessments. Shapiro at 4; Cole at 5; Bowers at 4. In addition, the local ODSA representative for Lake County has the ability to conduct field monitoring if necessary. Tr. 2878 (Cole).

28. Each State team is composed of one or more technicians from ODSA and the Ohio EPA. Team members are identified and placed on "alert" at an Unusual Event, and are dispatched at the Alert emergency stage. The response team supervisor is dispatched by helicopter to the site area to perform an aerial survey. The helicopter's response time to the PNPP site is about one hour and 15 minutes, and the field teams are in place 3 to 3 1/2 hours after they are dispatched. Cole at 2-3.

29. The State monitoring teams obtain gross gamma readings which provide the data needed by the State's Dose Assessment Group in the State EOC in Columbus. The information received from the monitoring teams is fed into a dedicated computer system in the State EOC which plots the plume and identifies plume parameters. Cole at 2, 4; Tr. 2890-91 (Cole).

30. Field monitoring teams are directed by the response team supervisor operating out of the State communications van. The supervisor is in direct communication with the State EOC, the County EOCs, the PNPP EOF, and the State monitoring teams. Cole at 4.

31. The State of Ohio field monitoring teams have demonstrated their ability to perform accident assessment during eight emergency planning exercises, including the November 28, 1984 exercise for PNPP. Shapiro at 5; Cole at 5. All three counties within the PNPP plume exposure pathway EPZ rely on the State's field monitoring capabilities. Cole at 5-6; Tr. 2891-92 (Cole).

32. Independent monitoring assessment also will be provided by Lake County, which will maintain two fully trained and equipped monitoring teams for response to a radiation emergency at PNPP. Each team will consist of two Lake County Health District employees who will be trained to perform both radiation and airborne activity surveys. For each team, two additional trained personnel will be available as backups. Bowers at 5.

33. The Lake County monitoring teams will be activated at the Alert emergency stage. Team members will report to the County Health District offices in Painesville, where they will pick up the survey kits and vehicles designated for their teams. It is estimated that the teams can be dispatched and in place within 1.0 and 1.5 hours during normal working hours, and within 1.5 and 2.0 hours during off-work hours, after declaration of an Alert. The teams will communicate with the County EOC, and will perform surveys as directed by the County Radiological Officer in the EOC. Id.

34. In addition to the State and Lake County, the Department of Energy, the U.S. EPA, and the NRC all have capability for gross gamma monitoring, environmental sampling and analysis, independent meteorological capability, and plume identification and tracking in the event of an accident at PNPP. A central location for consolidating and coordinating all field data - the Federal Radiological Monitoring and Assessment Center - would be set up by DOE and would relay information to the State and County EOCs, the EOF and FEMA. Cole at 5. See Tr. 2842-44 (Cole).

35. The PNPP Plan calls for two radiation monitoring teams to be dispatched at an Alert, and a third team to be dispatched at a Site Area Emergency, to monitor the actual conditions downwind of the plant. Additional teams may be organized

as the situation warrants. All these teams are staffed by Plant personnel. Bowers at 4.

36. The CEI teams will provide field monitoring capabilities prior to the deployment of the State and County teams. Depending on the time of day and site staffing, teams can be dispatched and in place within 30 to 45 minutes after declaration of an Alert. Bowers at 5-6.

37. There is an excellent network of roads in the vicinity of PNPP which allows effective tracking of the plume by mobile teams in land-based vehicles. Tr. 2932 (Bowers).

38. Releases over Lake Erie which returned to land would be tracked by Applicants' computerized dose projection system and could be detected by mobile teams along the shore. Tr. 2958-59 (Bowers). In addition, DOE helicopters are capable of conducting offshore monitoring. Tr. 2901 (Cole).

39. There are two fixed independent radiation monitoring systems in place around PNPP. The State of Ohio and the NRC have 27 and 25 TLD monitors, respectively, arranged in rings within the plume exposure pathway EPZ. The TLD monitors measure the doses from accidents, as well as any doses from normal plant operation, if any measureable doses are produced. These fixed systems are in addition to the 25 TLD monitors placed and maintained by CEI throughout the EPZ. Although these devices

cannot give instantaneous indications, they would be valuable to measure the doses during an accident. They could be changed during an accident to evaluate doses during various stages of the accident. Bowers at 6.

4. Contention P: Hospitals

40. Contention P states:

Emergency plans are deficient with respect to hospital designations and medical services as well as procedures required to assist contaminated individuals.

January 10, 1985 Memorandum and Order at 6. Although the wording of the contention itself does not explicitly limit the medical services and contamination assistance aspects of the issue to hospitals, Sunflower's objection which formed the basis for this contention was restricted to hospitals.^{50/}

41. The Commission's emergency planning regulations, at 10 C.F.R. § 50.47(b)(12), require that:

[a]rrangements are made for medical services for contaminated injured individuals.

See also 10 C.F.R. Part 50, Appendix E, § IV.E. This planning

^{50/} See Sunflower Alliance's Particularized Objection to Proposed Emergency Plans in Support of Issue No. 1, dated August 20, 1984, at 19. A contention cannot extend beyond the intervenor's own self-imposed limitations. Cleveland Electric Illuminating Co. (Perry Nuclear Power Plant, Units 1 and 2), ALAB-675, 15 N.R.C. 1105, 1115 (1982).

standard is addressed by NUREG-0654, Criterion L.1, which provides:

Each organization shall arrange for local and backup hospital and medical services having the capability for evaluation of radiation exposure and uptake, including assurance that persons providing these services are adequately prepared to handle contaminated individuals.

42. Radiation injuries result from either exposure to radiation or contamination by radioactive materials. In the case of radiation exposure, the patient suffers injury from the energy deposited in the cells during the period of radiation, but the patient is not radioactive and presents no hazard to response personnel. Contamination results from loose radioactive particles adhering to the body. An exposure hazard remains until these particles are removed. Radioactive contamination is easy to detect and decontamination is easily accomplished by removing contaminated clothes and bathing the affected area. Linnemann at 2. The emergency plans call for people who are contaminated and not injured to go to relocation centers rather than hospitals. Tr. 2995, 2998 (Linnemann).

43. The characteristics of radiation injury make it one of the easiest medical emergencies to handle. Radiation injuries are seldom if ever immediately life-threatening. The consequences unfold over a period of time with predictable sequence. Therefore, treatment of any life-threatening traumatic

injury or serious illness always takes precedence over treatment of the radiation injury. Once the patient is resuscitated and stabilized, he can be decontaminated and placed in a regular hospital bed. There is then time for assessment and treatment of the radiation injury. No special equipment is needed (such as lead-lined operating rooms, radiation resistant equipment, etc.) because of the nature of radiation exposure or the conditions of its treatment. Any contaminated materials would be disposed of following the same procedures used for nuclear medicine departments. No special equipment would be needed to handle this disposal. Linnemann at 3; Tr. 2989-90, 3004, 3029-33 (Linnemann).

44. Should a patient be exposed and otherwise injured, no special emergency facilities are needed. The patient can be handled as any other injured patient. Linnemann at 2; Tr. 2987-88 (Linnemann).

45. If the patient is contaminated and otherwise injured, procedures are implemented to reduce exposure and control the spread of any contamination. However, these procedures are not unique to radiation injury cases; similar steps are taken for chemical contamination or septic cases. Linnemann at 2; Tr. 2990-91, 3026-29 (Linnemann).

46. In Dr. Linnemann's 15 years experience at 25 nuclear power plant sites, only two cases involved multiple injuries - in each case involving two employees. Linnemann at 6.

47. Even a nuclear power plant accident with substantial offsite release of radiation would not involve the generation of large numbers of traumatic casualties. The only way in which an offsite population can be affected is through overexposure to radiation. Linnemann at 3. See McTrusty at 3; Sternglass at 13.

48. Large doses of radiation over a short period of time are required to initiate the first symptoms of radiation sickness. An exposure of approximately 150,000 millirem over a period of a few hours would be necessary for an individual to require hospitalization. Linnemann at 3-4; Tr. 2984-86 (Linnemann). The characteristics of a radiation release and the relative ease of decontamination make it unlikely that anyone could receive these levels of exposure. Linnemann at 3-4; Tr. 2984-86, 2991, 2994 (Linnemann). At most, hospital emergency rooms might have to deal with a few cases where someone is incidentally injured and, at the same time, slightly contaminated or exposed. Tr. 2984-87, 3033-34 (Linnemann).

49. The Sandia Siting Study, NUREG/CR-2239, does not represent the risk of a severe nuclear power plant accident for any particular site. The purpose of the study was not to evaluate risk or accident consequences for actual operating reactors, but to provide technical guidance to the NRC to support rulemaking for reactor siting. Consistent with that purpose,

the study makes generic assumptions with respect to both probability and consequences. Hankins at 2, 4. See Tr. 3176 (Hankins).

50. The severe consequences reported in the Sandia Siting Study were not based on the PNPP design. The PNPP design is substantially different from the design assumed in the study. Hankins at 3.

51. The largest calculated consequences in the Sandia Siting study were based on an assumed siting source term (SST 1) which is an estimate of the largest possible release of fission products from a pressurized water reactor assuming worst case conditions. The SST 1 release is not a credible source term for a BWR/6 - Mark III design such as PNPP for two basic reasons. First, the PNPP design features multiple structural barriers to fission product release. Hankins at 4-5. Second, the Mark III pressure suppression containment provides effective filtration, or scrubbing, of potential releases from the containment. Realistic inclusion of fission product retention mechanisms results in negligible offsite releases of iodine and particulates. Hankins at 4-7.

52. The filtration mechanisms alone of the Mark III containment reduce the fission product releases to the levels represented by the Sandia Siting Study's SST 2 and SST 3 source terms. The SST 2 and SST 3 releases are two orders of

magnitude less than the SST 1 releases, producing no early fatalities and 0 to 4 early injuries. Hankins at 6, 8.

53. Severe accident evaluations of the BWR/6 - Mark III comparable to the PNPP specific design show releases orders of magnitude below those assumed in the Sandia Siting Study. Those releases would cause no early fatalities and no injuries requiring emergency care. Hankins at 7.

54. A GE evaluation of the consequences of a core-melt accident at PNPP shows that even at distances as close as one mile from the plant, such an accident would produce low doses (less than 25 rem) when PNPP specific fission product releases are coupled with the PNPP site specific features. GE estimated the probability of such a core-melt accident at PNPP to be one in 200,000 per reactor year. Hankins at 9; Tr. 3173-74 (Hankins).

55. The county emergency plans identify Lake County Memorial Hospital East, Lake County Memorial Hospital West, Geauga Community Hospital and Ashtabula County Medical Center as the local hospitals designated to handle members of the general public who may have radiation uptake or exposure. Linnemann at 4; Shapiro at 6. Letters of agreement with all of these hospitals are being obtained. See Shapiro, Att. 6 at 5, 12, 15. The PNPP Plan designates Lake County Memorial Hospital East as the hospital to receive highly-contaminated-injured persons

from onsite for initial treatment and decontamination. (If Lake County Memorial Hospital East were being evacuated due to an accident at PNPP -- it is within the plume exposure pathway EPZ -- these persons would be taken directly to Lake County Memorial Hospital West.) Definitive, long-term care for contaminated injuries and significant radiation overexposure is available through RMC's arrangements with Northwestern Memorial Hospital in Chicago, and the Hospital of the University of Pennsylvania, Philadelphia. Linnemann at 4-5.

56. In addition to 16 hours of training provided by the State, RMC has provided extensive training to personnel of both Lake County Memorial Hospitals (East and West), Ashtabula County Medical Center and Geauga Community Hospital. The eight hour training program has as its objectives to first insure that immediate emergency medical care is provided to an injured individual and, secondly, to perform appropriate decontamination and contamination control techniques. The topics of the training include the biological effects of ionizing radiation, personnel protective actions, use of emergency room equipment and supplies for the contaminated patient, contamination control techniques, and decontamination and bioassay procedures. Eight-five hospital personnel have been trained, including fifteen physicians, fifty-three nurses, eleven nuclear medicine and radiology personnel, and six emergency medical technicians. Linnemann at 5; Tr. 3010-13 (Linnemann).

57. The four local hospitals for PNPP, including APMC, are well prepared to handle contaminated injured patients. Tr. 3007-08 (Linnemann).

58. Dr. Linnemann has determined, based on personal visits to APMC, that APMC has adequate equipment, facilities and supplies for handling contaminated injured patients. These include: a radiation emergency area designated as part of the emergency room; survey instrumentation for detection of contamination; dosimeters and TLDs for recording doses for hospital personnel; floor coverings; coveralls for attendant personnel; and other supplies. Tr. 2981-84, 3007, 3016, 3025 (Linnemann).

59. The November 28, 1984 emergency exercise for PNPP demonstrated the APMC emergency room staff's knowledge of proper decontamination procedures. Shapiro at 6, 13; Tr. 3014 (Linnemann). Although FEMA found certain equipment items unavailable to APMC personnel during the exercise (Shapiro at 6; FEMA Ex. 2 at 58-59), the principal piece of equipment which was unavailable - a decontamination table container with a water collection system - has now been provided to APMC. Tr. 3014-15 (Linnemann).

60. The APMC emergency room staff recently demonstrated its preparedness to handle contaminated injured persons in the "ultimate test" for a hospital emergency room - an incident in which an individual walked unannounced into the emergency room

and stated that she might be contaminated. The patient was properly isolated in the designated area and surveyed for contamination, and determined not to be contaminated. Tr. 3008-3010 (Linnemann).

61. In the unlikely event of multiple contaminated and injured personnel, the four local support hospitals would be able to handle the increased numbers. Since hospitals already have procedures to handle mass casualty situations (for example, a bus accident), these can easily be applied to handle multiple injured contaminated patients. Incoming patients would be triaged on the basis of their injuries, since traumatic injury always takes precedence over contamination. If additional treatment rooms are necessary, the designated Radiation Emergency Area can readily be expanded. Linnemann at 6.

62. In addition to these four hospitals, there are some 26 hospitals in the counties around the plume exposure pathway EPZ which can receive and care for radiological accident cases.^{51/} These hospitals are capable of dealing with contaminated and exposed individuals, including those who have been otherwise injured. All of the hospitals have diagnostic and/or therapeutic radioisotope facilities. This requires that they

^{51/} Dr. Linnemann's testimony on the number of available hospitals was an update to information contained in the State Plan. Tr. 2981 (Linnemann).

are able to handle contaminated and injured patients which could result from injuries within their own facilities. All of these hospitals (plus the four local support hospitals) are accredited by the Joint Commission on Accreditation of Hospitals. The Standard V of the Commission's Accreditation Manual for Hospitals (1984) requires each accredited hospital to have procedures for:

The emergency management of individuals who have actual or suspected exposure to radiation or who are radioactively contaminated. Such action may include radioactivity monitoring and measurement; designation and any required preparation of space for evaluation of the patient, including, as required, discontinuation of the air circulation system to prevent the spread of contamination; decontamination of the patient through an appropriate cleansing mechanism; and containment, labeling, and disposition of contaminated materials. The individual responsible for radiation safety should be notified.

Linnemann at 6-7; Shapiro at 6-7; Tr. 3034 (Linnemann).

63. Given the existing emergency room and radioisotope facilities in the 26 backup hospitals, these hospitals would be more than adequate to handle any conceivable patient load arising from an accident at PNPP. Linnemann at 7. In addition, all hospitals have written disaster plans which provide for any emergency patient overflow from the hospital to be handled by other hospitals. Tr. 2998-99, 3041 (Linnemann).

5. Contention Q: Letters of Agreement for School Buses

64. Contention Q as originally admitted by the Board alleged that:

There are an inadequate number of buses to transport school children during an emergency and evacuation procedures have not considered transportation obstacles which might originate with parents picking up their children at school.

January 10, 1985 Memorandum and Order at 6-7. Summary disposition was granted except as to the issue of formal letters of agreement for the use of school buses with schools outside of the plume exposure pathway EPZ. March 13, 1985 Memorandum and Order at 1. See April 9, 1985 Memorandum and Order at 8.

65. Letters of agreement will be obtained by the Lake, Ashtabula and Geauga County Disaster Services Agencies from each of the school districts outside the plume exposure pathway EPZ for PNPP designated to supply school buses to support an evacuation of the plume exposure pathway EPZ. Baer (Contention Q) at 1-2; Shapiro at 9. It is anticipated that these letters will be obtained before fuel load. Baer (Contention Q) at 2.

66. The letters of agreement with school districts currently are under development. School district officials in all the school districts involved have been informed that letters will be sought. Tr. 3049-50 (Baer). The letters of agreement are scheduled to follow arrangements being made between CEI and

the school districts for the provision of radios for the buses.
Tr. 3051 (Baer).

6. Contention U: Handling Contaminated Property
at Reception Center

67. Contention U states:

Reception centers do not have the means or facilities for handling contaminated property.

January 10, 1985 Memorandum and Order at 7.

68. The radiological emergency response plans and procedures for Lake, Ashtabula, and Geauga Counties provide for monitoring, decontamination, and isolation of vehicles and property at reception centers. Applicants' Direct Testimony of John Baer on Issue No. 1 - Contention U, ff. Tr. 3055 (hereinafter "Baer (Contention U)"), at 1; Shapiro at 10.

69. The emergency plans for the three counties establish standard action levels for decontamination, including decontamination of property such as personal clothing, vehicles and other surfaces. Baer (Contention U) at 1-2.

70. These provisions of the plans are supported by Standard Operating Procedures ("SOPs") which are maintained as supporting documents to the plans by the Disaster Services Agencies of Lake, Ashtabula, and Geauga Counties. The Ashtabula County Decontamination SOP and individual fire department SOPs

for Lake and Geauga Counties provide guidance to fire department personnel, who are responsible for monitoring and decontamination at reception centers, on the handling of property and vehicles. Id. at 2; Shapiro at 10.

71. The SOPs provide directions for monitoring and decontamination of vehicles, and provide that vehicles that cannot be decontaminated will be impounded. Baer (Contention U) at 2; Shapiro at 10; Tr. 3058 (Baer). Personal property found to be contaminated will be sealed in plastic bags for disposal according to the State Plan, which provides for the Ohio EPA to arrange for disposal with a licensed commercial radioactive waste disposal firm. Baer (Contention U) at 2. See Tr. 3056-57 (Baer).

72. Approximately 554 fire department personnel, have received, or will be scheduled to receive prior to fuel load, training on decontamination procedures based on the Radiological Training Manual of the State of Ohio for the 16 Hour Radiological Monitoring Course. This is more than twice the number needed to conduct monitoring and decontamination activities at all reception centers. The Radiological Monitoring Course provides specific instruction for handling contaminated property and vehicles. Baer (Contention U) at 2-3.

73. Emergency kits containing equipment and supplies for monitoring, decontamination, and handling of property and

vehicles currently are being assembled. Some kits now are in place, and kits are scheduled to be in place for all reception centers prior to fuel load. Id. at 3; Tr. 3056, 3064-65 (Baer).

74. The contents of the emergency kits are specified in applicable procedures and include survey instruments for decontamination monitoring (CDV-700, GM Survey Meter, CDV-715), chargers and batteries for survey instruments, radiological monitoring handbook, equipment and supplies for decontaminating vehicles, plastic sheeting and bags, protective clothing, masking tape, disposable towels, soaps, brushes, etc. Baer (Contention U) at 3; Tr. 3060-61 (Baer). In addition, specific instructions will be provided with the kits directing where contaminated vehicles will be impounded and where contaminated property will be temporarily stored at each reception center. Baer (Contention U) at 3.

75. The reception centers designated in the Lake, Ashtabula and Geauga Plans are public educational institutions; therefore adequate facilities are available - i.e., parking lots and recreation fields - for isolating vehicles that require decontamination. Id. Access to these areas would be restricted if contamination of the area reached a preestablished limit. Tr. 3065-66 (Baer); Tr. 3205-06 (Wills).

7. Contention Z: Bus Driver Protection

76. Sunflower Contention Z claims:

The plans do not provide decontamination protection for bus drivers during an emergency.

January 10, 1985 Memorandum and Order at 7.

77. There is no regulatory requirement and no regulatory guidance that calls for bus drivers to be provided with protective gear such as respirators and goggles. 10 C.F.R. § 50.47(b)(11) requires that there be means for controlling radiation exposures to emergency workers. Further guidance on this topic is contained in NUREG-0654, Criterion K.3, which describes provisions for supplying dosimetry to emergency workers. Applicants' Direct Testimony of John Baer on Issue No. 1 - Contention Z, ff. Tr. 3069 (hereinafter "Baer (Contention Z)"), at 2.

78. The Ohio Department of Health requires that emergency workers be provided with respiratory equipment if they are assigned to an activity involving certain types of radioactive releases. Shapiro at 11. That requirement is being revised to effectively eliminate the need for respiratory equipment for bus drivers. Tr. 3200-01, 3207 (Wills).

79. Approximately 550 respirators are available for offsite emergency workers. Tr. 3075 (Baer).

80. The county emergency plans provide for the distribution of personnel dosimetry, both self-reading and permanent record types, and associated recordkeeping materials to those bus drivers who will be serving as emergency workers. Baer (Contention Z) at 2; Tr. 3076-78 (Baer). Dosimeters are reliable radiation detection devices. Shapiro at 11.

81. Bus drivers have access to dosimetry at assembly areas from which they will be deployed. Each bus driver will wear dosimetry equipment at all times. Training in the use of dosimetry has been and will continue to be provided to bus drivers. Three hundred and eighty-seven of the 718 regular and substitute bus drivers have received this training. Further training sessions will take place during the summer and early fall of 1985, and periodically thereafter, both for those bus drivers who have already had dosimetry training, as well as those who have not yet been trained. Baer (Contention Z) at 2.

82. SOPs for each school district require that bus drivers, as well as other emergency workers, read their dosimeters and record their readings at least once an hour. If the bus driver's self-reading dosimeter indicates any radiation exposure, the procedures call for him to report to a monitoring and decontamination station (all of which are outside the plume exposure pathway EPZ) for monitoring and, if needed, decontamination. Upon completion of a mission or shift, each bus driver

is required to turn in his or her dosimetry to be checked and recorded. Dosimetry records are forwarded to the county EOC and retained. Id. at 3.

83. FEMA found the Saybrook Fire Station in Ashtabula County inadequate for decontamination of emergency workers during the November 1984 emergency exercise for PNPP. Shapiro at 12; FEMA Ex. 2 at 62. However, the Ashtabula Plan includes two other facilities in Ashtabula County for emergency worker decontamination. In addition, Ashtabula County has informed FEMA that it will make the necessary improvements to the Saybrook Station or seek an alternate facility. Tr. 3197-98 (Baer).

84. Emergency response plans have been written so that an evacuation can be completed before the release of significant radioactivity occurs. Baer (Contention Z) at 3; Tr. 3080 (Baer).

85. The nature of bus drivers' duties will have them spending less time inside the plume exposure pathway EPZ than most other emergency workers, i.e., bus drivers leave the risk area as soon as their buses are loaded. Baer (Contention Z) at 3-4; Tr. 3072-74 (Baer).

86. There is a sufficient number of buses in the three counties to evacuate everyone needing transportation, including school students, in a single trip. Tr. 3080 (Baer).

87. Every bus driver will have a radio in his bus which will allow prompt receipt or transmission of pertinent information, including radiological information. Baer (Contention Z) at 4; Tr. 3080-81 (Baer).

88. State, Lake County and CEI radiological monitoring teams will be reading radiation levels and can provide information through emergency management channels that can be relayed to bus drivers. Each of the three county plans provides for the dissemination of information originating with the state radiological monitoring teams. Baer (Contention Z) at 4.

8. Contention BB: FEMA Interim Report

89. Contention BB alleges:

Offsite emergency plans are inadequate due to the planning deficiencies set forth in the Federal Emergency Management Agency Interim Report of March 1, 1984.

January 10, 1985 Memorandum and Order at 7. The FEMA Interim Report is FEMA Exhibit 1.

90. The FEMA Interim Report concluded that "there is reasonable assurance that the plans are adequate and capable of being implemented in the event of an accident at the site."

FEMA Ex. 1, ff Tr. 3111, found in March 1, 1984 FEMA Memorandum from Richard W. Krimm to Edward L. Jordan.

91. The FEMA Interim Report reflects the review by the FEMA Regional Assistance Committee ("RAC") of draft Ashtabula, Geauga and Lake County Emergency Plans submitted for review by the State of Ohio on March 17, 1983, and the schedule of corrections to the RAC review received by FEMA from the State on August 30, 1983. As reflected in the FEMA Interim Report, more than half (83 out of 145) of the planning deficiencies identified by the RAC were corrected and the corrective actions accepted by FEMA in the Interim Report itself. A subsequent submittal of corrections to be made to the county plans was made by the State to FEMA on March 29, 1984. Applicants' Direct Testimony of John Baer on Issue No. 1 - Contention BB, ff Tr. 3088 (hereinafter "Baer (Contention BB)"), at 2.

92. Each of the county plans was revised to reflect corrective actions made in direct response to the planning deficiencies noted in the FEMA Interim Report. The Ashtabula Plan was revised in May 1984. The Geauga Plan was revised in March and July 1984. The Lake Plan was revised in June and October 1984. Baer (Contention BB) at 2.

93. Mr. Baer's independent review of the Lake, Ashtabula, and Geauga Plans shows that, of the total of 145 planning deficiencies listed in the Interim Report, all have been corrected or are being addressed. Attachment A to his testimony shows the planning deficiencies noted in the FEMA Interim

Report, those deficiencies acknowledged by FEMA to have been corrected by the August 30, 1983 State submission, those remaining deficiencies corrected by the plan revisions made subsequent to the Interim Report, and where in revised plans the remaining deficiencies were corrected. Id. at 2-3.

94. The few items still being addressed primarily involve Applicants' emergency information material. Id. at 3. The emergency information handbook will be distributed prior to fuel load. Id. at 3; Tr. 3097, 3105-06 (Baer). The NRC has reviewed Applicants' emergency information handbook for PNPP and determined that the brochure complies with NUREG-0654. Tr. 3145-46 (Perrotti).

9. Contention CC: SER Resolution Items

95. Contention CC asserts:

The resolution items set forth by the staff in its Safety Evaluation Report, NUREG-0887, Supp. 4 (February 1984) pages 13-1 to 13-22, are uncorrected deficiencies in the emergency plans.

January 10, 1985 Memorandum and Order at 7. The referenced pages in SSER 4 set forth the Staff's evaluation of the PNPP Plan (through Revision 2), and identified 35 items which required resolution. Applicants' Direct Testimony of Daniel D. Hulbert on Issue No. 1 - Contention CC, ff. Tr. 3091 (hereinafter "Hulbert (Contention CC)"), at 2.

96. On April 28, 1984, CEI transmitted to the Staff Revision 3 to the PNPP Plan, as well as a cross-reference between the resolution items in SSER 4 and where in Revision 3 those items had been resolved. On August 20, 1984 and October 29, 1984, CEI provided to the Staff additional clarification of changes to the PNPP Plan which related to resolution items in SSER 4 and which were being incorporated in Revision 4 to the PNPP Plan. On February 20, 1985, CEI transmitted to the Staff Revision 4 to the PNPP Plan. This revision incorporated the information from the August 20 and October 29, 1984 correspondence identified above. Hulbert (Contention CC) at 2; Perrotti at 4-5.

97. The information contained in Revisions 3 and 4 and the identified correspondence demonstrate that all the emergency planning resolution items in SSER 4 have been resolved. Perrotti at 5; Hulbert (Contention CC) at 2. See Hulbert (Contention CC) at 2-7.

B. Issue No. 16: TDI Diesel Generators

98. Issue No. 16, as simplified by the Board, was admitted as a contention in this proceeding by Memorandum and Order (New Contention on Diesel Generators), LBP-83-80, 18 N.R.C. 1404 (1983). OCRE is the lead intervenor on the issue and the only intervenor which participated in its litigation.

99. Issue No. 16, as litigated, reads as follows:

Applicant has not demonstrated that it can reliably generate emergency on-site power by relying on four Transamerica Delaval diesel generators, two for each of its Perry units.

100. The four Transamerica Delaval ("TDI") diesel generators installed at Perry Nuclear Power Plant ("PNPP") are DSRV-16-4 engines. Applicants' Direct Testimony of John C. Kammeyer on Issue No. 16, ff. Tr. 2179 (hereinafter "Kammeyer"), at 2. These are TDI R-4 model engines, having 16 cylinders arranged in two banks in a V-type engine block, as compared to TDI's DSR-48 which is an inline, 8-cylinder engine design. Id; Staff Ex. 5 at 2.1. Each engine-generator set is rated for continuous operation at 7000 kw and has a short term overload rating of 7700 kw. Staff Ex. 5 at 2.1.

101. The TDI Diesel Generator Owners Group Program, which involved twelve U.S. utilities, including CEI, has provided an indepth assessment of the adequacy of the PNPP TDI diesel generators to perform their safety-related functions through a combination of design reviews, quality revalidations, engine tests, and component inspections. Kammeyer at 7-8. The NRC Staff's evaluation of the Owners Group Program Plan concluded that it incorporated the essential elements needed to resolve outstanding concerns relating to the reliability of the TDI diesel generators for nuclear service, and to ensure that the TDI diesel engines

complied with General Design Criteria ("GDC") 1 and GDC 17. Id. at 10; Staff Ex. 1 at 6.

102. The Owners Group Program did not rely on TDI's quality assurance program. Tr. 2240 (Christiansen, Kammeyer); Kammeyer at 14-15. Rather, the Owners Group Program, as implemented at PNPP, revalidated the diesel generators on-site. Tr. 2238 (Kammeyer), Tr. 2318-19 (Berlinger). While the Owners Group considered TDI's evaluations and recommendations as part of the program, it did not rely on TDI input in reaching its conclusions. Joint Testimony of Carl H. Berlinger, Drew Persinko, Spencer H. Bush, David A. Dingee, Howard M. Hardy, Adam J. Henriksen, and B.J. Kirkwood on Issue 16 Concerning TDI Emergency Diesel Generators at the Perry Nuclear Power Plant, ff. Tr. 2281 (hereinafter "Staff Testimony"), at 16.

103. The Owners Group Program was performed over a year and a-half, employed a number of nationally-recognized technical consultants, and involved four phases. Kammeyer at 11-25; Tr. 2181-83 (Kammeyer). Initially, experience data pertinent to TDI engines was assembled from both nuclear and non-nuclear sources; from this database, it was determined that sixteen components exhibited potentially generic problems.^{52/} Kammeyer at 11, 16-18;

^{52/} These sixteen components were the turbocharger, engine base and bearing caps, crankshaft, cylinder block, cylinder head studs, connecting rods, connecting rod bearing shells,

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Tr. 2238 (Kammeyer). A detailed review of these components was conducted in Phase I of the Owners Group Program to establish the adequacy of their design, address manufacturing concerns and to prepare maintenance requirements and inspection plans for them. Kammeyer at 12. Technical consultants performed documentation reviews, analyses and established testing requirements for each of the components. Id.

104. Pacific Northwest Laboratory, operated by Battelle Memorial Institute ("PNL"), has reviewed the Owners Group reports on the Phase I components for the NRC Staff (except for the report on the DSRV-20 crankshaft which is still in draft, but inapplicable to PNPP's DSRV-16-4 crankshaft). Tr. 2300-01, 2329 (Berlinger). See also Staff Ex. 5. PNL considers all of the Phase I components suitable for full-load operation; PNL considers the PNPP crankshaft adequate provided its review of the torsigraph testing

(Continued)

pistons, airstart valve capscrews, cylinder heads, fuel oil injection tubing, pushrods, rocker arm capscrews, jacket water pump, wiring and termination, and cylinder liner. Kammeyer at 11-12.

In its response to Applicants' motion for summary disposition of this issue, OCRE only indicated concerns with regard to the crankshaft, cylinder heads, engine base and bearing caps, turbocharger, cylinder blocks, cylinder liner, pistons, connecting rods, and connecting rod bearing shells. The NRC Staff, in turn, focused its pre-filed testimony on questions raised by OCRE regarding these nine components. At the hearing, OCRE focused its cross-examination on the first six components.

confirms the favorable results reported by Applicants. Staff Ex. 5 at 3.1; Tr. 2416 (Hardy). Safety Evaluation Reports ("SERs") will be issued by the Staff for each component. Tr. 2301-02 (Berlinger).

105. An independent engineering consulting firm, Southwest Research Institute ("SwRI"), reviewed, evaluated and independently verified the methodology, results and conclusions of each of the Owners Group Phase I studies on behalf of PNPP. Applicants' Direct Testimony of Edward C. Christiansen on Issue No. 16, ff. Tr. 2179 (hereinafter "Christiansen"), at 7-8. SwRI has extensive experience in diesel engine research of all kinds. Applicants' Direct Testimony of Charles D. Wood, III on Issue No. 16, ff. Tr. 2179 (hereinafter "Wood"), at 1-2. SwRI staff members who conducted the reviews were experienced in engine design and testing, metallurgy, stress analysis, fracture mechanics, and finite element modeling. Id. at 5. In some instances, SwRI made independent calculations using different equations, assumptions, and/or parameters. Id.; Tr. 2219 (Wood). Based on its investigation, SwRI concluded that the 16 Phase I components in the PNPP engines are of satisfactory design and will perform their intended function. Wood at 86-87.

106. Phase II examined components of the PNPP engines which were not evaluated in Phase I to assess their ability to reliably perform their intended functions. Kammeyer at 16. These

components were reviewed via a design review/quality revalidation ("DR/QR") program considered to be "an excellent revalidation program" by the NRC Staff. Tr. 2409 (Berlinger). The Phase II components have not had a history of problems associated with them. Tr. 2461 (Dingee). For the PNPP engines, 171 components were selected by a technical committee on the basis of their criticality to engine performance, past industry and site-specific performance, as well as on the engineering judgment and expertise of the selection committee. Kammeyer at 16-24. Absence of adverse operating experience did not necessarily exclude a component from the DR/QR process. Id. at 20. The nature of a specific component determined if a design review alone was required, quality revalidation alone was required, or both were necessary. Id. The critical attributes of a given component, and how best to verify those attributes (e.g., analysis, inspection, or both), dictated the nature of the required review. Id. Design review and/or quality revalidation requirements were reflected in task descriptions prepared for each component by the Owners Group. Id. at 21.

107. The Owners Group DR/QR Program is based on a "lead" engine -- "following" engine concept which was approved by the NRC Staff. Kammeyer at 22, Staff Testimony at 17. The lead engine for PNPP was a DSRV-16-4 engine at Comanche Peak Steam Electric Station ("Comanche Peak"). Kammeyer at 22. The Comanche Peak engine was subjected to an extensive evaluation and detailed component review. Id. Each of the 171 Phase II components identified

at PNPP were evaluated to determine if the Comanche Peak engine review was applicable, considering factors such as loading, application, and differences in design. Id. Results of this investigation dictated the nature of the review to be performed at PNPP, as reflected in PNPP's DR/QR Report. See, e.g., id. at 22-23. Eleven reports (some of which address multiple components) were prepared for components unique to the PNPP engines. Id. at 23.

108. OCRE expressed concern with the lack of quality revalidation on various PNPP engine components. See, e.g., Tr. 2224; Staff Testimony at 49. Quality revalidation was not required on certain components for a variety of reasons. See Tr. 2224, 2492-95 (Kammeyer). In some instances the component was not manufactured by TDI, or was a commercial grade item (e.g., nuts, bolts, seals, gaskets) purchased by TDI. Id. at 2493. The original quality revalidation for these components on the lead engine was a documentation review. Id. Once completed for the lead engine, the follow-on engines only needed to be checked to verify the component was the same. Id. at 2493-94. In other cases, maintenance and surveillance requirements incorporated any quality revalidation that was deemed necessary. Id. at 2494. In all cases, physical inspections required on the lead engine at Comanche Peak were also performed on the engines at PNPP. Id.

109. Where design review of a component was dictated, this task was implemented by the Owners Group technical staff.

Kammeyer at 22. Quality revalidation of components was carried out by a special task force of PNPP personnel following requirements established by the Owners Group. Christiansen at 9-11. Upon completion of the DR/QR effort, inspection results, document packages, design review findings, and calculation results were reviewed and approved by the Owners Group technical staff. Kammeyer at 24. Where results of these reviews and/or inspections indicated the need, additional action (e.g., component replacement, maintenance, etc.) was taken. Id.

110. The third phase of the program involved a complete disassembly of the PNPP engines, their inspection and reassembly under PNPP's quality control and quality assurance program. Tr. 2499 (Christiansen), Tr. 2182 (Kammeyer); Christiansen at 11. Replacement of components and routine maintenance on the engines were also performed during this time. Christiansen at 7, 11, Tr.. 2499 (Christiansen).

111. The final phase of the program is ongoing and involves the implementation of a comprehensive set of maintenance and surveillance recommendations. Christiansen at 12-13; Tr. 2183 (Kammeyer). PNPP is implementing all applicable Owners Group recommendations resulting from Phase I and Phase II of the program. Christiansen at 12. PNPP has also agreed to implement the maintenance and surveillance recommendations made by PNL and SwRI. Id. at 13; Tr. 2498 (Christiansen). See Staff Ex. 4. The maintenance

and surveillance recommendations to be implemented at PNPP will guarantee that the engines meet GDC 17 throughout the life of the plant. Tr. 2468 (Berlinger). The NRC Staff will review PNPP's implementation of required maintenance and surveillance. Id. at 2303.

112. Crankshaft. The PNPP diesel generators have 13" x 13" crankshafts. Wood at 74. While there have been no failures of 13" x 13" crankshafts on DSRV-16-4 engines in nuclear service, smaller 11" x 13" crankshafts have cracked on three DSR-48 engines at Shoreham. Id. at 74-75. The crankshaft was, therefore, included among the sixteen Phase I components and subjected to a detailed design review by the Owners Group. See id. at 74-81, Kammeyer at 13. The Owners Group review included a dynamic torsional analysis and a modal superposition analysis of the crankshaft for PNPP. Wood at 78-80. The Owners Group also reviewed the results of torsigraph testing performed by TDI on the Grand Gulf Nuclear Power Plant ("Grand Gulf") engine. Id. at 77. The engine type and the crankshaft at PNPP are of identical design to those at Grand Gulf. Id. at 75.

113. The PNPP crankshafts are required to meet the recommendations of the Diesel Engine Manufacturers Association ("DEMA"). Id. DEMA is considered a conservative standard for judging the adequacy of the PNPP crankshafts. Tr. 2340 (Hardy, Henriksen). DEMA recommends that no harmful torsional vibratory stresses occur

within five percent above and below rated speed. Wood at 75. PNPP's performance specification was even more stringent; the engines were required to be free of all deleterious critical speeds or torsional vibrations for any operating speed within the range of 90% to 110% of rated speed at any load from 0 to 110% of rated output. Tr. 2187 (Christiansen). The DEMA recommendations state that crankshaft torsional vibratory conditions shall generally be considered safe when they induce a superimposed stress of less than 5000 psi, created by a single order of vibration, or a superimposed stress of less than 7000 psi, created by summing the major orders of vibration. Wood at 75.

114. Crankshaft stresses were found to satisfy the DEMA requirements in the Owners Group analysis. Id. at 78-80. Good agreement was found between TDI's calculated stresses and the measured stresses. Id. at 78. As required by the Owners Group, torsionograph testing was conducted on both of the PNPP engines to confirm the prior analysis at TDI as well as the Owners Group calculations. Id. at 81; Tr. 2245-46 (Kammeyer). It was determined that the PNPP crankshaft has a fourth order critical speed of 436 rpm. Tr. 2245 (Kammeyer). Although 436 rpm is close to the engines' operating speed (450 rpm), the stress at this critical speed is significantly lower than the allowable DEMA standards (the single order stress is approximately two-and-one-half-times less than the DEMA allowable of 5,000 psi and the combined response is approximately 4,500 psi, which is significantly less

than the DEMA allowable of 7000 psi) and is not considered deleterious. Id. at 2245-46, Tr. 2196 (Christiansen). The engines, therefore, meet PNPP's specification. Tr. 2196 (Christiansen).

115. Because the fourth order critical is fairly close to the engines' operating speed, PNL recommends, and the NRC Staff concurs, that steady operation of the engines below 450 rpm should be minimized. Staff Ex. 5 at 4.10; Staff Testimony at 9. PNPP has, therefore, set the limit switches on the governor to limit the engines' speed range to $-1/2\%$ to 6% of 450 rpm during manually controlled operations when the diesels are not attached to the grid. Tr. 2498 (Christiansen).

116. Oil holes in the crankshaft are drilled through the journal, a total length of 13 inches. Tr. 2209-10 (Kammeyer). As recommended by the Owners Group, eddy current inspection of the oil holes on the crankshaft was performed to a depth of 3 inches. Id. at 2210. The machining marks which were revealed during this inspection were polished to a depth of 3 inches. Christiansen at 12. Repetition of the eddy current test on the polished oil holes indicated that they were free of defects. Id. At the hearing, OCRE expressed concern over the absence of eddy current inspection to the total depth of 13 inches. See Tr. 2210. While machining marks may exist at depths greater than 3 inches in the crankshaft oil holes, shear stress in these regions drops off radically and, therefore, any such marks would not be detrimental to engine operation. Tr. 2210 (Kammeyer).

117. Minor cracking has been observed in the main journal oil holes on the crankshaft of a TDI diesel at San Onofre. Tr. 2331 (Berlinger). At the hearing, OCRE questioned the applicability of this problem to the crankshafts at PNPP. See Tr. 2326-31. San Onofre has a DSRV-20 engine and a crankshaft which is significantly different from the PNPP DSRV-16-4 crankshaft. Tr. 2329 (Berlinger). The problem with the San Onofre crankshaft is believed to be caused by fast starts during which the engine passes through a combination of 3 critical speeds in close proximity which contribute major stress at around the 300 rpm range. Id., Tr. 2327 (Hardy). This situation is unique, and has not been observed in any of the other TDI engines. Tr. 2329 (Berlinger). The problems experienced with the San Onofre crankshaft are irrelevant to the PNPP crankshafts. Tr. 2409 (Hardy).

118. At the hearing, OCRE expressed concern over a crack discovered in a crankshaft oil hole plug at another facility. See OCRE Ex. 8; Tr. 2228-31. The problem was observed during routine inspection of the crankshaft. Tr. 2230 (Kammeyer). PNPP Deviation Analysis Report No. 231 evaluated this incident. Tr. 2228 (Christiansen); Christiansen at 25. While the PNPP engines were not identified as among those affected, PNPP will perform an inspection of all plugs to verify that they are the sixteen gauge plugs recommended by the manufacturer. Tr. 2262 (Christiansen). See also OCRE Ex. 8. The crack discovered in the oil hole plug is not considered to be a generic crankshaft problem. Tr. 2231 (Kammeyer).

119. OCRE expressed concern with regard to the effect of cylinder imbalance on crankshaft stresses; the NRC Staff, in turn, felt that some degree of cylinder imbalance should be investigated in PNPP's torsigraph testing. See Staff Testimony at 25. DEMA does not require the evaluation of cylinder imbalance (one cylinder firing stronger than another). Tr. 2333, 2339 (Hardy). The rules of the European ship classification societies, which are considered very conservative as applied to stationary diesels, generally do require such an evaluation. Tr. 2339-40 (Hardy, Henriksen). The PNPP diesels, however, are not required to meet the ship classification rules and the NRC Staff does not recommend that these rules be applied to land-based units. Staff Testimony at 25. Reasons against their use include: a) the generality of such rules, which are required to cover the wide range of engine sizes and types generally operating at variable speeds, and b) the continuous duty required at sea, which is inapplicable to nuclear service. Id.

120. Tests in which fuel is cut off to one cylinder on an engine have been conducted at PNPP to simulate radical cylinder imbalance. Tr. 2265 (Christiansen), Tr. 2311 (Kammeyer). Cylinder imbalance can be identified by monitoring cylinder firing pressures and exhaust temperatures. Staff Testimony at 9. This will be performed at PNPP. Tr. 2497 (Christiansen). It is unnecessary to provide continuous monitoring of these parameters, as suggested by OCRE, because severe imbalance would be noted by periodic

measurements. Tr. 2347 (Berlinger, Hardy). Cylinder imbalance would not present an emergency situation, as suggested by OCRE; at most, it would necessitate a planned shut-down of the engine for servicing. Tr. 2348 (Hardy).

121. TDI's specification allows individual cylinder pressures to be within plus or minus 75 psi of the average bank cylinder pressure. Tr. 2506 (Kammeyer). Based on torsigraph testing at other sites, the Owners Group has concluded that TDI's specifications produce acceptable results with regard to cylinder imbalance. Id. at 2506-07.

122. Both SwRI and the Owners Group concluded that the PNPP crankshafts are adequate for their intended service provided inspection, maintenance and surveillance recommendations are followed. Wood at 80-81. PNPP is committed to implementing the Owners Group recommendations. Christiansen at 12. The PNPP crankshaft is acceptable to the NRC Staff and PNL provided that review of the torsigraph results confirms that the stresses are below DEMA guidelines. Tr. 2416 (Hardy). The Staff's and PNL's interim basis for adjudging the crankshafts to be reliable is the torsigraph testing previously conducted at TDI and the fact that the Owners Group calculations confirmed the prior test results so closely. Id. at 2326. Results of torsigraph testing at other plants provides an additional basis for concluding that the PNPP crankshafts will operate reliably. Id. at 2324.

123. Cylinder Block and Liner. Cylinder blocks were included among the sixteen Phase I components due to cylinder block top cracking at Shoreham and elsewhere. Wood at 56. There have been no reported instances of failure of either a DSR-4 or DSRV-4 engine resulting from cylinder block cracks. Id. at 57.

124. The Owners Group analysis included strain gage testing, a metallurgical analysis, and tensile and fatigue tests of the block. Id. at 58-60. The Owners Group produced a cumulative fatigue damage index which accounts for hours of operation at different power levels and corresponding mean and cyclic stress at each level. Id. at 60. The index "quantifies" (in the comparative sense) the effect of different fatigue crack growth rates of different materials. Id. See also Tr. 2450 (Bush). The Owners Group fracture and fatigue life evaluation produced a cumulative damage analysis which applies this index and can be used to set future engine operation limits. Wood at 60-61.

125. The Owners Group analysis was extremely conservative in that it incorporated a number of factors of safety and even assumed some initial cracking of the block prior to operation. Tr. 2194-95, 2268-72 (Kammeyer). As a result of its analysis, the Owners Group concluded that the cylinder blocks were acceptable for use in nuclear standby service. Id. at 2193. SWRI concurred with the Owners Group's conclusion and recommendations. Wood at 62.

126. OCRE indicated concern with the Owners Group evaluation of the cylinder block and its recommended inspection requirements. See, e.g., Tr. 2194-95, 2219, 2358-74. The Owners Group recommends inspection of the block after 572 hours of operation at 100% load (7,000 kw); however, even after this period of operation there would still be a sufficient margin of safety to allow engine operation at peak load, if necessary. Tr. 2195, 2220, 2269 (Kammeyer). Any minor changes in peak loading at PNPP would result in only a small change in the number of hours between recommended block inspections. Id. at 2220. The peak engine load which would be required at PNPP in the event that loss-of-offsite power causes a forced plant shutdown is calculated at 5,634 kw. App. Ex. 16-1; Tr. 2241 (Christiansen). Cumulative damage to the block (as calculated using the Owners Group cumulative damage analysis) at Loss-of-Offsite Power/Loss of Coolant Accident ("LOOP/LOCA") load is less than 50% of that expected at 100% load. Tr. 2219-20 (Kammeyer).

127. The Owners Group recommends that cylinder blocks with known or assumed ligament cracks should be inspected for stud-to-stud cracks after any operation in excess of 50% of nameplate loading. Tr. 2370 (Bush); Wood at 62. The Owners Group believes that any stud-to-stud indications found which extend less than 1.5" from the block top are acceptable. Tr. 2372 (Bush); Wood at 62. Dr. Bush, one of the NRC Staff witnesses, disagrees with this Owners Group conclusion; he would limit the indications to 0.4" to

0.5" in the presence of ligament cracks. Tr. 2372-74 (Bush). PNPP's 100 percent inspection of cylinder block tops and liner landings found no evidence of any cracking of the block tops. Tr. 2222 (Christiansen, Kammeyer).

128. Analysis and experience indicates that ligament and stud-to-stud cracks initiate on the surface of the blocks and would, therefore, have been identified in the inspection performed at PNPP. Tr. 2262 (Kammeyer), Tr. 2413-14 (Berlinger, Bush). Even if cracks initiated sub-surface, they would quickly propagate to the surface where they would be detectable. Tr. 2413 (Berlinger).

129. Calculations indicate that it would take a very long time for ligament or stud-to-stud cracking to initiate in the cylinder block under conventional operation. Tr. 2441 (Bush). If cracks did initiate, only limited growth would be expected, even during a LOOP/LOCA event. Id. at 2440-41, 2451. While the probability of crack initiation is quite high, the compressive stress fields would prohibit crack propagation. Id. at 2368.

130. OCRE indicated concern regarding the material properties of the cylinder blocks. See, e.g., Tr. 2351-52. The presence of abnormal microstructure (e.g., Widmanstaetten graphite, as found in one of the cracked Shoreham blocks) in large amounts is easily detected. Tr. 2449 (Bush); Wood at 59. While minor amounts could occur within the block and not be readily detectable, minor

amounts of abnormal microstructure would also not be of much significance. Tr. 2449 (Bush). The Owners Group and SwRI recommended that the PNPP cylinder blocks be subjected to metallurgical evaluation to verify that the microstructure is characteristic of typical grey cast iron. Wood at 62. PNPP's engine program has incorporated all of the applicable Owners Group recommendations generated in Phase I of the program. Christiansen at 7. The PNPP blocks have been reported to have normal microstructure (typical Class 40 grey cast iron). Tr. 2351-52 (Persinko), Tr. 2410-11 (Bush, Berlinger, Dingee).

131. OCRE indicated concern with the possibility of liner to block fretting and loss of liner crush on the PNPP engines. See Tr. 2358; Staff Testimony at 42. Liner-to-block fretting is an undesirable condition, but would be very unlikely to lead to fatigue failure of the block or liner. Tr. 2358 (Bush, Henriksen). Cylinder liner proudness has been reduced at PNPP to reduce the pressure on the liner and thereby reduce the possibility of block cracking. Tr. 2447-48 (Henriksen, Persinko), Tr. 2508 (Christiansen). Cylinder liner proudness has been reduced down to two mils, thereby maintaining liner crush. Tr. 2448 (Persinko); Tr. 2508 (Christiansen).

132. Connecting Rod. The connecting rod was evaluated as a Phase I component because of the failure history associated with assemblies produced with 1-7/8" bolts. Wood at 82. PNPP is

supplied with the new design which utilizes 1-1/2" bolts. Id. The change in bolt diameter provides a greater material section, and reduces stress levels, in the master rod box. Id. There have been no failures with the 1-1/2" bolts at the currently-specified torque level. Tr. 2435-37 (Berlinger).

133. In its evaluation of this component, the Owners Group identified the failure mechanisms and performed a finite element stress analysis to predict performance in nuclear applications. Wood at 83-84. Results were compared to experimental data and operating history. Id. at 84. There is no history of buckling of V-engine connecting rods; the Staff does not recommend a buckling strength analysis. Staff Testimony at 32; Tr. 2435 (Henriksen). Nor have there been any failures of a wrist pin bushing in a TDI engine. Staff Testimony at 32-33.

134. The NRC Staff concurs with the Owners Group and SwRI that the PNPP connecting rods are suitable for their intended service. Staff Testimony at 6, Wood at 84-86. As required by the Owners Group and NRC Staff, preventative maintenance, including bolt torque checks, will be performed at PNPP. Tr. 2489-90 (Christiansen). See also Staff Testimony at 6, Wood at 86.

135. Connecting Rod Bearing Shells. Connecting rod bearing shells were reviewed as a Phase I component due to cracked bearing shells at Shoreham. Wood at 21-22. The large (1/4" x 45 degree) chamfer at Shoreham which caused the cracking has been replaced by

a smaller (1/6" x 45 degree) design. Id. at 22. The PNPP engines have the smaller chamfer. Id. The Owners Group evaluation included journal orbit analysis, tensile properties tests, finite element stress analysis and a fracture mechanics analysis. Id. at 22-23. SwRI performed an additional analysis to calculate oil film thickness and pressure for the higher peak cylinder firing pressure in the PNPP engines. Id. at 24-25. SwRI agreed with the Owners Group conclusion that the PNPP bearing shells have a fatigue life of 38,000 hours of full-load operation. Id. at 25.

136. The connecting rod bearings in place at PNPP have been inspected, per Owners Group requirements, and found to meet the Owners Group criteria for acceptance. Id. at 26; Tr. 2440 (Henriksen). The NRC Staff believes that bearings which meet the Owners Group acceptance criteria are adequate for their intended service. Staff Testimony at 36.

137. Pistons. Piston skirts were included among the Phase I components due to cracking in the skirt-to-crown stud attachment bosses in AF pistons at Shoreham. Wood at 49. The PNPP engines have AE pistons. Id. at 50. Due to a difference in heat treatment/cooling rates, AE piston skirts have only one-half the amount of ferrite as AF pistons. Id. at 51. The lower ferrite makes the AE skirts structurally stronger. Id.

138. The Owners Group evaluation of the piston included destructive and non-destructive examinations of a failed AF piston,

experimental stress analysis and finite element analysis. Id. at 50-53. The Owners Group and SwRI concluded that the AE piston skirts are adequate for unlimited life under full load conditions. Id. at 55. The PNPP AE piston skirts have been confirmed to satisfy Owners Group acceptance criteria. Staff Testimony at 27. The NRC Staff concludes that they will perform satisfactorily. Id. at 28.

139. OCRE expressed concern over fretting in AE pistons and instances of chrome flaking. See, e.g., Staff Testimony at 26. The instances of fretting that have been observed between the crown and skirt of AE pistons have not been serious. Tr. 2426-27 (Henriksen); Staff Testimony at 26. Nor have any instances of chrome flaking from piston rings and wrist pins resulted in any serious damage. Staff Testimony at 26.

140. Pushrods. The PNPP pushrods are of the friction-welded design. Wood at 38. No failures have been reported for this design. Id. Problems with two other designs ("forged head" and "ball end") resulted in the inclusion of pushrods among the Phase I components. Id.

141. The Owners Group investigation of the pushrod included metallurgical, fatigue and buckling stability/wear resistance analyses of the various designs. Id. at 38-39. SwRI extended the Owners Group buckling analysis to include buckling under dynamic loading conditions. Id. at 39. The Owners Group analysis of

critical loading yielded safety factors of 6.1 and 2.3 for the intake and exhaust pushrods and 2.1 for the exhaust intermediate pushrod. Id. at 40. The fatigue crack analysis indicated that, under cyclic loading, any potential fabrication crack is not expected to propagate in either the main or intermediate friction-welded pushrods. Id. Non-destructive examinations performed before and after fatigue testing of the intermediate pushrod showed no flaws. Id. at 40-41. The metallurgical evaluation of the friction-welded design showed typical microstructures for the materials. Id. at 41. Based on its analysis, the Owners Group concluded that the friction-welded design is the most reliable; SwRI concurred. Id. at 42.

142. PNL has also concluded that the PNPP pushrods are adequate for their intended service, given their favorable operating history and the satisfactory results obtained in PNPP's liquid penetrant examination of its pushrods. Staff Ex. 5 at 4.24-4.25. As required by the NRC Staff, PNPP will confirm that the Owners Group requirements regarding random sample testing of the pushrod have been followed. Tr. 2499 (Christiansen). See also Staff Testimony at 10.

143. Rocker Arm Capscrew. Rocker arm capscrews were evaluated as a Phase I component due to isolated failures resulting from insufficient preload application. Wood at 6. The Owners Group analysis included a fatigue life analysis, thread distortion

analysis, thermal stress evaluation, and a determination of the applied stress and endurance limits of the two capscrew designs in use. Id. at 7.

144. Based on their analyses, both the Owners Group and SwRI concluded that the rocker arm capscrews utilized at PNPP are adequate for nuclear service. Id. at 10. Maintenance will assure that loss of preload does not occur. Id. at 10-11. Based on PNPP's inspection of this component, analytical evidence and favorable operating history, PNL also concluded that the capscrew is suitable for use at PNPP. Staff Ex. 5 at 4.27.

145. Fuel Oil Injection Tubing. Fuel oil injection tubing was reviewed as a Phase I component due to problems with leakage. Wood at 11. The Owners Group analysis included an investigation of applied stresses on the tubing and comparison with its yield strength and endurance limits, as well as a fracture mechanics analysis. Id. at 12.

146. Both the Owners Group and SwRI concluded that the tubing in place at PNPP is adequate for continued use; this determination was based, in part, on PNPP's inspection of its tubing using eddy current techniques to assure the absence of flaws. Id. at 13-14. Christiansen at 7. PNL concurs that the tubing is suitable for its intended use. Staff Ex. 5 at 4.33.

147. Wiring and Termination. Wiring and termination were included as Phase I components as a result of TDI's identification of two potentially defective engine-mounted cables that did not meet IEEE-383-1974 standards. Wood at 27. The Owners Group performed an evaluation of both TDI-generic and PNPP-specific designs. Id. The analysis included a review of the circuit requirements, including a determination of the wire insulation rating, type and rating of termination, voltage, maximum temperature, flame retardancy requirements and routing. Id.

148. The Owners Group analyses resulted in a conclusion that the PNPP wiring and termination are satisfactory; SwRI agreed with this conclusion. Id. at 28-29. PNL concurs that PNPP's wiring and termination are suitable for their intended use. Staff Ex. 5 at 4.36.

149. Airstart Valve Capscrew. The airstart valve capscrew was evaluated by the Owners Group as a Phase I component because capscrews supplied to one utility by TDI were too long for their bolt holes; this prevented the valves from being properly seated. Wood at 34. A stress and dimensional analysis was performed for the capscrew by the Owners Group. Id. SwRI also performed a number of analyses to evaluate the functional attributes of the capscrew, with no significant difference in results from those obtained by the Owners Group. Id. at 35-36.

150. PNPP has inspected the bolt hole depth for every airstart valve capscrew on its engines to verify that they are the appropriate length so that the capscrews will not bottom out. Tr. 2223 (Christiansen), Tr. 2420-21 (Persinko).

151. Both SwRI and the Owners Group concluded that the airstart valve capscrew was of adequate design and satisfactory for nuclear service. Wood at 36. PNL concurs that the capscrew design is adequate. Staff Ex. 5 at 4.35.

152. Cylinder Head Studs. Cylinder head studs were evaluated as a Phase I component by the Owners Group due to isolated failures as a result of insufficient preload. Wood at 29. A stress analysis of both head designs ("straight" and "necked" shank) was performed by the Owners Group. Id. at 30. SwRI's review of the Owners Group results did not yield any significant differences. Id. at 31.

153. PNPP has performed the Owners Group recommended material verification and confirmed that its cylinder head studs meet AISI 4140 standards. Id. at 32-33.

154. Both the Owners Group and SwRI concluded that either cylinder head stud design is satisfactory. Id. at 32-33. PNL concurs. Staff Ex. 5 at 4.23. The "necked" design (utilized at PNPP) was recommended by SwRI because it is less likely to lose its preload, has a higher safety factor under fatigue loading and

lowers the stresses in the block adjacent to the liner landing. Wood at 33. Maintenance will assure preload is maintained. Id.

155. Jacket Water Pump. The jacket water pump used on DSRV-16-4 engines does not have a history of failures. Id. at 69. The jacket water pump received a detailed design review by the Owners Group due to failures on the inline, DSR-48 engines at Shoreham. Id. The Owners Group analysis included a torsional analysis and a stress analysis. Id. at 70-71. In conducting its review of the Owners Group analysis, SwRI took into account the smaller diameter of the PNPP pump impellers. Id. at 73. SwRI also considered impeller rotation and the effects of stresses due to centrifugal force on the drive fit. Id.

156. Based on its analysis, the Owners Group concluded that the pump design at PNPP was adequate for nuclear service. Id. at 71. SwRI concurred with the Owners Group evaluation as it applied to PNPP. Id. at 73. PNL also concurs with the Owners Group evaluation. Staff Ex. 5 at 4.31.

157. Cylinder Heads. Cylinder heads were evaluated by the Owners Group as a Phase I component because of cracking observed in a number of locations on the heads. Wood at 44. The Owners Group evaluation included a metallurgical analysis, an evaluation of thermal and pressure stresses on the head and modeling of the component. Id. at 44-46.

158. The cylinder heads in use at PNPP have all been stress-relieved and welded to meet new requirements. Staff Testimony at 6; Tr. 2234-35 (Kammeyer). Because of this treatment, the PNPP cylinder heads are not subject to valve seat cracking, a concern raised by OCRE at the hearing. Tr. 2232-35 (Kammeyer).

159. PNL considered it important that none of the PNPP heads have through-wall weld repairs performed on one side only, due to the stress concentration associated with such a repair. See Staff Ex. 5 at 4.20. The cylinder heads in place at PNPP do not have such weld repairs. Tr. 2428-29 (Berlinger).

160. All of the cylinders meet minimum fire deck thickness requirements, a concern raised by OCRE. Tr. 2431 (Kirkwood).

161. The PNPP engines will be air-rolled after all operations and before all planned starts to check for possible water leakage into the cylinders from cracking in the cylinder heads. Tr. 2489, 2501 (Christiansen). See also Staff Testimony at 6.

162. The Owners Group and SwRI concluded that the class of heads used at PNPP are adequate. Wood at 48. The cylinder head design is considered adequate by the NRC Staff and PNL based upon experience history as well as the analytical modeling performed by the Owners Group. Tr. 2427-28 (Berlinger, Henriksen). Inspections to be performed on the heads provide additional assurance of their acceptability. Id. (Berlinger).

163. Engine Base and Bearing Caps. The engine base and bearing caps assembly was included among the sixteen Phase I components due to cracking observed in DSR-4 inline engines, a nut pocket failure in a DSRV-16-4 engine, and through-bolt failures on a DSR-46 engine. Wood at 16. The Owners Group performed a fatigue and fracture analysis and stress analysis for both the saddle and caps. Id. at 16-17. The through-bolts and bearing cap and fastener system were also evaluated. Id. at 18-19. SwRI's review of the Owners Group analysis indicated that the interface between the cap and saddle was even stronger than calculated by the Owners Group. Id. at 19. This means that there will be no lateral movement of the cap under the influence of the crankshaft horizontal force. Id. at 19-20.

164. OCRE questioned the absence of metallurgical or chemical composition analyses of the base. See, e.g., Tr. 2216. Only one isolated failure due to material abnormalities has ever been reported in the hundreds of engines in operation. Tr. 2216 (Kammeyer). Metallurgical or chemical composition evaluations were deemed unnecessary by the Owners Group due to low loading on the engine base and its favorable operational history. Tr. 2216-17, 2504-05 (Kammeyer). The NRC Staff and PNL agree with this conclusion. Staff Testimony at 37-38. Any crack which did initiate in the engine base would propagate very slowly, if at all. Tr. 2442 (Berlinger). Inspection of the most highly loaded bearing cap and most highly stressed saddle, coupled with routine

maintenance and visual inspections at each outage is sufficient to ensure the base is fabricated from acceptable material. Tr. 2216 (Kammeyer).

165. PNPP routinely performs maintenance for this component which includes visual inspection of every bearing saddle area on both engines. Id. at 2238-39, 2260. Inspection of the critical saddle and cap at PNPP revealed minor casting indications common to the type of casting involved. Id. at 2216, 2218. Because of the large factor of safety (greater than 15.8) against growth of such small indications, it was considered unnecessary to remove them. Id. at 2218. Both the NRC Staff and PNL agree that the indications are not a cause for concern. Staff Testimony at 38.

166. The NRC Staff agrees with the Owners Group and SwRI that the base, bearing caps, and associated bolting are adequate for their intended service. Id. at 37, Wood at 20.

167. Turbochargers. The turbochargers were included among the Phase I components because of thrust bearing, nozzle vane, nozzle ring capscrew and washer, and nozzle ring failures on TDI nuclear standby diesel engines. Wood at 64. The Owners Group performed a number of analyses to determine loading and the load carrying capability of the turbocharger components. Id. at 64-65. Thrust bearings were also examined for wear. Id. at 65. The Owners Group analysis of nozzle ring capscrew, washer and vane failures determined the probable cause of the single ring failure and

nozzle vane failures; the cause of the cracked washer was not found; however, failure of a washer would not degrade engine performance. Id. at 67.

168. While vane failures in the steady-state operation of an engine may be predictable with some accuracy, early operational failures or fatigue failures cannot be predicted at this time. Tr. 2357-58 (Bush).

169. Operational experience indicates that vane failures may occur on the PNPP turbochargers in the future. Staff Testimony at 39. While vane breakage could severely damage or demolish the rotor, the history of the turbochargers in nuclear service reveals that none have suffered severe damage and some have not even evidenced any damage as a result of vane breakage. Id. at 40; Tr. 2443-45 (Henriksen).

170. Vane cracking, which initiates below the surface of the hub in the vane root, cannot be detected by visual or liquid penetrant inspections. Tr. 2353-54 (Berlinger). Because subsurface cracking is not identifiable by inspection, the turbocharger will be subjected to stringent maintenance and surveillance to identify any problem at an early stage. Tr. 2470-72 (Berlinger, Dingee), Tr. 2490 (Christiansen).

171. The NRC Staff considers the turbochargers' alignment adequate to prevent vibration problems. Staff Testimony at 6.

Pre-operational vibration tests will be run on the PNPP turbochargers. Tr. 2445-46 (Dingee), Tr. 2251 (Kammeyer).

172. OCRE felt that the Dresser Style 65 couplings on the PNPP engines should be replaced prior to plant operation. See Staff Testimony at 52. The NRC Staff feels eventual replacement will be needed, but observes that the gaskets pose no immediate problem. Id at 7. PNPP will monitor the Dresser Style 65 couplings on its engines for any leakage and replace them, as necessary. Tr. 2495 (Christiansen).

173. OCRE indicated concern regarding the sufficiency of the contact between the engine base and chocks. See Staff Testimony at 54-55. Applicants provided additional information on this item at the hearing. See Tr. 2496-97. PNPP's architect/engineer established an inspection requirement of 85% surface contact for all heavy machinery installations. Tr. 2496 (Christiansen). If surface contact was less than 85%, an engineering evaluation was required. Id. The PNPP foundation chock plates have been inspected for 85% surface contact. Id. An engineering evaluation was performed for chock plates with less than 85% contact. Id. In all cases, the contact exceeded TDI's minimum requirements. Id. at 2497. Hot and cold crankshaft deflection measurements have confirmed that TDI's criteria have been met and that the engine is well-supported. Id.

174. The PNPP engines will not operate beyond 185 psig brake mean effective pressure ("BMEP") without NRC Staff approval.^{53/} Id. at 2266. Given favorable torsionograph test results, engine operation to 224 psig BMEP will be acceptable. Tr. 2423-2424 (Berlinger).

175. The PNPP diesel generators will be tested prior to plant operation in accordance with Regulatory Guide 1.108 (as described in the PNPP FSAR) and the criteria of IEEE Std. 387-1977. Tr. 2204 (Christiansen); Christiansen at 28-31. Testing will include a demonstration of the ability of the diesel generators to start and load to LOOP/LOCA loads. Tr. 2215 (Christiansen). The range of loading calculations in the PNPP FSAR will be verified. Id. The diesels will also be tested once a month and during outages. Tr. 2205, 2255 (Christiansen).

176. Both the NRC Staff and PNL recommend the elimination of the additional ten fast-starts per engine PNPP was planning to perform.^{54/} Tr. 2455-56 (Berlinger); Staff Ex. 5 at 7.2. PNPP will formally propose the elimination of these additional fast-starts to the NRC Staff. Christiansen at 31.

^{53/} Preoperational testing, however, will be conducted at 7,000 kw rated load (224 psig BMEP) in accordance with Regulatory Guide 1.108. See OCRE Ex. 3.

^{54/} These fast starts were in addition to the required fast start testing to be conducted in accordance with Regulatory Guide 1.108. See Staff Ex. 5 at 7.1; Tr. 2456 (Perskino).

177. As of the time of the hearing, the PNPP Division 1 engine had run for approximately thirteen-and-one-half hours and the Division 2 engine had run for approximately seven hours. Id. at 31-32. No hardware-related incidents occurred during this operation. Id.

178. Successful testing and hundreds of hours of operation have already been accumulated on DSRV-16-4 engines at other plants. Id. at 26-27. A full, preoperational test program has been conducted on the Comanche Peak DSRV-16-4 engines. Id. at 26. Over 100 hours of operation have been logged on these engines. Id. at 27. Over 1600 hours of operation have been logged on the DSRV-16-4 engines at the Catawba Plant. Id. These engines provide additional assurance of the DSRV-16-4's capabilities. Id.

179. At the hearing OCRE reiterated its desire to have the PNPP engines run for 10^7 ^{55/} cycles prior to plant operation. See Tr. 2205. The engines will not be run for 10^7 cycles prior to plant operation. Tr. 2205 (Christiansen). Testing for 10^7 cycles is only necessary where experience and/or analysis does not establish that DEMA guidelines have been met; such testing is not necessary to confirm the adequacy of the PNPP diesels for loading to either 185 or 224 psig BMEP (7,000 kw). Tr. 2323 (Berlinger); Staff Testimony at 22.

^{55/} 10^7 cycles corresponds to about 750 hours at 450 rpm. See Staff Ex. 1, Enclosure-1 at 13.

180. An Owners Group review of the operational history of all diesel engines operating at nuclear sites has indicated that the TDI diesels are very reliable in starting. Tr. 2256 (Kammeyer). Regulatory Guide 1.108 requires 99% reliability with a 50% confidence level; the results of the study indicate a confidence level of nearly 100%. Id.

181. App. Ex. 16-1 gives the projected sequence and ultimate loading for each engine in the event that loss of offsite power causes a forced plant shutdown. Tr. 2241 (Christiansen). In this case, the most highly-loaded PNPP engine (Division II) would have a maximum load of 5,634 kw which is only 82% of the engines' nameplate rating. Id.; App. Ex. 16-1.56/ It would be expected to operate for a maximum of 287 hours at this load. Tr. 2244 (Christiansen); App. Ex. 16-1. While it is possible that additional loads could be added to the engines in the future, this would require an amendment to the PNPP FSAR (App. Ex. 16-1) which would be reviewed by the NRC Staff. Tr. 2258 (Christiansen).

182. An attachment to the performance specification for the PNPP diesel generators established PNPP quality assurance and quality control program requirements for TDI in conformance with NRC regulations. Id. at 2188-90. Periodic manufacturing audits of TDI were conducted for PNPP. Id. at 2191. The TDI quality

^{56/} Other loads, including the maximum load for a LOOP/LOCA (4,668 kw) are lower. Compare App. Ex. 16-1 at 8.3-76 with 8.3-81.

assurance program, as audited by Applicants, met the requirements of GDC 1. Id. at 2190. Applicants do not dispute, however, that there were deficiencies identified in TDI's quality assurance program. Tr. 2192 (Kammeyer). Indeed, deficiencies in TDI's quality assurance program were one of the reasons for the formation of the TDI Diesel Generator Owners Group Program and PNPP's participation therein. Id.

183. OCRE Ex. 1 documents an audit performed in 1982 to inspect TDI's manufacturing process for spare parts. Tr. 2236 (Christiansen). This audit resulted in a follow-up evaluation by both PNPP and its architect/engineer. Id. The subsequent evaluation verified the existence of complete TDI records addressing each area of concern identified in the earlier audit. Id. at 2237. The subsequent evaluation also verified that the hardware, as manufactured, was acceptable and that the TDI quality assurance program was adequate. Id. at 2267.

184. Based on PNPP's successful performance of the Owners Group revalidation effort and the testing to be performed in accordance with Owners Group and regulatory requirements, Applicants conclude that the PNPP TDI diesel generators will reliably perform their safety-related functions. Id. at 2257. The NRC Staff agrees that the PNPP Unit 1 TDI diesel generators will perform reliably and that the Unit 2 diesels will do likewise, provided they are also subjected to all phases of the Owners Group

Program in the future. Staff Ex. 2; Tr. 2405-06 (Berlinger, Dingee).

185. The Unit 2 diesels will complete the Owners Group Phase I component reviews, with components being replaced as needed. Tr. 2483 (Berlinger). The Unit 2 diesels will also be subjected to the same Phase II revalidation (tear-down and inspection). Id. at 2479, 2483. Inspection and maintenance requirements, as well as some component testing requirements (such as the torsigraph test) may change as additional operational experience is obtained. Id. at 2467, 2479, 2483-84. The Unit 2 diesels will be subjected to the same preoperational testing to be performed on the Unit 1 engines, as committed to in the PNPP FSAR. Tr. 2486 (Berlinger), Tr. 2515 (Christiansen).

186. While random component failures on the PNPP diesels are still a possibility, the Owners Group Program, as implemented at PNPP, has significantly reduced the likelihood of such an occurrence. Tr. 2263-64 (Kammeyer). The basis for redundancy of onsite power is to preclude such a random failure from causing any problem with the plant. Id. at 2263. PNPP will continue to be informed of any applicable problems with diesel generator components via reporting programs already in place (e.g., 10 C.F.R. Part 21 and Section 50.55(e) reports). Tr. 2230-31 (Kammeyer), Christiansen at 19.

187. Prior to licensing for operation above 5% of rated thermal power, PNPP will formally submit to the NRC Staff, for its review and approval, all information (including results of the torsionograph testing) identified in SER, Supp. No. 6, NUREG-0887, April 1985. Tr. 2474-76 (Berlinger).

CONCLUSIONS OF LAW

The Board has considered all of the evidence submitted by the parties for the second phase of the evidentiary hearing, concerning emergency planning and the TDI diesel generators. Based on the findings of fact set forth herein, which are supported by reliable, probative and substantial evidence in the record, the Board decides all matters in controversy, except for the hydrogen contention pending before this Board, in favor of authorizing operation of the facility. The Board concludes that, as to the matters resolved herein, the Director of Nuclear Reactor Regulation should be authorized, upon making requisite findings with respect to matters not resolved in the Board's partial initial decision, to issue licenses to operate the Perry Nuclear Power Plant to Applicants.

ORDER

WHEREFORE, IT IS ORDERED

1. All issues of material fact admitted under Issue No. 1 (emergency planning) and Issue No. 16 (TDI diesel generators) in this proceeding are found to be without merit and are dismissed.

2. Pursuant to 10 C.F.R. § 2.760(a), this is a partial initial decision that will constitute final action of the Commission forty-five (45) days from the date of issuance unless exceptions are taken pursuant to § 2.762 or the Commission directs that the record be certified to it.

3. Exceptions to this decision or designated portions thereof may be filed with the Commission, in the form required by § 2.762(a), within ten (10) days after service of this decision.

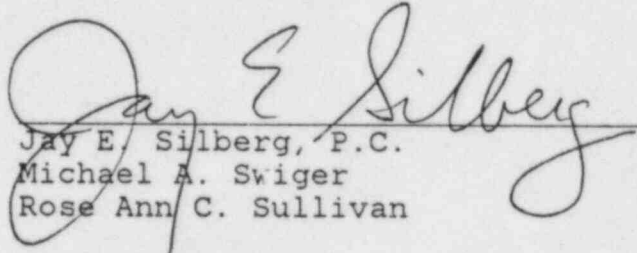
4. To pursue an appeal, briefs in support of a party's objection also must be filed, within thirty (30) days after filing the exceptions (or forty days in the case of the Staff of the Nuclear Regulatory Commission). The brief must comply with the requirements of § 2.762.

5. Within thirty (30) days of the service of the brief of the appellant (40 days for the Staff), parties may file opposing or supporting briefs that comply with the requirements of § 2.762.

6. Filings that do not comply with the rule governing appeals may be stricken.

Respectfully submitted,

SHAW, PITTMAN, POTTS & TROWBRIDGE



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Dated: May 13, 1985

APPENDIX A

WRITTEN TESTIMONY RECEIVED INTO EVIDENCE

Witness

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Statement of Qualifications of John Baer

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Baer on Issue No. 1 - Contention Q "

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BRANCH
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"Applicants' Direct Testimony of John
Baer on Issue No. 1 - Contention U"

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"Applicants' Direct Testimony of John
Baer on Issue No. 1 - Contention Z"

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Baer on Issue No. 1 - Contention BB"

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Statement of Qualifications of Carl H. Berlinger

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Drew Persinko, Spencer H. Bush, David A.
Dingee, Howard M. Hardy, Adam J. Henricksen,
and B. J. Kirkwood on Issue 16 Concerning
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Statement of Qualifications of Richard R. Bowers

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Bush, Spencer H.

Statement of Qualifications of Spencer H. Bush

2281

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Kirkwood, B. J

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^{1/} The Board ordered the words "Summary of," which appear in the original, stricken from the title of Dr. Sternglass' testimony. Tr. 2564.

ORAL TESTIMONY WITHOUT
WRITTEN TESTIMONY

Witness

Introduced on
Transcript Page

Wills, John M.
(Witness for Applicants)

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APPENDIX B
EXHIBITS

<u>EXHIBIT NUMBER</u>	<u>DESCRIPTION</u>	<u>IDENTIFIED AT TRANSCRIPT PAGE</u>	<u>ADMITTED AT TRANSCRIPT PAGE</u>	<u>FOLLOWING TRANSCRIPT PAGE</u>
App. Ex. 1-1	Advisory Committee on the Biological Effects of Ionizing Radiations, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation," Nov. 1972, pp. 177-79	2599	2602	2602
App. Ex. 1-2	Committee on the Biological Effects of Ionizing Radiations, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation: 1980," pp. 463-64	2608	2608	2608
App. Ex. 1-3	EPA Final Environmental Statement - "Environmental Radiation Protection Requirements for Normal Operations of Activities in the Uranium Fuel Cycle," November 1, 1976, pp. 186-88	2611	2611	2611
App. Ex. 1-4	EPA Letter from D. M. Costle to C. J. Dodd, dated August 9, 1978 re Strontium-90 Report by Dr. Sternglass	2618	2618	2618
App. Ex. 1-5	Letter from W. D. Rowe to J. C. Cleveland, dated August 2, 1978 re Report on Mortality Changes Around Nuclear Facilities in Connecticut, authored by Dr. Sternglass	2620	2620	2620

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<u>EXHIBIT NUMBER</u>	<u>DESCRIPTION</u>	<u>IDENTIFIED AT TRANSCRIPT PAGE</u>	<u>ADMITTED AT TRANSCRIPT PAGE</u>	<u>FOLLOWING TRANSCRIPT PAGE</u>
App. Ex. 1-6	EPA Letter from W. A. Mills to B. Lindell, dated February 7, 1980 re EPA comments on statements made by Dr. Sternglass	2622	2622	2622
App. Ex. 1-7	Newsletter Supplement - April 15, 1970 - Committee Statement - Committee on Environmental Hazards, American Academy of Pediatrics	2625	2625	2625
App. Ex. 1-8	Statement by Dr. Dade W. Moeller, President, Health Physics Society, to South Carolina Legislative Investigating Committee, September 30, 1971	2627	2627	2627
App. Ex. 1-9	NRC Letter from J. M. Hendrie to C. J. Dodd dated January 18, 1978, re NRC's evaluation of Strontium-90 Report by Dr. Sternglass	2628	2628	2628
App. Ex. 1-10	Letter from H. R. Denton to C. J. Dodd dated July 27, 1978, re review of Dr. Sternglass' allegation concerning levels of Strontium and Cesium in the Connecticut environment	2629	2629	2629
App. Ex. (Unnumbered)	Testimony by the Representatives of the Bureau of Radiological Health of the Public Health Service entitled, "A Critical Review of Infant Mortality and Nuclear Power Generation by E. J. Sternglass"	Document Not Marked in Record, <u>See</u> Tr. 2630	WITHDRAWN, 2631	

EXHIBIT NUMBER	DESCRIPTION	IDENTIFIED AT TRANSCRIPT PAGE	ADMITTED AT TRANSCRIPT PAGE	FOLLOWING TRANSCRIPT PAGE
App. Ex. (Unnumbered)	NRC Letter from L. Gossick to T. Cochran dated December 17, 1979, responding to Dr. Sternglass' allegations of rise in infant mortalities following Three Mile Island accident	Document Not Marked in Record, <u>See Tr. 2631-32</u>	WITHDRAWN, 2633	
App. Ex. 16-1	Table 8.3-1 from PNPP FSAR, "Connected, Automatic and Manual Loading and Unloading of Engineered Safety Evaluations Features Switchgear"	2242	2243	2243
Staff Ex. 1	Memo from D. Eisenhower to Commissioners dated August 29, 1984, re SER on TDI Owners Group Program Plan and San Onofre Crankshaft Indications; "SER on TDI Diesel Generator Owners Group Program Plan"	2284	2284	2284
Staff Ex. 2	"SER on TDI Diesel Generators, Perry Nuclear Power Plant, Unit 1;" Memo from C. H. Berlinger to B. J. Youngblood, enclosing SER, dated February 25, 1985	2286	2286	2286
Staff Ex. 3	"Post-Test Examination of the TDI Emergency Diesel Generator 103 Pistons and Related Components at Shoreham Nuclear Power Station"	2287	2287	2288

<u>EXHIBIT NUMBER</u>	<u>DESCRIPTION</u>	<u>IDENTIFIED AT TRANSCRIPT PAGE</u>	<u>ADMITTED AT TRANSCRIPT PAGE</u>	<u>FOLLOWING TRANSCRIPT PAGE</u>
Staff Ex. 4	Copy of a slide presentation, "Summary of Conclusions and Recommendations on Resolution of Known Problems in IDI Diesel Generator Components (Phase I of Owners Group Program), Pacific Northwest Laboratory"	2290	2290	2290
Staff Ex. 5	"A Review of the Operability and Reliability of TDI Diesel Generators at Perry Nuclear Power Plant, Unit 1," - PNL-5411, dated February 1985	2292	2292	2292
Staff Ex. 6	"SER Related to Operation of Perry Nuclear Power Plant, Units 1 and 2," dated February 1984 - NUREG-0887, Supp. No. 4	2294	2294	2294
Staff Ex. 7	"SER Related to Operation of Perry Nuclear Power Plant, Units 1 and 2," dated February 1985 - NUREG-0887, Supp. No. 5	2296	2296	2296
FEMA Ex. 1	FEMA Interim Report on Offsite Radiological Emergency Planning for the Perry Nuclear Power Station, dated January 10, 1984	3110	3111	3111
FEMA Ex. 2	Exercise Report from the November 28, 1984 exercise for the Perry Nuclear Power Plant	3110	3111	3111
FEMA Ex. 3	Regional Assistance Committee Consensus Review, November 20, 1984	3110	3111	3111
Sunflower Ex. 1	Slide of Upstate New York Infant Mortality Rate	2586	REJECTED, 2588	

<u>EXHIBIT NUMBER</u>	<u>DESCRIPTION</u>	<u>IDENTIFIED AT TRANSCRIPT PAGE</u>	<u>ADMITTED AT TRANSCRIPT PAGE</u>	<u>FOLLOWING TRANSCRIPT PAGE</u>
Sunflower Ex. 2	Slide of Ohio Infant Mortality Rate	2586	REJECTED, 2588	
Sunflower Ex. 3	Slide of Monthly Infant Mortality Rate Relative to the U.S.	2587	REJECTED, 2588	
Sunflower Ex. 4	Slide of Maryland Infant Mortality Rate for 1979 and 1980	2587	REJECTED, 2588	
Sunflower Ex. 5	Slide of Strontium-90 Levels	2587	REJECTED, 2588	
Sunflower Ex. 6	Slide of Infant Mortality Rates for Rhode Island and New Hampshire	2587	REJECTED, 2588	
Sunflower Ex. 7	Graph of Mortality Rate in the U.S. for Infants 0-1 yr.	2739	2739	2739
Sunflower Ex. 8	Draft Graph of U.S. Infant Mortality Rate per 1000 live births (0-1 year)	2739	2739	2739
Sunflower Ex. 9	Letter from D. B. Wedge to J. Dugan, dated March 26, 1984, re Comments on Time Evacuation Study	2807	3152	3152
Sunflower Ex. 111/	Article from <u>Reacts</u> , Oak Ridge Associated Universities, re the safe handling of radioactive cadavers	3021	REJECTED, 3153	
Sunflower Ex. 12	Ohio Disaster Services Agency Radiological Training Manual, p. 7-10	30622/	3154	3154

1/ Exhibit No. 10 erroneously omitted from numbering sequence.

2/ Exhibit No. 12 erroneously referred to Exhibit No. 10, Tr. 3062.

<u>EXHIBIT NUMBER</u>	<u>DESCRIPTION</u>	<u>IDENTIFIED AT TRANSCRIPT PAGE</u>	<u>ADMITTED AT TRANSCRIPT PAGE</u>	<u>FOLLOWING TRANSCRIPT PAGE</u>
Sunflower Ex. 13	EPA Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, September 1975, p. 1.29	Document Not Marked in Record	3155	3155
Sunflower Ex. 14	Appendix 10 of Ashtabula County Plan	Document Not Marked in Record	3156	3156
OCRE Ex. 1	Gilbert/Commonwealth - April 12, 1982 Letter of Transmittal and Report on Manufacturing Audit Conducted at TDI on February 23-25, 1982	2190	2191	2191
OCRE Ex. 2	Executive Summary Summarizing Status of Owners Group; "Proposal for Closure of TDI Owners Group," from the Executive Committee Meeting of January 9, 1985; Memo to File dated January 10, 1985 re Owners Group Executive Committee Meeting Minutes, January 9, 1985	2199	2200	2191, 2200
OCRE Ex. 3	Letter from B. J. Youngblood to M. Edelman dated March 25, 1985, re confirmation of TDI Diesel Generator Pre-Licensing Tests for Perry Nuclear Power Plant	2203	2203	2203
OCRE Ex. 4	"Applicants' Answers to OCRE 11th Set of Interroga- tories to Applicants," dated March 8, 1984 - Responses to Interrogatories 11-10 and 11-11	2207	2207	2207
OCRE Ex. 5	Memo from C. L. Ray, Jr. to Owners Group re July 11, 1984 Meeting between NRC/PNL/Owners Group (undated)	2212	2212	2212

<u>EXHIBIT NUMBER</u>	<u>DESCRIPTION</u>	<u>IDENTIFIED AT TRANSCRIPT PAGE</u>	<u>ADMITTED AT TRANSCRIPT PAGE</u>	<u>FOLLOWING TRANSCRIPT PAGE</u>
OCRE Ex. 6	Letter from B. K. Grimes to M. Edelman dated March 26, 1985, re Integrated Design Inspection 50-440/84-29, Supplement 1, with Portion of Report Addressing Unresolved Item U5.2-1, Motor Accelerating Time	2214	2214	2214
OCRE Ex. 7	"Metallurgical Evaluation of Diesel Generator Cylinder Head Valve Seat Cracks at Grand Gulf Nuclear Station, Unit 1," dated June 1984	2226	REJECTED, 2235	
OCRE Ex. 8	Letter from Boyer to NRC Director of Office of Inspection and Enforcement, dated March 18, 1985	2228	2229	2229
OCRE Ex. 9	Copy of the deposition of William Foster and Carl Berlinger from the Shoreham proceeding, dated May 22, 1984	2311	REJECTED, 2313	
OCRE Ex. 10	Board Notification 84-101; and Excerpt of Report of Investigation into the Shoreham crankshaft failure conducted by Franklin Research Center	2336	REJECTED, 2338	
OCRE Ex. 11	<u>Gambit</u> Newspaper article, no date supplied	2397	REJECTED, 2397	

May 13, 1985

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

DOCKETED
USNRC

Before the Atomic Safety and Licensing Board

'85 MAY 15 A11:07

In the Matter of

THE CLEVELAND ELECTRIC
ILLUMINATING COMPANY, ET AL.

(Perry Nuclear Power Plant,
Units 1 and 2)

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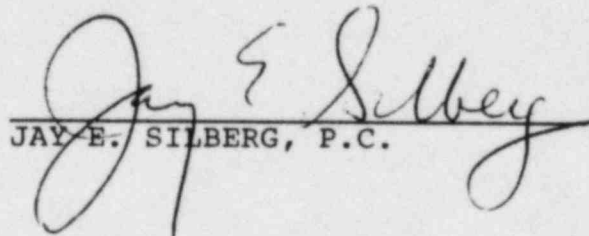
Docket Nos. 50-440
50-441

OFFICE OF SECRETARY
DOCKETING & SERVICE
BRANCH

CERTIFICATE OF SERVICE

This is to certify that copies of the foregoing "Applicants' Proposed Findings of Fact and Conclusions of Law in the Form of a Partial Initial Decision (Emergency Planning and TDI Diesel Generators)" were served by deposit in the United States Mail, First Class, postage prepaid, this 13th day of May 1985, to all those on the attached Service List.

Dated: May 13, 1985


JAY E. SILBERG, P.C.

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, <u>ET AL.</u>)	50-441
)	
(Perry Nuclear Power Plant,)	
Units 1 and 2))	

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