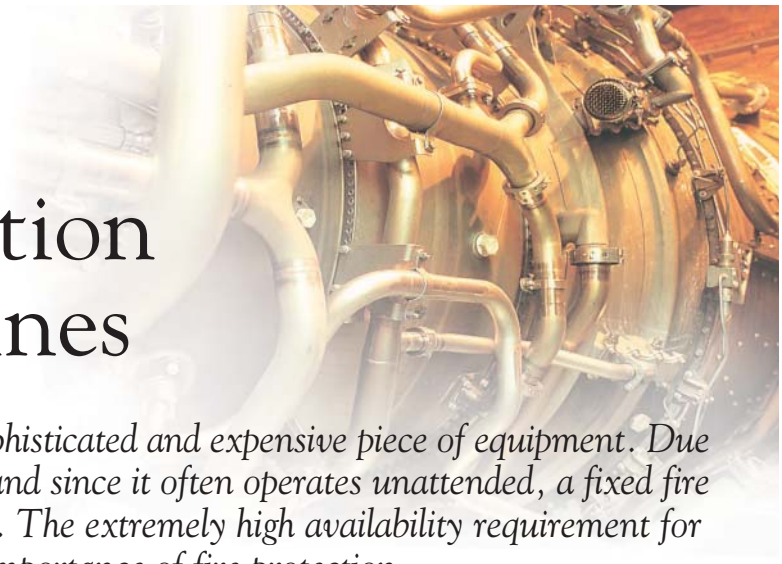
HI-FOG®
water mist fire protection



Fire protection of gas turbines

A modern gas turbine is a sophisticated and expensive piece of equipment. Due to the fire hazard it involves and since it often operates unattended, a fixed fire protection system is essential. The extremely high availability requirement for gas turbines emphasises the importance of fire protection.

The HI-FOG water mist systems are an ideal choice for gas turbines. They replace both dry chemical and gaseous systems, providing improved safety for the people, property and environment. HI-FOG systems have been approved by internationally recognised bodies such as International Maritime Organisation, Factory Mutual and VdS Loss Prevention.

General

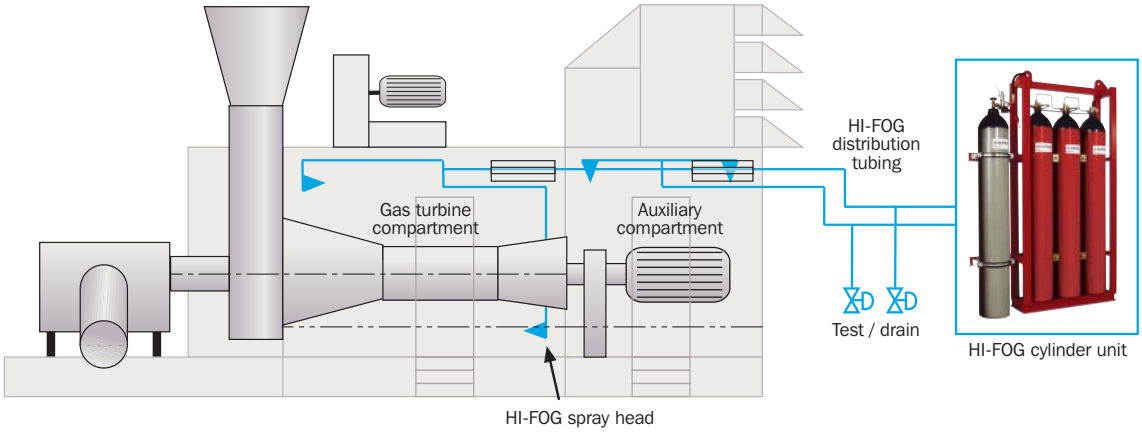
A gas turbine essentially consists of a compressor, a combustor and a power turbine. Filtered air is drawn into the turbine and compressed before entering the combustion chamber, where it is mixed with fuel and ignited. The exhaust gases drive the power turbine, which in turn drives a generator or a natural gas pipeline compressor, for example. A diesel engine, electric motor or similar is used for starting. A skid carries fuel and lubrication oil systems. Forced ventilation is used to provide cooling during normal operation.

The areas of protection are the turbine compartment and the auxiliary compartments (fuel and lubrications system, starter motor). If the driven equipment and drive shaft coupling are in their own compartments, they are often protected as well.

A gas turbine operates at high temperatures and cools slowly after shutdown. Outer surface temperatures can reach 480°C (900°F), exceeding the auto-ignition temperature of fuel or lubrication oil. Therefore, if such media comes in contact with turbine surfaces in air atmosphere, a fire can occur. While great care is applied when designing the fuel or lubrication oil system, the vibration and thermal cycling in an operating machine may cause failures.

To put the fire out quickly is not sufficient alone. If contact between the burning material and the ignition source exists, re-ignition may occur.

The fire protection system must be able to extinguish the fire and prevent re-ignition by atmospheric cooling and inerting during the shut-down period. Protection systems offering short or non-continuous agent discharge are of little value. Likewise, a fire protection agent that leaks out of the enclosure may fail to give adequate protection. The system should not be harmful to people, to the protected equipment, nor to the environment, regardless whether set off in a fire or discharged accidentally.



An example of gas turbine fire protection

MARIOFF

HI-FOG solution – features and benefits

The HI-FOG systems usually have a total flooding design. Fine water mist is used as the fire-fighting agent, only 2-4 spray heads with single tubing is needed to fill the protected space quickly and completely with mist. Compartments do not need to be gas tight – indeed fire tests are done with a door open. This increases fire protection system reliability significantly and reduces skid maintenance cost. HI-FOG systems provide:

- Own power supply and water storage
- Proven extinguishing efficiency and operational reliability
- Proven capability to protect equipment from thermal stresses
- Tolerance to poor enclosure integrity
- Easy installation in new and existing units
- A safe and reliable alternative to gaseous systems
- An environmentally friendly alternative to dry chemicals, halons and halon alternatives.

HI-FOG systems

There are two power unit options, MAU or GPU, which are chosen to according to the volume of the protected spaces.

The Machinery Accumulator Unit (MAU) protects enclosures up to 260m³ (9,175ft³), uses stored nitrogen cylinders and non-pressurised water cylinders. Nitrogen, when released, drives the water to the HI-FOG spray heads. There is a 16 mm (5/8") line from each power unit to the skid and two to four spray heads in each compartment with 12 mm (1/2") piping, making installation easy. Typical protection time is 20 or 30 minutes to accommodate turbine cool down time.

The Gas-driven Pump Unit (GPU) is approved for protecting spaces up to 500m³ (17,645ft³). It also uses stored nitrogen or compressed air cylinders, but these are used to drive a special pump, feeding water to the distribution network. Inside compartments, four spray heads are mounted with 12 mm (1/2") piping. Water for 30 minutes of continuous protection is normally stored in a 1.5 m³ (52 ft³) dedicated tank at the unit. A GPU can be used to protect against multiple hazards when using selector valves.

Both MAU and GPU are pre-engineered, self-contained units, solving problems with power and agent supply. As the systems are used in conditions ranging from offshore platform in the arctic to sandstorm prone hot desert, they are often built in protective or heated skids. Both systems carry Factory Mutual and VdS approvals for gas turbine protection.

References

Marioff has supplied HI-FOG systems to protect gas turbine skids around the world. The installations include on-shore, off-shore and shipboard systems. In North Sea approx. 100 HI-FOG systems are protecting various rotating equipment skids on off-shore platforms. Oil companies and power producers apply HI-FOG in compressor stations and oilfield applications in variety of conditions, including Arctic Sea and Nigerian oil fields.

Approvals

Factory Mutual	**Approval Report**	**HI-FOG system**
Combustion turbines, machinery spaces, and special hazard machinery spaces in..		
..enclosures with volumes up to, and including 9,175ft³ (260 m³)	*J. I. 0D5A4.AH, February 9, 1998*	*MAU*
..enclosures with volumes up to, and including 17,645ft³ (500 m³)	*ID. 3000430, June 5, 2001*	*GPU*
..enclosures with unlimited volumes	*Pending*	*SPU (MT3)*
VdS Loss Prevention	**Approval Report**	**HI-FOG system**
Combustion turbines, machinery spaces, and special hazard machinery spaces in..		
..enclosures with volumes up to, and including 9,175ft³ (260 m³)	*S 4040002, February 16, 2004*	*MAU*
..enclosures with volumes up to, and including 17,645ft³ (500 m³)	*S 4040003, February 16, 2004*	*GPU*
International Maritime Organization *)	**Approval Report**	**HI-FOG system**
Machinery spaces and pump rooms – Total flooding, MSC/Circ.668/728 (ISO 6182-9 & UL 2167 Ch. 38)	*Cert. No. F-17573, June 2004* *Cert. No. F-17150, January 2003* *Cert. No. F-17116, March 2003*	*GPU* *SPU and MT3*
Machinery Spaces – Local application, MSC/Circ.913	*Cert. No. F-17443, December 2003* *Cert. No. F-17445, December 2003* *Cert. No. F-17117, January 2003*	*GPU* *SPU*

**) Approvals are issued by various bodies, such as American Bureau of Shipping, Lloyds Register of Shipping, Bureau Veritas etc. In the table above the approvals listed are issued by Det Norske Veritas.*

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