M 点 H HEPORT #277B

PROJECT #77-15

INSULATION SYSTEM EVALUATION - 600 V. - SAFETY CLASS 1E FOR SERVICE TO 1 X 10° RADS RANDOM WOUND MOTORETTE

#### OBJECT .

To obtain thermal aging and radiation resistance test data on motorettes per prescribed procedures to qualify an insulation system for Safety Class 1E Service.

### REFERENCE

IEEE Std. 334-1974 "IEEE Standard for Type Test of Continuous Duty Class 1E Motors for Nuclear Power Generating Stations."

Paragraph 5.1.1 Thermal Endurance Paragraph 5.1.2 Radiation Endurance

# DISCUSSION

- A. The thermal qualification of the insulation system to be obtained by the motorette procedure as outlined in IEEE Std. 117-1974 "IEEE Standard Test Procedure for Evaluation of Systems of Insulating Materials for Random-Wound AC Electric Machinery."
- B. The radiation level qualification of the insulation system to be obtained on motorettes by passing a one minute. AC high potential test of two thirds of the sum of twice rated voltage plus 1000 volts after simultaneous exposure to gamma radiation total dosage of 1.1 x 10° Rads and a temperature of 170°C (338°F) (1)

(1)<sub>Note:</sub>

Par, 5.1.2 of IEEE 334 states that the temperature during radiation shall be the maximum temperature found when the motorette temperature-life curve is extrapolated to the installed life of the motor (350, 400 hours). As the temperature-life curve of this system will not be known until motorette thermal aging (Part A) has been completed it is proposed to run this test at 170°C to stay above expected final temperature. See plot in Attachment #

#### CONCLUSIONS

## A. Thermel Aging of Motorettes

As no failures have occurred at the accelerated aging temperatures to date, calculation of insulation system life line by prescribed methods is not possible. However, based on the "ten degree rule" and using actual test hours at each test temperature, the insulation system temperature index at forty years life ranges from 176.8°C to 207.7°C. [8]102180639 The motorette testing is continuing.

#### 5. Radiation Exposure of Mctorettes

Thirty (30) motorettes were simultaneously exposed to a total gamma radiation of 1.1 x 10° rads and total erature as follows:

- 1. 1046 x 10<sup>6</sup> rads at 170°C
- 29 x 10<sup>5</sup> rads at 140 170°C 2.
- 25 x 10<sup>6</sup> rads at 26°C 3.

After above exposure all motorettes rassed a high potential test of 1470 volts AC for 1 minute (2/3 (2E + 1000) ) which would qualify the insulation system for use to 1 X 10" rads total dosage.

#### PROCEDURE

#### Thermal Qualification A.

- 1. General
  - All heat aging tests were conducted using the motorette method to provide system evaluation. The testing followed predescribed periods of heat aging, vibration. humidity, and dielectric test based on IEEE Std. #117-1974.
- Test Specimens 2. Motorettes were insulated per L.A. specification PH-9061.

3. Test Procedure

Temperature exposure (for Class 200°C): Motorettes were oven heated each cycle per the foxlowing temperature-time exposures:

270° 250°	for for	1 day	:
2300	for	16 days	
220°	for	32 days	•

### b. Mechanical Stress Exposure:

Following each temperature exposure and after cooling to room temperature motorettes were placed on a shaker table and vibrated for one hour at 60 Hz. with a double emplitude of 8 mils (p to p).

c. Moisture Exposure:

After each mechanical stress exposure, motorettes were exposed for 48 hours to an atmosphere of 100% relative humidity with visible condensation on the windings.

d. Dielectric Check Test:

At the end of the moisture exposure period and while the motorettes are still wet, a 10 minute voltage and each coil winding to ground in sequence. Test between turns and 600 volts phase to phase and coil winding to ground.

- 4. Test Results (to date)
  - a. Summary of motorette data:

TEST TEMP.	TEST HEAT AGING HOURS	MOTORETTE FAILURES	TEMPERATURE
270	4660	0	207.7
250	10688	Ô	199.7
230	16176	O	185.6
220	17544	0	176.8

- \* Temperature Index from test hours extrapolated to 40 year life using 10°C rule.
- b. Motorette aging deta sheets shown in Attachment #2.
- c. Plot of test data in Attachment #3.
- Rediction Qualification
- 1. <u>General</u>

Radiation endurance made on motorettes to provide system evaluation. Radiation exposure and qualification testing followed the procedure as described in Paragraph 5.1.2 of IEFE #334-1974. ASTM D2953-71 used as reference for classification of system insulating materials.

2. Test Specimens

Thirty (30) motorettes were insulated per L.A. speci-

- 3. <u>Test Procedure</u> (Radiation exposure by capable radiation facility)
  - E. Type of radiation gamma (From Note 1 of Paragraph 5.1.2 of IEEE #334-1974 - The volume occupied by the sample shall receive an isotropic flux of gamma radiation such that if the volume contained air the specified radiation dose would result.)





- b. Total dos 1. X 10 rads (1100 megarads) (from Peragraph 6.3.4 of IEEE #323-1974 - a greater total dose than the service lifetime dose should be applied).
  - c. Exposure rate  $10^{4}$  to  $10^{7}$  Rads/hour in air (from IFEE #278-1967).
  - d. Exposure temperature 170°C.
  - e. Fost exposure dielectric test a high potential test of two-thirds of the sum of twice rated voltage plus 1000 volts, alternating current, for 1 minute -1,467 volts.

## 4. Test Results

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E. Summary of radiation and temperature exposure data (See Attachment #4 for report.):

- RADIATION EXPOSURE					
HOURS	TEMPERATURE °C	10 <sup>€</sup> RADS	PATE 10 <sup>6</sup> RADS/HOUR	TYPE	
2135	170	1046	0.49	GAMMA	
59	140-170	·- 29			
51 -	26	25 .			
2245		1100	•		

- b. Post radiation dielectric withstand test (See Attachment #5 for test data sheets.):
  - EE. Each coil to ground 1470 volts AC for 1 minute all (30) motorettes passed.
  - bb. Coil to coil 1470 Volts AC for 1 minute all (30) motorettes passed.
  - cc. Turn to turn, each coil 270 Volts AC for 1 minute all (30) mctorettes (or 60 coils) passed.
- c. Post radiation dielectric withstand test of sleeved cable to top coil of motorette (See Attachment #6 for test data sheet):

Sleeved cable to top coil - 1470 volts AC for 1 minute - all 30 samples passed.



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June 13, 1980

JIU ALLIS

Southern California Edison General Office No. 3 Apparatus Engineering Section P.O. Box 800 Rosemead, California 91770

Attention: Mr. Jack Cohon

Dear Mr. Cohon:

SUBJECT: Southern California Edison Purchase Order G8203651, Louis Allis Serial Number 7-117636

To confirm our telephone conversation of this morning, the motors on the above subject purchase order are indeed wound with an insulation system per our P4-9061, with the possible exception of lead cable. At the time your motors were manufactured, we had two choices for lead cable, one being Mica-Temp, the second being Nomex.

If you can send us a small sample of lead cable from your existing motors, we can analyze it to determine which cable you actually have.

Yours truly. Bonifas M As fistant Product Manager NEMA & Special Products

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cc: Mr. G. L. Calvert, Louis Allis, Milwaukee

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June 26, 1980

LOUIS ALLIS

Southern California Edison Co. General Office #3 Apparatus Engineering Section P.O. Box 800 Rosemead, California 91770

Attn: Mr. Jack Cohon

Dear Mr. Cohon

Subject: Southern California purchase order #G8203651, Louis Allis s.n. 7-117636

We have analyzed the sample of motor lead wire sent along with your June 19, 1980 and have determined that it is indeed NOMEX. As such we can certify that the motors on the above s.n. are insulated per P49061 and our test report #277B is applicable.

Sincerely,

Bonifas

Assistant Product Manager NEMA & Special Products

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#### June 19, 1980

Mr. J. M. Bonifas Asst. Product Manager NEMA & Special Products Louis Allis Division - Litton 427 E. Stewart Street P. O. Box 2020 Milwaukee, WI 53201

Dear Mr. Bonifas:

Subject: Southern California Purchase Order 08203651 Louis Allis Serial No. 7-117636

Thank you for your letter of June 13, 1980 identifying your insulation system P4-9061 as applicable to our motor and to your test report #277B.

I am enclosing a small sample of the motor lead. Would you please identify it so that we may determine if your test data on P4-9061 applies?

If it is other than the nomex wire tested with the P4-9061 system, please identify it. Any information on its radiation resistance and aging characteristics would be appreciated. If no test data is available, we need to identify the wire manufacturer to either obtain his test information or a wire sample for a qualification test.

Your early response to this request will be appreciated.

Yours truly

J. L. Cohon Senior Engineer

enclosure JLC:ned cc: P. Q. Nelson D. Martin AES Files