NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION

07-188-91

02-LOT-001-264-2-01 (OPS) Revision 7

TITLE: STANDBY DIESEL GENERATORS & AUXILIARIES

	SIGNATURE	DATE
PREPARER	G S Bridges	3/8/91
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PLANT SUPERVISOR/ USER GROUP SUPERVISOR	[signature] for D. Topley	3/10/91

Summary of Pages

(Effective Date: 3/18/91)

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ATTACHMENT 5
LESSON PLAN TEMPORARY/PUBLICATION/ADDENDUM CHANGE FORM

The attached change was made to:

Lesson plan title: Steady Diesel Generators and Auxiliaries

Lesson plan number: 02-LOT-001-264-2-01

Name of instructor initiating change: P. Walsh

Reason for the change: Add SOER 83-01 reviews to the system lesson plan. Change section 7 to include reviews of SOER-83-01 and add SOER 83-01 to reference section. Remove system history section.

Type of change:

1. Temporary change X
2. Publication change ____
3. Addendum change ____

Disposition:

X 1. Incorporate this change during the next scheduled revision.

____ 2. Begin revising the lesson plan immediately. Supervisor initiate the process.

____ 3. To be used one time only.

Approvals:

Instructor: [signature] /Date 7/29/91

Supervisor Operations Training (or designee): [signature] /Date 7/29/91

I. TRAINING DESCRIPTION

A. Title of Lesson: Standby Diesel Generators and Auxiliaries |7

B. Lesson Description: This lesson contains information pertaining to the Standby Diesel Generators and their auxiliaries. The scope of the training is defined by the learning objectives and in general covers the knowledge required of a Licensed Control Room Operator. |

C. Estimate of the Duration of the Lesson: 4 Hours

D. Method of Evaluation, Grade Format, and Standard of Evaluation:

1. Written Exam passing grade of 80% or greater |7

E. Method and Setting of Instruction:

This lecture should be conducted in the classroom. |7

F. Prerequisites:

1. Instructor: Certified in accordance with NTP-16 |7

2. Trainee:

a. Initial License Candidate - In accordance with the eligibility requirements of NTP-10. |7

b. Licensed Operator Requal - In accordance with the requirements of NTP-11.

G. References:

1. Technical Specifications

3/4.8.1.1 A.C. Sources-Operating
3/4.8.1.2 A.C. Sources-Shutdown
3/4.8.2.1 D.C. Sources-Operating
3/4.8.2.2 D.C. Sources-Shutdown
3/4.8.3.1 Distribution-Operating
3/4.8.3.2 Distribution-Shutdown
3/4.8 Electrical Power System-Bases

2. Procedures

N2-OP-100A Standby Diesel Generators, Rev. 1
N2-OP-57 DSL Gen. Bldg. Ventilation, Rev. 1

3. USAR |7
   Sect. 8.3
   Sect. 9.4
   Sect. 9.5
4. Engine Technical Manual E031A
   Cooper Bessemer Energy Services
5. SOER 83-01 rev 7/89/91 add chg 7/89/91

II. REQUIREMENTS

A. Requirements for Class:

1. AP-9.0, Administration of Training |7
2. NTP-10, Training of Licensed Operator Candidates |
3. NTP-11, Licensed Operator Requalification Training |
4. NTP-12, Unlicensed Operator Training |

III. TRAINING MATERIALS

A. Instructor Materials:

1. Transparency Package
2. Overhead Projector
3. Whiteboard and Felt Tip Markers
4. Lesson Plan 02-LOT-001-264-2-01 |7
5. Training Record |
6. Evaluation Form |

B. Trainee Materials:

1. EGS-1 Op Tech Chapter |
2. Pens, pencils, paper |
3. Handouts |

IV. EXAM AND MASTER ANSWER KEYS

Will be generated and administered as necessary. They will be on permanent file in the Records Room.

V. LEARNING OBJECTIVES

A. Terminal Objectives: |7

Upon completion of training, the trainee will have gained the knowledge to:

TO-1.0	Lineup the diesel generator auxiliary Systems.	(2640010101)
TO-2.0	Start a diesel generator locally.	(2640020101)
TO-3.0	Load the diesel generator	(2640030101)
TO-4.0	Monitor the diesel generator	(2640040101)
TO-5.0	Add fuel oil to the diesel generator storage tanks.	(2640070101)
TO-6.0	Operate the diesel generator starting air system.	(2640080101)
TO-7.0	Perform the auto start response checks for the diesel generator.	(2649050101)
TO-8.0	Perform an emergency stop of the diesel generator while in the test mode (EGS-EG1 & EG-3)	(2649080401)
TO-9.0	Perform the DG operability test	(2649180201)
TO-10.0	Perform DG ECCS start Div I & II, N2-OSP-EGS-R001	(2649220201)
TO-11.0	Start and load a diesel generator locally	(2649260401)
TO-12.0	Fill out the diesel generator run log N2-OSP-EGS-W001	(2649270101)
TO-13.0	(SRO ONLY) Obtain GETARS traces for the diesel generator monthly run.	(2649020103)

B. Enabling Objectives: |7

EO-1.0 Explain the purpose and function of the Standby Diesel Generators and Auxiliaries System.

EO-2.0 Describe the purpose and function of the following components and or sub-systems:

a. DG Fuel Oil Storage and Transfer System
b. DG Jacket Water System
c. DG Starting Air System
d. DG Control System
e. DG Lubrication System
f. DG Combustion Air and Exhaust System

EO-3.0 Locate correct drawing(s) and perform the following:

a. Identify electrical and mechanical components
b. Trace the flowpath of fluids or electricity
c. Identify interlocks and setpoints
d. Describe system operation
e. Locate information about specific components
f. Identify system interrelations

EO-4.0 Describe the indicators, meters and controls available at the following locations:

a. Main Control Room Panel 2CEC*PNL852
b. Local Control Room Panel 2CES*PNL406(408)
c. Locally in the DG room

EO-5.0 Determine how the Standby Diesel Generator System responds to a specific set of plant conditions.

EO-6.0 Describe the interrelationship with the Standby Diesel Generator System of the following systems:

a. D.G. Ventilation Systems
b. Service Water System
c. Plant Electrical Distribution System
   1) Non-divisional and divisional DC
   2) Non-divisional and divisional AC

EO-7.0 Explain the basis for the precautions and limitations listed in N2-OP-100A Standby Diesel Generators. |7

EO-8.0 Determine and use the correct procedure to identify the actions and or locate information on the Standby Diesel Generators related to the following:

a. Startup
b. Shutdown
c. Normal Operations
d. Off-normal operations
e. Annunciator responses

EO-9.0 Given NMP2 Technical Specifications and a set of plant conditions, determine the appropriate bases, limiting conditions for operation, and/or action statement as applicable.

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
I. INTRODUCTION		
A. Student Learning Objectives	- Show transparencies of the Terminal and	|7
1. Present to the students.	Enabling Objectives, discuss .	|
B. System Purpose	Pass out the TR	EO-1.0 |
1. The Standby Diesel Generator System (SDGS) provides onsite power to loads necessary to bring the plant to a safe shutdown condition following a loss of coolant accident (LOCA) and a loss of offsite power (LOOP). The SDGS also provides power to bring the plant to a safe shutdown after an extended loss of offsite power.	Pass out the Evaluation Form as appropriate Inform trainees of method of evaluation	| |7
C. General Description	Show Transparency Emergency AC Distribution, Fig. 1 from N2-OLT-67. Trace power distribution and loads.	
1. Standby AC Power System		
a. Standby Diesel Generator 2EGS*EG1 supplies power to Division I bus 2ENS*SWG101.		
1) Power supply for operation of Division 1 plant emergency systems.		
b. Standby DG 2EGS*EG3 supplies power to Division II bus 2ENS*SWG103.		

1) Power supply for operation of Division 2 plant emergency systems.

c. Diesels are normally in a standby status.

1) Warm jacket water and warm lube oil keeps the engine warm to increase the first-try starting reliability.

2) The DG's accelerate to rated speed, voltage, and frequency within 10 seconds from the starting signal.

3) On LOOP the DG's start picking up loads sequentially after 10 seconds.

4) On a LOCA the DG's continue running on no-load following the 10 second start.

II. DETAILED DESCRIPTION

A. Standby Diesel Generators-Division I and II

1. 600 rpm, 16 cylinder, 4 stroke turbo charged diesel engine.
2. Ratings of the diesel generator
   a. Continuous 4,400 KW
   b. 2 hr rating 4,840 KW
3. Generators are the synchronous type, rated for 4,400 kw, 5500 kva 4160 V, 3 phase, 60 Hz, 0.8 lag pf.
4. Loads carried by the Diesels in the following conditions have been calculated.
   a. Simultaneous LOOP and LOCA
   b. LOOP with subsequent LOCA
   c. LOCA with subsequent LOOP
   d. Simultaneous LOOP and Main Generator trip
5. Condition "b" most severe (approx. 4200 KW)

Show Transparency of X-section of engine point out various sub-system flow paths.

- Cooper Bessemer KSV-16-T
- 6135 H.P. at rated load
- Compression ratio 11.6:1

- Porter Incorp. Elect. Products
- Wye wound
- 12 pole, self ventilated

6. Auxiliary Systems to be discussed:
   a. Fuel oil storage and transfer
   b. Engine fuel oil system
   c. Jacket water cooling system
   d. Starting air system
   e. Lubrication system
   f. Combustion air intake and exhaust system

B. Fuel Oil Storage and Transfer Systems

1. The purpose of the Fuel Oil Storage and Transfer System is to store, filter and transfer fuel oil in sufficient quantities to allow for 7 days continuous operation of the associated diesel engine at rated capacity.

Show Transparency of the F.O. System Fig. 1, trace flow path

- Fuel oil is treated with "NUTMEG" 1 gal/2000 gal to
- Reduce sludge accumulation
- Acts as a bactericide
- Oxidation prohibitive

EO-2a
EO-3a,b, d,f

2. Fuel oil storage tanks
   a. One for each SDG of approximately 55,000 gallons. Enough for continuous operation at rated capacity for 7 days. (52,664 gallons)
   b. Buried below diesel generator building.

- ≥127" on dip stick = Tech Spec level requirement of ≥ 52,664 gal stored.

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
3. Fuel Oil Transfer Pumps		
a. Two pumps are mounted on top of each storage tank.	•Rated at 10 gpm •Low flow ann. at 7 gpm	
b. Each of the parallel pumps is capable of supplying the maximum fuel demand to the day tank for the diesel engine it serves.	•Cycle on day tank level: (58%) on (80%) off	
4. Day Tanks	Show Transparency of F.O. system, Fig. 2, trace flowpath	
a. A day tank is located in the day tank room above the engine generator control panel room and is enough fuel for approximately 1 hour at the 2 hour load limit.	•660 gal capacity •Tech Spec required level $\geq$ 409 gal.	
b. Provides suction head for the engine driven fuel pump.	•Fuel consumption @ 4840kw 409 gal/hr	
c. Fuel oil transfer pump start automatically on low day tank level and turn off on high day tank level.		

5. Indications — EO-4b,c | 7
   a. Local panel 406(408)
      1) Day tank level 0-100%
      2) Storage tank level 0-100%
   b. Local
      1) Dip sticks, one for each tank
         - Storage tk drop stick located outside the DG room on the south end of the tank.
         - Day tank is local on the tank
      2) Transfer pump discharge pressure (2 gages) 0-15 spig
      3) Transfer pump flow rate 0-20 gpm
      4) Transfer strainer d/p 0-30" H_2O
6. Controls
   a. Local panel 406(408)
      1) Transfer pumps, off, hand, auto

C. Fuel Oil Supply System

1. Engine Driven Fuel Pump
   a) located on left side of engine
   b) Driven off the back of the jacket water pump drive.
   c) •Rated 11 gpm at 50 psig

2. Motor Drive Fuel Pump
   a) DC motor driven
   b) Starts on engine start signal to prime the fuel system.
      1) Auto start on low header pressure
   c) Auto stop at 540 rpm engine speed
3. Fuel Oil Cooler
   a) located on front of engine below engine driven lube oil pump
   b) Cools oil in shell with jacket water on the tube side
   c) Mixes with oil returning from injectors to cool oil prior to returning to the Day Tank.
4. Head tank
   a) located on generator and at engine above between cylinder banks
   b) maintains flooded suction to all injector pumps

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
5. Fuel Injection Pumps (16) a) cam operated positive displacement b) they meter the fuel according to engine load and deliver high pressure oil to the fuel injection nozzles.	Show Transparency of fuel oil pumps, and injectors. Discuss operation of injector pumps and injectors, as time allows - not necessary for meeting objectives.	7
6. Excess fuel returns to the day tank through an orifice line.	Show TP of Fig. 4b Describe operation of fuel racks	7
D. <u>Jacket Cooling Water System</u>	Show Transparency of jacket water sys. Fig. 3, trace flowpath. Show Transparency of x-sect. of engine. Trace flowpath.	EO-2b EO-3a,b d,f
1. Purposes of the Jacket Cooling Water System are: a. keep the engine warm when in standby status b. cool the following components during engine operation		
1) Cylinder jackets 2) Combustion air intercoolers 3) Lube oil cooler 4) Governor oil cooler 5) Fuel oil cooler 6) Turbocharger	•Water chem. treated •Sodium nitrite, 500ppm •Sodium silicate, on initial fill only 50ppm. Above info. on water treatment not necessary to meet objectives.	

2. A 440 gal. standpipe serves as a reservoir, deaerator, and expansion tank.
   a. The standpipe contains a level indicator, and a low level control switch.
   b. Low level ann. 13 "below normal add demin" water.
3. Engine-driven main water pump
   a. Mounted on top of the forward end housing on the left side of the engine.
   b. Chain driven from the forward end of the camshaft.
   c. Capacity 1100 gpm, low pressure ann. 12psig.
4. Motor-driven jacket water circ. pump 175gpm capacity
   a. Circulates water warmed by a heater through the engine when the DG is in STANDBY.
   b. The AC induction motor operates on 600V.
      PIA-MCC103A
      PIB-MCC303B
   d. The heater is 18 kw, 600 VAC.
      Htr-MCC103A/303B

e. Heater and pump are controlled by a temperature control switch. On at 120°F and off at 130°F.

f) •Low Temp. ann. @ 100°F

5. Thermostatic valves (2)

a. Controls water temperature when engine is running.

b. Two-way valve ensures water to all coolers during startup (<165°F).

c. Three-way valve controls the flow of jacket water after water temperature has reached 165°F.

When T<165° in full bypass position.

d. The three-way valve modulates between 165°F and 175°F

e. <165°F the two-way valve is closed.

•High temp. ann. 190°F
Eng. Trip at 205°F

f. > 175°F all flow is directed through the coolers by the three-way valve.

6. Jacket water coolers (2)
   a. Shell and tube type with heat transferred to service water which flows through the tubes.
7. A combustion air intercooler warms the combustion air at startup, and cools it when the diesel generator is in operation.
8. Lube oil, governor oil and fuel oil coolers also use jacket water for cooling.
9. Jacket water flows from the main header to each cylinder through individual connections, and also to the turbocharger and heater portion of the combustion air intercoolers.
10. Indications
    a. Local panel 406(408)
       1) Engine temperature meter, various selector switch positions, °F
       2) Jacket Water pressure 0-60 psig

EO-4b 7
EO-4c

11. Controls		7
a. Jacket Water Heater		
b. Jacket Water Circ pump		
E. Starting Air System	Show Transparency Fig. 4	EO-2c
1. Purpose of the Starting Air Systems is to:	trace flowpath	EO-3a,b d,f
a. Compress and store sufficient air to start the engines up to 5 times without recharging the air receivers.		
b. Supply engine control air during all modes of operation.		
2. Division I and II consist of two independent, redundant subsystems.		
3. An air compressor, desiccant air dryer air receiver tank, moisture separator, starting air control valve, two starting air distributors, and air starting valves.		

4. Air compressors
   a. Two-stage, AC motor-driven.
      1) MCC103A/303B 32 CFM each
   b. Either receiver can be charged from either air compressor in the respective division, through a crossover pipe.
      1) Receiver 130 cu. ft. each
   c. Maintains the air receiver between 240 psig (minimum operating pressure) and 250 psig (maximum operating pressure).
   d. Each air compressor and receiver is a separate start system capable of starting the engine up to five times using only the air in the receiver.
5. Air Dryers
   a. Two automatic regeneration desiccant type air dryers.

b. Cycles desiccant towers based on moisture level of desiccant.

c. Automatically regenerates stby tower with processed/dryed air.
   1) Shifts air towers every 5 minutes of operation.

d. Two modes - Auto, Fixed
   Auto - regenerates based on moisture content only.
   Fixed - regenerates based on a timer regardless of moisture content.

6. Moisture separator
   a. Traps any moisture that may be contained in the air after it leaves the receiver.
   b. Outlet valves are supervised.
      1) Air start In-Op ann. if supervised valves are shut.

- Amloc - brand name
- Desiccant used, activated alumina
- Moisture sensing probes

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7. Starting air control valves
   a. Air pressure from its associated receiver is constantly applied to this valve.
   b. Flow through these valves on an engine start signal goes through the vent outlet and check valve to the manual shutoff valves. Air then flows through the shuttle valve to the engine controls.
   c. When the turning gear is disengaged, the interlock valves are open permitting air to operate the starting air control valves if an engine start signal is present. Operating air for the starting air control valves passes through the interlock valve, a solenoid valve, and a shuttle valve.

•Turning gear received air from the left bank only.

8. Starting air distributors
   a. Act as timers to open and close the starting air valve in each cylinder head according to the firing order of the engine.
   b. Either of the dual sets of starting air control valves will crank the engine. Both sets are normally energized for reliability.

•Distributors driven off cam shafts.

F. Engine Control System

Show Transparency Fig. 4A trace flowpath.

EO-2d
EO-3a,b d,f

1. Purpose - Provide means for controlling and adjusting engine speed, load and response to trip signals.
2. Governors
   a. Control governor - electronic hydraulic isochronous type.
      1) Driven off left cam shaft drive sprocket.

2) Controls engine speed by positioning via mechanical linkage fuel racks.

3) Controls engine speed after power loss to governor - hydraulic governor controls, engine response will be slower and operate at higher speed.

4) Local adjustments for speed, load and droop - affect only hydraulic governor.

b. Overspeed governor - centrifugal hydraulic type setpoint 660rpm.

1) Driven off right cam shaft drive sprocket.

Show Transparency Fig. 4B tract linkage motion.

2) Two actions:
   a) Causes fuel racks to move to the "no fuel" position by extending the fuel control cylinder.
   b) Via cable trips butterfly valve on engine air intake shut.

3. Engine Trips
   a. Pneumatic, starting air system is control air source.
   b. Operation
      1) Trip actuation bleeds air off safety trip valve, valve shifts porting air off the piolet fuel control valve. Piolet fuel control valve shifts to block air to fuel control cylinder, the other side of the fuel control cylinder is vented. Cylinder extends to move fuel racks to the "no fuel" position.

•Safety Trip Valve shift at approx. 20 psig.

2) Loss of control air - engine will not shut down - manual quadrant lever provided to locally manually move fuel racks to the "no fuel" position.

3) Emergency mode - only two trips operable - engine O.S. and generator differential current high - other trips locked out. Locked out by the solenoid fuel control valves (energized) - actuation of the safety trip valve has no effect on fuel control cylinder.

Show Transparency Fig. 4A & 4B demonstrate how system responds.

EO-5

4) Eutectic trip mechanisms - melt at setpoint or wear limit. Dump air pressure on safety trip valve good for one trip actuation then must be replaced.

- Used for high temperature trips

4. Indications

a. Local panel 406(408)

1) Starting Air Pressure (duplexgage) 0-400 psig

b. Local

1) Receiver air pressure (2 gages) 0-400 spig

c. MCR

1) None

5. Controls

a) Local control panel 406(408)

1) Compressor #1(2) Hand-Off-Auto

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G. Lubrication System

1. Purpose of the Lubrication System is:
   a. Cool, flush and lubricate engine bearings and moving components during engine operation.
   b. Assist in keeping the engine warm when in standby status.

Show Transparency Fig. 5 trace flowpath.

EO-2e
EO-3a,b
d,f

2. Motor-Driven Lube Oil Circulating Pump and Heater.
   a. When the pump is running, the heater maintains warm oil temperature.
      1) Pump rated at 120 pgm
   b. Warm oil circulates through the engine any time the engine speed is below 280 rpm.
      1) Pump auto off when engine speed >280rpm
   c. The heater energizes at 120°F and deenergizes at 130°F when the pump is running.

3. Engine driven main Lube Oil Pump
   a. Pump rated at 530gpm @ 90psig @ 600rpm engine speed
   b. Mounted on the forward end of the engine and driven by the end of the crankshaft through a flexible coupling.
4. Thermostatic Valve
   a. Three-way valve set at 165°F to modulate bypass flow around the coolers.
   b. Below 160°F all the oil is bypassing the coolers.
   c. Above 170° all the oil goes through the coolers.
5. Lube Oil Cooler
   a. Shell and tube type
   b. Lube oil on shell side
   c. Jacket water circulates inside the tubes.
6. Turbocharger Oil Variable Pressure Regulator
   a. Located after the filters

b. Regulates Turbocharger lube oil pressure at 5 psi above turbocharger blower discharge pressure for proper turbocharger lubrication.

7. Turbocharger Ratio Relay

a. The turbocharger ratio relay senses combustion air inlet pressure and provides a doubled control air pressure signal to the turbocharger oil pressure regulator via the shuttle valve.

b. By using this control air signal, the turbocharger oil pressure regulator maintains oil pressure 5 psi above turbocharger discharge pressure.

- Turbo charger uses a pressurized labyrinth seal for a oil seal.
- It provides it's own sealing air.
- Oil pressure regulated to prevent forcing oil past seal and into inlet air stream.

8. Turbocharger Post Lube Control Valve

   a. Between the regulator and turbocharger is a post-lube valve which will stop oil flow to the turbocharger when the circulating pump is operating after the engine is stopped for 2-3 minutes.

   Prevents filling turbo air intake with oil.

9. Indications

   EO-4b,c

   a. Local panel 406(408)

      1) Lube oil pressure at turbocharger — 0-60 psig
      2) Lube oil pressure at engine — 0-60 psig
      3) Lube oil temperature

   b. Local on the engine

      1) Crankcase oil level — Sight glass — Low sump level gives "Mech. Fail" ann.
      2) Lube oil pressure at turbocharger — 0-60 psig
      3) Lube oil pressure at engine — 0-100 psig
      4) Lube oil filter d/p — 0-50 psig

   c. Main Control Room

      1) None

10. Controls

a. Local panel

1) Lube oil heater — Hand-Off-Auto

2) Lube oil circ pump — Hand-Off-Auto

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H. Air Intake and Exhaust System

Show Transparency Fig. 6

Trace flowpath

EO-2f

EO-3a,b d,f

1. Purpose:

a. Supply filtered, warmed air to the turbocharger for engine operation.

b. Provide a normal and an alternate exhaust path.

2. Division I and II Systems are separate and identical, consisting of:

a. Intake filter

b. Silencer

c. Turbocharger

d. Intercooler-heater

e. Exhaust silencer

f. Exhaust relief valve

3. Combustion air intake

a. Drawn from protective overhang area on the southern wall of the DG Bldg.

b. Missile hood and labyrinth wall protects against missiles generated by tornados or any other source.

4. Turbocharger
   a. Intake air passes through piping and a flexible expansion bellows to the turbocharger.
   b. Turbocharger forces air through the intercooler and heater into two air intake manifolds for distribution to the cylinders.
5. Intercooler and heater functions
   a. Cools the air that picked up heat from the compressor action of the turbocharger, using cooled water through the water jacket.

b. Warm water passing through the water jacket heats the air when its temperature is below 105°F during startup.

6. Exhaust

a. Gases pass from the cylinders to the exhaust manifold, then through the turbine section of the turbocharger.

b. The gases exit through a silencer mounted on the roof above the diesel generator.

c. A relief valve protects the exhaust piping by providing an exhaust path in the event the silencer is inoperable. The relief valve at 20" water.

Must be manually reset after an actuation.

|7

III. INSTRUMENTATION, CONTROLS AND INTERLOCKS

EO-4a

A. Instruments

1. The following meter indication are provided on Panel 852 for each diesel generator:
   a. Ammeter (0-1000 amps)
   b. Frequency (55-65 Hz)
   c. Wattsmeter (0-6000 KW)
   d. Generator speed
   e. Vars (4500-0-4500 KVAR)
   f. Exciter field voltmeter (0-120 VDC)
   g. Voltmeter (0-5.25 KV)
   h. Synchroscope
   i. Incoming and running voltmeters (0 - 5.25 KV)
2. Indicating lights on panel 852 show the status of the fuel oil and air start system.

B. Controls

EO-4a

1. The following controls are located on panel 852 for 2EGS*EG1 and 2EGS*EG3.
   a. Diesel Generator Start Control Switch allows remote starting of diesel generator.
   b. Emerg. Diesel Generator Output Breaker and Neutral Breaker control switch allows remote breaker operation.
   c. Emerg. Diesel Voltage Regulator Control Switch allows for manual adjustment of DG output voltage.
   d. Diesel Generator Governor Switch allows for manual adjustment of DG speed.
   e. Voltage Regulator Mode Switch

f. Synch. Emerg. Dsl. Gen to Bus Switch provides synchronizing the DG to the emergency bus.

g. Emerg. Diesel Generator LOCA Signal Bypass Switch

1) On: disable D/G auto start on a LOCA and will prevent ECCS component from starting.

h. Diesel Generator Parallel Switch determines operating mode

1) On: Parallel

2) Off: Isochronous

Mode also determined by offsite power breaker

1) Closed: Parallel

2) Open: Isochronous

C. System Interlocks

1. Load Shedding

a. Trips offsite supply breakers

EO-5

b. Starts Standby Diesel Generator

c. Permits closure of DG breaker when Diesel Generator is up to rated speed and voltage.

d. Sheds the following 4.16 KV loads
   1) RHS Pumps
   2) LPCS Pump
   3) Service Water Pumps
   4) SFC Pumps
   5) Trips stub bus supply breaker
   6) Starts load sequencing

e. Load Shed allows a controlled loading of the DG in order to prevent over loading, sequences loads on individually allowing starting currents to dissapate prior to next load starting

f. 43LS Switch
   1) Located on ENS switchgear

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2) Used for testing purposes, when in the "ON" position defeats the degraded voltage/loss of voltage start of the DG.

2. The standby diesel generator will automatically start on:
   a. Division I (II) LOCA signal
      1) Drywell pressure $\geq$ 1.68 psig
      2) RPV level low, level 2 (108.8")
   b. Sustained undervoltage and or loss of voltage on 2ENS*SWG101 (103)

3. The standby diesel trips when any of the following conditions exist:

a.	Engine overspeed	660rpm
b.	Generator Differential Current	
c.	High jacket water temp.	>205°F
d.	Low turbo lube oil pressure	<4psig
e.	Low lube oil press	<30psig
f.	High lube oil temp.	>185°F
g.	Turbocharger thrust bearing failure.	<.011" clearance
h.	Excessive engine vibration	>5g

EO-5

	i. Main and connecting rod high bearing temp.	Mn-228°F C. Rod 197°F	
	j. Generator pedestal bearing high temp.	228°F	
	4. All mechanical and electrical shutdowns are locked out when the DG is operating in the LOCA mode.	86-2EGPX01 lockout	7
	EXCEPT, Generator differential and Engine overspeed		7
D.	Emergency Mode		
	1. Response to a Loop:		EO-5.0
	a. Diesel generator starts and accelerates to rated speed, voltage and frequency		
	b. Load shed		7
	c. DG output breaker 101-1 (103-14) closes in		
	d. Offsite feeder breaker 101-13 (103-4) opens		
	e. Load sequensing begins	SWP pumps begin sequensing	

2. Response to a LOCA

EO-5

   a. Diesel generator starts on LOCA signal and accelerates to rated speed, voltage, and frequency.
   b. Diesel idles at rated speed voltage and frequency awaiting closure of diesel generator supply breaker in the event of a loss of offsite power.

3. Response to a Simultaneous LOOP and LOCA

   a. Degraded/Loss of Voltage and/or LOCA start signal received by DG
   b. DG starts and accelerates to rated speed, voltage and frequency (approx. 10 sec.)
   c. DG output breaker 101-1 (103-14) closes restoring power to the bus
   d. Offsite feeder breaker 101-13 (103-4) open

7

e. ECCS loads begin sequencing on | 7
   1) 1 sec. after bus is re-energized LPCI-A (Div I) and LPCI-B (Div II) start
   2) 6 sec. after bus is re-energized LPCS (Div I) and LPCI-C (Div II) start
   3) 32 sec. after bus is re-energized SWP pumps begin sequensing on

IV. SYSTEM INTERRELATIONS

A. Diesel Generator Auxiliaries — EO-6

The following auxiliary systems provide support for diesel generator operations:

1. Fuel oil storage and transfer system
2. Jacket Water Systems
3. Diesel generator starting system
4. Lubrication System
5. Air intake and exhaust System

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
B. DG BLDG Ventilation System The Normal Ventilation Subsystem provides individual temperature control and ventilation for each of the emergency diesel generator room and associated control rooms when the diesels are not running. The Standby Ventilation Subsystem provides cooling to the diesel generator rooms when the diesels are running.	DG Building Ventilation covered by separate lesson plan.	EO-6a
C. Service Water System		EO-6b |7
1. The Service Water System provides cooling water for the diesel generators during operation.	Show TP of SWP supply to DG's & explain	|
2. SWP to the DG's have low pressure interlocks such that if a supply header to a DG were to fail it would automatically isolate to prevent robbing flow from the other two DG's.		|7 |
a. If SWP supply pressure to a Div I or II DG is low, <18 psig for 60 seconds and the DG is running then the associated SWP outlet value 2SWP*MOV66A(B) closes.		| | | | | | |

3. If the Remote Shutdown Panel is activated and a Div I or II DG starts, operator action is required to line up SWP to the DG's. |7
   a. Controls (open - close) for 2SWP*MOV66A and B are provided on the Remote Shutdown Panels since the automatic opening of 2SWP*MOV66A(B) when an engine starts is disabled during the Remote Shutdown Panel activation.

D. Plant Electrical Distribution — EO-6c

1. Starting and control power for the diesels in the test mode provided by a nondivisional 125V DC battery.
2. Control power for diesel operation in the emergency mode is supplied from its divisional 125 VDC.
3. The AC power required to support the diesel generators is supplied by the ENS AC Power System. |7
4. The DG's can during extended losses of site power provide power to the "stub" buses 2NNS-SWG14 and 2NNS-SWG15. The loads powered off these two buses will allow placing the plant in and maintaining it in a safe condition. |7

V. PRECAUTIONS AND LIMITATIONS — EO-7.0 | 7

1.0 "Ensure technical specifications are being met any time a standby diesel generator is taken out of service."

a. Serves as a reminder for the operators that the DGs are covered extensively by tech. spec.'s and to ensure that all LCOs are met when a STBY DG is out of service.

2.0 "In the emergency mode of operation, the governor controls at panel 2CES*PNL852 have no effect"

a. This is a reminder to the operator that these controls will not effect diesel generator operation during emergency operation. This should avoid confusion during this mode if adjustment of the DG voltage and or frequency is attempted.

3.0 "Do not attempt to restart and engine after a safety shutdown occurs or if and overheating condition exists until the problem has been found and corrected".

a. A common sense precaution to avoid damage to the engines.

4.0 "The diesel generator is limited up to 6 hours maximum running time at rated speed with no load. If the running unloaded time exceeds 6 hours, the engine shall be loaded to greater than 75% full load (3300KW) for at least 30 minutes prior to engine shutdown".

a. This is done to avoid a condition called "souping". Souping is where an accumulation of unburned fuel and incompleted combustion products builds up in the exhaust manifolds causing a potential fire hazard. Running for long periods with light or no loads may also result in diluting the lube oil with fuel oil resulting in reduced lubrication of the engines moving parts. Both these conditions can be avoided by loading the engine to cause operating temperatures to rise resulting in more complete combustion of the fuel oil.

5.0 "The diesel generator continuous and 2 hour short-term power output ratings must be strictly adhered to: Continuous rating 4400KW 2 Hour short-term 4850KW".

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a. Limits placed on the operation of the generator to avoid generator damage from over heating.

6.0 "DG 2EGS*EG1 (*EG3) LOCA Bypass Switch shall be in "OFF" position unless a specific task requires the switch be placed in "ON". The switch in "ON" position disables the diesel generator automatic start on LOCA signal. The switch in the "ON" position with or without offsite power available will prevent the ECCS components in the division from starting on a LOCA signal".

a. An important reminder to the operators of the impact of the LOCA Bypass Switch.

7.0 This precaution deleted

8.0 "The standby diesel generator shall be operated in the parallel mode only during surveillance load testing IE 84-69".

a. This P/C ensures compliance with the NRC Standard Review Plan which prohibits the use of EDGs for purposes other than supplying standby power and permits interconnection of the onsite and offsite sources only for short durations for the purpose of EDG load testing.

7

9.0 "Following an engine shutdown, do not remove any crankcase doors until the engine has cooled down."

a. Removing a crankcase door immediately after a engine is shutdown will allow air to enter the crankcase, the gases and vapors in the crankcase may still be hot enough to combust when sufficient oxygen is present. The air entering the crankcase through the opened crankcase door will provide the necessary oxygen and the possibility of a crankcase explosion or fire exists.

10.0 "If the room temperature in the Div. I(II) diesel bay cannot be maintained above 65F follow the actions specified in N2-OP-57 section H.4.0".

a. This procedure directs the room temperature to be raised with portable air circulating electric heaters and monitoring air temperature hourly. If the DG room air temperature lowers to 40F then the DG must be started or declared inoperable. Declaring a DG inoperable is a mode restraint and thus may stop plant startup, it may be combination with other inoperabilities also cause the plant to be shut down.

7

11.0 "The control power for operating the standby diesel generator during the test mode is supplied from non-divisional DC.
2CES*IPNL406 - 2BYS-A102 ckt 5
2CES*IPNL408 - 2BYS-A102 ckt 6
2BYS-A102 - 2BYS-SWG1A ckt 28
If the circuits or panel described above are de-energized while the diesel generator is operating in the test mode an engine shutdown will occur".

a. This precaution is in the procedure to prevent repeating this mistake.

12.0 "Perform surveillance testing only on one diesel generator at a time"

a. This is a further precaution along with P/C 8.0 to prevent the possibility of losing DG operability and or emergency bus de-energization due to offsite power grid perturbations.

13.0 "All applicable evolutions in this procedure shall be monitored and controlled in accordance with Radiation Protection Procedures."

a. The standard P/C put into most all operating procedures for ALARA and Rad Protection concerns.

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14.0 "Paralleling EDG during surveillance test when grid conditions are unstable, and while another EDG is inoperable could result in a complete loss of offsite and onsite AC power."

a. This is a further precaution along with P/C 8.0 and P/C 12.0 to reduce the possibility of emergency bus de-energization due to offsite power grid perturbations.

15.0 "Dark gray or black smoke emitting from the diesel crankcase vent is an indication of internal burning of engine lube oil. This burning can be caused by an internal hot spot on a cylinder liner. The hot spot occurs when tin is transferred from the piston coating to the cylinder liner. An internal cylinder liner inspection should be performed."

a. This precaution is to warn the operator of an abnormal operating condition that may occur in the engine type used in Division I and II.

VI. DETAILED SYSTEM REFERENCE REVIEW

Review each of the following referenced documents with the class.

A. Procedures — EO-8

1. N2-OP-100A Standby Diesel Generators

B. Technical Specifications — EO-9

1. 3/4.8.1.1 A.C. Sources-Operating
2. 3/4.8.1.2 A.C. Sources-Shutdown
3. 3/4.8.2.1 D.C. Sources-Operating
4. 3/4.8.2.2 D.C. Sources-Shutdown
5. 3/4.8.3.1 Distribution-Operating
6. 3/4.8.3.2 Distribution-Shutdown

C. Technical Specification Interpretations

1. T.S.I. # 31 Describes Ambient Start Conditions
2. T.S.I. # 41 Fuel oil tank 10 yr. cleaning requirements
3. T.S.I. # 60 Ambient air temperature vs Engine operability
4. T.S.I. # 78 Fuel oil sample requirements

7

VII. RELATED PLANT EVENTS

A. ~~Refer to addendum "A" and review related events with class (if applicable).~~ Review SOER 83-01.

Add chg 7/29 7/29/91

VIII. SYSTEM HISTORY

A. ~~Refer to addendum "B" and review related modifications with class (if applicable).~~

Add chg 7/29 7/29/91

IX. WRAP-UP

A. Review the student learning objectives.