UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 16, 1997

ORGANIZATION: Baltimore Gas and Electric

SUBJECT: SUMMARY OF MEETING WITH BALTIMORE GAS AND ELECTRIC COMPANY (BGE) ON BGE LICENSE RENEWAL ACTIVITIES

On October 16, 1996, the Nuclear Regulatory Commission (NRC) staff met with representatives of BGE in Rockville, Maryland, to discuss BGE's license renewal program for cables. A list of meeting attendees is provided in Attachment 1. Attachment 2 is a copy of the materials distributed during the meeting.

During the meeting, BGE discussed the type, including materials of construction, of cables and environmentally qualified (EQ) equipment installed at Calvert Cliffs. BGE discussed it's aging management evaluation process and identified the potential aging effects that it determined to be plausible. The thermal screening process BGE is using for non-EQ equipment and the results of this process was also discussed. BGE discussed it's cable aging management program which will require some cables to be (1) replaced prior to the period of extended operation, (2) subject to a condition monitoring program, (3) partially replaced, with only the portion of the cable replaced that is subject to Harsh Environment when loss of coolant accident (LOCA) survivability not assured, or (4) subject to a performance monitoring program. For EQ equipment, BGE stated that it would rely on it's current 10 CFR 50.49 program as an aging management program, and would also rely on this program to justify that the current licensing basis (CLB) will be maintained until resolution of generic safety issue (GSI) 168 is resolved.

As a follow on to this meeting, the staff conducted a site visit on November 25, 1996, to review on-site documentation related to BGE's license renewal program for cables. The staff reviewed a number of documents including the cable aging management program summary, and EQ files.

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License Renewal Project Directorate
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-317, 50-318

Attachments: 1. Attendance List
2. Meeting Handouts

cc w/attachments: See next page

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BSheron (BWS)
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ATTENDANCE LIST
NRC MEETING WITH BALTIMORE GAS AND ELECTRIC
October 16, 1996

NAME	ORGANIZATION
1. Scott Flanders	NRR/DRPM/PDLR
2. Scott Newberry	NRR/DRPM/PDLR
3. Barth Doroshuk	BGE/LCM
4. James C. KilPatrick	BGE/Design
5. Richard Buttner	BGE/Design
6. Barry Ticder	BGE/LCM
7. Carl Yoder	BGE/LCM
8. Paul Shemanjki	NRC/NRR/DRPM/PDLR
9. P. T. Kuo	NRC/DRPM/PDLR
10 Chris Gratton	NRC/NRR/DSSA/SPCB
11. Sam Lee	NRC/NRR/PDLR
12. Jit Vora	NRC/RES/DET
13. Satish Aggarwal	NRC/RES
14. John Moulton	NRC/NRR/PDLR
15. John Knox	NRC/EELB
16. Paul Colaianni	Duke Power
17. Alice Carson	Bechtez
18. Fred Polaski	PECO Energy
19. Tricia Heroux	for EPRI
20. Boriz	GPU Nuclear

Attachment 1

BGE

Life Cycle Management Unit

License Renewal Discussions
Cables & EQ

October 16, 1996

ATTACHMENT 2

CABLES & EQ

OVERVIEW OF CABLES & EVALUATION PROCESS

POTENTIAL/PLAUSIBLE AGING MECHANISMS

EVALUATION PROCESS DETAILS

THERMAL SCREENING PROCESS

RESULTS OF EVALUATION

AGING MANAGEMENT OF CABLES

EQ EQUIPMENT

QUESTIONS

ALL CABLES w/o LR PRE-SCREENING

REASONS FOR COMMODITY EVALUATION OF ALL CABLES

Original Cables at CCNPP purchased as Safety-Related, without regard to application or system resulting in a common set of cables for a broad range of applications across the site.

Cable & Service Types and Aging Processes Independent of System.

Inclusion of All Cables provides Assurance against Loss of Data by Omission.

Pre-screening per LR Rule would not yield benefits, commensurate with effort, such as elimination of entire cable types of concern except in limited cases such as PVC and Teflon.

REFERENCES

(1) CCETS (Calvert Cliffs Electrical Tracking System)

(2) Digital Engineering System 1000

(3) IEEE Standard 101 - 1987, "IEEE Guide for the Statistical Analysis of Thermal Life Test Data"

(4) EPRI NP-4172SP, "Radiation Data for Design and Qualification of Nuclear Plant Equipment"

(5) EPRI TR-103841, "Low-Voltage Environmentally-Qualified Cable License Renewal Industry Report"

(6) DOE, "Cables & Terminations Aging Management Report" (DRAFT)

(7) ES-014, "Summary of Ambient Environmental Service Conditions used at Calvert Cliffs Nuclear Power Plant"

(8) EQ Files (Calvert Cliffs)

PROJECT PARTICIPANTS

Plant Support Engineering Section of CCNPPD

EQ Project

Electrical Engineering Unit of NED

Plant Testing Unit of CCNPPD

Life Cycle Management Unit of NED

CABLES

STARTING POINT

CCETS Report (now CRS) which included all scheduled cables.

CABLES & SERVICE TYPES

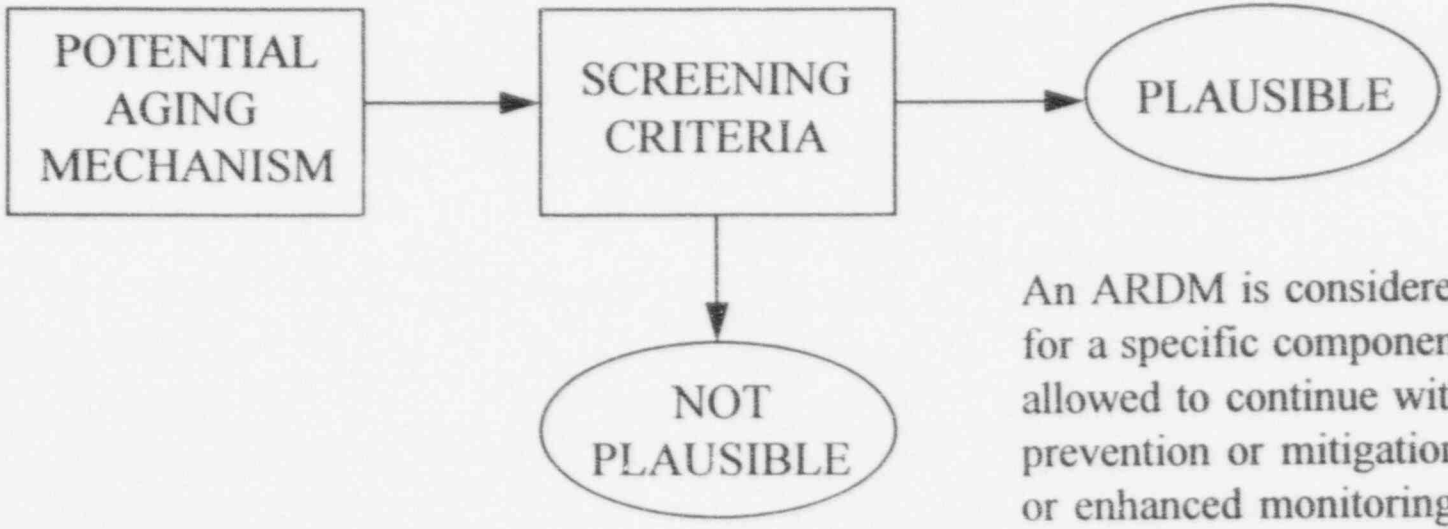
Insulating Material	Power	Cntrl	Instr
Silicone Rubber	X	X	X
XLPE	X	X	X
EPR (incl HTK)	X	X	X
Mineral	X	---	X
Kapton	---	---	X
Fiber Optic	---	---	X
Teflon	---	---	X
PVC	---	X	X
Misc	X	X	X

CABLES

NOTES RELATIVE TO CABLE POPULATION AT CCNPP

- Over 80% of scheduled cables are silicone rubber insulated.
- Silicone Rubber insulated cables do not undergo significant thermal aging during 60 years of service at CCNPP due to plant specific derate practice.
- Mineral insulated cables do not undergo significant thermal aging during 60 years of service at Calvert Cliffs.
- No PVC or Teflon insulated cables at CCNPP are in the scope of LR.

PLAUSIBILITY SCREENING CRITERIA

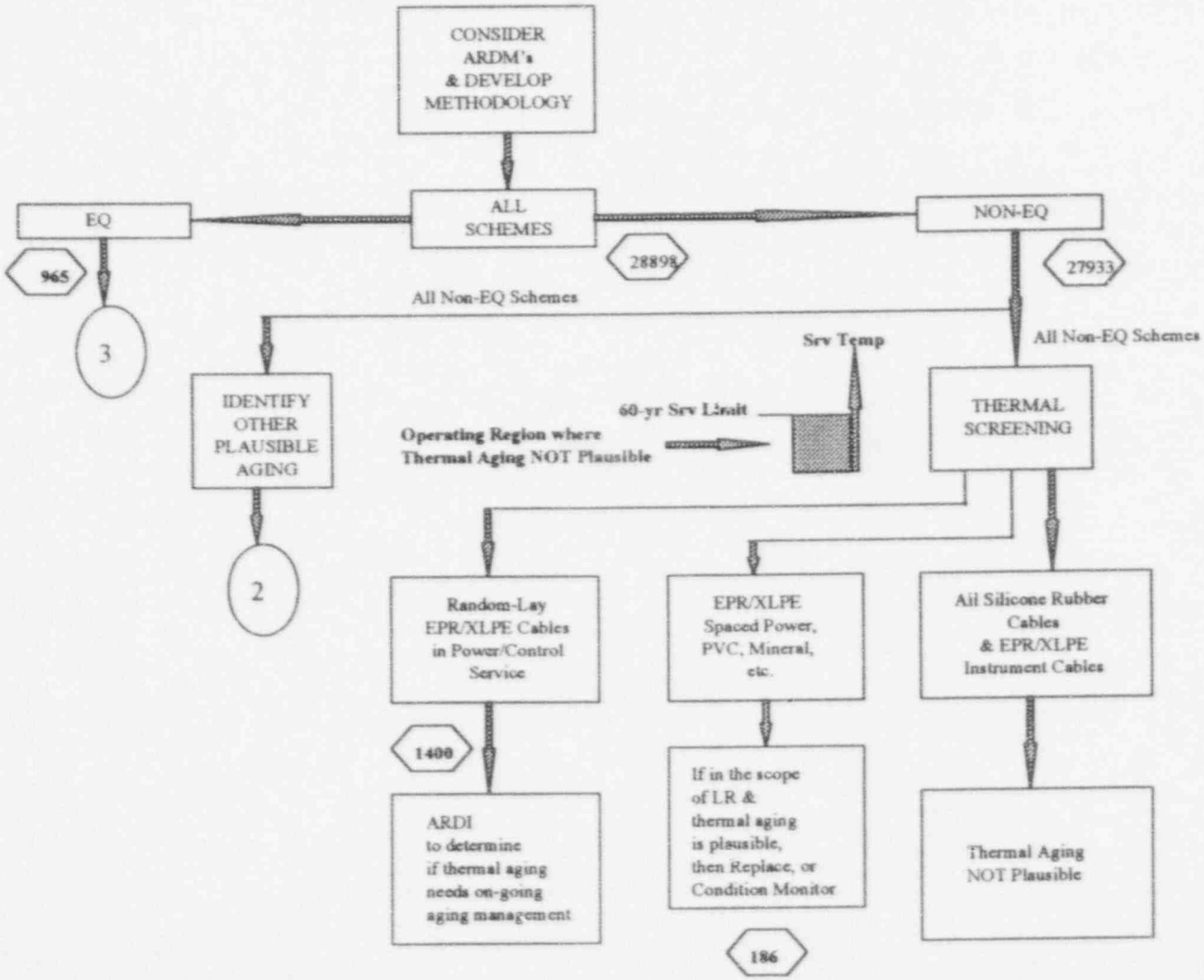


An ARDM is considered plausible for a specific component if, when allowed to continue without any prevention or mitigation measures or enhanced monitoring techniques, it could not be shown that the component would maintain its capability to perform its intended, passive function throughout the period of extended operation.

POTENTIAL/PLAUSIBLE AGING MECHANISMS

Aging Effects & Mechanisms	*Plausible*	*Summary of Justification*
Mechanical Stress	NO	Precluded by Installation Practices QV following SR installation
Electrical Stress	NO	Precluded by Derating & Design
Water Treeing	NO	XLPE not used in High Voltage Applications
Radiation Stress	NO	No Teflon Cables are in the scope of LR
Thermal Aging	YES	Non-Silicone Rubber Power & Control Cables
Kapton Specific Aging	YES	Kapton Cables in Cntmt
Radioactive Clouding	NO	In-scope FRO. Cables in low Rad Environment
IR Reduction	YES	Certain non-Silicone Rubber Instrument Cables
Synergistic Thermal/Radiative Aging	YES	EPR/XLPE Power Cables in Cntmt
Chemical Attack	NO	Exposure to Degrading Chemicals minimized by plant practices

Life Cycle Management Unit



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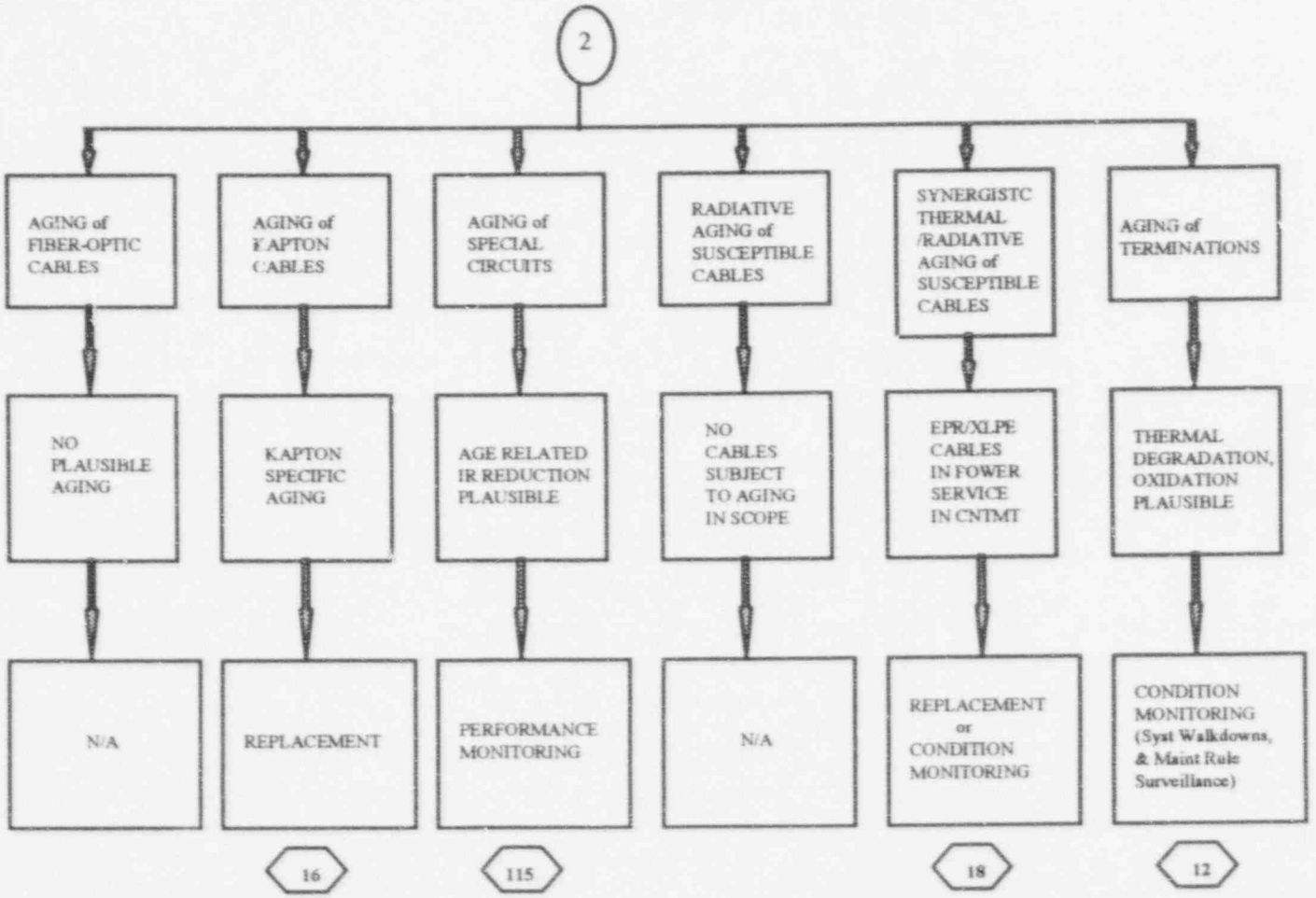
BGE

Life Cycle Management Unit



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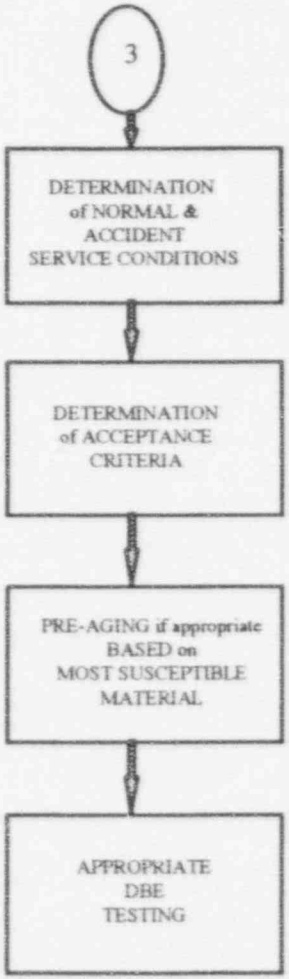
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DETERMINATION of NORMAL & ACCIDENT SERVICE CONDITIONS
DETERMINATION of ACCEPTANCE CRITERIA
PRE-AGING if appropriate BASED on MOST SUSCEPTIBLE MATERIAL
APPROPRIATE DBE TESTING

CABLE AGING PLAUSIBILITY DETERMINATION

Thermal Aging Screen: **Arrenhius based T(60) < Operating Temp**	EPR or XLPE cables in power or control service, No PVC cable in scope
Radiative Aging Screen: **Radiation Damage Threshold < 1.5 MRad**	No Teflon cable in scope
Kapton Aging Screen: **Kapton inside Containment** (Kapton under mechanical stress in hot, wet environment)	16 cables
Synergistic Rad/Thermal Aging Screen: **EPR or XLPE insulated power service cable in containment**	18 cables
IR Reduction Screen: **EPR or XLPE instrument cables servicing wide dynamic range instruments**	115 cables
Split Jacket Screen: **EQ cable, EPR insulated with bonded Hypalon jacketed used in containment**	CBL018 not used in containment CBL038 is SIS wire (not jacketed) WRNMS1, & CETX01 include this config but evaluated in response to INFO Notice

THERMAL SCREENING

(1) Determine a 60 year service limiting temperature for each insulation material in use.

Dielectric Failure may result if a cable is continuously exposed to temperatures at or above this limit for 60 years.

Arrenhius methodology (Ref 3) applied to conservative selection from System 1000 data-base (Ref 2)

(2) Determine upper bound on operating service temperature of cable in normal service.

Determine maximum ambient temperatures based on max design & plant temperature surveys (Ref 7)

Maximum ambient temperature is 160F (Main Steam Piping Penetration Room)

Evaluate ohmic heating of the cable.

Ohmic Heating of Instrumentation Cables negligible.

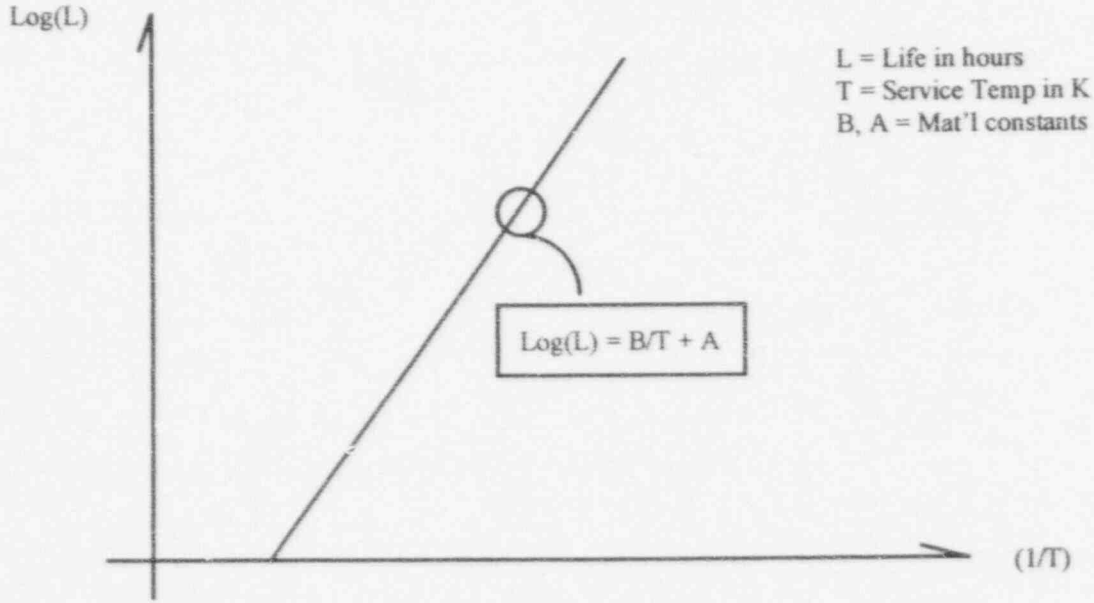
Ohmic Heating of Spaced Power Cables determined by IPCEA model.

Upper Bound on Operating Service Temperature of Unspaced (Random Lay) Power and Control Cables Determined Empirically.

(3) If operating service temperature exceeds the 60 year service limiting temperature, then thermal aging is plausible and must be managed.

CABLES

ARRENHIUS METHODOLOGY



L = Life in hours
T = Service Temp in K
B, A = Mat'l constants

THERMAL SCREENING

60 year service limiting temperatures:

SR > 194F (90C)
EPR - 184F
XLPE - 182F
PVC - 112F (none in scope)

Thermal Aging Not Plausible:

Silicone Rubber Cables -	23175
Mineral Insulated Cables -	135
Non-SiliconeRubber Cables in Instrument Service -	1635
Spaced Power Service EPR/XLPE Cables -	110

Thermal Aging Plausible or Validation of Upper Bound on Service Temperature Required:

Unspaced EPR/XLPE Power and Control Cables -	1400
Spaced Power Service EPR/XLPE Cables -	186

Some Cables Found to be Out of the Scope of License Renewal:

All PVC Cables -	256
Spaced Power Service EPR/XLPE Cables -	259

RANDOM-LAY PWR/CNTRL SERVICE
ARDI

Needed to assess approximately 1500 EPR, XLP cables in power and control service.

Development of an all-encompassing model to address ohmic heating of random lay cables not feasible.

Consistent with the desire to be comprehensive in evaluating cables, all cables in the target group are considered whether in or out of the scope of License Renewal.

INITIAL ANALYSIS

(1) Rank all 480V power service trays by a heat transfer model which included consideration of circuit loads, ambient temperatures, cable mass, and tray covers.

(2) Identify cable trays near significant external radiant heat sources such as hot pipes.

(3) Analyze results of steps 1 and 2 and select thermal survey locations.

REFINING THERMAL SURVEY

(4) Perform a thermal survey of candidate "hot" tray locations and external radiant heat sources to find "bounding" locations for long-term operating temperature monitoring.

ON-GOING TEMPERATURE SURVEY

(5) Install temperature probes at "bounding" locations.

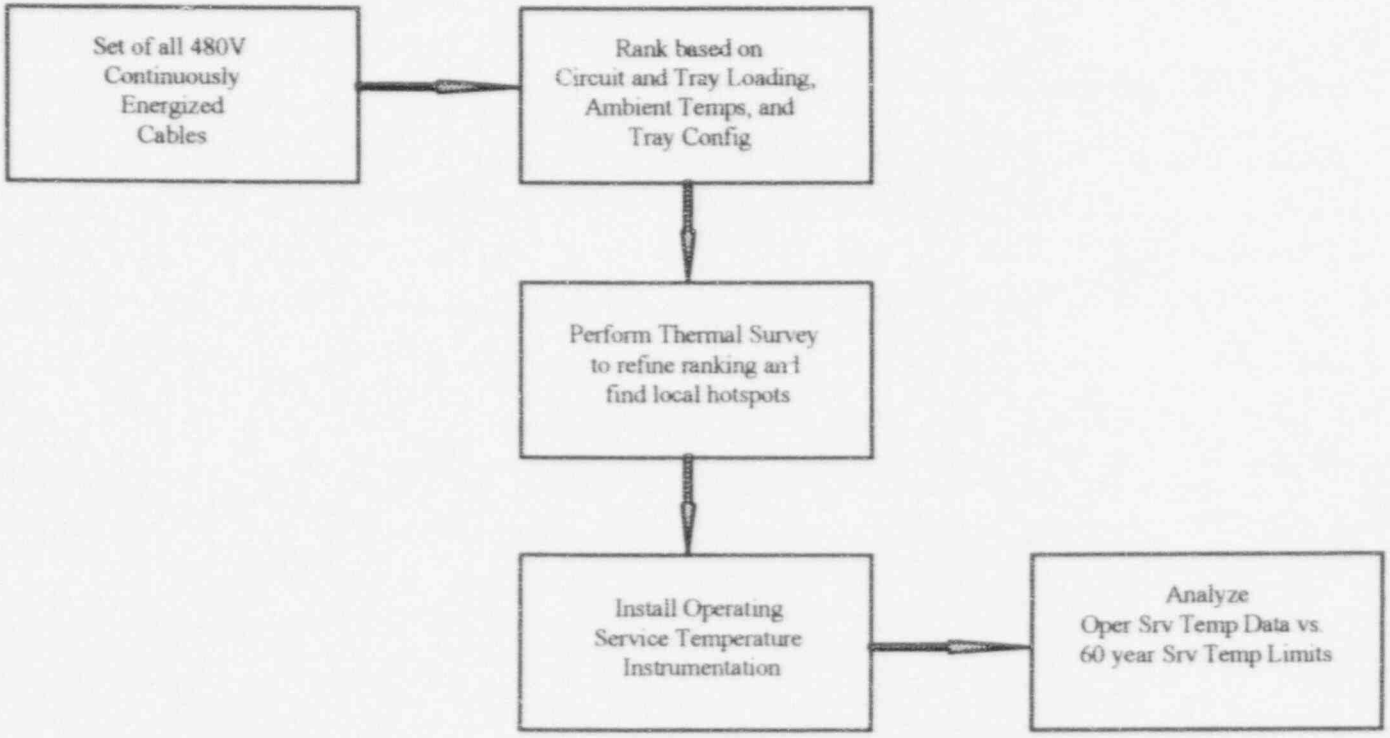
FINAL ANALYSIS

(6) Collect service temperature data over sufficient time to capture peak operating temperatures.

(7) Compare data with 60 year service limiting temperatures.

(8) Determine additional activities, if any, based on data, industry initiatives, and NRC research.

CABLES
EPR/XLPE IN RANDOM-LAY POWER SERVICE



CABLES

OTHER AGING PLAUSIBLE	149	Kapton cables in containment, EPR/XLPE Instr cables subject to Crit IR Reduction, EPR/XLPE Pwr cables subject to Synergistic Aging
THERMAL AGING PLAUSIBLE	1586	186 Spaced EPR/XLPE Power Cables, 1400 Random-Lay EPR/XLPE Power Cables Note: 18 Random-Lay Power Cables included in above group not included in this total
EQ	965	
NOT IN-SCOPE	1139	
OK	25059	

CABLE AGING MANAGEMENT

Replacement Prior to Period of Extended Operation

Kapton Cables in containment in fire detection service - 16

Condition Monitoring

Unspaced EPR/XLPE Power and Control Cables -	1400
Spaced Power Service EPR/XLPE Cables -	186
EPR/XLPE Cables in Power Service in Containment -	18

Replacement of portion of Cable subject to Harsh Environment when LOCA Survivability not Assured

EQ Cables - 965

Performance Monitoring

EPR/XLPE Cables in Wide Dynamic Range Instrumentation Service - 115

EQ EQUIPMENT

Regulatory Basis of current EQ Program is 10CFR50.49

ELEMENTS OF CURRENT PROGRAM

(1) Identification of equipment required to be environmentally qualified per 10CFR50.49(b).

Safety-related electrical equipment which is required to perform an electrical safety function after being subjected to or while exposed to harsh environmental conditions induced by design basis events.

(2) Documentation to substantiate environmental qualification of in-scope equipment.

An Environmental Qualification Documentation File (EQ File) is maintained for each equipment group. The EQ File contains data on subparts susceptible to environmentally induced degradation, the basis of environmental qualification including acceptance criteria, test data, analysis of qualification process and anomalies, etc.

(3) Maintenance and surveillance to maintain qualification on a continuing basis.

Qualification Maintenance Requirement Sheets (QMRS) are maintained for each equipment subgroup. The QMRS identifies installation, maintenance, testing, refurbishment, and monitoring requirements necessary to maintain environmental qualification of EQ equipment.

(4) Program controlling procedures.

EQ EQUIPMENT

THE FOLLOWING EQ ISSUES AFFECT LICENSE RENEWAL

(1) The CLB is to be maintained.

(2) The management of plausible aging must be demonstrated for long-lived equipment with passive functionality.

Long-lived passive device groups include cable, electrical penetrations, seals, terminal blocks, solenoid valves. The current EQ Program manages the aging of organic subparts which could adversely affect the required electrical functionality of the EQ equipment.

(3) EQ is considered a TLAA by NRC.

To support conclusion that action will be taken in accordance with the CLB per 10CFR54.29, NRC staff has requested that certain information be provided.

(4) A GSI exists and must be addressed.

The GSI is documented as Issue 168 of NRC Task Action Plan. The SOC to the LR Rule (60FR22484) allows LR applicants to resolve the issue and incorporate resolution in their LRA, or justify that the CLB will be maintained until reasonable options to manage the aging become available.

EQ EQUIPMENT
TLAA

INFORMATION REQUESTED BY STAFF

(1) Evaluation Methodology

Attempted extension of qualified life by refurbishment, retest, and/or reanalysis within bounds set by EQ Program and its regulatory basis.

(2) Acceptance Criteria

Qualified Life of 60 years.

(3) Corrective Actions

Option (1): Replace EQ equipment at end of qualified life with identical equipment.

Option (2): Replace EQ equipment at end of qualified life with equivalent equipment.

Option (3): Replace EQ equipment at end of qualified life with new equipment.

Option (4): Use of condition-based life assessment. (FUTURE)

(4) Timing of Resolution

Program administered to ensure that environmental qualification of installed equipment is maintained. Replacements are scheduled and re-evaluations are executed in a timely manner. Qualified Lives are not allowed to expire during the current license period and will not be allowed to expire during the period of extended operation.

EQ Equipment
GSI

PRIMARY FOCUS IS CABLES

Accelerated Aging Qualification Process

- Accuracy of life predictions provided by Arrenhius methodology; i.e., is pre-aging adequate?
- Limitations of using an estimated activation energy?
- How does humidity affect qualification results?

Failure Mechanisms of Special Cables

- Multi-conductor cables
- Bonded-jacket cables

Cable Installation and Environments

- Affect on qualification of Hot-spots, Excessive Vibration, Water/steam Impingement, Physical Damage.
- Affect on qualification of Bends, Overhangs, Vertical Runs, Trays, Conduits, Fire Protective Coatings, and Improper Installation

CM Techniques

- Effectiveness?
- Can they be used to predict accident survivability?

License Renewal

- Acceptable re-qual options?
- Viability of condition-based life?
- Use of operating experience?
- Extension of qualified life using current qual process?

EQ EQUIPMENT
GSI

BGE RESPONSE TO GSI

BGE will continue to meet its CLB with respect to 10CFR50.49 until such time that reasonable options to manage aging become available or the issue is considered closed.

BGE will continue to follow industry developments.

BGE will respond to new regulatory requirements.

ADDITIONAL CONSIDERATIONS

Failure Mechanisms of Special Cables

BGE's acceptance criteria is directly linked to critical electrical characteristics or a known precursor to electrical property changes.

Cable Installation and Environments

BGE's cable installation practices have been and are designed to address and mitigate the effects of these issues.

License Renewal

BGE has reviewed its EQ Program and concluded that it will continue to provide reasonable assurance that intended EQ functions will be maintained consistent with the CLB during the period of extended operation.

BGE PARTICIPATION IN INDUSTRY ACTIVITIES

Member of NUGEQ

Member of EPRI

Research on Cable Aging is underway

Research on Cable Condition Monitoring proposed

Operating Experience Unit

All SOER's received by BGE are reviewed for applicability to CCNPP

January 16, 1997

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Original signed by:
Scott C. Flanders, Project Manager
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Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-317, 50-318

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