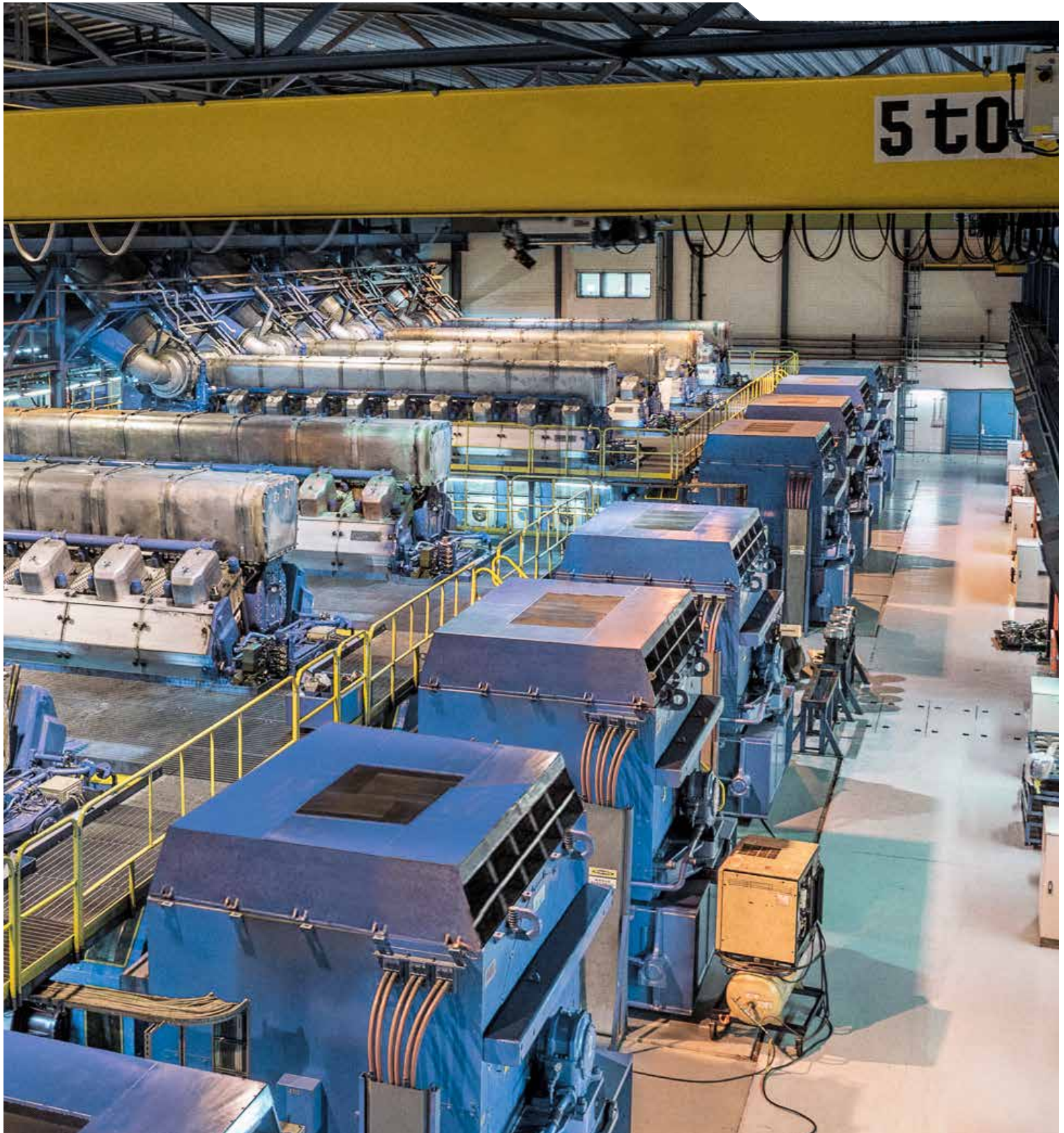


# SOLUTIONS FOR GENERATOR SETS







# Whether big or small – we serve them all.

**VULKAN couplings are** found not only in main and auxiliary ship drives, PTOs, PTIs and boat drives, but also in stationary power plants used for permanent, temporary or emergency power supply. Generator couplings from VULKAN have always been the first choice for highly flexible couplings of diesel motors with generators.

Capacity utilisation in terms of performance and duty cycle is usually high in stationary diesel power plants and CHP's, so the couplings also need to be extremely reliable and offer a long service life. Container and emergency generators and mobile sites, however, are operated on a temporary basis. They are used when the public grid fails or where failure



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**MINING**



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**BUILDINGS/  
FACILITIES**



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**DATA  
CENTER**



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**PORT  
CARGO  
HANDLING**



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**OIL REFINERY**



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**CARGO  
VESSEL**

Container  
Tanker  
Bulk carrier  
RoRo

of the grid would have grave consequences, for example in hospitals, chemical plants, server rooms and, last but not least, in nuclear power stations where the generators would ensure decay heat is removed in the event of disconnection or failure of the power grid.



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**STATIONARY  
POWER  
PLANT**



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**FLOATING  
POWER  
PLANT**



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**PASSENGER  
VESSEL**

Passenger ship  
Coastal ferry  
RoPax



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**FPSO/FSRU**

Floating, production,  
storage, offloading  
Floating production  
regasification unit



---

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**OFFSHORE  
SUPPORT  
VESSEL**

Platform supply vessel  
Anchor handling tug supply  
Wind farm service vessel



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**DRILLING  
VESSEL**

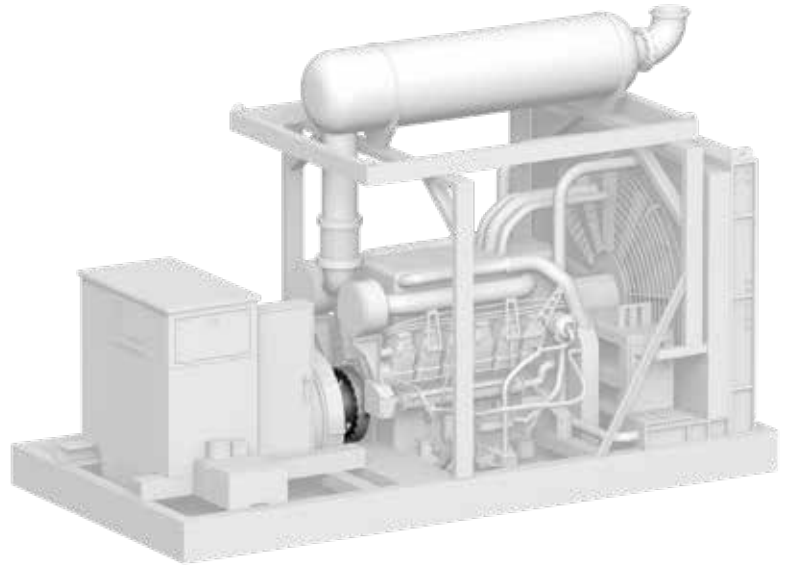
Jack-up rig  
Semi-submersible platform  
Drilling ship





20 -  
300  
kWe

20 – 300 kWe



## PORT CARGO HANDLING

The increasing difference in sizes of ports reflects changes in ship operations and the effort to fully realize economies of scale to reduce transportation costs. The port turnaround time represents competitiveness between maritime ports. Nowadays onshore power supply for vessels at berth results in a significantly lower emission levels of sulfur dioxide and nitric oxide.

## OIL REFINERY

Petroleum demand for emerging economies is increasing rapidly due to an increasing consumer demand for petroleum products. VULKAN meets the requirements of tough petroleum industry standards, such as Appareils destinés à être utilisés en **AT**mosphères **EX**plosibles (ATEX) directive, **A**merican **P**etroleum **I**nstitute (API), **GO**sudarstvennyj **ST**andard (GOST) and others.

## BUILDINGS/FACILITIES

Critical infrastructure systems rely on a power back-up and protection system to ensure that maximum uptime is achieved and blackouts are minimised. The power outages due to a natural disaster, a man-made disaster, or a blackout, should not and cannot be ignored. VULKAN products are installed in many “mission critical” backup generator installations to protect commercial facilities like factories, hospitals, data centers and pumping centers – to name just a few – from losing electrical power.

### VULASTIK L



**0.52 kNm –  
52.00 kNm**  
Torque range



### VD SERIES



**2.30 kN –  
24.00 kN**  
Load range



### VDM SERIES



**0.40 kN –  
7.90 kN**  
Load range





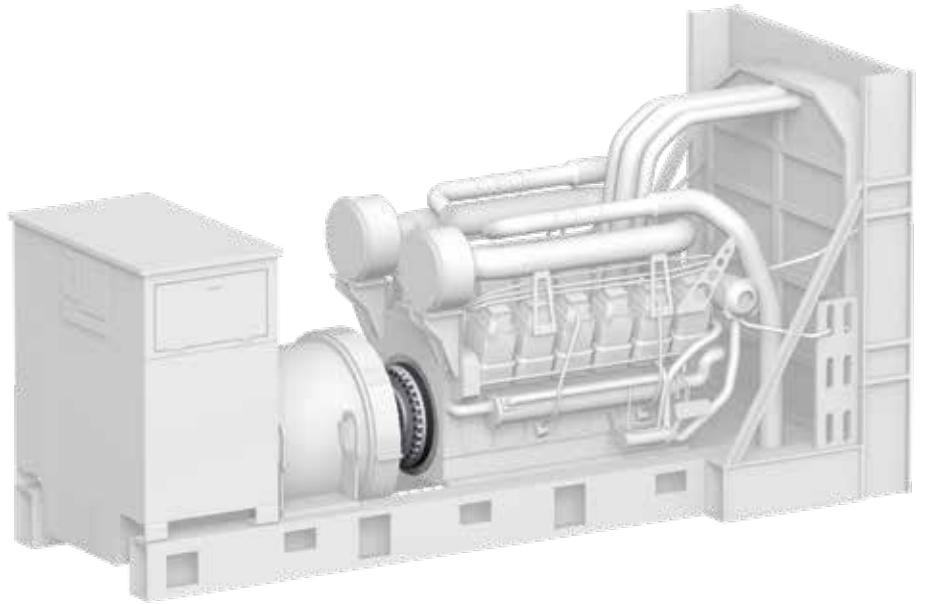


3000 –  
30000  
kWe





300 – 3.000 kWe



## OFFSHORE SUPPORT VESSEL

Under the term offshore support vessels diverse types of vessel can be found, starting with seismic survey ships, Platform Supply Vessels (PSV), Anchor Handling Tug Supply vessels (AHTS), Remotely Operated Vehicle (ROV) support vessels, dive support vessels and a variety of combinations of these. These vessels, especially with diesel-electric propulsion systems demand the highest level of total reliability with continuous operation.

## PASSENGER VESSEL

Passenger vessels are characterised in particular by comfort-based conventional diesel-mechanic or diesel-electric propulsion concepts. The onboard generator set does not only need to cover system redundancy but also needs to be quiet and smooth running. VULKAN elastic engine mounts combined with VULKAN couplings can effectively prevent vibration and noise transmission and meet the increasing demands on the acoustic environment by adding the high degree of onboard comfort demanded by the passengers.

## MINING

Many million tons of material needs to be moved to recover raw materials. Giant machines such as cleaning machines, bucketwheel excavators, agitators, mining trucks and others are working 24 hours of continuous operation, 365 days a year. VULKAN offers proven products which work under extreme temperature and weather conditions, with the possibility of severe contamination and high levels of vibration in conjunction with severe shocks.

### VULASTIK L



**0.52 kNm –  
52.00 kNm**  
Torque range



### VULKARDAN F



**5.20 kNm –  
16.25 kNm**  
Torque range



### VULKARDAN G



**10.40 kNm –  
81.90 kNm**  
Torque range



### T SERIES



**4.00 kN –  
128.00 kN**  
Load range



### VDM SERIES



**0.40 kN –  
7.90 kN**  
Load range





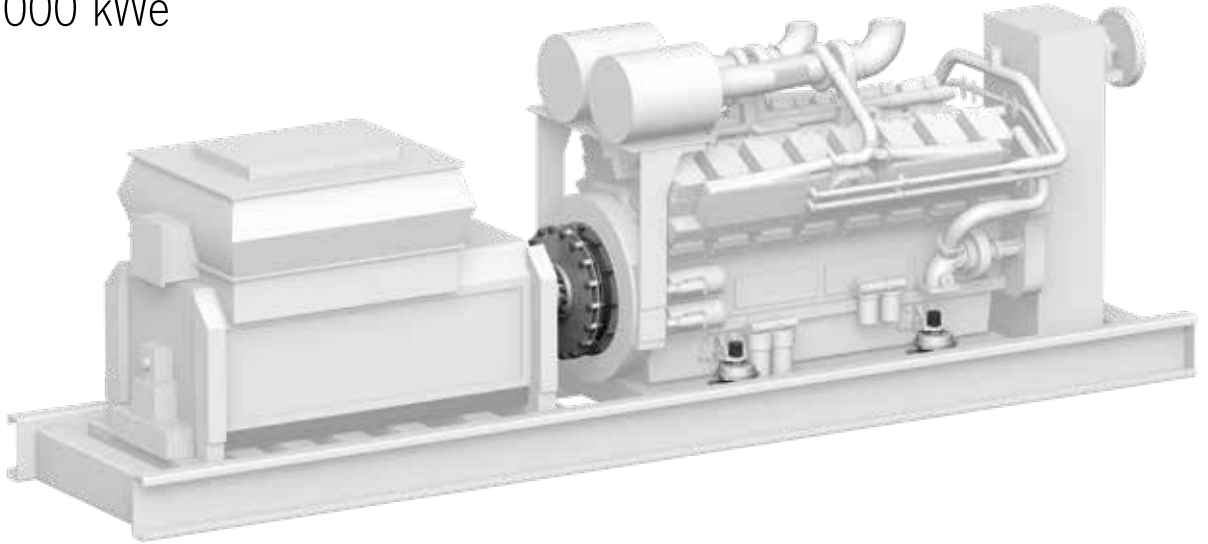
3.000 -

6.000

kW<sub>e</sub>



3.000 – 6.000 kWe



## DATA CENTER

Digitalisation to improve business processes is a current major global trend. A data center is a centralised repository, which may be physical or virtual, that houses computer systems for management, storage, and dissemination of information and data organised around a business entity. These massive facilities consume an unthinkable amount of energy to power such extensive servers. VULKAN products in the generator set package play an important role to guarantee continuous power supply.

## CARGO VESSEL

Mega-intercontinental cargo vessels such as container vessels, bulk carrier and oil tankers are currently a major trend. This main driving force behind this trend is a demand for decreased maritime transportation costs and increasing competitiveness. Highly flexible couplings not only find application in main drives but also in auxiliary drive configuration for generating power on cargo vessels.

## DRILLING VESSEL

To meet the power supply demands and harsh conditions in the offshore drilling environment, drilling generators with EPA Marine Tier 2 and IMO Tier II emission standards are favoured. VULKAN offers a wide variety of robust solutions to meet these tough conditions and to ensure that they do not experience power outages.

### RATO R+



**26.50 kNm – 530.00 kNm**  
Torque range



### VULASTIK L



**0.52 kNm – 52.00 kNm**  
Torque range



### VULKARDAN F



**5.20 kNm – 16.25 kNm**  
Torque range



### VULKARDAN G



**10.40 kNm – 81.90 kNm**  
Torque range



### T SERIES



**4.00 kN – 128.00 kN**  
Load range



### HD SERIES



**13.00 kN – 57.00 kN**  
Load range



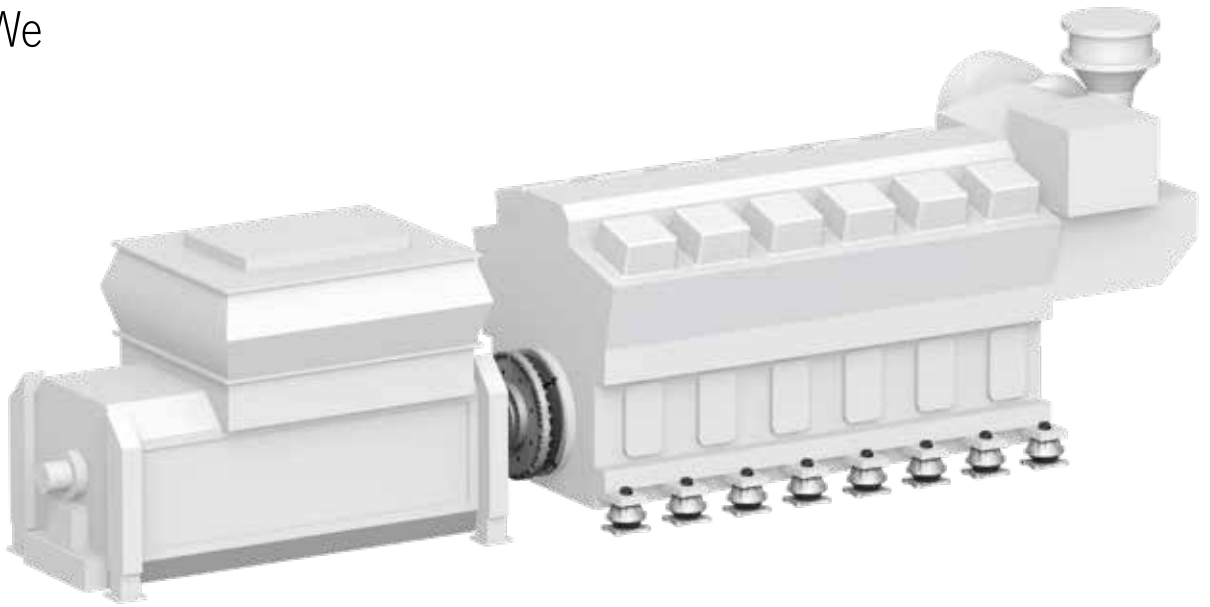




6.0000 +  
kWe



6.000+ kWe



## FLOATING POWER PLANT

The idea of floating power plants is an ideal solution for power production on an interim basis. These floating power plants can be relocated and connected to the grid to support local power shortages where and when needed. VULKAN provides customised solutions for the generator set packages onboard with consideration for the varying requirements demanded by this application.

## STATIONARY POWER PLANT

The design set-up of stationary power plants is commonly based on ISO 8528-1 standard with different modes of operation with continuous and limited time operation at constant and varying loads. As demands for operation hours differ by application, VULKAN differentiates between the common load profiles to find the optimised solution for any kind of load profile.

## FPSO/FSRU

VULKAN products can be found not only on Floating, Production, Storage, Offloading (FPSO) which moored as deep as the depth of 2,300 meters in US Gulf of Mexico; One can also find VULKAN presences in one of the world's largest FPSO as far as 320 km offshore in the Atlantic Ocean from Angola. VULKAN guarantees the power supply reliability in generator set packages whether for critical processes, such as the oil production system, or less critical processes such as the heating processes.

### RATO S+



**180.00 kNm – 360.00 kNm**  
Torque range



### RATO R+



**26.50 kNm – 530.00 kNm**  
Torque range



### RATO R+



**190.00 kNm – 530.00 kNm**  
Torque range



### T SERIES



**4.00 kN – 128.00 kN**  
Load range





# Safety in system operation with certified quality.

We see ourselves as part of our customers' quality chain and embrace our part of the responsibility for their success. Here we can set and achieve high goals. The quality of our products and services reflects the strength and tradition of the VULKAN Group: We tap into our experience as market leaders in the area of highly sophisticated marine propulsion technology, where highest quality standards in certification and acceptance processes

are ensured by international classification societies, and use it for projects in industrial fields of application. A steadily developed value-based quality management system reaches deep into the corporate structures of VULKAN and is integrated into all processes. Our understanding of quality management therefore goes far beyond the expected certification according to DIN/ISO 9001.



## EC 2006/42/EC

Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery and amending Directive 95/16/EC (in short: Machinery Directive) regulates a uniform level of protection for the prevention of accidents involving machinery and incomplete machinery when it is placed on the market within the European Economic Area (EEA) as well as Switzerland and Turkey.



## ATEX 94/9/EC

Explosion protection is a branch of technology that deals with the protection against the occurrence of explosions and their effects. It belongs to the field of safety technology and serves to prevent damage to persons and property caused by technical products, systems and other equipment. Explosion protection is achieved by technical solutions such as types of protection and zone classification and is described in standards (e.g. IEC or EN). The basis for this are legal regulations, such as the ATEX directives of the European Union or the National Electrical Code (NEC) in the USA.



## IAEA 50-C-QA

The International Atomic Energy Agency (IAEA) Code and Safety Guides contained in the Safety Series No. 50-C/SG-Q define basic quality assurance requirements, which must be considered to ensure safety, and provides recommendations on how to fulfil these basic requirements. The IAEA 50-C/SG-Q standard reflects the performance based approach to quality assurance covering all aspects of plant safety, economics and efficiency. The IAEA requirements and recommendations are generally used at the nuclear utility-regulator interface.



## CE 2014/34/EU

Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the member states concerning equipment and protective systems intended for use in potentially explosive atmospheres.



## IEEE 387

IEEE standard criteria for diesel-generator units applied as standby power supplies for nuclear power generating stations. This standard provides the principal design criteria, the design features, testing, and qualification requirements for the individual diesel-generator units that enable them to meet their functional requirements as a part of the standby power supply under the conditions produced by the design basis events catalogued in the plant safety analysis.



## KTA 1401 KTA 3702

The Nuclear Safety Standards Commission (KTA) has the task of ensuring that safety rules are drawn up and promoting their application in areas of nuclear technology in which a uniform opinion of experts from the manufacturers, constructors and operators of nuclear facilities, the experts and the authorities is emerging on the basis of experience.





## API 610 API 671

API 610 is a set of standards written and regulated by the American Petroleum Institute to ensure that reliability and safety standards are upheld in what can be a dangerous industry. While the coupling meets the API 610 requirements additional steps such as component serialisation, precision balance, record retention of 20+ years and an assembly print containing application information are just some of the additional requirements needed to meet the API 671 specification. This is to ensure that a high quality coupling was provided for a critical application and that spare components can be produced decades into the future.



## IACS

The International Association of Classification Societies (IACS) is a technically based non-governmental organization that currently consists of twelve member marine classification societies. Marine classification is a system for promoting the safety of life, property and the environment primarily through the establishment and verification of compliance with technical and engineering standards for the design, construction and life-cycle maintenance of ships, offshore units and other marine-related facilities. These standards are contained in rules established by each society.



# Understanding ISO 8528-1 generator set rating.

**Generator set ratings** guidelines are designed to size the generator set to meet the load requirements of an application. The four types of generator set ratings are standby, prime power, limited running time, and base load (continuous power). Consider building expansion and future load additions when determining generator set loads. The average power required of a generator set is a calculated value, as shown in the following paragraphs. The life expectancy – mean time between overhauls (MTBO) – and performance

of generator sets are contingent upon application of these guidelines. Generator set life depends upon engine load factors, fuel and lube oil quality, ambient conditions, operating load, installation quality, and the maintenance program. The charts at the bottom show typical engine MTBO curves. Generator set performance and overhaul intervals vary with operating load. As engine operating load decreases, the time between overhauls increases.

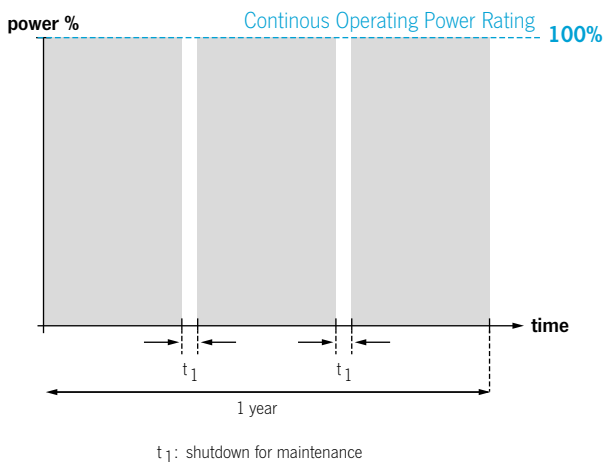
## Continuous Operating Power (COP)



Heat and power facilities in Oregon

### Rating definition: constant load, unlimited running hours

This rating is appropriate for a generator set paralleled with an infinite bus e.g. a national electrical supply network or grid where the generator set is run at 100% load, 24 hours a day, 365 days a year and any surplus power is exported into the grid.



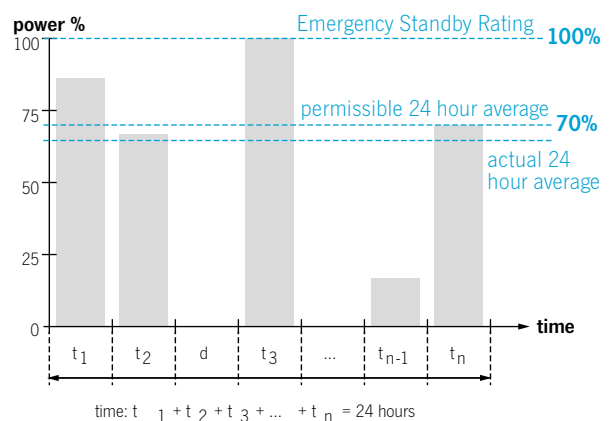
## Emergency Standby Power (ESP)



Emergency generator sets in nuclear power plants

### Rating definition: variable load, limited to 200 hours per year

This rating is appropriate for a generator set used in standby power applications where the normally available electrical supply network or grid fails and where it has been determined that the load will be varying and the running hours will be less than 200 hours a year.



To a point, reducing the load on an engine increases the time between overhauls. Follow the ratings guidelines to maximise MTBO for generator set engines.

The ratings shown in this technical information bulletin are common throughout the industry. Government agencies, military agencies, and other sources may publish their own definitions and ratings guidelines.

Before applying other ratings to generator sets, contact a factory representative for approval. Generator set ratings are similar between generator set manufacturers due to the industry standards as listed in each ratings sections of this bulletin. However, due to differences in manufacturing standards, each engine manufacturer may have different engine tolerances which affect engine ratings and, in turn, generator set ratings. Refer to this section for rating standards and rating tolerances.

## Prime Rated Power (PRP)



Modular power plants in the desert

## Limited-Time Power (LTP)



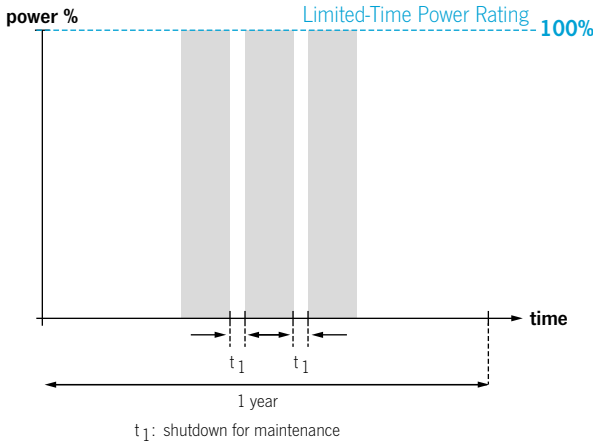
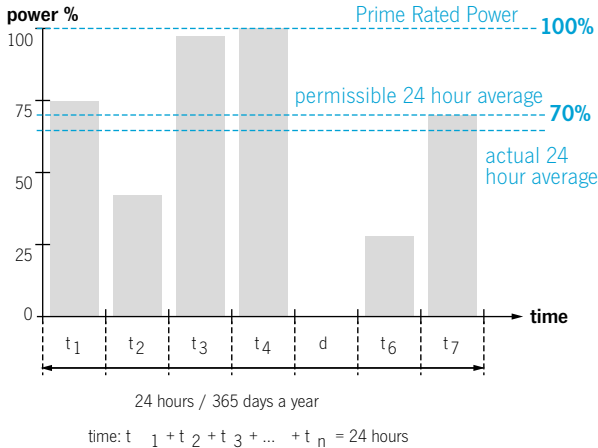
Power generators for use in drought in South Africa

### Rating definition: variable load, unlimited running hours

This rating is appropriate for a generator set used to supply power 24 hours a day, 365 days a year where there is no supply network or grid available.

### Rating definition: constant load, limited to 500 hours per year

This rating is appropriate for a generator set used in classic standby power application where the generator set is used when the normally available electrical supply network or grid fails. 500 hours is considered the maximum length of time the generator set will be required to run in any one year.





# Know-how for special applications.

In addition to a comprehensive product portfolio for standard generator sets, VULKAN is able to offer tailor-made solutions for a wide range of demanding industrial and special applications. We strive to ensure proximity to our customers by understanding their specific requirements, product life cycles and market trends to provide an integrated solution.

Our goal is to offer the user benefits from technical solution development, system component suppliers and after-sales service. This enables us to offer you the optimum technical solution and a high level of customer benefit throughout the entire life cycle of your process system.



## Mining Truck

### Requirements

- Robust coupling that meets the basic technical requirements with different engine load profiles. Reliable product that can be used in harsh environments such as dust, temperature fluctuations and terrain.
- Highest performance, reliability and availability as well as a maintenance-friendly product.

### Solutions

- Extensive cooperation with engine OEM for optimum selection of the VULKAN coupling.
- Well-proven coupling solution that meets the high requirements of this special application.

### Benefits

- Maintenance free product: extensive product and customer support with VULKAN service network.
- Comprehensive support with professional engineering teams.

## Oil Refinery

### Requirements

- Petrochemical refineries are hazardous areas consisting of any concentration of flammable gases, vapours, mists or combustible dusts. Ignition can lead to an explosion and cause serious damage to people and the environment.
- ATEX EU directives require that all equipment with a potential ignition source (electrical and non-electrical) meet the requirements of 94/9/EC.

### Solutions

- VULKAN offers the optimal drive solution for the oil and gas industry. VULKAN offers in particular a comprehensive product range for use in generators, which includes flexible, highly flexible and torsionally rigid couplings which comply to ATEX, API, etc.

### Benefits

- VULKAN product complies with the declaration of conformity according to the EC Directive 94/9/EC for equipment and protective systems intended for use in potentially explosive atmospheres (ATEX) in Annex X, B.
- VULKAN product complies with the declaration of conformity according to API 671.



## Diesel Power Plant

### Requirements

- ⌚ A power plant, regardless of being land-based or floating, has 3 main concerns: reliability, availability and ease of maintenance.
- ⌚ The coupling in this critical application must be reliable so that the system can be engaged even under harsh conditions to maximise uptime.
- ⌚ The generator downtime must be minimised through ease of maintenance, redundancy and readily available spare parts.

### Solutions

- ⌚ With good references from power plant operators from all over the world the highly flexible RATO coupling has an excellent track record of success.
- ⌚ The average operating hours of VULKAN couplings are far above the expectations, in many cases reaching 70.000 operating hours without a failure.

### Benefits

- ⌚ VULKAN has extensive experience in these applications and offers highly engineered couplings that can withstand the demanding loads.
- ⌚ Close cooperation and communication between the VULKAN service network and the plant operators ensures fast reaction when necessary to reduce downtime to as little as a single day.

## Mega Yacht

### Requirements

- ⌚ Noise and vibration damping on mega yachts continues to be the main concern of owners and operators.
- ⌚ One of the sources of noise and vibrations are the generator sets on board, which cause great discomfort and annoyance for crew and passengers.

### Solutions

- ⌚ A double elastic suspension is the solution: engine and alternator are mounted with vibration dampers on a common frame, which is then mounted elastically between the common frame and the hull. This configuration considerably reduces the noise and vibrations of the generator.

### Benefits

- ⌚ With the VULKAN product range we have various possibilities to reduce noise and vibration within the propulsion system and from the generator set to the ship structure. The prediction, control and reduction of excitation levels on the foundations is the technical goal of our activities so as to achieve a high level of comfort onboard.
- ⌚ VULKAN offers the best tuning options to reduce the vibrations transmitted from the generator set to the hull and thus offer comfort on board the ship.



## Navy Application

### Requirements

- ⌚ The requirement is that the power generation unit must still function under certain shock loads.
- ⌚ Generators are very important for Navy assignments whether as main power source, standby power or as emergency power. The requirement for a naval generator set installation are ruggedness and reliability.
- ⌚ The tasks of the generator are not only supplying power onboard in normal operation: under unexpected certain shock loads, the power generation unit will still need to be intact and functional.

### Solutions

- ⌚ Different double elastic suspensions are used here. High deflection mounts are installed between the unit and base frame for vibration damping and between frame and hull for reduction of shock loads.
- ⌚ Depends on the configuration of generator sets onboard, various calculations such as Torsional Vibration Calculation or the 6/12 degree of freedom calculation have to be carried to ensure the optimum combination of couplings and mounts.

### Benefits

- ⌚ This special configuration requires VULKAN's state-of-the-art experience and technology solution to meet Navy standards. Many years of extensive cooperation with the US Navy as well as Canadian, Australian, Spanish, Swedish and other Navies.

## Generator Set with Resilient Mounted Engine

### Requirements

- ⌚ A solution is needed for generator applications where the engine is elastically mounted and the generator is rigidly mounted to achieve better vibration performance. Depending on the system configuration, a solution is required to isolate the dominant ignition frequency of the engine and to meet the high demands for noise and vibration insulation.

### Solutions

- ⌚ Due to the internal movements of the resilient mounted devices, a high degree of misalignment capacity is required for the coupling. To meet this requirement, a relatively soft single or double-row coupling such as the RATO R+ or VUKARDAN F is generally suitable.
- ⌚ For other systems a torsionally stiff coupling such as VULKARDAN G is combined with a floating shaft to avoid interaction with the motor controller. This ensures a high degree of flexibility in radial, axial and angular direction for misalignment.

### Benefits

- ⌚ VULKAN as an expert in system engineered supplier can offer a system solution from a single source. VULKAN ensures that the combination of VULKAN products reduces the vibration level and dynamic forces of the motor with optimum service life.



# Basic coupling selection criteria.



## Medium Speed Engine

Coupling selection for medium speed engine – alternator generator set – have to take into different conditions such as running hours, load profile, type of application, etc.

Depending on the fore mentioned requirements VULKAN will be able to determine the optimum size and dynamic torsional stiffness for the application. Please contact your local VULKAN office for better insight into our product selection.



## High Speed Engine

Following the methodology of engine manufacturers, VULKAN is diversifying the technical product data of the couplings depending on the typical loads, i.e. rating and profiles of the different applications:

### Light Service

- ⊕ Intermittent operation with large variations in engine speed and/or power
- ⊕ With up to 1.500 operating hours per year
- ⊕ Average load factor is 55 – 65% of TKN
- ⊕ Power Generation in Standby Duty – standby with variable load

### Medium Service

- ⊕ Intermittent operation with some variations in engine speed and/or power
- ⊕ With up to 4.000 operating hours per year
- ⊕ Average load factor is 60 – 80% of TKN
- ⊕ Power Generation in Prime Duty – with variable load

### Continuous Service

- ⊕ Continuous operation with little or no variations in engine speed and power
- ⊕ Unlimited operating hours per year; with up to 100% of rated torque (TKN) up to 100% operating time, average load factor is 70 – 100% of TKN
- ⊕ Power Generation in Continuous Duty – with constant load, very little load variation

kWe

## COUPLINGS

20 – 300

### VULASTIK L



**0.52 kNm –  
52.00 kNm**  
Torque range

300 – 3.000

### VULASTIK L



**0.52 kNm –  
52.00 kNm**  
Torque range

### VULKARDAN F



**5.20 kNm –  
16.25 kNm**  
Torque range

### VULKARDAN G



**10.40 kNm –  
81.90 kNm**  
Torque range

3.000 – 6.000

### RATO R+



**26.50 kNm –  
530.00 kNm**  
Torque range

### VULASTIK L



**0.52 kNm –  
52.00 kNm**  
Torque range

### VULKARDAN F



**5.20 kNm –  
16.25 kNm**  
Torque range

### VULKARDAN G



**10.40 kNm –  
81.90 kNm**  
Torque range

6.000 +

### RATO S+



**180.00 kNm –  
360.00 kNm**  
Torque range

### RATO R+



**26.50 kNm –  
530.00 kNm**  
Torque range

### RATO R+



**190.00 kNm –  
220.00 kNm**  
Torque range

## MOUNTS

### VD SERIES



**2.30 kN –  
24.00 kN**  
Load range

### VDM SERIES



**0.40 kN –  
7.90 kN**  
Load range

### T SERIES



**4.00 kN –  
128.00 kN**  
Load range

### VDM SERIES



**0.40 kN –  
7.90 kN**  
Load range

### T SERIES



**4.00 kN –  
128.00 kN**  
Load range

### HD SERIES



**13.00 kN –  
57.00 kN**  
Load range

### T SERIES



**4.00 kN –  
128.00 kN**  
Load range

## VULKAN SERVICES

### Inspection and Maintenance



#### Prevention pays off.

Regular inspections assure the long-term performance of our products and thus prevents unscheduled and costly maintenance procedures. The results of the inspection are analysed by our experts and provide you with the necessary recommendations for planned downtime, maintenance and spare parts.

### Spare Parts



#### Fast, correct and guaranteed.

Through long-standing cooperation with our global logistics partners we assure fast, worldwide delivery of high-quality, VULKAN original spare parts. The extensive stock of spare parts in our central warehouse in Herne, as well as the parts in inventory at one of our many worldwide locations minimise downtime. With the use of this extensive and established network one thing can be assured: You get the right parts to the right place as quickly as possible... anywhere in the world.



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