February 1, 1985

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

AFFIDAVIT OF EDWARD C. CHRISTIANSEN

CITY OF WASHINGTON)
) ss:
DISTRICT OF COLUMBIA)

I, Edward C. Christiansen, being duly sworn, state as follows:

1. I am employed by The Cleveland Electric Illuminating ("CEI") Company as a Senior Design Engineer. My business address is Perry Nuclear Power Plant ("PNPP"), 10 Center Road, Perry, Ohio, 44081. As a Senior Design Engineer, I am responsible for the Electrical Unit of the PNPP Nuclear Construction Engineering Section. This responsibility includes the coordination of engineering and licensing activities involved with the standby power facilities (diesel generators and

D503

associated equipment) at PNPP. It also includes acting as CEI's technical representative to the Transamerica Delaval, Inc. ("TDI") Diesel Generator Owners Group. As such, I have been involved in the identification and resolution of potentially generic problems associated with TDI engines (Phase I of the Owners Group Program Plan) and the development of the Design Review/Quality Revalidation ("DR/QR") Program (Phase II), including the additional component inspections and testing as described in John C. Kammeyer's Affidavit ("Kammeyer Affidavit"). I have also acted as liaison to the consultant hired by CEI to review the Phase I Program for PNPP, as discussed at ¶ 6. I have personal knowledge of the matters set forth herein and believe them to be true and correct.

2. I have been employed by CEI for sixteen of the last seventeen years, beginning in 1968. During this period I spent one year (1981-1982) working for the Davy McKee Corporation as a Senior Electrical Engineer. I started on the Perry project as a Senior Engineering Technician responsible for the preparation of equipment specifications. As I have progressed through the project's organization, I have handled different engineering assignments, as needed, in support of the construction of the plant. Prior to my assignment to Perry, I was involved in a CEI system automation project.

3. I am a cum laude graduate of Cleveland State University with a Bachelor of Science degree in engineering

technology. My major was in electronics. In addition to my formal education, I have completed numerous short courses and seminars relating to my assignments at PNPP, including a course in "Diesel Generator Controls and Protective Devices" (conducted by Basler Electric Company). I am a registered professional engineer in the State of Ohio. I am also a member of the Institute of Electrical and Electronic Engineers Society. A copy of my professional qualifications is attached as Exhibit A.

I. IMPLEMENTATION OF THE OWNERS GROUP PROGRAM PLAN AT PNPP

A. Phase I Recommendations

4. Phase I of the Owners Group Program was designed to address the potentially generic concerns associated with TDI diesel generators. Results of the Phase I effort are incorporated in a series of thirty-six reports (fifteen subject reports plus supplements) which also contain the Owners Group conclusions as to overall adequacy of each component's design, recommendations for maintenance, inspection, testing, and recommendations concerning operating procedures and procurement specification requirements. The final Phase I reports and supplements, date of issuance, and applicability to PNPP are listed below:

PHASE I FINAL REPORTS WITH SUPPLEMENTS

REPORT	REPORT DATE	APPLICABILITY TO PERRY (Y/N)
a. CONNECTING ROD BEARING SHELLS	March 1984	Y
b. ROCKER ARM CAPSCREWS:		
(1) Shoreham only	March 1984	N
(2) All other engines	July 1984	Y
c. CYLINDER HEAD STUDS:		
(1) Shoreham only	April 1984	N
(2) All other engines	May 1984	Y
d. AIR START VALVE CAP-SCREWS:		
(1) Shoreham only	March 1984	N
(2) All other engines	April 1984	Y
e. PUSH RODS (ALL ENGINES)	April 1984	Y
f. CRANKSHAFTS:		
(1) DSR-48	April 1984	N
(2) DSRV-16	May 1984	Y
(3) DSRV-12 & 20	June 1984	N
g. JACKET WATER PUMPS:		
(1) DSR-48	April 1984	N
(2) DSRV-12 & 16	June 1984	Y

REPORT	REPORT DATE	APPLICABILITY TO PERRY (Y/N)
(3) DSRV-20	July 1984	N
h. FUEL OIL INJECTION TUBING (ALL ENGINES)	April 1984	Y
i. BASE AND BEARING CAPS:		
(1) DSR-48	April 1984	N
(2) DSR-48, REV. 1	July 1984	N
(3) DSRV (ALL)	August 1984	Y
j. CYLINDER HEADS (ALL ENGINES)	August 1984	Y
k. PISTONS:	July 1984	Y
(1) AE/AF Pistons (initial)	February 1984	Y
(2) AE/AF Pistons (final)	May 1984	Y
(3) AF/AE Pistons (Influence of Thermal Distortion on Fatigue Performance)	June 1984	Y
(4) AN/AH Pistons	November 1984	Y (Applicable prior to the date PNPP changed to AE-type pistons)
l. WIRING AND TERMINATIONS:		

	REPORT	REPORT DATE	APPLICABILITY TO PERRY (Y/N)
(1)	Shoreham	April 1984	N
(2)	Grand Gulf	June 1984	N
(3)	Comanche Peak	May 1984	N
(4)	River Bend, Rancho Seco, Midland, Perry, Shearon Harris, and San Onofre	July 1984	Y
m.	CONNECTING RODS:		
(1)	DSR-48	April 1984	N
(2)	DSRV - (all), preliminary	May 1984	Y
(3)	DSRV - (all), final	August 1984	Y
n.	TURBOCHARGER:		
(1)	DSR-48, DSRV-16	May 1984	Y
(2)	DSRV-12 & 20	July 1984	N
(3)	Supplemental report (valves and cap-screws)	November 1984	Y
o.	ENGINE BLOCK AND LINER		
(1)	Initial Report	June 1984	Y
(2)	Additional Metallurgical Testing and Refinement Analysis	December 1984	Y

5. PNPP has incorporated all of the applicable recommendations of each of the Phase I reports into its TDI engine program. For example, connecting rod bearing shells on the PNPP engines were inspected by the use of radiography, eddy current and liquid penetrant examination as well as by visual checks. Some bearing shells were replaced so that all shells presently installed in the engines meet the acceptance criteria established by the Owners Group. Likewise, the engines' fuel oil injection tubing was examined by eddy current testing for fabrication flaws similar to those found at Grand Gulf. No such flaws were discovered on the PNPP fuel lines. As an additional precaution, PNPP will install shroud lines around the tubing. A summary of the results of the PNPP inspections performed on the Phase I items is contained in the "PNPP TDI Diesel Generator Program Plan" submitted to the NRC on January 17, 1985.

6. CEI also employed an independent engineering consulting firm, Southwest Research Institute ("SwRI") to review, evaluate, and independently verify the methodology employed, results, and conclusions of each of the Phase I studies. SwRI's overall conclusion, with regard to the Phase I effort, was that the Owners Group reports were accurate in their evaluation of the potentially generic problems. See Affidavit of Charles D. Wood III.

B. Phase II Recommendations

7. The DR/QR portion of the Owners Group effort was developed to examine the important engine components not covered in Phase I of the Program. The components evaluated in Phase II did not have a history of potentially generic problems. The 171 PNPP diesel generator components subjected to the DR/QR program were determined by a Component Selection Committee, as discussed in the Kammeyer Affidavit at ¶¶ 14 to 16. The PNPP component selection was also based on PNPP site-specific experience and requirements, as well as the selections previously conducted for the Shoreham, Comanche Peak, Catawba, and Grand Gulf diesel engines.

8. Following classification of components as either Type A, Type B, or Type C, the Component Selection Committee established appropriate design review or quality revalidation requirements. Id., ¶¶ 17-21. These requirements were forwarded to the Owners Group Design Review Group and Quality Revalidation Group for preparation of task descriptions, id. ¶ 22. The quality revalidation requirements were then implemented by PNPP personnel as described in the following paragraphs. The design review requirements were implemented by the Owners Group technical staff. Id. The final DR/QR report was transmitted to PNPP by the Owners Group on December 31, 1984. PNPP transmitted this report to the NRC on January 17, 1985.

9. Component Revalidation Checklists ("CRCs") were prepared for each of the Phase II components designated for quality revalidation at PNPP. These checklists formed the basis for the field inspections which were then conducted during the engine revalidation effort. For example, the valve spring and retainers required a quality revalidation inspection. The Owners Group had identified a certain color-coded spring as being unacceptable. All springs on the Unit 1 engines were, therefore, visually inspected to verify the color coding. All springs on the two engines were found to be acceptable. Results of the inspection were recorded on a Quality Assurance Checklist ("QAC"). In addition to the springs, the flexible and overspeed trip couplings were also quality revalidated. The component's CRC required a visual examination of the couplings for signs of wear, deterioration, or any other discontinuities. The field inspection found the couplings to be in new condition. Results were also documented on a QAC.

10. In order to perform the required QR inspections on the PNPP engines, a task force was established consisting of project personnel from PNPP organizations such as:

(a) Nuclear Construction Engineering Section,

(b) Nuclear Test Section,

(c) Perry Plant Technical Department,

(d) Perry Plant Operation Department, and

(e) Nuclear Quality Assurance.

This task force was responsible for coordinating and implementing the disassembly, inspection, procurement of parts (as necessary) and reassembly of the TDI diesel engines. To expeditiously resolve day-to-day questions arising during the testing and revalidation effort, key task force members and technical support staff were moved to a single work area. Approximately forty individuals have been assigned full time to support this activity. Since early September, 1984, a meeting has been held each day to discuss progress and plan the next day's work-effort. Each of these key task force members is exclusively assigned to the diesel generator testing and revalidation effort and will remain so until all testing is completed.

11. The revalidation (tear-down, inspection and reassembly) of the Unit I PNPP TDI diesel engines was performed in accordance with PNPP's Quality Control Program. See ¶ 21. Procurement of parts to support the revalidation effort was also conducted in accordance with specified quality assurance standards as discussed at ¶ 20.

C. The Engine Revalidation Effort, Testing and Inspection

12. While the engines were disassembled, routine inspection and maintenance were also performed in accordance with PNPP site-specific procedures and the manufacturer's instructions. Changes recommended by TDI for the PNPP engines in its

Service Information Memos ("SIMs") were incorporated at this time. For example, connecting rod bolt washers located between the connecting rod bolt head and the master rod's face were reported to gall, via an SIM. The problem washer was replaced with a harder washer, as specified by TDI in its SIM.

13. All unfavorable inspection results were evaluated according to established PNPP procedures, and, in some cases, by the Owners Group. Non-Conformance Reports documenting hardware-related problems and Action Requests, documenting programmatic concerns, were written up and resolved in each case.

14. Only two notable concerns were encountered during this revalidation effort. During the inspection it was discovered that four rocker arms on the Division I engine and eight rocker arms on the Division II engine had come in contact with the swivel pad, indenting the rocker arm forging. The indention, or lip, restricted the movement of the hydraulic lifters. It appears that the problem occurred during the factory-run tests and was caused by improper adjustment of the lifter adjusting screw. The rocker arms have been restored to operating condition following procedures recommended by the Owners Group and TDI.

15. The second concern was detected when eddy current inspection of the oil holes on the crankshaft by an Owners Group consultant indicated excessive machining marks in the

unpolished surface at a depth greater than 1 inch. All crankshaft oil holes were polished to a depth of 3 inches. The eddy current test was repeated on the polished oil holes. The test indicated that the oil holes were free of defects.

D. Engine Maintenance

16. PNPP is implementing all applicable Owners Group recommendations resulting from Phase I and Phase II of the Owners Group Program. The Owners Group recommendations, when performed during the revalidation inspections, were listed on CRCs. If the Owners Group recommended ongoing maintenance for a component, this requirement was listed in the PNPP Maintenance Matrix. Both the CRCs and the Maintenance Matrix are part of the PNPP DR/QR Report. The SwRI recommendations will also be incorporated into the PNPP preventative maintenance program, as noted below.

17. Maintenance recommendations listed in the PNPP Maintenance Matrix, as well as SwRI's recommendations, will be logged on PNPP's computer-based preventative maintenance program (the "Repetitive Task System"). As the required maintenance period approaches, the computer will generate a work card describing the task and schedule for completion. The maintenance work will then be performed by the appropriate site-personnel.

18. An example of Owners Group recommenced maintenance requirements is provided below for the intercoolers and the turbocharger:

	Preventative Maintenance Recommendation	Daily	Monthly	Outage	5 Year
Intercoolers	1. Evaluate heat exchanger performance by checking engine operating parameters.		X		
	2. Clean/inspect shell and tube sides every outage or as necessary.			X	
	3. Visually inspect for external leaks.		X		
	4. Verify intercooler inlet plenum drain connection is open and clean.	X			
Turbocharger	1. Measure vibration and check with baseline data.			X	
	2. Clean impeller and diffuser.			X	
	3. Measure rotor end play (axial clearance) to identify trends of increasing clearance, i.e.; thrust bearing degradation.			X	

Preventative Maintenance Recommendation	Daily	Monthly	Outage	5 Year
4. Perform visual and blue check inspections of the thrust bearing.				X
5. Disassemble, inspect and refurbish.				X
6. Perform a spectrochemical engine oil analysis to assist the bearing monitoring program. To further expand/clarify chemical analysis, ferrographic analysis may be utilized. Particular attention shall be paid to copper level, and particulate size, which could signify thrust bearing degradation.			X	

E. Conclusion

19. As the NRC staff noted in its "Safety Evaluation Report-Transamerica Delaval, Inc. Diesel Generator Owners Group Program Plan," August 13, 1984, the Phase II DR/QR effort is a comprehensive review of all of the important diesel engine components, other than those covered by Phase I, to assure that their design and manufacture, including specifications, quality

control, quality assurance, and operational surveillance and maintenance, are adequate. PNPP has worked and will continue to work within the guidelines established by the Owners Group to ensure that each of these important components is, and will continue to be, adequate throughout the life of the PNPP diesel generators.

II. SUPPLEMENTAL QUALITY ASSURANCE PROGRAM IN PLACE AT PNPP

A. Supplemental Quality Assurance at TDI

20. Because of past problems identified by both the NRC and the Owners Group, PNPP has supplemented its normal quality assurance ("QA") review of TDI-supplied equipment by various measures. A PNPP QA representative was assigned full-time to TDI to witness factory inspections and hold points as specified in the procurement documents for each safety-related component ordered to support the revalidation effort. Witnessed were procedures such as heat treatments, non-destructive examinations and inspections of individual components (such as reworked cylinder heads and AE-type piston skirts). The PNPP representative also performed dimensional and visual checks, reviewed documentation packages, and verified cleaning, coating, painting, and tagging of components, prior to their final acceptance.

B. Conduct of Engine Revalidation

21. PNPP Site Quality Assurance was responsible for the inspection effort during the quality revalidation portion of the DR/QR effort, previously discussed. Their program assured that the work was performed as described below:

(a) All engine tear-down/reassembly activities were conducted in accordance with test work procedures and work authorizations approved by management and concurred in by the unit supervisor of the Operational Quality Section;

(b) Component inspections were planned, performed, documented, and reported by the Operational Quality Section in accordance with PNPP Procedure 1-1004 (Operational Quality Section Inspection Program);

(c) Hardware deficiencies were documented and evaluated on PNPP Non-Conformance Reports;

(d) Programmatic concerns were documented on PNPP Action Requests;

(e) Inspection results were indicated as either satisfactory or unsatisfactory;

(f) Information required by CRCs was obtained during inspections for evaluation by Site Engineering or the Owners Group;

(g) Replacement engine components (other than those inspected by the PNPP representative at TDI as previously discussed), were inspected on-site per the requirements of the CRCs;

(h) Final closure of inspection results is handled per PNPP Procedure 1-1004;

(i) Copies of all documents (i.e., PNPP Non-Conformance Reports, Inspection Reports, etc.) generated as a result of the inspection program were provided to the Owners Group for their review.

III. PROCUREMENT OF REPLACEMENT PARTS

22. Replacement parts for the TDI diesel engines are being procured in accordance with established PNPP procedures. These procedures allow for several methods of procurement, including the procurement of an item as identified by part number and environmental conditions or per an entirely new procurement specification. Applicable Owners Group requirements, in addition to PNPP-unique requirements, will be specified in all purchase requisitions. Quality assurance requirements (i.e., maintenance of a QA program meeting the requirements of 10 C.F.R. Part 50, App. B, a commitment to the requirements of 10 C.F.R. Part 21, the right of PNPP to perform audits, etc.) will also be specified in all procurement documents.

IV. PNPP FUTURE SURVEILLANCE PROGRAMS

23. Surveillance programs presently in place at PNPP will continue to monitor any problems with TDI-supplied equipment. These programs include those established pursuant to 10 C.F.R. Part 21 and 10 C.F.R. Part 50.55(e). When a component is found to be defective with a potentially significant impact on the performance of the TDI diesel generators, it will be reported pursuant to 10 C.F.R. Part 50.55(e). Also, any applicable information received by CEI through 10 C.F.R. Part 21 reports on equipment/components in place at PNPP, will be reported pursuant to 10 C.F.R. Part 50.55(e). All nuclear safety-related equipment procured from TDI has been bought, and will continue to be bought, in compliance with 10 C.F.R. Part 21. Each purchase requisition will continue to incorporate the requirements of Part 21 and to mandate TDI compliance.

24. Other methods of feedback, such as INPO reporting, will also be utilized to assure that the highest quality equipment and parts will continue to be used at PNPP. TDI's program supplying owners with information on potential problems and product enhancements (SIMs) will continue to be used to supplement PNPP's surveillance program.

V. PNPP DEVIATION ANALYSIS REPORTS

25. Nonconformance Reports at PNPP are written for any type of equipment hardware deviations, including those as minor as paint scratches or typographical errors on nameplates. All PNPP Non-Conformance Reports written against TDI equipment have been reviewed for reportability to the NRC. Where it was determined that a condition was possibly reportable, a Deviation Analysis Report ("DAR") was prepared. The DAR was then evaluated by PNPP Engineering and Quality Assurance for reportability to the NRC. Where the condition was determined to be significant, it was reported per established PNPP procedures.

26. To date, 28 DARs have been written with respect to the TDI diesels.1/ 22 of these DARs have been reported to the NRC as significant pursuant to 10 C.F.R. Part 21 and/or 10 C.F.R. Part 50.55(e). Of those reported, 19 involved equipment supplied or designed by TDI. The three remaining DARs concerned equipment designed by others. Below is a complete

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1/ Because DAR's are written to record all possibly significant deficiencies and to elevate the problem identified to a higher level of review, some DAR's turn out to be inapplicable to PNPP. For instance, 10 C.F.R. Part 21's reported by the manufacturer and received at PNPP are treated as possible significant deficiencies requiring further evaluation. These evaluations sometimes turn out to be inapplicable to PNPP or of a minor nature. While this procedure increases the number of DAR's written, it also serves as a conservative approach to monitoring the quality of safety-related equipment.

listing of the DARs (noting those which are not TDI-related), their reportability status, and their status with the NRC:

DAR#	CONDITION	REPORTABLE (Y/N) DATE	STATUS
17	Anchor bolts for DG high voltage cabinets not designated safety related/design control.	N	Closed out on 11/9/79. Anchor bolts are custom made. A follow-up TDI audit by PNPP confirmed the status of the bolts.
38	Potential link rod deficiency.	Y 10/08/80	Closed out on 01/20/83.
44	Turbocharger lubricating oil system defect (thrust bearings).	Y 12/30/80	Open. Work is complete - (Unit 1 only). NRC has reviewed and found acceptable-awaiting NRC staff documentation to close out.
56	Nonsafety sensing lines on safety-related receiver tanks (starting air system).	Y 06/12/81	Open. Hardware installed. Awaiting testing.
65	Intake & exhaust valve springs supplied by Melrose Spring Co.	N	Closed out on 9/9/81. Springs reported in the 10 C.F.R. Part 21 were not used at PNPP.
79	Starting air system check valve failed during seismic qualification (Wm. Powell).	Y 12/18/81	Closed out on 06/01/84.
81	Location of governor lube oil cooler.	Y 01/14/82	Open. Work is complete - NRC has reviewed and found acceptable-awaiting NRC staff documentation to close out.

DAR#	CONDITION	REPORTABLE (Y/N) DATE	STATUS
83	(TDI-related) ASME Code Data Reports.	Y 02/23/82	Closed out on 09/22/82.
89	ASME Code piping welds.	Y 03/29/82	Closed out on 11/10/83.
99	Capscrew length in starting air valve assembly.	Y 06/15/82	Closed out on 1/27/84.
101	Isoporene material used for governor drive coupling not suitable for engine gear case.	Y 07/30/82	Closed out on 04/05/84.
109	Commercial grade wire used in certain engine & panel circuits has failed IEEE 383 Flame Test.	Y 11/23/82	Closed out on 05/18/84.
117	Skid mounted pipe supports not built to ASME Sec. III, NF.	Y 02/23/83	Closed out on 05/18/84.
136	GAI design for DG exhaust piping (Part 21 report by GAI). [Non-TDI-related].	Y 08/05/83	Open. Work is complete (Unit 1 only). NRC has reviewed and found acceptable-awaiting NRC staff documentation to close out.
138	Use of fuses to isolate a non-Class IE strip chart recorder from IE tachometer transmittor.	N	Closed out on 8/19/83. Recorder is only used when in the test configuration.
139	Use of non-Class IE control power & control components in DG bldg. ventilation system.	Y 08/16/83	Closed out on 08/20/84.

DAR#	CONDITION	REPORTABLE (Y/N) DATE	STATUS
145	Inadequate support for fuel oil line from engine driven fuel transfer pump to engine fuel header.	Y 10/11/83	Open. Work is complete - NRC has reviewed and found acceptable-awaiting NRC staff documentation to close out.
156	Flexible coupling drive hubs on the overspeed governor and fuel transfer pump drive shafts.	Y 01/20/84	Open. Work is complete - NRC has reviewed and found acceptable-awaiting NRC staff documentation to close out.
160	Design for DG logic inconsistent with FSAR Fig. 8.3.5. [Non-TDI-related].	Y 02/16/84	Closed out on 05/18/84.
161	Synchronization between DG and alternate preferred power source. [Non-TDI-related].	Y 02/16/84	Closed out on 05/18/84.
174	DG IE voltage interfaces to non-IE engine recorder via a voltage transducer.	Y 04/04/84	Closed out on 07/18/84.
175	Piston skirt castings heat treating of 2 TDI spare parts pistons.	Y	Open. These will be scrapped. No longer intended for use. NRC has reviewed and found acceptable. NRC staff documentation to close out.
192	Belts Spring Co.	N	Closed out on 7/25/84. Springs were inspected and found to be acceptable.

DAR#	CONDITION	REPORTABLE (Y/N) DATE	STATUS
193	Bendix delivery valve holder	N	Closed out on 7/25/84. Pumps installed at PNPP were inspected and found to be acceptable.
203	Basler Electric Co. voltage regulators installed by RTE Delta.	Y 09/24/84	Open. Unit 1 modification complete--awaiting testing.
207	Fuel control shaft levers.	Y 10/16/84	DAR was determined not to be reportable on 11/14/84 after being called in to NRC on 10/16/84. An inspection of the levers found them to be acceptable.
214	Intake & exhaust rocker arm assemblies.	N	Closed out on 11/2/84. Rocker arm assemblies with indications would not have prevented the engines from running at capacity.
225	Control panel air filter-wrong air pressure rating.	Y 01/31/85	Called in to NRC on 1/31/85.

When PNPP becomes operational, any significant item will be reported pursuant to the requirements of 10 C.F.R. Part 50.73 which governs Licensee Event Reports ("LERs").

VI. OVERALL CONCLUSION

27. The PNPP TDI diesel generators have been thoroughly reviewed from both a design and quality standpoint by the TDI Diesel Generator Owners Group and PNPP's engineering and quality assurance personnel. Based on recommendations generated in Phase I of the Owners Group Program, the components with potentially generic problems were reviewed, inspected, replaced, and/or modified. All of the Owners Group recommendations are being implemented and will be completed prior to fuel load. Those offered by SwRI are being logged onto PNPP's preventative maintenance program and will also be implemented.

28. The Phase II DR/QR effort, and the third element of the Owners Group effort, which includes implementation of a maintenance program and additional engine testing and inspection of components, provides additional assurance that the PNPP TDI diesel generators will reliably perform their intended safety-related functions for the life of the plant. PNPP is committed to implementing each of the applicable Owners Group

recommendations and testing to verify the reliability of the TDI diesel generators.

Edward C. Christiansen

Edward C. Christiansen

Subscribed and sworn to before me this 1st day of February, 1985.

Katherine A. Norman

Notary Public

My Commission expires:

3/3/85

Edward C. Christiansen

Education: Cleveland State University, BSET, 1975, CumLaude
Generator Power Control and Protection course, 1981, Basler Electric.

Coordination of Protective Devices, 1980, University of Toledo.

Protective Relay School, 1977, Westinghouse
Seismic Seminar, 1976, Wyle Laboratories.

Boiling Water Reactor Fundamentals, 1975, CEI
USAF Missile Guidance and Control School, 1964, USAF.

Professional: Registered Professional Engineer in the State of Ohio, registration number E-041307.

Business Experience

1982-Present Cleveland Electric Illuminating (CEI) Co.
Perry Nuclear Power Plant
Nuclear Construction Department
Senior Design Engineer

Lead engineer responsible for the procurement and installation of all electrical equipment at the Perry Nuclear Power Plant. Among the responsibilities is the coordination of all project standby diesel-generator activities.

1981-1982 Davy McKee Corporation
Independence, Ohio
Electrical Engineering Department
Senior Engineer

In charge of the design of a 115/4.16kV electrical substation for TEMEX, S.A., located in Casoleacaque, Mexico. Wrote specifications and performed bid evaluations for oil circuit breakers, transformers, standby diesel generators, and battery packages.

1979-1981 Cleveland Electric Illuminating (CEI) Co.
Perry Nuclear Power Plant
Nuclear Engineering Department
Lead Electrical Equipment Engineer

Responsible engineer for the procurement and installation of electrical equipment at the Perry Nuclear Power Plant. This included the development of one lines, schematics, and the coordination of protective devices within the plant. Also responsible for the qualification

of electrical equipment used in nuclear safety related circuits.

1974-1979 Cleveland Electric Illuminating Co.
Cleveland and Perry, Ohio
Associate Electrical Engineer

As a member of the Perry Nuclear Power Plant design team, I was the engineer responsible for the procurement of the 13,800 and 4160 volt switchgear, 480 volt load centers, large motors, and cathodic protection equipment. Responsibilities included reviewing the specifications and design of the equipment, as well as evaluating vendor's quotations. Also, reviewed the design of the electrical systems in which the aforementioned equipment was applied.

1968-1973 Cleveland Electric Illuminating Co.
Senior Electrical Engineering Technician

Worked on the automation of the CEI transmission system. My responsibilities included specifying and evaluating the vendor's design of a dynamic computer driven display board showing transmission station equipment status. Assignment included reviewing assembly language programing of a minicomputer and application of power electronic circuits. This project also included the application of a data acquisition system to CEI's Lakeshore power plant. Included was the design of plant circuit breaker control circuits and monitoring of plant processes.

1963-1967 United States Air Force
Sergeant

Worked as a guidance and control technician on the Bomarc Interceptor Missile. Responsibilities included performing trouble-shooting and routine electrical and electronic maintenance on the aircraft and ground equipment.

PROFESSIONAL AFFILIATION

Member of the Institute of Electrical and Electronics Engineers (IEEE) Society