

Calculation No: 91-BOP-813-ES Revision No: 01

Title: MP2 Emergency Diesel Generator Operating Time With 24,000 gal Diesel Fuel Oil Available at Continuous Rated Load of 2750 KW Fuel Consumption.

Building/System/Component Code: System No. 2346A

QA Category: QA Cat 1

Total Pages: 7

Total # of Alphanumeric Revision Pages: 0

Total # of Attachment Pages: 11 (A1 - A7)

Total # of Appendix Pages: 5 (AP1 - AP14)

Total # of Document Pages: 23

Responsible Discipline: MP2 Design Engineering - Mechanical

Reviewing Method: Full Review
 Partial Review (Non-QA only)
 Alternate Review

Prepared by: Gary E. Komosky Date: 8/19/94

Reviewed by: Harold L. Thompson Date: 8/19/94

Reviewed by: NR Date: NR

Approved by: Rik W. Wells Date: 8/19/94

Quality Software Used and Rev. #/Level: None

Date CTP Data Entered:

Sections waived per Section 2.0 (non-QA only): None

Calculation ChecklistCalculation Identifying Number 91-BOP-813-ES Revision 011. PreparationInitials

1.1 Section 6.1.2

GEK

1.2 Section 6.1.3

GEK

1.3 Section 6.1.4

GEK

1.4 Section 6.4.6

GEK

TABLE OF CONTENTS NOT REQ'D.

2. Verification

2.1 Section 6.2.2.1

NLT

2.2 Section 6.2.2.2

NLT

2.3 Section 6.2.2.3

NLT

2.4 Section 6.2.2.4

NLT

2.5 Section 6.2.2.5

NLT

2.6 Section 6.2.2.6

NLT

2.7 Section 6.2.2.7

N/A

2.8 Section 6.2.2.8

NLT

2.9 Section 6.2.2.9

NLT

2.10 Section 6.2.2.10

N/A

2.11 Section 6.2.2.11

NLT

2.12 Section 6.2.2.15

NLT3. ApprovalInitial & Date

3.1 Section 6.3.1

RWH 8/19/04

3.2 Section 6.3.2

RWH

3.3 Section 6.3.3

RWH

3.4 Section 6.3.4

RWH

3.5 Section 6.3.5

N/A

3.6 Section 6.3.6

RWH4. Non-QA ApplicationsInitial & Date

4.1 Section 5.4 waived

NA

4.2 Section 6.1.4.7

NA

waived

NA

4.3 Section 6.2 waived

NA

Basis for Waiver(s)

NORTHEAST UTILITIES SERVICE COMPANY

SUBJECT MP2 Emergency Diesel Generator Operating BY GEX DATE 8/15/94
Time With 24,000 Gall. Diesel Fuel Oil Available CHKD. BY HLT DATE 8/19/94
At Continuous Rated Load of 2750 KW Fuel CALC. NO. 91-BOP-813-ES REV. 01
Consumption SHEET NO. 3 OF 7

REASON FOR CHANGE:

This calculation is being revised to include new fuel consumption information obtained from the manufacturer. The following calculation replaces Calculation Section 7B of Revision 00 in its entirety. Revision 00 is provided at Attachment 8.1.

1.0 ANALYSIS OBJECTIVE

To determine the length of time that the Emergency Diesel Generators (EDG) can operate at continuous rated load of 2750KW utilizing only 24,000 gallons of fuel which is the amount of fuel required to be stored by the Unit 2 Technical Specifications.

2.0 DESIGN INPUTS

- 2.1 NU Calculation No. 94-ENG-1095M2, Rev. 00, Millstone Unit 2 - Emergency Diesel Generator Run Time.
- 2.2 Coltec Engineering Report R5.08-0545, dated 12-16-93, Northeast Nuclear Energy Co. - Millstone 2 - Fuel Consumption Rates for Millstone 2 O.P. Diesel Generator Sets. Provided in Appendix 9.1.
- 2.3 Standard Practices for Low and Medium Speed Stationary Diesel and Gas Engines, Sixth Edition, Copyright 1972, Diesel Engine Manufacturers Association.
- 2.4 Specification No. 7604-M-160, Rev. 7, Specification of Emergency Diesel Generators for Millstone Unit 2.
- 2.5 Millstone Unit 2 Technical Specification 3.8.1.1, dated Dec. 8, 1978.

NORTHEAST UTILITIES SERVICE COMPANY

SUBJECT MP2 Emergency Diesel Generator Operating BY GEX DATE 8/19/94
Time With 24,000 Gall. Diesel Fuel Oil Available CHKD. BY HIT DATE 8/19/94
At Continuous Rated Load of 2750 KW Fuel CALC. NO. 91-BOP-813-ES REV. 01
Consumption SHEET NO. 4 OF 7

3.0 ASSUMPTIONS

- 3.1 Vortexing within the Day Tanks is not considered based on the following.

Fuel flow to one EDG has been measured at a flowrate of approximately 4.35 gal/min when the EDG is fully loaded. During the LOCA with an LNP the two day tanks are cross-connected. Therefore, the fuel flow out of each tank would be halved, or 2.18 GPM. Per the results of Reference 7.1, vortexing does not occur until a flowrate of approximately 2 GPM and does not have any significant impact on available fuel at a flowrate as high as 3.5 GPM. Based on the low fuel flowrate observed at full load, vortexing is not considered to be a concern.

- 3.2 Two EDGs operate for 1 hour, then one EDG operates for the remaining length of time.
- 3.3 The fuel level in the two Day Tanks is at the Tech Spec Minimum or 132 inches; this level equates to 12,000 gallons of fuel per tank or a total of 24,000 gallons.
- 3.4 EDG electrical loading is continuous rated load, 2750 KW.
- 3.5 Per Operating Procedure SP 2613E-1, diesel fuel oil can be accepted with an API gravity within the range of 28° to 38°. As recommended by the Engine Manufacturer in Appendix 9.1, the lightest fuel expected should be used; in this case, an API gravity of 38° shall be used. Also, the Engine Manufacturer recommends using the expected high heating value of the fuel as it will have the lowest energy content on a volume basis; in this case, per Table 4 of Design Input 2.3, the High Heating Value for an API gravity of 38° is 19,680 Btu/lb and 137,000 Btu/gallon.
- 3.6 The Underground Fuel Storage Tank does not contribute to the fuel capacity.

4.0 METHOD OF CALCULATION

The fuel consumption and timing calculations were performed using standard equations and conversions. The calculations were performed by hand.

NORTHEAST UTILITIES SERVICE COMPANY

SUBJECT MP2 Emergency Diesel Generator Operating
Time With 24,000 Gal. Diesel Fuel Oil Available
At Continuous Rated Load of 2750 KW Fuel
Consumption

BY GEK DATE 8/19/94
 CHKD. BY HLS DATE 8/19/94
 CALC. NO. 91-BOP-813-ES REV. 01
 SHEET NO. 5 OF 7

5.0 ANALYSIS

5.1 Determine the Fuel Consumption Rate for the continuous rated load, 1750 KW.

- load is 2750 KW.
- efficiency from The Generator Data Sheet in the EDG Spec, 7604-M-160 for 2750 KW load is 96.5
- to find the Gross KW load, divide KW by Eff:

$$\frac{2750 \text{ KW}}{96.5} = 2849.74 = 2850 \text{ KW}$$

- to convert the Gross Load to Brake Horsepower BHP, divide the Gross Load by 0.746:

$$\frac{2850 \text{ KW}}{0.746} = 3820.38 = 3820 \text{ BHP}$$

- determine fuel consumption (lb/hr) from Curve No. 1 of Appendix 9.1:

for 3850 BHP, fuel consumption is 1468 lb/hr

5.2 Determine the fuel consumed in gallons per hour:

- determine fuel consumption in Btu per hour by multiplying the High Heating Value of the fuel (Btu/lb) by the fuel consumption rate (lb/hr):

$$(1468 \text{ lb/hr})(19,680 \text{ Btu/lb}) = 28,890,240 \text{ Btu/hr}$$

$$= 28.8902 \times 10^6 \text{ Btu/hr}$$

- determine the fuel consumed in gallons per hour dividing the fuel rate (Btu/hr) by the high heating value (Btu/gal):

$$\frac{28.8902 \times 10^6 \text{ Btu/hr}}{137,000 \text{ Btu/gal}} = 211 \text{ gal/hr}$$

NORTHEAST UTILITIES SERVICE COMPANY

SUBJECT MP2 Emergency Diesel Generator Operating
Time With 24,000 Gal. Diesel Fuel Oil Available
At Continuous Rated Load of 2750 KW Fuel
Consumption

BY G&K DATE 8/19/94
CHKD. BY HLT DATE 8/19/94
CALC. NO. 91-BOP-813-ES REV.. 01
SHEET NO. 6 OF 7

- 5.3 Determine how many days that two EDGs can operate for 1 hour, then one EDG can operate with 24,000 gallons of fuel available:

$$(211 \text{ gal/hr})(1 \text{ hr}) + (211 \text{ gal/hr})(Y \text{ hr}) = 24000 \text{ gal}$$

$$211Y \text{ gal} = 24000 \text{ gal} - 211 \text{ gal}$$

$$Y = 23789/211$$

$$Y = 112.74 \text{ hours}$$

converting to days:

$$\frac{112.74 \text{ hours}}{24 \text{ hours/day}} = 4.6975 \text{ days}$$

use 4.7 days

6.0 SUMMARY OF RESULTS

Emergency power at Millstone Unit 2 is available for 4.7 days following a LOCA with a loss of normal power based on the Diesel Generators operating at the continuous rated load and expending the tech spec required amount of fuel.

Only one EDG operates for all but the first hour of the 4.7 days; during the first hour, both EDGs are operating.

No credit is taken for fuel in the underground storage tank or offsite replenishment.

The effect of an air intake temperature of greater than 90°F has not been considered.

NORTHEAST UTILITIES SERVICE COMPANY

SUBJECT MP2 Emergency Diesel Generator Operating
Time With 24,000 Gall. Diesel Fuel Oil Available
At Continuous Rated Load of 2750 KW Fuel
Consumption

BY GSK DATE 8/19/94
CHKD. BY HLT DATE 8/19/94
CALC. NO. 91-BOP-813-ES REV. 01
SHEET NO. 7 OF 7

7.0 REFERENCES

- 7.1 NU Calculation No. 91-004-370M2, Rev. 00, Vortex Formation Within MP2 EDG Fuel Oil Supply Tanks.
- 7.2 Operations Procedure SP2613E-1, Rev. 05, Diesel Generator Fuel Oil Delivery and Sampling.

8.0 ATTACHMENTS

- 8.1 NU Calculation No. 91-BOP-813-ES, Rev. 00, MP2 Emergency Diesel Generator Operating time with 24,000 gallons diesel fuel oil available at continuous rated load of 2750 KW fuel consumption.

9.0 APPENDICES

- 9.1 Colt Engineering Report, file no. R5.08-0545, dated 12-16-93, entitled "Fuel Consumption Rates for Millstone 2 O.P. Diesel Generator Sets".

FIGURE 7.2

CTP DATA BASE INPUTS

1. NUSCO Calculation Number 91-BOP-813-ES
2. Vendor Calculation Number NONE
3. Title MP2 EDG OPERATING TIME WITH 24,000 GAL OF DIESEL FUEL AVAILABLE AT CONTINUOUS
RATED LOAD OF 2750 KW FUEL CONSUMPTION.
4. Latest Revision/Date 01 8/19/94
5. CCN# NONE
6. Superseded By NA
7. Plant MP2
8. Building/System/Component Code 2346 A
9. Component I.D. _____
10. QA (Y/N) YES
11. Computer Code Used _____
12. P.A.# _____
13. Reference Calc. # _____
14. Reference Drawing _____
15. Comments _____



December 17, 1993

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NUSCO
PO Box 128
Waterford, CT 06385

Attention: Gary Komosky
PSD, Bldg-404

Subject: Millstone 2
NU PO 890321
Coltec Order 35-734305
Standby Diesel Generators

Enclosure (1) Coltec Engineering Report R5.08-0545, dated 12/16/93

Gentlemen:

Enclosure (1) is attached per subject order requirements.

If you have any questions or require additional information, please contact the writer at (608) 364-8424.

Very truly yours,

T. M. Stevenson
Supervisor Nuclear Parts

TMS/dr

cc: W. Martin
G. Monahan

Fairbanks Morse
Engine Division

ENGINEERING REPORT

SHEET 1 OF 2 PAGE NO. 1

FILE NUMBER R5.08-0545

DATE 12-16-93

PREPARED BY *J. Monahan*
BY *G. Monahan*

SUBJECT Northeast Nuclear Energy Co. - Millstone 2

REPORT TITLE Fuel Consumption Rates for Millstone 2 O.P.
Diesel Generator SetsAPPROVED BY *W. H. Hays*

This engineering report is prepared in response to Northeast Utilities Purchase Order No. 890321 (AIN 11498A). Northeast Utilities (Millstone 2) requested a formal engineering report indicating the fuel consumption rates for the Millstone 2 O.P. diesel generators S/N 38D872035TDSM12 and S/N 38D875022TDSM12.

I. BACKGROUND

Engine S/N 38D872035TDSM12 was originally manufactured with a turbo-parallel scavenging air system and was factory tested in June of 1972. Engine S/N 38D875022TDSM12 was built to the turbo-series design and factory tested in 1975. In 1992, the turbo-parallel engine, S/N 38D872035TDSM12 was overhauled and converted to the turbo-series design. The two engines now have identical builds such that performance and fuel rates of the two engines are expected to be approximately the same.

II. ASSESSMENTA. Turbo-Parallel Engine

Contract tests were run on the engine S/N 38D872035TDSM12 with the original turbo-parallel design. During the tests, fuel consumption rates were measured at various load conditions. The measured fuel consumption rates versus brake horsepower load are plotted on Curve No. 1.

B. Turbo-Series Engine

During contract tests on the turbo-series design engine S/N 38D875022TDSM12, fuel consumption was measured at the required loads. Results of fuel consumption plotted versus brake horsepower load are summarized on Curve No. 2.

C. Calculation Methodology

The measurement of fuel consumption was done using the same technique for both engines. The engine load was set using the kilowatt meter. With the load held constant, a stopwatch was used to measure the time elapsed while a set weight of fuel was consumed. The heating value of the fuel, obtained by sample analysis, is multiplied by the fuel rate in pounds per hour to determine the fuel consumption in BTU per hour.

example: (1500 LBS/HOUR)(19893 BTU/LB HHV)

=29.8 x 10⁶ BTU/HOUR (gross)

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ENGINEERING REPORT

SHEET 2 OF 2

PAGE NO. 2

Fairbanks Morse
Engine Division

SUBJECT Northeast Nuclear Energy Co. - Millstone 2

DATE 12-16-93

REPORT
TITLE Fuel Consumption Rates for Millstone 2 O.P.
Diesel Generator SetsPREPARED BY *G. Monahan*APPROVED BY *W. H. Hays*

To obtain the fuel consumption in units of gallons per hour, the expected high heating value of the fuel must be determined. For conservatism, the lightest fuel expected should be considered, as it will have the lowest energy content on a volume basis. The fuel rate in BTU per hour (gross) divided by the high heating value in BTU per gallon will yield the fuel consumed in gallons per hour.

$$\text{example: } \frac{29.8 \times 10^6 \text{ BTU/HOUR (gross)}}{133,000 \text{ BTU/GALLON}} = 224 \text{ GALLONS/HR}$$

D. Correction for Ambient Temperature

For engines running in ambient temperatures where the air intake temperature exceeds 90 degrees Fahrenheit, the expected fuel consumption is increased. The established correction for the O.P. engine is a 0.6% increase in fuel consumption for each degree Fahrenheit that the air intake temperature exceeds 90 degrees Fahrenheit. For an air intake temperature of 103 degrees Fahrenheit, the correction would be:

$$(224 \text{ GALLONS/HOUR}) [(103-90)(.006) + 1] = \\ = 241 \text{ GALLONS/HOUR}$$

III. SUMMARY/CONCLUSION

The fuel consumption data from the original factory contract tests can be used for calculating fuel storage requirements for operating at any given load. Data shown on the attached curves is typical for these engines when operating in the "as new" state. Fuel rates can be expected to decrease from the test floor values as operating hours are accumulated.

To determine the rate of fuel consumption at any given kilowatt load, the generator efficiency must be determined at that load from the efficiency curve at the desired power factor. The engine brake horsepower load can then be determined and the fuel rate read from the attached curves. The fuel rate in gallons per hour can then be calculated using the procedure outlined in this report and assuming a fuel higher heating value which corresponds with the lightest fuel that can be expected to be procured at the site. If an air intake temperature above 90 degrees Fahrenheit is to be assumed, the fuel rate correction given in Para. II.D. may be applied.

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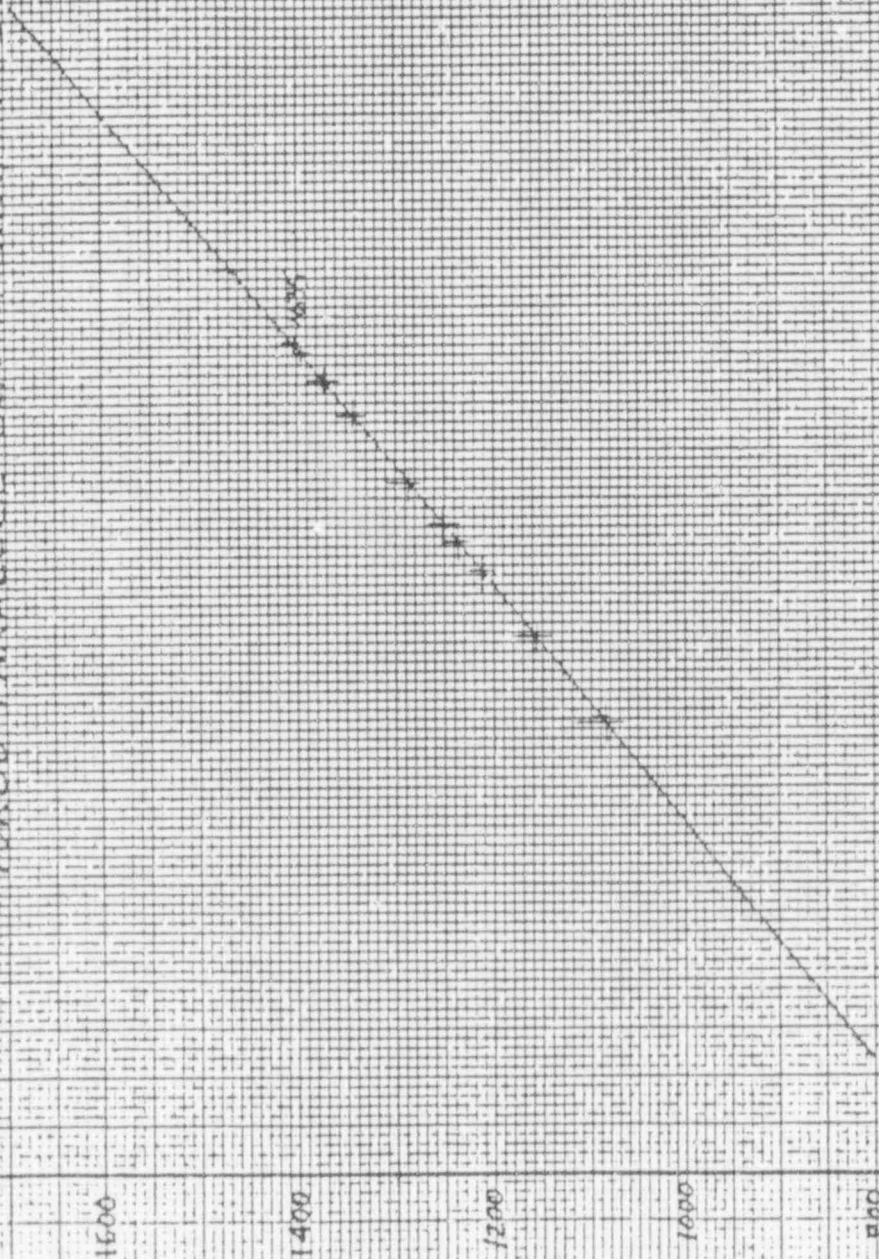
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CURVE NO. 1

CALL. 91-BOP-813-ES REV. 01
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FUEL CONSUMPTION VS. LOAD
 MODEL 38TDE-1/8 O.P. S/N 38D87208FTD8M12
 TURBO-PARALLEL SCAVENGING AIR SYSTEM

FUEL CONSUMPTION, LB PER HOUR



BRAKE HORSEPOWER LOAD

DATA TAKEN FROM CONTRACT
 TEST LOGS, HIGHER
 HEATING VALVE OF FUEL
 USED DURING TEST WAS
 14.71 BTU/LB (gross)

CURVE NO. 2

FUEL CONSUMPTION VS. LOAD

MODEL 38TDB-1/8 O.P. S/N 380875022TDSM12
TURBO-SERIES SCVENGING AIR SYSTEM

FUEL CONSUMPTION, LB PER HOUR

BRAKE HORSEPOWER LOAD

DATA TAKEN FROM CONTRACT
TEST LOGS. HIGHER
HEATING VALUE OF FUEL
USED DURING TEST WAS
19,843 BTU/LB (gross)

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APPENDIX 9.1 PAGE 5 OF 5

Report File No. R5.08-0545
G. Monahan d. Monahan

Calculation # : 91-BOP-813-ES REV 00

<u>Interface/ Distribution</u>	<u>date sent</u>
NPR	<u>7/8/92</u>
CHP	_____
_____	_____
_____	_____

TITLE: MP-2 Emergency Diesel Generator
Operating time with 24,000 gallons diesel
fuel oil available at continuous rated
load of 2750 KW fuel consumption.

Prepared by: Maurice J. Pomeroy (signed)
(printed)

Date 3/3/92

Reviewed by: R. D. Hart (signed)
(printed)

Date 4/30/92

Rereviewed: 5/14/92 ~~at~~

Approved by: R.E. McMullen (signed)
R.E. McMullen (printed)

Date 5/28/92

CCN # _____

Superseded by: _____

Method of review:

Line by line check of calculation, assumptions & method. Check
Calcs (simplified) performed.

CALC 91-BOP-813-ES REV 01

ATTACHMENT 8.1

Calculation Data Sheet

Page 2 of 11

Nusco Calc #: 91-BOP 813 ES
(prefix) (sequential (suffix)
number)

Latest
Revision # 0

A/E Calc #/ other : _____

CCN # _____

Superseded by: _____

Responsible discipline Balance of Plant Systems QA(y/n) Y

Plant	P.A.#	Component ID	computer code used	rev.#/level
<u>MP2</u>	<u>NA</u>	<u>T412A+B</u>	_____	_____
<u>MP2</u>	<u>NA</u>	<u>H7A+B</u>	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

PMMS code			Reference Drawings	sh.	Reference Calculations
structure	system	component			
<u>DG</u>	<u>DFS</u>	<u>TANK</u>	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Comment _____

MP-2 Emergency Diesel Generator
Operating time with 12,000 gallons each of
diesel fuel oil available at continuous rated
load of 2750 KW

M. J. Ramieri

3/30/92

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1. Analysis Objective

To determine the Emergency Diesel Generator Operating time at continuous rated load of 2750 KW fuel consumption and to establish that 12,000 gallons of diesel fuel oil are available per each diesel generator as per MP-2 Technical Specifications.

2. Summary of Results

The Diesel Fuel Oil Supply Tank capacity calculation indicates that at least 12,000 gallons of diesel fuel oil for each diesel generator or a total of at least 24,000 gallons of diesel fuel oil will be available at the start of a LOCA coincident with a Loss-of-Normal Power (LNP).

The fuel consumption calculation indicates that, based on the above fuel oil capacity, one diesel generator can operate for approximately 4.3 days and the second for one hour immediately following initiation without fuel oil replenishment.

MP-2 Emerg. Diesel Gen. Operating
time with 12,000 gal. each of diesel fuel
oil at continuous rated load of 2750 kW

M.J. Ranieri

3/30/92

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3. Method of Calculation

The supply tank and fuel consumption calculations were performed using standard volume and capacity equations.

The calculations were performed by hand.

(See section 5.4 of Design Input 4.6)

4. Design Inputs

4.1 Millstone Unit 2 Final Safety Analysis Report, page 8.3-4 and Table 8.3-1 dated 2/21/90.

4.2 NUSCO Drawing 25203-29031 Sh. 13, Diesel Oil Supply Tanks, T-48A & T-48B, Rev. 5 (attached)

4.3 Coltec Industries memo from Tom Stull to William A. Kramer concerning MP-2 diesel generator fuel oil consumption rate dated March 19, 1992. (attached)

4.4 Bechtel Calculation 2000-1 dated 5/24/74 (attached)

4.5 Millstone Unit 2 Technical Specification 3.8.1.2 dated August 3, 1975 (attached)

4.6 ANSI N195-1976 - Fuel Oil Systems for Standby Diesel Generators dated April 12, 1976 (attached)

4.7 Standard Practices for Stationary Diesel and Gas Engines, p. 127 published by Diesel Engine Manufacturers Association, sixth edition. (attached)

MP-2 Emerg. Diesel Gen. Operating
time with 12,000 gal. each of diesel
fuel oil at continuous rated load of 2750kW

M.J. Ranieri

3/30/92

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5. Assumptions

5.1 No credit is taken for fuel oil below centerline of fuel outlet pipe (bottom six inches of supply tanks)

5.2 Diesel Generators operate at continuous rated load of 2750kW.

5.3 Diesel Fuel Oil Storage Tank is unavailable.

6. References

6.1 Fax from Ted Stevenson - "Millstone 2 Engine Birth Certificates" dated November 27, 1991.

6.2 R.J. Halleck calculation, PA-79-126-885-GEE, Rev. 0, Millstone Unit 2 Diesel Generator Loading dated 7/24/90 (attached)

6.3 MP-2 Procedure SP-2613E, "Diesel Generator Fuel Oil Delivery and Sampling," Rev. 4

6.4 MP-2 Procedure 2346A "Emergency Diesel Generators", Rev. 13

MP-2 Emergency Diesel Gen. operating time
with 12,000 gal. each of diesel fuel oil
at continuous rated load of 2750 kW

M. J. Ranieri

3/30/92

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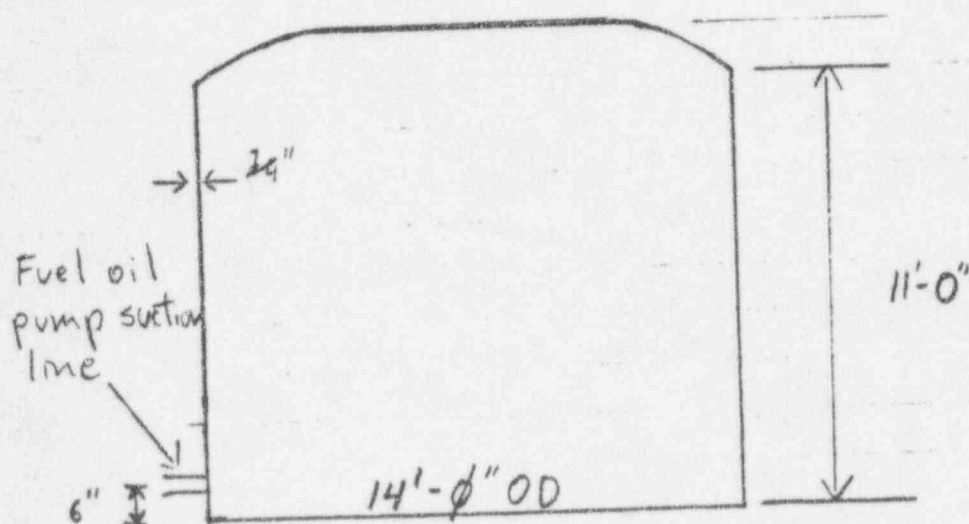
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7. Calculations

A) Calculate the volume of ^{a cylindrical section of} Diesel Fuel Oil Supply Tanks
T-48A and T-48B.

Tank dimensions are from Design Input 4.2.

1) Volume of cylindrical section of tank



For Tank:

$$ID = 13.958 \text{ ft. } \checkmark$$

$$r = 6.979 \text{ ft. } \checkmark$$

Volume of cylindrical section:

$$V_c = \pi r^2 (11'-0") (7.48 \text{ ft}) =$$

$$= \pi (6.979)^2 (11.0) (7.48) = 12,590 \text{ gallons } \checkmark$$

MP-2 Emerg. Diesel Gen. Operating time
with 12,000 gal. each of diesel fuel
oil at continuous rated load of 2750 KW.

M. J. Ramer

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The height of fuel required to meet the Technical Specification requirement of 12,000 gallons is:

$$V_{fs} = \pi r^2 (H_{ft}) (7.48 \frac{\text{gal}}{\text{ft}^3})$$

$$H_{ft} = \frac{V_{fs}}{\pi r^2 (7.48)}$$

$$H_{ft} = \frac{12,000}{\pi (6.979)^2 (7.48)} \checkmark$$

$$H_{ft} = 10.48 \text{ ft.} \checkmark \text{ or approximately } 10' - 6'' \text{ above bottom of tank.}$$

Note: The volume of the tanks top (domed) section and manway opening are not included since the vertical cylindrical section volume more than meets the 12,000 gallon Technical Specification requirement.

MP-2 Emerg. Diesel Gen. Operating
time with 12,000 gal each of diesel fuel
oil at continuous rated load of 2750 KW

M/J Ramiani

3/30/92

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Calculations (cont.)

Since the bottom 6 inches of the tank are not taken credit for then the height required to meet the 12,000 gallon Technical Specification requirement is 11'-0".

- B) Calculate the Emergency Diesel Generator operating time based on a continuous rated load of 2750 KW and a fuel supply of 12,000 gallons per supply tank (24,000 gallons site total)

Fuel consumption based on Design Input 4.3 at a load of 2750 KW is 1585 lbs/hr at an API gravity of 28° and its corresponding lower heating value.

As per reference 6.3, No. 2 diesel fuel oil can be accepted with an API gravity equal to and between 28° and 38° . For comparison purposes this calculation will use an API gravity at both 28° and 38° .

At an API gravity of 28° the weight of one gallon of fuel oil is approximately 7.387 lbs./gal. (see Design Input 4.7)

MP-2 Emerg. Diesel Gen. Operating time
with 12,000 gal. each of diesel fuel oil
at continuous rated load of 2750 kW

M. J. Ranieri

3/30/92

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Calculations (cont.)

Thus:

$$\frac{1585 \frac{\text{lbs}}{\text{hr}} \times 1 \text{ hr.}}{7.387 \frac{\text{lbs}}{\text{gal.}}} + \frac{1585 \frac{\text{lbs}}{\text{hr}} \times y \text{ hrs.}}{7.387 \frac{\text{lbs}}{\text{gal.}}} = 24,000 \text{ gallons}$$

$$214.566 \text{ gal.} + 214.566 y \text{ gal. hrs.} = 24,000 \text{ gallons}$$

$$214.566 y \text{ gal. hrs.} = 23,785.434 \text{ gallons}$$

$$y = 110.85 \text{ hours}$$

At an API gravity of 38° the weight of one gallon of fuel oil is approximately $\frac{6.951 \text{ lbs.}}{\text{gal.}}$ (see Design Input 4.7) It will be assumed that 1585 lbs/hr. will be consumed at an API gravity of 38° also. (see attachment A)

Thus:

$$\frac{1585 \frac{\text{lbs}}{\text{hr.}} \times 1 \text{ hr.}}{6.951 \frac{\text{lbs}}{\text{gal.}}} + \frac{1585 \frac{\text{lbs}}{\text{hr.}} \times y \text{ hrs.}}{6.951 \frac{\text{lbs}}{\text{gal.}}} = 24,000 \text{ gallons}$$

$$228.024 \text{ gal} + 228.024 y \text{ gal. hrs.} = 24,000 \text{ gallons}$$

$$228.024 y \text{ gal. hrs.} = 23,771.976 \text{ gal.}$$

$$y = 104.25 \text{ hours}$$

MP-2 Emerg Diesel Gen. Operating
time with 12,000 gal. each of diesel
fuel oil at continuous rated load of 2750KW

M. J. Ranieri

3/30/92

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Calculations (cont.)

Therefore:

At an API gravity of 28°:

$$y = \frac{110.85 \text{ hrs.}}{24 \frac{\text{hrs.}}{\text{day}}}$$

$$= 4.6 \text{ days}$$

At an API gravity of 38°:

$$y = \frac{104.25 \text{ hrs.}}{24 \frac{\text{hrs.}}{\text{day}}}$$

$$= 4.34 \text{ days}$$

Use 4.3 days.

Approximately 4.3 days of diesel fuel oil is available
in the event of a large break LOCA with loss-of-
normal power.

MP-2 Emerg. Diesel Gen. Operating
time with 12,000 gal. each of diesel fuel
oil at continuous rated load of 2750 kW.

M.J. Ramini

3/30/92

//

//

Attachment A

See Design Input 4.7 for fuel oil weight and BTU figures below.

Design Input 4.3 was calculated at an API gravity of 28°. At 28° API, one gallon of fuel contains approximately 134,600 BTUs. At the calculated consumption rate of 214.566 gallons per hour multiplied by 134,600 BTUs per gallon the number of BTUs consumed per hour is 28,880,583.

To approximate the fuel consumption rate at 38° API divide the above 28,880,583 BTUs/hour by 128,500 BTUs/gallon (BTUs per gallon at 38° API).

This gives a consumption rate of 224.75 gallons per hour

Thus:

$$x \text{ lbs/hr} \div 6.951 \frac{\text{lbs}}{\text{gallon}} = 224.75 \text{ gallons/hr.}$$

$$x \text{ lbs/hr} = 224.75 \text{ gal/hr} \times 6.951 \frac{\text{lbs}}{\text{hr}}$$

$$x \approx 1562 \text{ lbs/hr. at } 38^\circ \text{API}$$

Assume 1585 lbs/hr., the same consumption rate at 28° API.
This is slightly more conservative.

Docket No. 50-336
B15220

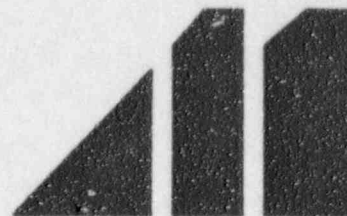
Attachment 3

Millstone Nuclear Power Station, Unit No. 2

Request for Additional Information
Excerpts from MP2 EDG Fuel Oil Supply Procedures

May 1995

MILLSTONE NUCLEAR POWER STATION
EMERGENCY PLAN IMPLEMENTING PROCEDURE



Event Assessment, Classification, and
Reportability

EPIP 4400

Rev. 2

Approval:

Stephen D. Pace
Vice President - Millstone Station

SORC Mtg. No:

93-27

Effective Date:

7-31-93

Level of Use
General

Subject Matter Expert:
Tom McCance

~~9411210237~~ 4pp

Procedure and Form Change Request

(Sheet 1 of 1)

Section 1 Change Initiation

Document Number: EPIP 4400 Revision No. 2 Change No. 2

Document Title: Event Assessment, Classification, and Reportability

Initiated By: W. Tom McCance Date: _____

Reason for Change: Reshaping of the Protection Action Recommendation (PAR)
zones for Millstone Station

Clarify LOCA/EDG fuel ordering.

Section 2 Non-Intent Change Approval

Section 2a. Approval of SORC Member or First Line Supervisor or Above

Signature: N/A Date: _____

Interim Approval

Section 2b. Shift Supervisor Approval

Signature: N/A Non-Intent change logged Date: _____

Upon completion of this section, change is effective on an interim basis pending final approval or cancellation not more than 14 days from signature date above.

Section 3 Instructions for Entering Change

Replace change 1. Attachment 2, Protective Action Recommendations Table
(sheet 2 of 2) (p. 36/37a of 62).

(p. 10 of 62)

Section 4 Intent Change Review

Qualified Reviewer Signature: [Signature] QAS Signature: N/A
(if required)

Section 5 Department Head Review

Is specific unreviewed safety question evaluation required? YES ☐ NO ☒

Is environmental review required? YES ☐ NO ☒

Is specific safety evaluation required? YES ☐ NO ☒

Signature: [Signature] Date: 10/31/94

Section 6 APPROVAL

SORC or PORC Chairman Signature: [Signature]

Meeting Number: 94-44 Approval Date: 11-3-94

Non-Intent or Intent
Effective Date: 11-15-94

STOP THINK ACT REVIEW

DC 1, Attachment 6

Rev. 3

64 of 68

4.8 Actions Performed for ^{LOCA or} Loss of Off-Site Power Event [✱ Ref 6.15]

4.8.1 Within 4 hours of a ^{LOCA or} loss of off-site power event, PERFORM the applicable action:

- Unit 1 and 2, EVALUATE the need to order emergency diesel generator or gas turbine fuel oil to extend on-site capacity and Go To Section 4.7, "Event Reclassification."
- Unit 3, PLACE an order for emergency diesel generator fuel and SPECIFY delivery is required within 24 hours.

Unit 3

4.8.2 IF fuel oil can not be delivered within the specified time, PERFORM the applicable action:

- IF Station Emergency Response Organization has *not* been activated, PERFORM the following:
 - 1) REQUEST affected unit's Manager of Technical Support Center to report to the station.
 - 2) Refer To FSAR Table 8.3-1 (pages 5 and 6) and EVALUATE load shedding alternatives and PROVIDE recommendations.
 - 3) Go To Section 4.7, "Event Reclassification."
- IF Station Emergency Response Organization *has* been activated, PERFORM the following:
 - 1) Affected unit's Manager of Technical Support Center Refer To FSAR Table 8.3-1 (pages 5 and 6) and EVALUATE load shedding alternatives and PROVIDE recommendations.
 - 2) Go To Section 4.7, "Event Reclassification"

NOTE:

It is good practice to initiate evaluation of load shedding options as soon as oil is ordered to conserve EDG Fuel Oil in case delivery is delayed.

5. REVIEW AND SIGNOFF

N/A

6. REFERENCES

- 6.1 "Final Safety Analysis Report Unit 1," Appendix G
- 6.2 "Final Safety Analysis Report Unit 2," Appendix 12A
- 6.3 "Final Safety Analysis Report Unit 3," Section 13.3 and 9.5.4
- 6.4 "Millstone Nuclear Power Station Emergency Plan"
- 6.5 Code of Federal Regulations 10CFR20.403
- 6.6 Code of Federal Regulations 10CFR30.14
- 6.7 Code of Federal Regulations 10CFR30.18
- 6.8 Code of Federal Regulations 10CFR50.72
- 6.9 Code of Federal Regulations 10CFR50.73
- 6.10 Code of Federal Regulations 10CFR50, Appendix E
- 6.11 Code of Federal Regulations 40CFR302
- 6.12 NUREG-0654, Revision 1, "Criteria for Preparation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants"
- 6.13 NUREG-0737, "Clarification of TMI Action Plan Requirements, Supplement 1, Requirements for Emergency Response Capability"
- 6.14 EPIP 4404, "Notifications and Communications"
- 6.15 NRC Memo to J. D. Opeka, Docket 50-423, dated June 7, 1993, subject; Design Basis for the Millstone Unit 3 Emergency Diesel Generator Fuel Oil Capacity.

Level of Use
General

EPIP 4400
Rev. 2
11 of 62

STATION PROCEDURE COVER SHEET

A. IDENTIFICATION

Number: EOP 2540B

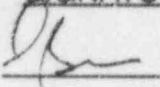
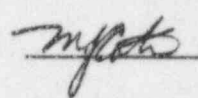
Rev. 7

Title: FUNCTIONAL RECOVERY OF VITAL AUXILIARIES (AC and DC POWER)

Prepared By: M. Cote

B. REVIEW

I have reviewed the above procedure and have found it to be satisfactory.

<u>TITLE</u>	<u>SIGNATURE/DATE</u>	<u>TITLE</u>	<u>SIGNATURE/DATE</u>
DEPARTMENT HEAD	 7-26-94	PWG	 7/26/94

C. SPECIFIC UNREVIEWED SAFETY QUESTION EVALUATION REQUIRED:

Modifies intent of procedure and changes operation of systems as described in design documents.

YES [] NO [X]

(If yes, perform written USQ determination and Safety Evaluation, and contact Manager, Safety Analysis Branch to determine need for Integrated Safety Evaluation.)

ENVIRONMENTAL REVIEW REQUIRED

(Adverse environmental impact)

YES [] NO [X]

D. SPECIFIC SAFETY EVALUATION REQUIRED

Affects response of safety systems, performance of systems which may have been credited in the safety analysis or non-credited systems which may indirectly affect safety system response.

YES [] NO [X]

(If yes, coordinate Safety Evaluations and contact Manager, Safety Analysis Branch to determine need for Integrated Safety Evaluation.)

E. INTEGRATED SAFETY EVALUATION REQUIRED

YES [] NO [X]

F. BIENNIAL REVIEW

This revision satisfies biennial review requirements.

YES [X] NO []

G. PROCEDURE REQUIRES PORC/SORC REVIEW

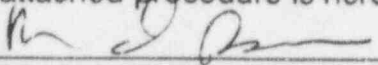
(In addition to review, items with a YES response must be documented in the PORC/SORC meeting minutes.)

YES [] NO [X]

H. PORC/SORC APPROVAL PORC/SORC Meeting Number Biennial Review 2-92-136
7-26-94

I. APPROVAL AND IMPLEMENTATION

The attached procedure is hereby approved, and effective on the date below:

 for
Sr. VICE PRESIDENT/DIRECTOR - UNIT/SERVICES

7-29-92
EFFECTIVE DATE

AC Power from Diesel Generators

CAUTION

Service water cooling is required to prevent diesel generator overheating. Each diesel generator's vital bus must be energized to supply service water.

2.4 Restore AC power using D/G's
(Refer to Schematic 4.6)

2.4

2.4.a. Verify availability of
D/G by

2.4.a.

- i. No Disabled Alarms (local)
- ii. No Trouble Alarms (local)
- iii. No Amber Breaker lites (local)

- i. If both diesel generators failed to start,
Then dispatch an operator with portable lights and communications to the diesel room to investigate
or

If either diesel generator starts but it's respective vital bus is not energized,
Then emergency trip the diesel to prevent overheating (C08)

- ii. GO TO Step 2.3 or 2.5

2.4.b. Start the affected D/G
Refer to OP 2346A
(C08)

2.4.b. Continue with this procedure

2.4.c. Verify at least one
vital AC bus (24C or
24D) energized (C08)

2.4.c. Continue with this procedure

Restore AC using D/G

Instructions

- 2.4.d. Align fire system to instrument air compressors (local)
- 2.4.e. Start instrument air compressors. Refer to Instrument Air, OP 2332B (local)
- 2.4.f. Prevent backdraft of Unit 1 stack gases into Unit 2 by the following
- i. Open 2-EB-50 (40) and 2-EB-51 (41), EBFS dampers (C01)
 - ii. Start A(B) EBFS Fan (C01)
 - iii. Close 2-EB-55 and 2-EB-56, Condenser Air Removal Fan Discharge to Unit 1 (C06)
 - iv. Close 2-EB-57, Condenser Air Removal to Unit 2 (C06)
 - v. Place switches for F-55A and F-55B in "stop" (C06)
- 2.4.g. Monitor diesel fuel oil tank level (C08)

Contingency Actions

- 2.4.d. Align RBCCW to instrument air compressors (local)
- 2.4.e. Notify Unit 1 and open the station air cross-tie valve to receive instrument air from Unit 1 (local)
- 2.4.f. Continue with this procedure.
- 2.4.g. If level falls below 92%,
Then raise tank level.
Refer to Diesel Generator,
Fuel Oil, OP 2346B

Restore AC using D/G

CW
1

STATION PROCEDURE COVER SHEET

A. IDENTIFICATION

Number: EOP 2528

Rev. 7

Title: ELECTRICAL EMERGENCY

Prepared By: S. K. BRINKMAN

B. REVIEW

I have reviewed the above procedure and have found it to be satisfactory.

<u>TITLE</u>	<u>SIGNATURE/DATE</u>	<u>TITLE</u>	<u>SIGNATURE/DATE</u>
<u>Department Head</u>	<u>[Signature] 12/31/92</u>	<u>Writer's Group</u>	<u>[Signature]</u>
<u>Writer's Guide Review</u>	<u>[Signature]</u>	<u>EOP Coordinator</u>	<u>[Signature] 12/30/92</u>

C. SPECIFIC UNREVIEWED SAFETY QUESTION EVALUATION REQUIRED:

Modifies intent of procedure and changes operation of systems as described in design documents.

YES | | NO | ☒

(If yes, perform written USQ determination and Safety Evaluation, and contact Manager, Safety Analysis Branch to determine need for Integrated Safety Evaluation.)

ENVIRONMENTAL REVIEW REQUIRED

(Adverse environmental impact)

YES | | NO | ☒

D. SPECIFIC SAFETY EVALUATION REQUIRED

Affects response of safety systems, performance of systems which may have been credited in the safety analysis or non-credited systems which may indirectly affect safety system response.

YES ☒ NO | |

(If yes, perform written Safety Evaluation and contact Manager, Safety Analysis Branch to determine need for Integrated Safety Evaluation.)

E. INTEGRATED SAFETY EVALUATION REQUIRED

YES ☒ NO | |

F. BIENNIAL REVIEW

This revision satisfies biennial review requirements.

YES ☒ NO | |

G. PROCEDURE REQUIRES PORC/SORC REVIEW

(In addition to review, items with a YES response must be documented in the PORC/SORC meeting minutes.)

YES ☒ NO | |

H. PORC/SORC APPROVAL PORC/SORC Meeting Number 2-92-300

I. APPROVAL AND IMPLEMENTATION

The attached procedure is hereby approved, and effective on the date below:

[Signature for JS Keenan]
STATION SERVICES UNIT DIRECTOR

1/6/93
EFFECTIVE DATE

ELECTRICAL EMERGENCY

1. ENTRY CONDITIONS

- a. Standard Post Trip Actions have been performed

and
- b. Plant conditions indicate that an electrical emergency has occurred by one or more of the following
 - i. Failure of NSST to properly transfer to RSST (C08)
 - ii. "Breaker Tripped" alarms on 6.9 and 4.16 KV buses (C08)
 - iii. Auto start of diesel generator(s) (C08)
 - iv. Loss of all RCPs (C03)
 - v. Reactor trips but half the TCBs indicate open or half have no indication (C04/RPS)
 - vi. 125V DC Trouble Alarms (C08)
 - vii. Extensive loss of various indications

or

A Station Blackout event has occurred, and at least one vital 4160 volt AC bus has been restored.

CAUTION

1. Before securing a diesel, ensure minimum safety related equipment will continue to operate.
 2. When 24E and 24C (or 24E and 24D) are powered from Unit 1 RSST, do not exceed 3.0 MVA or 460 amps on 14H. Refer to Figure 4.6.
-

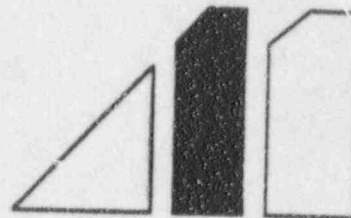
2.13 Verify proper diesel generator operation

- a. Diesel fuel oil supply tank (day tank) level is greater than 92% (C08)
- b. Ensure operating limits not exceeded. Refer to OP 2346A, Diesel Generator

2.13 Do the following

- a. Replenish fuel oil supply tank. Refer to Diesel Fuel Oil, OP 2346B
- b. If diesel fuel oil supply tank (day tank) is less than 92%, Then, do the following
 - i. Reduce loads on one diesel generator (C08)
 - ii. Stop within 1 hour (C08)
 - iii. Align both diesel fuel oil supply tanks to operating diesel (local)
- c. Utilize power from Unit 1 RSST to energize 24E and 24C (or 24D) to relieve diesel generator operation. Refer to Station Electrical, OP 2343

MILLSTONE NUCLEAR POWER STATION
SYSTEM OPERATING PROCEDURE



Diesel Fuel Oil System

OP 2346B

Rev. 7

Approval:

John Skene
Unit Director

PORC Mtg. No:

2-93-052

Effective Date:

4/17/93

Level of Use
General

Subject Matter Expert:
L. Nelson

4.5 Operation With "A" and "B" Diesel Oil Supply Tanks Cross Tied to Supply "A" and "B" Emergency Diesel Generators

4.5.1 Refer To Technical Specifications LCO, 3.8.1.1, for facility separation requirements.

4.5.2 UNLOCK and OPEN the following:

- Diesel oil supply tanks cross-tie, 2-FO-12
- Diesel generator engine fuel oil header cross-tie, 2-FO-84

4.5.3 WHEN cross-tie is *no* longer required, CLOSE and LOCK the following:

- Diesel oil supply tanks cross-tie, 2-FO-12
- Diesel generator engine fuel oil header cross-tie, 2-FO-84

- End of Section 4.5 -