DORKET HEAD LANDFILL

Environmental Permit Variation Application

Non-Technical Summary

Prepared for: Infinis Energy Services Limited
Client Ref: 416.01428.00053

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CONTENTS

DRAWINGS

APPENDICIES

1.0 INTRODUCTION

SLR Consulting Limited (SLR) has been instructed by Infinis Energy Services Limited (Infinis) to prepare an Environmental Permit (EP) variation application for FCC Recycling Limited for the Dorket Head Landfill, located at Woodborough Lane, Arnold, Nottingham, NG5 8PU. Hereafter referred to as 'the Site'.

This variation proposes to replace two existing landfill gas fuelled engines on Site (2x 1400kW Jenbacher J420) with one 1065kW (2.6MWth) engine, also fuelled on landfill gas. The purpose for the installation of this smaller engine is to reduce the installed generating capacity while still ensuring all available gas can be utilised.

This Non-Technical Summary (NTS) provides a summary of what is being applied for, the regulated facility and outlines the key technical standard and control measures that will be implemented at the Site as a result of the risk assessments.

In addition to this NTS, the EP application comprises the following documents:

- Section 2 – Application Forms Part A, C2, C3 and F1; and
- Section 3 – Air Emissions Risk Assessment.

1.1 Site Location

The Site is centred on National Grid reference SK 59841 47146 and is located on the north-westerly edge of the Arnold, in the Dorket Head area. The Site is located approximately 8km north-west of the centre of Nottingham.

The Site lies adjacent to Calverton road to the west and is bounded to the north by Woodborough Lane (B684). Access is gained to the Site via Woodborough Lane.

The Site lies in an area of mixed agricultural, industrial and residential land uses. The surrounding locale of the Site can be characterised as follows:

- Woodborough Lane lies immediately to the north, beyond which lies agricultural land;
- Agricultural/open land lies immediately to the east. Some local road networks and sparse residential lettings lie beyond this; and
- Immediately to the south lies agricultural land, beyond which is the town of Arnold; and
- Calverton Road lies immediately to the west, beyond this is a large industrial premise belonging to Ibstock Brick Dorket Head as well as a commercial farm property, Martins Farm.

The revised proposed Site Layout is illustrated on Drawing Inf/Dork/01/AK.

2.0 APPLICATION OVERVIEW

Two engines are currently permitted on the Site, comprising two 1400kw Jenbacher J420 engines. These engines are permitted to be fuelled on landfill gas, under the permit reference EPR/BV4444IQ/V008.

This environmental permit variation application seeks to replace these two existing engines with one single 1065kW Jenbacher J320 engine (Engine 1). The engine will be also fuelled from landfill gas and have a rated thermal input of 2.606MW. No other changes are proposed. The proposed location of the new engine can be seen on Drawing Inf/Dork/01/AK.

The 1065kW Jenbacher J320 engine is a second-hand unit first commissioned in 2006. As such, it is classed as an 'existing' MCP.

As the Site is regulated under Chapter II of the IED, the engine is exempt from Specified Generator regulations[1].

3.0 APPLICATION CONTENTS

3.1 Application Forms

Application forms and associated appendices have been completed and are enclosed in Section 2 of this application.

3.2 Drawings

Section 2 contains a drawing for the Site, illustrating the location of the proposed new engine and the Site layout.

3.3 Landfill Gas Risk Assessment

An updated Landfill Gas Risk Assessment (LFGRA) has been completed by SLR for the replacement of the landfill gas engines and is submitted in Section 4 of this application.

The LFGRA demonstrates that, given the design, control and management and monitoring for the site, the landfill will continue to be operated in compliance with the requirements of the Environmental Permitting Regulations. In particular:

- appropriate measures will continue to be taken in order to control the accumulation and migration of landfill gas;
- the landfill gas generated will continue to be collected, treated and, to the extent possible, used. The landfill gas will be used to generate electricity using gas engines employed at the landfill as long as sufficient gas is generated;
- the collection, treatment and use of landfill gas will continue to be carried out in a manner that minimises impacts on the environment, amenity or human health.

3.4 Application Fee

On the basis of the addition of the engine being classed as a normal variation under 1.17.2 (Section 5.2 – landfill for non-hazardous waste and lagoons/dredging sites subject to the Landfill Directive; including assessment of odour management plan), an application fee of £11,388 has been determined in accordance with the EA's Environmental Permitting Charging Scheme (2019).

4.0 TECHNICAL STANDARDS AND KEY CONTROL MEASURES

4.1 Technical Standards

Key technical standards laid out in the following documents govern the operation of the plant:

- EA - Environmental permitting: landfill sector technical guidance (January 2020);
- EA – Guidance on the management of landfill gas (LFTGON03 2004);
- EA – Guidance for monitoring of landfill gas engine emissions (LFTGN08 v2 2010);

[1] EA – Medium combustion plant and specified generators: environmental permits (September 2019)

4.2 Key Control Measures

Key control measures that will be applied at the Site are as follows:

- The plant will be operated to minimise emissions and comply with emission limits for oxides of nitrogen, carbon monoxide and total volatile organic carbon;
- Emissions to air from the landfill gas engine will be discharged through an individual stack terminating at 7.51m (above ground level) to aid atmospheric dispersal;
- An engine control system is employed which allows FCC to:
    - Monitor engine performance;
    - Control air-fuel ratio;
    - Actively and reactively control load;
    - Meter power;
    - Manage engine speed;
    - Control voltage; and
    - Remotely control the system.
- A preventative maintenance schedule is implemented.

5.0 CONCLUSIONS

An updated Landfill Gas Risk Assessment (LFGRA) has been completed by SLR for the replacement of the landfill gas engines and is submitted in Section 4 of this application.

The LFGRA demonstrates that, given the design, control and management and monitoring for the site, the landfill will continue to be operated in compliance with the requirements of the Environmental Permitting Regulations. In particular:

- appropriate measures will continue to be taken in order to control the accumulation and migration of landfill gas;
- the landfill gas generated will continue to be collected, treated and, to the extent possible, used. The landfill gas will be used to generate electricity using gas engines employed at the landfill as long as sufficient gas is generated;
- the collection, treatment and use of landfill gas will continue to be carried out in a manner that minimises impacts on the environment, amenity or human health.

With the replacement of the two existing engines with one smaller thermal input capacity engine, the Site is predicted to continue to provide a high level of protection to the environment as a whole.

FCC is fully committed to ensuring the highest standards are met and will undertake its activities in a manner consistent with best industrial practices and in accordance with the company's management system.

APPENDICES

APPENDIX A

Engine Technical Data Sheet

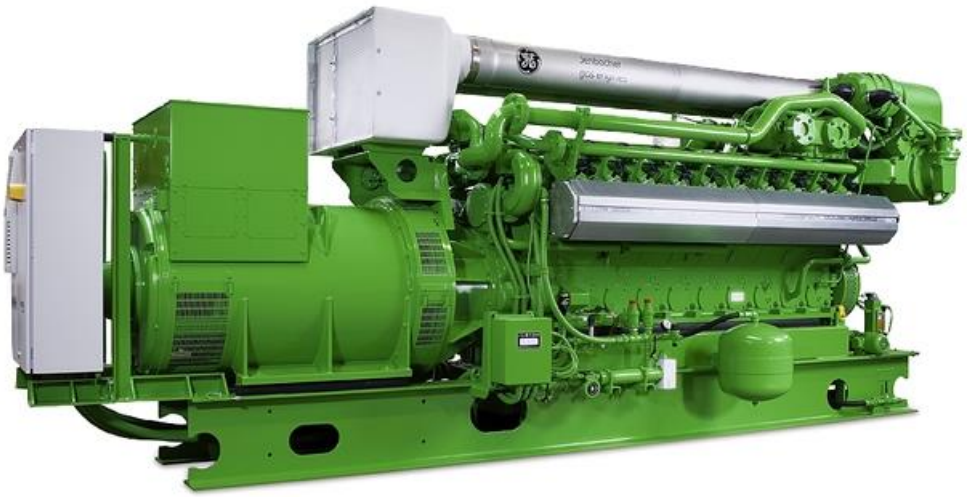
Technical Description

Cogeneration Unit

JMS 320 GS-N.L

dyn. Gridcode BDEW (DEU, DNK, AUT, BEL, GBR)

For Information Only



Electrical output	**1065 kW el.**
Thermal output	**1251 kW**

Emission values

NOx < 500 mg/Nm³ (5% O2)

0.01 Technical Data (at module)

Data at:				Full load	Part Load	
Fuel gas LHV		kWh/Nm³		9.5		
				100%	75%	50%
Energy input		kW	[2]	2,606	2,007	1,409
Gas volume		Nm³/h	*)	274	211	148
Mechanical output		kW	[1]	1,095	821	548
Electrical output		kW el.	[4]	1,065	797	528
Recoverable thermal output						
~ Intercooler 1st stage		kW		217	109	26
~ Lube oil		kW		121	109	95
~ Jacket water		kW		347	317	270
~ Exhaust gas cooled to 120 °C		kW		566	445	330
Total recoverable thermal output		kW	[5]	1,251	980	721
Total output generated		kW total		2,316	1,777	1,249
Heat to be dissipated						
~ Intercooler 2nd stage		kW		60	46	25
~ Lube oil		kW		~	~	~
~ Surface heat	ca.	kW	[7]	95	~	~
Spec. fuel consumption of engine electric		kWh/kWel.h	[2]	2.45	2.52	2.67
Spec. fuel consumption of engine		kWh/kWh	[2]	2.38	2.45	2.57
Lube oil consumption	ca.	kg/h	[3]	0.33	~	~
Electrical efficiency		%		40.9%	39.7%	37.5%
Thermal efficiency		%		48.0%	48.8%	51.2%
Total efficiency		%	[6]	88.9%	88.6%	88.7%
Hot water circuit:						
Forward temperature		°C		90.0	84.6	79.4
Return temperature		°C		65.0	65.0	65.0
Hot water flow rate		m³/h		48.2	48.2	48.2

*) approximate value for pipework dimensioning
[_] Explanations: see 0.10 - Technical parameters

All heat data is based on standard conditions according to attachment 0.10. Deviations from the standard conditions can result in a change of values within the heat balance, and must be taken into consideration in the layout of the cooling circuit/equipment (intercooler; emergency cooling; ...). In the specifications in addition to the general tolerance of ±8 % on the thermal output a further reserve of +5 % is recommended for the dimensioning of the cooling requirements.

Main dimensions and weights (at module)

Length	mm	~ 5,700
Width	mm	~ 1,900
Height	mm	~ 2,300
Weight empty	kg	~ 14,800
Weight filled	kg	~ 15,300

Connections

Hot water inlet and outlet	DN/PN	80/10
Exhaust gas outlet	DN/PN	250/10
Fuel Gas (at module)	DN/PN	80/16
Water drain ISO 228	G	½"
Condensate drain	DN/PN	50/10
Safety valve - jacket water ISO 228	DN/PN	2x1½"/2,5
Safety valve - hot water	DN/PN	65/16
Lube oil replenishing (pipe)	mm	28
Lube oil drain (pipe)	mm	28
Jacket water - filling (flex pipe)	mm	13
Intercooler water-Inlet/Outlet 1st stage	DN/PN	80/10
Intercooler water-Inlet/Outlet 2nd stage	DN/PN	65/10

Output / fuel consumption

ISO standard fuel stop power ICFN	kW	1,095
Mean effe. press. at stand. power and nom. speed	bar	18.00
Fuel gas type		Natural gas
Based on methane number | Min. methane number	MZ d)	94 | 70
Compression ratio	Epsilon	12.5
Min./Max. fuel gas pressure at inlet to gas train	mbar	80 - 200 c)
Allowed Fluctuation of fuel gas pressure	%	± 10
Max. rate of gas pressure fluctuation	mbar/sec	10
Maximum Intercooler 2nd stage inlet water temperature	°C	40
Spec. fuel consumption of engine	kWh/kWh	2.38
Specific lube oil consumption	g/kWh	0.30
Max. Oil temperature	°C	90
Jacket-water temperature max.	°C	95
Filling capacity lube oil (refill)	lit	~ 342

c) Lower gas pressures upon inquiry
d) based on methane number calculation software AVL 3.1 (calculated without N2 and CO2)

0.02 Technical data of engine

Manufacturer		GE Jenbacher
Engine type		J 320 GS-D05
Working principle		4-Stroke
Configuration		V 70°
No. of cylinders		20
Bore	mm	135
Stroke	mm	170
Piston displacement	lit	48.67
Nominal speed	rpm	1,500
Mean piston speed	m/s	8.50
Length	mm	3,320
Width	mm	1,358
Height	mm	2,065
Weight dry	kg	5,200
Weight filled	kg	5,700
Moment of inertia	kgm²	8.61
Direction of rotation (from flywheel view)		left
Radio interference level to VDE 0875		N
Starter motor output	kW	7
Starter motor voltage	V	24

Thermal energy balance

Energy input	kW	2,606
Intercooler	kW	277
Lube oil	kW	121
Jacket water	kW	347
Exhaust gas cooled to 180 °C	kW	464
Exhaust gas cooled to 100 °C	kW	600
Surface heat	kW	54

Exhaust gas data

Exhaust gas temperature at full load	°C [8]	442
Exhaust gas temperature at bmep= 13.5 [bar]	°C	~ 452
Exhaust gas temperature at bmep= 9 [bar]	°C	~ 477
Exhaust gas mass flow rate, wet	kg/h	5,665
Exhaust gas mass flow rate, dry	kg/h	5,260
Exhaust gas volume, wet	Nm³/h	4,497
Exhaust gas volume, dry	Nm³/h	3,992
Max.admissible exhaust back pressure after engine	mbar	60

Combustion air data

Combustion air mass flow rate	kg/h	5,485
Combustion air volume	Nm³/h	4,244
Max. admissible pressure drop at air-intake filter	mbar	10

Sound pressure level

Aggregate a)	dB(A) re 20µPa	96
31,5 Hz	dB	78
63 Hz	dB	90
125 Hz	dB	92
250 Hz	dB	89
500 Hz	dB	92
1000 Hz	dB	90
2000 Hz	dB	89
4000 Hz	dB	87
8000 Hz	dB	90
Exhaust gas b)	dB(A) re 20µPa	122
31,5 Hz	dB	97
63 Hz	dB	108
125 Hz	dB	118
250 Hz	dB	110
500 Hz	dB	113
1000 Hz	dB	114
2000 Hz	dB	117
4000 Hz	dB	115
8000 Hz	dB	114

Sound power level

Aggregate	dB(A) re 1pW	117
Measurement surface	m²	120
Exhaust gas	dB(A) re 1pW	130
Measurement surface	m²	6.28

a) average sound pressure level on measurement surface in a distance of 1m (converted to free field) according to DIN 45635, precision class 3.
b) average sound pressure level on measurement surface in a distance of 1m according to DIN 45635, precision class 2.
The spectra are valid for aggregates up to bmep=18 bar. (for higher bmep add safety margin of 1dB to all values per increase of 1 bar pressure).
Engine tolerance ± 3 dB

0.03 Technical data of generator

Manufacturer		Leroy-Somer e)
Type		LSA 52.2 M60 e)
Type rating	kVA	1,720
Driving power	kW	1,095
Ratings at p.f. = 1,0	kW	1,065
Ratings at p.f. = 0.8	kW	1,054
Rated output at p.f. = 0.8	kVA	1,318
Rated reactive power at p.f. = 0.8	kVar	791
Rated current at p.f. = 0.8	A	1,903
Frequency	Hz	50
Voltage	V	400
Speed	rpm	1,500
Permissible overspeed	rpm	1,800
Power factor (lagging - leading)		0,8 - 0,95
Efficiency at p.f. = 1,0	%	97.3%
Efficiency at p.f. = 0.8	%	96.3%
Moment of inertia	kgm^2	46.90
Mass	kg	3,950
Radio interference level to EN 55011 Class A (EN 61000-6-4)		N
Ik'' Initial symmetrical short-circuit current	kA	20.91
Is Peak current	kA	53.22
Insulation class		H
Temperature (rise at driving power)		F
Maximum ambient temperature	°C	40

Reactance and time constants (saturated)

xd direct axis synchronous reactance	p.u.	1.79
xd' direct axis transient reactance	p.u.	0.17
xd'' direct axis sub transient reactance	p.u.	0.09
x2 negative sequence reactance	p.u.	0.10
Td'' sub transient reactance time constant	ms	23
Ta Time constant direct-current	ms	41
Tdo' open circuit field time constant	s	3.08

e) GE Jenbacher reserves the right to change the generator supplier and the generator type. The contractual data of the generator may thereby change slightly. The contractual produced electrical power will not change.

0.04 Technical data of heat recovery

General data - Hot water circuit

Total recoverable thermal output	kW	1,251
Return temperature	°C	65.0
Forward temperature	°C	90.0
Hot water flow rate	m³/h	48.2
Nominal pressure of hot water	PN	10
min. operating pressure	bar	3.5
max. operating pressure	bar	9.0
Pressure drop hot water circuit	bar	1.00
Maximum Variation in return temperature	°C	+0/-5
Max. rate of return temperature fluctuation	°C/min	10

General data - Cooling water circuit

Heat to be dissipated	kW	60
Return temperature	°C	40
Cooling water flow rate	m³/h	25
Nominal pressure of cooling water	PN	10
min. operating pressure	bar	0.5
max. operating pressure	bar	5.0
Loss of nominal pressure of cooling water	bar	~
Maximum Variation in return temperature	°C	+0/-5
Max. rate of return temperature fluctuation	°C/min	10

Exhaust gas heat exchanger

Type		shell-and-tube
PRIMARY:		
Exhaust gas pressure drop approx	bar	0.02
Exhaust gas connection	DN/PN	250/10
SECONDARY:		
Pressure drop hot water circuit	bar	0.20
Hot water connection	DN/PN	100/10

The final pressure drop will be given after final order clarification and must be taken from the P&ID order documentation.

connection variant F

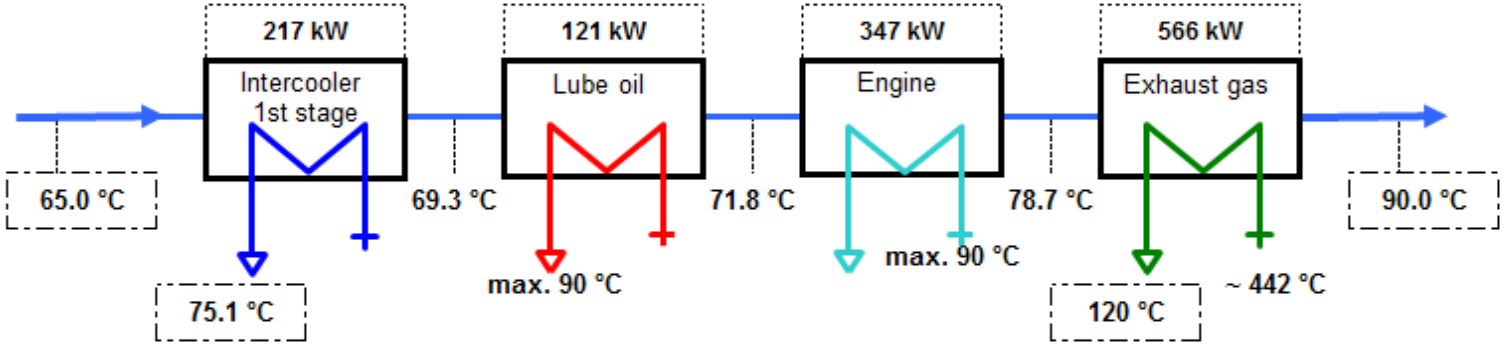
Hot water circuit (calculated with Glykol 37%)

For Information Only **J 320 GS-D05**

Recoverable thermal output = 1,251 kW

(±8 % tolerance +5 % reserve for cooling requirements)

Hot water flow rate = 48.2 m³/h

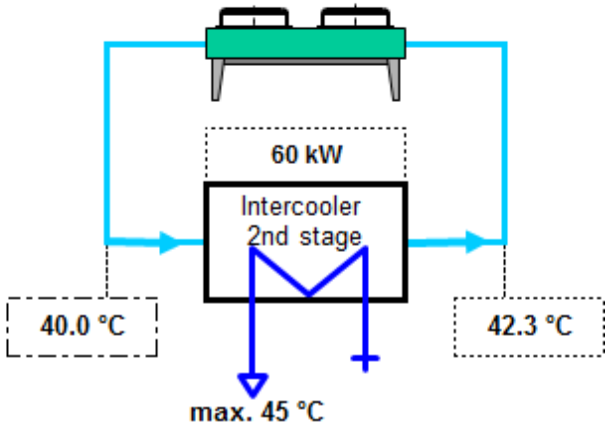


Low temperature circuit (calculated with Glykol 37%)

Heat to be dissipated = 60 kW

(±8 % tolerance +5 % reserve for cooling requirements)

Cooling water flow rate = 25.0 m³/h



0.10 Technical parameters

All data in the technical specification are based on engine full load (unless stated otherwise) at specified temperatures and the methane number and subject to technical development and modifications.

All pressure indications are to be measured and read with pressure gauges (psi.g.).

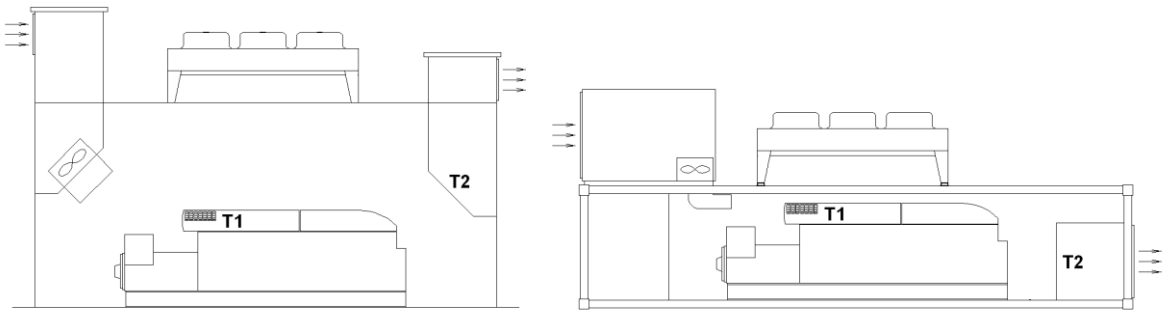
(1) At nominal speed and standard reference conditions ICFN according to DIN-ISO 3046 and DIN 6271, respectively
(2) According to DIN-ISO 3046 and DIN 6271, respectively, with a tolerance of +5 %.
Efficiency performance is based on a new unit (immediately upon commissioning).Effects of degradation during normal operation can be mitigated through regular service and maintenance work.
(3) Average value between oil change intervals according to maintenance schedule, without oil change amount
(4) At p. f. = 1.0 according to VDE 0530 REM / IEC 34.1 with relative tolerances
(5) Total output with a tolerance of ±8 %
(6) According to above parameters (1) through (5)
(7) Only valid for engine and generator; module and peripheral equipment not considered (at p. f. = 0,8)
(8) Exhaust temperature with a tolerance of ±8 %

Radio interference level
The ignition system of the gas engines complies the radio interference levels of CISPR 12 and EN 55011 class B, (30-75 MHz, 75-400 MHz, 400-1000 MHz) and (30-230 MHz, 230-1000 MHz), respectively.

Definition of output
- ISO-ICFN continuous rated power:
  Net break power that the engine manufacturer declares an engine is capable of delivering continuously, at stated speed, between the normal maintenance intervals and overhauls as required by the manufacturer. Power determined under the operating conditions of the manufacturer's test bench and adjusted to the standard reference conditions.
- Standard reference conditions:
  Barometric pressure: 1000 mbar (14.5 psi) or 100 m (328 ft) above sea level
  Air temperature: 25°C (77°F) or 298 K
  Relative humidity: 30 %

- Volume values at standard conditions (fuel gas, combustion air, exhaust gas)
  Pressure: 1013 mbar (14.7 psi)
  Temperature: 0°C (32°F) or 273 K

Output adjustment for turbo charged engines
Standard rating of the engines is for an installation at an altitude ≤ **500 m** and combustion air temperature ≤ **30 °C** (T1)
Engine room outlet temperature: **50°C** (T2) -> engine stop



If the actual methane number is lower than the specified, the knock control responds. First the ignition timing is changed at full rated power. Secondly the rated power is reduced. These functions are carried out by the engine management system.
Exceedance of the voltage and frequency limits for generators according to IEC 60034-1 Zone A will lead to a derate in output.

Parameters for the operation of GE Jenbacher gas engines
The genset fulfils the limits for mechanical vibrations according to ISO 8528-9.
The following "Technical Instruction of GE JENBACHER" forms an integral part of a contract and must be strictly observed: **TA 1000-0004, TA 1100 0110, TA 1100-0111**, and **TA 1100-0112.**
Transport by rail should be avoided. See **TA 1000-0046** for further details

Failure to adhere to the requirements of the above mentioned TA documents can lead to engine damage and may result in loss of warranty coverage.

Parameters for the operation of control unit and the electrical equipment
Relative humidity 50% by maximum temperature of 40°C.
Altitude up to 2000m above the sea level.

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