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Design Basis Document Preparation for Fire Protection and Suppression System with Particular Reference to Paper Industry

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Abstract:

*A Fire Fighting System **Design Basis Document (DBD)** defines the goals, criteria and design rationale for a specific project's need for such system ensuring that it meets acceptable level of safety by documenting the scope, components, applicable codes and standards and key design decisions like fire ring, pump capacities and hydrant locations*

DBD needs to be prepared and presented to the client by consultant before the bidding for such system can start. The document needs to be discussed between client and the consultant and to be agreed upon.

Normally, the relevant fire codes are a general narration, not specific to any process entity, and are very exhaustive in nature. Also, it leaves the onus of selection of measures for firefighting to the end users. So, end user along with relevant experts (consultants) have to agree on the scope that suits them and covers and mitigate all perceived risks

Thus, preparation of DBD upfront avoids confusions and clarifications about the scope at a later stage during the project implementation phase.

Keywords: *Design Basis Document (DBD), Fire Suppression Systems, NFPA Standards, Zone Demarcation, Fire Water Tank Capacity*

Introduction

The DBD document starts with the following:

- Name and the owner of the Project:
  - Here the basic details of the project and its owners are provided
- Brief details of the Project and its activities:
  - Here we mention the end product that the mill intends to manufacture
- Brief details of the consultant preparing DBD document:
  - The brief mention of the consultant who is preparing this DBD document on behalf of the Client
- Preamble of the DBD as:
  - "Record of the decision-making process in determining the fire prevention and fire protection for special hazards. DBD to be a living document that will continue to evolve with mutual consent as the plant **design is refined and to be maintained for any revision throughout the life of the plant"**
- Requirement of DBD document:
  - **New Project:** Mandatory for the project that is getting into implementation phase
  - **Existing Project:** to audit the existing facilities to find system shortcomings / improvements and upgrade the system with the latest technologies available in the market.

Fire Protection Philosophy

The aim of the fire protection policy is to minimize loss of life or serious injury, contain the spread of fire, detection and suppression at early stage to minimize damage and financial loss to the stakeholders

To achieve the above aims the following guidelines are followed and accordingly the equipment is supplied:

- Plant layout to be such that an incident in one area should not spread to adjacent areas
- Fire outbreak to produce alarm automatically along with manual alarm from any location in the plant
- Adequate **mobile** and **fixed firefighting** facilities are provided as agreed in this DBD

- Inclusion of **latest fire detection systems** available in the DBD, such as:
  - example, camera system using video-based fire detection
  - **IR flame detectors**
  - use of **AI technology**
- **Database of fire incidents in the similar industry** over the past decades and to ascertain that all such causes of fire hazards have been taken care of in the design
- Adequate **training** in the use of firefighting equipment to the site staff
- Define the **interfaces** of the fire protection system with other plant systems

Codes And Standards

This section defines all the codes that are going to be followed for the plant protection.

Some of the major relevant codes are as follows:

NFPA 10 : Standard for Portable Fire Extinguishers

NFPA 11 : Standard for low, medium and high expansion foam

NFPA 12 : Standard for Carbon Dioxide Extinguishing Systems

NFPA 13 : Standard for installation of Sprinklers System

NFPA 14 : Standard for installation of Standpipe and Hose System

NFPA 15 : Standard for installation of Water Spray Systems for Fire Protection

NFPA 16 : Standard for Installation of Foam- Water Sprinkler and Foam Water Spray systems

NFPA 20 : Standard for Installation of Stationary Pumps for Fire Protection

NFPA 22 : Standards for Water Tanks for Private Fire Protection

NFPA 24 : Standards for Installation of Private Fire Service mains & Appurtenances

NFPA 25 : Standard for Inspection, Testing & Maintenance of Water-based Fire Protection Systems

NFPA 72 : National Fire Alarm and Signalling Code

NFPA 204 : Standard for Smoke & Heat Venting

NFPA 850 : Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage DC converter Stations

NFPA 5000 : Building Construction & Safety Code

Other **relevant local codes** are as follows:

- National Building Code – 2016
- Indian Standard (IS) – 3844 – Internal Hydrant System
- Indian Standard (IS) 13039 – External Hydrant System
- Indian Standard (IS) 12469 - Pump for Fire Fighting System

Some special areas might have their own add on codes. These areas can be special economic zones, private or government industrial estates etc.

System Description

In this section, consultant defines in general all the systems that he thinks will be applicable for the project in question.

This entails:

- **Detection, Alarm and Control System –** This gives brief mention of different types of fire detectors, gas detectors, control cabling, fire alarm panel, central monitoring station, repeater stations, annunciations, control panels, local panels etc.
- **Smoke and Heat detectors –** Suitable for installation in clean vision and in dusty areas.
- **Manual Break Glass Boxes –** as a manual call point strategically positioned within reach along the path of escape, exit doors and in large rooms
- **Alarm System –** on receiving alarm notification, FACP need to send an alarm output. This alarm output is in the form of either bell, horns or strobe.
- Fire Alarm Control Panel (FACP) – Bain of the fire detection and alarm system, responsible for monitoring various alarm inputs and then activate output devices such as horns, bells, warning lights etc.

  Pre-action type has their own local control panel that communicates with CCU.
- Fire Suppression Systems – normally consists of hydrant system, spray system. Foam system and portable fire extinguishers

Desgin Criterion

In this section, following are defined:

- Hazard classification of various plant sections
- Design for the following:
  - Fire water pump house (including jockey pump) with water storage sizing – explained in detail below in the document
  - Sizing supply piping to fire water tank - explained in detail below in the document
  - Selecting final design parameters of fire pump considering requirement of both hydrants and spray systems - explained in detail below in the document
  - Design of main fire ring with fire hydrant location at strategic points covering the whole plant layout - explained in detail below in the document
  - Design of spray systems
  - Prepare flow schemes for hydrant / spray / foam systems
  - Specifications of piping, valves, pumps etc.
  - Specifying detection system
  - Specifications of control / monitoring system
- Design Concepts for Firefighting components with sufficient details:
  - Hydrant System:
- Indoor and outdoor
- Wet Vs. Dry type

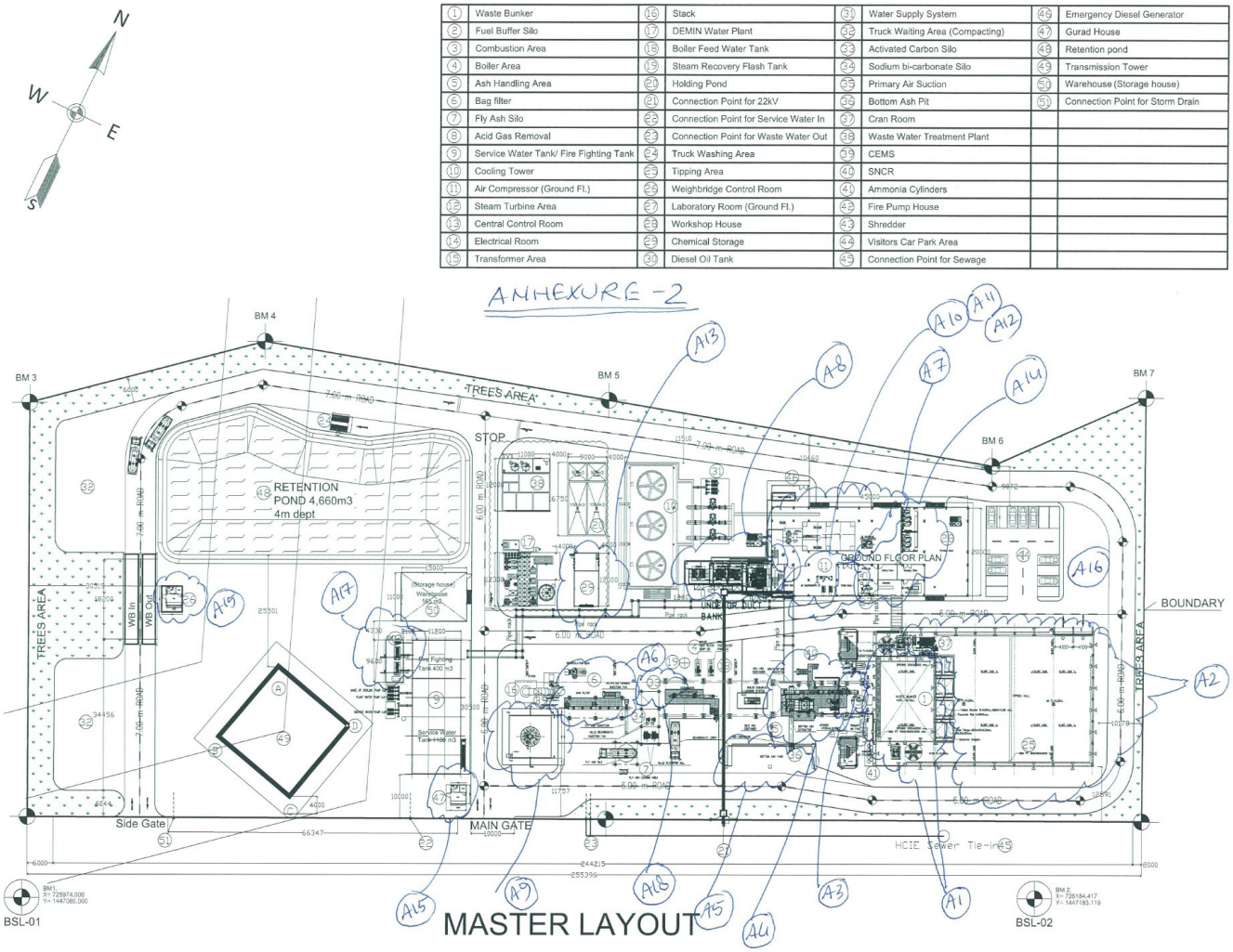
  –Mostly depends on the prevailing climatic conditions. Too cold climate, dry system is preferred for fear of freezing out
- Fire ring (underground Vs. overground)

  –Mostly depends on the operational staff preference and the prevailing climatic conditions
- Isolation valves, branch pipes, nozzles, hose boxes
- Standpipe and hose systems inside building and in plant areas with vertical footprint
- Water Spray System:
  - Automatic sprinklers – either pendant type or up-right type
  - Water cannons – specific to some areas
  - Pre-action System – mostly used for the turbine and generator bearings
- Foam Protection System – mostly for the furnace or diesel oil tank
- Fire Extinguishers – to be specified for various areas with locations
- Fire Pump House:
  - Fire water source
  - Fire pumps
  - Specifications of pumps
  - Design criterion for hydrant pump flow rate
  - Description of piping layout and schematic

Zone Demarcation For The Project

As the different areas and equipment in those areas need different protection systems, so for the scope definition the whole area is demarcated in separate zones, and a symbol is assigned to each zone.

Fig -1 below is a Waste to Energy (WtE) power plant layout that has been demarcated in different zones:



1	Waste Bunker	16	Stack	31	Water Supply System	46	Emergency Diesel Generator
2	Fuel Buffer Silo	17	DEMIN Water Plant	32	Truck Waiting Area (Compacting)	47	Gurad House
3	Combustion Area	18	Boiler Feed Water Tank	33	Activated Carbon Silo	48	Retention pond
4	Boiler Area	19	Steam Recovery Flash Tank	34	Sodium bi-carbonate Silo	49	Transmission Tower
5	Ash Handling Area	20	Holding Pond	35	Primary Air Suction	50	Warehouse (Storage house)
6	Bag filter	21	Connection Point for 22kV	36	Bottom Ash Pit	51	Connection Point for Storm Drain
7	Fly Ash Silo	22	Connection Point for Service Water In	37	Cran Room		
8	Acid Gas Removal	23	Connection Point for Waste Water Out	38	Waste Water Treatment Plant		
9	Service Water Tank/ Fire Fighting Tank	24	Truck Washing Area	39	CEMS		
10	Cooling Tower	25	Tipping Area	40	SNCR		
11	Air Compressor (Ground Fl.)	26	Weighbridge Control Room	41	Ammonia Cylinders		
12	Steam Turbine Area	27	Laboratory Room (Ground Fl.)	42	Fire Pump House		
13	Central Control Room	28	Workshop House	43	Shredder		
14	Electrical Room	29	Chemical Storage	44	Visitors Car Park Area		
15	Transformer Area	30	Diesel Oil Tank	45	Connection Point for Sewage		

Fig - 1

The definition of the various zones is as below:

- Waste Bunker building A1
- Tipping hall building (including shredder) A2
- Boiler burner station A3
- Boiler building A4
- Ash Handling area A5
- Bag House A6
- Steam Turbine area (Incl. Emergency Diesel Generator) A7
- Transformer area A8
- Fuel Oil Storage A9
- Cable room A10
- Switchgear & MCC rooms A11
- Main control room / Satellite control rooms A12
- Chemical storage (incl. NH3 handling) A13
- Admin Building A14
- Small houses (incl. de-min plant) A15
- Open space including plantation A16
- Fire pump house A17
- Activated carbon silo A18

Subsequent to the zone demarcation, the proposed fire protection and suppression systems are defined and agreed upon with the client before floating the Tender for the firefighting system.

Just for example, some of the main systems are presented below:

A 7 - Steam Turbine Area:

This area in the drawing is designated as A7

This area to have following system for fire detection and protection:

Fire Detection:

- Rate anticipation heat detectors for the pre-action system to be installed near the bearings (total 6 bearings)
- Manual call point
- Motor alarm bell / horn / strobe
- Pilot sprinklers for the pre-action system
- Sprinkler head detection for the turbine underneath (for the oil containment area)

Fire Suppression:

- Turbine is the main asset to be protected in this area. All the bearings in the turbine area to be protected with **Pre-action system** with deluge valve

- Turbine hall to be protected with the help of indoor fire hose racks strategically placed on the operating floor and ground floor as per standards
- **Automatic sprinklers over the hydraulic oil containment area (able to contain all the hydraulic oil + water spray for fire suppression)** created on the ground floor of the turbine house
- Automatic sprinklers for the hydraulic unit and hydraulic lines (as this is an integral turbine so the physical possibility for sprinkler system installation to be studied)
- **Fire walls** for 2 hrs rating between the turbine hall and adjacent buildings like control room and administrative block
- **Smoke vents** for the turbine building (Turbine building has louvres on the north side so in case, if fans are installed on the south side roof, then the smoke vents might not be required but in such case the electrical cabling to the fans to be fire resistant)
- Fire extinguishers (dry type)
- Portable CO2 fire extinguishers

Relay module would be provided by fire-fighting system supplier to send signal for necessary action

A 8 - Transformer Area:

This area in the drawing is designated as A8

Transformer area will be having the generator transformer and two (2) auxiliary transformers. Transformers are of oil filled type, so they need fire protection system

This area to have following system for fire detection and protection:

Fire Detection:

- Heat detectors installed over the transformers
- Automatic pilot sprinklers for deluge valve actuation

Fire Suppression:

- **Deluge valve** (hydraulic actuation) system
- Spray nozzles connected to deluge valve system
- Portable fire extinguishers (outdoor type)
- **Fire walls** with two (2) hour fire rating would be provided between all the three transformers and also on the either side as per the regulations of NFPA

A 9 - Fuel Oil Storage:

This area in the drawing is designated as **A9**

This area comprises of fuel oil unloading, transfer, storage and pumping system

This area to have following system for fire detection and protection:

Fire Detection:

- Rate anticipation heat detectors

  OR

- Pilot sprinklers for deluge valve actuation (might be at two levels)

Fire Suppression:

- **Deluge valve** (hydraulic actuation) system
- Spray nozzles connected to deluge valve system
- **Fire hydrant** installed near the tank area (from the fire ring main located in the vicinity)
- Foam bottle that can be attached to the fire hydrant through an eductor nozzle to mix along with the water for spraying
- Portable fire extinguishers (outdoor type)

In general:

- For a paper mill, the **major areas of concern** that needs special attention are as follows:
  - **Chips bulk storage:**
    - Fire hydrants all around the storage areas to cover with overlapping zones
  - **Coal yard:**
    - Fire hydrants all around the storage areas to cover with overlapping zones
  - **Finished goods storage area:**
    - Video assisted fire detection / IR flame detectors
    - Along with smoke detectors as usual (aspirated smoke detectors preferred for early detection of fire)
  - **Paper machine:**
    - All hydraulic units with foam spray
    - Spill containment (to avoid oil going to the ETP)
    - Separate storage of lubricants in a dedicated building
    - Dry broke collection below dryers – as mentioned above with IR detectors or video assisted
    - Special cameras to detect hot spots for some locations of concern
  - **Natural gas handling areas:**
    - Either dry powder, foam or gas-based systems (inert or clean agents)
  - **Turbine hall:**
    - Rate anticipation heat detectors for pre-action system for turbine bearings
    - Pilot sprinklers for pre-action system
    - Sprinklers for the turbine underneath (for the oil containment area)
    - CO_2 suppression system (if turbine has enclosure)
    - Smoke venting for the turbine hall
  - **Transformers:**
    - Heat detectors over the transformers
    - Automatic pilot sprinklers for deluge valve actuation
    - Deluge valve (hydraulic actuation)
    - Fire walls with two (2) hours fire rating between the transformers (if located adjacent to each other)
  - **Fuel oil storage:**
    - Rate anticipation heat detectors OR pilot sprinklers for deluge valve actuation (preferably at two levels)
    - Deluge valve (hydraulic actuation)
    - Foam bottle to be attached to fire hydrant through an eductor nozzle to mix along with spray water
    - FHC
  - **Chemicals (like methanol etc.):**
    - Smoke detectors
    - Sprinkler head detection
    - For Methanol area (the automation and cables to be fire resistant)
  - **Boiler: (particularly burner station):**
    - Fire hose rack at each floor level by the side of staircase
    - Fire extinguishers at suitable locations
    - Alarm bell and manual pull stations
    - Particularly for burner station:
      - Sprinkler head detection
      - Manual pull station
      - Sprinklers for the firing isles including the area 20 ft. beyond the burners and over nearby cable trays
      - Drip tray below the burner station
      - Floor below firing isle to be of RCC construction
      - Protection sleeves over flanges on burner station to avoid spillage in case of a gasket failure
      - Interlock of main inlet fuel valve to burner station with the fire alarm system. Boiler supplier to accept digital signal from fire panel to shut off the valve in case of fire

- **Electrical rooms:**
  - Smoke detectors
  - Manual pull station
  - Motor alarm bell / horn / strobe
  - Portable CO2 fire extinguisher
  - Smoke exhaust from room
  - Some MCC panel direct injection of CO2 or other safe gases (MCC panel supplier to be consulted for such arrangement)
- **Cable alleys:**
  - Smoke detectors
  - Sprinkler head detection / Some prefer deluge system

- Various hydraulic units throughout the plant:
  - All hydraulic units with foam spray
  - Spill containment (to avoid oil going to the ETP)

Detail Design Of The Systems

Based on DBD agreed with the client, the Tender is floated, and the Contractor for the job is finalized. Contractor first prepares the PIDs for each zone and subsequent to that the layout of the detectors and suppression elements is prepared.

Onward presentation, some examples of the PIDs & layouts for the above explained zones are presented in **Fig – 2 – Fig – 9 / Table – 1 to Table – 2.**

Fire Ring Main Layout:

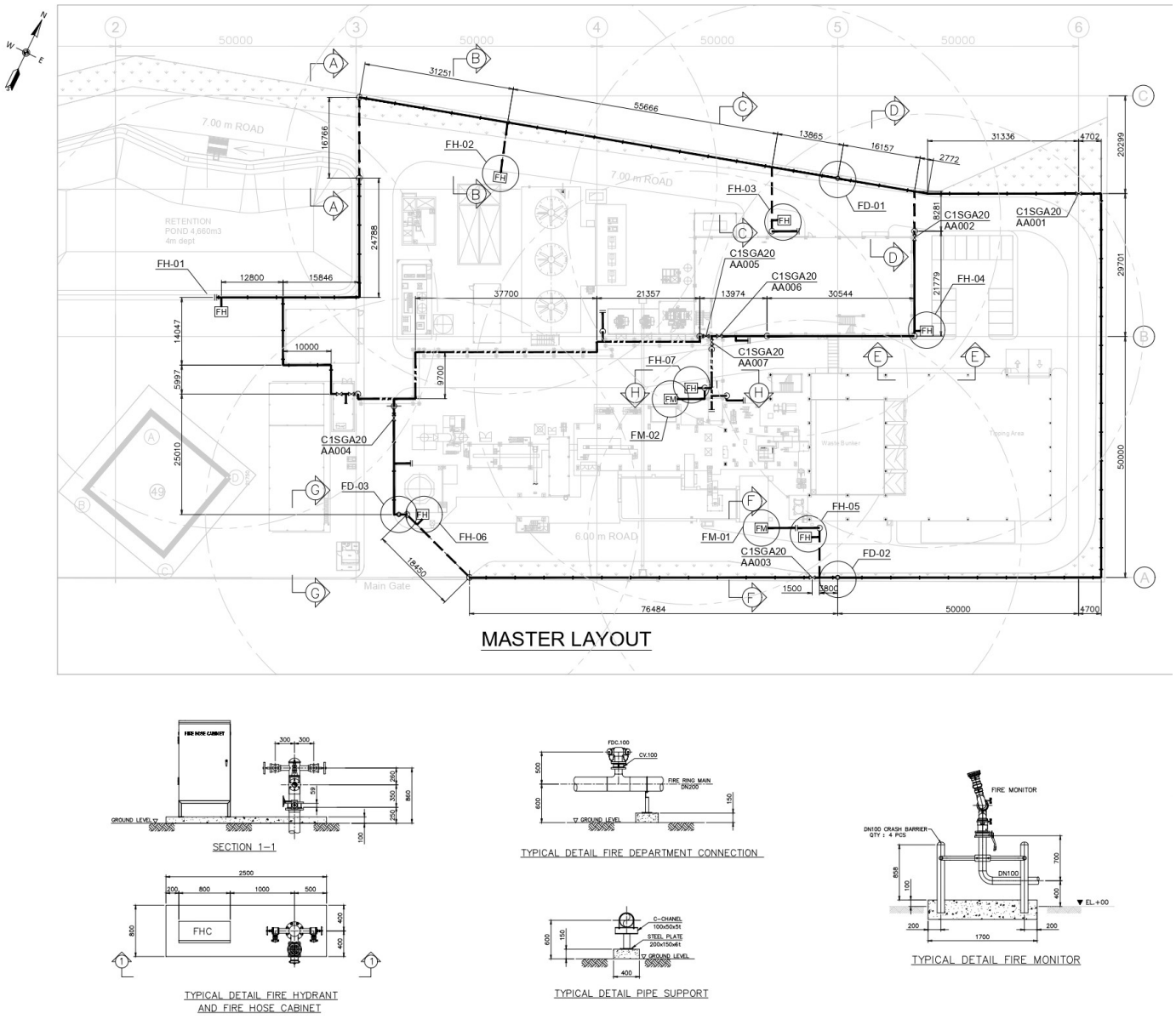


Fig - 2 Typical Fire Ring Main Layout

PID for Turbine House:

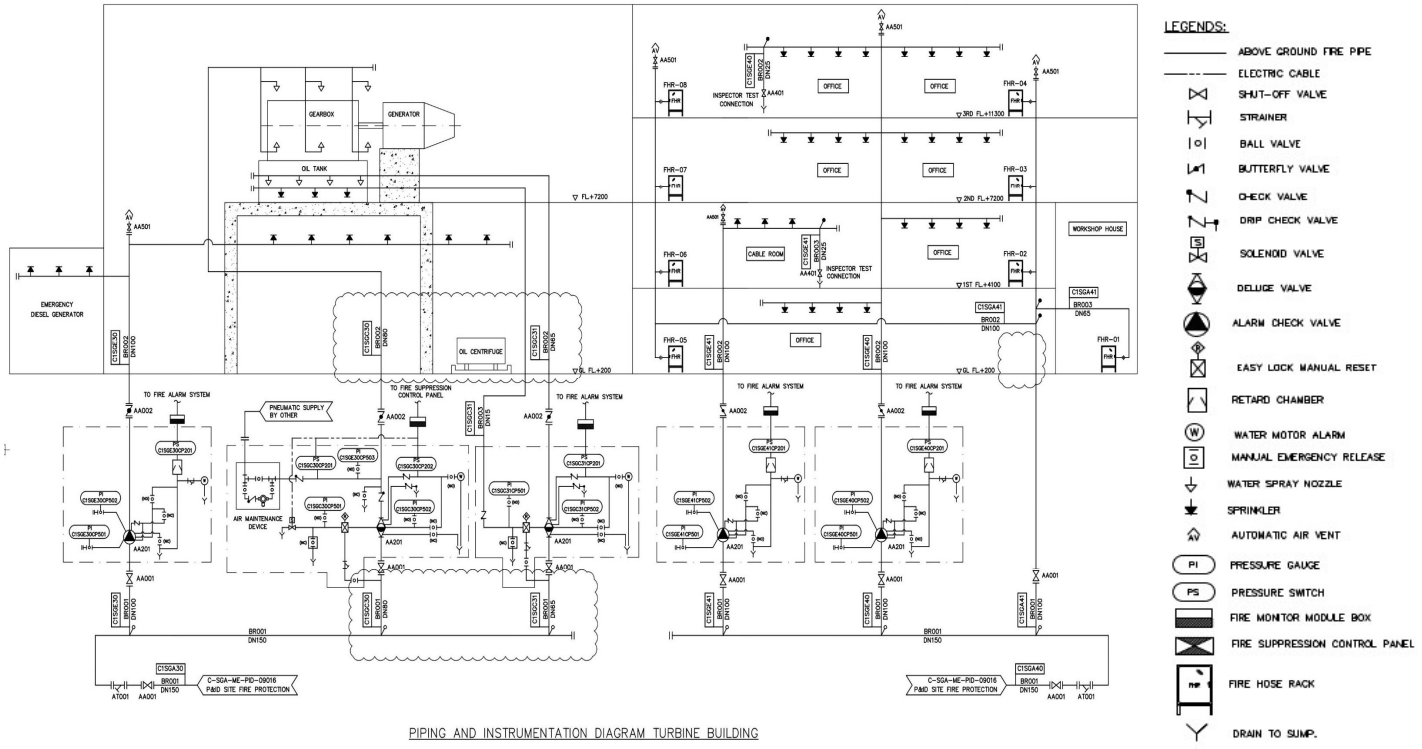


Fig - 3 PID for typical turbine house

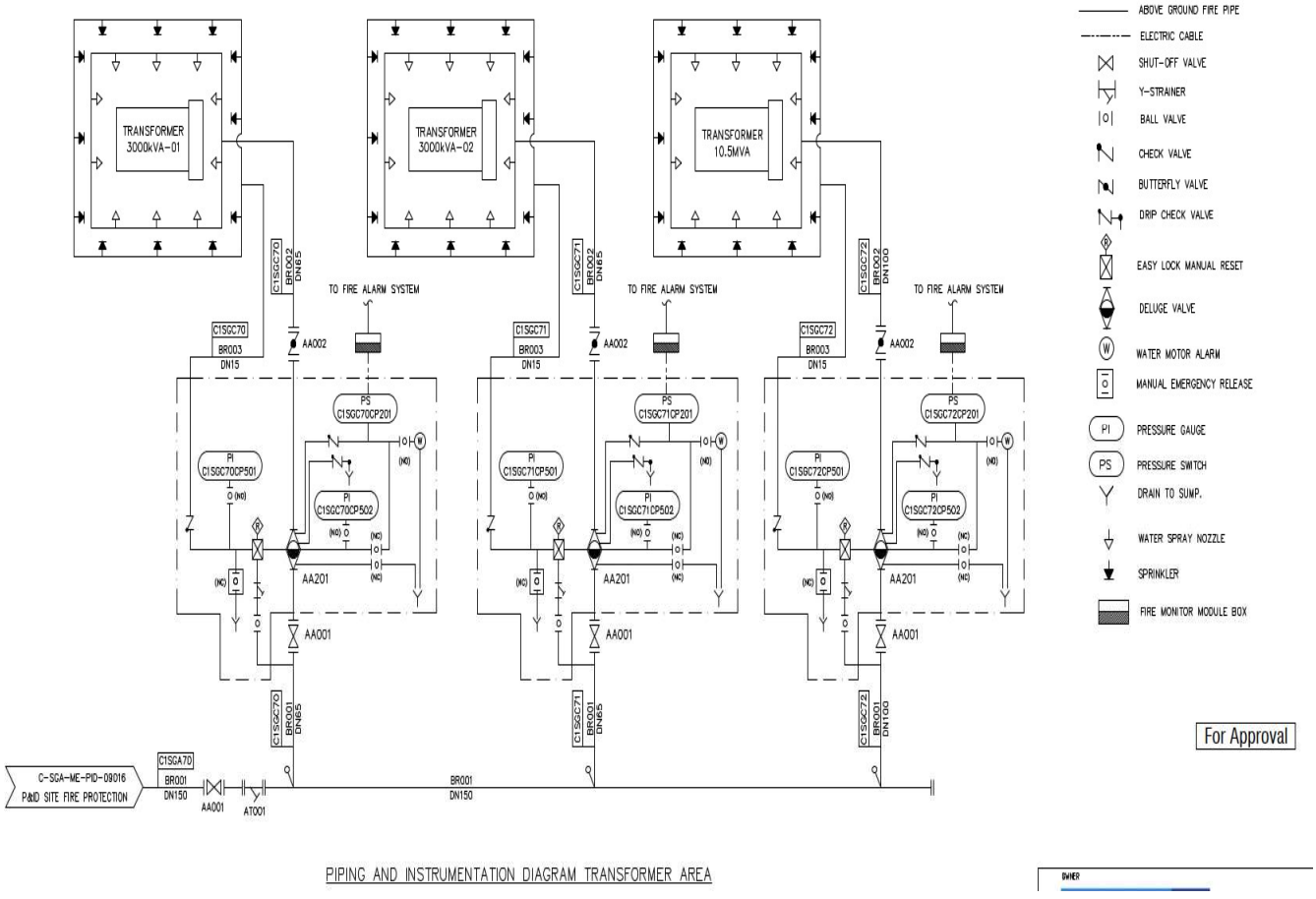


Fig - 4 PID & GA drawing for Transformer area

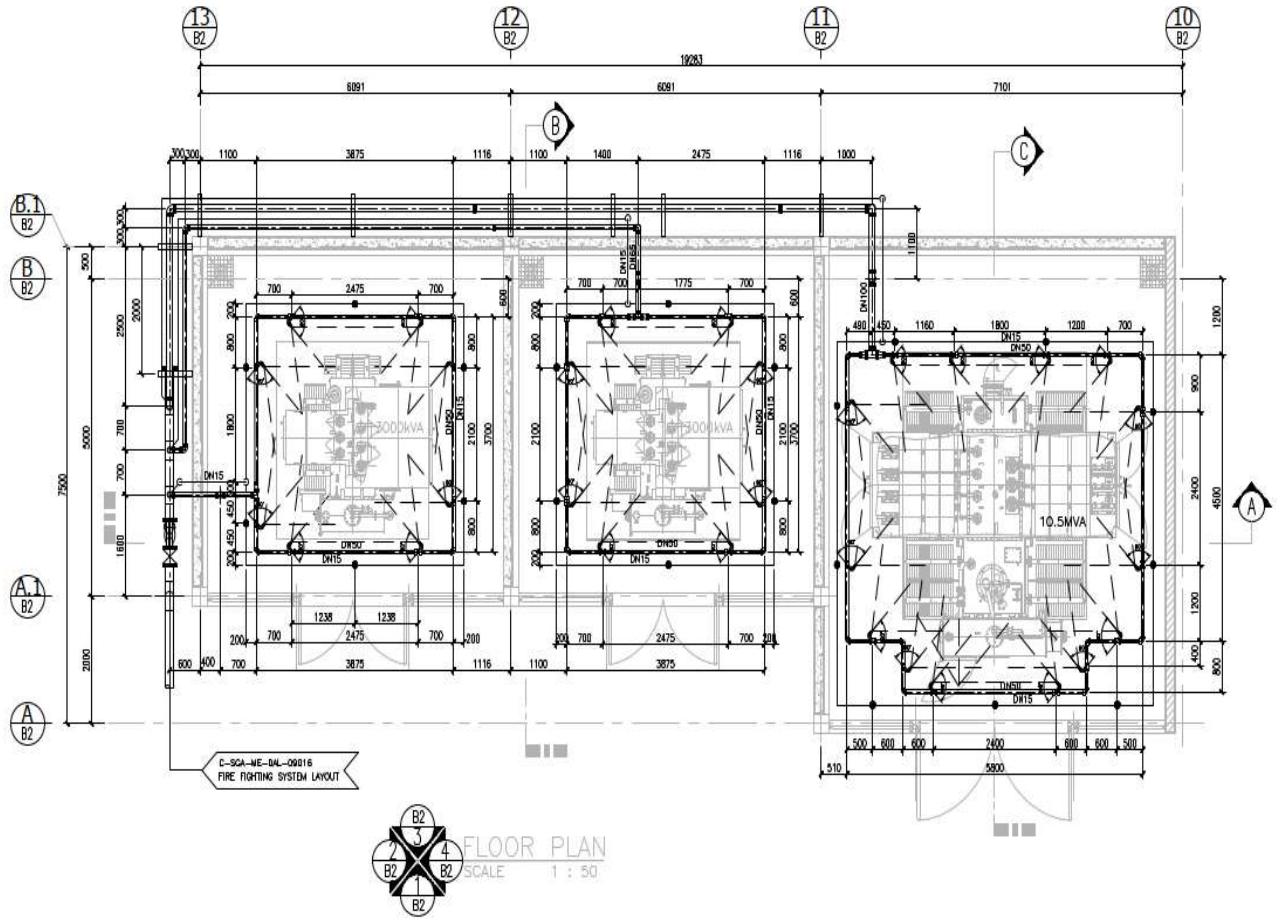


Fig - 4 PID & GA drawing for Transformer area

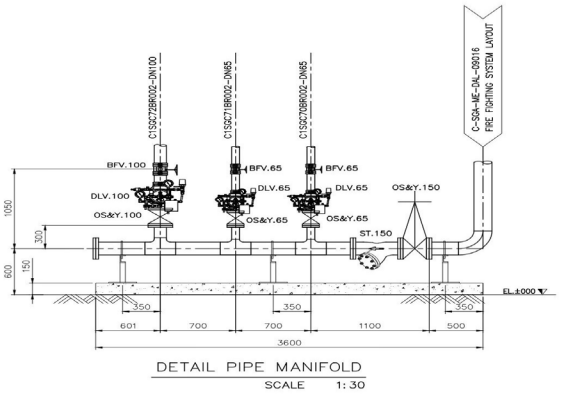


Fig - 5 Pipe Manifold details

Table - 1: Transformer nozzle table

NOZZLE TABLE				
LOCATION	DESCRIPTION	SPRAY ANGLE	K–FACTOR	Q'TY
3000kVA–01	VICTAULIC STYLE.V12	110°	1.2	12
3000kVA–02	VICTAULIC STYLE.V12	110°	1.2	12
10.5MVA	VICTAULIC STYLE.V12	110°	1.8	18

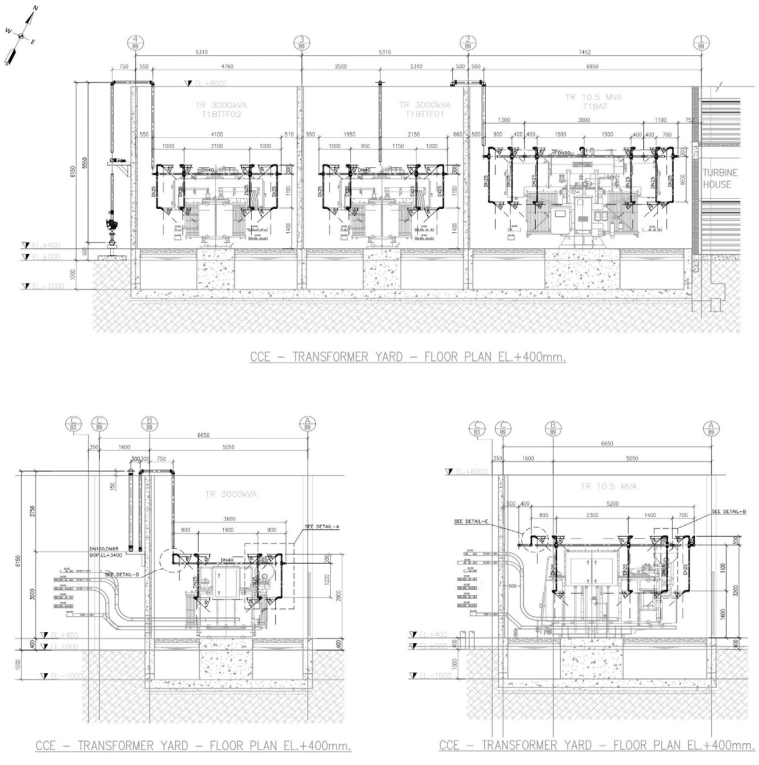
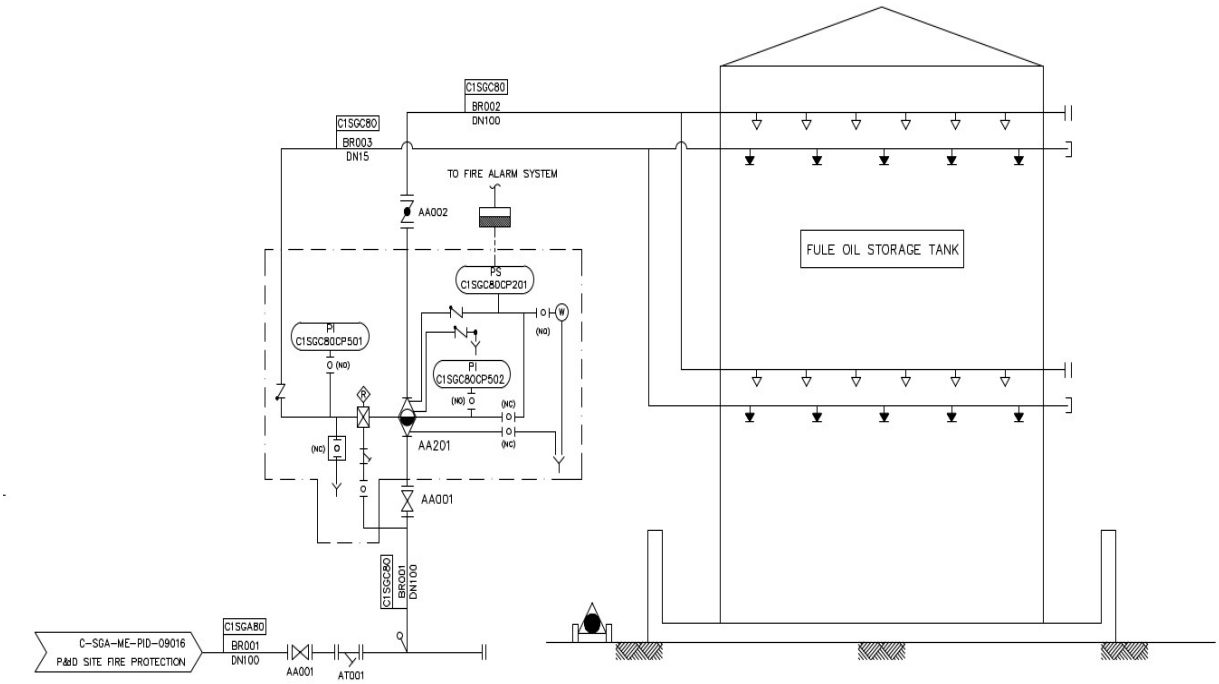
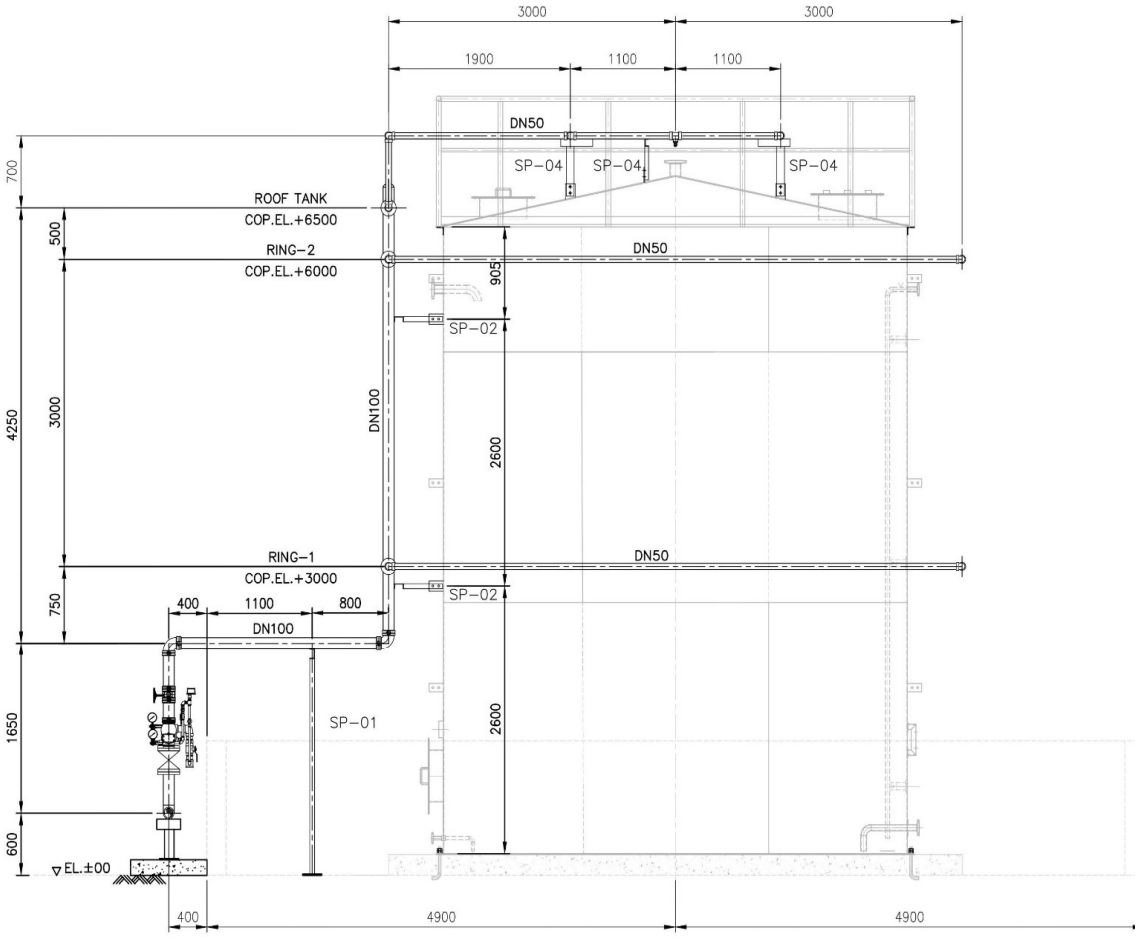


Fig - 6 Transformer yard – Piping elevations



PIPING AND INSTRUMENTATION DIAGRAM FUEL OIL STORAGE

Fig - 7 PID fuel oil tank storage tank



SECTION A-A

Fig - 8 GA drawing Fuel oil storage tank

Table - 2: Spray nozzle and pilot line for nozzle – Fuel oil storage tank

SPRAY NOZZLE AND SPRINKLER FOR PILOT LINE TABLE				
LOCATION	DESCRIPTION	SPRAY ANGLE	K–FACTOR	Q'TY
RING–2	VICTAULIC STYLE.V12	140°	1.8	6
	VICTAULIC MODEL.V27	–	5.6	4

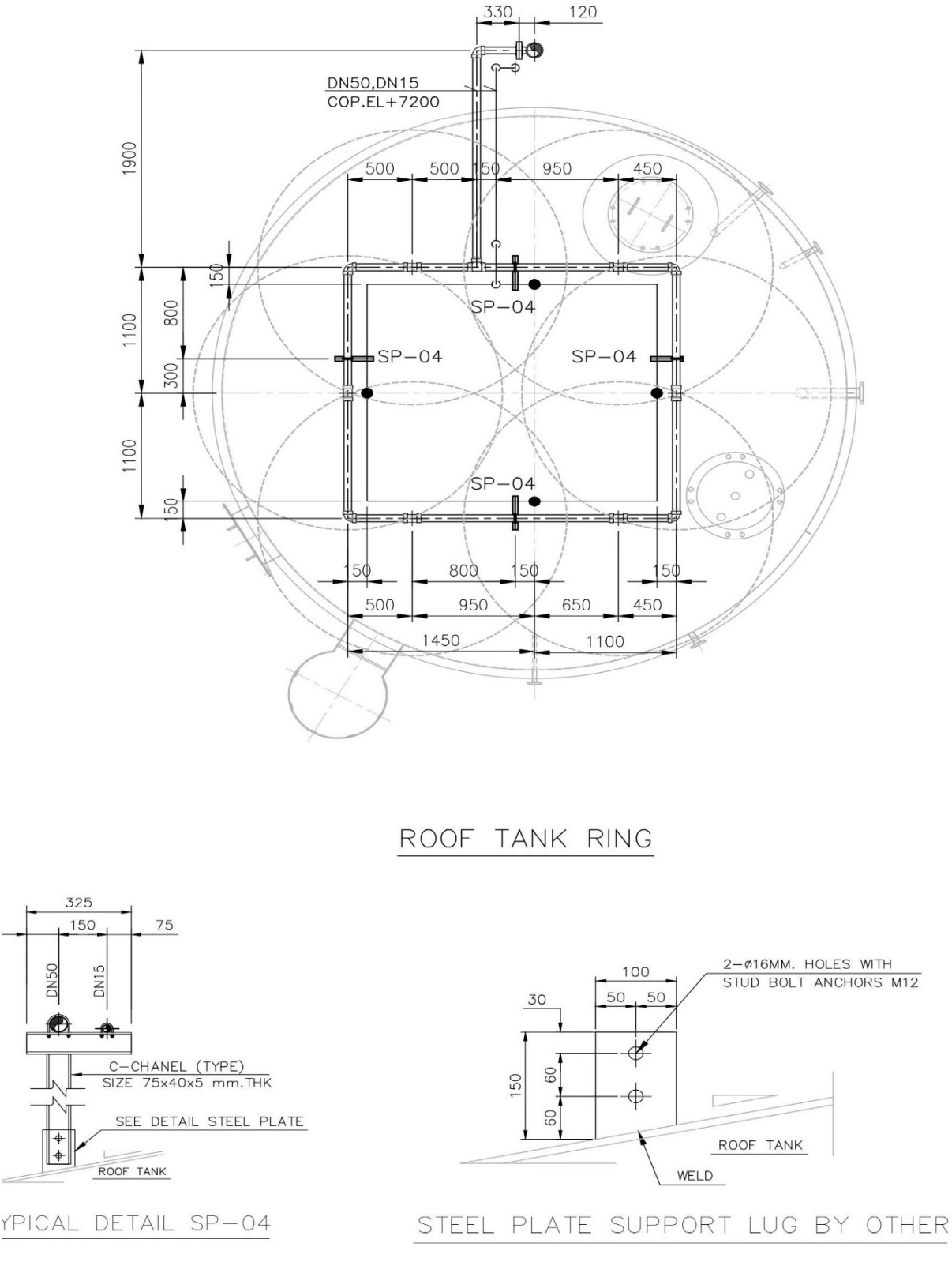


Fig - 9 Fuel oil tank roof plan sprinkler system

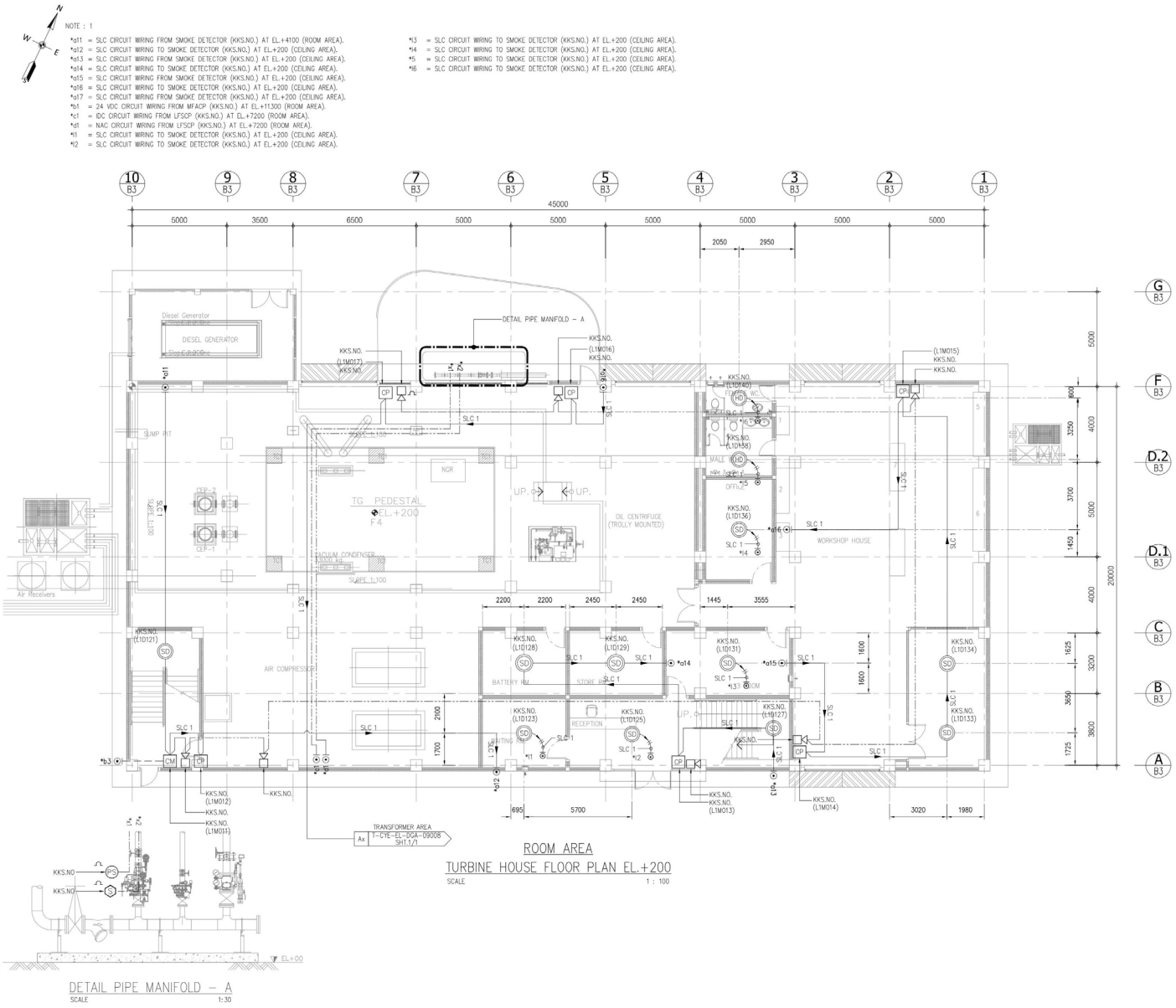


Fig - 10 Fire alarm and detector layout for Turbine area

Fire Tank Capacity Calculations

Fire tank capacity determination to be done in accordance with the NFPA 850 requirements. As per NFPA 850, the following clauses would be the main guidelines for the calculation of the fire water tank capacity.

- Chapter 5 – Clause 5.1.4 (for outdoor oil-insulated transformers)
- Chapter 6 – Clause 6.2.1(water supply)
- Chapter 7 – Clause 7.3 (for fuel-oil Handling)
- Chapter 7 – Clause 7.5.1.1 & 7.5.1.2 (for burner station)
- Chapter 7 – Clause 7.7.4 (Turbine generator areas & Turbine- generator bearings)
- Chapter 7 – Clause 7.8.2 (for cable spreading room and cable tunnels)
- Chapter 9 – Clause 9.3.3.1 (for tipping and receiving hall)
- Chapter 9 – Clause 9.3.3.2 (for MSW storage pit, charging floor, grapple laydown areas)

As per **NFPA 850,** for fire water requirement:

- **Largest fixed fire suppression demand** to be considered
- One **hose stream of 500 gpm (1890 lpm)** to be added to it in all cases
- Water supply for permanent fire protection should be based on **2-hour supply**

Based on the above guidelines, we have to select the largest fixed fire suppression systems for comparison. In a paper mill, we can identify them as follows:

- Raw material storage (Coal and wood logs / Wood chips)
- Finished goods storage
- Waste tipping hall
- Transformer bay
- Fuel oil storage tanks
- Turbine house

Just for an example for one project, the largest fixed fire suppression systems were identified as below:

Typical fire water requirement calculations are presented in Table - 3:

Table - 3: Fire Water requirement for different plant system

FIRE WATER REQUIREMENT FOR DIFFERENT PLANT SYSTEMS

NPFA design water tank 2hrs volume;

Building	System	Area consider	m2	lpm/m2	Qty	lpm	Remark
Waste bunker	Sprinkle	Roofing	279	8.1		2,259.9	
		Control Room Window	20	8.1		162.0	
	Water Spray	Waste Hopper	56.7	8.1			Waste hopper part of overall sprinkler system
	Monitor	Cannon		946	2	1,892.0	
	Hose	-				1,890.0	Waste bunker has no fixed hose but 2 water monitors
	Total consumption					6,203.9	
	2hrs water voulme [m3]					**744.5**	
Tipping Hall	Sprinklers	Hall area	279	12.2		3,403.8	Total hall area is 1130 m2
	Hose	Tipping hall				1,890.0	
	Total consumption					5,293.8	
	2hrs water voulme [m3]					**635.3**	
Turbine	Sprinkler	Turbine bearings	8	12.2		-	Figure not available now but not very large
		beneath (ground floor)	464	12.2		5,660.8	Oil containment area would be provided below the turbine floor
	Hose	Turbine building				1,890.0	
	Total consumption					7,550.8	
	2hrs water voulme [m3]					**906.1**	
Transformer	Deluge	Top + side	96	10.2		979.2	
		Fuel tank	9.4	10.2		95.9	
	Hose	Transformer area				1,890.0	
	Total consumption					2,965.1	
	2hrs water voulme [m3]					**355.8**	
Diesel oil Tank	Sprinklers	Roof	19.64	10.2		200.3	
		Shell	78.54	10.2		801.1	
	Hose	Diesel tank area				1,890.0	
	Total consumption					2,891.4	
	2hrs water voulme [m3]					**347.0**	

So as can be seen from the above Table - 3 that the **maximum demand occurs in the turbine hall.**

So:

- The fire water requirement would be considered as **900 m3**

Irrespective of calculated water demand, it is always advisable to have the fire water source to be of substantial supplier of water. For this it is suggested:

- A large fire water tank
- Water clarifier can be connected to the fire pump system
- If mill has a storm water storage or a green lake to store rainwater, then it can be a good source of fire water supply

Author's Experiences With Fire Accidents

Incident 1 – Fire in the Rice Straw Storage Yard

While working in a paper mill based on rice straw in Madhya Pradesh in 1985, there was a huge fire in the straw storage yard. Virtually all the stored straw got burnt down.

There were no measures for the firefighting available in the mill. The fire was so ferocious that in the radius of around 3 – 4 km people could feel the heat of it

Lesson from it:

- Raw material storage is one such area where the temperatures inside the material pile can reach to such proportions that it can propagate the fire. Particularly those areas where the summer are very dry and the temperature reaches up of 45 degrees are susceptible to such fire hazards.

Incident 2 – Fire in the Pulp Mill

While working in a paper mill based on bamboo in Assam during 1990, there was a huge fire in the pulp mill mezzanine floor. Within hours all the electrical and control cables were burnt down. The mill was forced to shut for over 2 – 3 months.

Reason for the fire was bad housekeeping. Lot of pulp from pulp deckers overflow has deposited on the cable trays below and this pulp caught fire somehow.

Lesson from it:

- Good housekeeping practices. There should be no deposition of fibres or flammable dust on the cable trays

Incident 3 – Fire in the Turbine Hall

While working in a paper mill in Thailand, the Mitsubishi 29 MW turbine got fire and was completely burnt out. This happened in year 2001.

Fire was so widespread along with the smoke and soot that it was not possible to even take few flights of the staircase and it was impossible to reach the turbine floor. The chronology of the events was as below:

- The turbine was under rolling (not synchronized to the grid) after a routine maintenance
- Investigation revealed a faulty maintenance on the feedback rod that allowed the locknut to get loosened and sending signal that the turbine is stalled, thus opening of governor and in-rush of steam, causing the turbine to go over speeding and bearing heat up
- The fire started in the hydraulic circuit of the turbine and spread throughout
- Turbine had no fire protection system in place
- Turbine had an enclosure
- It took almost one year to get the new turbine and commission it

Lesson from it:

- To be extra careful about while the turbine is under rolling and not synchronized to the grid
- Turbine hall building should have good ventilation to exhaust the smoke or have the smoke vents
- Firefighting systems were installed later on for the new turbine

Incident 4 – Fire in the Biomass Storage

While working in a biomass power plant in Thailand, there was a fire incident in the biomass (rice husk, bagasse etc.) storage. This happened in year 2017.

Fire started around 10 AM and it took almost 8 – 10 hours to quell the fire completely. Reason of the fire was not known.

There were no fire hydrant and water ring around the biomass storage yard. Every time the fire tender has to travel to the nearest water ring filling point to fetch water. This delayed the fire dousing operation a lot and caused lot of biomass fuel to get burnt

Lesson from it:

- Fuel storage to have the water ring all around with fire hydrants or water monitor located as per NFPA guidelines.
- Water supply source for the fuel storage area should be huge as the fire in such areas spreads fast depending upon the wind conditions

Potential New Sources Of Fire In The Industry

Based on the new development world-wide, some unaccounted technologies and equipment creep into the industry and their potential threats are not yet taken seriously.

As per author, the following are the new threats to paper industry that should be taken care of to avoid any fire hazard in future.

1. Solar Panels

Now a days there is a trend of installing **roof top solar panels.** This is a very popular trend as it helps the industry to lower their carbon footprint.

For the mills where the summer temperatures tend to reach close to 50 deg C, there is a risk of panel getting burnt. So, the mills should take special care in:

- Panels that can operate at higher temperatures without any damage
- To provide the cooling system for the panel in case of temperatures reaching the threshold point

2. NGV (CNG) and Electrical Vehicles

The automobile industry is moving towards NGV and electrical cars these days. This is also applicable for the two wheelers. These vehicles are susceptible to fire hazard

It is advisable to have separate parking areas for such vehicles. If the parking is common, then isolate these areas with a firewall.

In many countries, parking lots in the buildings, the NGV vehicles are not allowed inside.

In a recent accident in **Vietnam,** in a residential building, the electrical two wheelers were parked in the basement with people residing in upper floors. One vehicle caught fire and the fire spread to all the vehicles. None of the resident could move out and all perished due to fire and smoke

3. Paper Machine Basement with Dry Broke

Based on author experience, this is one of the area most susceptible to fire incident and most of the time there might not be any personnel in those locations.

Most of the paper machine fires have started from these locations. It is advisable that for these locations:

- To install the **IR flame detectors** – this detects the fire as soon as it starts and alarm the staff

Conclusions

- NFPA is a very general document, and it covers all the facets of fire probability and is not industry specific. So, the document becomes quite exhaustive covering many scenarios. The customer and the consultant to choose what is relevant to their plant.
- Sometimes the NFPA might not be able to cover a specific situation properly. One such problem faced by me for the turbine hall as below:
    - Turbine was installed over the hydraulic tank at the 7 m floor with all fire detection and protection measurements

- Still the NFPA mentioned the area below turbine floor to be extensively covered with sprinklers though there was no hydraulic system below the turbine floor. Client insisted on providing this
- Clarifications sent to NFPA for this got the normal response what is mentioned in the code, and this is normally the case for any such query to NFPA

- Fire pumps to be **UL/FM** approved. Sometimes the insurer might make it as an excuse not to entertain a claim. This to be clarified with the insurer before any contract with them
- Normally the mills put a lot of emphasis on fire detectors and suppression elements but vary little attention is paid to the **smoke handling.** In many fire incidents, it is smoke that hampers the approach to the area of concern. Some advice:
  - Smoke vents to be provided for such areas that are enclosed with not so good ventilation and having bulk storages
  - Smoke vent calculations are quite complicated as they depend on the building geometry. So, need to be done with some expert on this
  - The building stairways should have exhaust at every landing, and they should be connected to the fire alarm system to operate in case of fire. This helps people safe evacuation through the stairways
- **ATEX** areas to be defined and special cables and explosion proof instruments to be used in such areas
- Most modern fire detection elements to be used like **aspirating smoke detection, spark detection systems** for dust pneumatic conveying lines, **wireless monitoring options** for difficult areas
- **Fire water supply source –** The mill should preferably have a bigger fire water storage like a green lake or a storm water storage pond

Fire Alarm Control Panel – Use latest technologies to transmit wireless signals to the concerned authorities in case of a fire.