



CLASS GUIDELINE

DNV-CG-0588

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Containerised generator sets

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FOREWORD

DNV class guidelines contain methods, technical requirements, principles and acceptance criteria related to classed objects as referred to from the rules.

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CHANGES – CURRENT

This is a new document.

This document supersedes the DNV GL Technical and Regulatory news no.11/2016 and any other earlier publications describing requirements related to the acceptance of containerised generator sets (CGS) on board DNV classed vessels.

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SECTION 1 GENERAL

1 General

1.1 Introduction

On a regular basis, containerised generator sets (CGS) are placed on board ships to provide replacement power in case of a damage to one of the ship's generator sets, or additional power, e.g. to provide power to extra deck equipment or reefer containers. There are currently no clear rules and requirements for such time limited installations.

1.2 Objective

The objective of this class guideline is to provide guidance and ensure uniform interpretation of the applicable requirements for time limited installation of generator sets in container on board.

1.3 Scope

This guideline provides guidance for the installation of CGS on board DNV classed vessels, focussing on individual integration within the ship's systems and the location of the container.

Permanent installation of containerised generator sets are not covered by this guideline.

[App.A](#) provides a tabularised summary of all requirements, for ease of reference.

1.4 Application

This guideline applies to all CGS installed on board DNV classed vessels independent of the function they serve.

1.5 References

[Table 1](#) lists DNV references used in this document.

Table 1 DNV references

<i>Document code</i>	<i>Title</i>
DNV-RU-SHIP Pt.3 Ch.1	General principles
DNV-RU-SHIP Pt.4	Systems and components

[Table 2](#) lists other references used in this document.

Table 2 Other references

<i>Document code</i>	<i>Title</i>
SOLAS	International Convention for the Safety of Life at Sea, 1974
IMO MSC.1/Circ.1270	Revised guidelines for the approval of fixed aerosol fire-extinguishing systems equivalent to fixed gas fire-extinguishing systems, as referred to in SOLAS 74, for machinery spaces
MARPOL	Prevention of air pollution from ships

1.6 Definitions and abbreviations

1.6.1 Definition of verbal forms

The verbal forms defined in [Table 3](#) are used in this document.

Table 3 Definition of verbal forms

<i>Term</i>	<i>Definition</i>
shall	verbal form used to indicate requirements strictly to be followed in order to conform to the document
should	verbal form used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others
may	verbal form used to indicate a course of action permissible within the limits of the document

1.6.2 Definition of terms

The terms defined in [Table 4](#) are used in this document.

Table 4 Definition of terms

<i>Term</i>	<i>Definition</i>
additional power	electrical power provided by the CGS in addition to the electrical power supplied by the ship's generator sets
replacement power	electrical power provided by the CGS to replace the electrical power normally supplied by one of the ship's generator sets. Unless specified this includes both the emergency generator set and the auxiliary generator sets

1.6.3 Abbreviations

The abbreviations described in [Table 5](#) are used in this document.

Table 5 Abbreviations

<i>Abbreviation</i>	<i>Description</i>
CA	condition of authority
CC	condition of class
CGS	containerised generator set
ESB	emergency switchboard
MO	memo to owners
MSB	main switchboard

2 Acceptance criteria

2.1 General

Although the CGS units supplied on the market today normally meet the applicable criteria, their individual integration within the ship's systems and the location of the container shall be given special focus.

In order to accept a CGS for installation, the items in [2.4] to [2.12] shall be addressed. Please note that the requirements are based on a CGS with an engine power of more than 375 kW. If the engine is smaller, the CGS is not considered a machinery space of category A and some criteria may be relaxed or waived.

2.2 Limitations

Normally no more than one of the independent sources of power providing the normal seagoing load may be replaced by a CGS.

Installation of a CGS for an unlimited period of time is not covered by this class guideline. Such an installation is considered an alteration and shall follow the normal approval procedure for approval of a conversion.

2.3 Procedural requirements

2.3.1 General

In general, the installation of a CGS for a time limited period may be accepted by the attending surveyor. Drawing approval is only required when changes are made to existing, approved systems, for example the electrical installation connected to the main switchboard (MSB), or when new systems serving main functions are installed.

Because of the limited period of installation, the Society may accept some deviations from the rule requirements. However, statutory requirements such as SOLAS and MARPOL have no provisions for temporary installations. Therefore, the statutory requirements shall be complied with in full. Alternatively, the vessel may apply for an exemption from a statutory requirement to the vessel's flag state based on an equivalent measure.

2.3.2 Systematics

Installation of a CGS is always subject to a survey by the Society. Upon a satisfactory survey a condition of class (CC) or memorandum to owners (MO) will be issued according to the following:

- When a CGS is installed to temporarily replace one of the vessel's damaged auxiliary generator sets, a CC will be issued with a validity of up to three months. Depending on the reason for installation, a postponement of the CC may be possible, pending a satisfactory sighting survey of the installation carried out by the Society.
- When a CGS is installed to temporarily replace the vessel's damaged emergency generator, a CC will be issued with a validity estimated to be sufficient for the repair of the emergency generator to be completed, not exceeding three months.
 - Since CGS installations seldom fulfil the SOLAS requirements for an emergency source of power, a flag state exemption is normally required.
- When a CGS is installed to complement the vessel's own generator sets, e.g. to supply additional power to reefer containers, an MO will be issued stating the acceptance of the installation for a period of maximum one year. If during that one-year period the vessel is attended for the annual survey, the CGS shall be subject to inspection during that survey. After one year, the CGS shall be either removed or decommissioned.
- Any minor deficiencies at the time of installation may be accepted with a short term CC only, typically one month, for their rectification.

Independent of the reason for the installation of the CGS, any statutory requirement not complied with requires that the vessel applies for an exemption from the flag state. Depending on the flag state decision, this exemption may be granted in the form of a letter of exemption, short term or conditional certificate or a condition of authority (CA).

It is important to note that the installation of a CGS may lead to certain class notations being restricted based on an evaluation of the requirements regarding redundancy, automation, monitoring, e.g. **EO**, **AUT**, **DYNPOS**.

Acceptance of a CGS installed on board vessels required to comply with the requirements for safe return to port (**SRtP**) are normally subject to acceptance by the vessel's flag state.

2.4 Arrangement location

The CGS shall be securely fastened to the vessel's deck, taking into consideration the position of deck stringers and stiffeners, in an alongships direction in a non-hazardous, sheltered area and shall not limit access to life saving, firefighting or any other safety related equipment. The CGS shall not be located inside cargo holds or on car decks. Furthermore:

- for tankers, the CGS shall be located outside of cargo areas
- the CGS shall be located at least 2.4 m away from the nearest cargo or cargo area, as applicable, unless the CGS is a class A-60 insulated type
- the CGS shall be located at least 3 m away from any dangerous goods, unless the CGS is a class A-60 insulated type
- unless insulated to the A-60 standard the CGS shall not be located adjacent to or above accommodation spaces, service spaces or control stations, above Ro-ro or vehicle spaces or below any enclosed spaces
- the location of the CGS on board passenger vessels is subject to special consideration
- ventilation inlets and outlets should preferably be located not less than 4.5 m above the freeboard deck
- the CGS access openings shall be weather-tight to the best possible extent.

For smaller vessels such as high speed light crafts (HSLC), the CGS may have a considerable impact on the stability and therefore the location should be carefully evaluated.

2.5 Generator driver

The generator driver shall be a diesel engine of proven design and shall be suitable for the marine environment, preferably documented through a class society's product certificate, type approval or similar. Normally, only oil fuelled diesel engines are acceptable. Furthermore, the diesel engine shall:

- have sufficient power to drive the connected generator
- be SOLAS-compliant with respect to the insulation of hot surfaces, shielding of high-pressure fuel piping and fuel oil leakage alarm where jacketed fuel piping is installed.

When intended to function as replacement of the vessel's emergency generator, it shall be documented that the engine can operate at the angles required for emergency generators, see [Table 6](#) (or [DNV-RU-SHIP Pt.4 Ch.1 Sec.3 Table 3](#)). If this can not be documented, the engine shall be tested under load at the specified angles before being installed.

Guidance note:

Operation at the required angles may be demonstrated by hoisting the CGS on one side until the required angle is obtained.

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Table 6 Operating angles

Angle of inclination [degrees] ¹⁾	
Athwartships	Fore and aft

Angle of inclination [degrees] ¹⁾			
Static	Dynamic	Static	Dynamic
± 22.5 ²⁾	0 ± 22.5 ²⁾	± 10 ³⁾	0 ± 10 ³⁾
<p>¹⁾ Athwartships and fore and aft inclinations may occur simultaneously.</p> <p>²⁾ In ships for the carriage of liquefied gases and of chemicals, the emergency power supply shall also remain operable with the ship flooded to a final athwartships inclination up to a maximum of 30 degrees.</p> <p>³⁾ Where the length of the ship exceeds 100 m, the fore and aft static angle of inclination may be taken as 500/L degrees where L = rule length of the ship, in m, as defined in DNV-RU-SHIP Pt.3 Ch.1 Sec.4 [3.1.1].</p>			

Provided that the CGS' fuelling, cooling, or exhaust system are not an integral part of the ship, EIAPP certification is not required.

Guidance note:

A fuelling system is considered integral to the ship only if it is permanently affixed to the ship (see MARPOL Annex VI reg 2.12).

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2.6 Generator

The generator should be suitable for the marine environment, preferably documented through a class society's product certificate, type approval or similar. Normally the generator rating shall be less than or equal to the generator it replaces. However when the CGS functions as one of two independent power sources, as required by SOLAS, the generator shall have a rating which is sufficiently high for it to act as a single source of power during normal seagoing conditions.

When the CGS provides replacement power for the emergency generator, the generator rating shall at least be equal to the emergency generator load as per the approved electrical load balance, and be able to have the full emergency load applied in a single step.

Generators exceeding the original generator's rating may be accepted after formal approval of the following:

- updated single line diagram for the power distribution system with changes/modifications clearly indicated
- information regarding the cross section, cable size, setting of circuit breakers and overcurrent and short circuit protection shall be shown on the drawing
- updated load balance
- short circuit calculation
- selectivity analysis for all new installations, showing the selectivity between the generator breaker (if newly installed) and largest outgoing consumers
- making and/or breaking capacity of new and existing circuit breakers.

2.7 Electrical system

Except for cases where the CGS rating exceeds the damaged generator's rating, drawing approval is not required when the CGS is connected to the damaged generator's busbreaker. However, when a CGS is installed to provide additional power and is connected to the MSB, drawing approval according to [\[2.6\]](#) is required.

A CGS providing additional power feeding directly into a distribution board connected to the MSB is considered not connected to the MSB provided an interlock prevents the CGS from feeding into the MSB. Nevertheless, in such cases an updated short circuit calculation shall be submitted for approval.

Furthermore the following applies:

- additional distribution boards or switchboards installed with a rating > 100 kVA shall be certified by DNV, also when not connected to the MSB
- cables shall be type approved or case-by-case approved

- the cable between CGS and switchboard shall have short circuit protection at both ends
- power cables should be routed as per class requirements
- starting batteries for a CGS providing replacement power should be charged from the vessel's main supply or emergency supply, alternatively an inspection routine shall be established
- for a CGS providing replacement emergency power, two independent sources of starting energy shall be provided
- emergency stops for pumps and fans located inside the CGS shall be provided with an activation point outside the CGS.

2.8 Fire safety

A fire detection system with an alarm audible and visible at a continuously manned station shall be installed.

An approved fixed fire extinguishing system shall be installed, operable from outside the container (SOLAS Ch.II-2/10.5.2). Alternatively, a non-approved fixed firefighting system documented to be relevant for the application may be installed, provided an exemption has been obtained from the vessel's flag state.

Aerosol based fixed fire fighting systems shall be approved in accordance with the applicable IMO MSC Circ. 1270.

Furthermore:

- firefighting shall be feasible from outside the container
- the CGS shall be provided with two means of escape, unless considered unreasonable for smaller CGS
- at least one portable fire extinguisher shall be arranged near each entrance to the container
- ventilation of the CGS shall be possible to close or shut off from outside the container.

The vessel's fire and safety plan shall be updated to reflect the new arrangement. This may be done in the form of an annex to the approved fire and safety plan.

2.9 Piping

When fuel is supplied from the vessel's tanks, the piping between tank and CGS and within the CGS should consist of fixed piping. Connections between the vessel's piping and piping systems inside the CGS may be arranged with short flexible hoses. When a tank container is installed in the vicinity of the CGS for the purpose of serving the CGS, a flexible hose connection may be accepted, provided that the hose is properly fixed, closed on the tank side when the CGS is not in use, and adequately protected against mechanical damage.

Materials, hoses and pipe connections shall be in compliance with the Society's rules, this means that flexible hoses including couplings shall be type approved for their intended use.

Quick acting shut off valves are required, and the controls shall be located in an accessible location, at a safe distance from the CGS, at the following locations:

- in the way of connections below the top of fuel tanks containing more than 500 litres when these are open during normal operation
- in fuel supply lines led through the engine room boundary when these are open in normal operation.

Guidance note:

A ball valve where the closing action consists of a quarter turn (90°), operated from a safe location through e.g. a suitably routed steel wire may be accepted, provided that its effectiveness is demonstrated.

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Where the CGS provides replacement power, a fuel filter shall be installed before the engine, and the CGS service tank shall be provided with a low-level alarm. The alarm shall provide ample warning for the service tank to be refilled before the CGS shuts down due to lack of fuel. Where no level alarm is provided, a routine shall be established to check the fuel level when the CGS is in operation.

Where the CGS provides replacement emergency power, the fuel tank shall hold fuel for at least 18 hours of operation at full load.

Air and sounding pipes to fuel tanks shall be led to open air.

2.10 Safety, control and monitoring

Where the CGS provides replacement power, the alarms shall be connected to the main alarm system as individual or common alarms. For vessels with class notation **EO** or **AUT**, an alarm condition from the CGS shall initiate an alarm on the bridge. An active alarm signal shall not prevent indication of any new alarms. This also applies for group alarms that have been acknowledged.

In addition to the above, when connected as a common alarm, a sub-system showing the detailed alarms shall be installed locally.

Where the CGS provides additional power, the alarm shall be audible at a location which is continuously manned during operation of the CGS.

Alarms and safety actions for the generator driver shall be as per [Table 7](#). For a CGS providing replacement emergency power, no additional protective functions shall result in a shutdown.

Table 7 Safety, control and monitoring

	<i>Replacement auxiliary power</i>	<i>Replacement emergency power</i>	<i>Additional power</i>
Overspeed	SH	SH	SH
Crankcase explosive condition, engines ≥ 2250 kW or bore ≥ 300 mm	SH	SH	SH
Lubrication oil pressure	LA, SH	LA, SH	LA, SH
Lubrication oil temperature	HA	HA	
Cooling water temperature	HA, SH	HA	SH
Cooling water pressure	LA	LA	
Fuel oil pressure	LA	LA	
High pressure fuel oil leakage	A	A	A
Exhaust gas high temperature	HA	HA	
Turbocharger speed (>1000 kW)	HA	HA	
Starting energy source	LA	LA	
A = alarm activated for logical value LA = alarm for lowvalue HA = alarm for high value SH = automatic shut down with corresponding alarm.			

2.11 Pollution prevention

In locations where oils spill can be expected to occur, a drip tray or coaming of appropriate size shall be provided.

If the CGS's service tank is not provided with a high-level alarm, audible at the control position of the fuel transfer pump, a written procedure for fuel transfer shall be available.

2.12 Final on-board testing

After installation, the following items shall be tested:

- 1) Load test of the engine and generator:
 - a CGS providing replacement power and considered one of two independent power sources shall be tested at normal seagoing load
 - a CGS providing replacement power for the emergency generator shall be tested to the emergency generator load as per the approved electrical load balance
 - a CGS providing additional power or replacement power but not being one of two independent sources of power shall be tested to at least 60% load.
- 2) Generator and switchboard testing:
 - dynamic tests such as voltage regulation, speed governing and load sharing shall be carried out to verify that voltage and speed regulation under normal and transient conditions is within the limits given in the [DNV-RU-SHIP Pt.4 Ch.8 Sec.5 \[2\]](#)
 - if parallel-running facilities are provided, parallel running shall be demonstrated.
- 3) Generator and switchboard protection systems shall be tested as follows:
 - testing of overload protection
 - reverse power protection
 - overcurrent and short circuit protection
 - other protection such as earth fault, differential, undervoltage, overvoltage (if applicable).
- 4) Safety, control and monitoring system including, as a minimum, the connection to the vessel's alarm system and the engine's safety functions, shall be tested.
- 5) Verify function of quick acting shut-off valves.
- 6) Verification and testing of fire detecting system.
- 7) Verification that detailed instructions for operation of the CGS, including safety and fire extinguishing system, are posted locally and on the main switchboard panel and that the crew is familiar with these instructions.

Guidance note:

When it may be reasonably assumed that the time passed between the workshop testing and the onboard installation, and the onboard installation itself do not affect the functionality tested, the workshop testing may be accepted in lieu of onboard testing, provided that the workshop test has been witnessed by the Society.

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APPENDIX A SUMMARY OF REQUIREMENTS

1 Summary

Table 1 provides a summary of the requirements in Sec.1 [2], in case of discrepancy the requirements in Sec.1 [2] take precedent.

Table 1 Summary of the requirements

<i>Checklist item</i>	<i>Remarks</i>	<i>Replacement auxiliary power</i>	<i>Replacement emergency power</i>	<i>Additional power</i>
<i>Location</i>				
Alongships in a non-hazardous, sheltered area, not being a cargo hold or car deck, not limiting access to life saving, fire fighting or safety related equipment		X	X	X
Securely fastened to the vessel's deck		X	X	X
Outside of cargo areas	Tankers only	X	X	X
Located at least 2.4 m away from any cargo or cargo area, as applicable, unless the CGS is a class A-60 insulated type		X	X	X
Located at least 3 m away from any dangerous goods, unless the CGS is a class A-60 insulated type	Vessel approved for the carriage of dangerous goods	X	X	X
Not located adjacent to or above accommodation spaces, service spaces or control stations, above Ro-ro or vehicle spaces or below any enclosed spaces		X	X	X
Ventilation inlets and outlets preferably located > 4.5 m above the freeboard deck		X	X	X
Access openings are weather-tight		X	X	X
<i>Generator driver</i>				
Diesel engine of proven design suitable for the marine environment		X	X	X
Suitable to drive generator		X	X	X
SOLAS-compliant		X	X	X
EIAPP certification	only if fuelling, cooling or exhaust system are an integral part of the ship	X	-	X
Capable of operating at the required angles		-	X	-
<i>Generator</i>				
Proven design suitable for the marine environment		X	X	X

<i>Checklist item</i>	<i>Remarks</i>	<i>Replacement auxiliary power</i>	<i>Replacement emergency power</i>	<i>Additional power</i>
Rating sufficiently high	If 1 of 2 independent power sources or emergency generator	X	X	-
Rating less than or equal to original rating		X	X	-
Approval of single line diagram, short circuit calculation etc.	If CGS rating > original rating	X	X	-
<i>Electrical system</i>				
Approval of modifications	When possible to feed into MSB	-	-	X
Additional distribution or switch boards > 100 kVA certified by DNV		X	X	X
Cables type approved or case-by-case approved		X	X	X
Generator cable short circuit protected at both ends		X	X	X
Power cables routed as per class requirements		X	X	X
Battery chargers from the vessel's main or emergency power supply or inspection routine established		X	X	-
Two independent sources of power for the starting system		-	X	-
Activation point for emergency stops of pumps and fans provided outside the CGS		X	X	X
<i>Fire safety</i>				
Fire detection system with an alarm audible and visible at a continuously manned station		X	X	X
An approved fixed fire extinguishing system or non-approved fixed firefighting systems, documented to be relevant for the application	Flag state exemption required for non-approved system	X	X	X
Firefighting feasible from outside the container		X	X	X
Two means of escape unless unreasonable for a smaller CGS		X	X	X
At least one portable fire extinguisher near each entrance to the container		X	X	X
Ventilation able to be closed or shut off from outside the container		X	X	X
Fire and safety plan updated		X	X	X
<i>Pollution prevention</i>				

<i>Checklist item</i>	<i>Remarks</i>	<i>Replacement auxiliary power</i>	<i>Replacement emergency power</i>	<i>Additional power</i>
Drip trays or coaming		X	X	X
Service tank high-level alarm or written procedure for fuel transfer		X	X	X
<i>Piping</i>				
Fixed piping and/or short flexible hoses, including couplings, type approved for their intended use	Fuel supplied from vessel's tank	X	X	X
Adequate fixation and protection for fuel supply hose	Fuel supplied from tank container	X	X	X
Materials, hoses and pipe connections in compliance with DNV rules for classification		X	X	X
Quick-acting shut-off valves in way of connections below the top of fuel tanks when normally open		X	X	X
Quick-acting shut-off valves in fuel supply lines led through the engine room	Tanks > 500 litres	X	X	X
Controls of quick-acting shut-off valves accessible position from a safe location	When normally open	X	X	X
Fuel filtering		X	X	-
Air and sounding pipes for fuel tanks to open air		X	X	X
Low level alarm for the CGS service tank	Alternatively a routine to be established	X	X	-
Fuel available for minimum 18 hours full load		-	X	-
<i>Control and monitoring</i>				
Alarms connected to main alarm system		X	X	-
Detailed alarms available locally	E0/AUT when connected as common alarm	X	X	-
CGS alarm available on bridge	E0/AUT	X	X	-
Alarm audible at continuously manned location		-	-	X
Alarms as per Sec.1 Table 7		X	X	X
<i>Stability</i>				
Evaluate impact on stability	Normally only relevant for HSLC	X	X	X

CHANGES – HISTORIC

There are currently no historical changes for this document.

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