LOUISIANA POWER & LIGHT / 142 DELARONDE STREET
P. O. BOX 6008 • NEW ORLEANS, LOUISIANA 70174 • (504) 366-2345

MIDDLE SOUTH UTILITIES SYSTEM

L.V. MAURIN
Vice President Nuclear Operations

January 27, 1983

W3P83-0320
G.02
Q-3-A20.16

Mr. T. H. Novak
Assistant Director for Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: Waterford 3 SES
Docket No. 50-382
Formal Transmittal of
Official EQ Audit Record

Dear Mr. Novak:

Please find enclosed an official record of the Equipment Qualification audit for Waterford 3 SES which took place at the site, near New Orleans, Louisiana, on January 4, 5, & 6, 1983.

Included as Enclosure 1 is a list of attendees at the meeting. Enclosure 2 is a listing of equipment selected for audit, and Enclosure 3 is the documentation of the comments, in the order in which they were raised, and the resolutions presented during the visit.

A quick review of the record, as noted in Enclosure 2, will reveal only one open and one confirmatory item from the audit. A follow up on these items may be expected during early February, 1983.

Very truly yours,

L. V. Maurin

LVM/SMJ/cb

Attachments

cc: Jim Wilson (NRC), Hukam Garg (NRC), R. LaGrange (NRC), M. W. Yost (EG&G), E. R. Holloway (EG&G), E. Blake, W. M. Stevenson, Central Records, Nuclear Records (3)

A048

bcc (w/o attachments): R.P. Barkhurst, F. J. Drummond, D. B. Lester, T. F. Gerrets, G. B. Rogers, R. W. Prados, C. J. Decareaux, R. F. Burski, P. V. Prasankumar, J. R. McGaha, S. A. Alleman, G. R. Peeler, T. K. Armington, K. R. Iyengar, M. I. Meyer, L. L. Bass Richard Hymes, W. Cross, D. Herrin, Z. Sabri, R. W. Kenning, Central Records, Nuclear Records (2), Licensing Library

bcc(w/attachments): John Tompeck (Ebasco), Jon Hart (Ebasco), S. M. Jones, H. B. Mulliken (CE), H. deLaneuville

ENCLOSURE 1

LIST OF ATTENDEES

Elizabeth Borkouska	ESI
G. Buniak	ESI
M. Clary	LP&L
John DeBruin	ESI
Howard deLaneuville	LP&L
Angelo DeVito	ESI
Tom Farina	ESI
M. P. Flasch	LP&L
Hukam Garg	NRC
Larry Gradin	ESI
Douglas G. Graf	ESI
J. Hart	ESI
E. R. Holloway	EG&G
Sharon M. Jones	LP&L
Michael Leon	ESI
Bob LaGrange	NRC
L. V. Maurin	LP&L
Bertalan Molnar	ESI
Sibu Nath	ESI
Dennis H. Orban	LP&L
Roy W. Prados	LP&L
Sushil K. Sinha	ESI
R. K. Stampley	ESI
John Tompeck	ESI
M. J. Veteto	LP&L
C. A. Wells	LP&L
M. G. Williams	LP&L
J. Wilson	NRC
W. Wittich	ESI
M. W. Yost	EG&G

ENCLOSURE 2

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Note:

*21 is a Confirmatory item
+23 is an Open item
ALL OTHER ITEMS ARE CLOSED.

Reviewer: R. Holloway

Date: 1/4/83
Comment No.: 1
Page 1 of 6
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Penetration	Conax	7320-10001	PEN 104	680

COMMENTS	RESOLUTION 1
1) Is the Conax 7320-10001 penetration equivalent to the penetrations tested?	1) Please note the model no. is 7320-10000-01 and not 7320-10001. The principal qualification test report for penetration #104 (Part Number 7320-10000-01) is Conax Report 1PS-602, "Design Qualification Report of Medium, Voltage Power Penetration. Assemblies for St. Lucie Plant - Unit 2. The telex found in Tab B, Page B1B clearly states the Waterford St. Lucie penetrations contain identical materials. Therefore, Penetration part No.7320-10000-01 (15 KV) is equivalent to St. Lucie Penetration part No. 7310-10001-01 (15KV) and this is shown to be qualified by 1PS602. IPS 152.1 which is the seismic report for Waterford list the part No. on Page 4 as 7320-10000-01 for Medium Voltage Penetrations. Further description of Waterford MV Penetration is found in IPS-379. CLOSED The above provides adequate information that an equivalent to 7320-10000-01 was tested.
2) Is the Conax Telex 11/10/82 in the package?	2) Telex is in Tab B, Page B1B. CLOSED
3) Samples tested were not tested to all environmental conditions. Which samples were used for qualification?	3) Two samples were used for qualifying the MV Penetrations. One sample 7310-10007-01 (Test Data Base 1) was used for testing to the non-environmental requirements of IEEE 317-76. Sample 7508-10004 was tested to the requirements of IEEE 323-74 and 317-76 (Test Data Base 2). This is a medium voltage penetration similar to 7310-10001-01 (St. Lucie Penetrations) as stated in 1PS-602 Page 5, Sec. 4.5. The radiation entry on the QDEF will be corrected. CLOSED

Reviewer: R. Holloway

Date: 1/4/83
Comment No.: 1
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Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	ODEF NO.
Penetration	Conax	7320-10001	PEN 104	680

COMMENTS	RESOLUTION
4) Is there analysis showing the extrapolation of test data to the required operability time?	4) The required operability time of the Penetrations is 120 days at 120°F. The test samples were held at a temperature of 300°F average for 30 days (288 hrs.). As seen on the attached Arrhenius Plot for Kerite, 288 hours at 300°F is equivalent to 24,586 hours (1024 days) at 200°F. The 300°F temperature for 30 days exceeds the operability requirement by sufficient margin as seen on the attached graph. In addition, the above curve is based on results assuming continuous energizing of the equipment. It is noted that these penetrations are dedicated for power to the Reactor Coolant Pumps. These pumps do not operate during plant shutdown and all pumps do not operate continuously further adding to qualified life. Also, the Reactor Coolant Pumps do not perform a safety function and do not operate during a Design Bases event - the cables will be de-energized during Post LOCA and the Penetrations will act as a seal between the RCB & RAB. This further adds to the qualified life. CLOSED
5) Is there analysis showing that the peak DBA temperature is "covered" by a lower test temperature?	5) Test Data Base 2 tested the sample to a peak temperature of 405.5°F for 90 seconds as opposed to the short transient Waterford peak temperature of 414°F for 55 seconds. Conax references IPS-694 which states that during the MSLB transient the penetration will never exceed the corresponding saturated steam temperature corresponding to the MSLB temperature and pressure. (e.g. for a 418°F and 44 PSIG the equivalent is 291.6°F. This is the MSLB equivalent transient for the tested penetrations. This envelopes the 414°F Waterford transient. CLOSED

Reviewer: R. Holloway

Date: 1/4/83
Comment No.: 1
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Status: Closed

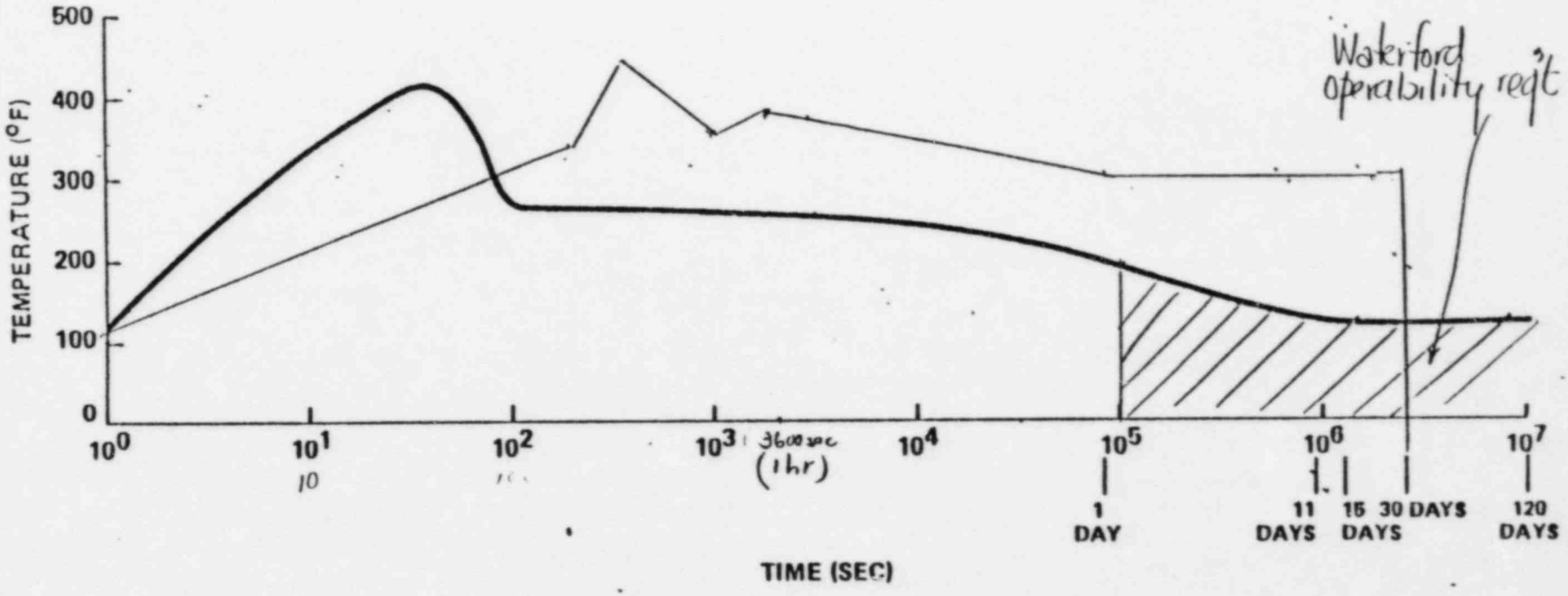
ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Penetration	Conax	7320-10001	PEN 104	680

COMMENTS	RESOLUTION
5) Continued	Furthermore, on July 7-10, 1981, NRC held public meetings on NRC Requirements regarding the Environmental Qualification of Safety-Related Electrical Equipment (Federal Register Notice Vol. 46, No. 112, page 30925). In the course of the July 7-10 meetings, Dr. L. L. Bonzon of Sandia National Laboratories (the Program Manager of the Qualification Testing Evaluation Program being conducted for the NRC's Division of Engineering Technology), presented actual test data which clearly demonstrated the significant "thermal lag" for safety-related components. Figure A-3 from the EQ Guidebook (attached) is a reproduction of the test (Catawba Penetration Test) data presented which demonstrates that thermal equilibrium is not achieved for many minutes in real time conditions (versus the time in seconds when the WSES-3 MSLB temperature exceeds the LOCA temperatures.) This test result validates the use on a "case-by-case basis" of the temperature of the crucial component in lieu of equipment surface temperature by test or analysis as clarified by NUREG-0588 Revision 1 comments and resolution to NUREG-0588, paragraph 1.2(5). In addition, the analyses used remain very conservative as no credit is taken for the substantial thermal resistance of the enclosure's internal ambient. Actual "real world" tests (Figure A-3) demonstrate the additional lag on the conductors surface (i.e. the surface of concern for qualification). CLOSED

LOUISIANA POWER & LIGHT CO.
Waterford Steam Electric Station

COMPOSITE LOCA/MSLB TEMPERATURE PROFILE



Date: 1/4/83
Comment No.: 1
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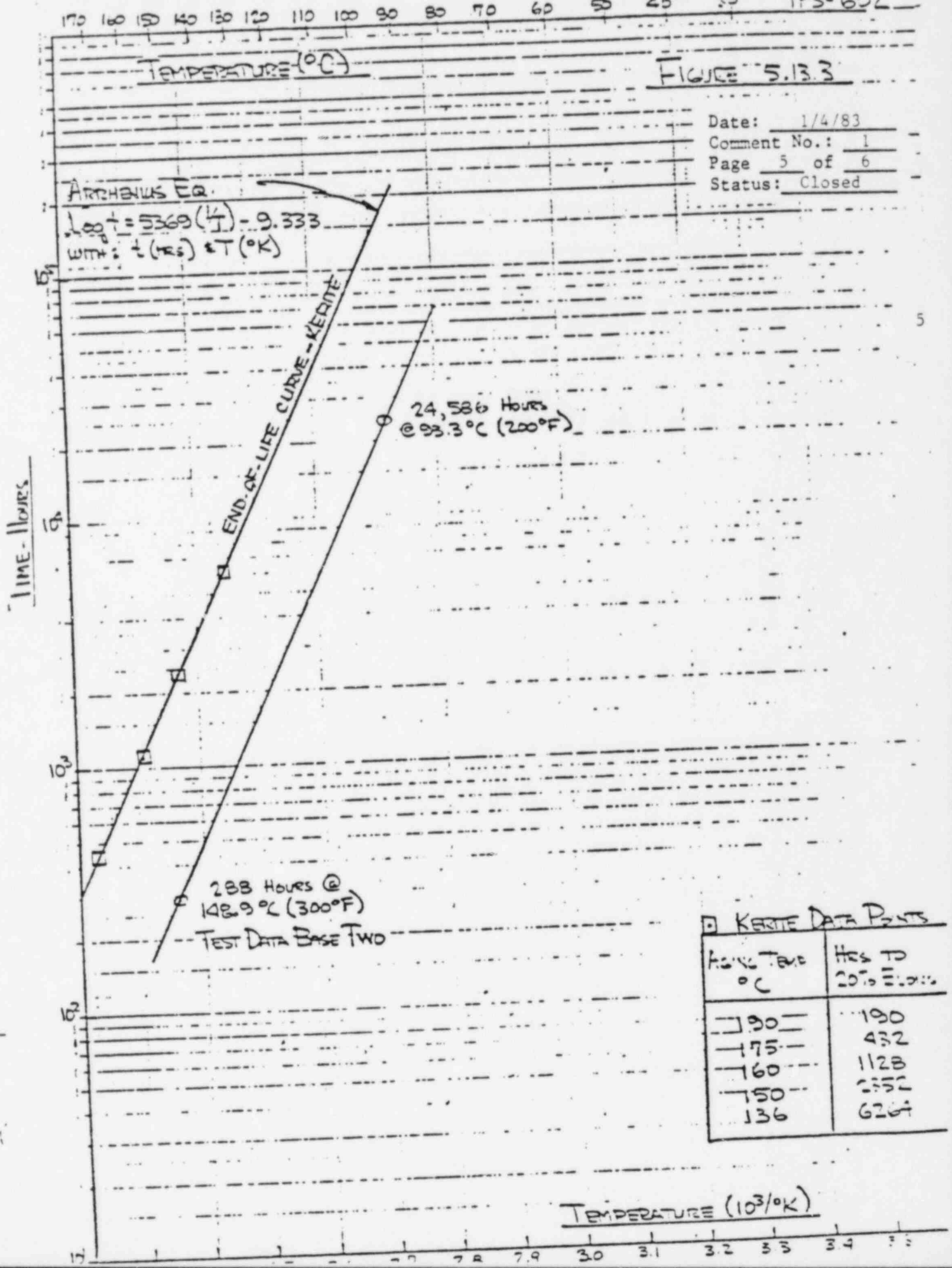
Status: Closed

REVISION 2 (11/82)

Figure 5


TEMPERATURE (°C)
FIGURE 5.13.3
Date: 1/4/83
Comment No.: 1
Page 5 of 6
Status: Closed
ARRHENIUS EQ.
$\log t = 5369\left(\frac{1}{T}\right) - 9.333$
WITH: t (HRS) & T (°K)
END-OF-LIFE CURVE - KERITE
24,586 Hours @ 93.3°C (200°F)
288 Hours @ 148.9°C (300°F)
TEST DATA BASE TWO
TIME - HOURS
KERITE DATA POINTS
AGING TEMP °C
HRS TO 200% ELONG
190 190
175 432
160 1128
150 2352
136 6264
TEMPERATURE (10^3/°K)
3.0
3.1
3.2
3.3
3.4

Date: 1/4/83
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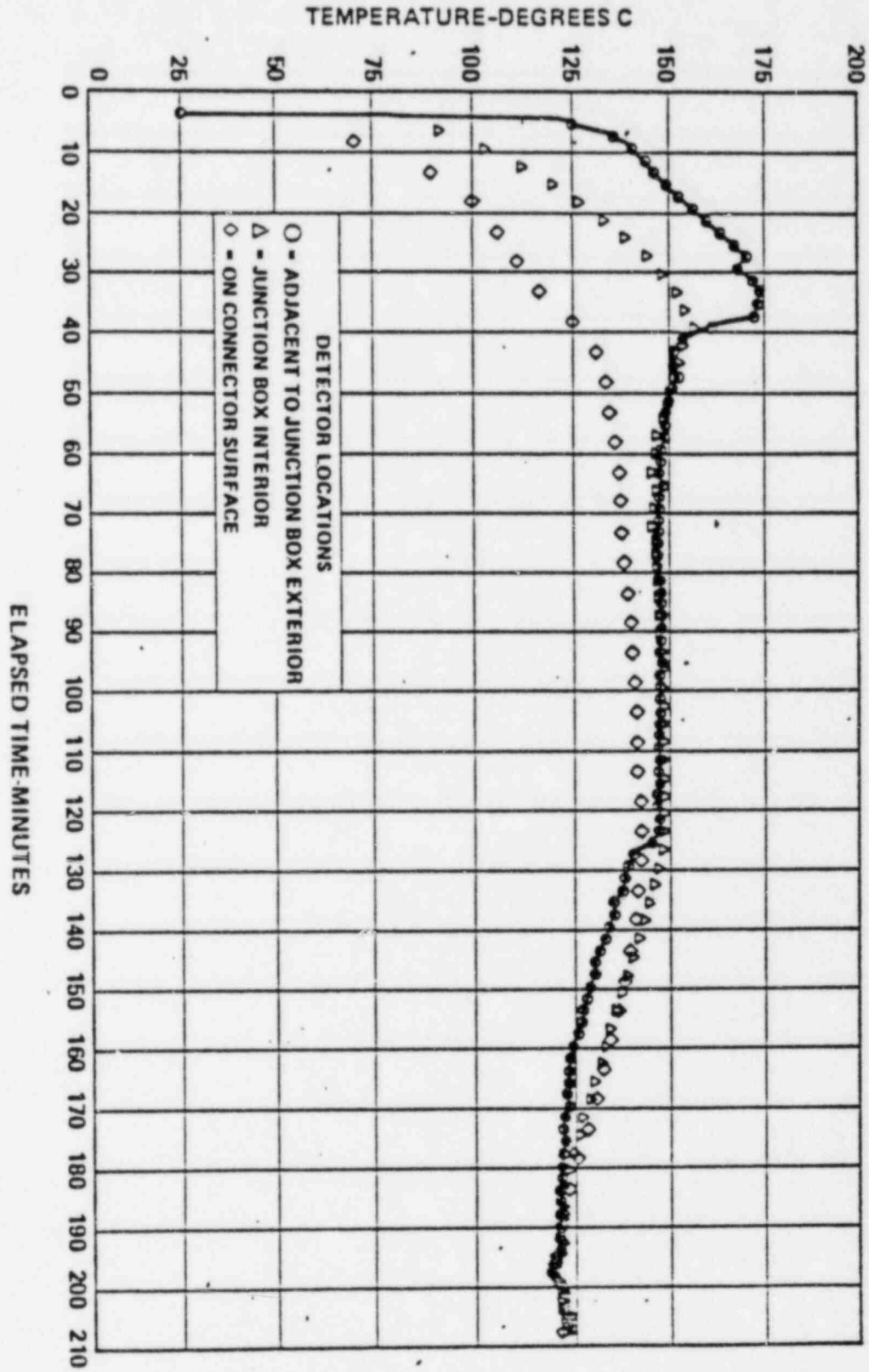
Page 6 of 6
Status: Closed



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LOUISIANA POWER & LIGHT CO. Waterford Steam Electric Station	CATAWBA PENETRATION TEST TEST CHAMBER INTERNAL TEMP. JUNE 15, 1981	Figure A-3

Date: 1/4/83
Comment No.: 2
Page 1 of 4
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Nuclear Instrumentation Pre-Amplifiers				4665 thru 4670

COMMENTS	RESOLUTION
Why are QDEF sheets not included for the Nuclear Instrumentation Pre-Amplifiers?	The QDEFs indicated pertain to the excore system or the Nuclear Instrumentation System. Per IEB 79-01B Supplement 2 Question Response 12, "The staff does not require that the nuclear instrumentation and its associated components be environmentally qualified for a LOCA or HELB. The nuclear instrumentation system is used for transient conditions but is not required for a LOCA or HELB." Consequently the harsh LOCA/HELB environment is not presently applicable to WSES-3. The above quotation is included in the EQ Report and Guidebook paragraph 3.0 "Methodology To Select Equipment Requiring Qualification." The specific QDEFs for the Excore System (sample QDEFs 2056, 2058) include this quotation and have properly reclassified these items as NUREG 0588 Appendix E Category D. Additional definition of the safety function of these devices confirming they do not provide LOCA/HELB mitigation functions is found in NRC accepted FSAR Section 7.2. LP&L continues to address licensing issues relating to environment qualification of its safety related equipment. This particular instrumentation system will provide Post Accident Monitoring functions as a type B variable for Reactivity Control (Neutron Flux) for the purpose of, "Function detection; accomplishment of mitigation" per table 2 of Regulatory Guide 1.97 Rev. 2. On the basis of the implementation schedule of RG 1.97 Rev. 2 LP&L will confirm the adequacy of the excore system for PAM functions by June 1, 1983. The current Master List (manual update revision 4A dated 1/2/83) includes the NUREG 0588 Category D classification for QDEFs 4665-4670 on attached page 137 of the Master List. CLOSED It should be noted that this schedule is consistant with Generic Letter 82-09 Question Response 1.

SYSTEM # & NAME: 31-RADIATION MONITORING

TAG NO	COMPONENT NAME	FUNCTION & SERVICE	MANUFACTUR.	MODEL/SER	PLANT LOCATION	LOCATION X,Y,Z	ENVIRONM. H/M	FUNCT. CATEG.	SAFETY FUNCTION		QDEF#	REV #
NONE	NUCLEAR INST. DET*CTR	REACTOR PROT. SYS(CPC) INPUT NEUTRON FLUX	GENERAL ATO MIC-REUTER	ELE-304-500 0	~~ANNEX~~ CONT1	66.0 65.0 +14.0	M	~~X~~ D	AM		2056	03 4A
B3486-SMA	NUCLEAR INST. PRE AMP	INPUT TO RPS CPC NEUTRON FLUX	GENERAL ATO MIC/REUTER	PA-SQ1		63.5 41.5 1.5	M	D	AM		4665	03
B3487-SMB	NUCLEAR INST. PRE AMP	INPUT TO RPS CPC NEUTRON FLUX	GENERAL ATO MIC/REUTER	PA-SQ1		61.5 42.0 1.5	M	D	AM		4666	03
B3488-SMC	NUCLEAR INST. PRE AMP	INPUT TO RPS CPC NEUTRON FLUX	GENERAL ATO MIC/REUTER	PA-SQ1		95.8 118.5 1.5	M	D	AM		4667	03
B3489-SMD	NUCLEAR INST. PRE AMP	INPUT TO RPS CPC NEUTRON FLUX	GENERAL ATO MIC/REUTER	PA-SQ1		57.5 108.5 1.5	M	D	AM		4668	03
B3490	NUCLEAR INST. PRE AMP	INPUT TO RPS CPC NEUTRON FLUX	GENERAL ATO MIC/REUTER	PA-SQ1		63.5 44.5 1.5	M	D	AM		4669	03
B3491	NUCLEAR INST. PRE AMP	INPUT TO RPS CPC NEUTRON FLUX	GENERAL ATO MIC/REUTER	PA-SQ1		57.5 118.8 1.5	M	D	AM		4670	03
RD-CA-5400 AS	DETECTOR	POST ACCIDENT MONITORING	GENERAL ATO MIC	RD-23	CONT3	144.0 78.0 99.5	H	A	AM		1623	03
RD-CA-5400 BS	DETECTOR	POST ACCIDENT MONITORING	GENERAL ATO MIC	RD-23	CONT3	8.0 76.0 99.5	H	A	AM		1625	03
RD-HV-0110	RADIATION DETECTI	POST ACCIDENT MONITORING NOBLE GAS	GENERAL ATO MIC	RD52/RD72	WING3	L9 8A1 +46	H	A	AM		1621	03
RD-HV-3024S	RADIATION DETECTO	CONTAINMENT PURGE ISOLA	GENERAL ATO MIC	RD-6	CONT3	96.0 106.0 +58.0	H	A	AM		1600	03
RD-HV-3025S	RADIATION DETECTO	CONTAINMENT PURGE ISOLA	GENERAL ATO MIC	RD-6	CONT3	54.0 45.0 +58	H	A	AM		1601	03

TAGS INCLUDED: NONE ----RD-HV-3025S
SORT TYPE:SYS,ALPHA GLOBAL REV#- 3 12/30/82

Date: 1/4/83
Comment No.: 2
Page 2 of 4
Status: Closed

LOUISIANA POWER AND LIGHT COMPANY
WATERFORD SES UNIT NO.3

QUALIFICATION DATA EVALUATION FORM

QDEF SHEET NO.-2059

Date: 1/4/83
Comment No.: 2
Page 3 of 4
Status: Closed

EQUIPMENT DESCRIPTION	ENVIRONMENT PARAMETER	ACTUAL (1)	DEM. QUALIF. (2)	DOCUMENTATION ACTUAL (3)	DEM. QUALIF. (4)	QUALIF. METHOD (5)	*H/M (6)	OUTS ITEMS (7)
TAG NO : NONE	OPERABILITY NORM/TEST	2 MIN.	SEE ANALYSIS	OPER. REVIEW	OPER. REVIEW	COMB. TEST& SUPP. REVIEW	/	NONE
EQUIPMENT: TYPE	DBA				SRSO			
COMPONENT: EXCORE SYSTEM CABLE	TEMPERATURE	120F NORM ~~F16.16 ACC~~ ~~DBA~~	SEE ANALYSIS	TCONT1 MAP T14S EQRPVOL1	NONE SRST	COMB. TEST& SUPP. REVIEW	H B M	NONE
MANUFACTURER: ITT	PRESSURE	~~-8"WG NORM FEAR F16~~ 6.2 PSIG ACC DBA	SEE ANALYSIS	~~PANNLS MAP R14S EQRPVOL1~~	NONE SRSP	COMB. TEST& SUPP. REVIEW	H B M	NONE
MAJOR : SUPPLIER								
MODEL AND: NOT APPLICABLE SERIAL #	RELATIVE HUMIDITY	20-100%NRM ~~100%DBA~~	SEE ANALYSIS	HCONT1 MAP H14S EQRPVOL1	NONE SRSH	COMB. TEST& SUPP. REVIEW	/	NONE
FUNCT.DES: INPUT TO RPS & SERVICE EXCORE SYSTEM CABLE	CHEMICAL SPRAY	~~1750-2150 PPM BORON PH9-6-9.0~~	SEE ANALYSIS	CCONT1 EQ REPT VOL1,7.3	NONE SRSC	COMB. TEST & EXTRA- POL'N	H B M	NONE
ACCUR. SPEC: NOT APPLICABLE	R GAMMA A BETA D R.SHIELD S T.I.D	~~2 REF 2.5E8 100%~~	SEE ANALYSIS	RCONT1 MAP R14S ZONE B3	SRSR	COMB. TESTS SUPP. REVIEW	H B M	NONE
ACCUR. DEM.: NOT APPLICABLE	AGE-INST LIFE (PER 323-1974 DEF.)	40 YEARS	SEE ANALYSIS	10CFR50 PARA.50.51	SRSA	COMB. TESTS SUPP. REVIEW	/	NONE
PLANT LOC.: ~~AUXS~~ CONT 1								
COORDINATES X- 66.0 Y- 65.0 Z- +14.0	SUBMERGED LEVEL	0.5 FEET	SEE ANALYSIS	SCONT1 FSARQSIN 211.#	SRSS	NOT APPLI- CABLE	H B M	NONE

REPLACEMENT: SEE INSTR. MANUAL
MAINTAIN.: SEE INSTR. MANUAL
NOTES

1) GENERIC FILE: EQ-CEIC-

2) RG 1.97 Rev 2 has this parameter. The qual exemptn is to be reviewed by RG 1.97 implementation date

SAFETY FUNCTION: AM (See ref 1) (See note 2) for PAM

INSTALLED (Y/N): ~~YES~~ N/A
INSTAL. REF: BY-ELD
QUALIF EXEMPTN: ~~NO~~ YES, REF 1

QUALIF STATUS	
~~QUALIFIED-ACCEPTING~~	
~~CONCLUSORY DATA~~	
NOT APPLICABLE	

EQ PACK # : N/A

PARAMETER	SUPPL. REVIEW
OPERABILITY	O
TEMPERATURE	T
PRESSURE	P
REL. HUMDTY	H
CHEM. SPRAY	C
RADIATION	R
AGING	A
SUBMERGEANCE	S

QSRP CATEG.: ~~NA~~ D
APPENDIX B

FOR PUNCHLIST ITEMS SEE WSES EQ PACKAGE INDICATED *See Ref 1

REFERENCES: 1) Per JEB 79-01B Supp. 2 Q/A 12, "The staff does not require that the nuclear instrumentation and its associated components be environmentally qualified for a LOCA or HELB. The nuclear instrumentation system is used for transient conditions but is not required for a LOCA or HELB."

QUALIFICATION SIGN-OFF FOUND IN DOCUMENTATION PACKAGE:

QDEF #-2053

REVISION # ~~11~~ 4A
DATE : ~~12/13/82~~ 1/2/83

SYSTEM : ENGINEERING SAFETY
TAG : NONE

LOUISIANA POWER AND LIGHT COMPANY
WATERFORD SES UNIT NO.3

QDEF SHEET NO.-2055

QUALIFICATION DATA EVALUATION FORM

EQUIPMENT DESCRIPTION

TAG NO : NONE

EQUIPMENT: TYPE

COMPONENT: NUCLEAR INST. DET'CTR & CABLE

MANUFACTURER: GENERAL ATOMIC-REUTER STOKES

MAJOR : SUPPLIER

MODEL AND: SERIAL # FLE-304-5000

FUNCT.DES: & SERVICE REACTOR PROT. SYS(CPC) INPUT NEUTRON FLUX DETECTION

ACCUR. SPEC: NOT APPLICABLE

ACCUR. DEM.: NOT APPLICABLE

PLANT LOC.: ~~AUXIL~~ CONT 1

COORDINATES X- 66.0
Y- 65.0
Z- +14.0

INSTALLED (Y/N): ~~YES~~ N/A
INSTAL. REF: 9Y-FLD
QUALIF EXEMPTN: ~~NO~~ YES, REF 1

QUALIF ~~QUALIFIED AWAITING~~
STATUS ~~CONFIRMATORY DATA~~
******** NOT APPLICABLE

EQ PACK # : N/A

ENVIRONMENT PARAMETER	ACTUAL (1)	DEM. QUALIF. (2)	DOCUMENTATION ACTUAL (3)	DEM. QUALIF. (4)	QUALIF. METHOD (5)	H/M (6)	OUTS ITEMS (7)
OPERABILITY NORM/TEST DBA	~~2 HR.~~ SEE REF 1	96 HR.	OPER. REVIEW	GEN ATOMIC TEST REPT GAE 115.49 SRSO	COMB. TESTS SUPP. REVIEW	/	NONE
TEMPERATURE	120F NORM ~~FIG.10 ACC DBA~~	310 DEG F 0-10 HR, 250 DEG F 10-96 HRS	TCONT1 MAP T145 EQRPVOL1	GEN ATOMIC TEST REPT GAE 115.49 SRST	COMB. TESTS SUPP. REVIEW	X D M	NONE
~~PRESSURE~~	~~9"WG NORM FSAR FIG 6.2-62B ACC DBA~~	65 PSIG 0-96 HRS	~~CANNLS MAP R143 EQRPVOL1~~	GEN ATOMIC TEST REPT GAE 115.49 SRSP	COMB. TESTS SUPP. REVIEW	X D M	NONE
RELATIVE HUMIDITY	20-100%NRM 100%DBA	0 %	HCONT1 MAP H145 EQRPVOL1	SRSH	COMB. TESTS SUPP. REVIEW	/ D M	NONE
CHEMICAL SPRAY	~~1750-2150 PPM BORON PH=8-9.0~~		CCONT1 EQ REPT VOL1,7.3	SRSC	COMB. TEST & EXTRA-POL'N	X D M	NONE
G GAMMA A BETA O B.SHIELD S T.I.D	~~2.9E7~~ ~~2.5E8~~ ~~100%~~		RCONT1 MAP R145 ZONE 88	SRSR	COMB. TESTS SUPP. REVIEW	X D M	NONE
AGE-INST LIFE (DEF 323-1974 DEF.)	40 YEARS	NONE	10CFR50 PARA.50.51	NONE SRSA	COMB. TESTS SUPP. REVIEW	/	NONE
SUBMERGED LEVEL	0.5 FEET	NONE	SCONT1 FSARQSTN 211.3	NONE SPSS	NOT APPLI-CABLE	X D M	NONE

PARAMETER	SUPPL. REVIEW
OPERABILITY	O
TEMPERATURE	T
PRESSURE	P
REL. HUMDTY	H
CHEM. SPRAY	C
RADIATION	R
AGING	A
SUBMERGENCE	S

DSRP CATEG.: X D
APPENDIX F

FOR PUNCHLIST ITEMS SEE WSES EQ PACKAGE INDICATED

See Ref 1.

REPLACEMENT: SEE INSTR. MANUAL
MAINTAIN.: SEE INSTR. MANUAL
NOTES

1) GENERIC FILE: EQ-CEIC-16

2) RG 1.97 Rev 2 has this parameter. The qual exemptn is to be reviewed by RG 1.97 implementation date

SAFETY FUNCTION: AM (See ref 1) (See note 2) for PAM)

QUALIFICATION SIS FOUND IN DOCUMENT PACKAGE:

QDEF #-2055

REVISION # : ~~01~~ 1A
DATE : ~~12/17/82~~ 1/1/83

SYSTEM : RADIATION MONITORING
TAG : NONE

Date: 1/4/83
Comment No.: —
Page 1 of —
Status: Closed

REFERENCES: 1) Per IEB 79-01B Supp 2 Q/A 12, "The staff does not require that the nuclear instrumentation and its associated components be environmentally qualified for a LOCA or HELB. The nuclear instrumentation system is used for transient conditions but is not

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Date: 1/4/83
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ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
(Generic question)				

COMMENTS	RESOLUTION
Some systems are not included in the Master Equipment List, e.g.; Emergency Feedwater System and the Shutdown Cooling System.	In regards to major "subsystems" or "systems" that are enveloped by other systems included in the Master Lists, a table which identifies subsystems was provided at an NRC/LP&L/Ebasco meeting in Bethesda, Md., December 21, 1982. The two majors "subsystems" are enveloped as follows: Subsystem — Enveloping System Emergency Feedwater System — Feedwater System Shutdown Cooling System — Safety Injection System The specific table is attached and will be included in our next revision of Table 2 in the EQ Guidebook. CLOSED

Date: 1/4/83
Comment No.: 3
Page 2 of 3
Status: Closed

WATERFORD SYSTEM DESIGNATIONS

SYSTEM NO.	SYSTEM TITLE	SAFETY RELATED	NON SAFETY RELATED	REMARKS
01	Chilled Water	X		
02	Blowdown	X		
03	Boron Management	X		
04	Containment Vacuum Relief	X		
04	Containment Purge	X		
05	Component Cooling Water	X		
06	Condensate	X		
06	Condensate Recovery	X		12
07	Chemical Feed		X	
08	Chemical & Volume Control	X		
09	Containment Spray	X		
10	Main Condensor Cooling Water		X	
11	Demineralized Water System		X	
12	Emergency Generator Starting Air	X		Contained in System 13
13	Emergency Diesel Generator	X		
14	Fire Protection	X		
15	Fuel Pool		X	Non Class IE
16	Feedwater	X		
17	Hydrogen Analyzer	X		
18	Heating & Ventilating	X		
19	Instrument Air	X		
20	Nitrogen Gas	X		
21	Reactor Coolant	X		
22	Station Air		X	
23	Safety Injection	X		
24	Sampling	X		
25	Waste Management	X		
26	Main Steam	X		
27	Shutdown Cooling	X		Contained in System 23

Date: 1/4/83
Comment No.: 3
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SYSTEM NO.	SYSTEM TITLE	SAFETY RELATED	NON SAFETY RELATED	REMARKS
28	Fuel Handing Bldg Ventilation	X		
29	Engineered Safety Features	X		
30	Emergency Feedwater	X		Contained in System 16
31	Radiation Monitoring	X		
32	Hydrogen Recombiner	X		
33	Containment Cooling	X		
34	Containment Atmospheric Release	X		
35	Shield Building Ventilation	X		
36	Control Room Air Conditioning	X		
37	Control Room Emergency Filtration	X		
38	Battery Room Exhaust	X		
39	Emergency Diesel Generator Room Ventilation	X		
40	Controlled Area Ventilation	X		
41	Switchgear Area Ventilation	X		
42	SFGD Pump Room A/C	X		
43	Shutdown HX Room A/C	X		
44	Charging Pump Room A/C	X		
45	CCW Equipment Room A/C	X		
46	Aux FW Pump Room A/C	X		
51	Direct Current	X		
52	Inverter	X		
53	Cable & Raceway	X		
54	Penetrations	X		
55	Cable Assemblies	X		

13

Reviewer: R. LaGrange

Date: 1/4/83
Comment No.: 1
Page 1 of 1
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Solenoid valve	ASCO	HT2068323F	2SL-F1502 A/B	1164

COMMENTS	RESOLUTION 14
What is meaning of HT prefix in model no.?	Optional design features required and available are indicated by the vendor's prefix or suffix added to the basic catalog number. Addition of the HT prefix to a valve catalog no. indicates that the valve is provided with a high temperature coil for higher temperature conditions. Also refer to documentation package p. I4 in tab I for temperature limitations and thermal characteristics of ASCO solenoids and coils of class H coil insulation. Throughout the test report reference is made to the class H solenoids (e.g. test report page I1, paragraph 2, package page D227). Table 3.1 of the report (package page D11) clearly includes, "Identification of Generic Families Included In this Qualification Program." Generic Family designation VDSS3.1 includes generic family 206-832. The bulletin for generic family 206-832 is included in the package as page I5, tab. I. A review of the data contained within the package provides clear traceability of the complete catalog number as follows: HT 206832 3 F F — Suffix F means normally closed (note at bottom page I5) 3 — Specific orifice, C_v etc. as shown on first table page I5 206832 — 206-832 Traceability to generic family 206-832 (page I5 traceable back to test report table 3.1, package page D11) HT — Package Page I4 which indicate this coil has maximum thermal capability or "excess margin" CLOSED

Reviewer: R. LaGrange

Date: 1/4/83
Comment No.: 5
Page 1 of 2
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Solenoid Valve	ASCO	HV2068323F	2SI-F605TK1A	1149,1171,1169, 1167,1165,1163, 1153,1149,etc.

COMMENTS	RESOLUTION	15
What is meaning of HV prefix in model no?	The prefix HV indicates the drawing no. which ASCO uses for internal control. The model no. is not affected in any way by this prefix. Refer to telephone conversation record attached. CLOSED	

Date: 1/4/83
Comment No.: 5
Page 2 of 2
Status: Closed

RE-ORDER FORM # 8802

Jiffy Reply Memo

IVES BUSINESS FORMS, INC. - NEW ORLEANS, LA. 40634/382

TO

FROM

EQ Package # 3.2W3

S K SINHA
MECH. ENGR.
EBASCO

16

TELEPHONE CONVERSATION

MESSAGE

DATE 01-05-1983

Mr. Joe Damato, sales engineer of ASCO Main Plant (Tel. # 201-966-2000) said that the prefix "HV" in the ASCO model no. indicates the size of the drawing which is for internal control only. He further indicated that this prefix does not change the model no. in any way.

SIGNED

REPLY

DATE

Sushil K. Sinha

SIGNED

SEND WHITE AND PINK COPIES WITH CARBONS INTACT. PINK COPY IS RETURNED WITH REPLY

DETACH THIS COPY – RETAIN FOR ANSWER

Reviewer: R. LaGrange

Date: 1/4/83
Comment No.: 6
Page 1 of 1
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Solenoid Valve	ASCO	NP 8321A2E	D-70 (SB)	960

COMMENTS	RESOLUTION	17
QDEF indicates 40 year qual. life. Test report and App. E indicate 8 (or more) years. How is replacement schedule determined and tracked?	QDEF's indicate 40 years of installed life and not the qualified life. This is per IEEE 323-1974 definition of installed life, "The interval from installation to removal, during which the equipment or component thereof may be subjected to design service conditions and system demands." Also see the note on p.8 of IEEE 323-1974 which says "Equipment may have an installed life of 40 years with certain components changed periodically." Licensee review of qualification files includes identification of any scheduled maintenance or replacement required to maintain qualification. This information is given to plant maintenance for inclusion in their preventive maintenance schedule. This is a computer based scheduling and reporting system which governs all maintenance. CLOSED	

Reviewer: R. LaGrange

Date: 1/4/83
Comment No.: 7
Page 1 of 1
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	ODEF NO.
Solenoid valve	ASCO	NP831664F	2CH-F1518A/B	808

COMMENTS	RESOLUTION	18
Field verification form indicates model no. not given.	The field verification sheet indicates that the entered serial no. is correct, while the model number is not given. Only the model number has been supplied in Box A on the field verification sheet. The field verifier inadvertently indicated this model number to be the serial number. No serial numbers are identified on the ASCO field verification sheets. CLOSED	

Reviewer: R. LaGrange

Date: 1/4/83
Comment No.: 8
Page 1 of 2
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Solenoid Valve	ASCO	HP 8320A1	2BM-F108A/B	800

COMMENTS	RESOLUTION
App. E states valve will be relocated above flood level. QDEF only states that valve will be replaced with qualified valve. Also, field verification form indicates different model no. than QDEF - neither appears qualified by test report.	The field verification sheet indicates the model number is HP6320A1. Since there is no such model number, it was presumed that the first number has been mistakenly read as a 6 instead of 8. As the intent of the package is to replace this solenoid, no further checking of the field verification data was necessary. Note (1) on the QDEF has been revised to indicate that the valve would be relocated above the flood level consistent with the resolution contained in Tab E. (See attached QDEF #800 Rev. 04B dated 01/04/83). Another revision of the QDEF will be issued after replacement of the existing solenoid. CLOSED

LOUISIANA POWER AND LIGHT COMPANY — QDEF SHEET NO.-0800
WATERFORD SES UNIT NO.3 — ***QUALIFICATION DATA EVALUATION FORM***

EQUIPMENT DESCRIPTION	PARAMETER	ENVIRONMENT ACTUAL (1)	DEM. QUALIF. (2)	DOCUMENTATION ACTUAL (3)	DEM. QUALIF. (4)	QUALIF. METHOD (5)	H/M (6)	OUTS ITEMS (7)	
TAG NO : 23M-F103 A/B	OPERABILITY	40 YEARS	NONE	OPER.	NONE	SEE	/	YES	
		NORMAL	SEE	REVIEW	SEE	NOTE		SEE	
	NORM/TEST	120 DAYS	NOTE (1)		NOTE (1)	(1)		NOTE	
EQUIPMENT: VALVE OPERATORS	DBA	POST DBA			SRSO 3.2W3			(1)	
TYPE									
	TEMPERATURE	120F NORM	NONE	TCONTI	NONE	SEE	H	YES	
COMPONENT: SOLENOID		FIG.10 ACC	SEE	MAP T145	SEE	NOTE		SEE	REPLACEMENT:
		DBA	NOTE (1)	EQRPVOL1	NOTE (1)	(1)		NOTE	
					SRST 3.2W3			(1)	
MANUFACTURER: ASCO									MAINTAIN.:
	PRESSURE	ATMOS NORM	NONE	PCONTI	NONE	SEE	H	YES	
		FIG.9 ACC	SEE	MAP P145	SEE	NOTE		SEE	
MAJOR : ITT GRINNELL		DBA	NOTE (1)	EQRPVOL1	NOTE (1)	(1)		NOTE	NOTES
SUPPLIER VALVE DIVISION					SRSP 3.2W3			(1)	
									1)NO QUALIFICATION
MODEL AND: HP8320A1	RELATIVE HUMIDITY	20-100%NRM	NONE	HCONTI	NONE	SEE	/	YES	DOCUMENT AVAILABLE
SERIAL #		100%DBA	SEE	MAP H145	SEE	NOTE		SEE	QUALIFIED REPLACE-
			NOTE (1)	EQRPVOL1	NOTE (1)	(1)		NOTE	MENT WILL BE IN-
FUNCT.DES: ROT STOP &					SRSH 3.2W3			(1)	STALLED ABOVE
& SERVICE ISOLATION VLV									FLOOD LEVEL
	CHEMICAL SPRAY	1750-2150 PPM BORON	NONE	CCONTI	NONE	SEE	H	YES	BEFORE FUEL
			SEE	EQ REPT	SEE	NOTE		SEE	LOADING.
		PHS-0-9.0	NOTE (1)	VOL1,7.3	NOTE (1)	(1)		NOTE	
ACCUR. SPEC: N/A					SRSC 3.2W3			(1)	
	R GAMMA	3.3E7	NONE	RCONTI	NONE	SEE	H	YES	
ACCUR. DEM.: N/A	A BETA	3.3E8	SEE	MAP P145	SEE	NOTE		SEE	
	D B.SHIELD	100%	NOTE (1)	ZONE CC	NOTE (1)	(1)		NOTE	
	S T.I.D				SRSR 3.2W3			(1)	
	AGE-	40 YEARS	NONE	IOCFR50	NONE	SEE	/	YES	SAFETY FUNCTION:
	INST LIFE		SEE	PARA.50.51	SEE	NOTE		SEE	AM
	(PRE 323-		NOTE (1)		NOTE (1)	(1)		NOTE	
PLANT LOC.: CONTI	1974 DEF.)				SRSA 3.2W3			(1)	
	SUBMERGED	0.5	NONE	SCONTI	NONE	SEE	H	YES	
COORDINATES X- 94.0	LEVEL	FEET	SEE	FSARQSTN	SEE	NOTE		SEE	
Y- 74.0			NOTE (1)	211.2	NOTE (1)	(1)		NOTE	
Z- -10.0					SRSS 3.2W3			(1)	
INSTALLED (Y/N): YES									
INSTAL. REF:HY-FLD	PARAMETER	SUPPL. REVIEW	FOR CHECKLIST ITEMS SEE WSES EQ PACKAGE INDICATED					QUALIFICATION SIGN-OFF FOUND IN DOCUMENTATION PACKAGE:3.2W3	
QUALIF EXEMPTN: NO	OPERABILITY	O 3.2W3							
**********	TEMPERATURE	T 3.2W3						QDEF #-0811	
QUALIF REPLACE-SEE NOTE (1)*	PRESSURE	P 3.2W3							
STATUS	SEL. QUALITY	H 3.2W3							
********	CHEM. SPRAY	C 3.2W3		REFERENCES:					
*	RADIATION	R 3.2W3							
**********	AGING	A 3.2W3						REVISION # : ~~04A~~ 04B	
	SUBMERGENCE	S 3.2W3						DATE : ~~01/02/83~~ 01/04/83	
IS EACH A : 3.2W3									
	OSS CATEG.: A							SYSTEM : BORON MANAGEMENT	
	APPENDIX A							TAG : 23M-F103 A/B	

Date: 1/4/83
Comment No.: 8
Page 2 of 2
Status: Closed

Reviewer: H. Garg

Date: 1/4/83
Comment No.: 9
Page 1 of 3
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Limit Switch	Namco	EA170-XX302	3CC-TM148A	1081

COMMENTS	RESOLUTION
1) There are many QDEF's with the qualification status as "Replace". Are these limit switches to be replaced with EA170 series qualified component?	1) Yes, these limit switches will be replaced with EA170-XX302 limit switches. CLOSED
2) The test report indicates that conduit sealant should be used, however, field verification stated that no conduit sealants are used.	2) Since all these switches are located outside Cont. Bldg. away from high-energy lines, conduit sealant is not required. The standard enclosures are adequate, as harsh environment parameters which relate to these limit switches are radiation and a moderate temperature rise above ambient. The Qualification Package demonstrates qualification for these parameters. The switches and their conduit entry meet the National Electric Manufactures Association requirements for NEMA Type 4 enclosures, providing more than adequate sealing for the indoor limit switches. This enclosure is in fact considered water-tight and dustlight, suitable for Indoor and Outdoor service. The following is extracted from NEMA Standards Publication, "Industrial Controls and Systems" Publication ICS-1970: **ICS 1-110.15 Type 4—Watertight and Dusttight—Indoor and Outdoor** .1 NONVENTILATED ENCLOSURES Type 4 enclosures are intended for use indoors or outdoors to protect the enclosed equipment against splashing water, seepage of water, falling or hose-directed water, and severe external condensation.

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Limit Switch	Namco	EA170-XX302	3CC-TM148A	1081

COMMENTS	RESOLUTION
	ICS 1-110.56 Hosedown Test (Watertight) .1 METHOD The enclosure and its external mechanisms shall be subjected to a stream of water from a hose which has a 1-inch nozzle and which delivers at least 65 gallons per minute. The water shall be directed at the enclosure from all angles from a distance of 10 to 12 feet for a total period of 5 minutes. A conduit may be installed to equalize internal and external pressures but shall not serve as a drain. .2 EVALUATION The enclosure is considered watertight and dust-tight if no water has entered the enclosure.
	A vendor letter on this item is committed to in Tab K. CLOSED
3) In accordance to the test report limit switches with 148°F DBA temperature have qualified life of only 16 years, however, the QDEF states that the elastomeric components to be replaced after 20 years.	3) QDEF indicates the replacement after 20 years based on 104°F normal temperature which is inconsistant with the qualified life calculated in Calc No. 9.1W3-1 on Pg. E13 in Tab E of the document. This inconsistency will be resolved when the surveillance and maintenance schedule is developed per EQ Guidebook Section 11.2 in detail for individual limit switches. This QDEF will be corrected & others checked. CLOSED
4) Test report does not identify any periodic maintenance.	4) Sec. 1.2 of EA17990051 maintenance schedule on P. 4-17 (D68) of the test report recommends maintenance every 5 years if the switch is exposed to a service temperature higher than 50°C. CLOSED

Date: 1/4/83
Comment No.: 9
Page 3 of 3
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Limit Switch	Namco	EA170-XX302	3CC-TM148A	1081

COMMENTS	RESOLUTION
5) From the report, it is not clear that performance testing was performed after every stage of the test sequence.	5) Section 5.3 on page D81 in Tab D of our documents indicate that the test sequence was conducted in keeping with IEEE standard guidelines. These IEEE standards include IEEE-323-1974, 382-1972 and 344-1975 (See p. D11 in Tab D of the document). CLOSED

Reviewer: R. LaGrange

Date: 1/4/83
Comment No.: 10
Page 1 of 2
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Solenoid valve	ASCO	?	?	842

COMMENTS	RESOLUTION
QDEF missing. Field verification form references this QDEF.	QDEF No. 842 references 8320A175MO ASCO solenoid valve serving 2WM-F157 A/B Cont. Waste Gas Isolation Valve. The missing copy is herewith attached. CLOSED

LOUISIANA POWER AND LIGHT COMPANY
WATERFORD SES UNIT NO. 3

QUALIFICATION DATA EVALUATION FORM

QDEF SHEET NO. -0942

EQUIPMENT DESCRIPTION	PARAMETER	ENVIRONMENT 1 ACTUAL	ENVIRONMENT 2 DEM. QUALIF.	DOCUMENTATION 3 ACTUAL	DOCUMENTATION 4 DEM. QUALIF.	QUALIF. METHOD 5	H/M 6	QUALIF. ITEMS 7	
TAG NO : 2WM-F157A/B	OPERABILITY	40 YEARS	NONE	OPER.	NONE	SEE	/	YES	
		NORMAL	SEE NOTE	REVIEW	SEE NOTE	NOTE		SEE	
	NORM/TEST	120 DAYS	(1)		(1)	(1)		NOTE	
EQUIPMENT: VALVE OPERATORS	DBA	POST DBA			SRSO 3.2W3			(1)	
TYPE									
	TEMPERATURE	120F NORM	NONE	TCONT1	NONE	SEE	H	YES	
COMPONENT: SOLENOID		FIG.10 ACC	SEE NOTE	MAP T145	SEE NOTE	NOTE		SEE	REPLACEMENT:
		DBA	(1)	EQRPVOL1	(1)	(1)		NOTE	
					SRST 3.2W3			(1)	
MANUFACTURER: ASCO									MAINTAIN.:
	PRESSURE	ATMOS NORM	NONE	PCONT1	NONE	SEE	H	YES	
		FIG.9 ACC	SEE NOTE	MAP P145	SEE NOTE	NOTE		SEE	
MAJOR : ITT GRINNELL		DBA	(1)	EQRPVOL1	(1)	(1)		NOTE	NOTES
SUPPLIER VALVE DIVISION					SRSP 3.2W3			(1)	
									(1)NO QUALIFI-
MODEL AND: R320A175MO	RELATIVE	20-100%NRM	NONE	HCONT1	NONE	SEE	/	YES	CATION DOCUMENTS
SERIAL #	HUMIDITY	100%DBA	SEE NOTE	MAP H145	SEE NOTE	NOTE		SEE	AVAILABLE. QUALI-
			(1)	EQRPVOL1	(1)	(1)		NOTE	FIED REPLACEMENTS
FUNCT.DES: CONT WASTE GAS					SRSH 3.2W3			(1)	WILL BE INSTALLED
& SERVICE ISOL VALVE									BEFORE FUEL
	CHEMICAL	1750-2150	NONE	CCONT1	NONE	SEE	H	YES	LOADING.
	SPRAY	PPM BORON	SEE NOTE	EQ REPT	SEE NOTE	NOTE		SEE	
		PH5-0-7.0	(1)	VOL1,7.3	(1)	(1)		NOTE	
ACCUR. SPEC: N/A					SRSC 3.2W3			(1)	
	R GAMMA	3.3E7	NONE	RCONT1	NONE	SEE	H	YES	
ACCUR. DEM.: N/A	A BETA	3.3E8	SEE NOTE	MAP R145	SEE NOTE	NOTE		SEE	
	D B.SHIELD	100%	(1)	ZONE CC	(1)	(1)		NOTE	
	S T.I.D				SRSR 3.2W3			(1)	
	AGE-	40 YEARS	NONE	10CFR50	NONE	SEE	/	YES	SAFETY FUNCTION:
	INST LIFE		SEE NOTE	PARA.50.51	SEE NOTE	NOTE		SEE	AM
	(REF 123-		(1)		(1)	(1)		NOTE	
PLANT LOC.: CONT	1974 REF.)				SRSA 3.2W3			(1)	
	SUBMERGED	0.5	N/R	SCONT1	-	NOT	H	NONE	
COORDINATES X- 47.0	LEVEL	FEET		FSARQSEM		APPLI-			
Y- 16.0				211.8		CABLE			
Z- 410.0					SRSS 3.2W3				

INSTALLED (Y/N): YES
INSTAL. REQ'MT-FLD
QUALIF EXEMPTN: NO

PARA-METER	SUPPL. REVIEW
OPERABILITY	O 3.2W3
TEMPERATURE	T 3.2W3
PRESSURE	P 3.2W3
REL. HUMIDITY	H 3.2W3
CHEM. SPRAY	C 3.2W3
RADIATION	R 3.2W3
AGING	A 3.2W3
SUBMERGENCE	S 3.2W3

EQ PACK # : 5.245

CLASS CATEG.: A
APPENDIX B

FOR PUNCHLIST ITEMS SEE WSES EQ PACKAGE INDICATED

REFERENCES:

QUALIFICATION SIGN-OFF FOUND IN DOCUMENTATION PACKAGE: 5.245

QDEF #-0942

REVISION # : 04A
DATE : 01/02/83

SYSTEM : BASIC MANAGEMENT
TAG : 2WM-F157A/B

Date: 1/2/83
Comment No.: 10
Page 2 of 2
Status: Closed

Reviewer: M. Yost

Date: 1/4/83
Comment No.: 11
Page 1 of 1
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Cable: 600V Power & Control	Okonite	EPR Insulation	D25 D50 D82	(File No. G.1W3)

COMMENTS	RESOLUTION
Need FSAR section on thermal lag analysis incorporated in Environmental Qualification data package.	The required analysis has been incorporated into the file in Tab E. CLOSED

Date: 1/4/83
Comment No.: 27
Page 1 of 1
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Pressure transmitter	ITT Barton	764	LT-RC 1103AS	2729

COMMENTS	RESOLUTION
Page 364 of the Pre-Audit Master List shows ITT Barton Transmitters Model 764 on QDEF's 4729 and 2729. We could not find these in the QDEF's, please explain.	ITT Barton Pressure transmitter Model 764 which appeared on the master list for QDEF 4729 is an exact duplicate of the ITT Barton transmitter that appears on QDEF 2729, namely LT-RC 1103AS. Therefore, sheet 4729 is now deleted and QDEF 2729 is included as page A19b in package 8.2W3. The Qualification Status and Punchlist (page 49) provided to the NRC includes only the single QDEF (2729). CLOSED

Date: 1/4/83
Comment No.: 13
Page 1 of 1
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Instrument Cabinet				3667

COMMENTS	RESOLUTION 28
Page 369 of the Pre-Audit Master List shows Instrument Cabinet on QDEF 3667. We could not find these in the QDEF's, please explain.	The instrument cabinet C-1C that appeared as 0588 category A on Pg. 369 of the master list submitted on 12/29/82 is actually located in a mild environment as shown on the latest master list on page 98, i.e. it is 0588 category D, and the QDEF sheet is not required as noted. The reason that this cabinet originally appeared as a Category A item is our systems engineering approach, which begins with an assumption that all electrical safety related items are in the worst environment, performing a safety function for the maximum time duration. As EQ work progresses, this conservatism is reduced to reflect actual environments and required operability. CLOSED

Date: 1/4/83
Comment No.: 14
Page 1 of 1
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
	ITT Barton	764	FTSI-1307AS	4730
	Rosemount	1153DA6	FTSI-0390BS	0213
	Rosemount	1152	LISI 0301	4723
			LISI 0302	4724

COMMENTS	RESOLUTION
a) Page 383 of the Pre-Audit Master List shows ITT Barton Model 764 on QDEF 4730. We could not find these in the QDEF, please explain.	a) Sheet 4730 (FTSI-1307AS) which appeared on page 383 of the Master List (dated 12/2/82) can be found on page A176 in Document Package 8.2W3. CLOSED
b) Page 383 of the Pre-Audit Master List shows Rosemount Model 1153DA6 on QDEF 4734. We could not find these in the QDEF's, please explain.	b) Sheet 4734 (FT SI 0390BS) was a duplicate of sheet 0213 and has been deleted. Sheet 0213 can be found on page A86 of Document Package 8.1W3. CLOSED
c) Page 384 of the Pre-Audit Master List shows Rosemount Model 1152 on QDEF's 4723 and 4724. We could not find these in the QDEF's, please explain.	c) Sheets 4723 and 4724 (LI SI0301 and LI SI0302, respectively) were incorrectly tagged. The correct tag nos for these sheets are located in Package No. 8.1AW3 (Pages A11 and A12). CLOSED

Date: 1/4/83
Comment No.: 15
Page 1 of 1
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
	Rosemount	1153DA5	LTSI 0311	4719
			LTSI 0321	4720
			LTSI 0331	4721
			LTSI 0341	4722

COMMENTS	RESOLUTION	30
Pages 384 and 385 of the Pre-Audit Master List shows Rosemount Model 1153DA5 on QDEF's 4719-4722. We could not find these in the QDEF, please explain.	Sheets 4719, 4720, 4721 and 4722 (LT SI 0311, LT SI 0321, LT SI 331 and LT SI 341) which were found on pages 384 and 385 of the Master List, can be found in Package 8.1W3 (pages A99, A100, A101 and A102). CLOSED	

Reviewer: R. LaGrange

Date: 1/15/83
Comment No.: 16
Page 1 of 28
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
5KV Cable	Okonite	EPR	D15-01 D15-02	618

COMMENTS	RESOLUTION
1) There is no clear connection between the 5KV cable being used in Waterford and the cable tested and described on Page D2 of the test report. Do they have the same insulation thickness, etc?	1) The documentation (traceability) path can be demonstrated as described below: Included in this and every documentation package under Tab G is either a vendors certificate of compliance or verification that such availability of QA documentation exists. Attached hereto is a copy of a sample of QA documentation readily retrieved from the site QA vault. Such documentation includes purchase order number, reference to technical specifications, reference to insulation type (okoguard; okoprene) production testing, QC review and acceptance, etc. CLOSED
2) Although the QDEF does not indicate this cable is qualified for submergence, page E8 states that it is This statement should be deleted from p. E8 unless comment 3 under splices (QDEF 606) is adequately addressed and the cable tested for immersion is the same cable used in Waterford 3.	2) This particular cable services Class 1E medium voltate (5KV) services (switchgear motors, etc). As there are no class 1E medium voltage loads or services in containment, there are no medium voltage cables subject to containment flooding. The documentation package will be modified to clarify any confusion on this issue.
3) QDEF says required rad is 4.2×10^6R. Page E7 states $8.9 \times 10.^6$R.	3) Maximum radiation is 4.2×10^6 rads in zone U (the location of class 1E medium voltage motors served by this cable such as LPSI, HPSI and CSP motors). Page E7 inconsistancy has been corrected. Cables are actually qualified for radiation level greater than 40 times this value. CLOSED

WATERFORD STEAM ELECTRIC STATION
1977 - 1165 MW INSTALLATION - UNIT NO 3
QUALITY CONTROL
MATERIAL RECEIVING INSPECTION REPORT

DATE: APR 06 1977 REPORT NO. MRR 701313 MRIR 1703502

P.O.# NY-43447 Supp. #6 VENDOR OKONITE Co.

SUBCONTRACT P.O.# N/A MANUFACTURER "

HEAT # LOT OR BATCH # N/A

DESCRIPTION OF ITEM: #1, 3 reels 5KV, 1/c 250 mcm, Symbol EPRSN Elec. Cable, Reel No. D15-01-21 1930', Reel No. D15-01-20 1960' Reel No. D15-01-19 1925'

32

IS ITEM FREE OF DAMAGE THAT COULD HAVE BEEN CAUSED BY:	Yes	No	N/A
EXPOSURE TO FIRE	X		
EXPOSURE TO HIGH TEMPERATURE	X		
PROLONGED EXPOSURE TO WEATHER	X		
ENVIRONMENTAL DAMAGE	X		
IMPROPER TIE-DOWN OR BLOCKING	X		
IMPROPER HANDLING	X		
EXTREME IMPACT	X		
IS SPECIFIED IDENTIFICATION STAMPED, ETCHED, STENCILED OR OTHERWISE MARKED ON THE ITEM OR ON TAGS SECURELY AFFIXED TO THE ITEM	X		
WAS MANUFACTURING DOCUMENTATION INCLUDED OR PREVIOUSLY RECEIVED	X		
DO COVERS AND SEALS MEET INTENDED PURPOSE	X		
ARE COATINGS AND PRESERVATIVES APPLIED IN ACCORDANCE WITH SPECIFICATIONS	X		
ARE INERT GAS BLANKET PRESSURES WITHIN ACCEPTABLE LIMITS			X
IS DESICCANT STILL EFFECTIVE			X
ARE ALL PARTS OF ITEMS NOT BROKEN, CRACKED, MISSING, DEFORMED OR MISALIGNED	X		

	Yes	No	N/A
DO ROTATING PARTS TURN WITHOUT BINDING			X
ARE ACCESSIBLE AREAS FREE OF DETRIMENTAL GOUGES, DENTS, SCRATCHES AND BURRS	X		
ARE ACCESSIBLE AREAS WITHIN SPECIFICATION REQUIREMENTS FOR DIRT, SOIL, MILL SCALE, WELD SPATTER, OIL, GREASE OR STAINS	X		
DO PHYSICAL PROPERTIES CONFORM TO SPECIFICATION REQUIREMENTS	X		
DO IMPORTANT DIMENSIONS CONFORM WITH DRAWINGS AND SPECIFICATIONS	X		
ARE WELD PREPARATIONS IN ACCORDANCE WITH APPLICABLE DRAWINGS AND SPECIFICATIONS			X
IS WORKMANSHIP SATISFACTORY TO MEET THE INTENT OF THE REQUIREMENTS	X		
IS THERE PRESENCE OF PROPER LUBRICANTS AND OILS IF REQUIRED			X
WAS PROPER CUSHIONING MATERIAL USED	X		
DOES INSULATION RESISTANCE TEST FOR MOTORS, GENERATORS, CONTROL AND POWER CABLE ENSURE CONFORMANCE WITH SPECIFICATIONS	X		
WAS THE RECEIVING INSPECTION PERFORMED IN AN AREA EQUIVALENT TO THE LEVEL OF STORAGE REQUIREMENT FOR THE ITEM	X		

REVIEWED & ACCEPTED

LEAD Q. C. ENGINEER

DATE APR 7 1977 SIG [signature]

* A NO is indicative of a non-conformance - see comments below:

COMMENTS None

See DISCREPANCY NOTICE NO. N/A

DISPOSITION: Q. C ACCEPTED STORAGE LEVEL C

Q. C. REPRESENTATIVE P. [signature]

WATERFORD STEAM ELECTRIC STATION
1977 - 1165 MW INSTALLATION - UNIT NO 3
QUALITY CONTROL
MATERIAL RECEIVING INSPECTION REPORT

MRR 701313

DATE: APR 06 1977

REPORT NO. MRIR 7703503

P.O.# NY403447 Supp. #6 VENDOR OKONITE Co.

SUBCONTRACT P.O.# N/A MANUFACTURER

HEAT # LOT OR BATCH # N/A

DESCRIPTION OF ITEM: #4 2 reels, 15 KV ¼c 750 mcm, Symbol EPRSN, Elect. Cable REEL NO. D-10-02-15 1595'

REEL NO. D-10-02-5 1302'

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IS ITEM FREE OF DAMAGE THAT COULD HAVE BEEN CAUSED BY:	Yes	No	N/A
EXPOSURE TO FIRE	X		
EXPOSURE TO HIGH TEMPERATURE	X		
PROLONGED EXPOSURE TO WEATHER	X		
ENVIRONMENTAL DAMAGE	X		
IMPROPER TIE-DOWN OR BLOCKING	X		
IMPROPER HANDLING	X		
EXTREME IMPACT	X		
IS SPECIFIED IDENTIFICATION STAMPED, ETCHED, STENCILED OR OTHERWISE MARKED ON THE ITEM OR ON TAGS SECURELY AFFIXED TO THE ITEM.	X		
WAS MANUFACTURING DOCUMENTATION INCLUDED OR PREVIOUSLY RECEIVED	X		
DO COVERS AND SEALS MEET INTENDED PURPOSE	X		
ARE COATINGS AND PRESERVATIVES APPLIED IN ACCORDANCE WITH SPECIFICATIONS	X		
ARE INERT GAS BLANKET PRESSURES WITHIN ACCEPTABLE LIMITS			X
IS DESICCANT STILL EFFECTIVE			X
ARE ALL PARTS OF ITEMS NOT BROKEN, CRACKED, MISSING, DEFORMED OR MISALIGNED	X		

	Yes	No	N/A
DO ROTATING PARTS TURN WITHOUT BINDING			X
ARE ACCESSIBLE AREAS FREE OF DETRIMENTAL GOUGES, DENTS, SCRATCHES AND BURRS	X		
ARE ACCESSIBLE AREAS WITHIN SPECIFICATION REQUIREMENTS FOR DIRT, SOIL, MILL SCALE, WELD SPATTER, OIL, GREASE OR STAINS	X		
DO PHYSICAL PROPERTIES CONFORM TO SPECIFICATION REQUIREMENTS	X		
DO IMPORTANT DIMENSIONS CONFORM WITH DRAWINGS AND SPECIFICATIONS	X		
ARE WELD PREPARATIONS IN ACCORDANCE WITH APPLICABLE DRAWINGS AND SPECIFICATIONS			X
IS WORKMANSHIP SATISFACTORY TO MEET THE INTENT OF THE REQUIREMENTS	X		
IS THERE PRESENCE OF PROPER LUBRICANTS AND OILS IF REQUIRED			X
WAS PROPER CUSHIONING MATERIAL USED	X		
DOES INSULATION RESISTANCE TEST FOR MOTORS, GENERATORS, CONTROL AND POWER CABLE ENSURE CONFORMANCE WITH SPECIFICATIONS	X		
WAS THE RECEIVING INSPECTION PERFORMED IN AN AREA EQUIVALENT TO THE LEVEL OF STORAGE REQUIREMENT FOR THE ITEM	X		

REVIEWED & ACCEPTED

LEAD Q. C. ENGINEER

DATE APR 7 1977 SIG:

* A NO is indicative of a non-conformance - see comments below:

COMMENTS None

See DISCREPANCY NOTICE NO. N/A

DISPOSITION: Q. C ACCEPTED STORAGE LEVEL C

Q. C. REPRESENTATIVE

IMPLEMENTATION OF QUALITY ASSURANCE PLAN FOR MECHANICAL OR ELECTRICAL ITEMS

SUPPLIER RECORDS/DOCUMENTATION CHECKLIST

CLIENT/PROJECT (1)	VENDOR, MANUFACTURER OR CONTRACTOR (2)	P O NO./SUPPL NO (3)
LOUISIANA POWER & LIGHT WATERFORD SES UNIT # 3	OKONITE CO.	NY403447

SPECIFICATION NO./REVISION NO. (4)	COMPONENT, PART OR SYSTEM DESCRIPTION (8)	SAFETY CLASS/SEISMIC CATEGORY (8)
Lou. 1564.266	5KV & 15 KV Power Cable	1E

SITE QAE RECORDS REVIEW CHECK LIST

DOCUMENTS RESULT OF TESTS, INSPECTIONS, ETC., TO BE CONTAINED IN QA RECORDS PACKAGE PRIOR TO SHIPMENT OF ITEMS, AS REQUIRED BY PURCHASE ORDER SPECIFICATION.

ITEM IDENTIFICATION (8)	PQAE CHECK IF REQUIRED (7)	REPORTS ON INSPECTION, TESTS, ETC.	Radiography	Radiographic Film*	Dye Penetrant	Magnetic Particle	Ultrasonic	Eddy Current	Visual	Hydrostatic	Leak	Performance – Mechanical	Performance – Electrical	Performance - Other	Resistance Measurements	No-Load Test	Load Test	Dielectric Tests	1. Applied Potential (Hi-Pot.)	2. Induced Voltage	3. Insulation Resistance (Megger)	4. Impulse Test	Flame Test	Temperature Test	Radiation Test	Post Loca Test	Other AGING - After air oven	Other AGING - After oil immersion	*VQAR to assure that RT film has been reviewed and NDE number has been assigned. Disposition of film shall be in accordance with specification requirements.	OTHER CERTIFICATIONS, REPORTS AND DOCUMENTS	Mill Test Reports	Material Certificates of Compliance	Welding Material Certifications	Dimensional Conformance	Welding Repair Maps	Welding Proc. Qualification(s)	Heat Treatment Records	Cleaning Records	Packaging Shipping Certifications/Records	Vendor QC Release Report(s)	Nonconformance Report(s) When Applicable	Code Data Report(s)	Manufacturer's Approved Seismic Report	Certification of Compliance to Specification	Other	Other	Other	Other	Other
DIS-01-19	✓																	X	X		X		X				X	X									X	X							
DIS-01-20	✓																																												
DIS-01-21	✓																																													

VQAR enter item identification (shaded area) of record package reviewed and check appropriate box when review of document is satisfactory.

PREPARED BY (PQAE OR DESIGNEE) (9)	DATE	REVISION NO./DATE (10)
[signature]	8-5-76	2 / 12-15-76

DOCUMENTATION PACKAGE (9) REVIEWED BY (VQAR) (11)	DATE	☐ VQAR CHECK IF ADDITIONAL PAGES USED (12)
[signature]	3/30/77	

IMPLEMENTATION OF QUALITY ASSURANCE PLAN FOR MECHANICAL OR ELECTRICAL ITEMS

SUPPLIER RECORDS/DOCUMENTATION CHECKLIST

PAGE _____ OF _____

CLIENT/PROJECT (1)	VENDOR, MANUFACTURER OR CONTRACTOR (2)	P O NO./SUPPL NO (3)
LOUISIANA POWER & LIGHT WATERFORD SES UNIT # 3	OKONITE CO.	NY403447

SPECIFICATION NO./REVISION NO. (4)	COMPONENT, PART OR SYSTEM DESCRIPTION (5)	SAFETY CLASS/SEISMIC CATEGORY (6)
Lou. 1564.266	5KV & 15 KV Power Cable	1E

SITE QAE RECORDS REVIEW CHECK LIST

DOCUMENTS RESULT OF TESTS, INSPECTIONS, ETC., TO BE CONTAINED IN QA RECORDS PACKAGE PRIOR TO SHIPMENT OF ITEMS, AS REQUIRED BY PURCHASE ORDER SPECIFICATION.

ITEM IDENTIFICATION (8)	PQAE CHECK IF REQUIRED (7)	REPORTS ON INSPECTION, TESTS, ETC.	Radiography	Radiographic Film*	Dye Penetrant	Magnetic Particle	Ultrasonic	Eddy Current	Visual	Hydrostatic	Leak	Performance – Mechanical	Performance – Electrical	Performance – Other	Resistance Measurements	No-Load Test	Load Test	Dielectric Tests	1. Applied Potential (Hi-Pot.)	2. Induced Voltage	3. Insulation Resistance (Megger)	4. Impulse Test	Flame Test	Temperature Test	Radiation Test	Post Loca Test	Other AGING – After air oven	Other AGING – After oil immersion	*VQAR to assure that RT film has been reviewed and NDE number has been assigned. Disposition of film shall be in accordance with specification requirements.	OTHER CERTIFICATIONS, REPORTS AND DOCUMENTS	Mill Test Reports	Material Certificates of Compliance	Welding Material Certifications	Dimensional Conformance	Welding Repair Maps	Welding Proc. Qualifications	Heat Treatment Records	Cleaning Records	Packaging Shipping Certifications/Records	Vendor QC Release Report(s)	Nonconformance Report(s) When Applicable	Code Data Report(s)	Manufacturer's Approved Seismic Report	Certification of Compliance to Specification	Other	Other	Other	Other	Other
D10-02-3																		X	X		X		X			X	X										X	X								
D10-02-15																		✓	✓		✓		✓			✓	✓										✓	✓								

VQAR enter item identification (shaded area) of record package reviewed and check appropriate box when review of document is satisfactory.

PREPARED BY (PQAE OR DESIGNEE) (9)	DATE	REVISION NO./DATE (10)
Willie J Tim	8-5-76	2 / 12-15-76

DOCUMENTATION PACKAGE(S) REVIEWED BY (VQAR) (11)	DATE	VQAR CHECK IF ADDITIONAL PAGES USED (12)
P Burgard	3/30/77	☐

1305-1/6-73

EBASCO SERVICES INCORPORATED

MATERIALS ENGINEERING & QUALITY COMPLIANCE DEPARTMENT

VENDOR QUALITY COMPLIANCE REPORT
RELEASE FOR SHIPMENT

Distribution:
White - Ebasco Chief Vendor QC Rep (for distribution per project distribution schedule)
Yellow - Vendor, Manufacturer or Contractor (for inclusion with shipment)
Pink - Ebasco Vendor QC Rep

PURCHASE ORDER NO. _____

CLIENT AND PROJECT		MANUFACTURER
P. O. COMPLETE ☐ YES ☒ NO	DATE 3-15-77	LOCATION N Brunswick New Jersey

The materials, equipment, fabrications described below are released by The Ebasco Vendor Quality Compliance Representative for shipment, subject to conditions and terms stated:

MATERIAL DESCRIPTION (Quantity, Size, Rating, Piece Mark, Mfrs. Serial No., etc.)

Cont: 5KV 1/c 250 MCM Symbol EPRSN 3 reels lengths as follows:

D15-9-1925, D15-01-20-1960 D15-0-21-[illegible]30 36

LIST AND EXPLAIN ANY DETECTED SPECIAL CONDITIONS AND DEVIATIONS FROM PURCHASE CONTRACT APPLICABLE TO THIS RELEASE. (If none, so state).

None

If required by the purchase contract, the Vendor, Manufacturer or Contractor has certified that the above described material meets all requirements of the purchase contract, drawings and specifications.

Evidence supporting this release has been reviewed and except as specified above and/or on Vendor's certification statement, no deviation from such requirements has been detected.

This document serves to release the above described material for shipment to the designated destination. It does not constitute an acceptance thereof and does not relieve the Vendor, Manufacturer or Contractor of any and all responsibility or obligation imposed by the purchase contract. It does not waive any rights the purchaser may have under the purchase contract, including the purchaser's right to reject the above described material upon discovery of any deviations from requirements of the purchase contract, drawings and specifications after arrival at destination.

REMARKS

BY _____
EBASCO VENDOR QC REPRESENTATIVE

THE OKONITE COMPANY
U. S. Highway #1
P.O. Box 67
North Brunswick, New Jersey 08902

Date 1 MARCH 1977

Report No. 921

Certified Test Report

Customer LOUISIANA POWER & LIGHT COMPANY

Customer Order No. NY-403447, SUP. 6 Item No. 1 Cable Code No. EPRSN

Okonite Order No. 03-5313-1 37

Applicable Specification(s): EBASCO 860-72, LOU 1564.266

Cable Description 1 CONDR., 250MCM (37 STRD.) ALUMINUM, 0.120" OKOGUARD
0.030" SC-EPR, SHIELDED, 0.080" OKOPRENE, 5KV

Quantity Ordered	Quantity Accepted for Shipment	Number of Reels
53,220 Ft.	5,815 Ft.	3

SHIPMENT CONSISTS OF REELS #61076-B3, #61076-B1 & #61075-A3

Statement of Compliance:

The above material has been manufactured and has met or exceeded all applicable requirements. We certify that the statements herein are true and the data presented are an accurate presentation of the tests conducted.

The Okonite Company

Engineer of Test

A. J. McTHOMAS

Sworn To and Subscribed Before Me
This 1ST Day of MARCH 1977

Notary Public

NOTARY PUBLIC, STATE OF NEW JERSEY
MY COMMISSION EXPIRES APRIL 3, 1977

REVIEWED BY

Q116-A

THE OKONITE COMPAN
U. S. Highway #1
P.O. Box 67
North Brunswick, New Jersey 08902

INSPECTION SHEET FOR WIRE AND CABLES

Electrical Test Dept.
Date 22 FEBRUARY 1977

CABLE CODE EPRSN

MFG Order 03-5313-1 Customer's Order NY-403447, SUP. 6 Item No. 1

For LOUISIANA POWER & LIGHT COMPANY Type Compound OKOGUARD - SC-EPR - OKOPRENE
(Insulation) (Ins/Jkt) (Jacket)

Spec. No. EBASCO 860-72, LOU-1564.266 Cable Description 1 CONDR., 250MCM (37 STRD.)

ALUMINUM, 0.120" OKOGUARD, 0.030" SC-EPR, SHIELDED, 0.080" OKOPRENE, 5KV

Electrical Requirements:

[redacted] Time 16.0 KV/ [redacted] Mins

[redacted] Time 45.0 KV/ 15 Mins.

[redacted] Value) 50,000

CEV (Min.) 11.0 KV ---

Test Conditions:

XXXXXXXX Final XXX Dry ____ (Min) Hours Immersed

Test Temp. 72°F F(C) Coeff. 1.58

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REQUIREMENTS			7300		.0722			Dimensional Data								
Okonite Cable No (Customers)	Length (Ft)	No of Conds	[redacted] at 15.6C	Cond Size	[redacted] Ohms/M 20C		Sequential Nos Tape Print			Jkt/Belt (Ave)	Jkt/Belt (Min)	Ins/Jkt (Shld) (Ave)	Ins/Jkt (Shld) (Min)	Insulation (Ave)	Insulation (Min)	Std Shld (Ave)	Std Shld (Min)
61076-B3	1,925	1	30900	250 MCM	.0693	T B		1.225" 1.230"		.080	.064	.030	.027	.120	.108		
[redacted]					1.56 CU. TAPE	T											
61076-B1	1,960	1	32200		.0702	T B		1.225" 1.235"									
[redacted]					1,61 CU. TAPE	T											
61075-A3	1,930	1	31700		.0698	T B		1.220" 1.215"		.100	.090	.031	.030	.115	.110		
[redacted]					1.87 CU. TAPE	T											
						T B											
						T B											
						T B											
						T B											
						T B											
						T B											
						T B											
						T B											
						T B											
						T B											
						T B											

REQUIREMENTS
Sample Identification: 61076-B3

Q-117A

Inspected and passed
For _____ Company
By _____ Inspector

REVIEWED BY

The Okonite Company
By _____
Engineer of Test
A. J. McTHOMAS

THE OKONITE COMPANY
U. S. Highway #1
P.O. Box 67
North Brunswick, New Jersey 08902

Physical Test Report

Date: 1 NOVEMBER 1976 Factory Order No.: 03-5313-1 Customer: LOUISIANA POWER & LIGHT CO.

Description: 1/C, 250MCM (37 STRD.) OKOGUARD SC-EPR, OKOPRENE, 5KV Specification: EBASCO 860-72

Following physical test data supports acceptance of cable shipped on the above factory order number.

Sample Identification (QC Length No.)	#61072-B2					
Physical and Aging Properties	Insulation		JACKET			
Unaged	Actual	Minimum Acceptable	Actual	Minimum Acceptable	Actual	Minimum Acceptable
Tensile Strength (PSI)	1360	700	2943	1800		
Elongation (%)	295	250	580	300		
Tensile Stress @200% (PSI)			822	500		
Set Test (%)			10.9	20 MAX.		
[redacted] Aging	168 Hrs. at 121 C.		168 Hrs. at 100 C.		___ Hrs. at ___ C.	
Tensile Strength	1410		2610			
% of Unaged	103.7	75.0	88.7	50.0		
Elongation	260		450			
% of Unaged	88.1	75.0	77.6	50.0		
After Air Pressure Heat Aging	42 Hrs. at 127 C. And 80 PSI		___ Hrs. at ___ C. And ___ PSI		___ Hrs. at ___ C. And ___ PSI	
Tensile Strength	1350					
% of Unaged	99.3	80.0				
Elongation	305					
% of Unaged	103.4	80.0				
After Oxygen Bomb Aging	___ Hrs. at ___ C. And ___ PSI		___ Hrs. at ___ C. And ___ PSI		___ Hrs. at ___ C. And ___ PSI	
Tensile Strength						
% of Unaged						
Elongation						
% of Unaged						
[redacted]	___ Hrs. at ___ C.		18 Hrs. at 121 C.		___ Hrs. at ___ C.	
Tensile Strength			2310			
% of Unaged			78.5	60.0		
Elongation			525			
% of Unaged			90.5	60.0		
Miscellaneous Tests						

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REVIEWED BY
A. E. Hilliard 11/4/76
EBASCO VOA REP.

WIRE AND CABLE DIVISION
THE OKONITE COMPANY
P.O. Box 67 U.S. Highway #1
North Brunswick, NJ 08902
201-247-0680

CUSTOMER: LOUISIANA POWER & LIGHT COMPANY

ORDER NO: 03-5313-1

QUALITY CONTROL NO. [redacted]B2

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	VOLUME RESISTIVITY OHM-CM		
	90°C	110°C	130°C
SPECIFICATION	100,000 MAX.	---	100,000 MAX.
CONDUCTOR SHIELD	472	---	530
SPECIFICATION	50,000 MAX.	50,000 MAX.	---
INSULATION SHIELD	240	300	---

	OBSERVED	SPECIFICATION
[redacted]	PASSED	PASSED, NO AFTER BURN
STRIPPABILITY	10-9-11 LBS.	1/2" STRIPS AT ROOM TEMP. 4 TO 18 LBS.
SOLVENT EXTRACTION TEST ON WAFER 15X	PASSED	INSUL. SURFACE COVER
DIMENSIONAL STABILITY	0	160 MILS MAX.
MECHANICAL MOISTURE	35.72	40.0 MAX.
VOID & CONTAMINATION 15X	PASSED	10.0 MILS MAX.
VOID & CONTAMINATION 40X	PASSED	10.0 MILS MAX.
HEAT DISTORTION	4.65	10% MAX.

PREPARED BY: G. WILLS

REVIEWED BY
A. E. Mathis 7/6
EBASCO VQA REP.

THE OKONITE COMPANY
U. S. Highway #1
P.O. Box 67
North Brunswick, New Jersey 08902

Physical Test Report

Date: 1 NOVEMBER 1976 Factory Order No.: 03-5313-1 Customer: LOUISIANA POWER & LIGHT CO.

Description: 1/C, 250MCM (37 STRD.) OKOGUARD SC-EPR, OKOPRENE, 5KV Specification: EBASCO 860-72

Following physical test data supports acceptance of cable shipped on the above factory order number.

Sample Identification (QC Length No.)	#61073-A2					
Physical and Aging Properties	Insulation		JACKET			41
Unaged	Actual	Minimum Acceptable	Actual	Minimum Acceptable	Actual	Minimum Acceptable
Tensile Strength (PSI)	1337	700	2857	1800		
Elongation (%)	300	250	530	300		
Tensile Stress @200% (PSI)			775	500		
Set Test (%)			9.4	20 MAX.		
[redacted]g	168 Hrs. at 121 C.		168 Hrs. at 100 C.		___ Hrs. at ___ C.	
Tensile Strength	1397		2597			
% of Unaged	104.5	75.0	90.9	50.0		
Elongation	270		400			
% of Unaged	90.0	75.0	75.5	50.0		
After Air Pressure Heat Aging	42 Hrs. at 127 C. And 80 PSI		___ Hrs. at ___ C. And ___ PSI		___ Hrs. at ___ C. And ___ PSI	
Tensile Strength	1367					
% of Unaged	102.2	80.0				
Elongation	310					
% of Unaged	103.3	80.0				
After Oxygen Bomb Aging	___ Hrs. at ___ C. And ___ PSI		___ Hrs. at ___ C. And ___ PSI		___ Hrs. at ___ C. And ___ PSI	
Tensile Strength						
% of Unaged						
Elongation						
% of Unaged						
[redacted]	___ Hrs. at ___ C.		18 Hrs. at 121 C.		___ Hrs. at ___ C.	
Tensile Strength			2252			
% of Unaged			78.8	60.0		
Elongation			505			
% of Unaged			95.3	60.0		
Miscellaneous Tests						

REVIEWED BY
O. E. Mathur 11/16/76
EBASCO VQA REP.

WIRE AND CABLE DIVISION
THE OKONITE COMPANY
P.O. Box 67 U.S. Highway #1
North Brunswick, N.J. 08902
201-247-0580

CUSTOMER: LOUISIANA POWER & LIGHT COMPANY

ORDER NO: 03-5313-1

QUALITY CONTROL NO. 61073-A2

	VOLUME RESISTIVITY OHM-CM		
	90°C	110°C	130°C
SPECIFICATION	100,000 MAX.	---	100,000 MAX.
CONDUCTOR SHIELD	510	---	562
SPECIFICATION	50,000 MAX.	50,000 MAX.	---
INSULATION SHIELD	240	325	---

	OBSERVED	SPECIFICATION
VERTICAL FLAME	PASSED	PASSED, NO AFTER BURN
STRIPPABILITY	8-9-7 LBS.	1/2" STRIPS AT ROOM TEMP. 4 TO 18 LBS.
SOLVENT EXTRACTION TEST ON WAFER 15X	PASSED	INSUL. SURFACE COVER
DIMENSIONAL STABILITY	0	160 MILS MAX.
MECHANICAL MOISTURE	34.52	40.0 MAX.
VOID & CONTAMINATION 15X	PASSED	10.0 MILS MAX.
VOID & CONTAMINATION 40X	PASSED	10.0 MILS MAX.
HEAT DISTORTION	2.87	10% MAX.

PREPARED BY: G. WILLS

REVIEWED BY
A. E. 11/4/76
EBASCO QA REP.

THE OKONITE COMPANY

Post Office Box 340
Ramsey, New Jersey 07446
201-825-0300/Cable: Okonite

CERTIFICATION
FOR

Louisianna Power & Light Co. - Waterford Nuclear Station
Order #NY403447

We certify that the Okoguard insulating compound being supplied on your order meets the following requirements:

ACCELERATED WATER ABSORPTION: EM 60 Electrical Method: After immersion in 75°C water, the Okoguard insulation does not exceed the following values when tested in accordance with IPCEA methods:

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Dielectric Constant (SIC)		
After 24 hours immersion, max	3.5	---
After 14 days immersion, max.	3.5	(4.0)
Power Factor		
After 14 days immersion, max %	1.5	(1.5)
Electrical Stability		
Increase in capacitance 1-14 days, max %	3.0	(3.0)
Increase in capacitance 7-14 days,	1.5	(1.5)
Stability factor after 14 days, max %	1.0	(1.0)

We certify that actual tests have been performed in our laboratory as indicated above and the formulations released to our manufacturing plants for the Okoguard insulation is of the identical recipes.

Because of the bonded semiconductive EP insulation shield covering, these tests cannot be performed on production samples nor are they required to be performed per IPCEA specifications.

knm

Dr. J. S. Lasky
Vice President-Research/
Engineering

Subscribed and sworn to before
me this 3rd day of
November 1976.

James D. Cleaver
Notary Public
Bergen County, New Jersey

REVIEWED BY
A. E. Hoffman 11/4/76
[illegible] VEA REP.

THE OKONITE COMPANY
959 Market Street
Paterson, New Jersey 07513

CERTIFIED TEST REPORT

DATE November 4, 1975

CUSTOMER Louisiana Power & Light Co.

CUSTOMER'S ORDER NO. NY403447

MANUFACTURING ORDER NO. 03-5313-3 CODE NO.

SPECIFICATION APPLYING: CUSTOMER'S AEIC No. 6-73

MANUFACTURING

IPCEA

CABLE DESCRIPTION 500kcm aluminum, 175 mils Okoguard shielded Okoprene 15kV Cable

QUANTITY 35 foot sample

CABLE HAS BEEN TESTED TO THE ABOVE SPECIFICATION. THE FOLLOWING TESTS WERE PERFORMED:

a. Structural Stability Test
b. AC High Voltage Time Test

SWORN TO AND SUBSCRIBED BEFORE ME

THIS ___ DAY OF ___ 19__

Notary Public

REVIEWED BY
a. e. 11/4/75
EBASCO VGA REP.

We hereby certify this to be a true and Accurate copy of results of tests Conducted in Accordance with orders And specifications listed.

THE OKONITE COMPANY
Paterson, New Jersey 07513

Engineer of Tests

Cable Construction: 500-37x kcmil aluminum standard concentric conductor, 25 mils extruded semiconducting strand screen, 175 mils Okoguard insulation, 40 mils extruded semiconducting insulation screen, 1" x 5 mil tinned copper shield tape, mylar tape, tape, 80 mils neoprene jacket, 15kV.

Test Results

(a) Structural Stability Test: Test consists of measuring %Power Factor and Corona Discharge levels both initially and after subjecting sample to conductor loading to obtain 6 hours each at 90C and 130C conductor temperatures; measurements obtained at ambient temperature. Current required for 90C - 725 amperes, for 130C - 860 amperes. 45

	Initial	After Heating
%Power Factor at 25C, 8.7kV (operating voltage)	0.412	0.370
Corona Discharge, Picocoulombs, at 27kV (150v/mil)	0	0

(b) AC High Voltage Time Test: Above sample subjected to the following voltage levels, at ambient temperature:

Time	Average Stress, Volts/mil (Based on Wall thickness)	Applied Voltage kV		
4 hrs.	200	35.0	Cable	Passed
1 hr.	300	52.5	"	"
1 hr.	360	63.	"	"
1/2 hr.	400	70.	"	"
"	440	77.	"	"
"	480	84.	"	"
"	520	91.	"	"
"	560	98.	"	"
"	600	105.	"	"
"	640	112.	"	"
"	680	119.	"	"
"	720	126.	"	"

After 20 minutes at the next step, 760 v/mil - 133kV, a cable failure occured approximately 10 feet from the base of one terminal. Failure was a straight radial puncture.

Rocke LaBozetta

Rocke LaBozetta

REVIEWED BY
a. e. Mathur 11/11/76
EBASCO VQA REP.

THE OKONITE COMPANY

Post Office Box 340
Ramsey, New Jersey 07446
201 825 0300 Cable: Okonite

VERTICAL TRAY FLAME TEST

IEEE Standard No. 383

Criteria: The flame test is to be sufficiently severe to demonstrate that the cable does not propagate fire even after its outer covering and insulation have been destroyed in the area of flame impingement.

Test Specimens: Test specimens are 7/C #12 AWG multi-conductor control cable.

Flame Test Facility & Procedure: Test is conducted in a naturally ventilated room free from excessive drafts and spurious air currents. 46

The vertical tray is a metal ladder type, three inches deep and not less than six inches wide and eight feet high.

Multiple lengths of cable are arranged in a single layer filling the entire tray and with a separation of approximately one-half the cable diameter between each cable and between cable and side rails.

The flame source is a gas ribbon burner rated 7,000 BTU/hour/inch or 70,000 BTU/hour for its total width. It is manufactured by American Gas Furnace Company, 10 inches wide; 11-15-drilling, ribbon type; Catalog #10X11-55 with air-gas Venturi mixture; Catalog #14-18 (2PSIG max. pressure). The burner is mounted horizontally such that the flame impinges on the specimens midway between the tray rungs, and so that the burner face is 3 inches behind and approximately two feet above the bottom of the vertical tray. Due to the uniform heat content, Natural Grade propane is preferred in place of commercial gas.

The flame temperature is 1400-1500° F measured by a thermocouple located in the flame close to but not touching the surface of the test specimens.

Under dynamic conditions, the propane pressure is -2.6 ±0.3 cm of water at the supply side of the Venturi mixture.

When using commercial gas the pressure is -0.9 ±0.1 cm of water measured at the supply side of the Venturi misture. For propane gas, the air pressure is 4.3 ±0.5 cm. For commercial gas, it is 5.6 ±0.5 cm of water, measured at the air inlet to the mixer.

The gas burner is ignited and allowed to burn for 20 minutes. The temperature at the point of impingement is recorded throughout the test, length of time flame persists after the gas burner is shut off, jacket char distance and distance insulation is damaged are also recorded.

Evaluation: Cables which propagate and burn the total height of the tray fail the test. Cables which self-extinguish when flame source is removed pass the test. Cables which continue to burn after the flame source is shut off or burns out are allowed to burn to determine if propagation will occur.

REVIEWED BY
a. e. 11/16/76
EBASCO YORK

Signed and subscribed before me
this 12th day of January, 1976.

R. A. Guba
Manager, Utility Marketing

Specimen 1/C 4/0 AWG copper, extruded strand screen, .175" Okoguard insulation, extruded insulation screen, copper tape, .080" Okolon jacket.

Flame Source 70,000 BTU Gas Burner

Exposed Vertical Length 73 inches

Test Time Minutes	Temp. °F Max.	Flame Height (inches)
1	1320	27
2	1560	25
3	1540	24
4	1510	27
5	1500	26
6	1500	27
7	1480	28
8	1470	28
9	1470	28
10	1470	28
11	1450	28
12	1450	27
13	1440	26
14	1440	26
15	1450	26
16	1450	27
17	1450	29
18	1460	27
18	1400	32
20	1400	34

Afterburn min. sec. - 1 - 05
Core Damage - 27 inches
Jacket Char - 29 inches
Propagate - No

THE OKONITE COMPANY
U. S. Highway #1
P.O. Box 67
North Brunswick, New Jersey 08902

Quality Assurance
Traceability Schematic

Customer LOUISIANA POWER & LIGHT COMPANY Factory Order No. 03-5313-1

Construction 1 CONDR., 250MCM (37 STRD.) ALUM., OKOGUARD, SC-EPR, SHLD., OKOPRENE, 5KV

Prepared By: J. P. DOLAN

Shipping Reel Q.C. Length Number	Length (ft.)	Customer Reel Number (where applicable)	Q.C. No. Single Conductors In Finished Cable	Sequential Q.C. No. of Single Conductors In Finished Cable*	Approved Compound Identification (Batch/Lot Nos.)			
					Single Conductor			Cable
					Ext. Strand Shield	Insulation	Insulation Jacket (Shield)	Jacket
61076-B3	1,925	D-15-01-19	61076-B	61075	271488	8037	271452	5733
					271487	3969	271451	5775
						3996	271492	5895
						7371		5640
								5896
61076-B1	1,960	D-15-01-20	61076-B	61076	271487	7239	271452	DITTO
						7240	271492	
						7372		
						7241		
61075-A3	1,930	D-15-01-21	61075-A					5735
								5646
								5734
								5639

*Optional Use For Multiconductor Constructions NA = Not Applicable

Q 130A

THE OKONITE COMPANY
U. S. Highway #1
P.O. Box 67
North Brunswick, New Jersey 08902

Date 1 MARCH 1977

Report No. 922

Certified Test Report

Customer LOUISIANA POWER & LIGHT COMPANY

Customer Order No. NY-403447, SUP. 6 Item No. 4 Cable Code No. EPRSN

Okonite Order No. 03-5313-4 49

Applicable Specification(s): EBASCO 860-72, LOU 1564.266

Cable Description 1 CONDR., 750MCM (61 STRD.) TINNED COPPER, 0.175" OKOGUARD
0.040" SC-EPR, SHIELDED, 0.110" OKOPRENE, 15KV

Quantity Ordered	Quantity Accepted for Shipment	Number of Reels
20,700 Ft.	2,887 Ft.	2

SHIPMENT CONSISTS OF REELS #61071-A2 & #61067-B

Statement of Compliance:

The above material has been manufactured and has met or exceeded all applicable requirements. We certify that the statements herein are true and the data presented are an accurate presentation of the tests conducted.

The Okonite Company

Engineer of Test
A. J. McTHOMAS

Sworn To and Subscribed Before Me
This 1ST Day of MARCH 1977

Notary Public

NOTARY PUBLIC, STATE OF NEW JERSEY
MY COMMISSION EXPIRES APRIL 3, 1977

REVIEWED BY
3/15/77
REP.

Q116-A

THE OKONITE COMPANY
U. S. Highway #1
P.O. Box 67
North Brunswick, New Jersey 08902

INSPECTION SHEET FOR WIRE AND CABLES

Electrical Test Dept.
Date 22 FEBRUARY 1977

CABLE CODE EPRSN

MFG. Order 03-5313-4 Customer's Order NY-403447, SUP. 6 Item No. 4

For LOUISIANA POWER & LIGHT COMPANY Type Compound OKOGUARD - SC-EPR - OKOPRENE
EBASCO 860-72 (Insulation) (Ins./Jkt.) (Jacket)

Spec. No. LOU 1564.266 Cable Description 1 CONDR., 750MCM (61 STRD.) TINNED

COPPER, 0.175" OKOGUARD, 0.040" SC-EPR, SHIELDED, 0.110" OKOPRENE, 15KV

Electrical Requirements:

A-C Voltage/Time 27.0 KV/ 5 Mins

D-C Voltage/Time 70.0 KV/ 15 Mins.

I R Constant (K Value) 50,000

CEV (Min.) 19.3 KV

Test Conditions:

XXXXXXXXX Final XXX Dry (Min) Hours Immersed

50

Test Temp. 72°F F(C) Coeff. 1.58

REQUIREMENTS			7500		.0151			Dimensional Data										
Okonite Cable No. (Customers)	Length (Ft.)	No. of Conds.	IR MEGS-mft. at 15.6C	Cond. Size	DC Cond. Resistance OHM/mft. 20C	Sequential Nos. Tape/Print	OVERALL DIAMETER			Jkt./Belt		Shld. (Shld.)		Ins./Jkt.		Insulation		Sig. Shld.
										(Ave.)	(Min.)	(Ave.)	(Min.)	(Ave.)	(Min.)	(Ave.)	(Min.)	(Ave.)
[redacted]	,302	1	28000	750 MCM	.0138	T / B	1.830" / 1.870"			.110	.088	.040	.036	.056	.055	.175	.190	
[redacted]					0.60 CU. TAPE	T												
[redacted]	,585	1	29100		.0137	T / B	1.825" / 1.820"											
[redacted]					1.06 CU. TAPE	T												

REQUIREMENTS Sample Identification: 61071-A2

Q-117A

Inspected and passed

For [redacted] Company

By [redacted] Inspector

REVIEWED BY

The Okonite Company

By [signature]
Engineer of Test
A. J. McTHOMAS

THE OKONITE COMPANY
U. S. Highway #1
P.O. Box 67
North Brunswick, New Jersey 08902

Physical Test Report

Date: 2 NOVEMBER 1976 Factory Order No.: 03-5313-4 Customer: LOUISIANA POWER & LIGHT CO.

Description: 1/C, 750MCM (61 STRD.) OKOGUARD GC-EPR , OKOPRENE, 15KV Specification: EBASCO 860-72

Following physical test data supports acceptance of cable shipped on the above factory order number.

Sample Identification (QC Length No.)	#61071-B4					
Physical and Aging Properties	Insulation		JACKET			
Unaged	Actual	Minimum Acceptable	Actual	Minimum Acceptable	Actual	Minimum Acceptable
Tensile Strength (PSI)	1176	700	2693	1800		
Elongation (%)	300	250	600	300		
Tensile Stress @200% (PSI)			653	500		
Set Test (%)			9.4	20 MAX.		
[redacted]	168 Hrs. at 121 C.		168 Hrs. at 100 C.		___ Hrs. at ___ C.	
Tensile Strength	1264		2408			
% of Unaged	107.5	75.0	89.4	50.0		
Elongation	285		460			
% of Unaged	95.0	75.0	76.7	50.0		
After Air Pressure Heat Aging	42 Hrs. at 127 C. And 80 PSI		___ Hrs. at ___ C. And ___ PSI		___ Hrs. at ___ C. And ___ PSI	
Tensile Strength	1205					
% of Unaged	102.5	80.0				
Elongation	295					
% of Unaged	98.3	80.0				
After Oxygen Bomb Aging	___ Hrs. at ___ C. And ___ PSI		___ Hrs. at ___ C. And ___ PSI		___ Hrs. at ___ C. And ___ PSI	
Tensile Strength						
% of Unaged						
Elongation						
% of Unaged						
[redacted]	___ Hrs. at ___ C.		18 Hrs. at 121 C.		___ Hrs. at ___ C.	
Tensile Strength			2163			
% of Unaged			80.3	60.0		
Elongation			510			
% of Unaged			85.0	60.0		
Miscellaneous Tests	REVIEWED BY A. C. Mathur 11/16/76 EBASCO QA REP.					

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WIRE AND CABLE DIVISION
THE OKONITE COMPANY
P.O Box 67 U.S. Highway #1
North Brunswick, N.J. 08902
201-247-0500

CUSTOMER: LOUISIANA POWER & LIGHT COMPANY

ORDER NO: 03-5313-4

QUALITY CONTROL NO. [redacted]

52

	VOLUME RESISTIVITY OHM-CM		
	90°C	110°C	130°C
SPECIFICATION	100,000 MAX.	---	100,000 MAX.
CONDUCTOR SHIELD	540	---	582
SPECIFICATION	50,000 MAX.	50,000 MAX.	---
INSULATION SHIELD	220	325	---

	OBSERVED	SPECIFICATION
[redacted]	PASSED	PASSED, NO AFTER BURN
STRIPPABILITY	9-10-9 LBS.	1/2" STRIPS AT ROOM TEMP. 4 TO 18 LBS.
SOLVENT EXTRACTION TEST ON WAFER 15X	PASSED	INSUL. SURFACE COVER
DIMENSIONAL STABILITY	0	160 MILS MAX.
MECHANICAL MOISTURE	36.17	40.0 MAX.
VOID & CONTAMINATION 15X	PASSED	10.0 MILS MAX.
VOID & CONTAMINATION 40X	PASSED	10.0 MILS MAX.
HEAT DISTORTION	3.00	10% MAX.

PREPARED BY: G. WILLS

REVIEWED BY
A. E. Mattur
11/16/76
EBASCO VQA REP.

THE OKONITE COMPANY

Post Office Box 340
Ramsey, New Jersey 07446
201-825-0300/Cable: Okonite

CERTIFICATION
FOR

Louisianna Power & Light Co. - Waterford Nuclear Station
Order #NY403447

We certify that the Okoguard insulating compound being supplied on your order meets the following requirements:

ACCELERATED WATER ABSORPTION: EM 60 Electrical Method: After immersion in 75°C water, the Okoguard insulation does not exceed the following values when tested in accordance with IPCEA methods:

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Dielectric Constant (SIC)

After 24 hours immersion, max	3.5	---
After 14 days immersion, max.	3.5	(4.0)

Power Factor

After 14 days immersion, max %	1.5	(1.5)

Electrical Stability

Increase in capacitance 1-14 days, max %	3.0	(3.0)
Increase in capacitance 7-14 days,	1.5	(1.5)
Stability factor after 14 days, max %	1.0	(1.0)

We certify that actual tests have been performed in our laboratory as indicated above and the formulations released to our manufacturing plants for the Okoguard insulation is of the identical recipes.

Because of the bonded semiconductive EP insulation shield covering, these tests cannot be performed on production samples nor are they required to be performed per IPCEA specifications.

knm

Dr. J. S. Lasky
Vice President-Research/
Engineering

Subscribed and sworn to before
me this 3rd day of
November 1976.

James D. Cleaver
Notary Public
Bergen County, New Jersey

REVIEWED BY
A. E. 11/11/76
EBASCO VQA REP.

THE OKONITE COMPANY
959 Market Street
Paterson, New Jersey 07513

CERTIFIED TEST REPORT

DATE November 4, 1976

CUSTOMER Louisiana Power & Light Co.

CUSTOMER'S ORDER NO. MY403447

MANUFACTURING ORDER NO. 03-5313-3 CODE NO. 54

SPECIFICATION APPLYING: CUSTOMER'S AEIC No. 6-73

MANUFACTURING

IPCEA

CABLE DESCRIPTION 500kcm aluminum, 175 mils Okoguard shielded Okoprene 15kV Cable

QUANTITY 35 foot sample

CABLE HAS BEEN TESTED TO THE ABOVE SPECIFICATION. THE FOLLOWING TESTS WERE PERFORMED:

a. Structural Stability Test
b. AC High Voltage Time Test

SWORN TO AND SUBSCRIBED BEFORE ME

THIS ___ DAY OF ___ 19__

Notary Public

REVIEWED BY
[illegible]
EBASCO VGA REP.

We hereby certify this to be a true and Accurate copy of results of tests Conducted in Accordance with orders And specifications listed.

THE OKONITE COMPANY
Paterson, New Jersey 07513

Engineer of Tests

Cable Construction: 500-37x kcmil aluminum standard concentric conductor, 25 mils extruded semiconducting strand screen, 175 mils Okoguard insulation, 40 mils extruded semiconducting insulation screen, 1" x 5 mil tinned copper shield tape, mylar tape, tape, 80 mils neoprene jacket, 15kV.

Test Results

(a) Structural Stability Test: Test consists of measuring %Power Factor and Corona Discharge levels both initially and after subjecting sample to conductor loading to obtain 6 hours each at 90C and 130C conductor temperatures; measurements obtained at ambient temperature. Current required for 90C - 725 amperes, for 130C - 860 amperes.

55

	Initial	After Heating
%Power Factor at 25C, 8.7kV (operating voltage)	0.412	0.370
Corona Discharge, Picocoulombs, at 27kV (150v/mil)	0	0

(b) AC High Voltage Time Test: Above sample subjected to the following voltage levels, at ambient temperature:

Time	Average Stress, Volts/mil (Based on Wall thickness)	Applied Voltage kV		
4 hrs.	200	35.0	Cable	Passed
1 hr.	300	52.5	"	"
1 hr.	360	63.	"	"
1/2 hr.	400	70.	"	"
"	440	77.	"	"
"	480	84.	"	"
"	520	91.	"	"
"	560	98.	"	"
"	600	105.	"	"
"	640	112.	"	"
"	680	119.	"	"
"	720	126.	"	"

After 20 minutes at the next step, 760 v/mil - 133kV, a cable failure occured approximately 10 feet from the base of one terminal. Failure was a straight radial puncture.

Rocke LaBozetta

Rocke LaBozetta

REVIEWED BY
A. C. Maitur 11/16/76
APPROVED FOR REP

THE OKONITE COMPANY

P.O. Box 340
Ramsey, New Jersey 07446
201 825 0100 Cable: Okonite

VERTICAL TRAY FLAME TEST

IEEE Standard No. 383

Criteria: The flame test is to be sufficiently severe to demonstrate that the cable does not propagate fire even after its outer covering and insulation have been destroyed in the area of flame impingement.

Test Specimens: Test specimens are 7/C #12 AWG multi-conductor control cable.

[redacted] Test is conducted in a naturally ventilated room free from excessive drafts and spurious air currents. 56

The vertical tray is a metal ladder type, three inches deep and not less than six inches wide and eight feet high.

Multiple lengths of cable are arranged in a single layer filling the entire tray and with a separation of approximately one-half the cable diameter between each cable and between cable and side rails.

The flame source is a gas ribbon burner rated 7,000 BTU/hour/inch or 70,000 BTU/hour for its total width. It is manufactured by American Gas Furnace Company, 10 inches wide; 11-15-drilling, ribbon type; Catalog #10X11-55 with air-gas Venturi mixture; Catalog #14-18 (2PSIG max. pressure). The burner is mounted horizontally such that the flame impinges on the specimens midway between the tray rungs, and so that the burner face is 3 inches behind and approximately two feet above the bottom of the vertical tray. Due to the uniform heat content, Natural Grade propane is preferred in place of commercial gas.

The flame temperature is 1400-1500° F measured by a thermocouple located in the flame close to but not touching the surface of the test specimens.

Under dynamic conditions, the propane pressure is -2.6 ±0.3 cm of water at the supply side of the Venturi mixture.

When using commercial gas the pressure is -0.9 ±0.1 cm of water measured at the supply side of the Venturi misture. For propane gas, the air pressure is 4.3 ±0.5 cm. For commercial gas, it is 5.6 ±0.5 cm of water, measured at the air inlet to the mixer.

The gas burner is ignited and allowed to burn for 20 minutes. The temperature at the point of impingement is recorded throughout the test, length of time flame persists after the gas burner is shut off, jacket char distance and distance insulation is damaged are also recorded.

Evaluation: Cables which propagate and burn the total height of the tray fail the test. Cables which self-extinguish when flame source is removed pass the test. Cables which continue to burn after the flame source is shut off or burns out are allowed to burn to determine if propagation will occur.

REVIEWED BY
a. e. Mathur
11/4/76
EBASCO VQA REP.

Signed and subscribed before me
this 12th day of January, 1976.

R. A. Guba
Manager, Utility Marketing

XNG-4 Rev. 1 (1-76)

Specimen 1/C 4/0 AWG copper, extruded strand screen, .175" Okoguard insulation, extruded insulation screen, copper tape, .080" Okolon jacket.

Flame Source 70,000 BTU Gas Burner

Exposed Vertical Length 73 inches

Test Time Minutes	Temp. °F Max.	Flame Height (inches)
1	1520	27
2	1560	25
3	1540	24
4	1510	27
5	1500	26
6	1500	27
7	1480	28
8	1470	28
9	1470	28
10	1470	28
11	1450	28
12	1450	27
13	1440	26
14	1440	26
15	1450	26
16	1450	27
17	1450	29
18	1460	27
18	1400	32
20	1400	34

57

Afterburn min. sec. - 1 - 05
Core Damage - 27 inches
Jacket Char - 29 inches
Propagate - No

REVIEWED BY
U. E. Mettus
4/16/76
EBASCO VQA REP.

THE OKONITE COMPANY
U. S. Highway #1
P.O. Box 67
North Brunswick, New Jersey 08902

Quality Assurance
Traceability Schematic

Customer LOUISIANA POWER & LIGHT COMPANY Factory Order No. 03-5313-4

Construction 1 CONDR., 750MCM (61 STRD.) TINNED COPPER, OKOGUARD, SC-EPR, OKOPRENE, 15KV

Prepared By: J. P. DOLAN

Shipping Reel Q.C. Length Number	Length (ft.)	Customer Reel Number (where applicable)	Q.C. No. Single Conductors In Finished Cable	Sequential Q.C. No. of Single Conductors In Finished Cable*	Approved Compound Identification (Batch/Lot Nos.)			
					Single Conductor			Cable
					Ext. Strand Shield	Insulation	Insulation Jacket (Shield)	Jacket
61071-A2	1,302	D-10-02-5	61071-A	61067	272600	7246	272560	7327
						7251	272559	7284
						7252	271479	5732
						5676	271478	5628
						7249	291476	7283
						7021	291475	5966
						7025		
61067-B	1,585	D-10-02-15	61067	61071	272472	3992	272558	7333
						3980	271495	7330
						3985		7334
								7336
								7331

REVIEWED BY

*Optional Use For Multiconductor Constructions NA = Not Applicable

Q-130A

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Reviewer: R. LaGrange

Date: 1/5/83
Comment No.: 17
Page 1 of 7
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Splices	Okonite	T-95 inr.tape No. 35 junc.tape	T-95 No. 35	606

COMMENTS	RESOLUTION
1) Did the cable used in the long term water immersion test (pages D36 and D37) include splices? Were they aged, tested samples, or new?	1) The test report clearly envelopes the inclusion of both cables and splices (e.g. package report page D1, D2, D3, etc.). Page D31 clearly states that the Okonite T-95 and #35 tape was used including full accident profile. The vendors report package page D3 ties the qualification report and its results to IEEE Std 383-1974 for cables and splices. IEE 383-1974 paragraph 2-3 provides the tie to the IPCEA/NEMA and AEIC standards described in comment resolution 23. The attached catalog cut also includes the vendor tie to IEEE383. The test report includes on page D31 the clear statement that "the unaged and radiated sample and thermally aged and radiated sample were then placed in a autoclave and subjected to the temperatrue-pressure profile for simulation of a LOCA condition. This profile is shown in Figure II, at ached".
2) Rad. T.I.D. of 1.97×10^7 on QDEF is incorrect.	
3) A water immersion test is not technically valid to qualify for submergence unless done under pressures that would exist in containment following the accident <u>after</u> the splices become submerged. Additionally, the cable and splices should have gone through the entire test sequence prior to a submergence test. Page D4 states the aged, tested splices were immersed only 5 min. Why is this plus the long term immersion test sufficient to demonstrate qualification for submergence?	The test profile included very significant margin above the pressure profile of WSES-3 (refer to figure E2-16.2 W3, page E6 of package). Combined with this profile is the significant accident temperature transients. Against this severe steam/pressure combined test capabiltiy we have the submergence concern which by definition must be at a much lower temperature (to have water not steam) and pressure (even accounting for a water head). Conservatively assuming that splices are at the lowest level of the safety injection sump which is, -11.00 feet per General Arrangement Dwg. LOU-1564 G146, we have a total water head to the maximum water level of 11.5 feet. Using the standard conversion factor of 2.3 feet of water per 1 psi we have 5 psi attributable to this water head. Consequently the total water head, which combines 44 psig accident pressure peak with 5 psi of water head, results in total water pressure on the splice of 63.7 psi. The package tested LOCA curve shows a peak of 113 psig or 127.7 psi. Consequently proving a margin [(127.7-63.7)/63.7]x100=100% or twice the
4) If a thermal leg analysis was done to account for the test profile not enveloping the required temp. profile, it should be included (or referenced) in the qualification package. If not, it should be stated that the period of time the period is not enveloped is not sufficiently long to cause the splice temp. to increase above the test profile temp.	

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Splices	Okonite	T-95 Inr.tape No.35 juct.tape	T-95 No.35	606

COMMENTS	RESOLUTION
4) Cont'd NOTE: Were the cable(s) these splices are to be used on that are subject to submergence tested as above to demonstrate qualification for submergence?	1) Cont'd necessary requirements. Furthermore, the long term immersion testing of Okonite has included splices. Mr. Etore Bartolucci, Sr. Applications Engineer at Okonite, confirmed this in a telecon on 1/5/82. Okonite will transmit a copy of additional long term immersion testing data to LP&L which provides specific SIC, SIR and PF values demonstrating long term stability equivalent to comment resolution 23. 2) The manual entry on the QDEF's prepared prior to the audit to assure currency of data led to this inconsistency. Use of the computerized zone file will assure this inconsistency will not reoccur. 3) Already resolved in response 1 above. Furthermore, as indicated in the EQ Guidebook Section 7.6, no safety related equipment required to function subsequent to flooding is below the flood level. As the splices/terminations are at the equipment, there are no splices/terminations below the flood level required to function "post-flooding". CP307 which is the Construction procedure for terminations will be revised to specifically prohibit splices/terminations using this Okonite material below elevation 0.5 feet (in-containment flood level). 4) Reference can be made to the FSAR analysis in Section 6.2.1 is being placed in package 6.1W3. However, the key to the demonstration that the very short transient is enveloped by the qualification is stated on page E2 which includes mention of the short circuit withstand capability of cables. This withstand capability being based on Appendix C of IPCEA S68-516 is 250C (see attached Okonite catalog cut). 250C is equal to 482F which by industry standard is the withstand

Date: /5/83
Comment No.: 17
Page 3 of 7
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Splices	Okonite	T-95 inr.tape No.35 junc.tape	T-95 No.35	606

COMMENTS	RESOLUTION
	4) Cont'd capability of the insulation, furthermore, thus providing the integrity of the cable insulation at this higher temperature. As these cables are in metallic raceways the inherent thermal lag of the metallic enclosure, the heat sink of the inner conductor (in relation to external short term ambient) would more than demonstrate qualification without use of the FSAR Section 6.2 thermal inertia analysis.

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LOUISIANA POWER AND LIGHT COMPANY
WATERFORD SES UNIT NO.3

QUALIFICATION DATA EVALUATION FORM

QDEF SHEET NO.-0505

EQUIPMENT DESCRIPTION

TAG NO : SPLICES T-95+ NO.35 JCTN TPE

EQUIPMENT: SPLICES
TYPE

COMPONENT: CLASS 1E-FIELD SPLICES

MANUFACTURER: OKONITE

MAJOR : N/A
SUPPLIER

MODEL AND: T-95 INSL TAPE-
SERIAL # NO 35 JCTN TPE

FUNCT.DES: INSULATING &
& SERVICE JACKETING TAPE

ACCUR. SPEC: N/A

ACCUR. DEM.: N/A

PLANT LOC.: ~~AUX~~ CONT1

COORDINATES X- 25.0
Y- 73.0
Z- -1

INSTALLED (Y/N): ~~YES~~ note 1
INSTAL. REF: BY-FLD
QUALIF EXEMPTN: NOT APPLIC

ENVIRONMENT			DOCUMENTATION		QUALIF.	H/M	OUTS	
PARAMETER	ACTUAL	DEM. QUALIF.	ACTUAL	DEM. QUALIF.	METHOD		ITEMS	
	1	2	3	4	5	6	7	
OPERABILITY NORM/TEST DBA	40 YEARS NORM 120 DAYS(DBA) 9 YEARS	40 YRS (NORM) >132 DAYS (DBA)	OPER. REVIEW	APPENDIX 4 REF 1 SRSO 16.2W3	COMB. TEST& SUPP. REVIEW	/	NONE	
TEMPERATURE	120F NORM FIG.10 ACC DBA	120F NORM FOR DBA REFER TO E1.16.2W3	TCONT1 MAP T145 EQRPVOL1	LOCA GRAPH 1.4.1.3 OF REF 1 SRST 16.2W3	COMB. TESTS SUPP. REVIEW	H	NONE	
PRESSURE	ATMOS NORM FIG.9 ACC DBA	FOR DBA REFER TO E2-16.2W3	~~PRESS~~(CONT1 MAP P145 EQRPVOL1	LOCA GRAPH 1.4.1.3 OF REF 1 SRSP 16.2W3	COMB. TESTS SUPP. REVIEW	H	NONE	
RELATIVE HUMIDITY	20-100%NRM 100%DBA	100%	HCONT1 MAP H145 EQRPVOL1	LOCA GRAPH 1.4.1.3 OF REF.1 SRSH 16.2W3	COMB. TESTS SUPP. REVIEW	/	NONE	
CHEMICAL SPRAY	1750-2150 PPM BORON PHS-0-9.0	3000PPM BORON PH 10.5	CCONT1 EQ REPT VOL1,7.3	LOCA GRAPH 1.4.1.3 OF REF 1 SRSC 16.2W3	SEQ. TYPE TEST	H	NONE	
R GAMMA A BETA D B.SHIELD S T.I.D	*3.3E 7 *3.3E 8 *50% *1.97 E8	 200 M.RADS	RCONT1 MAP R145 ZONE 2	APPENDIX 3 OF REF.1 SRSR 16.2W3	COMB. TESTS SUPP. REVIEW	H	NONE	
AGE-INST LIFE (PER 323-1974 DEF.)	40 YEARS	40 YEARS	10CFR50 PARA.50.51	APPENDIX 2 OF REF 1 A16.2W3 SRSA 16.2W3	COMB. TESTS SUPP. REVIEW	/	NONE	SAFETY FUNCTION: AM
SUBMERGED LEVEL	N/A	D S A N/A A	N/A	N/A 3	NOT APPLI-CABLE	H	NONE	

PARAMETER	SUPPL. REVIEW
OPERABILITY	O 16.2W3
TEMPERATURE	T 16.2W3
PRESSURE	P 16.2W3
REL. HUMDTY	H 16.2W3
CHEM, SPRAY	C 16.2W3
RADIATION	R 16.2W3
AGING	A 16.2W3
SUBMERGENCE	S 16.2W3

EQ PACK # : 16.2W3

CSSR CATEG.: A.
APPENDIX E

FOR PUNCHLIST ITEMS SEE WSES EQ PACKAGE INDICATED

REFERENCES: 1) OKONITE REPORT NQRN-3 6/23/80

QUALIFICATION SIGN-OFF FOUND IN DOCUMENTATION PACKAGE: 16.2W3

QDEF #-0605

REVISION # : 4A
DATE : 11/2/83

SYSTEM : CABLE & RACEWAY
TAG : SPLICES T-95+

REPLACEMENT: N/A

MAINTAIN.: N/A

NOTES

CABLES ARE ASSUMED TO BE IN WORST CASE ENVIRONMENT AND SUBMERGED

QUALIF. EXEMPTN: NOT APPLIC

****
QUALIF QUALIFIED-WITHOUT *
STATUS EXCEPTION *
****
*
****

A

Okonite T-95 Tape

High Voltage Insulating Tape

Heat, Corona and Moisture Resistant

SPECIFICATIONS		
PHYSICAL PROPERTIES	GUARANTEED VALUES	TEST METHOD
Tensile Strength, p.s.i.	250 Min.	ASTM D - 1373
Elongation, percent	300 Min.	ASTM D - 1373
After air oven aging at 121 C for 168 hours:		
Tensile Strength, min. percent of unaged values	75	
Elongation at rupture, min. percent of unaged values	75	
Ozone resistance at 300 P.P.M., 24 hours	PASS	ASTM D - 1373
Fusion, number turns	3 Max.	ASTM D - 3391
Tack	PASS	ASTM D - 1373
Specific gravity	1.35	
Temperature rating:		
Max. continuous	90 C	IEEE
Max. emergency*	130 C	ICEA-NEMA
Min.	-55 C	MIL 13825
Gravimetric Water Asorption after 7 days @ 70 C, MG./SQ. IN. Max.	10	ASTM D-470
ELECTRICAL PROPERTIES:		TEST METHOD
Dielectric strength A-C Volts (at room temperature and 90 C)	600 Min.	ASTM D - 1373
Specific Inductive Capacity at 60 Hz	3.75 Max.	ASTM D - 150
Power factor, percent	1.0 Max.	ASTM D - 150
Volume resistivity ohm-cm [Min.]	2.5×10^{15}	ASTM D - 257
Specific Insulation Resistance, Megohms - 1000'	30,000 Min.	ASTM D - 257

*Tape must be capable of withstanding five 100 hour periods at 130 C and still be serviceable electrically and physically. This exposure in contact with bare copper shall have no harmful effect on either copper or tape.

Applications

Okonite T-95 Tape, an ethylene-propylene based thermosetting compound, with the optimum balance of electrical and physical properties, is designed as a high voltage, high temperature splicing tape and is recommended for insulating splices and terminations on high voltage cables insulated with ethylene-propylene, butyl, oil base and polyethylene (thermoplastic and cross-linked) compounds.

It is also used for splicing and terminating cables in nuclear enviroments.

Rated 90C continuous and 130C emergency, in accordance with ICEA-NEMA, Okonite T-95 Tape is capable of withstanding five 100 hour periods at 130C and remain physically and electrically serviceable. No harmful effects are produced when in contact with bare or coated copper, or aluminum conductors.

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Product Features

- High dielectric strength.
- Outstanding moisture resistance.
- Excellent ozone and corona resistance.
- Optimum heat resistance—rated 90C continuous, 130C emergency.
- Nuclear qualified to IEEE 383.

Additional Information

For additional information contact your local Okonite representative or Service Center Manager.

Okonite T-95 Tape

High Voltage Insulating Tape

Heat, Corona and Moisture Resistant

		PACKAGING		
Cat. No.	Roll Size	Roll	Rolls/ Unit Pack	Rolls Per Case
602-25-5010	3/4" x .020" x 30' 19mm x 0.5mm x 9.1m	Cello	10	100
602-25-5020	1" x .020" x 30' 25mm x 0.5mm x 9.1m	Cello	6	72
602-25-5030	1½" x .020" x 30' 38mm x 0.5mm x 9.1m	Cello	4	48
602-25-5040	2" x .020" x 30' 50mm x 0.5mm x 9.1m	Cello	3	36

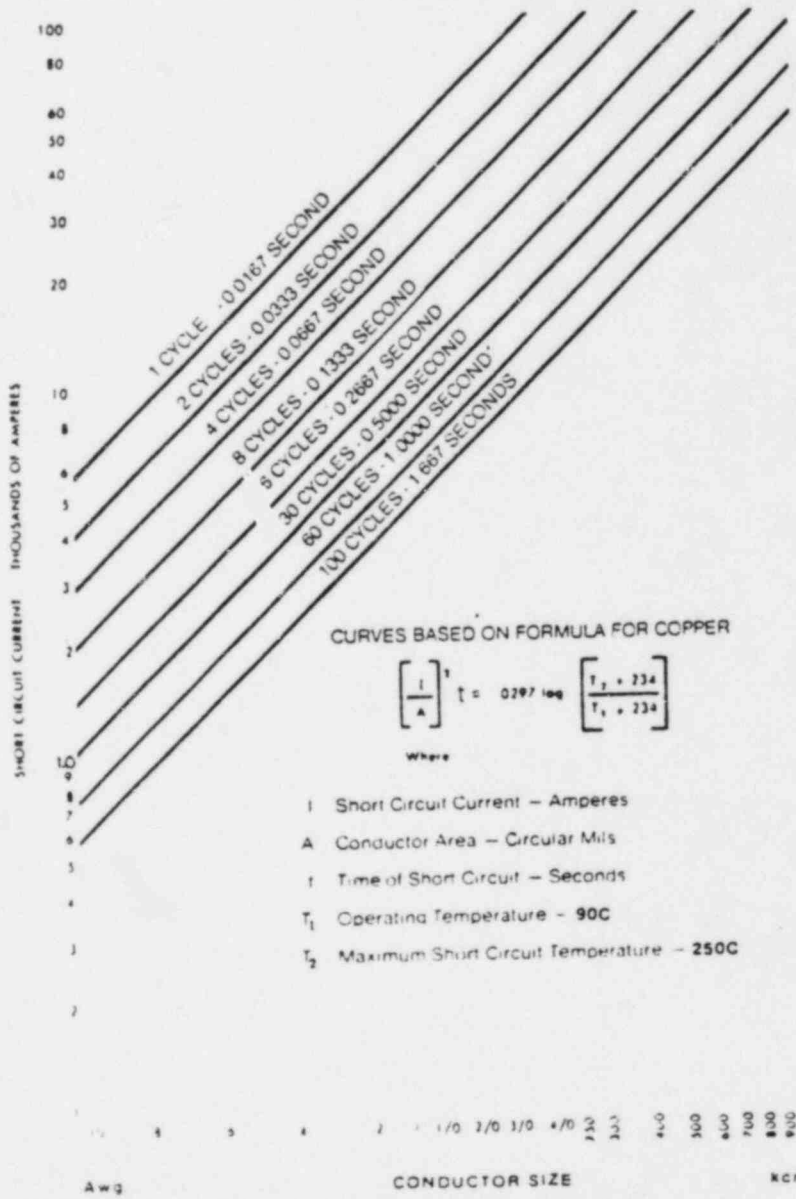
THE OKONITE COMPANY
Ramsey, New Jersey 07446

With the ever-increasing kva capacity of power systems, the possible short circuit currents are becoming so high that it is frequently necessary to consider the effect of these short circuits on the heating of the cables. The conductor size must be large enough to carry the short circuit current for a sufficient length of time to permit the circuit breakers to open before the conductor is heated to the point where it damages the insulation.

The chart below shows the maximum currents to which various size copper conductors can be subjected for various times without injuring the insulation. It is based on a 90C conductor operating temperature. The maximum current for short circuit ratings for 75C conductor temperatures and for other than 250C may be obtained by multiplying the value obtained for T_1 = 90C and T_2 = 250C from chart by appropriate correction factor for other values of T_1 and T_2.

ALLOWABLE SHORT CIRCUIT CURRENTS FOR INSULATED COPPER CONDUCTORS*

Table 0-3



CURVES BASED ON FORMULA FOR COPPER

$$\left[\frac{I}{A}\right]^2 t = 0.297 \log \left[\frac{T_2 + 234}{T_1 + 234}\right]$$

Where

I Short Circuit Current – Amperes

A Conductor Area – Circular Mils

t Time of Short Circuit – Seconds

T_1 Operating Temperature – 90C

T_2 Maximum Short Circuit Temperature – 250C

COPPER & ALUMINUM CORRECTION FACTORS FOR VARIOUS SHORT CIRCUIT TEMPERATURES

	Short Circuit Temp. (T_2)			
	175C	200C	225C	250C
T_1 75C	84	92	99	1 06
T_1 90C	76	85	93	1 00

* For Aluminum Conductors Multiply Value Obtained from Chart by 0 65

Reviewer: M. Yost

Date: 1/5/83
Comment No.: 18
Page 1 of 1
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Containment Fan Cooler Motor	Joy/Reliance	Frame 449T	AH-1(3A-SA)	0884
			AH-1(3B-SB)	0954
			AH-1(3C-SA)	0952
			AH-1(3D-SB)	0885

COMMENTS	RESOLUTION
No Comments	None Required

Reviewer: M. Yost

Date: 1/5/83
Comment No.: 19
Page 1 of 4
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
H_2 Analyzer	Compsip-Delphi Inc.	K-III	48A	13.1W3

COMMENTS	RESOLUTION
Qualification File does not address post LOCA sample pump bearing failure at Day 42 and sample pump diaphrams leaks at 100 days.	Comsip Delphi has agreed to submit a re-test of the Sample Pump Motor by Reliance Inc. The purpose of this report is to address the cause of the bearing/ diaphragm failures. This item will be clearly addressed in the Tab K entries and on page ii of 13.1W3. As stated in EQ Guidebook, the NRC has previously recognized that the definition of "long-term" is variable, being accident scenario and equipment dependent. In question response 23 to IEB-79-01B Supplement 2, the NRC stated: "Long-Term" for the purpose of qualifying equipment for a harsh environment is variable. A determination of "long-term" for qualification of equipment should be based on the considerations listed below for each postulated accident scenario. Justification for the value used should be provided with the equipment qualification documentation. (1) The time period over which the equipment is required to bring the plant to cold shutdown and to mitigate the consequences of the accident. (2) The ability to change, modify or add equipment during the course of the accident or in mitigating its effects which will provide the same safety-related function. Based on the above, the failure of the bearings of the sample pump after the first 100 days of LOCA does not invalidate qualification. The fact that Comsip-Delphi was contacted to supply information regarding the failure will serve to provide additional data above the minimum required. The actual request dated April 6, 1982 is attached. As indicated in paragraph 3, the test plan appropriate is 1035-8 the same one applicable to WSES-3 (refer to sample pump test plan in package 13.1W3,page D84).

I
Rev
Tab K

Page 1 of 1

EQUIPMENT QUALIFICATION

Package No. 13.1 W3

Punchlist

Date 11/4/82 Rev. 0
By: A DeVito

Reference Number	Scheduled Date	Drawing or Ref. Number	Item Description/Information	Responsible Party
~~1~~	~~11/15~~	~~Tab A~~	~~Add QDEF p~~ ~~nout~~	
~~2~~	~~11/15~~	~~Tab H~~	~~Field Verification Sheet~~	
1	5/30/83	Tab D	Comsip Delphi to submit re-qualification of Sample Pump Motor.	A. DeVito

Date: 1/5/83
Comment No.: 19
Page 2 of 4
Status: Closed

EQF-2-1 (sheet 1)
Rev. 0
(b) Preface Section
Summary

Date: 1/5/83
Comment No.: 19
Page 3 of 4
Status: Closed

ENVIRONMENTAL QUALIFICATION

Documentation Package Summary Sheet

Package # 13.1W3

This Documentation Package is an important collection of data which provides a reasonable basis using a systematic, auditable and thorough approach, to provide tangible evidence, that Environmental Qualification is demonstrated. This package fulfills the requirements of IEEE 323 and NUREG-0588 on Documentation and verifies that the contained safety related equipment with reasonable assurance, is:

Package Is:

- [x] Complete (See EQF-2-2)
- [ ] Not Complete (See EQF-2-2)

Qualification Status*

- [ ] Qualified - Without Exception
- [x] Qualified - Awaiting Confirmatory Data** (Minor Analysis/Comments)
- [ ] Qualified - For Interim Operation**
- [ ] Relocate Equipment**
- [ ] Shield Equipment**
- [ ] Retest Equipment** (Or undergoing Generic Qualification)
- [ ] Replace Equipment **
- [ ] Qualified-Awaiting Minor Analysis**
- [ ] Demon. NUREG 0588 Cat. C (Not Safety Related)
- [ ] Requires ** Major Analysis
- [ ] Modify **

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Items & Comments Outstanding: Comsip Delphi to submit retest data on Reliance Sample Pump Motor by 5-30-83

Engineer: Print Name & Sign/Date Angelo DeVito / Angelo DeVito 10/13/82

Checker: Print Name & Sign/Date O. F Montalbano / O. F Montalbano 11/4/82

The basis for this documentation package is the FSAR commitments in Section 3.11 of the FSAR.

* Definitions are found in attached form EQF-2-2.

*See EQF-2-2

Note: It is not the intent of this package to include the complete engineering of system components, rather it provides the direction to reasonably demonstrate qualification.

1-b

TO: J TOMPECK J. Twomey - 80

EBASCO SERVICES INCORPORATED

Two World Trade Center, New York, N.Y. 10048

EBASCO

April 6, 1982

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Comsip Delphi Systems Division
3030 Red Hat Lane
Whittier, California 90601

Attn: Ms Beth Hunsaker

Re: FLORIDA POWER & LIGHT COMPANY
ST LUCIE PLANT UNIT # 1 & UNIT # 2
IEEE-323-1974 ENVIRONMENTAL QUALIFICATION
IEEE-344-1975 SEISMIC ANALYSIS

Ref: 1. Ebasco to Comsip 2/18/82, Letter File # SL2-EQ-1-82-107
2. Comsip to Ebasco 3/22/82

We have recieved your letter (ref. 2.) addressed to G N Lemmon, in reply to our request (ref. 1.) for clarifications and additional data relating to Environmental Qualification (EQ) of the H_2 Analyzer.

Our review of the Environmental and Qualification package was conducted in accordance with IEEE-323-1974 and IEEE-344-1975, and Ebasco specification No. FLO 2998.140A Rev. 2 dated 10/8/80.

We have no further comments to the EQ package, including the Seismic Qualification portion reviewed earlier (ref. telex 10/29/81). However, we will require a copy of the test report of the retest of the sample pump, per the test plan document No. 1035-8.

This review in no way relieves Comsip-Delphi of responsibility for conformance to the above mentioned IEEE documents or from all other liability under the H_2 Analyzer purchase contract.

Very truly yours,

L Yemin
Lead Discipline Radwaste Engineer

LY:ml

cc: J Houghtaling
G Sinclair
S Zuchmann
L Gradin
EQ Core Group
R Farmer
D Carlsen

Reviewer: R. LaGrange

Date: 1/5/83
Comment No.: 20
Page 1 of 16
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Transmitter (Pressure)	Rosemount	1153 AA6	PTCA 6750AS	118
(Flow)		1153 DA6	FTSI0390AS	2733

COMMENTS	RESOLUTION
1) Specified and demonstrated accuracy shown on QDEF do not agree with test report. All units tested show deviation 0.5% of span.	1) As indicated in Volume 1 of the November 17, 1982 submittals (page VI-3, attached), the value for "Demonstrated Accuracy" given on the QDEF sheet is for the long term stable operation of the instrument, and not for the accident transient. Pace C3 of document package 8.1W3 demonstrates that significant changes in instrument accuracy have been acknowledged by Ebasco reviewers. Setpoints are selected to take into account these deviations in accuracy. The methodology for this selection is in accordance with IEEE 603-1980, ISA Standard S67.04, and Regulatory Guide 1.105. A program to provide guidelines for proper setpoint selection has been implemented to assure adherence to this methodology in the selection of setpoints. Attached hereto is a copy of a viewgraph used in the recent CE led LP&L seminar, "The Plant Protection System Explicit Setpoint Calculation for LP&L Waterford - 3" provided to our I&C Engineers.
2) How long did test last? (Figure 1 on P. D25 is not clear).	2) The LOCA Test Profile provided on page D25 is actually a planned test profile. The actual duration of testing for each of three specimens is indicated more clearly on pages D17 and D18, and is approximately sixty-five hours for each.
3) Since operability for 132 days has not yet been demonstrated (per page E1), why does QDEF state qualified for 132 days? NOTE: SER will require submittal identifying resolution of aging & operability issues.	3) The QDEF statement that the equipment is qualified for 132 days is based on the aging review provided in SRS #A8.1W3 (page E18). That is, the computer program with which the Arrhenius calculations were performed is designed to first take into account the required operability of the equipment (in this case 120 days plus 10% margin), and then provide the resultant remaining life. A further discussion of this methodology will be provided to the reviewers in response to other questions regarding this subject. Attached is a summary of this program which provides the methodology used for this computer program.

ACCUR. SPEC - THIS IS EITHER THE REQUIREMENT FOR ACCURACY USED IN STATION SAFETY ANALYSIS OR THE STANDARD MANUFACTURER'S LIMITS USED IN GENERIC TESTING OF INSTRUMENTS, WHICHEVER IS LESS.

ACCUR. DEMON. - THIS IS A VALUE WHICH SHOULD BE EQUAL TO OR BE LESS THAN THE ACCUR. SPEC ENTRY. VALUE IS FOR THE LONG TERM STABLE OPERATION OF INSTRUMENTS NOT THE ACCIDENT TRANSIENT.

PLANT LOCATION - THE ACTUAL BUILDING LOCATION IN WHICH THE COMPONENT IS LOCATED.

COORDINATES
X-COLUMN
Y-COLUMN
Z-ELEVATION - THE COLUMN AND ELEVATION COORDINATES LOCATE THE EQUIPMENT WITHIN THE PLANT AND MORE IMPORTANTLY WITHIN THE ENVELOPE OF THE ENVIRONMENTAL ZONES. 72

INSTAL. Y/N - THE SOURCE OF DATA FOR INSTALLATION STATUS WHICH IS GENERALLY THE FIELD VERIFICATION SHEETS.

QUALIFICATION EXEMPTN - ENTRY (RARELY MADE) TO INDICATE EQUIPMENT NEED NOT BE QUALIFIED BY USE OF QDEF. FOR EXAMPLE, A MECHANICAL ONLY DEVICE MAY BE ON THE MASTER LIST AND IS NOT TO BE QUALIFIED. IF THIS IS SO, ENTRY OF NOTES IN THE REFERENCE SECTION OF QDEF IS EXPECTED. IN ADDITION, CERTAIN EQUIPMENT PURCHASED AND INSTALLED AS SAFETY-RELATED MAY NOT BE REQUIRED TO FUNCTION DURING THE LIMITING CONDITIONS OF DBA PROVIDING A BASIS FOR QUALIFICATION EXEMPTION.

QUALIFICATION STATUS - THE MOST IMPORTANT ENTRY OF ALL. ENTRY MAY BE -

a) Qualified - Without Exception
b) Qualified - Awaiting Confirmatory Data
c) Qualified - For Interim Operation
d) Relocate Equipment
e) Shield Equipment
f) Retest Equipment
g) Qualified with Surveillance/Maintenance
h) Replacement

FOR ADDITIONAL EXPLANATION REFER TO APPENDIX IV.

INDUSTRY STANDARDS

ISA STANDARD S67.04

SETPOINTS FOR NUCLEAR SAFETY-RELATED INSTRUMENTATION USED IN NUCLEAR POWER PLANTS

WILL REQUIRE THAT THE FOLLOWING ITEMS BE ACCOUNTED FOR IN SETPOINT SELECTION:

- ACCURACY OF EQUIPMENT
- ACCURACY OF TEST EQUIPMENT
- PROCESS MEASUREMENT ACCURACY
- TRANSIENT OVERSHOOT
- TIME RESPONSE EFFECT
- ENVIRONMENTAL EFFECTS
- DRIFT

THIS HAS BEEN APPROVED BY ISA AND WILL BE FORMALLY ISSUED IN THE NEAR FUTURE.

COMPUTER PROGRAM USED FOR THERMAL AGING

SUMMARY OF PROGRAM 2644

THIS SUMMARY EXPANDS ON DATA PROVIDED IN THE EQ GUIDEBOOK APPENDIX H PART 2.

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INTRODUCTION

In order to be able to assess the "relative aging" caused by two arbitrary temperature profiles on identical samples of a material, a mathematical model based on chemical kinetics or more specifically the Arrhenius model is potentially useful.

One of the fundamental assumptions of this model is that the thermal aging of a given sample could be characterized by the fraction of the unchanged molecules.

Accumulated aging due to a Required Temperature Profile (RTP) and a Test Temperature profile (TTP) for accelerated aging tests could then be assessed by comparing the fractions of unchanged molecules.

A ~~preliminary~~ FORTRAN program entitled "BAREBONES" ~~BAREBONES~~, has been developed for carrying out the comparison of the accelerated aging temperature profile to the required temperature profile. The input information is fed to the computer via an interactive terminal, and the computations proceed following completion of all data entry. Depending on the input data, the output will be:

a) Aging Ratio (Required/Test) and

b) Comparative remaining life at a specific temperature if the aging ratio (required/test) obtained in part (a) is less than 1.0.

The theoretical model is based on the outcomes of References 1 (given in Appendix I). Following a time t at temperature T the number of remaining unchanged molecules n is related to the original number n_o of molecules by equation 7 of Reference (1):

$$\ln (n/n_o) = - A t e^{-E/kT} \qquad (1)$$

where A is a constant for the material
E is the activation energy for the reaction
k is the Boltzmann's constant.

The Barebones Program

BAREBONES is an interactive program with all input being initiated by the computer in a manner that is easily understood. Input is in free format with variables separated by commas.

A representative sample which is used for implementing this program is the following:

Irradiated Polyvinlychloride (from Ref. 6a)
β = 5000 using eq. (10), E = 0.99eV
TTP used : 7.298×10^2 hours at 240°F

The RTP is:

40 years (≡ 3.504×10^5 hours)	at 110°F
2 hours	at 270°F
22 hours	at 240°F
30 days (≡ 720 hours)	at 150°F

The results of the machine computations appear on sheet II-6

Comparison of computer results with manual results appears in Table I.

TABLE I

Manual Result	BAREBONES Result
6.09×10^{-1}	6.17×10^{-1}

Explanation of Sample Run

The program execution for SAMPLE could have been initiated by entering:

Eb$(REM)BAREBONES2644 [CR] · b stands for a blank space

[CR] stands for carriage return

Following a horizontal line composed of asterisks, the case-name would be asked; then the corresponding case name (irradiated Polyvinlychloride) entered:

IRRADIATEDbPOLYVINLYCHLORIDE [CR]

following a horizontal line composed of small line segments the activation energy (in electron volts) would be asked. Hence the activation energy (0.99 eV) would be entered: 76

.99 [CR]

Next, since the test temperature profile considered was new, 0 would be entered:

0 [CR]

following this, a brief comment regarding the TTP would also be entered (if no comment just [CR]):

EPRIbREPORTbUSED [CR]

then the number of TTP periods was asked; since there was only one period at constant temperature;

1 [CR]

then the TTP data in the "period, time (hours), temperature (Degree Fahrenheit)" sequence was entered as:

1,7.298E+2,240 [CR]

then 0 was entered because the required temperature profilt (RTP) was used for the first time:

0 [CR]

following the question on the number of RTP periods;

4 [CR]

followed by the RTP data in the sequence "period, time (hours), temperature (Degree Fahrenheit)":

1,350400, 110 [CR]

2,2,270, [CR]

3,22,240, [CR]

4,720, 150 [CR]

following this, the aging ratio (required/test) was computed and since it turned out to be less than unity, one could enter 0 to obtain only the aging ratio (required/test) or 1 to obtain the comparative remaining life.

Following a list of the inputted data, the aging ratio (required/test)was given, followed by a horizontal line composed of asterisks. At this point, to consider a new case:

1 [CR]

Following the horizontal line composed of asterisks, the new case name would be asked and the new sequence could proceed in a similar fashion. To exit, one could enter:

0 [CR]

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For a functional example where the aging ratio (required/test) was less than unity and the comparative remaining life in hours was to be obtained, see computer output for CASE 9 (Sheet II-14 of this memorandum). Following the entry for the value of A1 (See Appendix II for the function of variable A1):

1 [CR]

the temperature during the remaining life, in degree Fahrenheit was asked: and

217.4 [CR]

Again, following a list of the inputted data, the aging ratio (required/test) and the comparative remaining life in hours was obtained.

In a case where the aging ratio (required/test) was larger than unity, the options of comparative remaining life and/or aging ratio would not be available; instead, followed by a listing of inputted data only the aging ratio (required/test) would be obtained.

```
E $(PHM)BAREBONES/Z644
=RUNNING M280
*********************************************************************
CASE NAME ?•                                    SAMPLE CASE
=?
IRRADIATED POLYVINYLCHLORIDE
---------------------------,
ACTIVATION ENERGY(ELECTRON VOLTS) ?•
.99
ENTER 1 TO USE PREVIOUS TTP(ENTER 0 OTHERWISE)•
0
DATA ON THE TEST TEMPERATURE PROFILE(TTP)•
COMPLEMENTARY INFORMATION ON TEST CONDITIONS ?•
EPRI REPORT USED
# OF TEST PERIODS ?•
1
PERIOD•      TIME(HOURS)•      TEMPERATURE(DEG. F)••
1•7.298E+2•240
ENTER 1 TO USE PREVIOUS RTP(ENTER 0 OTHERWISE)•
0
DATA ON THE REQUIRED TEMPERATURE PROFILE(RTP)•
# OF REQUIRED PERIODS ?•
4
 PERIOD•      TIME(HOURS)•    TEMPERATURE(DEG. F)•
   1400•110•
2•2•270•
3•22•240•
4•720•150
        ENTER 0 TO OBTAIN THE AGING RATIO ONLY•
        ENTER 1 TO OBTAIN COMPREHENSIVE REMAINING LIFE & AGING RATIO•
0
<<<<<<<<DATA USED FOR THE COMPUTATIONS>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
          IRRADIATED POLYVINYLCHLORIDE
         ---------------------------------,
         ACTIVATION ENERGY(ELECTRON VOLTS)=• 0.99•
         ••••TEST TEMPERATURE PROFILE•••••
          EPRI REPORT USED
         PERIOD• TIME(HOURS)• TEMPERATURE(DEG. F)•
         • 1•   • 729.8• 240.0•
         ••••REQUIRED TEMPERATURE PROFILE•••••
         PERIOD• TIME(HOURS)• TEMPERATURE(DEG. F)•
         • 1• 35040.0• 110.0•
         • 2• 2.0• 270.0•
         • 3• 22.0• 240.0•
         • 4• 720.0• 150.0•
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
AGING RATIO(REQUIRED/TEST)=• 0.616893800451•
*********************************************************************
ENTER 1 FOR NEXT CASE(ENTER 0 FOR EXIT)•
```

REFERENCES

1. P. H. G. Allen and A. Tustin, "The Aging Process in Electrical Insulation - A Tutorial Summary", IEEE Transactions on Electrical Insulation Vol. EI-7 (3) September 1972, pp. 153-158.

2. S. P. Carfagno and R. J. Gibson, "A Review of Equipment Aging Theory and Technology", prepared by Franklin Research Center for Electric Power Research Institute, EPRI NP - 1558 Project 890 - 1 Final Report September 1980. (See Sections 4.4, 6.4.2).

3. Ebasco internal memorandum from Herbert Bardach to Marian Wang, dated July 14, 1980, Subject: Parametric Analysis of Thermal Aging Evaluations of Component Materials Utilizing Arrhenius Methodology - Phase I Applied Physics Department (5 pages).

4. See Chapter 6 of Reference 2.

5. L. J. Berberich and T. W. Dakin, "Guiding principles in the thermal evaluation of electrical insulation", AIEE Trans. (Power Apparatus and Systems) Vol. 75, pp. 752-761, August 1956.

6. Florida Power and Light Co., St. Lucie Unit 1 NRC IE Bulletin 79-01B, Thermal Evaluations, i.e. 6a, 6b, 6c, 6d, 6e, 6f as listed below:

   6a. St. Lucie # 1 - IE Bulletin 79 - 01B
   Engineering Analysis Thermal Aging Evaluation
   (AP-TA-026) Pressure Transmitter by John Stevens
   8/14/80, 12 sheets, checked by Gregory Listvinsky
   8/14/80.

6b. St. Lucie # 1 - IE Bulletin 79 - 01B Engineering Analysis Thermal Equivalence Evaluation for CES1I37 (File No. 3-TA-1, Calc. No. 003) Pressure Transmitter by Victor Zalak 7/28/80, 5 sheets checked by Gregory Listvinsky 8/5/80.

6c. St. Lucie #1 - IE Bulletin 79 - 01B Engineering Analysis Thermal Aging Evaluation (AP-TA-006) Pressure Transmitter by Carl Panek 7/21/80, 5 sheets checked by Gregory Listvinsky 7/22/80.

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6d. St. Lucie #1 - IE Bulletin 79-01B Engineering Analysis Thermal Aging Evaluation (AP-TA-008) Temperature Element by Carl Panek 7/21/80, 6 sheets checked by Gregory Listvinsky 7/22/80.

6e. St. Lucie #1 - IE Bulletin 79-01B Engineering Analysis Thermal Aging Evaluation (AP-TA-005) Temperature Transmitter by Carl Panek 7/21/80, 192 sheets checked by Gregory Listvinsky 7/23/80.

6f. St. Lucie #1 - IE Bulletin 79 - 01B Engineering Analysis Thermal Aging Evaluation (AP-TA-014) Containment Fan Cooler Motor by John Stevens 7/24/80, 12 sheets checked by Gregory Listvinsky 7/24/80.

APPENDIX 1

J P

E 2

The Aging Process in Electrical Insulation: A Tutorial Summary

SHEET NO. 37 OF 46
JOB NO. ELO 2524-183
JUN 12 1981

PETER H. G. ALLEN AND ARNOLD TUSTIN

ract—Calculating the life expectancy of electrical insulation teresting application of Arrhenius's law. Büssing's analytical ent is derived for the simple case of life at constant tempera- s extension to variable temperature conditions is explained e application of the same techniques to calculating mechanical due to creep and capacitor failure due to electrode diffusion. recently developed techniques for rapid determination of the of Arrhenius's-law graphs for insulation life are reviewed.

Introduction

ALCULATING the life expectancy of electrical insulation may at first sight seem a somewhat specialized topic to include in electrical engineer- courses. However, its theoretical basis is a direct cation of physical laws and experimental results ystems obeying the underlying assumptions can good agreement with calculation. Understanding nalysis leads to a qualitative appreciation of how rial useful life depends on temperature while, in w number of applications, design for a limited p ble life at elevated temperature can show hwhile savings in cost and/or size. In addition, it the electrical engineer an insight into other pro- s where the same laws apply.

The Analysis of Insulation Deterioration

ectrical insulation eventually fails due to changes particular electrical or mechanical property. Which erty proves to be the critical one in a given ap- tion depends on circumstances but the changes in e a matter of chemistry and can be analyzed as n by Büssing [1] and Dakin [2] in terms of its . Let the chemical process causing change in the cal property involve n_0 molecules. At any time t the commencement of useful life, n of these mole- s remain unchanged and, according to Guldberg and n's law of mass action

$$\frac{d}{dt}(n_0 - n) = kn, \tag{1}$$

e k is the velocity coefficient for the chemical pro- concerned. The operating temperature of the ma- al affects its life because k depends on the absolute e T this according to the Arrhenius equation

$$k = A \exp\left(-\frac{E}{RT}\right), \tag{2}$$

where A is a constant, E is the activation energy for the reaction, and R is the gas constant.

From (1)

$$\frac{dn_0}{dt} - \frac{dn}{dt} = kn, \tag{3}$$

which, since n_0 is constant, reduces to

$$\frac{dn}{dt} = -kn. \tag{4}$$

Substituting in (4) the value of k given in (2), we have

$$\frac{dn}{dt} = -nA \exp\left(-\frac{E}{RT}\right), \tag{5}$$

which can be rearranged as

$$\frac{dn}{n} = -A \exp\left(-\frac{E}{RT}\right) dt. \tag{6}$$

Life Expectancy Operating at Constant Temperature

If failure occurs after operation for time t_f at constant absolute temperature T when n_f of the original n_0 molecules remain unchanged then, integrating the left-hand side of (6) with respect to n and the right-hand side with respect to t for corresponding limits (n_0 to n_f and 0 to t_f, respectively)

$$\ln \frac{n_f}{n_0} = -A \exp\left(-\frac{E}{RT}\right) t_f. \tag{7}$$

Rearranging slightly and taking logarithms of both sides of (7), we have

$$\ln\left(\ln \frac{n_0}{n_f}\right) = \ln t_f + \ln A - \frac{E}{R}\left(\frac{1}{T}\right). \tag{8}$$

If the material behaves consistently, n_0/n_f is the same for each failure and (8) may be rearranged as

$$\ln t_f = C + \frac{B}{T}, \tag{9}$$

where C and B are constants for the material. Thus the logarithm of times to failure t_f at a number of constant absolute temperatures T may be plotted against $1/T$ to give a straight-line graph of slope B, which may be used to predict t_f at any other T.

anuscript received July 7, 1971.
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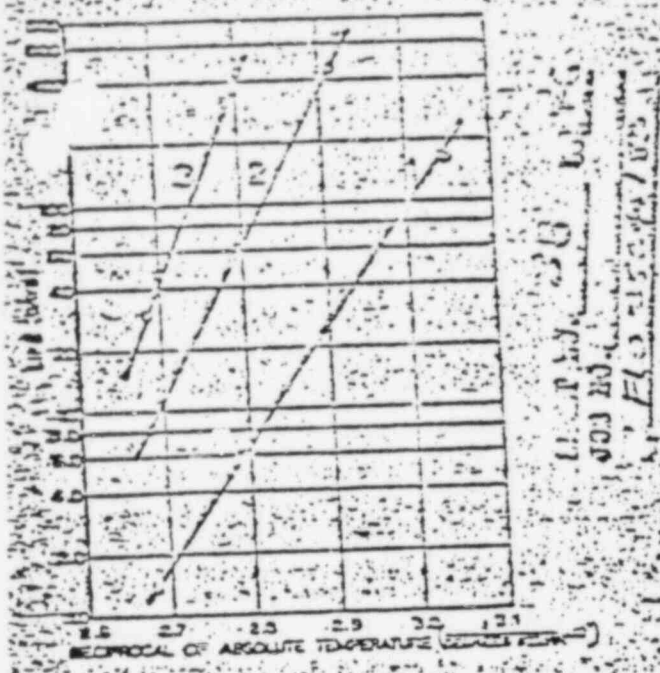

1. Results of life tests on chlorinated diphenyl kraft paper capacitors (after Berberich and Friedmann [3]). Curve 1—with 2 additive; curve 2—with 0.5-percent azobenzene; curve 3—with 5.0-percent azobenzene.

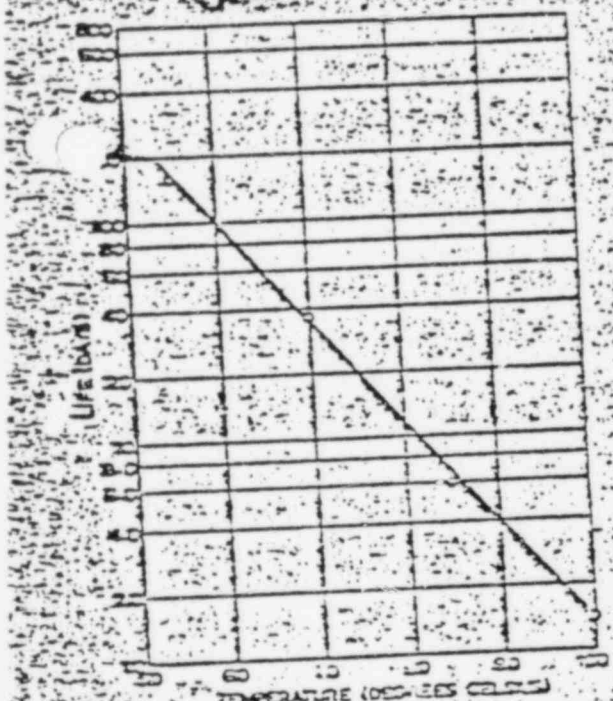

Fig. 2. Replot of curve 1, Fig. 1.

This correlation has proved remarkably reliable where aging is due to a single process. Fig. 1 shows an example. It gives data from Berberich and Friedmann [3] for life tests on kraft paper capacitors impregnated with chlorinated diphenyl alone and with two different amounts of azobenzene additive. The dielectric was stressed electrically at 10^6 V/in (dc). A great deal of data, based on statistical analysis of carefully controlled aging experiments using high-density paper in air and oil, and cotton yarn (loose and spun on to copper, washed and unwashed) and enameled wire, in air, was given by Malmlow [4]. A series of tests on a variety of insulants by Berberich and Dakin [5] included a demonstration that different criteria for aging (gas evolution and loss of tensile strength in oil impregnated paper) can give the same graph slope B. The importance of environmental effects, and thus of simulating service conditions, in aging tests was exemplified.

Fig. 2 shows a factor that for many years obscured the mathematics of aging. The data of curve 1 of Fig. 1 are replotted as the logarithm of life against temperature in degrees Celsius and because, over ranges of about 100°C, $1/T$ decreases nearly linearly with $(T - 273)$, a good approximation to a linear graph results. This empirical fact was observed and used by Montsinger [6] long before the present theory was developed.

The very considerable effect on insulation life of relatively small increases in its operating temperature can be judged from Fig. 1. A mere 6-percent increase in T leads to a tenfold life reduction from 100 to 10 days.

Life Expectancy at Varying Temperatures

Life at a continuous constant temperature is, of course, uncommon. For a somewhat more general case where it may be considered as made up of time t_1 at absolute temperature T_1 leaving n_1 molecules unchanged, t_2 at T_2 leaving n_2 molecules etc., we have from (7)

$$\ln \frac{n_1}{n_0} = -A \exp\left(-\frac{E}{RT_1}\right) t_1 \tag{10a}$$

$$\ln \frac{n_2}{n_1} = -A \exp\left(-\frac{E}{RT_2}\right) t_2 \tag{10b}$$

etc. If on the other hand the material were operated continuously at the various temperatures T_1, T_2, etc., then its life values t_{f1}, t_{f2}, etc. would be given by (7) in

$$\ln \frac{n_f}{n_0} = -A \exp\left(-\frac{E}{RT_1}\right) t_{f1} \tag{11a}$$

$$\ln \frac{n_f}{n_0} = -A \exp\left(-\frac{E}{RT_2}\right) t_{f2} \tag{11b}$$

etc. Dividing (10a) by (11a), (10b) by (11b), etc. give

$$\frac{t_1}{t_{f1}} = \left(\ln \frac{n_1}{n_0}\right) \Big/ \left(\ln \frac{n_f}{n_0}\right) \tag{12a}$$

$$\frac{t_2}{t_{f2}} = \left(\ln \frac{n_2}{n_1}\right) \Big/ \left(\ln \frac{n_f}{n_0}\right) \tag{12b}$$

etc. so that, if total life consists of m such periods

$$\frac{t_1}{t_{f1}} + \frac{t_2}{t_{f2}} + \cdots \frac{t_m}{t_{fm}} = \frac{\ln \frac{n_1}{n_0} + \ln \frac{n_2}{n_1} \cdots \ln \frac{n_m}{n_{m-1}}}{\ln \frac{n_f}{n_0}} \tag{13}$$

and $n_m = n_f$ so that by diagonal cancellation between successive terms in its numerator, the right-hand side of (13) becomes 1 and

$$\frac{t_1}{t_{f1}} + \frac{t_2}{t_{f2}} + \cdots \frac{t_m}{t_{fm}} = 1 \tag{14}$$

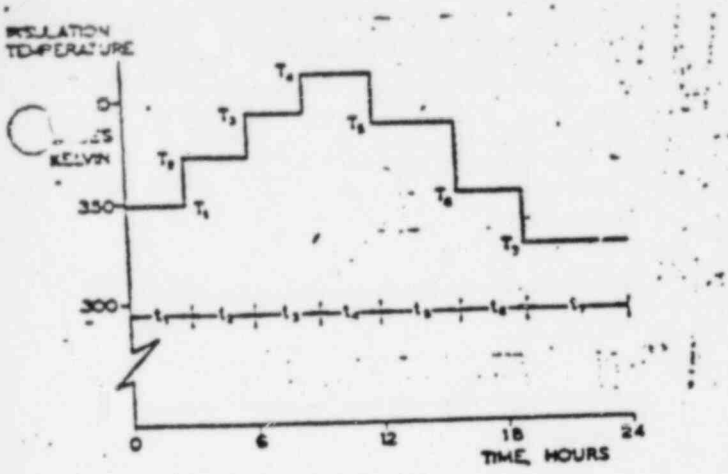

Fig. 3. Hypothetical daily temperature cycle.

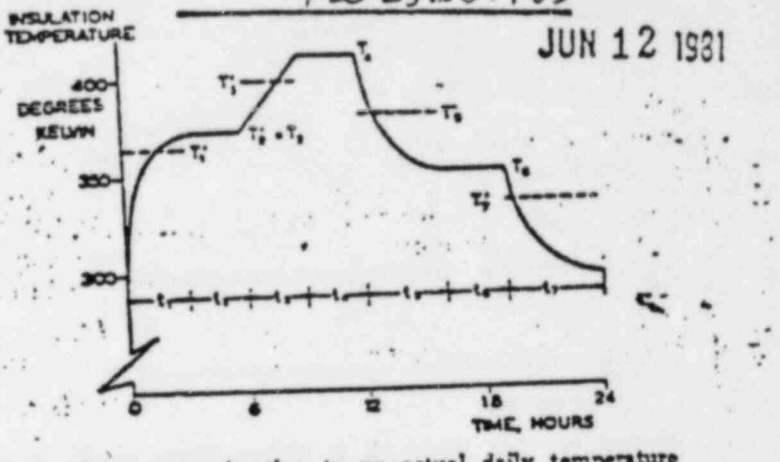

Fig. 4. Closer approximation to an actual daily temperature cycle.

hence the condition for material failure is

$$\sum_{p=1}^{n} \frac{t_p}{t_{fp}} = 1. \qquad (15)$$

Thus, at variable temperature, the condition that life is "used up" is equality to unity of the sum of the fractions that the period at any temperature is of the whole life continuously at that temperature. This is independent of the sequence in which the various operating temperatures occur. To calculate the fractions, [illegible] of t_{f1}, t_{f2}, etc. can be read off the ln t_f versus $1/T$ graph.

This simple picture suffices to understand the mathematical analysis of aging. It assumes that the insulation has a temperature history of the type shown in Fig. 3, i.e., that it operates at a series of constant temperatures for a series of time intervals. In practice, the history would be more likely to resemble Fig. 4. One can then either subdivide further and use the mean T for each small section or calculate an equivalent constant temperature T_1', T_2' etc. for each period t_1, t_2 etc. giving the same aging effect as the varying ones specified. This has been done for exponential heating and cooling by Ben Uri [7] and for linear heating as well as for exponential heating and cooling by Frentz [8].

Ben Uri emphasizes that, because of its greater length, a cooling period can consume much more life than the heating one preceding it. Frentz gives tables relating a factor F to the absolute temperatures (nondimensionalized by dividing by B) at beginning and end of each period. F then multiplies the higher of these to give T'/B for the period. T', used with the ln t_f versus $1/T$ graph, gives the t_f corresponding to constant T' for that period. Often a sequence of periods, e.g., a daily or weekly load pattern, repeats cyclically throughout life. [illegible] life consumption during each such cycle can be [illegible]ated and compared with that incurred when operating at some constant temperature. For example, Frentz's data shows the duty cycle of Fig. 4 to have an aging effect equivalent to about 393 K continuously. These ideas had already been combined with laboratory test results of the Fig. 1 type to estimate the life consuming effect of repeated overload cycles on small distribution transformers by Sumner *et al.* [9].

Other Engineering Applications

Any thermally activated process where the rate equation (2) applies can be analyzed in the way described. Diffusion in solids is such a process and one that can limit useful electrical life, e.g., that of metallized paper capacitors. These fail eventually due to diffusion of the metal into the paper. During life tests at rated voltage, this makes their capacitance increase very slightly and then decrease fairly rapidly. If component accuracy is essential for correct circuit operation, the time at which it regains its initial value may be defined as its useful life. Fig. 5 gives the results of tests [10] defining life in this way and shows that the analysis applies.

Creep behavior in metals is another process amenable to this analysis [11]. Although strain-time curves at particular temperatures are difficult to predict or extrapolate theoretically, experimental expense may be minimized by interpolating curves for temperatures between the test ones using the fact that the time to reach a particular strain depends on temperature according to (9). This process, and calculating cumulative strain at varying temperature, are greatly assisted by B values for metals being well known.

It is worth remarking that Miner's law [12] for predicting life under varying stress amplitudes from constant stress fatigue test results is analogous with (15). (Time t_p is replaced by cycles n_p at stress range S_p, the average life at which, n_{fp} cycles, replaces t_{fp}.)

Time-Saving Techniques

Evidently, calculations depend on reliable ln t_f versus $1/T$ data. Insulation life test results at relatively high temperature can soon be obtained but points higher up the graph may take years. This difficulty has recently been overcome using techniques to determine the graph slope $E/R = B$ directly. These greatly increase the re-

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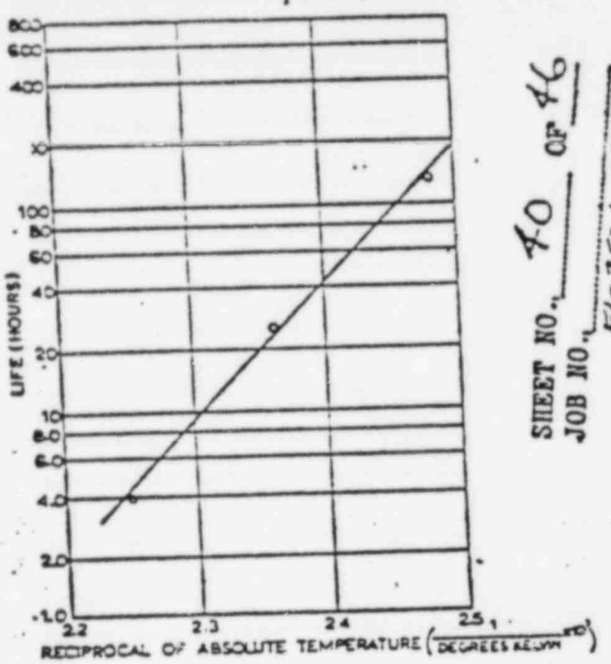

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JUN 12 1961

Fig. 5. Results of life tests on metalized paper capacitors (based on data from [10]).

liability with which short-life-high temperature test data may be extrapolated. Also, they employ existing physical chemical techniques and apparatus.

One process, known as differential thermal analysis (DTA) has been used by Randino and Andreotti [13] to study the deterioration due to oxidation of modified polyester insulating varnishes. It depends on the precise measurement of exothermic and endothermic effects when oxygen is injected at intervals during a cycle of increasing temperature. By contrast thermal gravimetric analysis (TGA) described by Smith and Koerner [14] observes weight loss either under increasing temperature or under isothermal conditions. Their tests were made on Formvar and polyimide insulations.

The second difficulty is that to obtain sufficient resolution, these methods use temperatures considerably above those at which the insulation will normally operate. Under these circumstances there is a distinct possibility that the deterioration mechanisms may be different (giving different B values) in the two temperature ranges. To overcome this, a DTA apparatus of greatly increased sensitivity has recently been developed by Paloniemi [15] for use at temperatures as low as, e.g., 80°C for cellulose paper.

Temperature is but one factor, although a vital one, causing insulation deterioration and others, such as humidity, dirt, and ultraviolet irradiation level, must not be overlooked, especially when designing for adverse climatic conditions. For some kinds of electrical breakdown at least, there appears to be a linear relationship between energy causing property change and the logarithm of exposure time to a given UV irradiation level. This can probably be exploited to accelerate thermal life tests.

Classically, the end of useful life has been determined by destructive tests such as high-voltage breakdowns of various kinds or yield tests such as tearing strength. Thus large numbers of specimens must be life tested as some are withdrawn for testing at regular intervals. It seems likely that the future will see an increasing use of nondestructive methods, such as infrared absorption spectrometry, thin-layer chromatography, and fine X-ray structure analysis to detect the physiochemical changes underlying the deterioration of the useful electrical and mechanical properties.

Conclusions

Although the mathematical treatment given applies where a single process predominates in causing ultimate insulation failure, it has often proved quite adequate in practice. This is more than ever true of simple, but important, components such as capacitors, which in applications such as aerospace may have a short life at high temperature. In power applications, lives are much longer, insulation systems more heterogeneous, and the possibility of entirely extraneous factors causing premature insulation failure is much greater. Such factors include: short-circuit forces causing abrasion, transient overvoltages, and moisture ingress due to cooling water leaking from internally cooled conductors. Thus, although the study of insulation aging grew up around the problem of electrical machinery life, it can probably be applied with much greater accuracy to electronic equipment. Nevertheless, its influence on power engineering continues. It is evident in recent proposals for more meaningful classifications of insulating materials in terms of their life expectancy and for its application to rating oil-immersed distribution transformers [16].

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JUN 12 1981

JOB NO. FLO 2521-153

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Discussion

Discussion on "Theory of Life Testing and Use of Thermogravimetric Analysis to Predict the Thermal Life of Wire Enamels," and "The use of Thermogravimetric Analysis as a Rapid Screening Test for Large Numbers of Experimental Insulations"[1,2]

TOR ORBECK

Thermogravimetric analysis (TGA) test methods are useful in evaluating degradation phenomena of insulating materials in the first stage of material development. But it is questionable if these methods can be used to predict the thermal performance of insulating components like the enameled wire example used in Toop's papers, above.[1,2]

Most isothermal test methods adopted as ASTM or IEEE standards are quite specific in their aims. They state that their primary purpose is the determination of changes in essential functional characteristics of a material or a system under specified test conditions derived from actual service conditions of specific apparatus or equipment. The TGA methods are analytical tests that span a wide temperature range and the weight loss of the sample is continuously recorded at dynamic temperature conditions far from actual service conditions or operating temperatures. Toop's conclusion that a correlation can be shown between the TGA results and a functional test such as ASTM 2307 on wire enamel comes as a surprise, since it deviates in principle from the test philosophy previously adopted by the IEEE and ASTM. It is therefore necessary to discuss Toop's basic assumptions and technical approach in regard to the thermal-aging test philosophy established by IEEE Standards Publication 98 [1] (formerly AIEE Standards Publication 1D).

The basic problem in thermal endurance testing of insulating materials has been to establish a realistic end criterion that makes it possible to predict or compare performance of materials or systems for their intended function in apparatus or equipment.

In 1948 Dakin [2] provided the graphic model that, by use of the classical chemical reaction-rate theory, made it practical to demonstrate the temperature–life relationship for insulating materials and systems. The Arrhenius relationship made possible the correlation of test data at several temperatures above the operating temperatures and gave a promise of possible extrapolation of results to lower actual operating temperatures for electrical apparatus.

But, early in the development of thermal-endurance test procedures, it was found that to apply an arbitrary change in a physical property such as electrical breakdown as an end criterion was often misleading since, in service, the insulation function of the same material varied drastically with the application, involving factors like vibration, shock, radiation, humidification, etc.

To bridge the gap between physical chemistry and electrical engineering, the concept of functional evaluation was added to the standard recommendations for the establishment of temperature limits and temperature classifications for insulating materials and systems. The functional evaluation concept proposes that a suitable screening test be used to evaluate insulating materials and insulation systems while they are performing their intended functions in specific equipment. A simple comparison of the original proposal for the twisted wire test in AIEE Standards Publication 57—1953 [3] with the ASTM D2307—1968 shows that establishment of an end criterion was primarily based on functional philosophy rather than arbitrary choice of a physical failure criterion. (Note 5 in D2307 is in this sense somewhat misleading.) The relatively high test voltage used is not in itself a functional requirement, but instead is used for detecting the development of discontinuities in the elongated enamel, a purpose of vital functional importance. In AIEE Standards Publication 57 it was optional to add a moisture-conditioning exposure to the specimen to make it easier to detect flaws or cracks in the enamel coating as a result of aging. This means that it was necessary to select an end point for the twisted wire test that directly or indirectly had a functional significance. This means that the test is not really based on a reduction in the electrical strength of the unbroken enamel. Therefore, the established correlation (by Toop) between the electrical-strength decrease and weight loss of a material does not prove that there will be a correlation between the TGA results and the ASTM D2307 results.

The introduction of the functional end points in thermal endurance tests have not changed the graphical and statistical presentation of data by the Arrhenius lifeline. But in using this technique, the Dakin concept has really been stretched very far. Therefore, test experience has shown the need of a good sampling plan, accurate statistical treatment of data, and limited extrapolation to make test information meaningful.

I agree with Toop that the time element and test control limitations are weaknesses in present thermal endurance tests. But this really should initiate more test development work and use of statistical analysis to improve test information and shorten test length. A recent paper by Johnson [4] studies proposed methods to deal with truncated failure-distributions in thermal endurance testing. Goldenberg [5], a colleague of Toop from Engineering Research Associates, has touched upon the same subject before.

At present, there are no "easy" answers to thermal endurance testing. The test-ladder concept established by Mathes showed how different tests are required at different stages in development work; no shortcuts are really available.

The latest revision of IEEE Standards Publication 1 introduces the concept of temperature index. The concept of the temperature index recognizes that the temperature–life relationship may depend upon a number of service and environmental factors. A single material may have two or even more

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The author is with Technical Services and Development, Dow-Corning Corporation, Midland, Mich. 48640.
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Contributors

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From 1939 to 1946 he was in the military service. He then obtained practical training as a Graduate Apprentice and professional experience as Transformer Engineer with the British Thomson-Houston Co., Rugby, Warwick. In 1960 he joined the Machine and Power Systems Section, Department of Electrical Engineering, Imperial College, London, as Lecturer.

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Mr. Isobe is a member of the Institute of Electrical Engineers of Japan.

Date: 1/5/83
Comment No.: 21
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Status: Confirmatory

Reviewer: H. Garg

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Flow Indicating SW	ITT Barton	581-1	DPISHV5051BS	419

COMMENTS	RESOLUTION
1) Similarity between tested equipment and installed equipment is not demonstrated.	1) The test report is for specimens with suffix "0", whereas switches to be qualified has suffix "1". The only difference between the two is in the sealing and bezel arrangement, see pages B2 and B6. Considering that the series "1" switches will not be subjected to the harsh conditions (pressure, temperature and steam) of the in-containment environment, the special construction features of the series "0" are not required. Since all other aspects of these two series of switches are the same, the applicability of the test report is justified. A telecon record with the vendor (page E24) further confirmed the above. CLOSED
2) Since the microswitch failed (common mode failure) on all three test samples and were replaced after 9th cycle, the credit for the aging for all the thermal aging cycle (before and after the failure) cannot be taken into account as same switch wasn't subjected to the complete aging cycle.	2) No credit was taken in the aging analysis for the before-failure test cycles. Credit was taken only for the remaining portion of the test cycles. Page D8: The"remaining portion" of the test cycle qualified the microswitches for 96, 116 and 116 years, see Table D11, D13, D15. CLOSED
3) Shrink Tubing Material was changed during the aging test. Is this change incorporated in Waterford?	3) Limit Switch Failures a) During "15 environmental stress cycles" some Microswitch subminiature switches failed. b) Test specimen Model 581-0, S/N 778-004: Failure occurred during test cycle No. 5. This failure occurred after 149,485 cycles. Page D-30. CLOSED c) Another failure occurred after aging cycle no. 7 This failure occurred after 187,141 cycles of operation. Page D-30.

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ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Flow Indicating SW	ITT Barton	581-1	DPISHV5051BS	419

COMMENTS	RESOLUTION
3) Cont'd	d) On a very conservative basis we can assume that each switch will undergo 1000 cycles per year. So it makes up for a total of 20,000 cycles for the qualified life of 20 years. However, the failure occurred after 150,000 cycles which is 750% of the cycles required for the qualified life of the switch. e) Furthermore, the vendor specifies that shrink tubing insulation material was replaced with an improved material, Page D31. f) Even if the tubing is not replaced, the switch will not fail in 20,000 cycles of operation. g) For detailed analysis and continued discussion, please see page E-3 of the package.
4) Thermal aging was performed from October 1979 thru August 11, 1980, and the radiation was performed from May 20 to July 17, 1980. Was the test conducted on the same piece or different pieces?	4) Thermal and radiation aging was performed on the same test specimens. (a) Model 580-0, S/N 778-001, See D11 and D35. (b) Model 581-0, S/N 778-003, See D13 and D36. CLOSED
5) The following has to be confirmed from the vendor: a) If same type of o-ring was used for sealing '-1' series as was used for '-0' series of ITT Barton pressure switches b) However, Why thermal aging was done on three and radiation on two specimens	S. Nath to Confirm

Date: 1/5/83
Comment No.: 22
Page 1 of 1
Status: Closed

Reviewer: R. Holloway

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Selector Switch	GE	CR294QUS205E	B/M C8-1	ALL

COMMENTS	RESOLUTION
1) Provide the analysis taking into account space attenuation showing that the TID for 40 years plus 1 year post LOCA will be 0.85 Mrad for any switch.	1) LP&L to submit analysis directly to H. Garg; the basic methodology is included in Appendix I of the EQ Guidebook.

Reviewer: M. Yost

Date: 1/5/83
Comment No.: 23
Page 1 of 14
Status: Open

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Cable	Okonite 600V Power & Control	EPR Insulation	D25, D50 D82	601

COMMENTS	RESOLUTION
1) The QDEF sheet states cables are assumed to be in worst case environment, submerged and demonstrated acceptable however, the aged cables were only submerged for 5 min. post loca.	The Okonite cable data included in the test report for "Long Term 90°C Water Immersion Test" (package page D33 and 34 and attached) demonstrates the excellent long term water immersion stability of the cables. This demonstration envelops the worst case submergence assumption. The specific parameters measured are Power Factor (PF), Specific Inductive Capacity (SIC) and Specific Insulation Resistance (SIR), all of which have significant bearing on insulation moisture resistance. These parameters and their significance are defined as follows: a) Power Factor of a cable is a measure of the power losses that occur in the cable as a result of the storage of energy in insulation of the cable (i.e. if energy is divided into 100 parts and 5 parts are stored in the cable due to SIC, the power factor is 5%). Power factor is sensitive to moisture. The general acceptance value for power factor is 2 percent after 24 hours at 80 volts/mil utilizing IPCEA S-68-516 "Interim Standards for Ethylene-Propylene-Rubber-Insulated Wire and Cable" and AEIC 6-73, "Specifications for Ethylene-Propylene-Rubber-Insulated Shielded Power cables rated 5-46 KV". Both of these standards included in the latest IEEE 383 Standard (1974) "IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations". All these standards included in the technical specs of package tab C (e.g. page C58, C7).

90

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Cable	Okonite 600V Power & Control	EPR Insulation	D25, D50, D82	601

COMMENTS	RESOLUTION
	Power factor measurements are considered the most accurate and sensitive indicators of insulation deterioration available in general and the most reliable means of determining moisture withstand. The absolute value must not be exceeded and the PF must not significantly increase with water immersion time (standards allow slight increase with time) Okonite values actually decrease. b) Specific Inductive Capacity (SIC) or Dielectric Constant of the insulation relates to the ability of an insulation to store a charge. An Electrical cable insulation consists of an insulation material between two or more separate conducting surfaces which in fact is considered a capacitor. The actual formula being (reference IPCEA S-68-516 paragraph 6.21.2) SIC (Dielectric Constant) = $13600\ C \log_{10} \frac{D}{d}$ where C = capacitance in microfarads of the 10 foot (3.05-meter) section. D = diameter over the insulation d = diameter under the insulation Obviously the introduction of water degradation will significantly change the capacitance of the insulation material resulting in a rapid change of SIC. c) Specific Insulation Resistance (SIR) for cable is the resistance measured between conductor and the outside surface of the insulation. The actual value being dependent on the material (EPR in this case),

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Cable	Okonite 600V Power & Control	EPR Insulation	D25, D50, D82	601

COMMENTS	RESOLUTION	92

temperature (very severe 90C continuous water temperature in this case) and its physical dimensions (insulation thickness). Frankly, insulation resistance is the least significant of the three (3) electrical tests as its absolute value varies significantly with temperature.

Insulation Resistance change as a factor of temperature is included in paragraph 6.28 Table 6-10 of IPCEA S68-516.

An approximation derived from Westinghouse "Maintenance Hints" Chapter 19 "Insulation Testing" indicates that the "insulation resistance will be halved by a 5° to 15°C rise in temperature..." Consequently, the IR values can range from 1 per unit (at IPCEA S68-516 60F base) down to 0.03 to 0.0000305 for "halving temperatures of 15°C and 5°C, respectively". A review of the various values in the table show extremely stable power factor, SIC & SIR. The SIR value indicated has a typographical error as the value indicated should be "SIR x M x 10^3" not "SIR x 10^3". This typographical error was discussed with Okonite's Sr.Applications Engineer, Etore Bartolucci, on 1/5/83, who confirmed the ommission. A letter confirming the Okonite oversight will be sent to Ebasco and inserted in the documentation package.

The factor which ultimately verifies the stability of the insulation water integrity is the Stability Factor. This is defined in IPCEA S-68-516 paragraph 6.21.2 as:

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Cable	Okonite 600V Power & Control	EPR Insulation	D25, D50, D82	601

COMMENTS	RESOLUTION	93
	"Stability Factor - The stability factor is the difference between the percentage power factor at 80 and 40 volts per mil after the test specimen has been immersed in water at 75°C ± 1°C for the specified time. The alternate to stability factor is the 14-day stability factor minus the 1-day stability factor". The actual acceptance values for the far less severe commercial test is found in IPCEA S-68-516 Table 3-3, paragraph 3.6.3.2. The above analysis of the Okonite data demonstrates submergence capability. In addition, a comprehensive investigation of submergency is available in the St. Lucie 1 FUSAR Section 3.11, Appendix 3A which includes experience and test data for Okonite (IEEE technical paper T74-044-4" Class IE Cables for Nuclear Power Generating Stations). This data having been updated as recently as August 11 and 19, 1981, in the St. Lucie 2 EQ Guidebook, Section 7.6. (Attached)	

ATTACHMENT TO NO 33

ATTACHMENT 1 TO SECTION 3A, PART D

Excerpt from paper T74 044-4, "Class IE Cables for Nuclear Power Generating Stations", by E. E. McIlveen, V. L. Garrison, G. T. Dobrowski.

Moisture Resistance

Moisture resistance is a major factor in determining the normal life of a solid dielectric insulated conductor. It has become traditional to gain assurance of long life performance by totally immersing a #12 or 14 conductor insulated with a 45 mil wall of dielectric in water at an elevated temperature to accelerate the deteriorating effects of moisture. Monitoring the electrical properties then provides an indication of long term behavior. In the 1950-57 era with service gained experience that negative dc potential presented the most severe condition, IPCEA developed a 16 week test procedure along these lines based on a continuous immersion at 50° C while under 600 volts dc. At this time, more than sixteen years later, new generation moisture resisting insulations of similar geometry can be continuously immersed at 75° C while under the same dc potential, and survive from 1-1/2 to 2 years, or more. This is at least 5 times longer and at an effective temperature acceleration rate of 6 times greater than anticipated by the IPCEA procedure. Since insulated conductors of the 1957 vintage dielectrics installed at Shippingsport, Indian Point and Peach Bottom, among others, have not experienced distress due to moisture, it can be reasoned that control cable insulations now specified which have the capability of withstanding total immersion at 75° C under 600 V dc as discussed herein should develop the designed life of the cable plant. Fig. 1 presents data for a 45 mil wall of an ethylene-propylene base insulation conductor, and Fig. 2 illustrates the electrical behavior of a composite wall composed of 30 mils EP base plus 15 mils neoprene compound. 94

Reference to Table I discloses similar data for an ethylene-propylene base dielectric and also a flame resistant cross-linked polyethylene compound (FR-CLPE), but at 90°C continuous water immersion while under 600 V ac potential except when percent power factor (% PF) and the specific inductive capacity (SIC) are being measured at 40 and 80 V/mil ac. Following each test measurement the specimens were subjected to a 5 minute withstand test at 110 V/mil. The specific insulation resistance (SIR) were made at 500 V dc while at 90°C. The difficulty of predicting long term performance based on the customary 2 week test data is obvious. It may be of interest that the time to failure for a particular specimen is a complex function of several variables, one of which is the degree of mechanical perfection of the dielectric wall. Failure is often sudden with little or no forewarning, and occurs when the cable is undergoing 60 cycle power factor and capacity measurements, or during the subsequent withstand at 110 V/mil.

Fig. 3 not only shows the SIC values for an ethylene-propylene base insulation during a long term continuous water immersion study, but also the accelerating effect of temperature as manifested by a change in the 60 cycle capacity. The 142°C/42 psig steam autoclave exposure further accelerates the increase in the SIC value but could change the reaction mechanism. In any event, if plotted on Fig. 3 the end point is still some two years out on the time scale.

Date: 1/5/83
Comment No.: 24
Page 1 of 1
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.

COMMENTS	RESOLUTION
Pages 276 and 284 of the Pre-Audit Master list identifies QDEF's 3014, 3019-22, 3086-3089. We could not find these in the QDEF's, please explain.	QDEF's 3014, 3019-22, 3086-3089 provided the specific sheets for electrical boxes which are shown qualified by reference to QDEF 0648. QDEF's 3014 and 3086 were deleted in revision 4A after the electrical engineering group verified that design had not placed these terminal boxes in areas not enveloped by QDEF 0648. The other QDEF's, namely 3019-22 and 3087-89 are now included under package 17.2W3 since they are enveloped by the generic QDEF 0648 for terminal blocks.

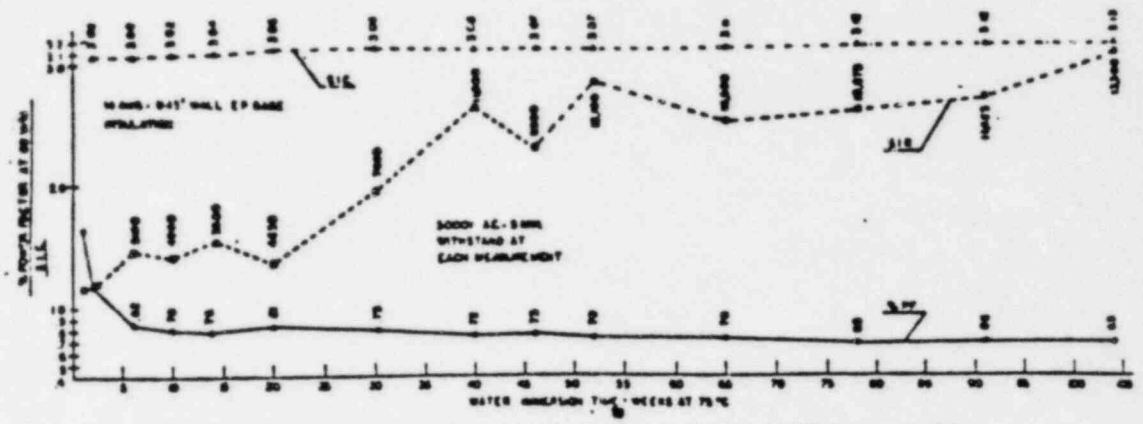


Fig. 1. Water Immersion Test of EP Dielectric Under 600 V Negative DC

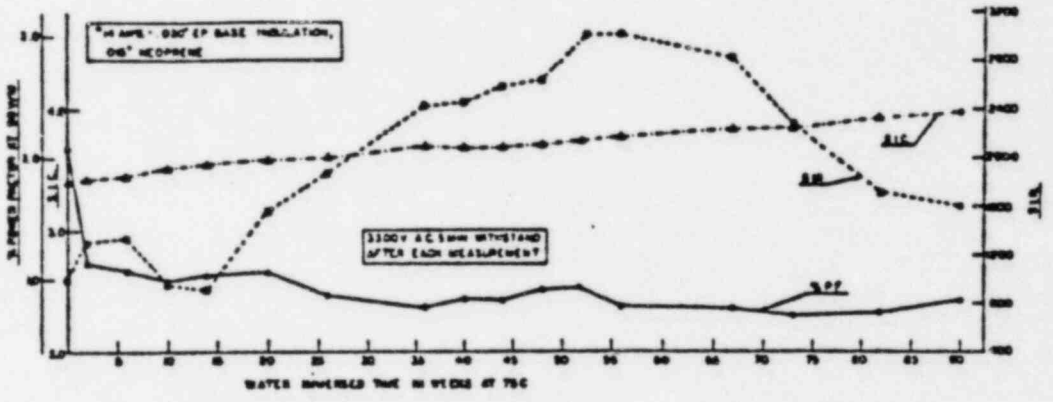


Fig. 2. Water Immersion Test of EP/Neoprene Under 600 V Negative DC

Table I

90°C Water Immersion--600 V AC

.045" Wall		EP Base			FR-CLPE		
Time Period	Stress V/mil	PF %	SIC @ 90°	SIR x 10^3	PF %	SIC @ 90 C	SIR x 10^3
1 day	40	2.84	3.09	1.3	1.06	2.88	2.0
	80	2.89	3.09	-	1.09	2.88	
7 "	40	1.52	3.05	.8	1.07	2.94	3.0
	80	1.55	3.05	-	1.08	2.94	
14 "	40	1.36	3.0	2.1	1.09	2.95	2.9
	80	1.36	3.07		1.11	2.95	
28 "	40	1.13	3.08	2.3	1.24	2.96	2.8
	80	1.16	3.08		1.25	2.96	
2 mos.	80	1.10	3.09	3.1	1.51	3.11	3.5
6 "	80	0.87	3.17	3.5	2.37	3.17	4.5
12 "	80	0.79	3.20	4.3	3.31	3.28	4.7
18 "	80	0.70	3.26	4.7	3.43	3.36	5.4
24 "	80	0.70	3.30	5.1		continuing	

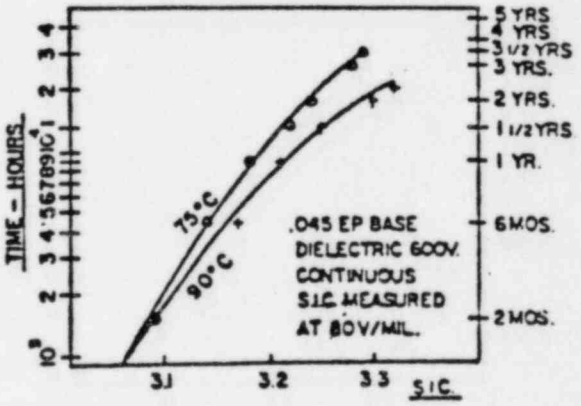


Fig. 3. Accelerating Effect of Temperature on SIC Values During Water Immersion

ATTACHMENT 1 TO
APPENDIX 3A, PART D.

Date: 1/6/83
Comment No.: 25
Page 1 of 1
Status: Closed

ENVIRONMENTAL QUALIFICATION AUDIT REVIEW SHEET

EQUIPMENT ITEM	MANUFACTURER	MODEL NO.	TAG NO.	QDEF NO.
Generic				

COMMENTS	RESOLUTION
1) A sampling of about 20% of the QDEF's should be done to reverify the accuracy of the information on the sheets.	This will be done and an evaluation made based upon the results of the sampling.

THE OKONITE COMPANY

Post Office Box 340
Ramsey, New Jersey 07446
201-825-0300/Cable Okonite

November 27, 1974

Mr. L. D. Cronin
Ebasco Services, Inc.
2 Rector Place
New York, New York 10006

Dear Mr. Cronin:

Subject: St. Lucie Plant -- Cable Performance Certification

96

With reference to our conversation on November 26, 1974, this was relative to Qualification Testing of Class IE Cables for Submerged Service, Ebasco Project No. FLO-8770.292L, RO-May 20, 1974 and in particular, Table I, sample #1 and #11, both single conductor 500 MCM cables.

We submit as evidence of suitability of samples #1 and #11 for submerged service the data presented in IEEE paper T 74 044-4, Table I and identified as FR-CLPE. The use of a 45 mil wall specimen as shown in Table I (instead of 110), the use of a 90°C bath (instead of 40), and the excellent performance during an 18 months immersion (instead of 1) are three major parameters which significantly accelerate the "life" simulation well beyond those called out in the referenced document. In addition, it may be noted that the sample in Table I had no external covering.

As further evidence, we submit data which may be found in IEEE paper 68 TP 651-PWR, Table IX, under sample CB-CLPE or NF-CLPE. This shows that whether the samples had been irradiated or not, they maintained a voltage withstand level at 80 V/mil for more than 32 days in a steam autoclave at 142°C (40 psig).

Relative to a discussion with Mr. William Thue, you will find enclosed a graph identified as Fig. 5. It may be noted that a butyl insulation which was identical to that which has given excellent service in "submerged service" reached an end point in accelerated immersion tests at 90°C in 12 months whereas the CLPE (natural) was still doing fine after 36 months, a factor of at least three times.

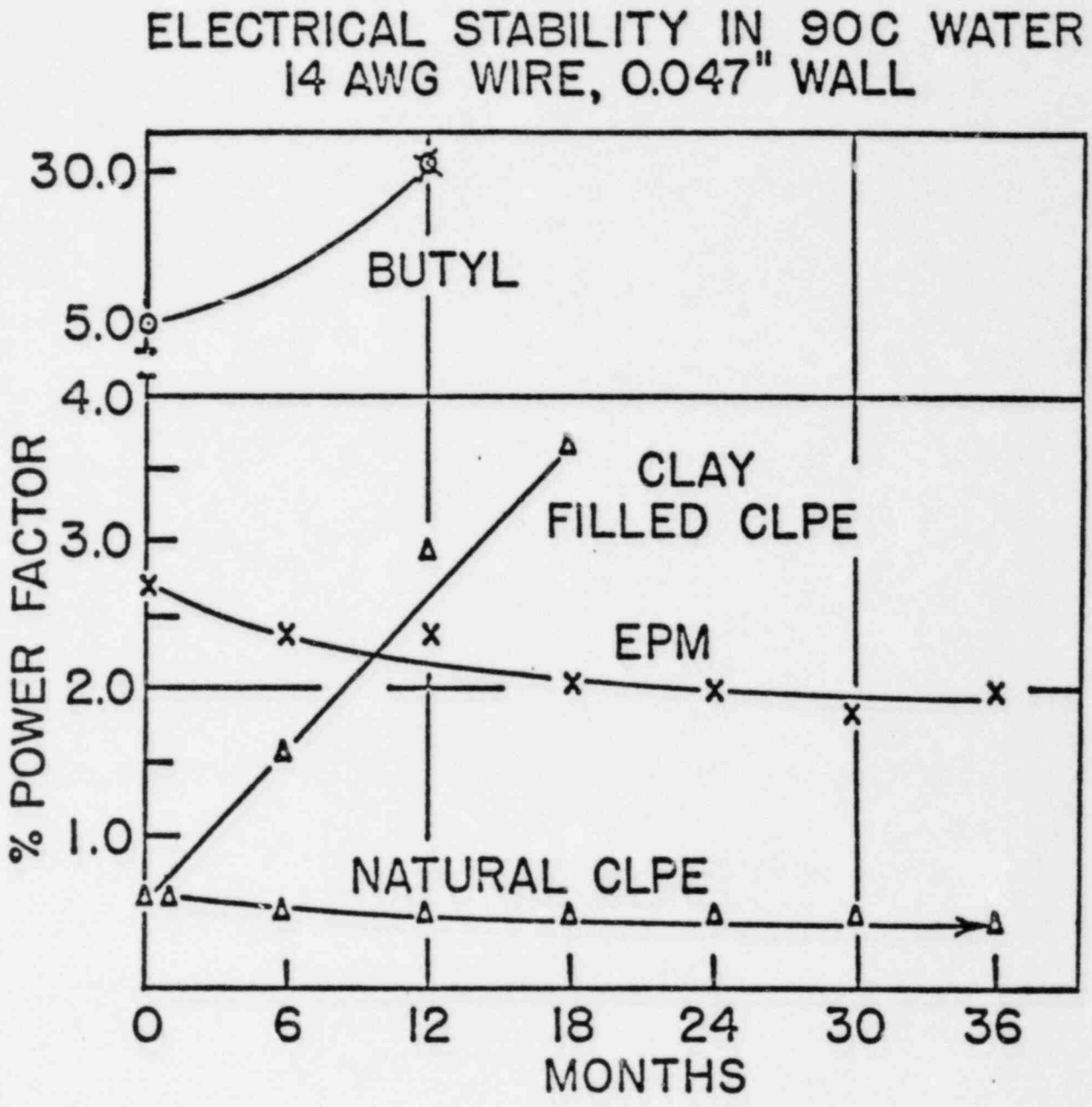
Very truly yours,

THE OKONITE COMPANY

E. E. McIlveen
Vice President - Engineering

EEM/row
cc: Mr. W. Thue

Attachments: T 74 044-4
68 TP 651 PWR
Fig. 5



97

Figure 3A-D1

ATTACHMENT 3 TO
APPENDIX 3A, PART D.

General Cable CORPORATION 800 RAHWAY AVENUE, UNION, N J 07083 / (201) 687-0250

December 17, 1974

Ebasco
Specification 211-69
FLO-8770-292-A

Florida Power and Light Company
Hutchinson Island Plant
Order No. NY 422273

Gentlemen:

In accordance with your recent request, we wish to advise the following information:

(1) The crosslinked polyethylene insulation employed by General Cable on cable fabricated for subject plant under referenced order exhibits the following long term electrical stability characteristics in water:

Test Results Long Time Immersion In Water

Water Temperature 90°C
600 Volts A.C. Applied between readings
Sample length 10 feet
14 AWG solid 30 mil wall XLPE

No. of Days Immersion	% Power Factor		Specific Inductive Capacity		Insulation Resistance Megohms/1000 ft. (3)
	(1)	(2)	(1)	(2)	
1	.39	.51	4.06	4.06	800
7	.39	.53	4.08	4.09	
14	.37	.53	4.08	4.08	
28	.42	.58	4.23	4.35	
54	.45	.61	3.94	3.94	
88	.36		4.07		
107	.39		4.12		
116	.41		4.14		
148	.48		4.24		
184	.59		4.27		55.4.
230	.66		4.45		40.5
287	1.10		4.55		49.0
329	1.50		4.70		33.0
429	2.14		4.72		40.0
522	2.18		4.84		
612	2.64		4.79		30.0
666	2.64		4.78		30.0
697	2.31		4.78		50.0
738	2.12		4.75		55.0
764	2.27		4.77		60.0
814	3.47		4.79		25.0
874	2.76		4.82		32.0
951	*		*		*

(1) Measured at 40 volts/mil 60Hz
(2) Measured at 80 volts/mil 60Hz
(3) Measured at 90°C
* Failed at 1200 VAC 60Hz

The data indicates that the insulation has excellent electrical stability in water when exposed to the accelerated test temperature of 90°C. The performance shown would be further enchanced by the overall covering of polyvinyl chloride (individual jacket and/or overall jacket) stipulated in the specification.

(2) A "Certified Test Report" dated May 31, 1973 attached, provides further indication of the insulation and jacket performance under various environmental conditions involving moisture exposure.

99

(3) Relative to the performance of lead sheathing in a saline water environment, we refer you to "Corrosion of Metals II Lead and Lead Alloy Cable Sheathing" by R. M. Burns - Bell System Technical Journal. We believe pages 617 and 618 extracted therefrom, and attached, give clear indication of the adequacy of lead sheathing performance when exposed to a sea water environment.

We trust the information given herein is adequate to answer the question of cable performance capability raised by Mr. Dennis Cronin of Ebasco. The question related to ingress of salt laden water into the duct system in which certain cables supplied under FLO-8770 are installed.

Very truly yours,

David A. Silver,
Director of Engineering
Power & Control Operation

DAS:gch

Cyprus Wire & Cable Company

421 Ridge Street
Rome, New York 13440
Telephone 315) 337-3000

Post Office Box 71
TWX 510) 243-9732

Mr. L. D. Cronin
Ebasco, Inc.
2 Rector Street
New York, N.Y. 10006

November 26, 1974

Dear Mr. Cronin:

100

This is to certify that the 7 conductor #10 AWG XLP insulated PVC jacketed control cable for Florida Power & Light (N.Y. Order #422-338) is good for use in both dry and wet locations. This cable employs a UL RHH-RHW and XHHW insulation with a UL THW jacket. The following data should help confirm the suitability of this cable for use in wet locations:

C-51801-Rome 0-600 Volt XLP Insulation for UL RHH, RHW or USE and XHHW

3-Year Immersion in 75°C Water		
% Increase in Capacitance	-	5.10
Stability Factor	-	.13
IR in Megohms-1000 Feet	-	1000

Attached find an Arrhenius plot which demonstrates the expected life of C-51801 XLP at its operating temperature.

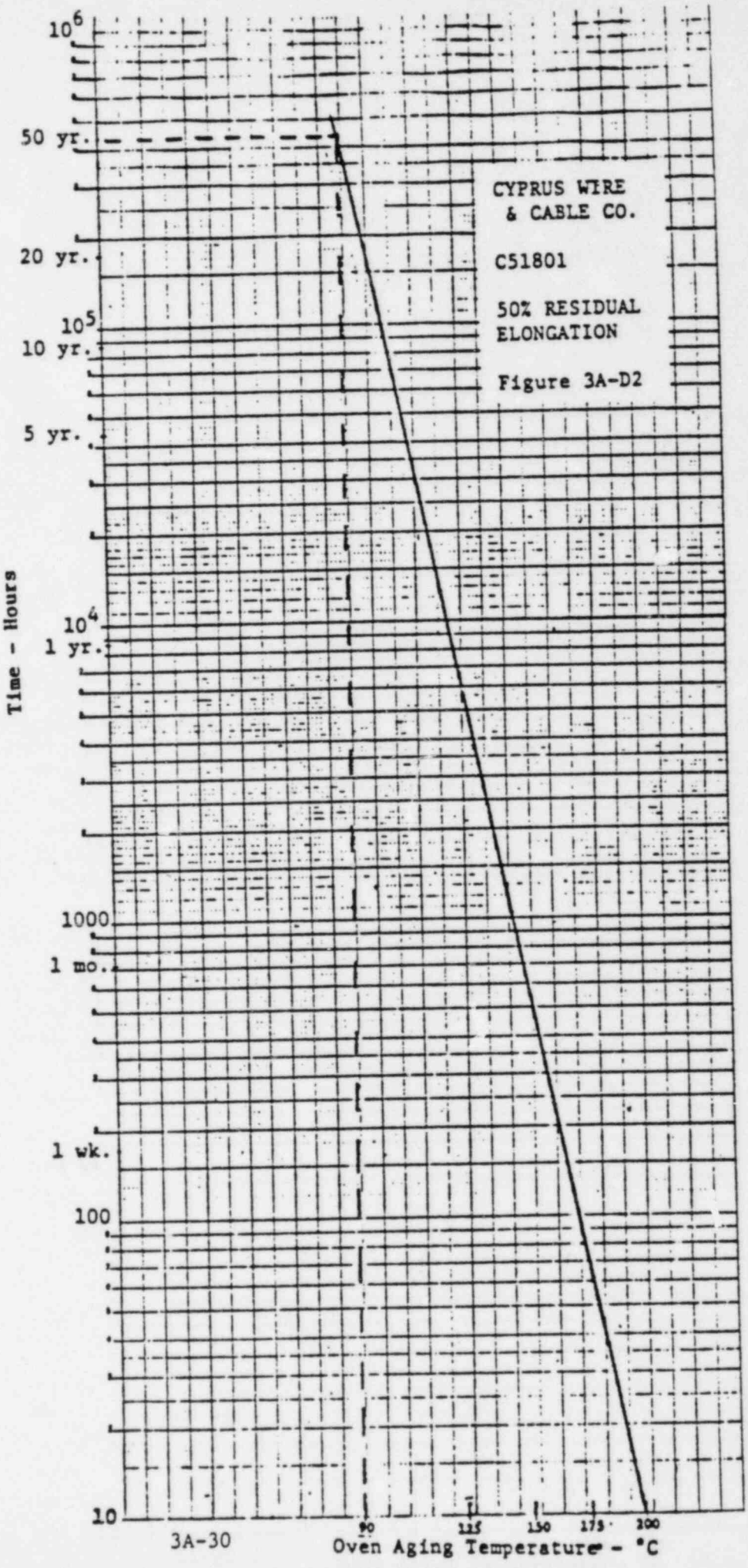
Very truly yours,

S. R. D'Agostino
Methods & Standards

SRD:bes

Attachment

CYPRUS


CYPRUS WIRE
& CABLE CO.
C51801
50% RESIDUAL
ELONGATION
Figure 3A-D2
Time - Hours
10^6
50 yr.
20 yr.
10^5
10 yr.
5 yr.
10^4
1 yr.
1000
1 mo.
1 wk.
100
10
90
125
150
175
200
Oven Aging Temperature - °C

RAYCHEM

November 27, 1974

Mr. L. D. Cronin
Electric Systems Consultant
Ebasco Services, Inc.
No. 2 Rector Street
New York, N.Y. 10006

102

Re: Ebasco Purchase Order NY422358
Raychem Bid No. 207
Florida Electric and Power Company

Dear Mr. Cronin:

This letter is in response to your inquiry regarding the assurances that we can give that the cables furnished under this order are suitable for operation in wet locations continuously, which can include operation submerged in water.

The instrument cables furnished are insulated and jacketed with Raychem Flamtrol™, which is of the generic class XLPE. This material has been designed for use in wet locations and has successfully passed the standard industry requirement for wet location service, which is to submerge a section of insulated wire in a water bath at 75°C and apply a negative d-c potential of 600 volts for 16 weeks. At two week intervals, a Dielectric Withstand Test is performed.

We have samples of Flamtrol that have been continuously immersed in water at 75°C for in excess of 20 months, with 600 volts of negative d-c applied to the conductor and which are periodically tested with an a-c withstand voltage. We also have measured the shift in capacitance over this period of time, as well as the stability factor. Within a few months, the capacitance had come to equilibrium value of approximately +12% and the stability factor is about 1.5. Both of these values are determined in accordance with the EM-60 Method.

Raychem Corporation
300 Constitution Drive
Menlo Park, California 94025
415/329-3333 · TWX 910-373-1728

RAYCHEM

The coaxial cables on this order are jacketed with the same material as the instrument cables, that is, Flamtrol. The dielectric material utilizes the same type of base resins as the jacket; therefore, these cables will perform in a wet location or submerged, as well as the Flamtrol instrument cables.

This should answer the questions that are being posed to you. Please call me again if I can help.

103

Very truly yours,

Frank E. La Fetra

Frank E. La Fetra
Market Manager - Utilities
Wire and Cable Division
415/329-3217

FEL/g

cc: Mr. J. A. Barresi - Raychem

Raychem Corporation
300 Constitution Drive
Menlo Park, California 94025
415/329 3333 · TWX 910-373-1778