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E. G. Case
R. S. Boyd
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O. Parr
S. Varga
L. Crocker
D. Crutchfield
F. Williams
R. J. Mattson
H. Denton
D. Muller
Project Manager W. Pike
Attorney, ELD
M. Rushbrook
IE (3)
ACRS (16)
L. Dreher
L. Rubenstein

NRC Participants:
P. Matthews
W. LeFave
D. Thatcher
V. Benoraya
G. Harrison

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Docket Nos. 50-352, 50-353, 50-387, 50-388, 50-397, 50-410
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STN-50-521, STN-50-552, STN-50-554, 50-522, 50-523
50-466, STN-50-556, STN-50-557, STN-50-447

APPLICANT: General Electric

FACILITY: Limerick 1, Limerick 2, Susquehanna 1, Susquehanna 2, WPPSS Nuclear Project 2, Nine Mile Point 2, Grand Gulf 1, Grand Gulf 2, Clinton 1, Clinton 2, River Bend 1, River Bend 2, Perry 1, Perry 2, Hartsville A1, Hartsville A2, Hartsville B1, Hartsville B2, Phipps Bend 1, Phipps Bend 2, Skagit 1, Skagit 2, Allens Creek, Black Fox Station 1, Black Fox Station 2, GESSAR

SUBJECT: SUMMARY OF DECEMBER 2, 1977 MEETING CONCERNING NEDO-10466, Rev. 1, "POWER GENERATION CONTROL COMPLEX DESIGN CRITERIA AND SAFETY EVALUATION"

We met with representatives of General Electric on December 2, 1977, to discuss our review of NEDO-10466, Rev. 1, "Power Generation Control Complex Design Criteria and Safety Evaluation." A list of attendees is enclosed.

1.0 Background

On February 29, 1972, we received a topical report from General Electric (NEDO-10466) concerning a factory-assembled arrangement of modules, terminals and panels for the installation of interconnecting wiring of control equipment within the control room. This modularized packaging concept has been named the General Electric Power Generation Control Complex (PGCC). The AEC staff issued a report on June 1, 1972, stating that final conclusions concerning the adequacy of the PGCC design would require a total review by the regulatory staff and the completion of the following activities: (1) development of separation criterion by the AEC; (2) completion of the separation safety guide by the AEC; and (3) completion of an industry standard on separation by an IEEE working group. After numerous meetings with the AEC/NRC staff GE subsequently submitted NEDO-10466, Rev. 1, for our review on October 3, 1977. Our review of this revised report was the subject of the meeting.

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2.0 Purpose and Scope of the Meeting

The purpose of the meeting was to achieve the following:

- An exchange of information between GE and the NRC staff on NEDO-10466, Rev. 1.
- To indicate to GE the additional information necessary for the staff to complete its review.

The scope of the meeting included both the instrumentation and control systems and the auxiliary systems review of NEDO-10466, Rev. 1.

3.0 Summary of Meeting

3.1 Instrumentation and Control Systems Review

3.1.1 Qualification of electrical equipment and components.

General Electric should add the following information to NEDO-10466, Rev. 1,:

1. An indication of parts of the PGCC to be furnished by GE and those to be furnished by other vendors.
2. Connector and termination devices qualification information. GE agreed to supply a copy of MIL-C-5015 (Reference 4).
3. Additional information should be supplied concerning implementation of IEEE 323-74.
4. In Section 4.2.4.2 it should be indicated that "associated circuits" meet the same requirements as Class IE circuits.
5. In Section 4.2.5.3 a clearer description of the relation between associated cables and Class IE cables should be supplied.

3.1.2 Interfaces

GE agreed to supply copies of References 26 and 27

3.1.3 Differences - BWR 4/5 vs 6

GE agreed to supply additional clarification on the differences between the BWR 4, 5, and 6 in Section 6.0.

3.1.4 Typical Routing

GE agreed to supply additional cable routing information on cables in cabinets that contain more than one safety related division.

3.2 Auxiliary Systems Review

3.2.1 Disclaimer of Responsibility

General Electric should remove the words "accuracy" and "completeness" from the Disclaimer of Responsibility statement.

3.2.2 General Staff Fire Protection Comments on the History of PGCC

1. GE had a fixed Halon system included in the PGCC Topical Report of 1972. The currently proposed system report does not include such a fire suppression system. BTP 9.5-1, Rev. 1 requires such a system. In addition Regulatory Guide 1.120, Rev. 1 requires under floor protection.

2. In NEDC-10466 Rev. 1, it is stated that no fixed fire suppression is needed for the PGCC.

3. On March 2, 1977, an agreement was signed between Mr. Harry Hendon (GE) and Mr. Vic Benaroya (NRC) which states that:

   a. A fixed, manual fire suppression system will be installed in PGCC floor sections.

   b. GE will investigate and recommend a design which will allow the manual, local introductions of a fire suppressant into the floor sections.

4. Tests were to be performed to show that the PGCC design is acceptable to meet the above clauses. These tests were performed in May 1977. The tests confirmed that PGCC having Tefzel would be adequately protected with a fixed system. Other type cables created a problem. The tests would have been needed to qualify the unique barriers anyway.

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5. On July 21, 1977 we had a meeting to discuss the preliminary findings. We reiterated that:

   a. The likelihood of accepting a PGCC without fire detection and suppression would be very remote unless it can be shown that none of the materials used in the PGCC will burn.

   b. The tests did not indicate that Tefzel doesn't burn. Therefore, to meet the defense-in-depth philosophy, a fixed suppression system is necessary.

   c. In actual practice there will be some deviations from the configuration used in the test. The presence of coaxial cables, armored power cables, and the effects of carpeting as a floor plate covering has not been determined and we are not ready to make any findings.

3.2.3 Fire Protection Requirements

1. BWR 4/5 - a fixed fire suppression system with automatic operation.

2. BWR 6 (with Tefzel insulated cable) - a fixed fire suppression system with manual operation.

3. GE stated that their tests justified a fixed fire suppression system as not being necessary. GE agreed to reconsider this point in view of the staff requirements.

3.2.4 Section by Section Comments on NEDO-10466, Rev. 1

GE should modify each section as appropriate.

Section 3.3.2.3

The configuration of the two right angle clips is not clear; descriptive material and drawings do not cover this. GE clarified the configuration of the clips and agreed to provide a figure.

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With regard to fire tests for carpeting, GE agreed to modify the report to either remove the fire-exposure criteria or more specifically address underfloor-exposure criteria. We informed GE that we are in the process of reviewing carpeting on a generic basis, and may reject carpeting in all nuclear plants as an acceptable floor covering. There may be, however, some justification to accept vinyl asbestos tile as an alternate. GE took this position under advisement.

Section 3.3.2.5

The reasons for omitting a fixed fire suppression system are not valid. Exclusive use is not made of Tefzel (or equivalent) cables. See 6.3.1 comment regarding the health hazard.

GE's position is that a fixed fire suppression system is not appropriate for Tefzel-based designs as shown by their highly successful tests. GE agreed to reevaluate the position or consider appealing to higher NRC management.

Section 3.3.2.6

A better specification or specific brands should be provided: "fire retardant silicone rubber" is a very general term. GE agreed to modify the report to be more specific on silicone rubber specifications. Due to trade restrictions, GE will not specify a manufacturer.

Section 4.2.1.1, 4.2.2 and Appendix B

The overheat possibility only considers normal current flow, not current flow in an electrical fault. Circuit breakers are not perfectly reliable, so overload conditions should be considered. GE agreed to modify the report to include overload conditions in the transient ranges.

Section 4.2.1.4b

What fire barrier tests were conducted with termination cabinets? No documentation of these tests is included.

GE agreed to revise the report to specify the barrier maintenance and repair requirements.

GE also agreed to include a summary of fire tests conducted on the termination cabinets and provide a copy of the test report.

GE stated that it was their position that the termination cabinets should be treated in the same way that the other control room panels will be treated for fire protection features.

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Section 4.2.1.6

The topic of separation within termination cabinets has not been previously considered. However, it appears the fire risk may be considerably greater there than in the duct.

GE stated that divisional separation is maintained within termination cabinets and that there is never more than one division per bay.

Section 4.2.2, p 13, para 2

There is no assured automatic access to the location of fire in the duct just because a floor plate may be removed. The removed plate may be remote from the point of fire not directly over it. GE agreed to change the word "automatically "(page 13, paragraph 2) to "readily available".

An extinguishing agent will still accumulate in the enclosed duct areas and, since Halon 1301 is several times as heavy as air, it will tend to remain in the duct even when a floor panel is removed. The Halon distribution system could be designed to minimize losses.

The NRC staff's consultant indicated that tests would be run sometime in 1978 to provide data on what percentage of concentration of Halon would be sufficient for deep-seated fires. He also indicated that NFPA is really guidance for surface fires, and in the meantime GE should use a 20 percent concentration to provide protection for deep-seated fires.

Section 4.2.2, p 4-14, para. 3

The discussions of Tefzel IEEE 383 test results does not include the test of a full tray conducted at the same time. Information we received indicated that when the test was modified using a full tray, the Tefzel cable burned readily.

GE agreed to modify the third paragraph (Page 4-14) on IEEE-383 tests to simply state that the cable meets the criteria.

Section 4.2.2, p 4-11, para 5

Tests at Sandia did not cover high resistance electrical faults which are another potential electrical ignition source. The statement on maximum possible load is not justified (see comments on 4.2.1.1)

GE agreed to investigate a modification to indicate that overload conditions are bounded by the Scandia Tests.

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Section 4.2.6

Smoke and toxic combustion gases are a concern for 2 minutes but Halon 1301 is a concern for 8 hrs. (per 6.3.1). There seems to be an inconsistency.

V. Benaroya (NRC) commented that Regulatory Guide 1.78 was not appropriate for the scope of the PGCC. Since the overall control room habitability is within the utility applicant's responsibility, GE agreed to modify this section to delete the 2-minute toxicity requirement.

Section 6.3.1

The 5% Halon design is not necessarily adequate to extinguish a deep seated fire.* The statement that concentrations over 10% are not permitted in normally occupied areas does not apply since the duct is not a normally occupied area. The ACGIH limit of .1% for 8 hours exposure to Halon 1301 is also used as a reason for limiting the Halon 1301 concentration. It is not clear whether this limit is based on an 8 hour day, 40 hour week continuing exposure or on 8 hours emergency exposure? Regardless of the limit, it would appear the consequences of radioactive releases far outweigh a standard such as this. If the fire is not quickly suppressed, the residual Halon 1301 will be of relatively minor significance. In addition, the Halon 1301 would be concentrated in the ducts and it would be a long time before it diffused throughout the control room. . . .

However, if Halon 1301 is of such a concern, there are other fire suppression agents such as water.

A surface fire is defined as a fire in which only the outer surface of material is heated above its ignition temperature; combustion would be largely in the vapor phase. A deep seated fire is defined as one in which much of the combustible is heated above its auto-ignition temperature; combustion occurs in both the solid and vapor phases. There is no line of demarcation between the two types of fires. NFPA standards arbitrarily and somewhat circularly define a surface fire as one that can be completely extinguished by 5% Halon 1301 within a soaking time of 10 minutes.

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* The quantity of Halon 1301 or other gaseous agent required to suppress a fire depends on the combustibles involved and whether it is a surface fire or a deep seated fire.

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A Halon 1301 system which would only extinguish surface fire is reasonable if reasonable if either:

1. Deep seated fires will not occur with the type of combustible material present

or

2. The fire detection system will provide early warning and will actuate the Halon system before a deep seated fire can develop.

Neither of these are judged valid for cable spaces.

Tests have shown that thermoplastics in some configurations did not produce deep seated fires. However, in cable fire tests glowing combustion has been observed which is characteristic of a deep seated fire. In addition, rubber base materials do produce a deep seated fire; some cable insulations are of synthetic rubber base materials. A deep seated fire involving a transient fire load is also possible.

Limited test data indicates a 20-30% concentration of Halon 1301 is necessary to extinguish deep seated fire in cellulosic materials. There is no data on deep seated fires in rubber or polymeric materials. Although the design assumptions of the Halon 1301 systems may not be confirmed, there is experimental data to indicate that this fire extinguishing system may contain or retard a deep seated cable fire and any transient load fire. Fire tests in simulated aircraft cargo compartments have shown that 3 1/4% Halon 1301 will suppress flaming combustion and retard deep seated combustion sufficiently to keep the temperature below 400 F for about 2 hours. Other tests have shown that 3-5% Halon 1301 will suppress flaming combustion in fires involving cellulosic materials although it would not suppress deep seated glowing and smoldering combustion even with long soaking times.

GE agreed to investigate the percent halon concentration and revise the report with a more appropriate number. GE also agreed to revise the first paragraph on Page 6-2 to indicate there is no problem with decomposition since the fire temperatures would in reality never reach decomposition temperature (i.e., use the actual test results to show no problem). Additionally GE will add some comments regarding Regulatory Guide 1.1.20 to indicate that the cable is capable of being wetted down.

Sections 4.1.6 and 4.2.6

These sections should be deleted because they are outside the scope of the report.

Appendix C

The "Fire Hazard Analysis of the PCCC Floor Section" should be replaced with test results information.

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4.0 Conclusions

General Electric has agreed to respond to all the above staff comments. Based on this agreement the staff will not issue formal questions but instead use this meeting summary as the official transmittal of staff questions. On December 3, 1977 GE phoned to get more guidance on an installed Halon suppression system. The staff informed GE that an acceptable concentration was 20% with a 20 minute soak time. The staff also informed GE that the GE test to be performed Friday December 9, at Berkeley, should be performed with a tile covering installed on the floor plate over the fire to achieve test results more closely resembling the installed system.

Original signed by

Walter J. Pike, Project Manager
Light Water Reactors Branch No. 3
Division of Project Management

Enclosure:
Attendees List

cc: See next page

OFFICE➤	LWR #3:LPM	DSS	LWR #3:BC			
SURNAME➤	WPike:tec	VBenaroya	OParr			
DATE➤	1/09/78	1/ 9/78	1/10/78			

NRC FORM 318 (9-76) NRCM 0240

50-522/50-523
SKAGIT NUCLEAR POWER PROJECT UNITS 1 & 2

Puget Sound Power and Light Company
ATTN: Mr. J. E. Mecca, Manager
Nuclear Licensing and Safety
Puget Power Building
Bellevue, Washington 98009

cc: Mr. F. Theodore Thomsen
Perkins, Coie, Stone,
Olsen & Williams
1900 Washington Building
Seattle, Washington 98101

Mr. Robert Lowenstein
Lowenstein, Newman, Reis
& Axelrad
Suite 1214
1025 Connecticut Avenue, N. W.
Washington, D. C. 20036

Roger M. Leed, Esq.
Shroeter, Jackson, Goldmark & Bender
540 Central Building
Seattle, Washington 98104

Mr. Lloyd K. Marbet
c/o Forelaws on Board
Senator Building
Portland, Oregon 97204

Mr. Nicholas D. Lewis, Chairman
Energy Facility Site Evaluation Council
820 East 5th Avenue
Olympia, Washington 98504

Richard M. Sandvik, Esq.
Assistant Attorney General
State of Oregon
Department of Justice
1133 S. W. Market Street
Portland, Oregon 97201

Mr. Eugene Rosolie
732 S. W. Third
Portland, Oregon 97204

Tennessee Valley Authority
ATTN: Mr. Godwin Williams, Jr.
Manager of Power
830 Power Building
Chattanooga, Tennessee 37401

cc: Mr. James A. Domer
Tennessee Valley Authority
303 Power Building
Chattanooga, Tennessee 37401

Mr. Herbert S. Sanger, Jr.
Attorney for Applicant
Division of Law
Tennessee Valley Authority
E11B33 C-K
400 Commerce Avenue
Knoxville, Tennessee 37902

Mr. E. G. Beasley
Tennessee Valley Authority
W9C165 C-K
400 Commerce Avenue
Knoxville, Tennessee 37902

Ms. Phyllis Pierce
1913 Seaver Road
Kingsport, Tennessee 37660

Philadelphia Electric Company

cc: Troy B. Conner, Jr., Esq.
Conner, Moore & Corber
1747 Pennsylvania Avenue, N. W.
Washington, D. C. 20006

W. William Anderson, Esq.
Deputy Attorney General
Room 512, Main Capitol Building
Harrisburg, Pennsylvania 17120

Frank R. Clokey, Esq.
Special Assistant Attorney General
Room 218, Towne House Apartments
P. O. Box 2063
Harrisburg, Pennsylvania 17105

Honorable Lawrence Coughlin
House of Representatives
Congress of the United States
Washington, D. C. 20515

Roger B. Reynolds, Jr., Esq.
324 Swede Street
Norristown, Pennsylvania 19401

Willard C. Hetzel, Esq.
312 Main Street
East Greenville, Pennsylvania 18041

Lawrence Sager, Esq.
Sager & Sager Associates
45 High Street
Pottstown, Pennsylvania 19464

Joseph A. Smyth
Assistant County Solicitor
County of Montgomery
Courthouse
Norristown, Pennsylvania 19404

Eugene J. Bradley
Philadelphia Electric Company
Associate General Counsel
2301 Market Street
Philadelphia, Pennsylvania 19101

Philadelphia Electric Company
ATTN: Edward G. Bauer, Jr.
VP & General Counsel
2301 Market Street
Philadelphia, Pennsylvania 19101

Illinois Power Company

cc: Mr. Peter V. Fazio, Jr.
Schiff, Hardin & Waite
7200 Sears Tower
233 South Wacker Drive
Chicago, Illinois 60606

Mr. George Wuller, Licensing Coordinator
Licensing Coordinator
Illinois Power Company
500 South 27th Street
Decatur, Illinois 62525

Illinois Power Company
ATTN: Mr. L. J. Koch
Vice President
500 South 27th Street
Decatur, Illinois 62525

The Cleveland Electric Illuminating Company

Gerald Charnoff, Esq.
Shaw, Pittman, Potts & Trowbridge
1800 M Street, N. W.
Washington, D. C. 20036

Evelyn Stebbins, Chairman
Coalition for Safe Electric Power
705 Elmwood Road
Rocky Road, Ohio 44116

Mr. David B. Disbennett
Acting Secretary
Ohio Power Siting Commission
P. O. Box 1735
Columbus, Ohio 43216

Donald H. Hauser, Esq.
Cleveland Electric Illuminating Company
P. O. Box 5000
Cleveland, Ohio 44101

Cleveland Electric Illuminating Company
ATTN: Mr. Dalwyn R. Davidson
Vice President - Engineering
P. O. Box 5000
Cleveland, Ohio 44101

Tennessee Valley Authority

ccs w/encl:
Alvin H. Gutterman, Esq.
Attorney for the Applicant
Tennessee Valley Authority
400 Commerce Avenue
Knoxville, Tennessee 37902

Mr. E. G. Beasley
Tennessee Valley Authority
W9C165, 400 Commerce Avenue
Knoxville, Tennessee 37902

Ms. Tish Jenkins
Tennessee Valley Authority
303 Power Building
Chattanooga, Tennessee 37401

Mr. William Hubbard
Assistant Attorney General
Supreme Court Building
Nashville, Tennessee 37219

Leroy J. Ellis, III, Esq.
Omer, Ellis & Brabson
Chancery Building
421 Charlotte Avenue
Nashville, Tennessee 37219

Raymond Gibbs, Esq.
111 Commerce Building
316 West Lytle Street
Murfreesboro, Tennessee 37130

Tennessee Valley Authority
ATTN: Mr. Godwin Williams, Jr.
Manager of Power
830 Power Building
Chattanooga, Tennessee 37401

Washington Public Power Supply System

ccs:
Joseph B. Knotts, Jr., Esq.
Debevoise & Liberman
700 Shoreham Building
806 Fifteenth Street, N. W.
Washington, D. C. 20005

Richard Q. Quigley, Esq.
Washington Public Power Supply System
P. O. Box 968
Richland, Washington 99352

Washington Public Power Supply System
ATTN: Mr. Neil O. Strand
Managing Director
3000 George Washington Way
Richland, Washington 99352

ccs:
Eugene B. Thomas, Jr.
LeBoeuf, Lamb, Leiby & MacRae
1757 N Street, N. W.
Washington, D. C. 20036

Anthony Z. Roisman, Esq.
Roisman, Kessler & Cashdan
1025 15th Street, NW
Washington, D. C. 20036

Mr. Richard Goldsmith
Syracuse University
College of Law
E. I. White Hall Campus
Syracuse, New York 13210

T. K. DeBoer, Director
Technological Development Programs
New York State Energy Office
Swan Street Building
Core 1 - 2nd Floor
Empire State Plaza
Albany, New York 12223

Niagara Mohawk Power Corporation
ATTN: Mr. Gerald K. Rhode
Vice President - Engineering
300 Erie Boulevard West
Syracuse, New York 13202

Troy B. Conner, Jr. Esq.
1747 Pennsylvania Avenue, N. W.
Washington, D. C. 20006

Mr. J. E. Booker
Safety and Licensing
Gulf States Utilities Company
P. O. Box 2951
Beaumont, Texas 77704

Stanley Plettman, Esq.
Orgain, Bell & Tucker
Beaumont Savings Building
Beaumont, Texas 77701

Karin P. Sheldon, Esq.
Sheldon, Harmon & Roisman
1025 15th Street, N. W.
Washington, D. C. 20005

William J. Guste, Jr. Esq.
Attorney General
State of Louisiana
P. O. Box 44005
State Capitol
Baton Rouge, Louisiana 70804

Richard M. Troy, Jr., Esq.
Assistant Attorney General in Charge
State of Louisana Department of Justice
234 Loyola Avenue
New Orleans, Louisiana 70112

Gulf States Utilities Company
ATTN: S. L. Adams
Senior Vice President
P. O. Box 2051
Beaumont, Texas 77704

ccs:
Mr. P. A. Horn
Project Manager, ACNGS
Houston Lighting & Power Company
P. O. Box 1700
Houston, Texas 77001

R. Gordon Gooch, Esq.
Baker & Botts
1701 Pennsylvania Avenue, N. W.
Washington, D. C. 20006

Mr. John Durham
The Houston Chronicle
801 Texas Avenue
Houston, Texas 77002

Melbert Schwarz, Jr. Esq.
Baker & Botts
1 Shell Plaza
Houston, Texas 77002

Kathleen Shea, Esq.
Lowenstein, Newman, Reis & Axelrad
1025 Connecticut Avenue, N. W.
Washington, D. C. 20036

Robert Pendergraft, Esq.
Office of the Attorney General
Environmental Law Section
P. O. Box 12548
Capitol Station
Austin, Texas 78711

Mr. G. W. Oprea, Jr.
Group Vice President
Houston Lighting & Power Company
P. O. Box 1700
Houston, Texas 77001

Public Service Company of Oklahoma

Michael I. Miller, Esq.
Isham, Lincoln & Beale
One 1st National Plaza
Suite 2400
Chicago, Illinois 60606

Mr. M. E. Fate, Jr.
Vice President - Power
Public Service Company of Oklahoma
P. O. Box 201
Tulas, Oklahoma 74102

Mr. Maynard Human
Generla Manager
Western Farmers Electric Cooperative
P. O. Box 429
Anadarko, Oklahoma 73005

Mr. Gerald F. Diddle
General Manager
Associated Electric Cooperative, Inc.
P. O. Box 754
Springfield, Missouri 65801

Ms. Carrie Dickerson
Citizens Action for Safe Energy, Inc.
P. O. Box 924
Claremore, Oklahoma 74107

Ms. Ilene H. Younghein
3900 Cashion Place
Oklahoma City, Oklahoma 73112

Andrew T. Dalton, Jr., Esq.
2536 E. 51st Street
Tulsa, Oklahoma 74105

Wallace Byrd, M.D.
316 N. Byrd
Coalgate, Oklahoma 7438

Ms. Roberta Ann Paris Funnell
3115 Harvey Parkway
Oklahoma City, Oklahoma 73118

Mr. Lawrence Burrell
Route 1, Box 197
Fairview, Oklahoma 73737

Ms. Sherri Ellis
3228 Northwest 44th Street
Oklahoma City, Oklahoma 73132

Mr. John B. Axton
P. O. Box 388
Coalgate, Oklahoma 74538

Director
State Grant-In-Aid Clearinghouse
4901 North Lincoln Boulveard
Oklahoma City, Oklahoma 73105

Mr. Tommy Dyer, Mayor
City of Inola
Inola City Hall
Inola, Oklahoma 74036

Public Service Company of Oklahoma
ATTN: Mr. B. H. Morphis
Assistant Vice President
Nuclear
P. O. Box 201
Tulsa, Oklhoma 74102

ccs:
Mr. W. Gilbert, Manager
Safety and Standards
General Electric Company
175 Curtner Avenue
San Jose, California 95125

Mr. I. Gifford, Manager
Regulatory Operations Unit
General Electric Company
4720 Montgomery Lane
Bethesda, Maryland 20014

General Electric Company
ATTN: Mr. Ivan F. Stuart, Manager
Safety and Licensing Section
Nuclear Energy Division
175 Curtner Avenue
San Jose, California 95114

Pennsylvania Power and Light Company
ATTN: Mr. Norman W. Curtis
Vice President - Engineering
and Construction
2 North Ninth Street
Allentown, Pennsylvania 18101

cc: Mr. Earle M. Mead
Project Manager
Pennsylvania Power & Light Company
2 North Ninth Street
Allentown, Pennsylvania 18101

Gerald Charnoff, Esq.
Shaw, Pittman, Potts, Trowbridge
& Madden
1800 M Street, N. W.
Washington, D. C. 20036

Mr. William E. Barberich
Licensing Engineer
Pennsylvania Power & Light Company
2 North Ninth Street
Allentown, Pennsylvania 18101

Mr. Robert J. Shovlin, Project
Manager Susquehanna
Pennsylvania Power & Light Company
2 North Ninth Street
Allentown, Pennsylvania 18101

Hubert Barnes, Esq.
Pennsylvania Power & Light Company
901 Hamilton Street
Allentown, Pennsylvania 18101

Edward M. Nagel, Esquire
General Counsel and Secretary
Pennsylvania Power & Light Company
2 North Ninth Street
Allentown, Pennsylvania 18101

cc: Mr. Robert C. Travis, Attorney
Wise, Carter, Child, Steen &
Caraway
P. O. Box 651
Jackson, Mississippi 39205

Troy B. Conner, Jr., Esq.
Conner, Moore & Corber
1747 Pennsylvania Avenue, N. W.
Washington, D. C. 20006

Bechtel Power Corporation
ATTN: T. W. Habermas, Project Engineer
Grand Gulf Nuclear Station
Gaithersburg, Maryland 20760

Mississippi Power and Light Company
ATTN: Mr. N. L. Stampley
Vice President - Production
P. O. Box 1640
Jackson, Mississippi 39205

ENCLOSURE

ATTENDEES LIST

NRC

P. Matthews
W. LeFave
D. Thatcher
W. Pike
V. Benoraya
G. Harrison

General Electric

R. Johnson

Gage-Babcock

J. Campbell

HLP

T. Hall
J. Hanson

Ebasco

E. Borelia