

**GAJANAN AND SONS
FIRE SAFETY PVT. LTD.**

**CLIENT:
M/s KDL 120MW COMBINED CYCLE POWER
PLANT PROJECT**

**DOC. NO.-
100-1101-L1L-R00
Rev -0
SHEET NO 1 of 12**

**FIRE FIGHTING
DESIGN BASIS REPORT**

**CLIENT: M/s KDL 120MW COMBINED CYCLE POWER
PLANT PROJECT**

REVISION NO.	R-0			
ISSUED FOR	ENGINEERING			
PREP. BY/DATE	16/08/12			
CHKD. BY/DATE	16/08/12			
APPRO. BY/DATE	16/08/12			

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While making this DBR, following regulations are considered

NFPA 10 portable Fire Extinguisher

NFPA 12 Carbon Dioxide Extinguishing Systems

NFPA 13 sprinklers

NFPA 14 Installation of Standpipe, private Hydrants, and Hose System

NFPA 15 Water Spray fixed system for fire Protection

NFPA 24 Yard hydrants

NFPA 30 Flammable and combustible Liquids Code

NFPA 70 National Electrical Codes

NFPA 72D9E National fire Alarm Code

NFPA 850 Recommended Practice for Fire Protection for Eclectic Generating plants and
High Voltage Direct Current Converters Stations.

ANSI B31.1 Power Piping

ASME VIII Pressure Tank

IEEE 383 Fire retardant Cable

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UTILITY WORKS:

1. SCOPE OF WORK

Fire Protection system:

- Hydrant System.
- Sprinkler system.
- Deluge system.
- Fire Fighting Pump sets.
- Portable first aid & fire extinguishers.
- Automatic Fire Extinguishers for Electrical Panels
- Photo luminescent safety signages.
- Fire rated sealant.
- Analogue Type Fire detection & Alarm system.

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2. FIRE PROTECTION & DETECTION SYSTEM

System Description

Water shall be drawn from fire reserve tanks by electrically driven jockey pumps & fire pumps. A standby diesel engine driven pump for fire hydrants, deluge system and sprinkler system is provided. All pumps have separate suction lines from the suction header and delivery is connected to the system. The function of pumps is to maintain 3.5 Kg/Sq.cm at the farthest hydrant. Diesel engine driven fire pump shall be of the same capacity and shall back up the electrically operated fire hydrant / sprinkler pump, as per fire regulations. This pump is operated in case of total electrical power or electrical pump failure. Jockey pump is operated intermittently in order to take care of hydraulic losses in the system and to maintain the minimum pressure.

- A/g Fire Water Storage Tank : 250 M³

Pumps:

- | | |
|-------------------------------------|--|
| - Main Pump (For Hydrant/Sprinkler) | - 1 No, 273 M ³ /Hr, Head 71 m.
Elect. Driven Pump |
| - Standby Pump | - 1 No, 273 M ³ /Hr ,Head 88 m
- Diesel Engine Driven Pump |
| - Jockey Pump Set | - 1 No, 10.8 M ³ /Hr ,Head 71 m. |

Fire Hydrant System:

The Plant shall be provided with separate fire hydrant riser connected to the hydrant landing valve with fire hose cabinet consisting of swinging hose reels, fire man's axe, 63 mm dia canvas hose and nozzles.

Externally, a fire fighting ring main shall be provided around the Plant. External yard hydrants shall be suitably located at 30 meter centers. Necessary hose pipe and nozzle shall be placed in a closed cabinet with glass shutters at these yard hydrants.

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We had design system for 6 cases in which the capacity for reservoir has been taken as 250 m³. One electric driven pump of capacity 273 m³ /hr , 71 m Head and one diesel engine driven pump of capacity 273 m³/hr , 88 m Head along with one jockey pump of capacity 10.8 m³/hr, 71 m Head have been installed.

Working pressure:

1. The mains are always kept pressurized at 7.1 kg/cm². If the pressure reduces from 7.1 kg/cm² due to leakage of line or deluge valve, the jockey pump operates and automatically cut off at 7.1 kg/cm².
2. When pressure reduce below 6 kg/cm², the Electric operated pumps (273 m³/hr) operates and automatically cut off at 7.1 kg/cm².
3. Still if pressure drops below 5.0 bars due to opening of several fire hydrant points, electrical pump (273 m³/hr) will start (along with diesel pump 273 m³/hr)

Design basis:

- 1) Flow rate consideration for Single hydrant (SH), Water Monitor (WM) & Fire escape hydrant (FEH): 900 lpm. Flow rate consumption for single spray nozzle considered as 90 lpm, there are 3 Deluge valves operating in whole the system with 96 spray nozzles each. Flow rate consideration for single sprinkler is depending on K Factor of that sprinkler and operating pressure at that time. In our case we had considered as 40 sprinklers for Admin building at 2 bar pressure having k factor 80 and for Warehouse sprinklers k factor will be 360.
- 2) For analysis purpose we had considered, Furthestmost point (Remotest Hydrant) and remotest sprinkler.

CASE: 1

When all 3 pumps are in working conditions and only Hydrant to open and no any sprinkler and Deluge valve will operate.

Flow rate for pumps = 556.8 m³/hr = 0.1546 m³/s

Flow rate dedicated required for Sprinkler System = 0 m³/hr = 0 m³/s

Flow rate dedicated required for Deluge System = 0 m³/hr = 0 m³/s

Flow rate available for SH /FEH = 556.8 m³/hr - 0 m³/h - 0 m³/hr = 556.8 m³/hr = 0.1546 m³/s

Maximum Flow rate for Single Hydrant / FEH = 900 lpm = 0.015 m³/sec

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$$\text{Number of hydrants} = \frac{\text{FLOWRATE FOR PUMPS}}{\text{Maximum Flow rate for Single Hydrant or FEH}}$$

$$= 0.1546 / 0.015$$
$$= 10.3$$

Therefore,

The total number of active hydrants = 11 Nos. with no sprinklers will operate

CASE: 2

When all 3 pumps operating and all Admin sprinklers is in operating condition & No Deluge valve is operating

Flow rate for pumps = $556.8 \text{ m}^3/\text{hr} = 0.1546 \text{ m}^3/\text{s}$

Flow rate dedicated required for Sprinkler System = $270 \text{ m}^3/\text{hr} = 0.075 \text{ m}^3/\text{s}$

Flow rate dedicated required for Deluge System = $0 \text{ m}^3/\text{hr} = 0 \text{ m}^3/\text{s}$

Flow rate available for SH /FEH = $556.8 \text{ m}^3/\text{hr} - 270 \text{ m}^3/\text{hr} = 376.8 \text{ m}^3/\text{hr} = 0.1046 \text{ m}^3/\text{s}$

Maximum Flow rate for Single Hydrant / FEH = $900 \text{ lpm} = 0.015 \text{ m}^3/\text{sec}$

$$\text{Number of hydrants} = \frac{\text{FLOWRATE FOR PUMPS}}{\text{Maximum Flow rate for Single Hydrant or FEH}}$$

$$= 0.1046 / 0.015$$
$$= 6.97$$

Therefore,

The total number of active hydrants = 7 with all Sprinklers in admin area in Active mode.

CASE: 3

When all 3 pumps operating and all Warehouse sprinklers is in operating condition & no Deluge system is operating.

Flow rate for pumps = $556.8 \text{ m}^3/\text{hr} = 0.1546 \text{ m}^3/\text{s}$

Flow rate dedicated required for Sprinkler System = $305.5 \text{ m}^3/\text{hr} = \text{m}^3/\text{s}$

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Flow rate dedicated required for Deluge System = 0 m³/hr = 0 m³/s

Flow rate available for SH /FEH = 556.8 m³/hr - 305.4 m³/hr = 251.4 m³/hr = 0.0698 m³/s

Maximum Flow rate for Single Hydrant / FEH = 900 lpm = 0.015 m³/sec

$$\begin{aligned}\text{Number of hydrants} &= \frac{\text{FLOWRATE FOR PUMPS}}{\text{Maximum Flow rate for Single Hydrant or FEH}} \\ &= 0.0698 / 0.015 \\ &= 4.65\end{aligned}$$

Therefore,

The total number of active hydrants = 5 with all Warehouse sprinkler System in Active mode.

CASE: 4

When all three pumps are operating and one Deluge Valve system is in operating condition and no sprinklers will operate.

Flow rate for pumps = 556.8 m³/hr = 0.1546 m³/s

Flow rate dedicated required for Sprinkler System = 0 m³/hr = 0 m³/s

Flow rate dedicated required for whole Deluge System = 518.4 m³/hr = 0.144 m³/s

Maximum Flow rate for Single Hydrant = m³/sec

$$\begin{aligned}\text{Number of hydrants} &= \frac{\text{FLOWRATE FOR PUMPS}}{\text{Maximum Flow rate for Single Hydrant or FEH}} \\ &= 0.0106 / 0.015 \\ &= 0.71\end{aligned}$$

Therefore,

The total number of active hydrants = 1.

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Above mentioned all calculations are done at extreme operating conditions of each individual system, Hence we can conclude that pump selected for whole system delivers required flow rate and pressure satisfactorily.

Deluge System:

Deluge system design shall be compliant with the requirements of NFPA 15. Deluge valves are supplied from the appropriate firewater ring main at two separate points to maintain supply under most foreseeable scenarios. Deluge systems shall be of dry type downstream of the deluge valves and shall be provided with both automatic and manual release actuation facilities.

Each deluge circuit shall have a manual release facility which shall be located outside the area being protected. All deluge circuits shall have the capability to be operated automatically from the F&G system (on detection of a Confirmed Fire in the area), or by remote manual activation from the PCR (via the F&G system). Release of a deluge circuit by any means shall be considered to be a Confirmed Fire and shall be signalled to the F&G system via PSL (system activated) and PSH (deluge valve open) pressure switches. The operation of deluge places large quantities of water on the ground floor. Drains shall be provided to evacuate this water and to prevent hydrocarbon release spilling over the water and possibly spreading the fire.

Automatic Deluge system is considered for following areas

- 1 Main power Transformers for GTG 1, GTG2, STG
- 2 Unit Auxiliary transformers.
- 3 Turbine oil tank and oil treatment Area.

For Gas turbine combustion Chambers Dry powder type portable extinguishers are considered.

For Diesel Driven fire water Pump, electrical motor driven pump and jokey pump – Dry powder type portable extinguishers are considered.

Portable Fire Extinguishers:

The portable fire extinguisher shall be suitably distributed in the entire plant in accordance with IS : 2190 and with respect to the requirement under Fire Prevention and life safety measures act (NFPA 10).

As per design 'ABC' Powder type & 'CO2' type Fire Extinguishers will be stored in each 100 M2 floor area, inside the building for minor Fire Extinguishing needs. The type of extinguisher (Powder / Gas etc) will be defined by the activity carried in that area.

- ❖ 15 nos. of CO2 type extinguishers and
- ❖ 25 nos. ABC powder type are designed to be installed at various required place.

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Sprinkler System:

Sprinkler system rated at 70 Degree Celsius.

Sprinklers with Alarm valve shall be provided in entire floor area, ware house & office area.

Sprinkler piping will be of CS Pipe of IS 1239 Pipes with fittings. Each sprinkler required will be installed about 3m between each other.

Design sprinklers are provided in various areas as per below, Sprinkler systems will be standard Response Pendant Type.

40 Nos sprinklers of type K80 (K5.6) are provided for admin area.

21 Nos sprinklers of type K360 (K25.4) are provided for admin area.

96 Nos Spray nozzle for equipments size of 1/2" orifice with 90 deg angle.

Smoke detector System:

The smoke detector can be used in all areas where Photoelectric Smoke Detectors are required. The wide range smoke chamber makes the PS24 well suited for fires ranging from smoldering to flaming fires. SB Series Style bases may be used with the PS24. Current interchangeable/compatible devices are the IS24 ionization detector.

Optical Smoke Detector (office area & store area) - 50 Nos.

Following area's are covered in this System

- 1 Gas Turbine Enclosures
- 2 Gas and Lube oil Containers
- 3 Steam turbine Enclosures
- 4 Fuel area including gas metering station
- 5 operating office

***Alarm Panels**

Detection system consists of

- 1 control panel location in main room
- 2 local Alarm panels provided
- Main power Transformers
- T.G Bearings
- Turbine Lube oil reservoirs and conditioners

***Fire warning devices**

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1 Fire detection warning Horns- These are provided at suitable locations in plant & and connected to main panel. These are to provide effective warning, ensuring the safety of people and environment.

2 Rotating Light or strobe beacons - These are provided at suitable locations in plant and it should be visible from every location of plant. It shall be placed at the topmost part of the building. These are actually high efficient LEDs or Xenon flash tubes and accompany sounders to ensure alarm is recognized.

3 Manual Pull station for manual initiation of fire alarm.

Details of fire detection and fire fighting system for each of following areas.

1. Electrical and administration & control Building - For this area sprinkler, portable extinguisher and smoke detectors are considered.
2. Ware house and workshop- For this area sprinkler, portable extinguisher and smoke detectors are considered.
3. Electrical switchyard Building - For this area smoke detector and automatic extinguishers are considered.
4. Temporary Guard House - For this area CO2 portable extinguisher is considered.
5. Power Building - For this area portable extinguisher is considered.
6. Analyzer Building - For this area dry powder type portable extinguisher is considered.
7. Maintenance and loading area - For this area dry powder type portable extinguisher is considered.

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3. SPECIFICATIONS & MAKES.

Sr. No	Description	Material / Specs.	Makes.
A	Fire Protection System		
1	Fire pumps	CI	Kirloskar/Mather & Platt
2	Diesel engine		Cummins/Graves/KOEL
3	Motors		Kirloskar/Siemence/BB
4	Pipes	GI/MS 'B' class (IS-1239)	Tata / Jindal
5	Landing Valves	Gun Metal	New Age/Safe guard
6	Hose pipe	RRL canvas	New Age/Safe guard
7	Hose Reel	Rubber	New Age/Safe guard
8	Hose Box	MS	
9	Control valve		New Age/HD/Tyco
10	Sprinkler heads	UL/FM Approved	New Age/Tyco/viking
11	Flow switch		Honeywell/ Spray safe
12	Butterfly Valves	CI	Audco/Intervalve
13	Ball valves	Gun Metal	RB / Zoloto
14	Fire extinguishers		Mimimax /safeguard