ENEL 674 Industrial and Commercial Power Systems

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Project Milestone 2

Back-up Generator

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Executive Summary

A backup diesel generator is an important component in ensuring uninterrupted power supply for critical loads during power outages. The generator is designed to provide emergency power to critical loads such as elevators, fire alarm systems, and emergency lighting, as well as general building loads during extended power outages.

The design and installation of the backup diesel generator required careful consideration of the building's electrical load requirements, fuel storage and delivery systems, and generator location and installation requirements.

The backup diesel generator provides a reliable and cost-effective solution for ensuring uninterrupted power supply for critical loads during power outages. Here, few benefits of backup diesel generators and recommendations for future installations are discussed.

Diesel generators are a popular choice for backup power due to their reliability, efficiency, and cost-effectiveness. They are widely used in various industries, including hospitals, data centers, telecom, and manufacturing, to ensure uninterrupted power supply to their critical loads. The backup diesel generator provides peace of mind to businesses and homeowners, knowing that they have a reliable source of backup power to keep their operations running smoothly during a power outage.

1. Description of Back-up generator

3-Phase 120/208V Diesel Generator - Model – RD030 by Protector™ Series

Includes:

- Two Line LCD Multilingual Digital Evolution Controller (English/Spanish/French/Portuguese) with external viewing window for easy indication of generator status and breaker position
- Isochronous electronic governor
- Sound attenuated aluminum enclosure
- Smart battery charger
- ±1% voltage regulation
- Integrated base tank options are available with run times over 90 hours without having to refuel
- Five-year limited warranty
- Meets code requirements for external vent and fill.

2. Features

- **INNOVATIVE DESIGN & PROTOTYPE TESTING** are key components of GENERAC'S success in “IMPROVING POWER BY DESIGN.” But it doesn't stop there. Total commitment to component testing, reliability testing, environmental testing, destruction and life testing, plus testing to applicable CSA, NEMA, EGSA, and other standards, allows you to choose GENERAC POWER SYSTEMS with the confidence that these systems will provide superior performance.
- **TEST CRITERIA:**
    - PROTOTYPE TESTED
    - NEMA MG1-22 EVALUATION
    - SYSTEM TORSIONALTESTED
    - MOTOR STARTING ABILITY
- **TRUE POWER™ ELECTRICAL TECHNOLOGY:** Superior harmonics and sine wave form produce less than 5% Total Harmonic Distortion for utility quality power. This allows confident operation of sensitive electronic equipment and micro-chip-based appliances, such as variable speed HVAC systems.
- **MOBILE LINK® CONNECTIVITY:** FREE with all Protector Series Home standby gen- erators, Mobile Link Wi-Fi allows users to monitor generator status from anywhere in the world using a smartphone, tablet, or PC. Easily access information such as the current operating status and maintenance alerts. Users can connect an account to an authorized service dealer for fast, friendly, and proactive service. With Mobile Link, users are taken care of before the next power outage.
- **SOLID-STATE, FREQUENCY COMPENSATED VOLTAGE REGULATION:** This state-of-the-art power maximizing regulation system is standard on all Generac models. It provides optimized FAST RESPONSE to changing load conditions and MAXIMUM MOTOR STARTING CAPABILITY by electronically torque-matching the surge loads to the engine. Digital voltage regulation at ±1%.
- **SINGLE SOURCE SERVICE RESPONSE** from Generac's extensive dealer network provides parts and service know-how for the entire unit, from the engine to the smallest electronic component.
- **GENERAC TRANSFER SWITCHES:** Long life and reliability are synonymous with GENERAC POWER SYSTEMS. One reason for this confidence is that the GENERAC product line includes its own transfer systems and controls for total system compatibility.

3. Specifications of the model

GENERATOR SPECIFICATIONS

Type	Synchronous
Rotor Insulation Class	H (15 & 20 kW) or F (30, 48, & 50 kW)
Stator Insulation Class	H
Telephone Interference Factor (TIF)	<50
Alternator Output Leads 1-Phase	Three wires
Alternator Output Leads 3-Phase	Six wires
Excitation System	Direct
Total Harmonic Distortion	< 5%

ELECTRICAL SYSTEM

Battery Charge Alternator	50 amp (15 & 20 kW), 65 amp (30 kW), and 50 amp (48 & 50 kW)
Static Battery Charger	2 amp
Recommended Battery (battery not included)	Group 27F, 700 CCA Group 31, 925 CCA batteries can also be used with 30kW units
System Voltage	12 volts

ENGINE SPECIFICATION: 30 KW

Make	Perkins
Model	In-line
Cylinders	4
Displacement (Liters)	2.2
Bore (in / mm)	3.30 / 84
Stroke (in / mm)	3.94 / 100
Compression Ratio	23.3:1
Intake Air System	Turbocharged / aftercooled
Cylinder Head Type	Cast iron OHV
Piston Type	Aluminum

FUEL SYSTEM: 30 KW

Fuel Type	Ultra low sulfur diesel fuel
Fuel Pump Type	Mechanical engine driven gear
Injector Type	Mechanical
Fuel Specification	ASTM

WEIGHTS AND DIMENSIONS

kW size	Tank size	Weight (lb / kg)	Dimensions (L x W x H) (in / cm)
30 kW	57 Gal	1,857 / 842	95 x 35 x 59 / 241 x 89 x 150
30 kW	132 Gal	2,070 / 939	95 x 35 x 68 / 241 x 89 x 173

TANK SPECIFICATIONS

			Total Capacity	Usable Capacity	Run Time at 1/2 Load (hrs)
kW size	30 kW	57-Gal Tank (gal / L)	61 / 233	57 / 215	41.6
		132-Gal Tank (gal / L)	138.5 / 524	132 / 500	96.4

Meeting of future load demand by Diesel Generator

We have considered 30KVA capacity of Diesel Generator. As of now we are feeding 21KVA of Emergency bus (Distribution Panel – U) loading; however, we can feed up to 30KVA without any further expense. We kept 9KVA extra capacity considering future load growth on Emergency bus.

GENERATOR OUTPUT VOLTAGE / KW-60 HZ

		kW (Standby)	Amp (Standby)	kW (Prime)	Amp (Prime)	CB Size
RD030	120 / 240 V, 1Ø, 1.0 pf	30	125	24	100	150
	120 / 208 V, 3Ø, 0.8 pf	30	104	24	83	125
	120 / 240 V, 3Ø, 0.8 pf	30	90	24	72	100
	277 / 480 V, 3Ø, 0.8 pf	30	45	24	36	50

ENGINE FUEL CONSUMPTION

		gal / hr	L / hr
RD030	25% of rated load	0.97	3.67
	50% of rated load	1.37	5.19
	75% of rated load	1.97	7.46
	100% of rated load	2.77	10.49

POWER ADJUSTMENT FOR AMBIENT CONDITIONS

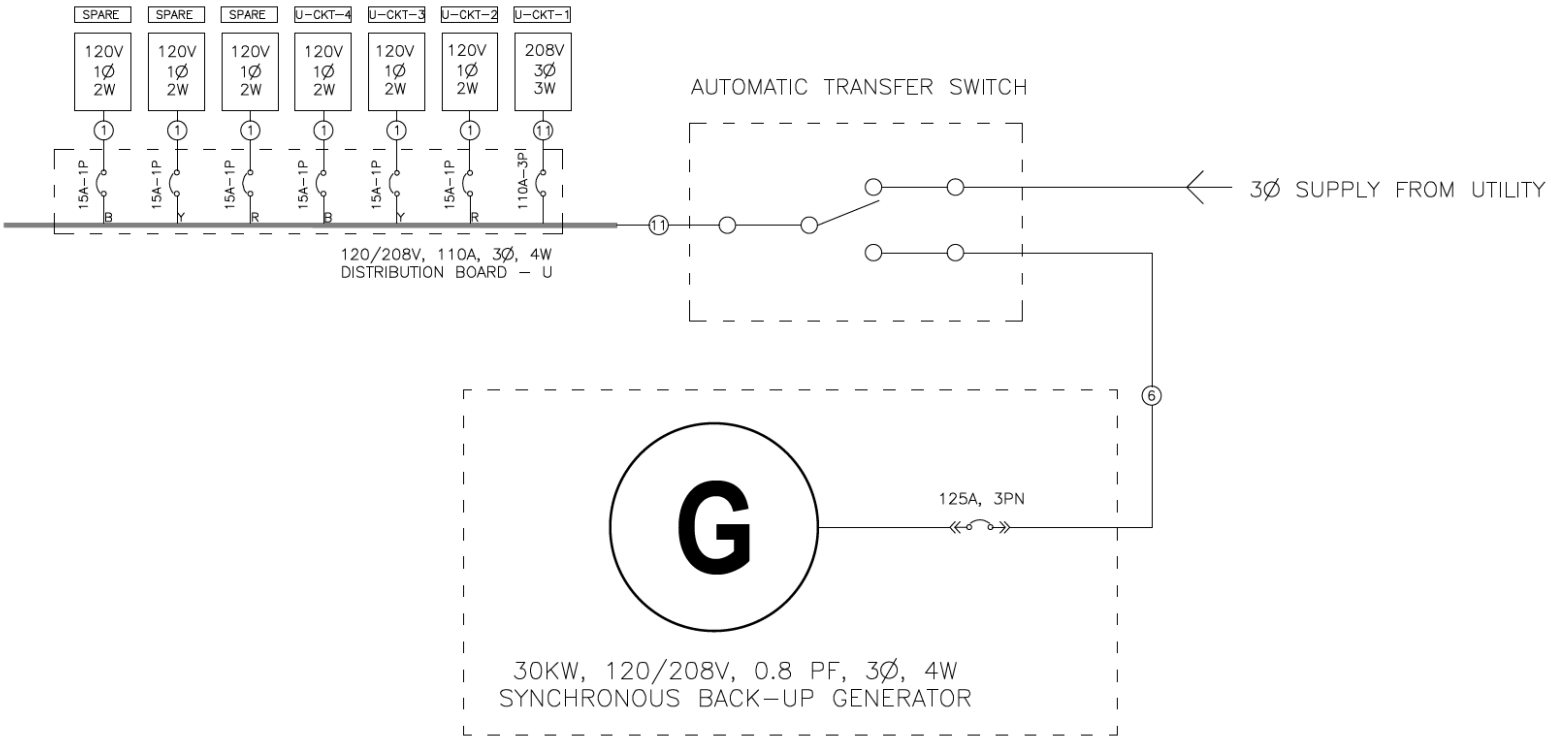
- Temperature Deration 3% for every 5 °C above 25 °C or 1.7% for every 5 °F above 77 °F
- Altitude Deration (15, 30, 48, and 50 kW) 1% for every 100 m above 915 m or 3% for every 1,000 ft above 3,000 ft.
- Altitude Deration (20 kW) 1% for every 100 m above 305 m or 3% for every 1,000 ft above 1,000 ft.

4. Available Accessories

Model #	Product	Description
G0071690	Mobile Link® 4G LTE Cellular Accessory	Generac's Mobile Link allows you to check the status of your generator from anywhere that you have access to an Internet connection from a PC or with any smart device. You will even be notified when a change in the generator's status occurs via e-mail or text message. Note: Har- ness Adapter Kit required. Available in the U.S. only.
G006478-0	Harness Adapter Kit	The Harness Adapter Kit is required to make liquid-cooled units compatible with Mobile Link®.
G006502-0	Spill Box	The 5-gallon spill box screws into the existing fuel fill port of the base tank. It captures and contains fuel if over fueling or spilling occurs during the fill process.
G006504-0	90% Fuel Level Alarm	The 90% fuel level alarm alerts the fuel fill operator when the tank reaches a 90% fill level by sounding an audible alarm and triggering an LED warning light.
G006506-0—30, 48, & 50 kW	Tank Risers	mounting on rough surfaces.
G006507-0	Fuel Fill Drop Tube	A powder coat painted, steel fuel fill drop tube is required in some municipalities to prevent sparking due to static electricity buildup, which can be caused by the fuel dropping into the tank from the fill area. Using a drop tube also results in submerged filling, which increases the fuel delivery flow rate and reduces vapors, foam and potential tank evaporation.
G007661-0—30 kW	Stainless Steel Fuel Lines	provided with the diesel generator products. These stainless steel lines are fire resistant for additional safety.
G006510-0	E-Stop	E-stop allows for immediate fuel shutoff and generator shutdown in the event of an emergency.
G006511-0	Spill Box Drainback Kit	The spill box drainback kit allows fuel that was captured in the 5-gallon spill box to be drained directly back into the fuel tank to avoid vapors.
G006588-1	Vent Extension Support Kit	The vent extension support kit consists of two aluminum plates with the appropriate pipe cutouts to secure the vent extension pipes coming through the top of the generator enclosure. It helps to minimize stress on the NPT fittings integrated on the tank and also helps protect against pests.
G006512-0	Lockable Fuel Cap	The cast iron, lockable fuel cap provides the ability to lock the fuel system to prevent unwanted fuel tampering or fuel siphoning.

G007641-0—30 kW	Maintenance Kits	The Protector Maintenance Kits offer all the hardware necessary to perform complete maintenance on Generac Protector generators.
G007651-0—30 kW	Cold Weather Kits	(0 °C). The Cold Weather Kits consist of a block heater with all necessary mounting hardware and a battery warmer with a thermostat built into the battery wrap.
G005703-0	Paint Kit	If the generator enclosure is scratched or damaged, it is important to touch up the paint to protect from future corrosion. The paint kit includes the necessary paint to properly maintain or touch up a generator enclosure
G007000-0 (50 Amps)	Smart Management Module	Smart Management Modules (SMM) optimize the performance of a standby generator. They
G007006-0 (100 Amps)		manage large electrical loads upon startup and load shed to aid in recovery when overloaded. In many cases, SMMs can reduce the overall size and cost of the system.
A0000018981	Ultrasonic Cleaner Solution	An ultra-concentrated anti-corrosive cleaning solution engineered to reach the smallest cavities to
		clean the toughest contaminants. This water-based formula is non-toxic, biodegradable, and safe for both metal and plastic surfaces and is superior in rinsability.
A0000019001	All Surface Protectant	All Surface Protectant for vinyl, rubber, and plastics creates a barrier that seals & protects surfaces from water and UV rays while renewing the look of the surface.

5. Emergency SLD accommodating backup Diesel Generator system



6. Geographic Location of back-up generator in layout

We are suggesting to place back-up generator outside the building considering the following factors.

- Space availability : The availability of the space is one of the primary factors to consider when deciding where to install a DG set. We don't have enough space to accommodate back-up generator inside the electrical room.
- Ventilation: Proper ventilation is critical for a backup diesel generator to operate safely and efficiently. In our building, we do not have adequate ventilation or exhaust system in the electric room, so it may be necessary to install the generator outdoors.
- Noise: Backup diesel generators can be noisy, especially when they are running at full capacity.
- Fuel storage: Diesel generator require a fuel source, which is typically stored in a fuel tank located near the generator. It could create a fire hazard inside the building.
- Fire hazard: Close premises can increase the risk of fire or explosion. Diesel generator sets require a certain amount of airflow to maintain safe operating temperature and close room can restrict the air circulation, potentially leading to overheating and catastrophic failure.

7. Advantages of Diesel Generator system over UPS System

While both diesel generator systems and UPS (Uninterruptible Power Supply) systems can provide backup power during outages, diesel generators offer several advantages over UPS systems:

Longer Run Times: Diesel generators can run for extended periods of time, providing power for days or weeks if necessary. In contrast, UPS systems typically have limited run times, usually ranging from several minutes to a few hours depending on the size and capacity of the battery bank.

Higher Power Output: Diesel generators can provide higher power output levels than UPS systems. This is important for large industrial or commercial applications that require a lot of power.

Lower Cost Per Kilowatt: Diesel generators have a lower cost per kilowatt than UPS systems. This is especially true for larger power capacities where the cost of batteries can be significant.

Easy to Refuel: Diesel generators are easy to refuel, as diesel fuel is widely available and can be stored in large quantities. In contrast, UPS systems require battery banks, which can be heavy and expensive to replace.

Reliable in Extreme Conditions: Diesel generators are reliable in extreme weather conditions, such as high winds, heavy rain, and snow. In contrast, UPS systems are sensitive to temperature and humidity levels and may require environmental controls to operate efficiently.

Overall, diesel generators offer several advantages over UPS systems, including longer run times, higher power output, and lower cost per kilowatt. However, they require more maintenance, emit exhaust fumes, and can be noisy, which can be disadvantages in some applications. The choice between a diesel generator and a UPS system ultimately depends on the specific requirements and needs of the application.

8. Cost benefits of back-up Diesel Generator over UPS system

A 30kVA diesel generator's price compared to a 30kVA UPS's price can differ according on the manufacturer, features, fuel type, installation cost, and maintenance cost.

On general, the price of a 30kVA UPS ranges from $10,000 to $20,000 (excluding battery rack), depending on the manufacturer, battery type, and amount of backup hours needed. On the other hand, the price of a 30kVA diesel generator can range from $15,000 to $30,000, depending on the manufacturer, the kind of fuel, and the cost of installation. It is crucial to remember that a diesel generator often has lower operating expenses than a UPS since diesel fuel is less expensive than the replacing & commissioning cost of batteries.

9. Conclusion

The backup diesel generator is an essential element of any facility or building's electrical system. It provides a reliable source of backup power in the event of a power outage, allowing the critical equipment and systems to continue functioning.

In areas with extreme weather conditions or frequent power outages, a backup diesel generator can prevent costly disruptions to business operations, data loss, and potential safety hazards. It also ensures continuity of services in critical facilities such as hospitals, data centers, and emergency response facilities.

Furthermore, diesel generators are known for their durability, reliability, and fuel efficiency. They can operate for extended periods without maintenance and are less prone to failure than other backup power sources such as batteries or propane generators.

To conclude, the backup diesel generator provides a reliable and efficient backup power source that can prevent costly disruptions and ensure the continuity of critical services.