EMERGENCY DIESEL GENERATOR SETS
FOR NUCLEAR POWER PLANTS
MTU Onsite Energy is one of the core brands of Rolls-Royce Power Systems AG, which is a world-leading provider of high- and medium-speed diesel and gas engines, complete drive systems, distributed energy systems and fuel injection systems for the most demanding requirements.

MTU Onsite Energy offers complete power system solutions: from mission-critical to standby power to continuous power, heating and cooling. We also provide a full line of service products to help you get the most from your equipment.

More than 60 years of power generation systems expertise and over a century of diesel engine engineering experience have enabled us to provide complete solutions all over the globe. And we continue to develop sustainable alternatives, with systems that produce greener energy from climate-neutral, regenerative fuels, such as combined heat and power (CHP) plants fueled by biogas, landfill gas or sewage gas.

Emergency diesel generators for nuclear power plants
MTU Onsite Energy has been supplying emergency diesel generators for nuclear power plants for more than 50 years. With over 300 systems supplied to over 50 nuclear power plants and other nuclear installations in 15 countries worldwide, we have not only gained a wealth of experience and expertise, but also a leading market position. We provide products that deliver outstanding reliability and performance.

Since every customer and every project is different, we have developed a major NPP-based engineering section with approximately 100 specialists capable of handling every aspect of project-specific NPP requirements.

All our EDG projects are organized and implemented in line with NPP-related quality standards such as IAEA 50-C-Q, KTA 1401 and the Chinese standard HAF. Our EDGs are safety-classified to meet the strictest regulations in the nuclear power industry, with qualifications in line with IEEE 387 and KTA 3702, for example. In addition, our NPP-specific digital engine controller – SafeDEC – is qualified to comply with IEC 60880 standards.

MTU Onsite Energy EDGs combine the shortest start-up time in the NPP sector – just ten seconds – with an industry-best load-acceptance capability of 50 % for the first load step. And, with the smallest footprint in the industry, they can be integrated into any existing diesel engine facility suitable for the power range.

Whether you’re planning a new build or a modernization project, our combination of outstanding technology, over half a century of proven reliability and the expertise of our NPP engineering staff mean that MTU Onsite Energy is the partner you can rely on.

Technical excellence
// Safety classified EDGs in the power range between 1500 kW e and 8000 kW e
// Starting time of up to 10 s
// Load acceptance capability up to 50 % load in first step
// Space saving compact baseframe design with integrated auxiliary components
// MTU Gensets are compatible with all diesel building designs within its power range
// Excellent start-up reliability and in-operation reliability over the entire service life, proven by broadest EDG installed base
MTU Onsite Energy EDGs for nuclear power plants are based on MTU Series 956/4000 or Bergen 32:40 16V engines covering a power range between 1500 kWe and 8000 kWe.

The basic scope of supply includes the diesel generator set, a safety-classified instrumentation and control system (I&C) and air starting system, plus the supervision of installation and commissioning. Depending on project requirements, MTU Onsite Energy also realizes additional mechanical systems or EDG building internal pipework, as well as installation and commissioning.

**A COMPREHENSIVE PORTFOLIO COVERING ALL REQUIREMENTS.**

**MTU preferred scope of supply:**
- Genset
- I&C (with further electrical auxiliaries)
- Starting system
- Supervision of installation & commissioning

**Additional scope:**
- Further mechanical auxiliaries
- Pipe engineering
- Pipe material
- Installation & Commissioning

**Features:**
- Electronic engine governor SafeDEC
- Sequential turbocharging
- Pump-line-nozzle injection
- Compact dimensions
- Light weight

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**Series 4000 NPP Genset**

<table>
<thead>
<tr>
<th>Engine model</th>
<th>Dimensions</th>
<th>Weight approx.</th>
<th>Starting time</th>
<th>Power output</th>
<th>Nuclear codes</th>
<th>Number of cylinders</th>
<th>Rated speed</th>
<th>Cylinder config.</th>
<th>Bore/Stroke mm</th>
<th>Electronic engine governor</th>
<th>Load profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>12V 4000 P63</td>
<td>L x W x H</td>
<td>5.5 x 1.8 x 2.7 m</td>
<td>24 t</td>
<td>1500 kWe</td>
<td>KTA 3702</td>
<td>12V</td>
<td>1500 rpm</td>
<td>90°V</td>
<td>170/190</td>
<td>MTU SafeDEC</td>
<td>MTU SafeDEC</td>
</tr>
<tr>
<td>16V 4000 P63</td>
<td>L x W x H</td>
<td>6.0 x 1.8 x 2.7 m</td>
<td>26 t</td>
<td>2000 kWe</td>
<td>KTA 3702</td>
<td>12V</td>
<td>1500 rpm</td>
<td>90°V</td>
<td>170/190</td>
<td>MTU SafeDEC</td>
<td>MTU SafeDEC</td>
</tr>
<tr>
<td>20V 4000 P63</td>
<td>L x W x H</td>
<td>6.5 x 1.8 x 2.7 m</td>
<td>29 t</td>
<td>2500 kWe</td>
<td>KTA 3702</td>
<td>12V</td>
<td>1500 rpm</td>
<td>90°V</td>
<td>170/190</td>
<td>MTU SafeDEC</td>
<td>MTU SafeDEC</td>
</tr>
</tbody>
</table>

**Features:**
- Electronic engine governor SafeDEC
- Compact dimensions
- Light weight

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**Series 956 NPP Genset**

<table>
<thead>
<tr>
<th>Engine model</th>
<th>Dimensions</th>
<th>Weight approx.</th>
<th>Starting time</th>
<th>Power output</th>
<th>Nuclear codes</th>
<th>Number of cylinders</th>
<th>Rated speed</th>
<th>Cylinder config.</th>
<th>Bore/Stroke mm</th>
<th>Electronic engine governor</th>
<th>Load profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>12V 956 TB34</td>
<td>L x W x H</td>
<td>8.1 x 3.0 x 3.7 m</td>
<td>44 t</td>
<td>3750 kWe</td>
<td>KTA 3702</td>
<td>12V</td>
<td>1500 rpm</td>
<td>90°V</td>
<td>230/230</td>
<td>MTU SafeDEC</td>
<td>MTU SafeDEC</td>
</tr>
<tr>
<td>16V 956 TB34</td>
<td>L x W x H</td>
<td>8.3 x 3.0 x 3.7 m</td>
<td>50 t</td>
<td>5040 kWe</td>
<td>KTA 3702</td>
<td>12V</td>
<td>1500 rpm</td>
<td>90°V</td>
<td>230/230</td>
<td>MTU SafeDEC</td>
<td>MTU SafeDEC</td>
</tr>
<tr>
<td>20V 956 TB34</td>
<td>L x W x H</td>
<td>8.4 x 3.0 x 3.7 m</td>
<td>65 t</td>
<td>6300 kWe</td>
<td>KTA 3702</td>
<td>12V</td>
<td>1500 rpm</td>
<td>90°V</td>
<td>230/230</td>
<td>MTU SafeDEC</td>
<td>MTU SafeDEC</td>
</tr>
</tbody>
</table>

**Features:**
- Electronic engine governor SafeDEC
- Compact dimensions
- Light weight

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**Bergen NPP Genset**

<table>
<thead>
<tr>
<th>Engine model</th>
<th>Dimensions</th>
<th>Weight approx.</th>
<th>Starting time</th>
<th>Power output</th>
<th>Nuclear codes</th>
<th>Number of cylinders</th>
<th>Rated speed</th>
<th>Cylinder config.</th>
<th>Bore/Stroke mm</th>
<th>Electronic engine governor</th>
<th>Load profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>12V Bergen</td>
<td>L x W x H</td>
<td>11 x 3.6 x 4.8 m</td>
<td>140 t</td>
<td>8000 kWe</td>
<td>KTA 3702</td>
<td>16V</td>
<td>750 rpm</td>
<td>55°V</td>
<td>320/400</td>
<td>SafeDEC</td>
<td>*</td>
</tr>
</tbody>
</table>

**Features:**
- Electronic engine governor SafeDEC
- High power output
- Pump-line-nozzle injection

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- Variable load with 10% overload. TBO (time between overhauls) 8000 h.
- Load profile until TBOs
- 5% of the time with 110% load
- 20% of the time with 100% load
- 60% of the time with 70% load
- 75% of the time with load less than 15%
A typical layout of a nuclear power plant application includes the Emergency Diesel Genset with its main subsystem components.

Air Starting System
The Air Starting System consists of an electrically driven air compressor, compressed air vessels and start up valves.

Fuel System
The Fuel System ensures the supply of fuel from the fuel storage tank through the service tank into the diesel engine.

Exhaust Gas System / Combustion Air System
The purpose of the air intake system is to supply the diesel engine with the combustion air required during the operation. The combustion air is sucked in via the intake air filters and the silencer. The exhaust gas is discharged through a stainless steel pipe and exhaust gas silencer.

Lube Oil System
The lube oil circuit, featured with a level monitoring, is supplying the engine with lubricating oil and dissipating heat in a cooling circuit.

Cooling System
The diesel engine is cooled by two independent cooling circuits: the engine coolant system (high temp.) and the charge air coolant system (low temp.). The heat for both circuits is dissipated via external electrical ventilator cooling units, tube bundle heat exchangers or plate heat exchangers. The coolant pump is engine driven.

MTU SafeDEC NPP digital engine governor
MTU Onsite Energy has developed the world’s first and only 1E safety-classified digital diesel engine governor for NPP applications.

The SafeDEC meets the requirements of the nuclear safety standard IEC 60880 for software based category A systems. This standard is focused on stringent development processes, functional safety and high reliability. The SafeDEC undergoes a seismic qualification according to IEEE344 (real testing).

The SafeDEC functions have been pared down to essential core functions compared with a standard ADEC control unit, which increases its reliability. The core functions include regulating engine speed or fuel rod, controlling the common rail fuel injection system and diagnosing the operating status. Thereby, a previously unattained level of fault immunity and system reliability has been achieved.

DEPENDABLE COMPONENTS FOR CONSTANT OPERATION.

PROVEN, RELIABLE, SAFE: SAFEDEC DIGITAL ENGINE GOVERNOR.
GLOBAL PROJECTS:
TRUST IN OUR COMPETENCE.

New build projects with CPN600 / CPR1000 reactors

**CHINA**
Ling Ao II 1-2
- Reactor type: CPR1000
- 4 x 20V 956 TB33 EDGs with 6,0 MWe
- Delivery: 2008

China
Fuping 1-2; 3-4
- Reactor type: CPR1000
- 9 x 20V 956 TB33 EDG with 6,0 MWe
- Delivery: 2011/2014

China
Ginshan II 3-4
- Reactor type: CPN600
- 13 x 20V 956 TB33 EDGs with 6,0 MWe
- Delivery: 2008/2009

China
Fangjiashan 1-2
- Reactor type: CPN600
- 5 x 20V 956 TB33 EDGs with 6,0 MWe
- Delivery: 2011/2012

New build projects with VVER reactors

**CHINA**
Tianwan 1-2; 3-4
- Reactor type: VVER 1000
- 16 x 20V 956 TB33 EDGs with 5,5 MWe
- Delivery: 2003/2015

Slovakia
Mochovce 3-4
- Reactor type: VVER 440
- 1 x 20V 4000 additional EDG with 2,5 MWe
- Delivery: 2014

Russia
Novovoronezh II 1-2
- Reactor type: VVER 1200
- 6 x 20V 956 TB33 EDGs with 6 MWe
- Delivery: 2011

Retrofit projects at existing sites

**Switzerland**
Beznau
- Reactor type: Westinghouse PWR
- 4 x 12V 956 TB33 EDGs with 3,7 MWe
- Delivery: 2013

Sweden
Plex Oskarshamn
- Reactor type: ABB BWR
- 2 x 20V 4000 P63 EDGs with 2,5 MWe
- Delivery: 2012

Belgium
Doel
- Reactor type: Westinghouse PWR
- 5 x 20V 4000 P63 EDGs with 2,5 MWe
- Delivery: 2011
HIGHEST STANDARDS PROVIDE PEACE OF MIND.

The Genset series 4000 and 956 are certified for the use as NPP emergency generators according to the German standard KTA 3702 and the American Standard IEEE. The Genset series 20V 956 are licensed according to the Russian GOST norms for Novovoronezh II project.

Depending on the project specific requirements, the quality documentation is provided as the following:

- Type approval certificate for engine and qualification report for the generator
- Engine and Genset FAT according to NPP standards plus manufacturing documentation according to the project-specific quality plan

MTU Customized Care for Nuclear Power Plants.

MTU Customized Care can provide experienced support for the following jobsite activities:

- Supervision of installation
- Supervision of commissioning
- Site acceptance test

MTU can provide optimum support to the power plant operator with:

- Prompt provision of necessary spare parts
- Necessary tools for maintaining the system
- Basic training to your employees

In case of open questions, our experts are power plant driven and take responsibility for troubleshooting and fault clearance.

Benefits:

- Optimal engine availability and reliability
- Maximum cost certainty
- Optimal planning and long term budgeting
- Professional repairs by MTU experts
- Protection of your investment

MTU NPP SERVICE: MAINTAIN RELIABILITY.

KTA 1401
General Requirements Regarding Quality Assurance

IAEA 50-C-Q
Quality Assurance for Safety in Nuclear Power Plants and other Nuclear Installations

EN ISO 9001 : 2008
Quality Management System

DIN EN ISO 14001
Environmental Management System