

# OPERATIONS MANUAL

## SYSTEM OPERATING PROCEDURE

Facility Name, Building, Worksite or Plant ID:

**Subject:**  
Emergency Diesel Generator

Approved by:

Document Version Number:

Issue Date:

Generator Location:

Prepared By:

**LEGAL DISCLAIMER:** This Operations Manual for an Emergency Standby Generator is provided by Diesel Service & Supply to be a general guide, template and reference point for creating your own unique Operations Manual for your specific facility, plant, building or worksite. Since power generators are complex electrical pieces of equipment, certain aspects of the document will not apply to all situations. Any time electrical work and details are involved we always suggest consulting a certified electrician and/or experienced generator technician for final approval or doing any on-site services that may be required. Since this is intended as a guide only, Diesel Service & Supply assumes no responsibility for the content and references contained within this document.

**TABLE OF CONTENTS**  
SECTION TITLE PAGE

Introduction.....	3
System Description.....	3
A. Description .....	3
B. Control and Protection.....	4
C. Design Conditions .....	5
Operating Precautions and Limitations .....	5
Operating Prerequisites .....	8
Normal Startup.....	9
A. Normal Startup Procedure.....	9
Normal Operation .....	10
A. Normal Operation .....	10
Normal Shutdown .....	11
Abnormal/Emergency Procedures.....	11
A. Emergency Operation .....	11
B. Abnormal Operating Conditions .....	12
C. Emergency Shutdown .....	12

**TABLES**

Table 1, Major System Instruments and Settings.....	7
Table 2, Annunciator Alarms.....	8

**Emergency Diesel Generator**  
REFERENCE DIAGRAMS

Emergency Generator Typical Fuel Layout.....	13
Emergency Generator Typical Load Layout.....	13

**CHECKLISTS**

Pre-Startup Normal Valve Lineup - for fuel and cooling water if water cooled

Emergency Diesel Generator Connection Diagram Sheets  
Motor Control Center and One Line Diagram  
Alarm System Schematics for the Emergency Generator if Applicable  
Emergency Generator Synchronizing and Metering  
Emergency Generator Controls

**REFERENCES & APPENDICES**

Basic Diagram of your Fuel and Load Center Layouts  
Instruction Manual for your particular generator set should be included  
Manufacturer Specification/Data Sheet for your genset should also be attached

**OPERATING PROCEDURE**  
Emergency Diesel Generator

INTRODUCTION

This Operating Procedure shall be used by operating personnel at the facility referenced above to operate the Emergency Diesel Generator and the associated auxiliary equipment. Only the most recently approved revision of this document shall be used and previous versions shall be destroyed to prevent confusion.

The following personnel shall have the specified roles and responsibilities:

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**SYSTEM DESCRIPTION**

A. DESCRIPTION

The emergency diesel generator is provided to maintain power to those loads which are necessary for protection of equipment and personnel during a total loss of station and off-site power.

The emergency diesel generator is located at \_\_\_\_\_ and is connected to Motor Control Center \_\_\_\_\_ by cable through a locally mounted motor operated circuit breaker and manually operated disconnect switch.

The emergency diesel generator manufactured by \_\_\_\_\_ consists of one turbo charged diesel engine coupled to the generator shaft and mounted on a common structural steel base with spring vibration isolators. The engine is complete with its own battery starting system, lube oil pump, filter and coolers, jacket water cooling pump, radiator, fan with guard and shroud, air intake filter, and exhaust silencer. The generator is also provided with its own voltage regulator, protective devices, and shaft mounted exciter.

A \_\_\_\_\_ gallon fuel oil day tank with a working capacity of about \_\_\_\_\_ consumption is mounted separately from the engine. A gear driven pump for pumping fuel from the day tank to the engine is furnished. Fuel transfer from diesel oil storage tank to day tank is by an electric motor driven rotary type pump which is controlled by a level switch on the day tank. The day tank pump is rated for 120 VAC and receives power from lighting panel# \_\_\_\_\_. A control cabinet, located on the generator, is supplied for mounting of engine controls, electric meters, relays, and voltage regulator.

ADDITIONAL DETAILS FOR YOUR SYSTEM:

## **OPERATING PROCEDURE**

### Emergency Diesel Generator

#### B. CONTROL AND PROTECTION

The emergency diesel generator can be controlled locally or from

Generator voltage control, governor control and synchronization control as well as operation of the generator circuit breaker and MCC feeder breaker can be accessed from the locations above.

A mode selector switch, located locally, with "MANUAL-OFF-AUTO" positions is typically provided to allow for routine testing of the emergency generator. In the "MANUAL" position, the mode selector switch allows starting only from the local control panel. All automatic control and manual control from the remote panel is disabled. In the "AUTO" position, the switch allows for full automatic starting, running, and shutdown of the emergency generator. Manual control from the remote panel is allowed only with the mode selector switch in the "AUTO" position.

A "MANUAL-AUTO" switch is also typically provided on the remote panel to allow remote control of the emergency generator. In the "MANUAL" position, the switch causes the diesel engine to start. In the "AUTO" position, manual control is allowed from the local control panel as well as full automatic starting, running, and shutdown of the emergency generator. Both the mode selector switch and the remote mounted "MANUAL-AUTO" switch must be in the "AUTO" position for full automatic control of the emergency generator. With both switches in the "AUTO" position, the emergency generator will start automatically upon loss of voltage on your facility load center. The local controls automatically regulate speed, voltage, and frequency. As soon as the generator reaches about 1500 RPM, a relay trips the feeder breaker in your facility load center which feeds your facility load center and closes the emergency generator main breaker. If the load center feeder breaker is racked out, the emergency generator main breaker will not close due to electrical interlocks. Upon return of normal power supply, the emergency generator main breaker trips and the load center feeder breaker closes automatically.

ADDITIONAL PROTECTION DETAILS FOR YOUR ENVIRONMENT:

**OPERATING PROCEDURE**  
Emergency Diesel Generator

C. DESIGN CONDITIONS  
*(Fill in the blanks with your particular generator set's data)*

**Mechanical Data**

Engine Type:  
Engine Manufacturer:  
Model Number:  
RPM:  
Brake Horsepower:  
Fuel Consumption:  
Fuel Type:  
Lubricating Oil Type:  
Cooling Medium:  
Auto Start/Stop:  
Safety Shutdown:  
Engine Mounted Radiator:

**Electrical Data**

Manufacturer:  
Generator Capacity:           KW,           KVA  
Generator Rating:  
Model Number:  
Serial Number:  
Model Year:  
Hours:  
Voltage:  
Phase:  
Hertz:  
Amps:  
Circuit Breaker:  
Number of Leads:  
Muffler:  
Enclosure:  
Generator Control Panel:  
Synchronous Speed:  
Cooling Medium:  
Exciter:  
Full load voltage:  
Full load amps:  
Starting System/Battery:       Volt, lead-acid battery, with battery charger  
Insulation class:  
Fuel Tank Type and Storage:  
Note Additional Electrical Specs Here:

## OPERATING PRECAUTIONS AND LIMITATIONS

The following summary of operating precautions and limitations is generally applicable to all system operations. Operating personnel must be familiar with all of these limitations.

- A. Adhere to plant safety rules and observe manufacturer safety precautions.
- B. If any maintenance work has been done, VERIFY the work has been completed, the work clearances have been removed, the areas where work took place are cleared and do not present any risk during system operation, and the equipment, circuits, sensors, etc. are ready for operation.
- C. Prior to startup, a visual inspection of all system components should be performed to ensure personnel safety and that all components are ready for operation. Corrective action shall be taken to correct any deficiencies.
- D. Before handling any Hazardous Chemicals associated with the performance of this procedure, all operators shall be familiar with the precautions and first-aid instructions provided in the applicable Material Safety Data Sheet (MSDS). A copy of each plant MSDS should always be available in the location of your facilities MSDS documentation.
- E. Personnel shall regularly monitor the Emergency Diesel Generator remote, if available, and local indicators for the conditions and parameters listed in Table 1 below in order to recognize and respond to the approach or actuation of any listed alarm or automatic "trip" function. All operating personnel should be familiar with the expected normal operating parameters and with the listed alarm or trip setting (if one is listed) for each listed control function.
- F. The emergency generator is a standby unit and should be kept well maintained at all times and periodically test run once a week.
- G. Check all local gauges when emergency generator is running.
- H. Check that diesel oil transfer pump on day tank is in good working condition.
- I. All controls must remain in the "AUTO" mode or position.
- J. Check to see that all batteries are fully charged and in good working condition.
- K. Check that diesel oil storage and day tanks are kept full at all times and the fuel has been properly maintained.
- L. Document Any Additional Details for your Facility below (including details on specific motors and soft starts, automatic transfer switches, transformers, etc.):

**OPERATING PROCEDURE**  
Emergency Diesel Generator

Table 1, Major System Instruments and Settings

Instrument Control/Indicator Function Settings:

Located Locally: (on diesel storage tank)

Low Oil Pressure Switch      psi (alarm and trip)  
High Circulating Water Temperature      °F (alarm and trip)  
Over-speed Control      rpm (alarm and trip)  
Crank cut-out:      rpm (trip)  
Speed Switch      rpm  
Oil temperature      °F-      °F (Normal)  
Time Delay Engine "Auto Start":      -      seconds  
Time Delay Engine "Cool-down"      minutes  
Level indicator - monitors level of diesel oil inside of storage tank  
Range: 0 to      gallons

Table 1, Major System Instruments and Settings

Instrument Control/Indicator Function Settings:

Located Locally: (on diesel generator or control panel)

Ammeter - Monitors generator output      Amps (Normal)  
Frequency Meter – Indicates generator output frequency      Hz (Normal)  
Kilowatt Meter - Monitors generator output power      Watts (Normal)  
Incoming Voltmeter - Indicates bus voltage at source (*If any*) volts.  
Synchroscope - Indicates when generator is synchronized with system.  
Running Volts - Indicates generator output voltage      Volts (Normal).  
Additional Settings & Notes (include any primary details below):

Table 2, Annunciator Alarms

Window No. Description Condition Alarmed

*(Only used if your generator is equipped with a local annunciator and/or your facility is equipped with a remote annunciator)*

**EMERGENCY GENERATOR**

- a. engine oil pressure low
- b. engine cooling water temperature high
- c. engine over-speed
- d. engine over-cranking
- e. day tank fuel level high
- f. day tank fuel level low
- g. battery failure

**OPERATING PROCEDURE**  
Emergency Diesel Generator

OPERATING PREREQUISITES

- A. Ensure all system flow path and instrument valves are properly aligned.
- B. Ensure that your facility's low voltage electrical system is working properly, if testing, or was working properly prior to loss of voltage.
- C. Check the Emergency Diesel Generator electrical line-up as follows:
  - 1. Engine mode selector switch must be in "AUTO" position.
  - 2. Generator circuit breaker must be "open."
  - 3. Load Center (*or power destination*) feeder breaker "racked in/open" position.
  - 4. If your facility has a control power source the Switch in DC Panel must be closed to provide 125 VDC control power.
  - 5. Breaker in Panel must be closed to provide power to battery charger and day tank.
  - 6. Breaker in AC Power Panel must be closed to provide power to the engine heaters, if equipped.

*(Disregard the following three lines if no remote panels exist)*

  - 7. Remote panel "MANUAL-AUTO" switch must be in "AUTO" position.
  - 8. Remote panel sync-switch must be in "OFF" position.
  - 9. Remote panel emergency generator governor control switch "RAISE-LOWER" must be in the center position.

D. ADDITIONAL OPERATING PREREQUISITE NOTES:



**OPERATING PROCEDURE**  
Emergency Diesel Generator

STARTUP

A. NORMAL STARTUP PROCEDURE

1. Be sure any lockout/tag-out devices have been released.
2. Check the lube oil level, coolant level and make a visual inspection, front and rear, to see that there are no loose parts or hoses.
3. Ensure that day tank is full of fuel oil.
4. Ensure that breakers and disconnect switches for supplying AC and DC power to engine control cabinet and various devices are closed.
5. Ensure that your facilities' load center breaker is in the "racked in/ closed" position.
6. Verify that the system valves are in the proper positions.

NORMAL OPERATION NOTE\*

Operation of the emergency generator is not a normal operating procedure. However, periodic testing of the machine may and should be required. The following procedures outline the steps required for testing the "Manual" and "Automatic" modes of the machine.

A. NORMAL OPERATION  
Automatic Operation Test

NOTE\*

This test is to be done only during a time when critical equipment is not deemed essential. Be sure the generator main disconnect is "open".

Place the engine mode selector switch at the local control panel in "AUTO" position. (All automatic control is lost if mode selector switch is not in "AUTO" position.) Place the generator feeder circuit breaker switch at the BTG panel in "OPEN" position which will spring return to center position and cause the green light to come on. Place the "MANUAL-AUTO" switch on the BTG panel in the "AUTO" position.

To simulate loss of bus voltage, trip the circuit breaker in your facilities' under-voltage relay (27) circuit. This circuit breaker is located in  
Upon loss of voltage, the control circuit causes the emergency diesel engine to start automatically as follows. An under-voltage relay located in the local panel detects the loss of normal power supply and energizes a timer. The timer allows about \_\_\_\_\_ seconds for confirmation of loss of normal power supply before engine starts. If the normal bus voltage is restored before the timer times out, the engine will not auto start.

This scheme ensures that the engine starts only upon total loss of your facility or station's power.

## **OPERATING PROCEDURE**

### Emergency Diesel Generator

After the engine has started, the controls automatically regulate speed, voltage and frequency. The generator voltage may be adjusted from Remote panel if required. Further speed control is possible from the remote panel, if your facility has one, using the governor switch.

After voltage is restored to the under-voltage relay, the diesel engine automatically shuts down after a cool off period of 5-10 minutes, or whatever your setting is. Synchronizing and load pickup may also be tested but this should be done when testing the "Manual" operation mode as described below.

#### Manual Operation Test *(If your facility has Remote capability)*

This test should be performed at least once a week. Place the engine mode selector switch at the local control panel in "AUTO" position, to allow manual control from the remote panel. Placing the mode selector switch in the "MANUAL" position defeats all automatic control and causes the engine to start. Therefore, manual start control from the remote panel is only possible with the mode selector switch in "AUTO". Place the generator feeder circuit breaker switch at the remote panel to the "open" position.

Place the "MANUAL-AUTO" switch on the remote panel in the "MANUAL" position. Once the engine starts, the indicating light above the switch will come on indicating the engine is running. Confirmation of engine running can be made by observing the frequency meter on the remote panel or by turning the sync-switch "ON" and observing the "running" voltmeter. To shut down the engine, place the "MANUAL-AUTO" switch on the remote panel in the "AUTO" position. The engine automatically shuts down after a cool-off period of 5-10 minutes. Unless load pickup or synchronizing testing is desired no other controls on the remote panel should need adjustment.

#### Load Pickup and Synchronizing Test *(If your facility has Remote capability)*

For the most thorough testing possible, you should consider having a load bank test performed by an experienced generator technician on an annual basis. To perform a version of this test yourself instead, the test should be done only during a unit outage since service to essential equipment may be interrupted.

The running load in kilowatts on your facility MCC must be known to make this test effective. To begin, make sure the emergency generator main disconnect is "closed".

Start the emergency generator in the "Manual" mode as described above. With the engine running, observe the frequency meter on the remote panel until the meter stabilizes. This ensures the engine-generator is at a steady-state, no load condition.

Place the sync-switch in the "ON" position which enables the Running Voltmeter, Incoming Voltmeter, generator breaker close circuit, and the close circuit of your facility load center or MCC. Observe the Running Voltmeter and adjust the running voltage to equal the voltage shown by the Incoming Voltmeter. Adjust the generator frequency to be just a little faster than the system frequency. When this condition exists, the synchroscope pointer rotates in the clockwise direction. Continue to adjust the generator frequency until the pointer rotates in the clockwise direction at about four revolutions per minute. When incoming and running voltages are matched observe the synchroscope. When the synchroscope indicator is at about 11 o'clock turn generator breaker control switch to "close".

## **OPERATING PROCEDURE**

### **Emergency Diesel Generator**

#### **CAUTION**

Never try to close the generator breaker unless the pointer on the synchroscope is moving in the "faster" or clockwise direction and is close to the 11 o'clock position. A red light, if your facility has one, above the control switch indicates when generator breaker closes. Place sync-switch in "off" position. The Diesel generator is now synchronized with the facilities' electrical system. Loading of the unit is done by turning the governor control switch to "RAISE". Continue loading the generator until the kilowatt meter on the remote panel corresponds to the known running load on your facility's MCC, then place the control switch marked (Your facility MCC) in the "TRIP" position. The green light, if you have one, above the switch indicates when the breaker is open.

#### **7. NORMAL SHUTDOWN**

The emergency generator will automatically shut down when the normal power is restored to the Plant Load Center 1A. The emergency generator will supply power until verification is made that normal service has been restored continuously. After this time the controls trip the generator breaker and close the load center feeder breaker to Plant MCC 1A. Typically, the generator automatically shuts down after a 5-10 minute cool-off period.

#### **8. ABNORMAL/EMERGENCY PROCEDURES**

##### **A. EMERGENCY OPERATION**

In the event of a total loss of station and off-site power, the generator automatically starts and comes up to rated speed, frequency, and voltage. The automatic controls trip the load center feeder breaker to your facilities' load center and close the generator main breaker. Once the generator is at rated speed and frequency some loads will start up automatically depending on control mode.

##### **NOTE**

Manual loads should be added one at a time with a few seconds between each addition to allow the emergency generator to adjust to each new load addition. These could include emergency lighting, critical oil pumps, battery chargers, environmental controls and/or other equipment relevant to your facility.

Include Specific Notes for your Facility:

## **OPERATING PROCEDURE**

### Emergency Diesel Generator

#### **B. ABNORMAL OPERATING CONDITIONS**

VAR loading of the emergency generator should be constantly monitored whenever the generator is synchronized with the plant system. The emergency generator should always be operated at minimum VAR loading, which is accomplished by maintaining the emergency generator output voltage slightly above the plant system voltage.

#### **C. EMERGENCY SHUTDOWN**

The engine-generator is shutdown automatically upon any of the following conditions:

- Engine oil pressure is too low
- Cooling water temperature high Engine over-speed.
- Batteries are not charged or no longer hold a full charge
- Fuel has run out of the day tank and/or on-site storage tank

#### **PRE-STARTUP NORMAL VALVE LINEUP**

The manually operated valves listed below shall be checked and verified to be in the specified position (Open/Closed) before each normal system startup. The listed valve numbers correspond to the Piping and Instrumentation Diagrams listed as Drawings and/or References on the first page of this document. The following general guidelines are applied in the line-up:

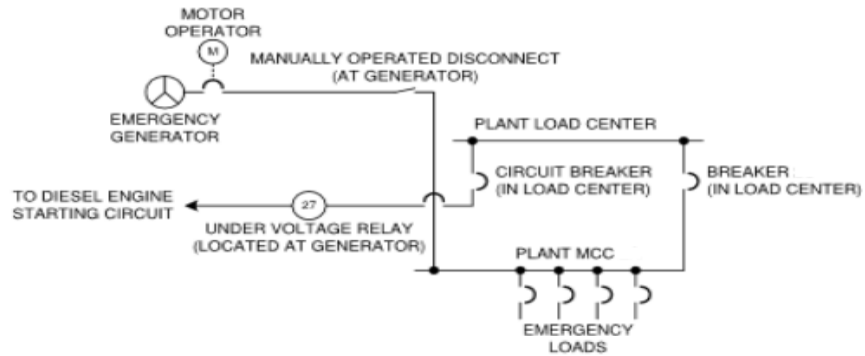
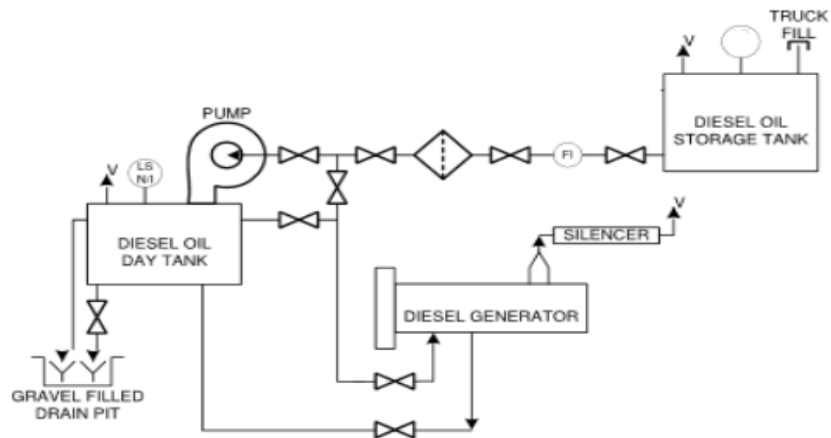
- All equipment isolation valves shall be opened, unless otherwise specified below.
- All gauge and instrument isolation valves shall be opened.
- All gauge and instrument vent and drain valves shall be closed.
- All differential pressure equalizing and bypass valves shall be closed.
- All test connection isolation valves shall be closed.
- All manual system vent valves shall be closed, unless otherwise specified below for startup.
- All manual system drain valves shall be closed, unless otherwise specified below for startup.
- Include any additional pre-startup notes for your operation below:

# OPERATING PROCEDURE

## Emergency Diesel Generator

### Emergency Diesel Generator REFERENCE DRAWINGS

Example Emergency Generator Fuel and Load Center Basic Diagram  
*(Include diagrams of your own facilities' fuel and load center in the appendix)*





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**OPERATING PROCEDURE**

Emergency Diesel Generator

**Emergency Diesel Generator**

REFERENCES & APPENDICES

Create a diagram of your facility and/or worksite's Fuel and Load Center Layouts and include here.

Include a copy of the Instruction/Owner's Manual for your specific generator set here.

Also include a printed copy of the Data Sheet that contains specifications for your specific generator set make and model.

*These documents can usually be obtained by searching the manufacturer's website (or potentially from the generator dealer or distributor you purchased it from).*



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