Generator Basics & Preventative Maintenance

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Generator Rating and Applications

Standby / Emergency Rating
• Output Available With Varying Load For Duration Of Normal Power Source Interruption.
• Typical Applications = Building Service Standby

Prime Rating
• Output Available With Varying Load For An Unlimited Time.
• Typical Applications = Industrial, Pumping, Construction, Peak Shaving or Cogeneration

Continuous Rating
• Output Available Without Varying Load For An Unlimited Time.
• Typical Applications = Base Load, Utility, Cogeneration, Parallel Operation.
Typical Installations

Majority Of Reciprocating Engine-generator Sets Installed In Hawaii Are Diesel Standby Duty Providing Power During Utility Outages.

1500 kW Standby Generator

200 kW Standby Generator
Loads Connected to Standby Generators

Life Safety Equipment As Required By Building Code
- Fire Alarm System
- Exit & Emergency Lighting
- Fire Protection Equipment
- Elevators for Fire Service
- Mechanical Ventilation
- Electrically Operated Exit Locks

All Other Loads Required To Maintain Operations
- Domestic Water Booster Pump
- Computers / Data Centers / Communications Equipment
- Air Conditioning
- Cold Storage / Food Service
- Entire Building
Can You Afford Not To Have Emergency Power?

- Emergency Power For Life Safety To Limit Liability
- Loss of Business & Revenue
- Loss of Data / Communications
- Loss of Cold Storage / Food
- Additional Revenue From Being Open For Business
- Think of Your Generator as “Insurance”
  - Estimate Lost Annual Revenue
  - Amortized Annual Cost Of Generator
Type Of Fuels

**Diesel No. 2**
- Most Common Fuel For Standby Generators in Hawaii
- High Energy Content Compared to Gas.
- Good Transient Response. Well Suited For Pumps and Motors.
- Higher Emissions

**Synthetic Natural Gas (SNG)**
- No Onsite Fuel Storage
- Not Suitable For Life Safety Emergency Power
- Lower Emissions

**Propane / LPG**
- High Octane Grade Required For Engines
- Lower Emissions
- Large Storage Tanks
Type Of Fuels

Biodiesel
- Made From Renewable Sources Such Palm Oil, Jatropha, Rapeseed Oil, Soybean Oil, Waste Vegetable Oil, or Animal Fats.
- Feedstock Must Be Processed (Esterfication) To Form Methyl Esters That Can Be Used In Diesel Engines.
- Lower Emissions for CO, HC, Particulates, Smoke & Odor
- Increase in NOx Emissions
- Storage Issues (Solidification, Oxidation, & Microbial Growth)
- Potential Compatibility Issues with Hoses & Seals
- Oil Change Intervals May Be Affected
- Please Consult with Engine Manufacturer’s Prior to Use.

Landfill / Digester Gas
- Utilize Methane Collected (Gas Typically 40 to 65% Methane)
- Contaminants –Corrosive Elements & Solid Particles
- Units Must Run In Parallel With Utility – Fluctuating Gas Quality
Generator Basics & Preventative Maintenance

Emissions- New Source Performance Standard (NSPS)

- EPA was under court order to issue minimum national standards for exhaust emissions from stationary compression ignition (diesel) engines.
- Initially proposed on July 11, 2005
- Finalized on July 11, 2006
- Engine built on April 1, 2006 and later are subject to NSPS
- A comparable regulation for spark ignited engines will be finalized in the future.
Emissions Tier Levels Summary

- Requires All Engines Built in 2007 and Later to be EPA Certified.
- EPA Tier 4 for Non-Emergency Generator Sets by 2011-2012.
- After Treatment will be required to meet Tier 4 Levels
NSPS: Owner/Operator Compliance Requirements

• Responsible Over Entire Life Of The Engine
  – Required To Maintain Engine In Accordance With Manufacturer’s Guidelines

• Fuel Usage Requirement
  – 500 ppm Sulfur Starting Oct. 1, 2007 (Low Sulfur Diesel)
  – 15 ppm Sulfur Starting Oct. 1, 2010 (Ultra Low Sulfur Diesel)
  – Not Allowed To Used Existing Inventory That Does Not Comply After Deadlines.
  – ULSD May Cause Problems In Older Engine. Check With Engine Manufacturer.

• Retain Data Showing Compliance For Pre-2007 Engines
  – Only If The Engine Is Not Certified
  – Could Come From Manufacturer Or Their Own Tests

• 100 Hr/Yr Maximum Maintenance/Testing For Emergency Engines.
Preventative Maintenance – Standby Generators

• Standby Generators Must Be Ready To Operate At Any Time
• Establishing a Weekly Maintenance Program
  – Minimize Downtime
  – Reduce Engine Operating Costs
  – Increase Engine Life

• Weekly Maintenance Can Be Performed By Operator
• Yearly and Three Year Maintenance Should Be Performed By An Authorized Mechanic or Generator Dealer

• Follow Generator Manufacturer’s Recommended Guidelines and Procedures
Preventative Maintenance – General Recommendations

• Safety, Safety, Safety
  – Observe Basic Safety Rules & Precautions
  – Improper Operation or Repair Could Result in Injury or Death
  – Maintenance Should Only Performed By Persons With Proper Training, Skills, and Tools
  – Make Repairs With Engine Stopped & Starting System Disabled

• Maintain Log or Record Keeping System
  – All Gauge Readings
  – Problems & Repairs
  – Maintenance

• Space Heaters
  – Moisture Harmful to Generators & Electrical Equipment
  – Operate Space Heaters To Maintain Winding Integrity
Weekly Maintenance: Before Starting Engine

- Check Oil Level  (Add Oil As Needed)
- Check Coolant Level  (Add Coolant As Needed)
- Walk-Around Inspection
- Check Air Cleaner Indicator (Change Filter As Needed)
- Check Battery Charger For Proper Operation
- Fuel System – Check for Leaks, Drain Water Separator, Check Fuel Level
- Inspect Belts (Adjust or Repair As Needed)
- Clean Battery Tops. Check Electrolyte Level. Check Connections.
- Inspect Control Panel & Gauges
- Check Generator for Moisture, Dust, Oils, & Debris. Clean As Needed.
- Check Generator Space Heater for Proper Operation
Weekly Maintenance: With Engine Running

Check Should Take 5 Minutes to Complete. Longer Periods of Operation Not Required. Record All Reading For Future Reference.

- Check for Proper Oil Pressure
- Check for Proper Jacket Water Temperature
- Check for Proper Fuel Pressure
- Check Oil Level
- Check Frequency (RPM) and Voltage
- Check Louvers for Proper Operation
- Check for Leaks & Unusual Noises
- Record Engine Run Hours
Weekly Maintenance: After Stopping Engine

- Automatic Switches – Check Switches In Proper Position for Automatic Start
- Check Fuel Level. Refill Tank If Below 3/4 Full.
- Record Battery Charger Charging Amperage Reading
- Report Any Malfunctions & Make Any Needed Repairs
Yearly Maintenance: Before Starting Engine

- Perform All “Weekly Before Starting Engine” Maintenance First
- Add Coolant Conditioner As Needed
- Drain Water & Sediment From Fuel Tank.
- Change Fuel Filters
- Inspect and Clean or Replace Air Filter Element If Needed
- Clean Crankcase Breather
- Check & Adjust Valve Lash As Required
- Check & Adjust All Linkages
- Test All Engine Protective Devices
- Check Generator Winding with Megohmmeter
- Check Generator Bearing. Lubricate As Required.
- Wipe Down & Clean Engine As Needed.
Yearly Maintenance: With Engine Running

- Perform All “Weekly With Engine Running” Maintenance First
- Inspect Engine Mounts. Check for Proper Torque.
- Load Test Engine to Minimum 30% Load for Minimum 2 Hours. Record All Gauge Readings.
- Engine Slobbering Can Occur If Load Test Not Conducted
- Jacket Water Temperature Will Be Higher Compared To Weekly No-Load Tests
Yearly Maintenance: After Stopping Engine

- Perform All “Weekly After Stopping Engine” Maintenance First
- Obtain Oil Sample for Analysis of Wear, Chemical & Physical Test, and Oil Condition
- Oil Analysis is Best Indicator of What’s Taking Place Inside Engine Structure & Provide Early Warning of Unacceptable Contamination
- Change Engine Oil
- Replace Oil Filter. Cut Filter & Inspect for Foreign Material
Three Year Maintenance: Before Starting Engine

- Perform All “Weekly & Yearly Before Starting Engine” Maintenance
- Cooling System
  - Drain, Clean, & Flush
  - Replace Thermostats
  - Refill with Coolant Solution & Conditioner
  - Inspect Radiator Cap & Replace If Needed
- Replace All Hoses & Belts
- Replace All Batteries
- Inspect / Check Turbocharger for Proper Operation
- Perform Engine Adjustment & Tune-Up
Three Year Maintenance: With Engine Running

- Perform All “Weekly & Yearly With Engine Running” Maintenance
- Inspect Engine Mounts. Check for Proper Torque.
- Load Test Engine to Minimum 30% Load for Minimum 2 Hours. Record All Gauge Readings.
- Engine Slobbering Can Occur If Load Test Not Conducted
- Jacket Water Temperature Will Be Higher Compared To Weekly No-Load Tests
- Check Exhaust System for Leaks. Repair As Needed.
Three Year Maintenance: After Stopping Engine

- Perform All “Weekly & Yearly After Stopping Engine” Maintenance
- Obtain Oil Sample for Analysis
- Change Engine Oil
- Replace Oil Filter. Cut Filter & Inspect for Foreign Material
- Obtain Sample of Used Coolant for Analysis
Questions?

Mahalo!

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