ENCLOSURE G

Report

Millstone Unit 1

Diesel Generator DC Field Rewind

MT Smaga

July 15,1991

Millstone Unit 1 is a boiling water nuclear power plant located in the town of Waterford, Connecticut. The plant is rated at 650 megawatts electrical power and was placed into commercial service in 1970. This plant has two emergency electrical generators. These two generators supply emergency power to equipment that is required to support the safe shutdown and post-accident operations in the event of a loss of normal power. One emergency supply is a gas turbine driven generator rated at 13.5 MVA. The second emergency supply is driven with a Fair-Banks Morse diesel. This unit is rated at 3.33 MVA, 0.8 PF, 4160 volts, 3-phase. The Louis-Allis (Magna-Tech) Company manufactured the generator. The diesel driven generator is the subject of this report.

During the 1991 Millstone Unit 1 refueling outage, the diesel generator was disassembled for cleaning. The cleaning of the generator was implemented in accordance with a Generation Test Service Memo, Ref.1. This recommendation was made based upon review of the test data. This memo stated that the test data, and the result of several years of megger tests indicated that insulation resistance was decreasing. The reason for this deterioration was the accumulation of dirt on the field winding. The AC stator was cleaned with solvents while the DC field was steam cleaned. With the completion of the steam cleaning the field was tested with a megger. The results of this megger test showed a resistance value "0" with a 500 vdc megger. This was an unacceptable resistance value and action was taken to increase the resistance.

The first remedial action taken was to heat the field with current. The field was connected to a DC source and heated to a temperature of 150^{0}F. After approximately 24 hours at this temperature the field was retested with no appreciable change. This process was repeated with no change in results. A decision was made to ship the field to a service shop to have the field baked in an oven and for additional cleaning if required.

While attempting to restore the field to an operable condition, the manufacturer of the diesel generator and the generator were contacted to determine if a spare field was available. Also other utilities were contacted. The results of this search was that there was no replacement field available.

At the service shop the field was placed in an oven and "baked out" at an oven temperature of 220^{0}F for 24 hours. After the field cooled to room temperature it was tested again with a megger showing no meaningful change. The field was steam cleaned twice more and "baked out". After the last cleaning and bake out cycle on May 29,1991 the megger readings increased to a maximum value 10,000 megohms for two poles and a minimum value of 170 megohms for one pole. With all the poles connected together the 1 minute megohm reading was 150 with a 500 volt megger. Succeeding this, the resistance of each pole was measured to check for shorted turns.

The results of this test indicated that some poles may have shorted turns. After the initial cleaning at the service shop, the field was checked for shorted turns without any indication of shorts. The testing method employed with all the coils connected in series was to apply 245 vdc to field terminals and measure the voltage drop across each coil. If the coils are not shorted than the voltage drop across each should be within 5%. The following is a list of the measured voltage drops after the last cleaning:

Coil No.	Voltage
1	74.7
2	48.0
3	5.7
4	21.5
5	2.2
6	26.8
7	26.0
8	50.7

A review of the test results indicates that several field poles had shorted turns. It appeared that steam cleaning the field had moved the contamination to between coil turns where the contamination filled voids in the electrical insulation. At this point, the Electrical Engineering Department recommended rewinding the field or replacing the field.

As part of the investigation under the direction of NUSCO's Electrical Engineering Department the service shop removed one of the poles. With the pole removed NU's Electrical Engineering Department and Generation Test Services unwound the copper wire from the pole piece. Attached is a sketch of a typical pole. As the insulated copper wire was removed several observations were noted. These were:

- The conductor was square bare copper wire covered with a glass fiber insulation.

- Between the windings and the steel pole a thick fiber glass board separated the two.

- As each turn was removed the glass insulation broke away from the copper at the corners of the coil. The insulation was brittle and completely dried out.

- The contamination was observed along sides of the fiber glass insulation used to insulate the conductors from the steel pole piece. This contamination was from the outside edge of the insulator to the inside edge.

- With several turns removed, the conductors were covered with contaminates. The contamination was lodged between the degraded glass fibers making an electrical path between conductors.

- Although the electrical insulation was brittle and cracked with age, there were no signs of burnt insulation or insulation heated beyond its temperature rating.

- Each turn appeared adequately secured with no indication of loose turns that could vibrate against one another, wearing away the insulation between turns.

Although the external examination of the field revealed no indications of potential problems, the examination of internal sections revealed that as a result of the voids in the insulation, contaminates were allowed to migrate into the coil turns. The first indication was a short to ground and the second was shorted turns.

Additional vendors were contacted for rewinding the field prior to releasing a rewind purchase order. All of the possible vendors were unapproved suppliers with respect to QA programs, and repair times quoted were greater than the repair time quoted by the vendor that had the field in their shop. An additional advantage was the service shop location, allowing NU engineering and QA to closely monitor the rewind. With the decision to rewind the field a QA Category-1 purchase order was provided to the local service shop. Since this service shop is an unapproved supplier NUSCO's QA department provided QA oversight for the entire repair.

The damaged field winding was analyzed to determine the type of original electrical insulation. In addition the generator manufacturer was contacted to verify the insulation Class and materials. The manufacturer verified that the insulation was a Class "B" rated for 130°C. A material list was not available. However, a visual examination allowed us to determine the material with laboratory analysis confirming our initial observations. The original winding consisted of:

- A square size 4 bare copper conductor covered with a layer of fiber glass

- A layer of Glastic, fiber glass board, placed around the steel pole separating the conductors from the steel

- A layer of paper-mylar-paper placed over the Glastic with some mica in between Glastic and the paper/mylar

- After the field was wound it was dipped in a polyester varnish and baked

In consideration of the method of winding failure, the migration of contaminates into the winding turns due to the voids in the degraded insulation system, it was decided to upgrade the insulation system. In addition, an upgrading of the insulation thermal rating was planned. To decrease the probability of the same type of failure occurring again, the design of the new insulation system would provide at least two barriers to contaminates. The first

barrier is an enamel coating of the conductor, in conjunction with a double layer dacron and glass tape over the enamel. The second barrier is provided by a vacuum pressure impregnation of each wound pole with an epoxy varnish.

The new insulation system is a Class H system rated for 180^{0}C and consists of the following:

- The size 4 square copper conductor coated with a heavy film of polyester varnish with a amide-imide overcoat 3-4 mils thick covered with a double layer of dacron-glass 6-8 mils thick. The completed insulated copper conductors passed dielectric tests at 2,800 volts.

- Installation of Glastic SG-200 material around the pole piece, rated for 210^{0}C with a dielectric rating of 500 volts per mil. The thickness of the Glastic is 3/16" at the ends with 1/16" pieces on the sides. This material is the same thickness as the original.

- Two layers of Nomex 414, 0.10" thick, covers the glastic and is rated for 180^{0}C. The dielectric strength of this material is 920 volts per mil.

- A mica-wrapper covered with a layer of glass tape rated for 180^{0}C was wrapped over the brazed connection to a flat copper strip leading out the first turn to the external connections.

- Each pole piece external connection was wrapped with a layer of glass tape and treated with a varnish.

As each pole was wound, a coating of the same varnish as used in the VPI process was painted on each layer of the winding. After a coil was wound it was placed in an oven for curing the varnish. With the coil still warm it was placed in the tank for the VPI process. This process consists of placing the coils in a sealed tank. A vacuum is drawn to remove the air in the tank and in the coils. An Epoxy varnish is then released to cover all the coils and pressurized to force the varnish into all voids. After a predetermined length of time the varnish is pumped out and the coils placed in a curing oven.

Prior to installing the coils the field shaft slip ring assembly was checked for runout. The slip rings were turned to reduce the runout to less than 0.001".

The completed coils on the poles were installed on the rotor spider using the same wedges that were initially used for each pole. The connections between poles and the slip rings were completed. Following testing of the winding the field was balanced using a two balancing technique. The balancing was administered by NUSCO's Reliability Engineering group to ensure an acceptable balance.

Numerous tests were performed to ensure the new winding is equal to or better than the original. The testing consisted of three parts, consisting of material tests on the original winding materials, tests of the copper conductors and electrical tests of the assembled winding, and performance testing of the rewound field in the generator.

Materials from the original winding were sent to a laboratory to confirm the insulation type and also to identify the contamination. The contamination consisted of petroleum products possibly from combusted diesel fuel and particulates primarily carbon and some silicates and iron. The analysis confirmed that the copper conductor was coated with only a glass fiber with some dacron fibers approximately 0.01" thick. The lab analysis also confirmed that insulation around each pole was a fiber glass material with a paper-mylar-paper wrapper with some mica present.

Close attention was given to the manufacture of the copper conductor and the application of the enamel and dacron-glass coating. A NUSCO QA person was present during the manufacture of the wire. The initial order for the wire was given to a company that purchased the enameled wire and then applied the dacron-glass coating. Unfortunately, the wire manufacturer was not capable of controlling their process to produce the required 350 lb reels of wire without a defect in the enamel coating. Only a single reel of wire was manufactured without a defect from a production run of approximately 5000 lbs. While this company was attempting to produce an acceptable product a second company was contacted to manufacture the wire. This company was able to produce eight reels of wire. In addition wire samples were taken from each reel and sent to a laboratory to confirm the copper content. The lab reports showed that the copper content was greater than 99.9%. In addition, as the wire was produced NUSCO QA witnessed all the manufacturing tests. The reels of acceptable wire were shipped by air to the service facility.

After the service shop wound a coil, the resistance of each coil was measured and a check for grounds was performed. After each coil had completed the VPI process, the coil resistance was measured and a megger test was performed. With all the coils installed the following tests were completed:

- The resistance of the completed winding was measured and compared to the original winding resistance. The winding resistance measured was 3.06 ohms and the original winding resistance was 3.04 ohms. The field resistance was well within the 5% tolerance that NUSCO required.

- A 500 and 1000 volt megger test was completed. The results of the 500 volt megger test was beyond the range of the megger, while the 1000 volt megger showed 4950 Mohms.

- A 2550 volt DC Hi-Pot was performed. The leakage current after 1 minute was 0.5 micro-amps.

- The 500 volt polarization index test was completed. The resultant PI of 3.8 was acceptable.

- The voltage drop across each coil was measured with 246.7 VDC applied to the field. The voltage across the coils varied less than one volt with a maximum variation of 2.3% from the average voltage drop.

The DC field successfully passed all of the preoperational testing. With the completion of these tests the field was balanced and shipped to the Millstone Unit 1 for assembly and operational testing.

The testing of the field at Millstone consisted of the following:

-Initial static testing such as megger tests, 10 min. polarization tests, and measure the field resistance.

-No-Load Testing

-A 24 hour Full Load Test

-Post operation static tests

The initial static tests showed that field was acceptable. The field megger tests showed a resistance greater than 10,000 Mohms @ 500 V. The field resistance was within the acceptable range.

The no-load tests showed that for a range of field voltages the output voltage was within 5% of the original generator test results. The next test was to operate the generator at full load for one hour, stop the generator and perform an inspection to discover any changes in the field winding configuration. Although the generator output during test reached 2665 KW, rated KW, the full 3330 KVA rating of the generator was not achieved due to system conditions that prevented full KVAR capability output. However, the generator was loaded to approximately 3058 KVA, 91% of rated KVA. The resulting inspection with the generator shut down showed no degradation of the field winding. Temperature measurements of the field winding were taken at the end of the test run. The field winding temperature was approximately 50^{0}C well below the 180^{0}C temperature rating of the insulation system. The generator was restarted and completed an additional 23 hour run at 91% of rated output. The static tests showed that there was no degradation of the field winding during the tests. A comparison of the these test results with initial test results indicate that the operating characteristics of the generator are unchanged. Since rated KVA of the generator was not achieved due to electrical system voltage restrictions, a comparison was made of the original and present field current vs generator KVAR. This graph, attached, shows that for a given field current the generator provides the same kvar. The generator response for a given load remains essentially unchanged.

Later during the LNP-MCA tests the generator was started and the emergency loads were sequenced onto the generator. At one point during this test the output of the generator reached 3.4 MVA, 103% of rated capacity. The diesel generator was able to start all of the required loads.

However, during this test one point was noted. When the first load was started the generator voltage is at 70% of rated voltage. With the start of this first load, the A LPCI motor, the voltage of the generator drops below 70% of rated voltage for less than one second and then recovers. A review of a previous generator start shows this same characteristic.

Following a review of the generator field rewind, the reason for the rewind, and the testing of the generator I have the following recommendations.

-Clean the generator more frequently. If the generator was cleaned more often less contaminates would build up on the field and decrease the possibility of a degraded field.

-Only wipe the field clean with an approved solvent, removing the contaminates, and reducing the probability of contaminates migrating to the inside of the winding.

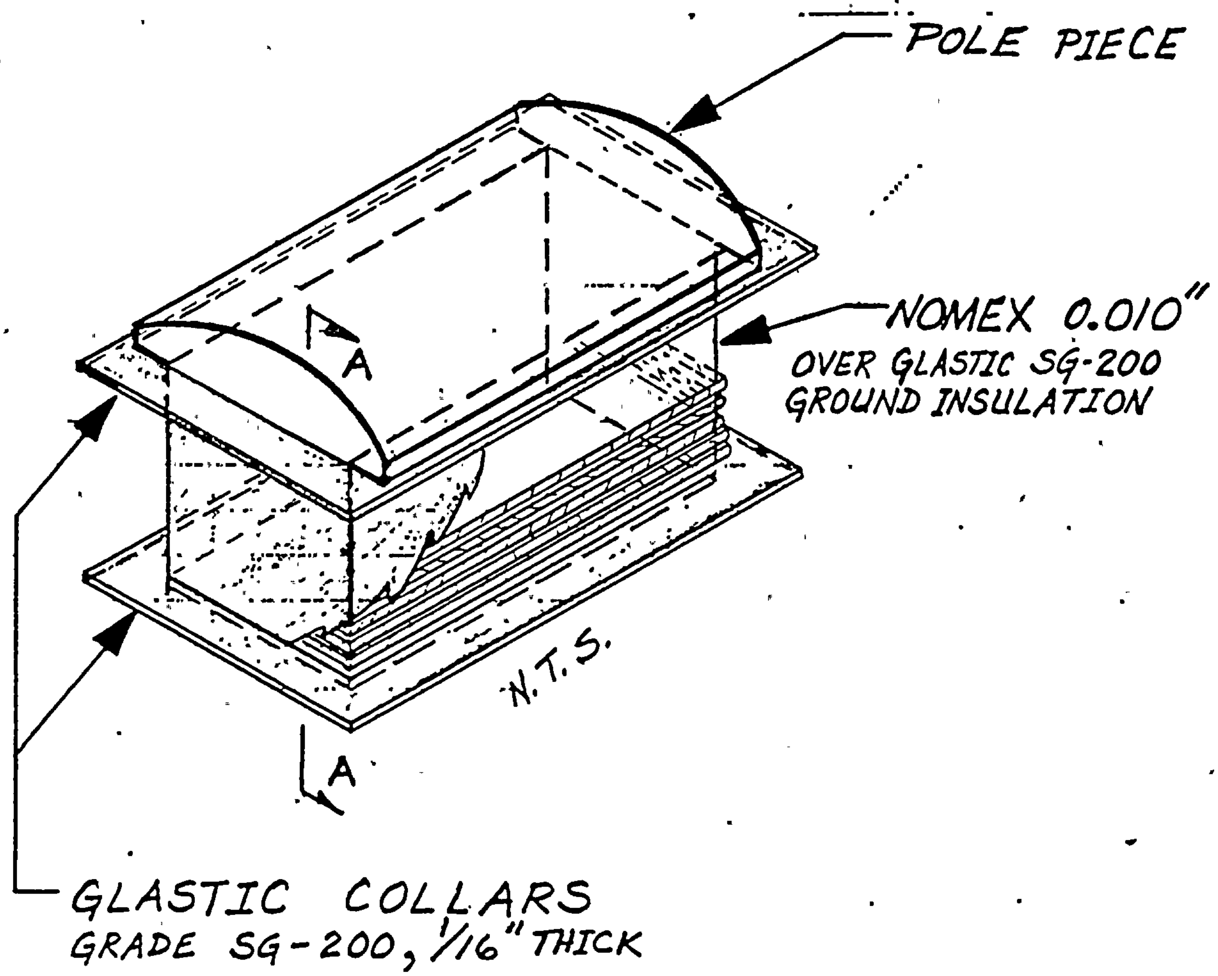
-Change the voltage relay setting for closing the diesel generator output breaker and sequencing the first load. This would result in a higher voltage during the start of the first motor and maintain a voltage greater than 70% of rated. This suggestion was reviewed with the Safety Analysis Branch and a preliminary review shows this is acceptable.

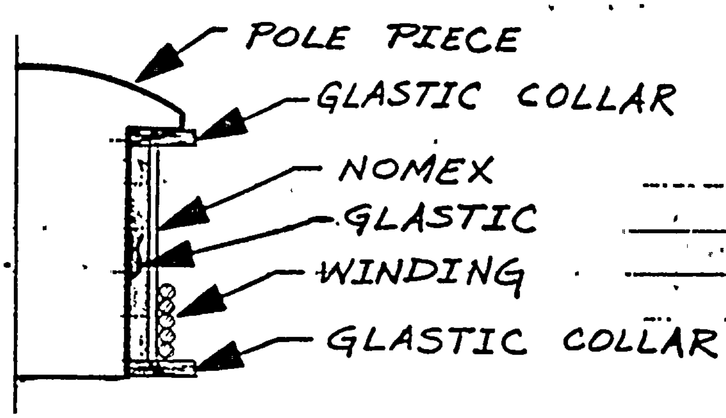
-Perform an inspection of the other emergency generators at NU's nuclear power plants to determine if cleaning is required.

-Provide a plan to clean and maintain clean the emergency generators without any degradation to the generator components and avoiding future failures of this type.

Although the rewind of the generator field was successful. The team effort between Electrical Engineering, QA, Engineering Mechanics, Mechanical Engineering, Purchasing, Plant Engineering, Generation Test Systems, Nuclear Plant Operations, and the service facility was extensive and arduous. It did however lead to the diesel generator returning to service in a minimum of time considering the magnitude of the task.

MPI DIESEL GENERATOR MAL/MTS 5-31-9.
D.C. FIELD
POLE PIECE INSULATION





SECTION A-A
N.T.S.

REV. 2-71

NORTHEAST UTILITIES SERVICE COMPANY

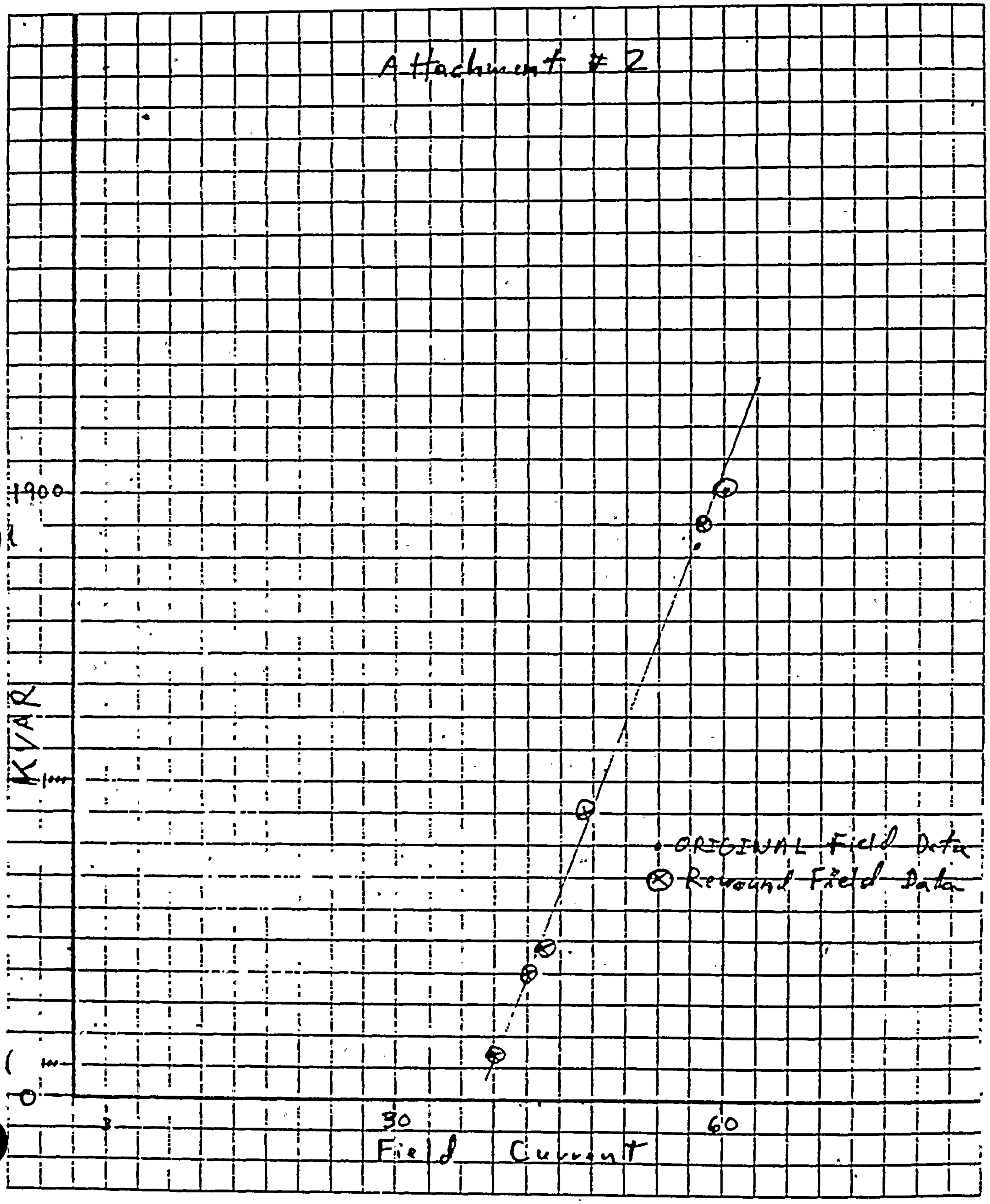
SUBJECT MP#1 Diesel Generator Field Rewind Full Load Test Results

BY PFH DATE 6-28-91

CHKD. BY ______ DATE ______

W. O. NO. ______

SHEET NO. ______ OF ______



Docket No. 50-245
B13942

Attachment No. 2

Millstone Nuclear Power Station, Unit No. 1

Motor Overcurrent Alarms

Additional Information

October 1991

MILLSTONE UNIT NO. 1

ELECTRICAL DISTRIBUTION SYSTEM FUNCTIONAL INSPECTION

NUSCO/NNECO POSITION ON APPARENT VIOLATION #5

The concern of this finding is that no procedure exists for responding to motor overcurrent alarms.

Response

For every main control room panel (CRP) which contains an annunciator panel, there is a control room alarm book (CRAB). This book contain index sheets for each annunciator panel on that CRP, and an "Annunciator Alarm And Response" sheet for each annunciator window. These sheets provide information regarding the cause of the alarm condition, any action that occurs automatically, the required operator initial and subsequent actions, and the system operating procedure to refer to for additional information. In every system operating procedure, section 6 (entitled "ALARMS AND MALFUNTIONS"), provides specific initial and subsequent operator action to be taken in response to any alarm condition.

Attached for reference, is a copy of a typical CRAB index sheet and an Annunciator Alarm And Response sheet for the LPCI Pump "A" Overload (OL) or Tripped alarm. Also attached is page 11 of operating procedure OP335 - LPCI System, which provides information regarding the LPCI Pump A (C) OL or Tripped alarm and the operator initial and subsequent actions for an overload or tripped condition.

In addition, attached is Departmental Instruction NO. 1-OPS-6.18, regarding RESET OF ELECTRICAL FAULT TRIPS.

Hopefully this information will demonstrate the adequacy of our procedures for responding to a motor overload condition.

APPROVED BY R Hubert
DATE 4-15-82
PORC MTG NO 1-82-21

CRP 903 A1

OPS FORM NO. 230-1
REV. 0
DATE 4/15/82

CONTAIN CLG SERV. WATER PUMP A OL OR TRIPPED (1-1)	STANDBY GAS TREATMENT LO FLOW (1-2)	LPCI SYS. I OR II HX INLET HI TEMPERATURE (1-3)	REACTOR PRESS. LOW (1-4
CONTAIN CLG SERV. WATER PUMP "C" OL OR TRIPPED (2-1)	TIP SYSTEM SHEAR VALVE TROUBLE (2-2)	DRYWELL HI PRESSURE (2-3)	LPCI SYS. I HX LO TUBE TO SHELL DIF. PRESS. (2-4
LPCI PUMP A OL OR TRIPPED (3-1)	STANDBY GAS TREAT SYS. "B" CHARCOAL BED TEMP HI-LO (3-2)	CORE SPRAY SYSTEM I VALVE LEAKAGE DETECT HI-PRESS. (3-3)	LPCI SYS I LO FLOW (3-4
LPCI PUMP "C" OL OR TRIPPED (4-1)	AUTO BLOWDOWN SYS. TIMERS INITIATED (4-2)	CORE SPRAY HEADER "A" HI DIF PRESSURE (4-3)	SYS. I CONT. SPRAY/PUMP NOT ON AUTO (4-4
STANDBY GAS TREAT SYS. "A" CHARCOAL BED TEMP HI-LO (5-1)	AUTO BLOWDOWN SYS. FUSE MONITOR (5-2)	CORE SPRAY SYS I PUMP BUS/ LOGIC POWER FAILURE (5-3)	LPCI SYSTEM I PUMP A OR C ON AUTO RUN (5-4
TORUS/DRYWELL VENT VALVE ISOL BYPASSED (6-1)	SAFETY & BLOWDOWN VALVE LEAKAGE (6-2)	CORE SPRAY PUMP A OL OR TRIPPED (6-3)	LPCI SYSTEM I PUMP BUS POWER FAILURE (6-4
STANDBY GAS TREATMENT SYS. A HI MOISTURE (7-1)	(7-2)	CORE SPRAY PUMP "A" RUNNING ON AUTO (7-3)	LPCI SYS. I TIMERS NOT HOME (7-4
STANDBY GAS TREATMENT SYS B HI MOISTURE (8-1)	AUTO BLOWDOWN SYS HI-DRYWELL PRESS. SEALED - IN (8-2)	CORE SPRAY SYS. I VALVES MOTOR OVERLOAD (8-3)	LPCI SYS. I AND II HEADER HI PRESS. (8-4
STANDBY GAS TREATMENT TROUBLE (9-1)	AUTO BLOWDOWN SYS. A/C INTERLOCK (9-2)	LPCI SYSTEM I & II IN TEST STATUS (9-3)	LPCI PUMPS ABCD HI SEAL FLOW (9-4

6. ALARMS AND MALFUNCTIONS

6.1 LPCI Pump A (C) OL or Tripped

6.1.1 Location: Panel 903, Section A-1, Window 3-1, 4-1.

6.1.2 Initiating Device:

6.1.2.1 Relay 51B.

6.1.2.2 Relay 51A, C.

6.1.2.3 Relay 50A, B, C.

6.1.3 Setpoint:

6.1.3.1 Relay 51B - 70 amp.

6.1.3.2 Relay 51A, C - 120 amp.

6.1.3.3 Relay 50A, B, C - 800 amp.

6.1.4 Automatic Action:

6.1.4.1 Relay 51B - Alarm only.

6.1.4.2 Relay 51A, C - Trip pump on time overcurrent.

6.1.4.3 Relay 50A, B, C - Trip pump on instantaneous overcurrent.

6.1.5 Initial Operator Action:

6.1.5.1 If pump has not tripped, then PROCEED as follows:

a. DECREASE LPCI flow or START additional pump(s) according to available power supplies.

b. CHECK for proper power supply voltage and frequency.

c. If alarm cannot be cleared and pump is not required to ensure adequate core cooling, then STOP pump and START another pump, if required.

6.1.5.2 If pump has tripped, then START alternate pumps, as required.

6.1.5.3 CHECK Emergency Bus loading.

6.1.6 Subsequent Operator Action:

6.1.6.1 INITIATE ACTION to determine cause of pump overcurrent.

6.1.6.2 If pump tripped on overcurrent during routine surveillance, then FOLLOW dictates of Tech. Spec. 3.5.B.3.

Jal P. Atf

FORM APPROVED BY UNIT 1 SUPERINTENDENT

10-19-88

EFFECTIVE DATE

1-88-83

PORC MTG. NO.

ANNUNCIATOR ALARM AND RESPONSE

PANEL/SECTION 903 A-1 WINDOW 3-1

ALARM TITLE

LPCI Pump A OL or Tripped

INSTRUMENT AND SETPOINT

1. Relay 51B - 70 AMP
2. Relay 51A, C - 120 AMP
3. Relay 50A, B, C - 800 AMP

AUTOMATIC ACTION

1. Relay 51B - Alarm only.
2. Relay 51A, C - Trip pump on time overcurrent.
3. Relay 50A, B, C - Trip pump on instantaneous overcurrent.

INITIAL ACTION

1. If pump has not tripped:
   (a) Start additional pump(s) according to available power supplies.
2. If pump has tripped (one pump operating - core level recovered):
   (a) Start alternate pumps to reflood core. (Pumps will auto. start if core level again reaches low-low point.) Check emergency bus loadings.

NOTE: If pump(s) were running for surveillance reasons, an L.N.P. signal would trip them as part of the load shedding scheme.

SUBSEQUENT ACTION

1. Initiate action to determine cause of pump overcurrent.
2. If pump tripped on overcurrent during routine surveillance, follow dictates of Tech. Spec. 3.5.B.3.

REFERENCES

OP 335 TECH SPEC 3.5.B.3

P&ID 25202-28056 Sh. 1 C.W.D. 761

MILLSTONE NUCLEAR POWER STATION
UNIT 1

TO: DISTRIBUTION

DEPARTMENTAL INSTRUCTION NO. 1-OPS-6.18

FROM: OPERATIONS MANAGER

REVISION 1

DATE July 10, 1991

SUBJECT: RESET OF ELECTRICAL FAULT TRIPS

PAGE 1 of 1

In the event an electric fault trip lockout should occur to equipment, the equipment should not be restarted (via reset of 86 lockout relay) until a detailed investigation has been performed by NUSCo Generation Test and a review by Engineering.

In the event of an electrical breaker trip, refer to the System Operating Procedure or CRAB book for guidance. Lacking specific guidance, then proceed as follows:

- Do not reset electrical fault trips on 4160 motor breakers. Rack out the breaker, red tag to the Shift Supervisor and submit a Trouble Report to Generation Test Department.
- For motors 480 volt or less, resetting overloads is permitted for trouble shooting or operational convenience provided that there is no obvious overheating or other damage to the motor or breaker. If the breaker will not stay reset, then open or rack out breaker, red tag to Shift Supervisor and submit Trouble Report to Generation Test Department.

JAF:clc

Docket No. 50-245
B13942

Attachment No. 3

Millstone Nuclear Power Station, Unit No. 1

DC System Design Basis

Additional Information

October 1991

Millstone Unit No. 1
Electrical Distribution System Functional Inspection
Design Basis For The Station Batteries

One unresolved item noted during the EDSFI exit meeting held on September 30, 1991, was lack of a definitive design basis for the 125vdc Station batteries. The attached information provides historic design documents as well as the current NNECo position.

The attached information consists of the following:

- Enclosure No. 1-Original FSAR Section VIII.4, Station Battery System
- Enclosure No. 2-Millstone-1 Technical Specification Changes To Reactor Coolant Chemistry Limits And Station Battery Testing Requirements
- Enclosure No. 3-FSAR Change No. 91-MP1-6, Changes and Corrections to MP1 FSAR Section 8.3.2, DC Power Systems
- Enclosure No. 4-Current Station Battery Loading Calculation No. PA83-068-221-GE, Rev. 01
- Enclosure No. 5-Plant Design Request No. 1-53-84, Station Battery 18A Replacement (18B is similar)
- Enclosure No. 6-Original 125vdc System Design Specifications and Battery Sizing Calculations

Enclosure 1 provides the most definitive summary of the original design basis. Enclosures 2 and 3 document changes to the Safety Technical Specifications and FSAR which change the original design requirements to reflect current 125vdc system operating practices and industry standards. The "Technical Review" attached to the FSAR change provides the basis for changing the duration of the Class 1E Station Battery design load profile from eight (8) to two (2) hours. Enclosures 4, 5, and 6 are provided for additional background information.

ATTACHMENT No. 3
ENCLOSURE No. 1

ORIGINAL

FSAR

SECTION VIII.4

STATION BATTERY SYSTEM

SECTION VIII

TABLE OF CONTENTS

ELECTRICAL SYSTEM

4.0 STATION BATTERY SYSTEM

4.1 125 Volt DC Station Battery System. The two station battery buses (DC 1 & 1A) are fed by two 125 Volt DC batteries and by individual battery chargers. These buses are connected through automatic bus transfers to the interruptable buses (DC 11AB) and motor control centers (MCC 11A-1 & 27), shown in Figure VIII-4.1. The system is designed for selective tripping so that only the faulty portion will be disconnected. The 125 Volt DC system is divided into three categories characterized by the nature of their loads as follows:

a. Continuous Bus (DC Buses 1 & 1A)
b. Interruptable Bus (DC Buses 11A-3)
c. Motor Control Centers (MCC 11A-1 & 2)

The continuous bus is able to supply nominal 125 Volt DC power to vital control circuits without interruption, so long as a source of 125 Volt DC power exists within the plant. Either station battery or any one of the three battery chargers can provide the necessary 125 Volt DC power. Either station battery can carry any DC load; however, the battery chargers cannot power the DC motors. Simultaneous loss of both buses DC 1 & 1A, even momentarily, would scram the reactor. The loads supplied by these buses are the control panel and the DC switchgear.

The interruptable bus, the motor control centers, and the emergency lube oil pumps are also supplied from continuous buses DC 1 & 1A. Both the interruptable bus and the motor control centers have dual feeders with automatic transfer; thus the failure of one feeder or its bus will not disable the interruptable bus or motor control center. The interruptable bus supplies loads which can withstand the momentary transient due to a transfer from one continuous bus to another. The motor control centers furnish power to heavy loads which are connected only in an emergency condition. In general, these loads are motor loads such as back-up isolation valves.

The station batteries are each sized to cary the connected load for eight hours without recharging. Each battery has a 1950 ampere-hours capacity, which supplies the following principal connected loads:

Direct Connected Loads	Estimated Power Required
1. Turbine Emergency Bearing Oil Pump	40 hp
2. Turbine Generator Emergency Seal Oil Pump	7.5 hp
3. Vital AC Motor Generator	40 hp
4. Automatic and Remote Manual Closing Isolation Valves and Control Valves actuated by Signals from the Reactor Protection System (RPS)	26 hp (374 amperes)

5.	Continuous Load (including DC lighting)	72 amps
6.	Breaker Control Circuits	690 amps/2 secs inrush
7.	Recirculation Motor-Generator Sets Emergency Lube Pumps	1 hp
8.	Diesel Engine DC Air Compressor	1 hp

Estimated 125V DC 8-Hour Discharge Cycle (assuming 2 secs initial inrush condition)

Continuous Load (incl. DC lighting):	72 A
Emer. Brng. Oil Pump Inrush:	980 A
Tripping of 30 4.16-KV Bkrs:	600 A
Tripping of 14 Solenoid Operated 480V Bkrs:	27 A
Tripping of 2 Motor Operated 480V Bkrs:	64 A
Isolation & R.P.S. Mov's Inrush:	1,958 A
Vital AC Mtr. Inrush:	280 A
Emer. Seal Oil Pump Inrush	116 A
	4,097 A First 2 Secs.
Continuous Load:	72 A
Emer. Brng. Oil Pump Flc.:	280 A
Closing Breakers:	100 A (estimated)
Vital AC Mtr. Flc:	280 A
Emer. Seal Oil Pump Flc.:	58 A
R.P.S. Mov's Operation:	200 A (estimated)
	990 A Next 118 Secs.
Continuous Load:	72 A
Emer. Brng. Oil Pump Flc.:	280 A
Vital AC Mtr. Flc.:	280 A
Emer. Seal Oil Pump Flc.:	53 A
	690 A Next 58 Minutes
Continuous Load:	72 A Next 419 Minutes
Continuous Load:	72 A Constant
Closing Breakers:	100 A
	172 A Last Minute

4.2 Nuclear Instrument Supply ± 24 Volt DC System. The neutron monitoring batteries are integral part of the ± 24 Volt DC system which include the battery chargers, breakers, distribution panels, and other auxiliaries.

The redundant buses are able to supply nominal ± 24 Volt DC power to the nuclear instruments. The four batteries or either of the four battery chargers may qualify as a valid source.

The neutron monitoring batteries have been sized to carry their required connected load for four hours without recharging. The batteries are sized 80 AH each. The batteries will supply the following nuclear instrument systems:

1. Neutron monitoring source, intermediate range monitors, and auxiliaries.
2. Process radiation monitoring and auxiliaries.

4.3 Battery Design Evaluation. The battery and DC switchgear are installed in areas enclosed by fire walls. The battery and DC switchgear meet requirements for Class I equipment.

The redundant DC power supply cables to 4 KV and 480 volt switchgear, and motor control centers, are physically separated by a floor, i. e., one set below and one set above the mezzanine floor in the turbine building. Similar separation is provided in the reactor building.

4.4 Testing and Inspection. Station Batteries: The station batteries and other equipment associated with the ± 24, and 125 volt DC system are readily accessible for inspection and testing. Service and testing will be accomplished on a routine basis in accordance with recommendations of the manufacturer. Typical inspections would include visual inspections for leaks and corrosion, and checking all batteries for voltage, specific gravity and level of electrolyte.

ATTACHMENT No. 3
ENCLOSURE No. 2

Millstone Unit 1

Technical Specification Change

Station Battery Testing Requirements