STAMFORD

power generation

Installation Guideline – Crane Applications

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INTRODUCTION

This leaflet is designed to prompt the installation or specifying Engineer of a generating set, on the topics that need to be considered. Due to the variation in requiring elements encountered around the World, Newage can only highlight likely topics for consideration, and makes no attempt herein to explain these in any level of detail. Installation instructions applicable to Newage Stamford generators are included in the manual supplied with each one.

In all instances, installation or specifying Engineers of generators must take account of local, national and other regulations when considering an installation. Allowance should also be made for access around the generator for essential maintenance, and consideration should be given to access routes to the machine, in the unlikely event of replacement of major components.

Newage generators are warranted against faults caused by the incorporation of defective materials or bad workmanship by Newage. The warranty is provided in good faith on the basis that specification of the generator, installation, protection and other matters are performed with due regard to these guidelines.

Leaflets in this series are currently available to cover the following generator applications: -

Standby
Prime Power
Embedded Parallel / Cogeneration
Crane
Marine
Rental

SITE LOAD

The generator should be installed and operated so that it is not exposed to the direct effects of weather or airborne contaminants.

Any airborne contaminants (chemical, dust, sand, oil, engine exhaust, salt, water, etc.) should be adequately filtered so that they do not have an adverse effect on the generator.

The following site conditions are considered to be the standard operating environment for a generator: -

Ambient Temp	< 40°C
Humidity	< 60%
Altitude	< 1000m

Operation outside any of these conditions may be considered, but due consideration should be given to de-rating the generator to compensate; refer to factory for details.

If the generator is to be operated in locations with a high humidity or left stationary for long periods of time anti-condensation heaters should be fitted to help prevent condensation on the windings. The generator windings should be inspected before use, dry out and check the insulation value if moisture is detected.

The generator should be adequately rated for the application and operating conditions. The duty cycle, non-linear load and motor starting loads need to be considered.

AIRFLOW

Then air inlet temperature (normally the generator ambient temperature) must not rise above the ambient temperature as indicated on the nameplate.
The airflow through the generator during operation should be such that the outlet air temperature does not exceed that for the type of generator and class of winding insulation, as stated on the generator rating plate.
The volume of cooling air passing through the generator must not fall below the volume quoted in the generator's datasheet. Any restriction in airflow must be taken into consideration when sizing the generator.
Air inlet filters supplied by Newage carry a 5% derate in output kVA.

VIBRATION

The engine and generator assembly should be coupled so that the vibration of the generator does not exceed the following rms. **broadband** levels in the range 10hz – 1000hz [1], when running on full load.

Vibration - displacement	0.32mm
Vibration - velocity	20mm/s
Vibration - acceleration	13m/s^2

[1] ISO 8528-9 1995 (E)

The coupling arrangement of the engine and generator is a critical factor in ensuring alignment and limiting torsional vibrations.

Any vibrations, which can be caused by external forces (machinery, seismic disturbances, etc), should be taken into account when measuring vibration levels.

The foundations must be adequate to support the weight of the generating set under all conditions.

BEARINGS

The coupling housing and arrangement should be designed such that the maximum temperature of the bearings under operating conditions does not exceed **90°C.**
With Rubber Tyre Gantry Cranes the designer needs to be aware of the shunt loads on the generator. The orientation should be such that the load is taken on the bearings in a radial direction. Consideration should be given to the use of a two bearing generator for this application.

CABLE TERMINATIONS

The generator terminal box is designed to terminate the supply cables/bus-bars to the load.

The cables/bus-bars should be sized so that the rated temperature and current carrying capacity are not exceeded.

If single core cables are used, the gland plate on the terminal box should be made from non-ferrous metal.

If the cables/bus-bars are connected in parallel they should be de-rated according to the relevant supplier's data sheets.

The cables/bus-bars should be adequately supported so that they cannot be damaged during operation and do not cause stress on the generator terminals or terminal box.

The fixing of the cables/bus-bars to the terminal box should be such that it will allow for movement of the set under operating conditions without undue stress on the cable/bus-bar or terminals. The cables/bus-bars should be adequately supported so that they will not be damaged nor cause any damage under operational or fault conditions.

Any extensions to the terminal box should be adequately fixed so that they do not cause excessive vibration during operation, or undue strain on the existing terminal box.

EARTHING

If the crane is mobile ground potential earth points cannot be considered. However, for safety reasons the designer of the crane's total electrical scheme may require one part of the generator's output windings to be referenced to the crane metalwork, in order to create an zone of 'equal potential'.

All metal-work of the crane should be bonded so that there is a continuous low impedance path from all parts of it back to the generator 'earth' terminal, as this is the provided point for output winding 'referencing'.
The cable used for bonding should be rated to withstand any fault currents that may occur, without damage to the cable.

NOTE: -
The generator is delivered without any part of the output winding connected to the generator's metalwork.

PRIME MOVER / FUEL

The type of fuel used by the engine should be considered.

Some types of gas fuels can be of variable quality. This can induce engine problems, with associated changes in the set vibration patterns experienced by the generator, with the possibility that this could become seriously harmful.

For any generating set which will run in parallel with another set (or mains utility etc.) consideration should also be given to the possibility of fuel starvation or running out. Suitable reverse power protection should be installed to prevent the generator motoring in event of fuel supply failure.

METERING

Adequate metering should be fitted to the generator to ensure that it is operating correctly.

The level of metering required is detailed below

METERING		
	Min	Option
Voltmeter (Generator)	X	
Voltmeter (Utility)	X	
Ammeter (On 3 phases if 3phase machine)	X	
Hz Meter		X
kW Meter		X
kVA Meter		X
PF Meter		X

MOTOR STARTING

1. Non Linear Loads

The principal electrical loads of a crane are the various motor drives associated with the crane's movements.

It is most important to confirm the electrical characteristics of the crane's motors and their speed control system(s).

On a modern crane it is likely that modern technology Variable Speed Drives [VSD] are used, and these employ power electronic semiconductor devices.
Any electrical equipment that includes power electronic semiconductor devices, as a means to control the VSD output operating speed, will generate harmonics on to the supplied current waveform. In turn, this harmonic current distortion will harmonically distort the power supply's [the generators] output voltage waveform.

Ensuring these non-linear loads, and any other crane loads, will operate satisfactorily on a generator supply requires careful consideration of the type of generator being used.

2. Fixed Speed Induction Motors.

The following is offered as guidance for conventional induction motors, but fixed speed motors are unlikely to be used on a crane.
When an electric motor is started, it subjects the connected electrical power supply system to a rapid load step change, in the form of a high impact kVA, at a low power factor.
This high impact kVA may only be present for a short period of time, but sufficient to cause the generator's output voltage to momentarily reduce, a situation referred to as a Transient Voltage Dip, or TVD%.

If the TVD% is too great it will prevent the motor from starting, by either causing the motor to stall, or causing a malfunction of the motor's control gear.

3. General Motor Starting

All motor starting methods will subject the generating set to an 'Impact kVA'. The value of impact kVA will be used in conjunction with the generator's 'Locked Rotor Curves' to identify the expected TVD%. The value of TVD% must be established to ensure full consideration has been given regarding the overall effects on the performance of the generating set, the motor being started, and other connected load already being powered, during the motor start.

Traditional motor starting techniques include Direct on Line, Star-Delta and Autotransformer.

Modern motor starting techniques involve the short-term use (during start only) of power electronics to engineer a 'Soft-Start', or continuous use situation as a Variable Speed Drive. Both are forms of Non-linear Loads, which introduce harmonic distortion onto the electrical supply system. For more information regarding these Non-linear Loads, see the appropriate section of this leaflet.

All motor starting impact load (kVA) will occur at low lagging power factor, but the motor's demand for start /acceleration torque will always subject the generating set to a demand for real engine power (kW). The actual level of kW required from the generating set can usually be considered to be the same as the motor's rated input kW. This should be compared with the engine's single load step kW capability, which for a modern turbo-charged engine may be only 60% of its continuous rated power.

Electric motor manufacturers publish helpful data regarding the starting performance and associated requirements for various types of motor designs. Additionally, identification of

the motor's mechanically coupled load, and guidance regarding the characteristics of this load during the motor start should be established. Consideration of all these aspects is required to ensure the performance of the proposed generating set will be satisfactory.

Newage offers various types of excitation systems and associated AVR's, each is designed to offer optimum performance under different generating set application duties.

Motor starting is just one of these many duties that benefits from a thorough understanding of the load characteristics, and resulting correct choice of generating set components.

Generator data sheets including a graph showing TVD% against impact kVA are available for every generator.

ELECTROMAGNETIC COMPATIBILITY

Additional Information: European Union Council Directive 89/336/EEC

For installations within the European Union, electrical products must meet the requirements of the above directive, and Newage ac generators are supplied on the basis that:

- They are to be for power generation or related function.

- They are to be applied in one of the following environments:

    - Portable (open construction - temporary site supply)
    - Portable (enclosed - temporary site supply)
    - Containerised (temporary or permanent site supply)
    - Ship-borne below decks (marine auxiliary power)
    - Commercial vehicle (road transport / refrigeration etc.)
    - Rail transport (auxiliary power)
    - Industrial vehicle (earthmoving, cranes etc.)
    - Fixed installation (residential, commercial and light industrial - home / office / health)
    - Energy management (Combined heat and power and/or peak lopping)
    - Alternative energy schemes.

The standard generators are designed to meet the 'industrial' emissions and immunity standards. Where the generator is required to meet the residential, commercial and light industrial emissions and immunity standards reference should be made to Newage document reference N4/X/011, as additional equipment may be required.

The installation 'earth' scheme involves connection of the generator frame to the site protective earth conductor using a minimum practical lead length.

Maintenance and servicing with anything other than factory supplied or authorised parts will invalidate any Newage liability for EMC compliance.

Installation, maintenance and servicing are carried out by adequately trained personnel fully aware of the requirements of the relevant EC directives.

ELECTRICAL PROTECTION

Adequate electrical protection should be provided so that there will be no danger to personnel, danger of fire or damage to the generator under fault conditions.

The level of protection required is detailed below.

PROTECTION	Min	Option
Overcurrent	X	
Short Circuit	X	
Under Volts		X
Over Volts		X
Under Hz		X
Over Hz		X
Differential		X
Earth Fault		X
Stator RTDs		X
Vibration Monitoring		X
Bearing Condition Monitor		X

If the overload and short circuit protection is provided by a circuit breaker, care must be taken with the protection settings. Circuit breakers are designed for operation with the utility supply, which can provide much higher and longer fault levels than a generator. The circuit breaker, overcurrent and short circuit settings should therefore be set according to the overcurrent/short circuit curves of the circuit breaker and not the overcurrent/short circuit dials on the circuit breaker.

The generator overload and short circuit settings on the protection should be set so that they are below the thermal damage curve for the generator.

Generator data sheets are available to help calculate these settings.