T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Maintenance, Installation and Repair for Engineering and Manufacturing

Employer-Set Project (8712-033)

Sample Brief

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Version 1.0

City & Guilds | eal

Contents

The employer

Generator One Limited are a local company who provide short term solutions to customer's complex power and temperature control issues. They design and install engineering systems such as an Uninterruptible Power Supply (UPS) that provides temporary, cost effective, efficient solutions, that are flexible to meet the customers changing demands.

Generator One Limited ensures the optimum solution is implemented, across a range of applications offered to clients. These include:

- planned electrical and mechanical shutdowns
- unplanned shutdowns and emergencies
- onsite equipment replacement
- supplementary power, heating, or cooling.

The project

Generator One Limited has been approached by a client, the local NHS Trust, who requires their existing hospital backup power systems and standby power system to be replace with a UPS.

The existing back up power system is in the hospital grounds, in an outside caged storage facility, located near the main entrance. The new system will need to be installed into this area.

You have been asked to propose the installation of a standby/offline Diesel Rotary Uninterruptible Power Supply system (DRUPS) (refer to Diagram 1), where the load is powered directly by the input power and backup power circuitry is only invoked when the utility power fails - combining the functionality of a battery-powered or flywheel-powered UPS and a diesel generator.

The ideal of this new system is that a DRUPS will have enough fuel to power the load for days or even weeks in the event of failure of the mains electricity supply.

The commissioning of the end-product will be conducted by a third party.

The client has requested identification of strategies for implementing preventative maintenance systems and routine maintenance programmes as part of the replacement system offering a more reliable and robust solution.

The client has requested identification of requirements for bespoke manufacturing constraints to accommodate a replacement system and is interested in the environmental impact.

The client has provided specification requirements including output voltage, engine data, fuel consumption, lubrication and cooling and generator size.

Working as part of the Generator One Limited team, you need to propose the system that will enable the hospital to continue to deliver the best support and care from the doctors and nurses to all patients.

Specification

Introduction

The requirement is to design a system which will be presented to the customer for consideration.

The following information should be noted:

- main switchboards already installed
- main distribution boards already installed
- Power Distribution Unit (PDU) already installed.

Specification and technology requirements

System element	Requirement
Generator Specification	Ratings 400 V - 50 Hz Standby 165 kVA 132 kWe Power factor (Cos Phi) 0,80 Emergency Standby Power (ESP): Average load factor per 24 hours of operation is <85% efficiency Prime Power (PRP) . Average load factor per 24 hours of operation is <75% efficiency Voltage (V) 400/230, 3 phase Type of Cooling: Mechanical driven fan, electrical driven from the generator
Dimensions of the DRUPS	Length (mm) 2370 Width (mm) 1114 Height (mm) 1470 Tank capacity (L) 340 Dry weight (kg) 1578
Engine	Cylinders configuration: L Number of cylinders: 6 Compression ratio: 17 : 1 Speed (RPM): 1500 minimum Maximum stand-by power at rated RPM (kW): 153 Charge Air coolant: Air/Air
Alternator	Number of poles: 4 Number of bearings: Single Bearing
Control Unit	Generator control module

System element	Requirement
Outside caged storage facility	To access the storage facility for the DRUPS • the caged roof top must be unbolted and removed using suitable lifting machinery or equipment • the roof must be placed in a secured location once removed • the caged double doors must be unlocked and open fully so access can be given from the front. The dimensions of the outside storage facility are no more than • Length (mm) 3500 • Width (mm) 2000 • Height (mm) 1600. The caged facility is protected by a secured combination lock that only estates have access to and must be present on site.
Installation of equipment in hospital grounds	To unload electrical generating sets from their transport supports with optimum safety and efficiency, you must ensure that the following points are observed: • the lifting machinery or equipment is suitable and correctly rated for the work required • the sling is correctly positioned in the central lifting eye or the lifting arms are correctly positioned in the fork-lift pockets intended for this purpose • the ground is able to bear the load of the generating set and its lifting machinery without stress (otherwise lay down stabilising beams of sufficient strength). • the generating set is put down as close as possible to its place of use or transport, in a clear space with free access.

System element	Requirement
Installation checks	• Check that the general recommendations from section "Installation" (ventilation, exhaust, connections, etc.) are followed. • Carry out level checks (oil, grease, coolant, diesel, battery). • Carry out free rotational checks of shaft/bearing systems. • Carry out seal system checks. • Ensure that the generating set is correctly earthed (earthing rod). • Ensure that the electrical connections have been made properly. • Ensure that the mechanical connections have been torqued correctly. • Ensure locking features are securely fastened. • Ensure safety covers/guards are securely fastened. • Ensure that the fuel connection has been made properly (valve position), if the generating set is equipped with the three-way valve option enabling external supply.
Checks after starting the generating set	• Carry out the mechanical checks (oil pressure, water temperature, absence of excessive noise, vibration etc.). • Carry out the electrical checks (voltage, current, frequency, rotary field, etc.). • Carry out bearing temperature and unit vibration checks. • Carry out the safety checks (emergency shutdown, oil pressure, coolant temperature, etc.). • Carry out the check on Normal/Emergency Inverter switching or coupling (if fitted).

System element	Requirement
Pre-Start Inspection (engine)	• Inspecting the engine compartment. • Inspect the engine carefully. • Wipe all the grease fittings and caps before carrying out any maintenance to reduce the risk of contaminating the circuits. • Checking the engine oil level - Top up the oil as required. Use an oil whose viscosity is suited to the environmental and operational conditions.

Budget

The NHS Trust have budgeted for one completed project setup including installation to be £38K.

Timescale

Duration of installation, calibration and commissioning/testing of the system amendments and new technology will depend on responses to the project – installation time in excess of ten days will have a significant impact on switch over from existing generator back up to new DRUPS.

Installation can take place within the working day, or at night provided prior arrangement is made and does not affect the hospital operation or disruption to the service**.**

Plant site considerations

The site can be accessed for installation within the working day, or at night provided prior arrangement is made and that traffic diversions are put into place.

There is good accessibility to the site for delivery of equipment and components, and the DRUPS and associated systems are located in an accessible area of the site itself, where access can be requested through the estate managers.

Additional information

Diagram 1: A Typical Layout of a DRUPS

(Source of image: **Diesel Rotary UPS (DRUPS) - SPG (standbypowergeneration.co.uk))**

Part Number	Part Name	Part Number	Part Name
1	Electro-magnetic Clutch	6	Vibration dampers
2	Diesel Engine	7	Assembly block
3	Touch Screen Panel	8	Accumulator
4	Power Panel	9	Brushless Exciter
5	Alternator		

Table 1: DRUPS diagram key table

(Source of image: **Diesel Rotary UPS (DRUPS) - SPG (standbypowergeneration.co.uk)**

The T Level is a qualification approved and managed by the Institute for Apprenticeships and Technical Education.