

Turbine Protection to FMDS 7-101



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- **Current market situation from view of a specialized installer**
 - Inquiries received from market
 - Samples of available standards
 - Solutions in place on market

- **FMDS 7-101 as reliable and binding solution**
 - Sample of requirements
 - Sample of solutions

- **Conclusions from view of a specialized installer**

Inquiries received from market

“Please find a request for protection of the turbine. What norms and standards do you recommend that we should follow? Our fire and risk guy is stating SBF 110 and SBF120 as well as FM Global or VdS or NFPA.

Another question is what kind of extinguishing is recommend, there will be no sound hood above and around the turbine. Will inert gas be an options as we have it already in electrical rooms? ...“ → Request from owner

“Specification Fire Extinguishing System Turbo Set

System design requirements: machinery directive, DIN, VdS, NFPA and or other applicable standards

Location: UAE (Dubai)” → Request from OEM

“...The fire fighting, protection and detection systems shall be designed in accordance to local/EU standards and shall be subject to the approval by an authorized insurance company. Further details will be advise with inspection procedure of authorities. ...” → Request from general contractor



Who is responsible for the risk analysis of the systems and equipment?

Why OEM's & GC's are not aware about standards, requirements and regulations?

When is the right time to define requirements, standards and demand?

Who are the experts to create the specifications for an active fire protection system?

Why owners, invest a lot of money in production equipment, but are not aware how to handle fire risks?



Sample of available standards

- **NFPA 850 Recommended Practice for Fire Protection for Electric Generating Plants and HVDC Converter Stations**

7.7.4 Fire Protection

7.7.4.1 Turbine & Generator Area

7.7.4.1.1* *All areas beneath the turbine-generator operating floor that are subject to oil flow, oil spray, or oil accumulation should be protected by an automatic sprinkler or foam-water sprinkler system. This coverage normally includes all areas beneath the operating floor in the turbine building. The sprinkler system beneath the turbine generator should take into consideration obstructions from structural members and piping and should be designed to a density of 0.30 gpm/ft² (12.2 mm/min) over a minimum application of 5000 ft² (464 m²).*

7.7.4.1.2 *Lubricating oil lines above the turbine operating floor should be protected with an automatic sprinkler system covering those areas subject to oil accumulation including the area within the turbine lagging (skirt). The automatic sprinkler system should be designed to a density of 0.30 gpm/ft² (12.2 mm/min).*

7.7.4.1.3* *Lubricating oil reservoirs and handling equipment should be protected in accordance with 7.7.4.1.1. If the lubricating oil equipment is in a separate room enclosure, protection can be provided by a total flooding gaseous extinguishing system.*

...

7.7.4.2* Turbine-Generator Bearings

7.7.4.2.1* *Turbine-generator bearings should be protected with an automatic closed-head sprinkler system utilizing directional nozzles. Automatic actuation is more reliable than manual action. Fire protection systems for turbine-generator bearings should be designed for a density of 0.25 gpm/ft² (10.2 mm/min) over the protected area of all bearings.*

7.7.4.2.2* *Accidental water discharge on bearing points and hot turbine parts should be considered. If necessary, these areas can be permitted to be protected by shields and encasing insulation with metal covers.*

3.2 NFPA Official Definitions

3.2.6 Should. Indicates a recommendation or that which is advised but not required

Sample of available standards

- VdS 3132 Fire Protection in Power Plants

6 Fire Protection Systems / Technical Fire Protection

Aggregate	Main Fire Risks	Fire Detection Measure	Fire Extinguishing System
Steam Turbine	Fires by leakages of oil filled parts of machinery	Smoke Detectors (point or linear type); Flame Detectors; Heat Detectors	Pre-Action or manual released extinguishing system: Spray deluge / water mist deluge

Furthermore we have to refer to A3 “Objektbezogene Zuordnung der Löschanlagentechnik” of VdS 3132

LA-Typ / Kraftwerkskomponente	Sprinkleranlage	Sprühwasserlöschanlage	Feinsprühlöschanlage (ND)	Feinsprühlöschanlage (HD)	Schaumlöschanlage	Gaslöschanlage mit sauerstoffverdrängenden Gasen	Gaslöschanlage mit chemischen Löschgasen
Dampfturbine (DT) Lager + Ventile	-	□	☑	□	-	-	-
Ölversorgungsräume/-kanäle (DT)	-	☑	☑	□	□	□	-
Generatoren (DT und GT) Lager	□	□	☑	□	-	-	-

Legende: ☑ = Empfehlung □ = optional - = nicht geeignet

- ❖ Turbine and Generator bearing + valves are classified with active fire protection measures
- ❖ Oil rooms and also medium channels with oil pipes fire are as well classified with active fire protection measures

Sample of available standards

- **FMDS 7-101 Fire Protection for Steam Turbines and Electric Generators**

Fire Protection measures will be part of second section.

Unfortunately there are also many other standards, local requirements or individual concepts (like white papers) on global market available which are not mentioned here.

FM Global
Property Loss Prevention Data Sheets **7-101**
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FIRE PROTECTION FOR STEAM TURBINES AND ELECTRIC GENERATORS

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Solutions in place on market



Variations of different fire protection applications for exactly the same steam turbine model according to NFPA

refer to table as example / OEM No. 01

GT - Geno - ST combined – single shaft application

OEM No. 1		Steam Turbine Operating Floor			Steam Turbine Beneath Operating Floor		Generator			Auxiliary Block	
		ST. Bearings	ST. Valves	ADV Pit	Oil Pipe -Channels	Whole area	Beneath	Bearings	Seal Oil & H2	Seal Oil Unit	Lube Oil
1	Kep	Flame & Smoke Detector Sprinkler	Flame & Smoke Sprinkler			Sprinkler	Smoke & Heat Preaction Sprinkler	Smoke & Heat Preaction Sprinkler	Flame & Heat Detector Sprinkler	Flame & Heat Detector Water Spray	
2	Ban	Smoke & Flame Detector	Smoke & Flame Detector					Smoke Detector	Flame & Heat Detector Sprinkler	Flame & Heat Detector Water Spray	
3	KN3	Smoke & Heat Detector Sprinkler	Sprinkler		Sprinkler			Smoke & Heat Detector Preaction Sprinkler	Flame & Heat Detector Water Spray	Flame & Heat Detector Water Spray	
4	Tza	Flame & Smoke Detector Preaction Sprinkler	Flame & Smoke Detector Preaction Sprinkler	Sprinkler		Fire Detector Preaction Foam Water	Smoke & Heat Detector Foam Water	Smoke & Heat Detector Preaction Sprinkler	Flame Detector Preaction Foam Water	Flame Detector Preaction Foam Water	
5	Car	Flame, Smoke & Heat Detector Water Spray	Flame, Smoke & Heat Detector Water Spray (Minifog)		Smoke & Heat Detector Water Spray			Heat Detector	Flame & Heat Detector Water Spray	Flame & Heat Detector Water Spray	

Solutions in place on market



Variations of different fire protection applications for exactly the same steam turbine model according to NFPA

refer to table as example / OEM No. 02

GT - Geno - ST combined – single shaft application

OEM No. 2		Steam Turbine Operating Floor			Steam Turbine Beneath Operating Floor		Generator		Auxiliary System		
		ST. Bearings	ST. Valves	ADV Pit	Oil Pipe -Channels	Whole area	Beneath	Bearings	Seal Oil Unit	Hydraulic Skid	Lube Oil Unit
1	Kn2	Smoke Detector Preaction Sprinkler (Collector Plates)				Sprinkler (Collector Plates)		Smoke Detector Preaction Sprinkler (Collector Plates)	Sprinkler (Collector Plates)	Sprinkler (Collector Plates)	Sprinkler (Collector Plates)
2	Ene	Smoke & Heat Detector Preaction Sprinkler			Sprinkler Gate Valve			Smoke & Heat Detector Preaction Sprinkler	Sprinkler	Sprinkler	Sprinkler
3	Hem	Smoke Detector Preaction Sprinkler				Smoke Detector Sprinkler	Smoke Detector Sprinkler	Smoke Detector Preaction Sprinkler	Smoke Detector Water Spray	Smoke Detector Water Spray	Smoke Detector Water Spray
4	Ber	Smoke & Heat Detector Preaction Sprinkler				Waterspray Hydraulic Sprinkler Release	Waterspray Hydraulic Sprinkler Release	Hydrogen Gas Detector Smoke & Heat Detector Preaction Sprinkler	Hydrogen Gas Detector Smoke Detector Water Spray	Smoke Detector Water Spray	Smoke Detector Water Spray

Sample of requirements

Severe fires involving steam turbines and electric generators occur as a result of the accidental release and ignition of mineral oil from lubrication-, control-, or seal-oil systems, and the release of hydrogen from the generator.



- A. Local and under-floor area automatic sprinkler protection where oil could spray or leak.
- B. Containment and drainage to limit the area involved.
- C. An effective emergency shutdown plan and adequate operator training to secure the unit so lube-oil pumps can be shut off as quickly and safely as possible in the event of a fire.
- D. Location of control rooms outside the turbine building when possible. Protection of control rooms located in turbine buildings to provide operators the opportunity to take action during a fire.
- E. Protection of power and control cables for the DC lube-oil pump to minimize the possibility of uncontrolled loss of lubrication systems.
- F. Use of an FM Approved industrial fluid for control- and seal-oil systems. This will eliminate the need for fixed fire protection systems for the oil hazard associated with these two systems. In most cases fire protection will be limited to that needed to protect grouped cables and exposure from mineral oil-based lube-oil systems.

Sample of requirements

■ FM 7-101 Fire Protection for Steam Turbines and Electric Generators

...

2.4.3.1 Solid Operating Floor with no Mezzanine(s)

2.4.3.1.1 Provide the following protection under solid operating floors with no mezzanine(s) (see Figure 8a).

A. Provide an automatic sprinkler system with the density recommended in Table 1 over a demand area of 5,000 ft² (465 m²).

B. The following optional protection scheme may be used (see Figure 8b).

...

2.4.4 Protection on Operating Floors

2.4.4.1 Provide a fixed, FM Approved, automatically actuated water-spray system with directional-spray nozzles or automatic sprinkler protection flowing 30 gpm (113 L/min) per nozzle. Include the maximum number of nozzles expected to operate in any single fire event in the system design. Ensure the temperature rating prevents accidental operation. Provide protection for the following systems containing mineral oil:

...

Many further requirements, detailed information with clear sketches for usage and recommendation.

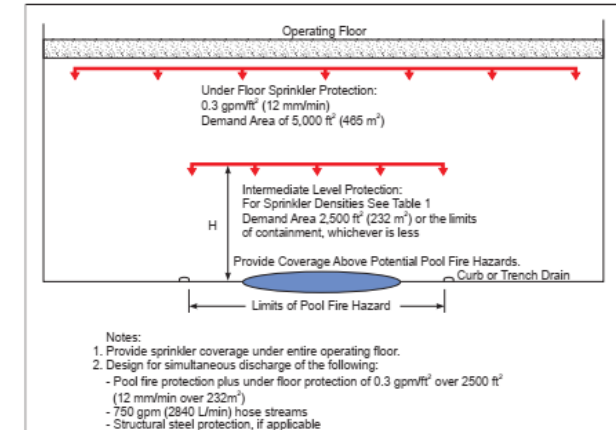


Fig. 8a. Optional protection for turbine buildings with solid operating floors higher than 30 ft (9.1 m)

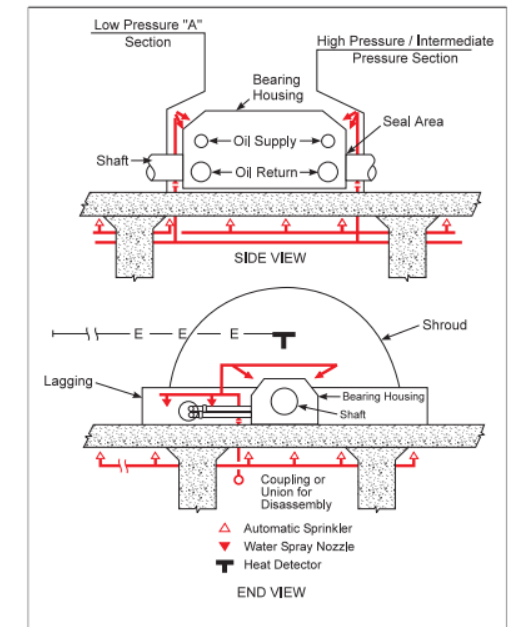
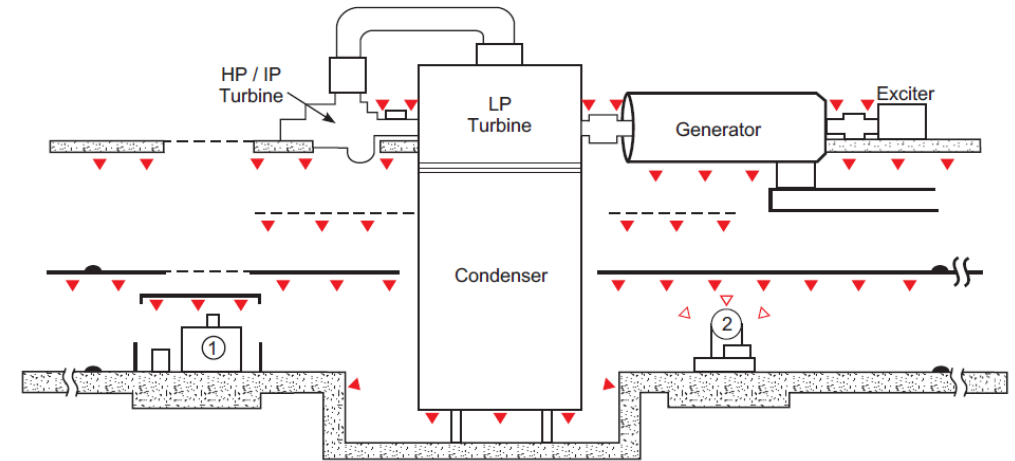
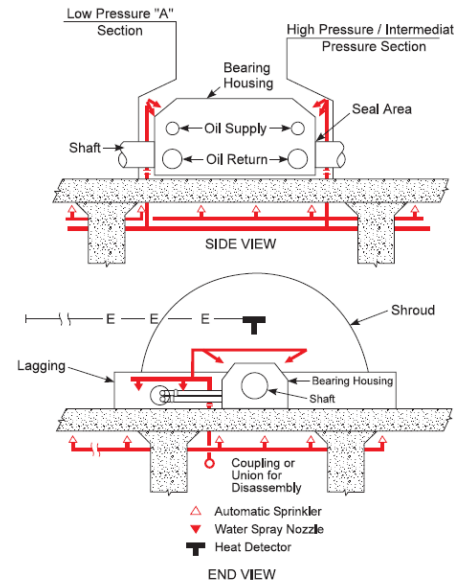
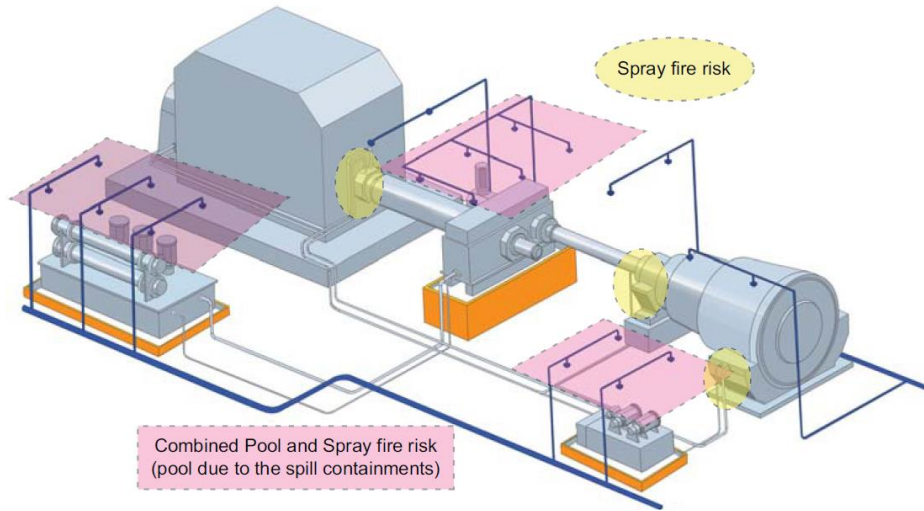


Fig. 9. Protection for bearing housing and areas under turbine skirts

Sample of requirements



- △ Deluge sprinklers
- ▲ Automatic sprinklers
- ①, ② Lube/seal oil systems

Sample of solutions

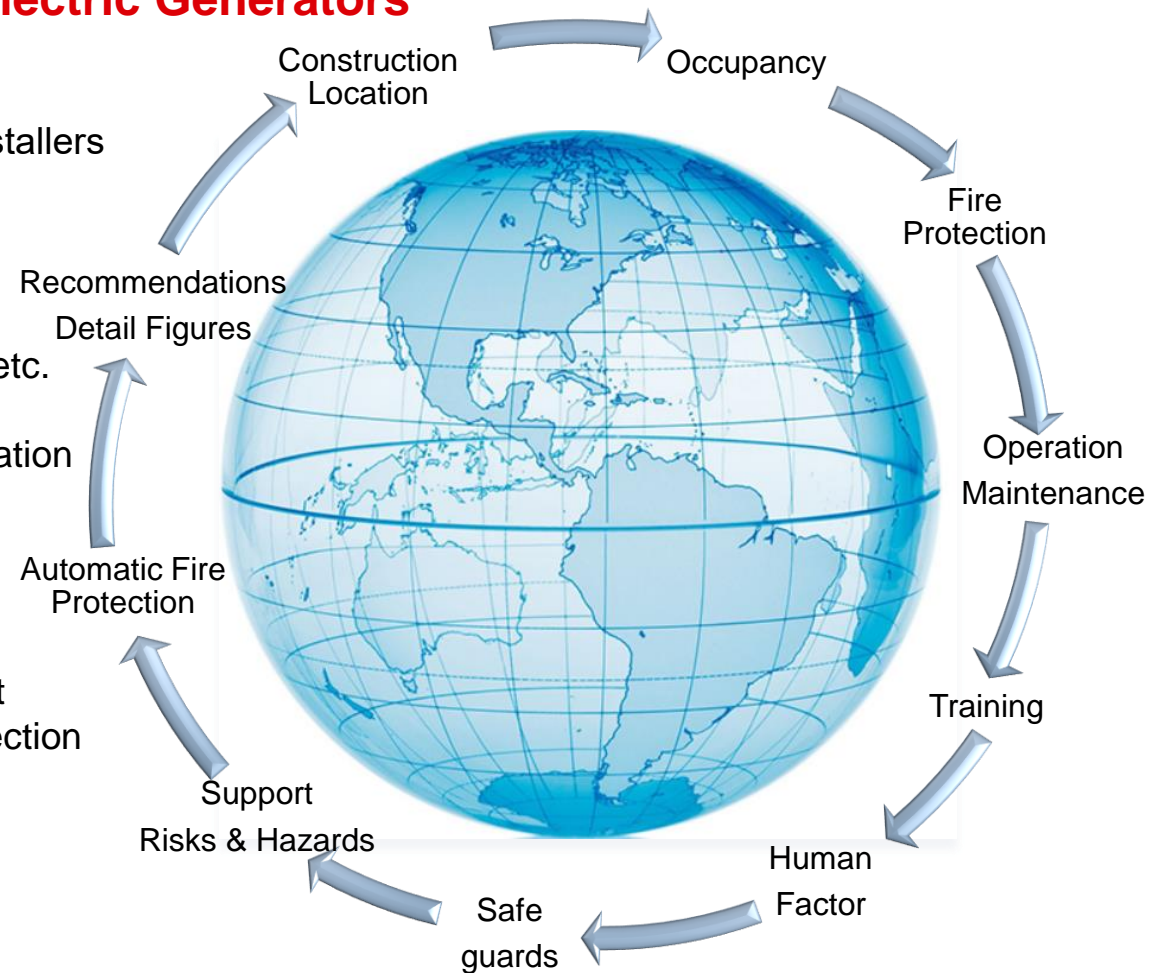


Sample of solutions



FM 7-101 Fire Protection for Steam Turbines and Electric Generators

- A. A solution with a clear guidance for costumers, OEM's and installers with many supporting figures with detailed recommendation
- B. A clear recommendation to consider the aggregate Steam Turbine and Electric Generator as a “package” including process control, general construction, maintenance, training, etc.
- C. Compared to NFPA850 FMDS 7-101 offers clear recommendation and is not only an advice which in “not required”
“Should. Indicates a recommendation or that which is advised but not required”
- D. Compared to VdS3132, FMDS 7-101 offers a general concept much more than indicating a general risk and advise the protection of e.g. bearings and valves
VdS: Fires by leakages of oil filled parts of machinery.



LA-Typ \ Kraftwerkskomponente	Sprinkleranlage	Sprühwasserlöschanlage	Feinsprühlöschanlage (ND)	Feinsprühlöschanlage (HD)	Schaumlöschanlage	Gaslöschanlage mit saurerstoffverdrängenden Gasen	Gaslöschanlage mit chemischen Löschgasen
Dampfturbine (DT)	-	□	☑	□	-	-	-
Lager + Ventile	-	☑	☑	□	-	-	-
Übersorgungsräume/-kanäle (DT)	-	☑	☑	□	-	□	-
Generatoren (DT und GT) Lager	□	□	☑	□	-	-	-

Legende: ☑ = Empfehlung □ = optional - = nicht geeignet

Thanks for your attentions !

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