TECHNICAL SPECIFICATION FOR APPROVAL OF DESIGN & INSTALLATION OF FIRE DETECTION AND PROTECTION SYSTEM AS PER TAC

PROJECT	**4 x 225 MW ARUN-3 HYDRO ELECTRIC PROJECT, NEPAL**
CUSTOMER	**SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC)**

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1.0 INTRODUCTION:

This specification covers the scope of work, inspection and documentation for Approval of Fire detection and Protection system (FDPS) as per TAC guidelines for 4 x 225 MW ARUN-3 HEP near Khandbari town in Sankhuwa sabha district of Nepal.

Scope of work shall include drawing review and approval, inspection of facilities (PDPS) at site and report submission by Agencies.

Design, Engineering & supply of Fire protection & detection system and Installations for this plant is in the scope of Project Engineering & systems division (PE&SD), BHEL, Hyderabad. Erection of FDPS at site is by PSER, BHEL.

As per Customer Specification requirement, Design and Engineering and Installation of the complete fire protection & detection system is to be carried out as per relevant TAC/NFPA/Equivalent International standards. Accordingly, Fire protection & detection system is being provided for all the buildings, facilities and equipment for this power plant as per relevant TAC/IS/NFPA Standards.

2.0 INTENT OF SPECIFICATION:

1. The intent of this document is to establish the requirement of **Review & Approval** of all the engineering documentation of fire protection and detection package of 4 x 225 MW ARUN-3 HEP. The engineering documentation includes the documentation of all the sub-systems of fire protection and detection system package as well as Interface Engineering Documentation.

2. The design information, specifications and drawings as part of the annexures indicate the "Minimum" requirements and are intended to enable Bidders to ascertain the extent of the work involved.

3.0 INSTRUCTIONS TO BIDDER:

1. Bidders are advised to contact BHEL for any technical queries in writing within one week of issue of this Enquiry. In the event of any conflict within the specification, data sheets, related standards, codes etc. the vendor shall refer the matter to the purchaser for clarifications before bid submission. The discrepancies/queries raised after pre-bid stage or during order execution stage, it shall be binding on the bidder to comply with the final decision made by the BHEL without any techno-commercial implications.

2. Offers with incomplete information will not be considered for evaluation, and are likely to be rejected outright without any further interaction with the Bidder.

3. Bidder to refer to the Special Conditions of the contract (SCC) & General Conditions of the Contract (GCC) of tender specifications.

4. All such clarifications required by the bidder shall be intimated to BHEL together as a single notice within a week of receipt of enquiry by bidder in Deviation format attached as Annexure-9. In case no such clarifications are sought during pre-bid stage, it will be assumed that bidder has no comments or observations on BHEL's specification and no deviations to the specifications will be taken by the bidder in their Technical Bid.

4.0 SCOPE OF FIRE PROTECTION & DETECTION SYSTEM IN THE PROJECT:

1. DETAILED SCOPE OF WORK:

1.0	Scrutinizing and approval / stamping of drawings & documents of all the FDPS systems as per TAC.
2.0	Conduct Final inspection at site for approval / certification of all the FPS systems as per TAC.
3.0	Issue of Final Inspection Report / Certificate of all the FPS System for sanction of Extinguishing Appliances (FEA) discounts as per TAC.

Note: Please refer Annexure-3 for detailed breakup of Fire Detection and Protection systems envisaged for design, supplies and installation in the Project.

Scrutinizing and approval / stamping of drawings & documents shall be available in soft copy and stamping shall be given on soft copy (if required hard copy shall be forwarded for stamping)

The following are the sub-systems of Fire Protection and detection system, applicable for the project:

a. **Fire Water pressuring system:** consisting of Firewater storage tanks (overhead), pipes, valves, instrumentation etc. Please refer P&ID of hydrant/spray system for details of all equipment, which is enclosed as Annexure-4.

b. **Hydrant system:** consisting of fire escape hydrants, hydrant valves, hose boxes, hose pipes, hose reels and Hydrant/Spray piping running throughout the power plant area. Please refer P&ID for Hydrant system and Composite layout of Hydrant & Spray system, which is enclosed as Annexure-4 and Annexure-5 respectively and Annexure-2.

c. **Spray system:** consisting of High velocity water spray system (HVWS) for the transformers, as listed in design basis report and medium velocity water spray system (MVWS) for cable vaults/ cellars, Cable tunnels, DG oil tank, OPU. Please refer P&ID of Spray system for details of scope of work for water spray system, which is enclosed as Annexure-4.

d. **Fire detection and alarm system:** Consisting of multi-sensor detectors, beam detectors; air sampling detectors, manual call points, fire alarm panels, logics and interface engineering for the plant.

Please refer Scheme of FDA system for details, which is enclosed as Annexure-6.

e. **Inert gas system:** Shall be provided for Main Control Rooms. P&ID for Inert gas system is attached as Annexure-7

f. **Portable fire extinguishers:** Shall be placed all over the plant as per the approved scheme.

Notes:

1) Basic Schemes of all the above system are attached as Annexures as mentioned above. Bidder to refer the same for understanding the sub systems of Fire protection & detection system.

2) Bidder to refer Design basis report for detailed scope of Fire protection and detection system, which is envisaged for 4 x 225 MW ARUN-3 HEP. Design basis report is attached as Annexure-3.

3) The engineering drawings/documents furnished in Annexures is being prepared by PE&SD and are under review/approval catagories of End customer. Hence, these are subjected to change w.r.t. customer specification.

5.0 BIDDER'S SCOPE OF WORK:

1. The Engineering documentation of complete Fire protection and detection system will be reviewed & approved by bidder, in accordance with TAC/IS /NFPA Standards / Codes/ equivalent International standards.

2. Bidder has to review and approve all the engineering documentation of all the sub systems as per MDL (Annexure-2). Any other drawing/document as found necessary for compliance to TAC/ NFPA requirements or as deemed necessary during detail engineering stage.

3. The responsibility of review & approval of engineering documentation lies with Bidder till obtaining final approval from Customer or customer's Consultant. Whenever customer/consultant comments and returns the documents to BHEL, the same shall be corrected by BHEL as advised by the bidder and reviewed & stamped by bidder before resubmission to customer/ consultant. This process shall continue until final approval of each document.

Important Notes for Bidder:

1. List of engineering documentation is attached as Annexure-02. It may be referred to understand the quantum of the work involved w.r.t. review & approval of documents.

2. During the course of review & approval of documentation and Installation, Bidder may require to visit BHEL/Customer Offices in India or in Arun/Project Site in Nepal for discussions on drawings /documents. BHEL shall arrange these meetings as and when required. Bidder shall attend the meetings as and when intimated by BHEL.

3. Bidder shall employ suitable TAC/NFPA Certified Specialist engineers for the review and approval of sub-systems of Fire protection and Detection system. All the engineering documentation of Fire protection and detection shall be certified / stamped by an engineer holding a valid TAC/NFPA certificate.

4. Final approval of the drawing/document includes approval of As-built drawings.

5. Bidder to note that the annexures (part of this specification) are preliminary in nature. These drawings may get revised and /or new drawings will be furnished to bidder. Bidder to however note that they will not be eligible to raise any extra charges on account of this.

6.0 DOCUMENTATION SCHEDULE:

1. BHEL shall start submitting the drawings and documents during Kick-Off Meeting (KOM) and attending the same immediately after PO placement on Bidder.
2. KOM shall be at BHEL, Hyderabad and shall be included in bidder's lump sum offer as per Sl.no. A.1 of Price Bid format. No separate visit and meeting day charges are applicable for this meeting.
3. Bidder shall review the drawing/documents within 5 days for Rev. 00 drawings/documents submitted by BHEL.
4. Bidder shall review the drawing/documents within 3 days for Rev. 01 & subsequent revised drawings/documents submitted by BHEL.
5. Bidder shall ensure to meet the above mentioned schedule to avoid any delay in overall project documentation Schedule.

7.0 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER:

The bidder must submit the following documents along with their bid.

I) Un-priced copy of price bid format indicating quoted/ not quoted against each line item. (Annexure-1)

II) No Deviation certificate/Confirmation attached as Annexure-9

III) Supporting documents of Pre-Qualification Criteria (PQC)

In case of non-submission of above documents, Bidder's offer may be liable for Technical rejection.

1.1. After PO Placement:

Final documentation shall be submitted within stipulated time & in requisite sets (to be decided post order) of hard/soft copies.

Schedule for document submissions:

S.no	Description of Work by Bidder	Schedule
1	Approved and Stamped copies of all the drawings and documents of all the FPS Systems	10 days from the receipt of all the drawings/documents by bidder
2	Issue of Final Inspection Report / Certificate of all the FPS Systems	15 days from the date of Inspection by bidder

* The Final Inspection Report submitted by vendor shall be strictly in compliance to all applicable standards and specification as per TAC. Inspection will be carried out in multiple phase depending on site progress, one-week prior notice will be given for bidder to reach site. After each site visit, bidder has to generate intermediate Inspection report within the seven days of the visit.

RECORD OF REVISIONS				
Rev. No.	**Date**	**Revision Details**	**Prepared By**	**Approved By**
00	02-01-24	First Issue	--	--

ANNEXURE-1 OF PY-51968

Un-Priced Price Bid format
[For Engineering Services]

Fire Protection & Detection System

Project: 4 x 225 MW ARUN-3 HEP | Rev. 00

Name of the Bidder :

Offer Ref. with date :

S. No		Item Description	Quantity	UNIT	Price Weightage in % age	BIDDERS CONFIRMATION (Quoted)
[A]	ENGINEERING SERVICES					
	i	TAC approval Services for Fire protection and detection system as per Specification PY-51968	1	Lot	65.12%	
[B]	CHARGES FOR VISITS AND MEETINGS					
	i.	Travel charges for attending meetings at BHEL Hyderabad.	2	Visit	7.70%	
	ii.	Manday charges for attending the meetings at BHEL Hyderabad which shall include lodging, boarding,local transportation, etc.	4	manday	6.34%	
	iii.	Travel charges for International meetings at Arun/ project site, Nepal.	2	Visits	11.33%	
	iv.	Manday charges for attending the meetings at Project site which shall include lodging, boarding, local transportation, etc.	6	day	9.51%	
	Total in Rs. A[i]+B[i+ii+iii+iv] : _____				**100.00%**	

Notes:

1.	Bidder to quote for all the items as per price bid format. Incomplete/partial offer shall make bidder's offer liable for rejection.
2.	Price bid evaluation will be based on total price quoted as per Sl. No. A[i]+B[i+ii+iii+iv] of the above.
3.	Bidder is required to furnish confirmation to this priced bid format in their technical offer by indicated 'Quoted' against all the items listed above, failing which the offer is liable for rejection.
4.	Bidder to note that the Quantities of above Line items may vary upto any extent (+ or -).However, Unit rate shall be firm. Any extra claim above the unit rate shall not be entertained.
4.	Bidder to Quote Lumpsum Price for the Total Package.
5.	Line Item Rates of the individual items shall be derived by multiplying the "Price Weightage Factor" with the Lumpsum Price quoted.
6.	Unit Rates of the Individual items shall be further derived by dividing the Line item rates with the Quantities.
7.	Observations / Objections, if any, of the Bidder, to the "Price Weightage Factor" shall be brought to the notice of BHEL, during Pre-Bid Stage. No Observations / Objections shall be enterained after the Techno-Commercial Bid is opened.
8.	The Bid Evaluation is on Overall L1 Basis. Each and Every item of the Package shall be quoted by the bidder.
5.	Bidder to quote Total Lump price for complete requirement excluding taxes and duties .

Annexure-2 Of Tech Spec

ARUN-III: FDPS MDL

Sl. Nos.	Sub System	Engg. Group	IN HOUSE/ VENDOR	DWG. NO.	DRAWING/ DOCUMENTS
1	GENERAL	MPG	IN HOUSE	PYSZ4M110831501	DESIGN BASIS REPORT (DBR) - FIRE PROTECTION AND DETECTION SYSTEM
2					DESIGN BASIS REPORT (DBR) - FIRE PROTECTION AND DETECTION SYSTEM FOR GIS AREA
3	HYDRANT	MPG	IN HOUSE	PYDP1M110866101	P&ID OF HYDRANT & SPRAY SYSTEM
4	HYDRANT	MPG	IN HOUSE	PYLP0M110866101	COMPOSITE LAYOUT OF HYDRANT AND SPRAY SYSTEM
5					HYDRANT AND SPRAY SYSTEM FOR GIS AREA AND POTHEAD YARD AREA
6	HYDRANT	MPG	IN HOUSE	PYCD4M110866101	HYDRAULIC CALCULATION OF HYDRANT SYSTEM
7	HYDRANT	LPE	VENDOR	PYVD4M110866109	DATA SHEETS OF GATE VALVE
8	HYDRANT	LPE	VENDOR	PYVD4M110866110	DATA SHEETS OF BUTTERFLY VALVE
9	HYDRANT	MPG	VENDOR	PYVD4M110831601	DATASHEET AND GA DRG OF HOSE REEL
10	HYDRANT	LPE	VENDOR	PYVD4M110866111	DATA SHEETS OF MS & GI PIPES,FITTINGS, FLANGES, GASKETS AND STUD BOLTS FOR YARD PIPING
11	HYDRANT	MPG	VENDOR	PYVD4M110866112	DATASHEET AND GA DRG OF AIR RELEASE VALVE
12	HYDRANT	MPG	VENDOR	PYVD4M110866113	DATASHEET AND GA DRG OF FIRE HOSE (15 METER)
13	HYDRANT	MPG	VENDOR	PYVD4M110866114	DATASHEET AND GA DRG OF HYDRANT VALVES
14	HYDRANT	MPG	VENDOR	PYVD4M110866115	DATASHEET AND GA DRG OF BRANCH PIPES AND ACCESSORIES
15	HYDRANT	MPG	VENDOR	PYVD4M110866116	DATASHEET AND GA DRG OF HOSE BOX (750 X 600 X 250)
16	SPRAY	MPG	IN HOUSE	PYDP1M110866102	P&ID OF HVWS & MVWS AND ITS WRITE UP
17	SPRAY	MPG	IN HOUSE	PYVL1M110866101	HVWS SYSTEM FOR GENERATOR TRANSFORMERS (PLAN, ELEVATION, SIDE VIEW & ISOMETRIC VIEW)
18	SPRAY	MPG	IN HOUSE		HVWS SYSTEM FOR REACTOR TRANSFORMERS (PLAN, ELEVATION, SIDE VIEW & ISOMETRIC VIEW) AND ITS HYDRAULIC CALC.

Sl. Nos.	Sub System	Engg. Group	IN HOUSE/ VENDOR	DWG. NO.	DRAWING/ DOCUMENTS
19	SPRAY	MPG	IN HOUSE	PYVC4M110866101	HYDRAULIC CALCULATION FOR HVWS SYSTEM FOR GENERATOR TRANSFORMERS
20	SPRAY	MPG	IN HOUSE	PYVL1M110866103	MVWS SYSTEM FOR GOVERNOR/MIV OIL PUMPING UNIT (PLAN, ELEVATION, SIDE VIEW & ISOMETRIC VIEW)
21	SPRAY	MPG	IN HOUSE	PYVC4M110866102	HYDRAULIC CALCULATION FOR MVWS SYSTEM FOR GOVERNOR/MIV OIL PUMPING UNIT
22	SPRAY	MPG	IN HOUSE	PYVL1M110831601	MVWS SYSTEM FOR FUEL TANK FOR DG SETS (PLAN, ELEVATION, SIDE VIEW & ISOMETRIC VIEW)
23	SPRAY	MPG	IN HOUSE	PYVC4M110831601	HYDRAULIC CALCULATION FOR MVWS SYSTEM FOR FUEL TANK FOR DG SETS
24	SPRAY	MPG	IN HOUSE	PYVL1M110831602	MVWS SYSTEM FOR XLPE CABLES B/W SSB & UAB (PLAN, ELEVATION, SIDE VIEW & ISOMETRIC VIEW)
25	SPRAY	MPG	IN HOUSE	PYVC4M110831602	HYDRAULIC CALCULATION FOR MVWS FOR XLPE CABLES B/W SSB & UAB
26	SPRAY	LPE	VENDOR	PYVG3M110866101	G.A. & WIRING DIAGRAM FOR LOCAL CONTROL PANEL FOR DELUGE VALVE FOR HVWS / MVWS SYSTEM
27	FDA				FIRE TELEPHONE SYSTEM - WRITEUP/ LAYOUTS/ DATA SHEETS/ CERTIFICATIONS
28	FDA				FDA LAYOUT FOR SWITCHYARD AREA
29	FDA				DATA SHEET OF OUTDOOR MCP
30	FDA				DATA SHEET OF POWER SUPPLY & INTERFACE MODULES
31	SPRAY	LPE	VENDOR	PYVD3M110866103	GA & DATASHEET FOR Y - TYPE STRAINER
32	SPRAY	MPG	VENDOR	PYVD3M110866104	GA & DATASHEET FOR DELUGE VALVE
33	SPRAY	MPG	VENDOR	PYVD4M110866102	GA & DATASHEET FOR H.V.W.SPRAY NOZZLES
34	SPRAY	MPG	VENDOR	PYVD4M110866103	GA & DATASHEET FOR M.V.W.SPRAY NOZZLES
35	SPRAY	MPG	VENDOR	PYVD4M110866104	GA & DATASHEET FOR FRANGIBLE BULB HEAT DETECTORS

Sl. Nos.	Sub System	Engg. Group	IN HOUSE/ VENDOR	DWG. NO.	DRAWING/ DOCUMENTS
36	SPRAY	C&I	VENDOR	PYVD4M110866105	GA & DATASHEET FOR PRESSURE SWITCH
37	SPRAY	C&I	VENDOR	PYVD4M110866106	GA & DATASHEET FOR PRESSURE GAUGE
38	SPRAY	MPG	VENDOR	PYVD4M110866107	GA & DATASHEET FOR SOLENOID VALVE
39	GENERAL	C&I	IN HOUSE	PYVH4M110866101	INSTRUMNET HOOK DIAGRAM FOR ALL INSTRUMNETS
40	FDA	MPG	IN HOUSE	PYFL3M110866301	Schematic of Fire Detection & Alarm System for Main Plant and switchyard area
41	FDA	MPG	IN HOUSE	PYLF1M110866302	FDA Layout for MIV Floor
42	FDA	MPG	IN HOUSE	PYLF1M110866303	FDA Layout for Turbine Floor
43	FDA	MPG	IN HOUSE	PYLF1M110866304	FDA Layout for Generator Floor
44	FDA	MPG	IN HOUSE	PYLF1M110866305	FDA Layout for Machine Hall Floor
45	FDA	MPG	IN HOUSE	PYLF1M110866306	FDA Layout for Control Block
46	FDA	MPG	IN HOUSE	PYLF1M110866308	LHS Layout of Power House
47	FDA	C&I	VENDOR	PYVD4M110866301	DATA SHEET OF LOCAL / SATELLITE FIRE ALARM PANEL
48	FDA	C&I	VENDOR	PYVD4M110866302	DATA SHEET OF REPEATER PANEL
49	FDA	C&I	VENDOR	PYVD4M110866303	DATA SHEET OF MULTI SENSOR DETECTOR
50	FDA	C&I	VENDOR	PYVD4M110866304	DATA SHEET OF HEAT DETECTOR
51	FDA	C&I	VENDOR	PYVD4M110866306	DATA SHEET OF AIR SAMPLING DETECTOR
52	FDA	C&I	VENDOR	PYVD4M110866309	DATA SHEET OF BEAM DETECTORS
53	FDA	C&I	VENDOR	PYVD4M110866310	DATA SHEET OF IO MODULES
54	FDA	C&I	VENDOR	PYVD4M110866311	DATA SHEET OF SELF ILLUMINATING EXIT SIGN
55	FDA	C&I	VENDOR	PYVD4M110866315	DATA SHEET OF HOOTER CUM FLASHER
56	FDA	C&I	VENDOR	PYVD4M110866316	DATA SHEET OF DIGITAL LHS CABLE
57	FDA	C&I	VENDOR	PYVD4M110866319	DATA SHEET OF POWER CABLE
58	FDA	C&I	VENDOR	PYVD4M110866320	DATA SHEET OF CONTROL CABLE

Sl. Nos.	Sub System	Engg. Group	IN HOUSE/ VENDOR	DWG. NO.	DRAWING/ DOCUMENTS
59	FDA	C&I	VENDOR	PYVD4M110866322	DATA SHEET OF PC & PRINTER
60	FDA	C&I	VENDOR	PYVD4M110866323	DATA SHEET OF UPS
61	FDA	C&I	VENDOR	PYVD4M110866324	DATA SHEET OF INDOOR MCP
62	FDA	C&I	VENDOR	PYVD4M110866327	DATA SHEET OF SIREN
63	FDA	C&I	VENDOR	PYVD4M110866328	DATA SHEET OF BATTERY & BATTERY CHARGER(ALONG WITH BATTERY SIZING CALCULATIONS)
64	FDA	C&I	VENDOR	PYVD4M110866329	DATA SHEET OF RESPONSE INDICATOR
65	IGES	MPG	IN HOUSE	PYDP1M110866201	P&ID OF INERT GAS EXTINGUISHING SYSTEM
66	IGES	MPG	IN HOUSE	PYVZ4M110866201	DESIGN PHILOSOPHY & SYSTEM WRITE-UP OF IGES
67	IGES	MPG	VENDOR	PYVL1M110866201	PIPING LAYOUT OF IGES FOR MAIN PLANT
68	IGES	MPG	VENDOR	PYVL2M110866201	ISOMETRIC VIEW OF IGES PIPING SYSTEMS OF IGES
69	IGES	MPG	VENDOR	PYVD4M110866201	DATA SHEETS OF INERT GAS COMPONENTS (IMPORTED) OF IGES
70	IGES	MPG	VENDOR	PYVD4M110866202	DATA SHEETS OF INERT GAS COMPONENTS (INDIGENOUS) OF IGES
71					INERT GAS DOCS FOR HT TOOM OF SWITCYARD AREA INCLUDING PIPING LAYOUT AND TDS ETC.
72	PORT	MPG	VENDOR	PYVD4M110866401	TECHNICAL DATA SHEET OF FIRE EXTINGUISHERS
73	PORT	MPG	IN HOUSE	PYAZ4M110866401	ALLOCATION CHART OF PORTABLE FIRE EXTINGUISHER
74	SPRAY	MPG	VENDOR	PYVO4M110866101	O& M MANUALS FOR FPS
75	SPRAY	MPG	VENDOR	PYVO4M110866102	O& M MANUALS FOR SPRAY SYSTEM
76	FDA	MPG	VENDOR	PESD/OM/Arun-3	O& M MANUALS FOR FDA SYSTEM
77	GENERAL	MPG	IN HOUSE	PYSZ4M110831501	Erection Procedure documents along with all the drawings pertaining to this section (Erection Manual).

NOTE : THE ABOVE LIST IS TENTATIVE. ENGINEERING OF THE PROJECT IS UNDER PROGRESS AND HENCE THERE ARE PROBABILITY OF CHANGES IN THE PROJECT DOCUMENTATION AS REQUIRED FOR PROJECT COMPLETION.

21.05.2020	05	Revised based on customer comments	HAR/DVP	KAMALUDDIN	PCS
13.03.2020	04	Revised based on customer comments	HAR/DVP	KAMALUDDIN	PCS
13.02.2020	03	Revised based on customer comments	HAR/DVP	KAMALUDDIN	PCS
08.08.2019	02	Revised based on customer comments	HAR/DVP	KAMALUDDIN	PCS
03.06.2019	01	Revised based on customer comments	HAR/DVP	KAMALUDDIN	PCS
25.01.2019	00	First Submission	-	KAMALUDDIN	MNSR
Date	**Rev**	**Description of Revision**	**ALT**	**CHD**	**APPD**

CUSTOMER:	**SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC)**
CONSULTANT:	**SJVN LTD.**
CONTRACTOR:	**BHARAT HEAVY ELECTRICALS LTD** **PROJECT ENGINEERING & SYSTEMS DIVISION, HYDERABAD**

	BHEL Doc. No: PY-SZ-4-M110-8315-01		Rev: 05
PACKAGE	FIRE PROTECTION & DETECTION SYSTEM		
TITLE	DESIGN MEMORANDUM (DM) - FIRE PROTECTION AND DETECTION SYSTEM		
PREPARED BY	HARISH/D V PRASHANT		25.01.2019
CHECKED BY	KAMALUDDIN		25.01.2019
APPROVED BY	MNSR		25.01.2019

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1. SCOPE

The scope of this design memorandum covers the type of fire protection and detection systems to be provided for all buildings, equipment, transformers, etc., as per contract by BHEL –PE&SD, that are in the scope of BHEL with in power plant boundary limits of 4 x 225 MW Arun-III Hydro Electric Project, Nepal. The scope of this document however excludes Generator and Switchyard area which will be covered by our BHEL Bhopal Unit and TBG Unit separately.

The following is the matrix showing the type of fire protection & detection system provided for the various facilities / equipment covered in this contract:

Sl. No.	Building / Equipment	Hydrant System	HVWS	MVWS	Sprinkler System	IGES	FDA System	Portable
1.	**Switchyard Area**		*Please refer BHEL TBG Doc. No.* ***TB-405-552-002, Design Memorandum for Fire Fighting System (GIS Area)***					
2.	**Transformer Area**							
a	13 Numbers of Generator Transformers (92 MVA)	Yes	Yes	No	No	No	Yes	Yes
3.	**Power House Building**							
a	All floors of Power House	Yes	No	No	No	No	Yes	Yes
b	4 Numbers of Oil Pressure units of Governor / MIV	Yes	No	Yes	No	No	Yes	Yes
c	400 kV XLPE cable , Power cables between SSB and UAB, SSB, and in cable trays	No	No	Yes	No	No	Yes	No
d	Control Room	Yes	No	No	No	Yes	Yes	Yes
e	Offices / Conference Room	Yes	No	No	No	No	Yes	Yes
f	Mechanical & Electrical Utility Areas	Yes	No	No	No	No	Yes	Yes
g	DG Set (Diesel Fuel Tank)	No	No	Yes	No	No	Yes	Yes

TABLE: 01

Notes

1. The above Table details the Comprehensive Fire Protection Facility being provided by BHEL for the complete 4 x 225 MW Arun-III HEP. Apart from the system & facilities listed above, no other FPS shall be provided by BHEL. However all the items required for the completeness of the systems listed above shall be included in BHEL's scope as per the provisions of the contract.

2. Portable Fire Extinguishers shall be distributed throughout any floor area as per TAC guidelines.

3. Mandatory Spare for Fire Protection system envisaged as per contract are mentioned below.

S. No.	Description	Qty.
1.	Inert gas cylinders	10% of total quantity.
2.	Automatic and Manual Release System	10 % of total quantity.
3.	Cylinder Valve with Safety pressure relief Device	10 % of total quantity.
4.	Inert gas Nozzles	10 % of total quantity.
5.	Inert gas Release Push Buttons	10 % of total quantity.
6.	Detectors a) Multi sensor detectors b) Long-range beam smoke detectors (if applicable for Project) c) QB detectors	10 % of total quantity.
7.	Linear heat sensing cable with interface modules	10 % of total quantity.
8.	Manual pull station / Manual call point	10 % of total quantity.
9.	Audio visual combination devices	10 % of total quantity.
10.	Strainers, pipes and fittings, valves and specialities and expansion joints	10 % of total quantity.
11.	Butterfly valve , Deluge valve, nozzles, Hydrant Valves and Hose pipe connectors, pressure reducing valves/orifice plates (if applicable, refer Clause 3.3 (II) below), air release valves.	10 % of total quantity.
12.	Hose pipes and branch pipes	10 % of total quantity.
13.	Kits for filling up the portable fire extinguishers	50% of total capacity
14.	All type of cards used in FACP & air sampling system	1 No. each
15.	Repeater Panel	1 No.
16.	Pressure switches, pressure gauge, differential pressure gauge (if applicable), solenoid Valves	10% of installed capacity

2. CODES & STANDARDS

a. The design and installation of complete fire protection system will comply with the following standards :

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i. FP Manual regulations, Spray & Fire Alarm system of Tariff Advisory Committee (TAC).
ii. NFPA-850, NFPA-15, NFPA-2001.

b. Indian Standards (IS)

i. IS 1239 (Steel Tubes, Tubulars and Other Wrought Steel Fittings - Specification - Part 1 : Steel Tubes)
ii. IS 3589 Gr 410 (Steel Pipes for Water and Sewage (168.3 to 2540 mm Outside Diameter)
iii. IS 4736 (Specification for Hot-dip Zinc Coatings on Mild Steel Tubes)
iv. IS 15337 (Coal Tar Based Anticorrosion Tape for Protection of Underground Mild Steel Pipelines)
v. IS 14846 (Sluice Valve for Water Works Purposes, 50 to 1200 mm Size)
vi. IS 5290 Type A (Specification for landing valves)
vii. IS 636 (Non-percolating flexible firefighting delivery hose)
viii. IS 884 (Specification for first-aid hose reel for firefighting)
ix. IS 2871 (Specification for branch pipe, universal for firefighting purposes)
x. IS 15683 (Portable Fire Extinguishers - Performance and Construction)
xi. IS 3844 - Code of Practice for Installation & Maintenance of Internal Fire Hydrants and Hose Reels on Premises
xii. IS 2189 – Code of practice for selection, installation and maintenance of automatic fire detection and alarm system.
xiii. IS 2190 - Code of Practice for selection, installation & Maintenance of first- aid -fire extinguishers.
xiv. IS 9668 - Code of Practice for Provision & Maintenance of Water Supplies for firefighting.

3. SYSTEM DESCRIPTION & DESIGN CRITERIA

3.1 DESIGN CRITERIA

I. Fire Protection System for Arun-III H.E.P. 4 X 225 MW is designed as per Contract Specification ED/TS/ARUN/01.06.17, Book 4: Vol-3, Section 24: Fire Fighting System.
II. The fire protection system of this Plant has been designed considering the same as light hazard as per the clause no 7.2.1 of FP Manual (TAC).

3.2 Fire Water Source

R2

I. Overhead fire water tanks (4 Nos.) are envisaged as per contract. Fire water for these overhead tanks shall be sourced from the PPV 1 & 2 (Refer Power house Cooling water system ; Dwg. No. SJVN / ED/ARUN-III/EM-2017-06). The fire water tanks are in scope of Customer. The approx. capacity of each tanks is 150 m^3 and shall be erected at EL ~~640.0 m~~ (tentative) for requirement of water for firefighting application. Bracket, support etc. for Fire Water Tanks shall be supplied by BHEL.

770.0 m

II. The Fire Water storage tank shall be located at an elevation so that the fire water pressure requirement for the total power plant including switchyard area is met through gravity as per TAC guidelines.

III. The capacity of the tank is designed such that it supplies water for 2 hours for the single largest deluge (Relevant NFPA-850 abstract from for 2 hour application is indicated in Annexure-4). Please refer Annexure-1 for Overhead Fire water Tank Sizing Calculations.

3.3 Fire Water Network

I. As the overhead tank is located at an elevation EL. 640.0M (tentatively by SADPC), the head developed is sufficient to supply water at required pressure to every locations like transformer cavern, DG room, cable tray, Switchyard Area etc. Refer Annexure-2 for Basis of Calculation for Fire Water Tank Elevation.

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II. Pressure reducer/Orifice plate, drain plug, air vent etc. shall be provided as per the system requirement.

III. Sub headers shall be laid in transformer area, power house etc. to distribute the water for HVWS, MVWS, Hydrant System. In the event of fire, water shall be supplied from overhead tank via different sub headers of suitable sizes. Fire water requirement shall be as per TAC requirements.

IV. Automatic Backwash Filter along with cyclone separator has been provided at upstream of the fire water tank , hence no strainer has been considered for firefighting services (Pls refer Dwg. No. SJVN / ED/ARUN-III/EM-2017-06*).*

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V. Fire barriers and Fire Dampers :

a. Fire sealing/barrier material (Mortar Seal Type) of Two hours rating shall be provided for all entry and exit openings (of wall/ floor) for cables.

b. Fire Dampers of HVAC ducts facility for tripping of all fire dampers in the event of fire shall be provided.

c. Barrier walls between the transformer shall be provided. (refer BHEL Bhopal Dwg Title : Cross section and Plan of Transformer Cavern ; dwg. no. 12000020558)

VI. Paint Schedule: Refer Annexure –3 for Paint schedules.

3.4 Hydrant system

I. This system is in accordance with the clause no 7.6 of the FP manual of TAC.

II. Hydrant system shall be designed so that a minimum running pressure of 3.5 kg/cm^2 (g) is available at the remotest hydrant point.

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III. The velocity of flow of water is generally not exceeding 2.5 m/sec in Hydrant system header.

IV. The Hydrant system shall be provided throughout the Power house building, transformer area as mentioned in the Table 1 of this document.

V. A common Header for the Complete Water based System is provided. Tapping for the High Velocity Water Spray System, Medium Velocity Water Spray System shall be taken from the main Hydrant Header distributed throughout the Plant.

VI. Fire Water Piping shall be laid in transformer area, power house etc. to distribute the water for HVWS, Hydrant system. Fire water requirement shall be as per TAC requirements.

VII. The hydrant system shall consists of the following:

a) Single headed stand post type yard hydrants of 63 mm size as per IS: 5290 type-A, distributed all around the plant.

b) Internal hydrants (single headed landing valves) of 63 mm size as per IS: 5290 type-A, for outdoor as well as indoor applications.

c) Type-I hose cabinet for each internal hydrant (single headed landing valves) consisting of one no. of 15 m long RRL hose as per IS: 639 type-A, one no. of SS branch pipe &/or stream jet type nozzle as per IS: 903. The dimensions of the hose boxes shall be as per manufacturer's standard.

d) Hose reels of 20 NB size, 30 m length will be provided with internal hydrants.

e) Isolation valves at suitable places shall be provided in the ring mains for easy maintenance.

f) Hydrant pipes

i. Inside the building the pipes shall be supported from the roof of the building/ supported on the floor as per layout considerations.

ii. At approach roads where it shall be laid underground, in Hume pipes.

iii. Design calculations, drawings etc. shall be supplied. Minor civil works like chipping, supply of materials like inserts, clamping, channels, hangers, brackets, supports etc. shall be provided.

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iv. Routing of hydrant pipe shall be finalized during detailed engineering. However, minor change (if any), shall be done during installation as per site conditions.

3.5 Automatic High Velocity Water Spray (HVWS) Spray System

3.5.1 Design Guidelines:

1	Design Standard	Section -3 of rules for water spray systems (TAC)	
2	Water application rate	10.2 LPM/M2 of the surface area of the entire Transformer including the bottom surface, radiators , conservators etc.	Cl no 3.2.3.6.1 of rules for water spray systems (TAC)
3	Pressure Guidelines	The pressure at the remotest nozzle shall not be less than 3.5 kg/cm2 (g) and not exceeding 5.0 kg/cm2 (g).	
4	Maximum allowable velocity of water in the ring main	Shall be limited to 10 m/sec.	
5	Detection System	QBD /Wet Trim	

3.5.2 The following equipment shall be provided with HVWS system as per Contract Specification ED/TS/ARUN/01.06.17, Book 4: Vol-3, Section 24: Fire Fighting System.

S. No.	Area/Equipment
1.	13 Numbers of Generator transformers (92 MVA)

3.5.3 Description of the System

a) The deluge valve system shall consist of Wet Trim Deluge valve , Manual Isolation gate valve at Inlet and outlet of the deluge valve, Y type strainer at the Inlet of the Deluge valve , Deluge valve local Control Panel (DVLCP). Bypass line arrangement of deluge valve shall not be provided as per contract.

b) Each protected equipment shall be surrounded by ring fitted with open high velocity water spray nozzles.

c) The supply for water to the ring main will be tapped from the hydrant header line. The ring main will be connected to spray system header through wet pilot deluge valve with gate valves in upstream and downstream.

d) The header will remain charged with water under pressure up to the inlet of deluge valve. Wet detection system using Quartzoid Bulb Detectors (QBD), rated at 79°C; fitted on the ring mains is envisaged. This line will be pressurized with water and will be connected to deluge valve.

e) In the event of fire, the quartered bulb near the fire breaks, causing the pressure drop in the detection line. The loss of pressure causes the deluge valve to open, spraying the water through nozzles.

f) The location of the deluge valves shall be as follows:

S. No.	Area/Equipment	
1.	13 Numbers of Generator Transformers (92 MVA)	1. Deluge valve & DVLCP shall be located near to respective transformer. 2. The Spray & Detection Piping from the deluge valve shall be routed around the respective transformer. 3. The Spray System & detection rings around the transformers shall be supported from floor / wall.

3.6 Medium Velocity Water Spray (MVWS) System

3.6.1 Design Guidelines:

1	Design Standard	Section -4 of rules for water spray systems (TAC)	
2	Water application rate	12.2 LPM/M2 of the Exposed area of the cable racks	Cl no 4.8.2 of rules for water spray systems (TAC)
3	Pressure Guidelines	The pressure at the 2.8 bars shall be achieved at the hydraulically remotest point.	Cl no 4.8.3 of rules for water spray systems (TAC)

4	Maximum allowable velocity of water in the ring main	Shall be limited to 10 m/sec.	
5	Detection System	Multi Sensor Detectors / QBD / Digital LHS (as applicable)	

3.6.2 The Following Equipment shall be provided with MVWS system as per Contract Specification ED/TS/ARUN/01.06.17, Book 4: Vol-3, Section 24: Fire Fighting System:

S. No.	Area/Equipment
1.	400 kV XLPE cable, power cables between SSB and UAB, SSB, cable trays
2.	4 nos. Governor/MIV OPU.
3.	2 no. DG sets (in switchyard area)

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3.6.3 Description of the System:

a) The deluge valve system shall consist of Wet Trim Deluge valve , Solenoid Valve ,Manual Isolation gate valve at Inlet and outlet of the deluge valve , Y type strainer at the Inlet of the Deluge valve , Deluge valve local Control Panel (DVLCP). Bypass line arrangement of deluge valve shall not be provided as per contract.

b) Each protected equipment shall be surrounded by ring fitted with open medium velocity water spray nozzles.

c) The supply for water to the ring main will be tapped from the hydrant header line. The ring main will be connected to spray system header through wet pilot deluge valve with gate valves in upstream and downstream.

d) The detection in MVWS system is through multi sensor detectors. In the event of fire, the multi sensor detectors gives a signal to main fire alarm panel. With the receipt of fire signal from multi sensor detectors, the main fire alarm panel opens the solenoid valve placed in the detection line of deluge valve. As the solenoid valve opens, the water in detection line to flow out. This creates a pressure drop in the detection line. The pressure drop in detection line will open the deluge valve and water starts projecting out from the spray nozzles.

e) Provision for draining of the Water in the event of Operation / testing of Deluge valve shall be provided by Customer while designing the drainage arrangement of the Plant

f) Gate valves shall be provided in the upstream and downstream of each deluge valve.

3.7 Fire Detection & Alarm System

3.7.1 Scope of fire detection & alarm system

Fire alarm detection and protection system shall consist of the following major devices:-

I. One (01) Main fire alarm panel located in Control Room
II. One (01) set of Repeater Panel located at Entrance of Power House
III. One (01) lot of Detectors.
IV. One (01) Air Sampling Detector for Control Room and Battery room
V. One (01) lot of manual call points.
VI. One (01) lot of notification appliances (hooters & beacons).

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VII. One (01) lot of interface modules.
VIII. One (01) lot of cables.
IX. One (01) lot of fire telephone system.

Miscellaneous Items:-

I. Self-Illuminating exit signs shall be provided in control room and MCC rooms, battery charger rooms, escape stair case in power house building and transformer cavern.
II. One (01) no. of siren with 1 Km range (diametric). It will be operated by main fire alarm panel in case fire.
III. One (01) no. of PC with printer – connected to main fire alarm panel in Control room.
IV. Isolator modules shall be provided as per IS 2189.

All equipment such as fire detectors, panels, notification appliances shall be approved or listed by UL(Underwriters Laboratory)/FM(Factory Mutual)/LPCB(Loss Prevention Control Board) /VdS (Verband der Sachversicherer).

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3.7.2 General Description Of The System

I. This system is provided for the buildings and closed spaces within the scope of BHEL. Please refer to Table – 02 for details.

II. The Fire Detection and Alarm System will comprise of a network of Addressable Detectors (fire/smoke), Manual Call Points, Modules, Notification Appliances, Cables and other accessories required to form a network (i.e. Terminal Boxes and Junction Boxes).

III. Automatic Fire Detection and Alarm System detect fire / over-heating by means of the attendant phenomena of fire, such as smoke or heat. It initiates alarm in fire alarm control panel and actuates pre-programmed control actions. Based fire affected area – spray system (HVWS or MVWS) will be actuated. Detection of fire at an early stage permits rapid intervention by fire fighting forces. Thus the automatic fire detection and alarm system reduces damage to property and risk to human lives.

IV. The fire detectors will be wired on a common connecting line called loop. Each loop consists of about 100 to 250 detectors / devices based on OEM standard. The number of loops and location of detectors to be installed in the various areas will be finalized during detailed engineering stage based on standards mentioned above.

V. Proposed detectors/devices for Fire detection and alarm system for areas are given below:

Sl. No.	Area	Type of Detection
i.	All transformers of rating greater than or equal to 10 MVA and/or oil capacity more than 2000 liters.	Quartzoid Bulb Detectors and Manual Call Points
ii.	MIV Floor at El.520.5M	Multi Sensor Detectors and Manual Call Points
iii.	Turbine Floor at El.529M	Multi Sensor Detectors and Manual Call Points
iv.	Generator Floor at El.534M	Multi Sensor Detectors and Manual Call Points

v.	Power House Floor at El.539M	Multi Sensor Detectors and Manual Call Points
vi.	Service Bay at El.539M	Beam Detectors and Manual Call Points
vii.	Control room at El.539M	Air Sampling Detectors and Manual Call Points
viii.	Bus Duct Gallery at El.539M	Multi Sensor Detectors and Manual Call Points
viii.	Battery room at El. 543.6M	Air Sampling Detectors and Manual Call Points
ix.	Conference Room at El. 547.8M	Multi Sensor Detectors and Manual Call Points
x.	Transformer Cavern at El. 552M	Multi Sensor Detectors and Manual Call Points
xi.	Horizontal Cable Trays + Interconnecting Cable Tunnel	Digital LHS cable* and Manual Call Points
xii.	Office in Power house	Multi Sensor Detectors and Manual Call Points
xiii.	DG Set	Quartzoid Bulb Detectors
xiv.	Mechanical & Electrical Utility Area	Multi Sensor Detectors and Manual Call Points
xv.	OPU for MIV & Turbine	Quartzoid Bulb Detectors
xvi.	Ventilation Room	By BHEL TBG
xvii.	Workshop Building	Multi Sensor Detectors and Manual Call Points

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TABLE: 02

***Digital LHS cable along with interface module is considered as per zoning. No separate Digital LHS pointer is envisaged.**

VI. In case of fire, the detector or device envisaged in respective area will pick up appropriate signal and conveys it to fire alarm panels located in CCR. These signals triggers two types of actions, (1) audio alarms in Control room and affected area, and (2) actuates firefighting process. It initiates tripping of AHU for a/c system, fans in ventilation system, package air-conditioners, fire dampers, etc. related to the affected area. The system initiates operation of extinguishing systems such as deluge system, sprinklers and transmits alarm and fault signals to predetermined points. The system must ensure that more number of detectors / devices can be connected in a loop.

VII. The fire detectors are inherently addressable, which provide continuous surveillance in an area. The Microprocessor based Fire Alarm Control Panel located in Control Room will process the input signals from detectors at various locations of the plant and actuate the respective protection system.

3.7.3 Layout and Coverage of detectors/devices in Power House areas shall be as mentioned below:-

I. Spacing of detectors shall be as per cl. No. 6 of IS 2189.

II. Manual call points shall be located as per cl. no. 6.3.8 of IS 2189. The call points will normally be provided for every 30m distance in indoor areas and for every 45 m in outdoor areas. **Manual call points shall be break glass type or lever type**.

III. Hooter cum strobe shall be located as per cl. no. 4.3 of IS 2189.

IV. Detectors will be installed at the highest point of the ceiling (as per IS 2189) and coverage indicated by OEM will be considered.

V. The number of Detectors and their location will be so selected such that the internal area of the building is completely covered by the detectors. The zones of individual Detectors will overlap and no blind zone will be left.

VI. For Detectors mounted above false ceiling, a separate Response Indicator shall be mounted directly below the detector (on the false roof). When the detector is mounted below the false floor or in inaccessible position, response indicator for each of the detector shall be mounted on a separate box which shall be suitable for mounting on the wall.

3.7.4 Main Fire Alarm Panel

I. The microprocessor based Fire Alarm Control Panel comprise of processor, loop cards for detector loops, display unit, modules for alarm control & interlocks, communication modules for interfacing etc., as required by the system to incorporate all the features required.

II. All the fire alarm circuits will be of modular design using electronic printed card circuits to facilitate easy replacement of faulty circuits with spare cards. All the electronic components and cards will be compatible to non-air-conditioned environment for working satisfactorily.

III. The Microprocessor based Fire Alarm Control Panel will incorporate the following features:

- Continuous supervision of the detector connecting lines, individual detector performance / operation and disconnection / removal of Detectors. The system will automatically reset on clearance of a fault.
- The main fire alarm panel shall be interfaced with SCADA for the following signals
  - SYSTEM ON FIRE
  - SYSTEM HEALTHY
  - SYSTEM FAULT
- Programmed activation of various interlocks with fire protection system and other associated system such as ventilation and air conditioning, etc.
- The Fire Alarm Control Panels will have adequate number of loops so as to cover all the areas to be protected.

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3.7.5 Power supply system for fire alarm panel:

I. **The system shall be provided with main power supply (230V AC power supply) and a standby power supply (24V DC power supply from inbuilt battery). The standby power supply shall takeover automatically incase failure of main power supply without affecting the transmission of the signal.**

II. The fire detection and alarm system normally operates on 230 V AC power supply. Two (2) sets (1 working & 1 standby, 100% capacity) of 24 volts (2 x 12 V) SMF Lead Acid battery with charger has been provided as standby power source which will cut-in automatically in the event of AC power failure.

III. Float cum-boost charger of adequate capacity shall be provided to trickle charge the battery from AC supply during normal operation. The standby power source has been provided with a battery bank to power fire detection and alarm system for 24 hours of normal operation and 30 minutes of alarm condition.

IV. Generally Cable required for complete Fire Alarm System for interconnecting Fire Alarm Control Panels, Detectors, Manual Call Point, other field devices, Microcomputer, Repeater Panel, VDU, Printer, etc. shall be 1.1 kV – Low Voltage Copper Conductor Cables.

V. Control cables used for FDA system 2 core 1.5 sq.mm. copper conductor HRPVC (85 Deg. C rating) insulated twisted, armored, overall screened, overall sheathed ST-2 FRLS type.

VI. Power cables used for FDA system 2 core 2.5 sq.mm. copper conductor HRPVC (85 Deg. C rating) insulated armored, overall sheathed ST-2 FRLS type.

VII. All detectors, junction boxes, manual call points and cable marshalling boxes shall be earthed with 8 SWG GI wire in case the operating voltage of the system is greater than 24 V.

3.8 Inert Gas Extinguishing System

a) Inert Gas extinguishing system shall be provided for Control room of Power House.

b) IG-541 shall be used as inert gas in the inert gas system.

c) The gas release panel of the cylinder bank shall be connected to the main fire alarm panel located in control room for actuating the inert gas system through modules.

d) The main equipment in the system consists of gas release panel, cylinders, nozzles, directional valves, check valves and manifolds.

e) The gas release panel shall be power by 230 V normal AC power supply. Standby power supply shall be catered by Ni-Cd batteries.

f) Common cylinder bank with directional valve systems are provided for each protected area. Main cylinders will be calculated based on the single largest risk in each protected area and these cylinders will be located in the cylinder storage room near the protected area.

g) A reserve battery bank (100% standby) of inert gas cylinders (duly filled) with manifold, directional valves with manual changeover shall be provided.

Operation of Inert Gas Extinguishing System

a) Fire detectors used in these areas (areas where inert gas is provided) are cross zoned. Upon receipt of signal from any detector in the protected enclosure a fire signal shall be sent to the main fire alarm panel. Upon receipt of signal from second detector in the same protected enclosure a discharge signal shall be sent to the gas release panel to activate the solenoid valve on the master cylinder of inert gas system. Manual mechanical actuation of the inert cylinder is also possible using the Manual mechanical actuator of the master cylinder.

b) Every zone does have one master cylinder (which can operate slave cylinders) which has release unit consist of solenoid actuator, manual actuator and contact gauge, mounted on the cylinder valve. When the solenoid valve opens, propellant from the gauge port on the cylinder valve trips the internal actuating device opening the cylinder valve. The cylinder valve will remain open until internal cylinder pressure reaches approx. 1 bar. A high-pressure pilot hose(s) inter-connect the cylinder valves. The interconnected cylinder valves opens simultaneously as the internal actuators are pressurized at the same time. Thus releases inert gas to the protected room area through a restrictor, Selector Valve, the distribution pipe work and the discharge nozzles.

c) In Automatic operation, the detectors will send the fire signal to the main fire alarm panel. Then the signal is sent to the Pre-discharge Audio/Video Signal Unit to allow personnel evacuation prior to discharge. This alarm is for Personnel evacuation prior to system discharge takes place normally after a specified time delay of 0-3 minutes which is adjustable. Simultaneously, the solenoid valve on the manifold gets energized through a signal from gas release panel. This in turn will open the Inert Gas Cylinders.

R2

Operation philosophy of IGES shall be finalized during detailed engineering as per the provisions of contract and statutory requirements.

3.9 Portable Fire extinguishers

d. Portable fire extinguishers are provided as per TAC guidelines for indoor and outdoor areas.

e. Following type of fire extinguishers shall be provided.
- Portable Carbon Dioxide type.
- Portable Dry Chemical Powder type.
- Portable Foam type.

f. Distribution of these extinguishers in various locations shall be as per the guidelines of TAC. (Separate document shall be submitted for Portable & Mobile Fire extinguishers titled as “Fire Extinguisher Distribution Schedule”)

g. Sand and water buckets shall also be provided. However the quantity and locations shall be finalized during detailed engineering.

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4. MATERIAL OF CONSTRUCTION (MOC) OF MAJOR EQUIPMENTS

The major items of FPS system and their MOC are listed in the table below:-

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SL. NO.	ITEM	MOC
i.	Fire Water Pipes	Mild steel, Black, ERW to IS: 1239 Part-1 Medium & IS: 3589
ii.	Fire Water Pipes (Downstream of Deluge Valve)	MS ERW Galvanized to IS:1239, Part-1, Medium grade; Galvanized as per IS: 4736
iii.	Hose Pipe	Reinforced Rubber Lined Fire Hose as per IS 636, Type – A
iv	Hose Reel	Rubber braided as per IS 884
v.	Valves	
'a	Gate Valves	C.I as per IS 14846
'b	Basket/Y Strainer	Body : MS as per IS: 2062 , Wire Mesh of SS 316
vi.	HVWS Nozzle	SS 304
vii.	MVWS Nozzle	SS 304
viii.	Hydrant Valve	SS 304 as per IS 3444
ix.	Branch Pipe	SS 304
x.	Air Release Valve	Gun Metal as per IS 318
xi.	Deluge Valve	Cast Iron
xii.	Flanges	Fabricated from Plate conforming to IS: 2062 Gr. B
xiii.	Fittings	IS:1239, Part-II

5. LIST OF ANNEXURE

R3

LIST OF ANNEXURES		
Sl no	**Drawings/Documents**	**Drg/Doc no**
i.	Fire water Tank Sizing Calculations	Annexure-1A & 1B
ii	Basis of Calculation for Fire Water Tank Elevation	Annexure-2
iii	Painting schedule	Annexure-3
iv	Abstract of Standards	Annexure-4

RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised By	Checked By	Approved By
00	25.01.2019	Initial Submission	--	--	--
01	03.06.2019	Revised based on customer comments	HAR/DVP	KAMAL	PCS
02	08.08.2019	Revised based on customer comments	HAR/DVP	KAMAL	PCS
03	12.02.20	Revised based on customer comments	HAR/DVP	KAMAL	PCS
04	13.03.20	Revised based on customer comments	HAR/DVP	KAMAL	PCS
05	21.05.20	Revised based on customer comments	HAR/DVP	KAMAL	PCS

4 X 225 MW ARUN-III

ANNEXURE-1A to Doc. No. PY-SZ-4-M110-8315-01

1 Theoretical Water Requirement (approx.) for the HVWS System for Generator Transformer

R2

A.	**Approx. Dimensions of Transformer:-**		**Surface Area (M2)**	
	Dimension of Transformer (4.6M X 4.4M X 4.4M)		119.68	*2X ((LXB)+(BXH)+(LXH))*
	Dimension of Conservator Tank (1.3M Dia X 3.5M L)		17.091177	*3.14 X D X L+(3.14XD/2XD/2X2)*
	Dimension of Coolers (0.5 Dia X 2 M Length), 2 Nos.		6.28	*3.14 X D X L*
	Oil Piping (0.167 Dia X 10 M Length)		5.24	*3.14 X D X L*
B.	Total Surface Area (M^2)	:	148.29	
C.	Water Application Rate (Lpm/M2)		10.2	*(Chapter 7, Cl.7.4.4 of NFPA-15)*
D.	Water Demand (Lpm)	:	1512.6	(BXC)
E.	Supplementary hose stream protection (Lpm)	:	1890	*(Chapter 6, Clause 6.2 of NFPA 850)*
F.	Theoretical water requirement for the largest deluge (Lpm)	:	3402.6	*(D+E)*
G.	Total water requirements (M^3/H)	:	204.2	

2 Overhead tank sizing

A.	Overhead tank shall be suitable for at least 2 hours supply of the single largest deluge (Chapter 6, Clause 6.2 of NFPA 850)			
B.	Total Water Requirement for system (M^3)	:	408.3	*G X 2 Hours*
C.	Tentative capacity of the overhead tanks (M^3) (4 Nos X 150 M^3)	:	600.0	**Suitably Selected*

4 X 225 MW ARUN-III

ANNEXURE-1B to Doc No. PY-SZ-4-M110-8315-01

1 Theoretical Water Requirement (approx.) for the HVWS System for Shunt Reactor (Dwg. No. 34690001991 Rev 00)

R2

A.	**Approx. Dimensions of Shunt Reactor:-**		**Surface Area (M2)**	
	Dimension of Body (6.770M X 3.036M X 3.30M)		105.82704	*2X ((LXB)+(BXH)+(LXH))*
	Dimension of Conservator Tank (1.29M Dia X 3.2M L)		15.574557	*3.14 X D X L + 2*3.14*D/2*D/2*
	Dimension of Radiator (1.6M X 0.6M X 3.35M) x 8		133.28	*2X ((LXB)+(BXH)+(LXH))*
	Oil Piping (0.167M Dia X 5 M Length)		2.62	*3.14 X D X L*
B.	Total Surface Area (M^2)	:	257.30	
C.	Water Application Rate (Lpm/M2)		10.2	*(Chapter 7, Cl.7.4.4 of NFPA-15)*
D.	Water Demand (Lpm)	:	2624.5	(BXC)
E.	Supplementary hose stream protection (Lpm)	:	1890	*(Chapter 6, Clause 6.2 of NFPA 850)*
F.	Theoretical water requirement for the largest deluge (Lpm)	:	4514.5	*(D+E)*
G.	Total water requirements (M^3/H)	:	270.9	

2 Overhead tank sizing

A.	Overhead tank shall be suitable for at least 2 hours supply of the single largest deluge (Chapter 6, Clause 6.2 of NFPA 850)			
B.	Total Water Requirement for system (M^3)	:	541.7	*G X 2 Hours*
C.	Tentative capacity of the overhead tanks (M^3) (4 Nos X 150 M^3)	:	600.0	**Suitably Selected*

4 x 225 MW ARUN-III HEP

ANNEXURE-2 to Doc. No. PY-SZ-4-M110-8315-01

1) **The Fire Water storage tank shall be located at an elevation so that the fire water pressure requirement for the total power plant including switchyard area is met through gravity as per TAC guidelines.**

Basis of Calculation shall be as follows:-

BASIS : Considering a min. pressure of 7.0 kg/cm2 required at the terminal point of Switchyard Area	
Minimum pressure required at Terminal Point of Switchyard area is 7.0 kg/cm2	7.0 kg/cm2 = 70 MWC
Elevation level of Switchyard Area	EL 557.0 M
Pressure drop in piping between Tank and Landing Valve	10 MWC
Hence, Elevation Level of Fire Water Storage Tank	70 + 557 + 10 = EL. 637.0 M

The location of Fire Water Tanks as mentioned in the contract is 640.0 M, which is suitable for meeting pressure requirement for firefighting.

	ANNEXURE-3 to Doc. No. PY-SZ-4-M110-8315-01				
PAINTING SCHEDULE FOR FIRE PROTECTION SYSTEM					
1. Paint requirement For Over-ground (GI Pipe) pipes normally empty but periodically charged with water .					
SL No	Name of the item	Type	Number of coat	DFT of each layer in micron	Remark
1	Primer	Etch Primer: micaceous iron oxide (MIO)	2	6	
2	Final Paint	Synthetic Enamel paint (Long Oil Alkyd) to IS2932.	3	25	shade : RAL3000 PO RED
		Total DFT in micron		87	
	Note: Surface preparation shall be done either by manually or by any other approved method.				
2. Paints for external surfaces protection of piping / fittings/ Structural steel, etc. (Carbon steel /Mild Steel) to be installed indoor and outdoor.					
SL No	Name of the item	Type	Number of coat	DFT of each layer in micron	Remark
1	Primer	Red Oxide Zinc Phosphate primer to IS 12744 (Alkyd base)	1	30	
2	Final Paint	Synthetic Enamel paint (Long Oil Alkyd) to IS2932.	3	25	Shade : RAL3000 PO RED **shade for structural steel: Dark Admiralty Grey colour shade 632**
		Total DFT in micron		105	
3. Paints for external surfaces protection of Deluge valve and other Hydrant components etc. to be installed indoor and outdoor.					
SL No	Name of the item	Type	Number of coat	DFT of each layer in micron	Remark
1	Primer	Zinc filled epoxy Primer	1	35	
2	Final Paint	Aliphatic Polyurethane	3	30	shade : shade : RAL3000 PO RED
		Total DFT in micron		125	
Note:					
1	Paint shall be as per IS 2932.				
2	Surface preparation shall be done by means of Degreasing and Mech. Cleaning with wire brushing/hand tool (SP6 as applicable).				

5.7 Emergency Lighting.

5.7.1 Emergency lighting should be provided for means of egress. *(See* NFPA *101*, *Life Safety Code.)*

5.7.2 Emergency lighting should be provided for critical plant operations areas.

5.8 Lightning Protection.

Lightning protection should be provided for those structures having a risk index (R) of 4 or greater when evaluated in accordance with NFPA 780, *Standard for the Installation of Lightning Protection Systems*.

Chapter 6 General Fire Protection Systems and Equipment

6.1 General.

All fire protection systems, equipment, and installations should be dedicated to fire protection purposes.

6.2 Water Supply.

6.2.1 The water supply for the permanent fire protection installation should be based on providing a 2-hour supply for both 6.2.1(1) and 6.2.1(2) as follows:

(1) Either of the following, whichever is larger:

(a) The largest fixed fire suppression system demand

(b) Any fixed fire suppression system demands that could reasonably be expected to operate simultaneously during a single event [e.g., turbine under floor protection in conjunction with other fire protection system(s) in the turbine area, coal conveyor protection in conjunction with protection for related coal handling structures during a conveyor fire, adjacent transformers not adequately separated according to 5.2.4]

(2) The hose stream demand of not less than 500 gpm (1890 L/min)

6.2.2 A reliable water supply should be provided at this facility. The fire risk evaluation should evaluate the need for multiple sources. Factors to consider should include the following:

(1) Reliability of source

(2) Capacity of source

(3) Reliance on water-based fire protection systems

(4) Availability of alternate and backup sources

FIRST ANGLE PROJECTION

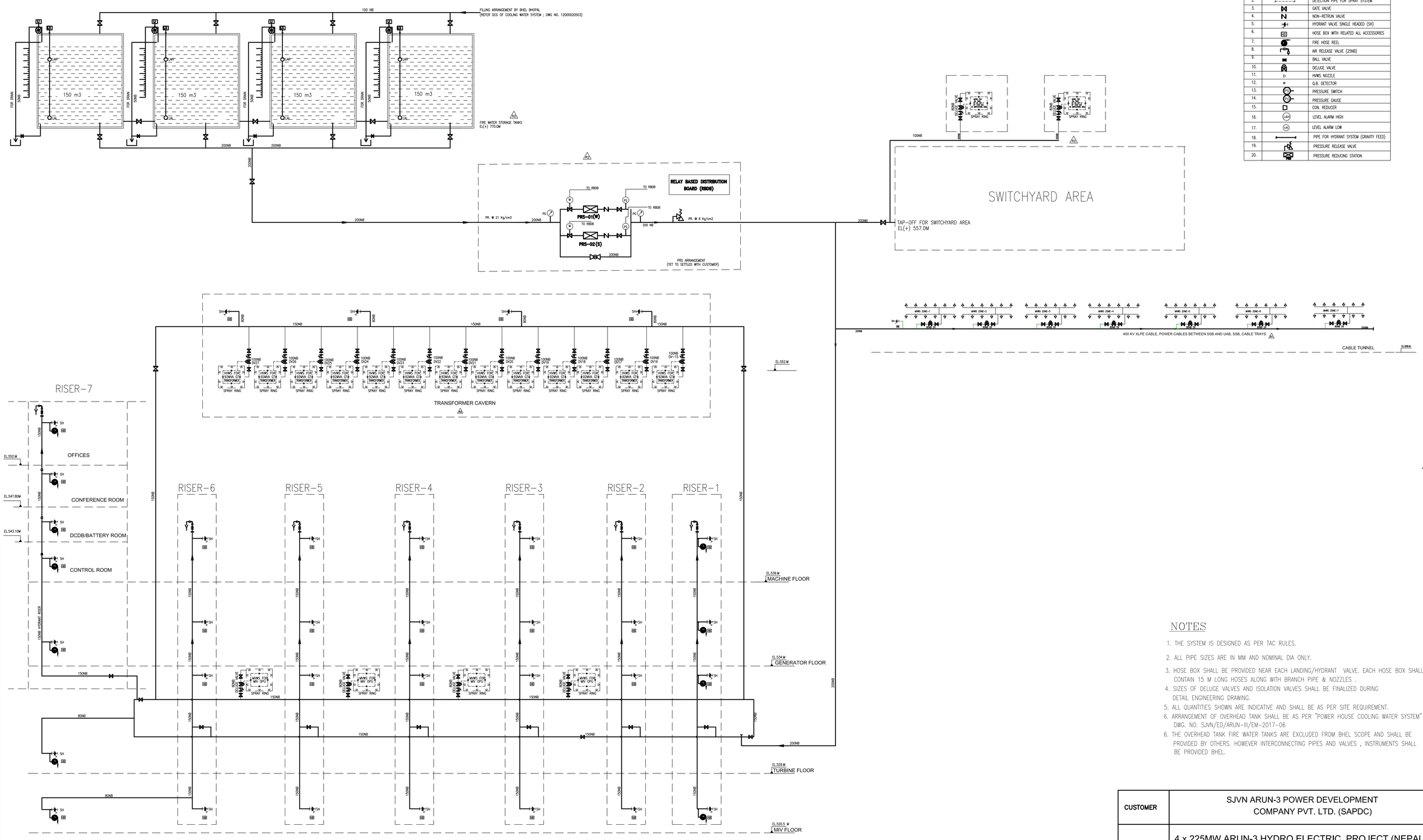
(ALL DIMENSIONS ARE IN mm)

DRG. NO. PYDP1M110866101

SH. OF

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

INVENTORY NO | SIGN. AND DATE | REF. DRG. NO. | COMPUTER FILE NAME



LEGEND		
SL.NO	SYMBOL	DESCRIPTION
1.		PIPE FOR SPRAY SYSTEM
2.		DETECTION PIPE FOR SPRAY SYSTEM
3.		GATE VALVE
4.		NON-RETRUN VALVE
5.		HYDRANT VALVE SINGLE HEADED (SH)
6.		HOSE BOX WITH RELATED ALL ACCESSORIES
7.		FIRE HOSE REEL
8.		AIR RELEASE VALVE (25NB)
9.		BALL VALVE
10.		DELUGE VALVE
11.		HWMS NOZZLE
12.		Q.B. DETECTOR
13.		PRESSURE SWITCH
14.		PRESSURE GAUGE
15.		CON. REDUCER
16.	LAH	LEVEL ALARM HIGH
17.	LAL	LEVEL ALARM LOW
18.		PIPE FOR HYDRANT SYSTEM (GRAVITY FEED)
19.		PRESSURE RELEASE VALVE
20.		PRESSURE REDUCING STATION

NOTES

1. THE SYSTEM IS DESIGNED AS PER TAC RULES.
2. ALL PIPE SIZES ARE IN MM AND NOMINAL DIA ONLY.
3. HOSE BOX SHALL BE PROVIDED NEAR EACH LANDING/HYDRANT VALVE. EACH HOSE BOX SHALL CONTAIN 15 M LONG HOSES ALONG WITH BRANCH PIPE & NOZZLES .
4. SIZES OF DELUGE VALVES AND ISOLATION VALVES SHALL BE FINALIZED DURING DETAIL ENGINEERING DRAWING.
5. ALL QUANTITIES SHOWN ARE INDICATIVE AND SHALL BE AS PER SITE REQUIREMENT.
6. ARRANGEMENT OF OVERHEAD TANK SHALL BE AS PER "POWER HOUSE COOLING WATER SYSTEM" DWG. NO. SJVN/ED/ARUN-III/EM-2017-06
6. THE OVERHEAD TANK FIRE WATER TANKS ARE EXCLUDED FROM BHEL SCOPE AND SHALL BE PROVIDED BY OTHERS. HOWEVER INTERCONNECTING PIPES AND VALVES , INSTRUMENTS SHALL BE PROVIDED BHEL.

REV.	DATE	ALTERED	CHD/APPD	ZONE
02	24.12.2020	AMIT	KD	
01	13.03.20	REVISED AS PER CUSTOMER COMMENTS	PCS	
		REVISED AS PER CUSTOMER COMMENTS	KAMAL	

CUSTOMER	SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC)
PROJECT	4 x 225MW ARUN-3 HYDRO ELECTRIC PROJECT (NEPAL)
CONSULTANT	SJVN LTD.

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD
PROJECT ENGG & SYSTEMS DIVISION

	NAME	SIGN.	DATE
DRN.	HARISH	–SD–	30.01.19
CHD.	KAMAL	–SD–	30.01.19
APPD.	PC SEKHAR	–SD–	30.01.19

NO.OF VAR. N.A.

DEPT.	UNTOL. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PED	GR.	N.T.S	N.A.	N.A.	N.A.	N.A.
CODE 450	g/w/f					

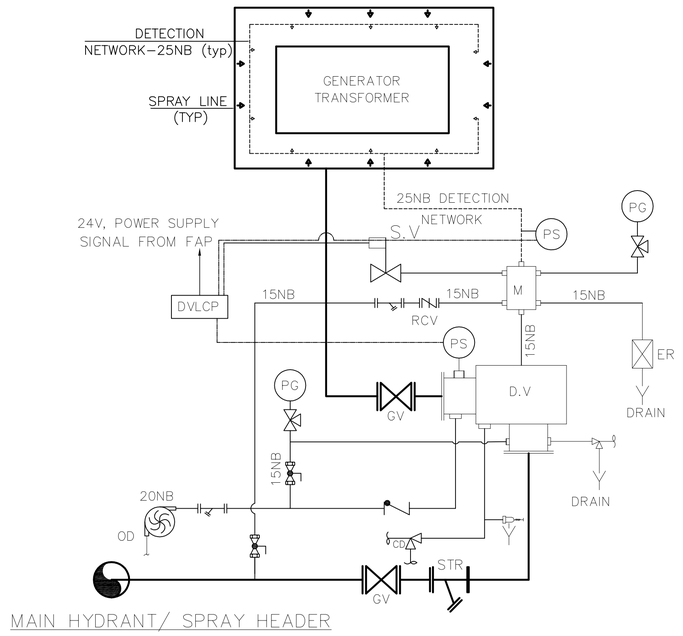
TITLE P&ID OF FIRE HYDRANT AND SPRAY SYSTEM

CARD CODE NA

DRG. NO. PYDP1M110866101 REV. 02

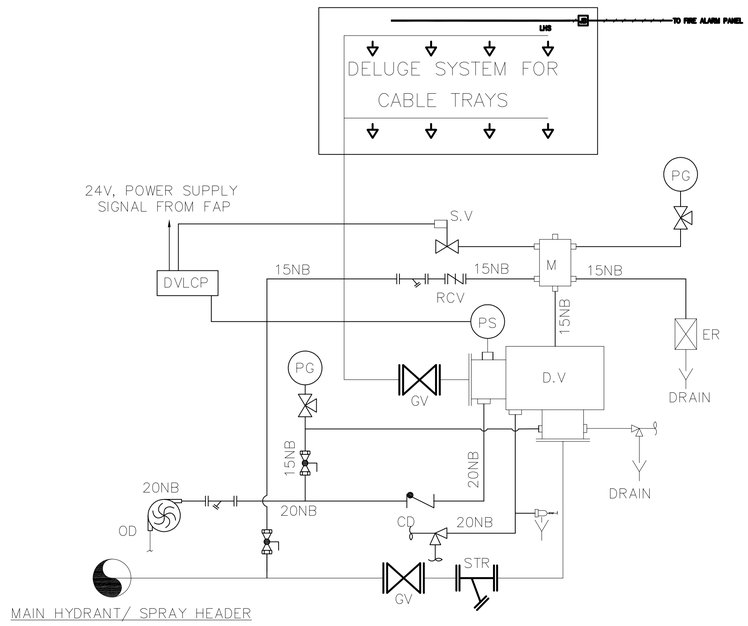
CUST. DRG. NO.

SHT. No 01 | No. OF SHT. 01 | SIZE – A1



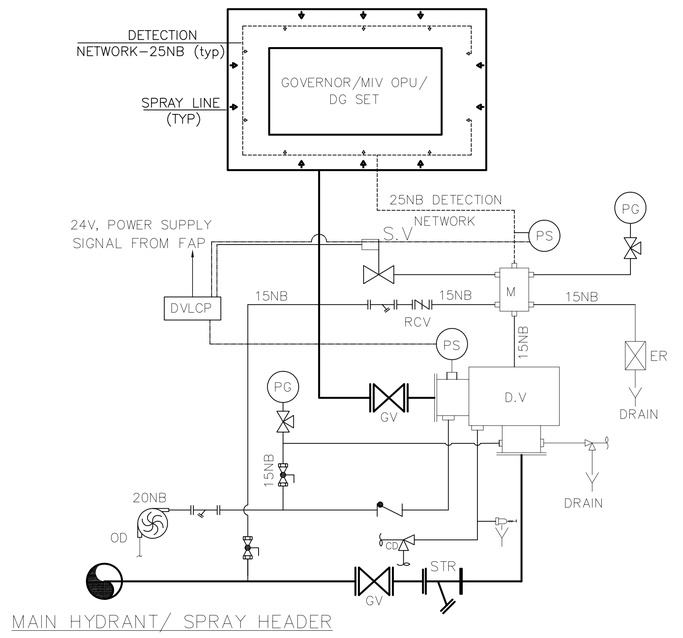
AUTOMATIC HVW SPRAY SYSTEM(TYP)

REFER TABLE–1



AUTOMATIC MVW SPRAY SYSTEM(TYP)

REFER TABLE–2



AUTOMATIC MVW SPRAY SYSTEM(TYP)

REFER TABLE–3

TABLE -1
EQUIPMENT TO BE PROTECTED BY HVWS SYSTEM

SL. NO.	AREA DESCRIPTION	QUANTITY (NOS.)
1	92 MVA SINGLE PHASE GENERATOR STEP UP TRANSFORMER	13

R3

TABLE-2
EQUIPMENT TO BE PROTECTED BY MVWS SYSTEM

SL. NO.	AREA DESCRIPTION	QUANTITY
1	400 KV XLPE CABLE, POWER CABLES BETWEEN SSB AND UAB, SSB, CABLE TRAYS	

R3

TABLE-3
EQUIPMENT TO BE PROTECTED BY MVWS SYSTEM

SL. NO.	AREA DESCRIPTION	QUANTITY
1	GOVERNOR/ MIV OPU	4
2	DG SET (DIESEL ENGINE TANK)	2

SYSTEM OPERATION MVWS

1	THE DETECTION IN MVWS SYSTEM SHALL BE THROUGH LHS CABLE, HEAT DETECTORS or QBDs AS INDICATED IN THE SCHEMATIC OF RESPECTIVE AREA. THE WATER SUPPLY TO THE SPRAY SYSTEM WILL BE CONTROLLED BY WET PILOT TYPE DELUGE VALVE WHICH WILL BE OPERATED HYDRAULICALLY AND IS NORMALLY CLOSED BY WATER PRESSURE. DELUGE VALVES SHALL BE TAPPED FROM NEAREST SPRAY HEADER.
2	IN THE EVENT OF FIRE, THE SURROUNDING TEMPERATURE INCREASES, AS THE SURROUNDING TEMPERATURE REACHES THE SET POINT TEMPERATURE, THE DETECTION MEDIA GIVES A SIGNAL TO MAIN FIRE ALARM PANEL WITH THE RECEIPT OF FIRE SIGNAL, THE MAIN FIRE ALARM PANEL OPENS THE SOLENOID VALVE PLACED IN THE DETECTION LINE OF DELUGE VALVE. AS THE SOLENOID VALVE OPENS, THE WATER IN DETECTION LINE TO FLOW OUT. THIS CREATES A PRESSURE DROP IN THE DETECTION LINE.
3	THE PRESSURE DROP IN DETECTION LINE WILL OPEN THE DELUGE VALVE AND WATER STARTS PROJECTING OUT FROM THE SPRAY NOZZLES. THIS WILL FURTHER CAUSE A DROP IN PRESSURE IN THE SPRAY HEADER FROM WHICH WATER SUPPLY IS TAKEN FOR MVWS SYSTEM.
4	IT IS ALSO POSSIBLE TO ACTUATE DELUGE VALVE BY OPERATING THE PUSH BUTTON PROVIDED ON LPBS OF DELUGE VALVE OR BY OPERATING A MANUAL LEVER PROVIDED ON DELUGE VALVE TRIM ASSEMBLY.
5	AUDIBLE ANNUNCIATION OF FIRE WILL ALSO BE ACHIEVED THROUGH ALARM GONG PROVIDED ON DELUGE VALVE ASSEMBLY.

SYSTEM OPERATION HVWS

1	THE WATER SUPPLY TO THE SPRAY SYSTEM WILL BE CONTROLLED BY WET PILOT TYPE DELUGE VALVE WHICH WILL BE OPERATED HYDRAULICALLY AND IS NORMALLY CLOSED BY WATER PRESSURE. DELUGE VALVES SHALL BE TAPPED FROM NEAREST SPRAY HEADER.
2	IN CASE OF HVW SPRAY SYSTEM, THE DETECTION SYSTEM WILL BE OF WATER FILLED DETECTION SYSTEM CONSISTING OF HEAT SENSING DETECTORS OF FUSIBLE TYPE (QUARTZOID BULBS). IN THE EVENT OF FIRE THE SURROUNDING TEMPERATURE INCREASES MORE THAN THE RATED TEMPERATURE OF QBD (79 DEG. C), THE DETECTOR BULB COLLAPSES AND CONSEQUENTLY THERE WILL BE DROP IN PRESSURE IN THE DETECTION NETWORK. THIS DROP IN PRESSURE WILL OPEN THE DELUGE VALVE AND WATER STARTS PROJECTING OUT FROM THE PROJECTORS.
3	IT IS ALSO POSSIBLE TO ACTUATE DELUGE VALVE BY OPERATING THE PUSH BUTTON PROVIDED ON LCP OF DELUGE VALVE OR BY OPERATING A MANUAL LEVER PROVIDED ON DELUGE VALVE TRIM ASSEMBLY.
4	AUDIBLE ANNUNCIATION OF FIRE WILL ALSO BE ACHIEVED THROUGH ALARM GONG PROVIDED ON DELUGE VALVE ASSEMBLY.

LEGEND :

SL.NO.	ITEM	DESCRIPTION
1.0		SPRAY PIPE LINE
2.0		SPRAY NOZZLE
3.0	DV	DELUGE VALVE
4.0		'Y' STRAINER
5.0		GATE VALVE
6.0		Q.B. DETECTOR
7.0		DETECTION LINE
8.0	S.V	SOLENOID VALVE
9.0		GLOBE VALVE
10.0		DRAIN
11.0		PRESSURE SWITCH
12.0		PRESSURE GAUGE
13.0		WATER MOTOR GONG
14.0	ER	EMERGENCY OVERRIDE
15.0	DV	DELUGE VALVE
16.0	DVLCP	DELUGE VALVE LCP

NOTES:

1. ALL PIPE AT THE DOWNSTREAM OF DELUGE VALVE SHALL BE GALVANISED ONLY. OTHER PIPES SHALL BE MS ERW.
2. SET POINT OF INSTRUMENTS SHALL BE FURNISHED SEPARATELY AFETR FINALISATION OF HYDRAULIC CALCULATION.
3. GATE VALVES SHALL BE PROVIDED FOR EACH DELUGE VALVE ON UPSTREAM AND DOWNSTREAM
   Y– STRAINER SHALL BE PROVIDED AT UPSTREAM OF EACH DELUGE VALVE.
4. SPRAY SYSTEM SHALL BE DESIGNED AS PER TAC GUIDELINES.
5. DELUGE VALVE QUANTITY AND LOCATIONS ARE INDICATIVE ONLY, SAME SHALL BE FINALISED BASED ON THE HYDRAULIC CALC. AND ACTUAL WATER REQUIREMENT.
6. THE MINIMUM RUNNING WATER PRESSURE AT ANY HVW SPRAY/PROJECTOR NOZZLES WILL NOT BE LESS THAN 3.5 KG/CM2 (G) AND NOT GREATER THAN 5.0 KG/CM2 (G).
7. FOR MVW SPRAY NOZZLE MINIMUM AND MAXIMUM PRESSURE SHALL BE 1.4 KG/CM2 AND 3.5 KG/CM2
8. PIPES & FITTINGS SHALL BE AS PER APPROVED DATASHEET.

REV.	DATE	ALTERED	CHD/APPD
03	13.03.20	HARISH	KAMALUDDIN
		REVISED AS PER CUSTOMER COMMENTS	
02	14.02.20	HARISH	KAMALUDDIN
		REVISED SUBMISSION	
01	03.06.19	HARISH	KAMALUDDIN
		REVISED AS PER CUSTOMER COMMENTS	

CUSTOMER	SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC)
PROJECT	4 x 225MW ARUN-3 HYDRO ELECTRIC PROJECT (NEPAL)
CONSULTANT	SJVN LTD.

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD
PROJECT ENGG & SYSTEMS DIVISION

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	HARISH	–SD–	11.01.19	N.A.
CHD.	KAMAL	–SD–	21.01.19	
APPD.	PC SEKHAR	–SD–	21.01.19	

DEPT.	UNTOL. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PED	OR.					
CODE 450	g/w/f	N.T.S	N.A.	N.A.	N.A.	N.A.

TITLE: P&ID OF HIGH VELOCITY WATER SPRAY SYSTEM (HVWS) AND MEDIUM VELOCITY WATER SPRAY SYSTEM (MVWS)

CARD CODE: NA

DRG. NO. PYDP1M110866102 REV. 03

CUST. DRG. NO.

SHT. No 01 | No. OF SHT. 01 | SIZE – A1

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO

FIRST ANGLE PROJECTION

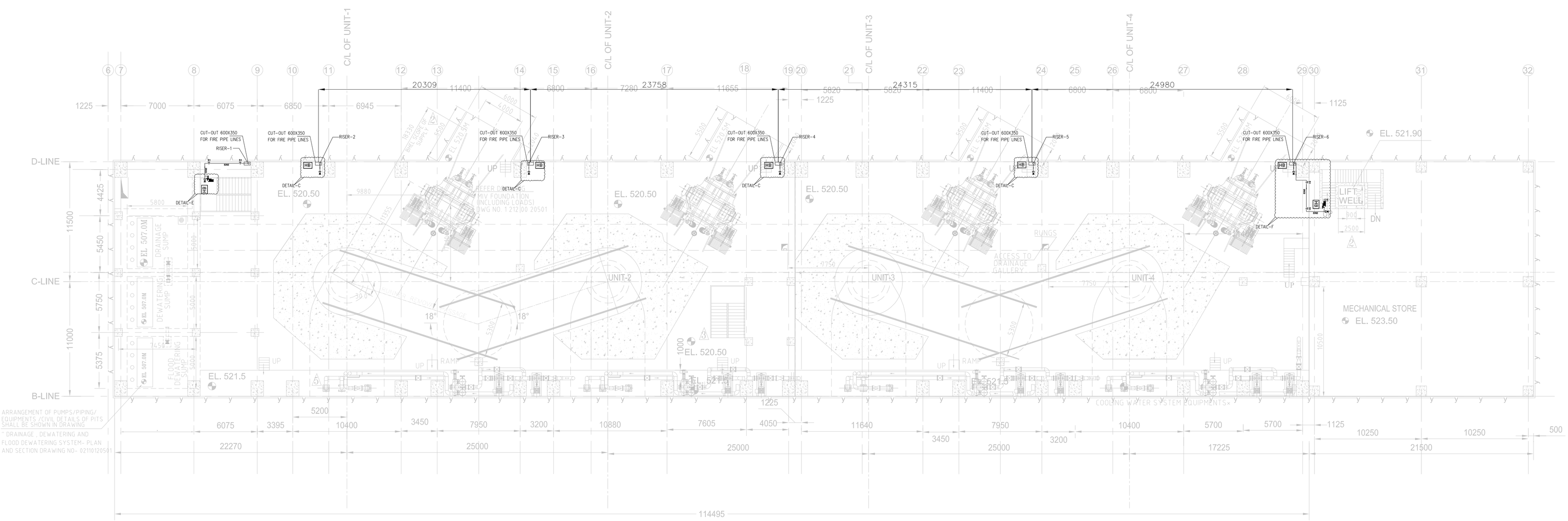
(ALL DIMENSIONS ARE IN mm)

DRG. NO. PY-DP-1-M110-8663-04

SH. 01 OF 01

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

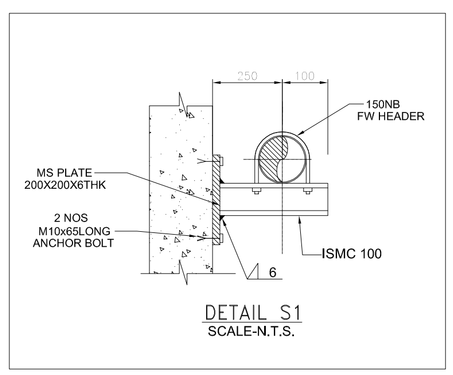
COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO



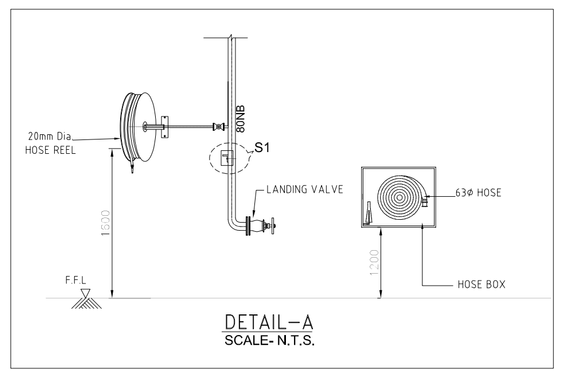
PLAN AT EL.520.5 (MIV FLOOR)

LEGEND			
SL.NO	SYMBOL	TAG	DESCRIPTION
01.	———	NB	FPS LINE
02.	——►		FLOW DIRECTION
03.	⋈		GATE VALVE
04.	⋈		Y STRAINER
05.	HB	HB	HOSE BOX
06.	⊗	DV	DELUGE VALVE
07.	⋈	SH	HYDRANT VALVE
08.	⋈	HR	HOSE REEL DRUM
09.			

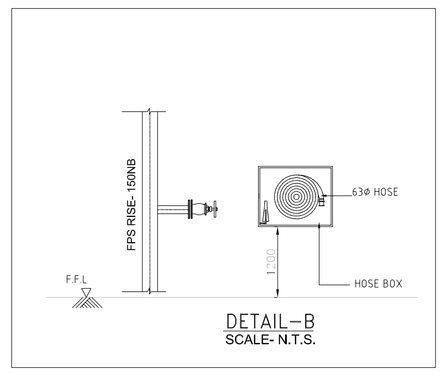
B.O.Q FOR HYDRANT SYSTEM			
SL. NO	ITEM	UNIT	QTY
01.	HYDRANT VALVE	NOS.	35
.02	15m HOSES ALONG WITH COUPLING	NOS.	35
.03	HOSE BOX	NOS.	35
.04	BRANCH PIPE & NOZZLE	NOS.	35
.05	HOSE REEL DRUM	NOS.	11



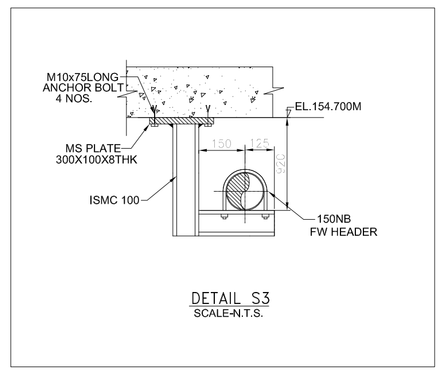
DETAIL S1
SCALE-N.T.S.



DETAIL-A
SCALE- N.T.S.



DETAIL-B
SCALE- N.T.S.



DETAIL S3
SCALE-N.T.S.

NOTES:

1. ALL DIMENSIONS ARE IN MM.& ELEVATIONS ARE IN MTRS UNLESS OTHERWISE SPECIFED.
2. THE SYSTEM HAS BEEN DESIGNED ON LIGHT HAZARD BASIS AS PER TAC NORMS AND TENDER SPECIFICATION.
3. ALL HYDRANTS WILL BE INSTALLED 1.2M ABOVE THE FGL.
4. LOCATION FOR PIPE SUPPORT (PS) SHOWN IS TENTATIVE AND THE SAME SHALL BE DONE AS PER SITE CONDITION.
5. THE SPACING OF SUPPORTS SHALL BE 3.5 M FOR 80, 100 AND 125 MM DIA. PIPES, 5M FOR 150, 200 AND 250 MM DIA PIPES AND 7 M FOR ABOVE 250 MM DIA PIPES.
6. SUITABLE SUPPORTS AS PER SITE CONDITION SHALL BE CONSIDERED.
7. MINOR MODIFICATIONS IN PIPE ROUTING, IF ANY, SHALL BE DONE AT SITE.
8. HOSE BOX SHALL BE PROVIDED NEAR EACH LANDING/HYDRANT VALVE. EACH HOSE BOX SHALL CONTAIN 15 M LONG HOSES ALONG WITH BRANCH PIPE & NOZZLES .
9. ARRANGEMENT OF OVERHEAD TANK SHALL BE AS PER "POWER HOUSE COOLING WATER SYSTEM" DWG. NO. SJVN/ED/ARUN-III/EM-2017-06

ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD
	ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE		

CUSTOMER	SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC)
PROJECT	4 x 225MW ARUN-3 HYDRO ELECTRIC PROJECT (NEPAL)
CONSULTANT	SJVN LTD.

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD
PROJECT ENGG & SYSTEMS DIVISION

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	AMT	-SD-	05.12.20	N.A.
CHD.	KD	-SD-	05.12.20	
APPD.	PC SEKHAR	-SD-	05.12.20	

DEPT. PED.	UNTOL DIMS. GR.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.
CODE 450	g/M/f		N.T.S	N.A.	N.A.

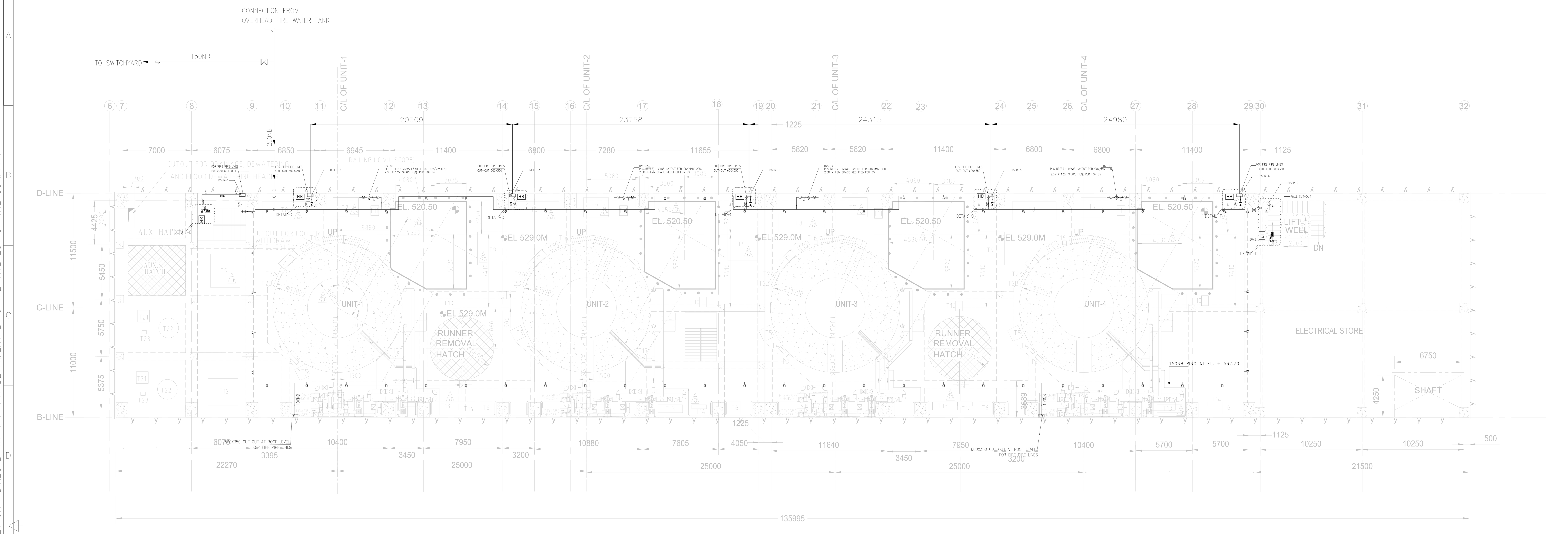
TITLE	CARD CODE	DRG. NO.	REV.
COMPOSITE LAYOUT OF HYDRANT & SPRAY SYSTEM (FOR MIV FLOOR AT EL. 520.5M)	NA	PY-LP-0-M110-8661-01	00
		G.OT. DRG. NO.	
		SHT. NO. 01	NO. OF SHT. 05 SIZE A1

FIRST ANGLE PROJECTION

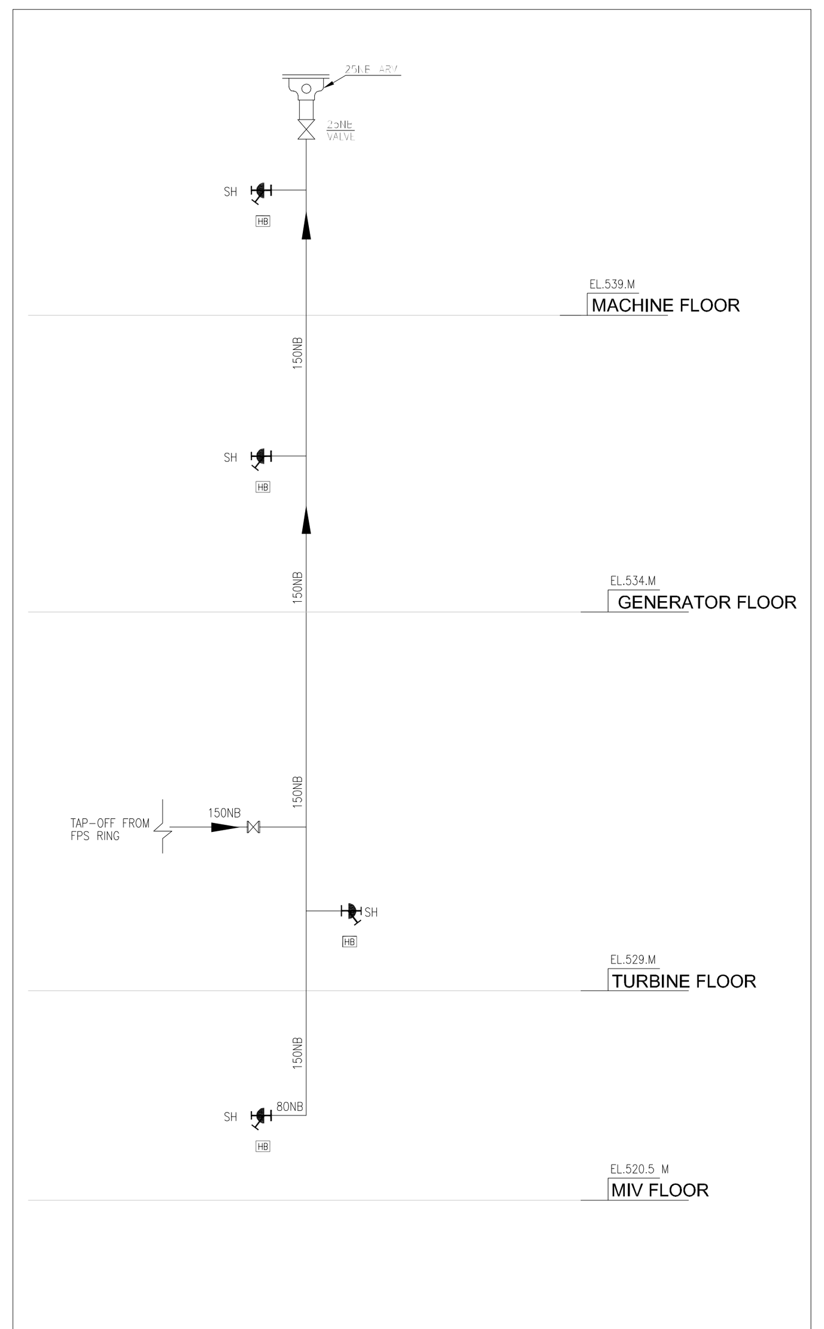
(ALL DIMENSIONS ARE IN mm)

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

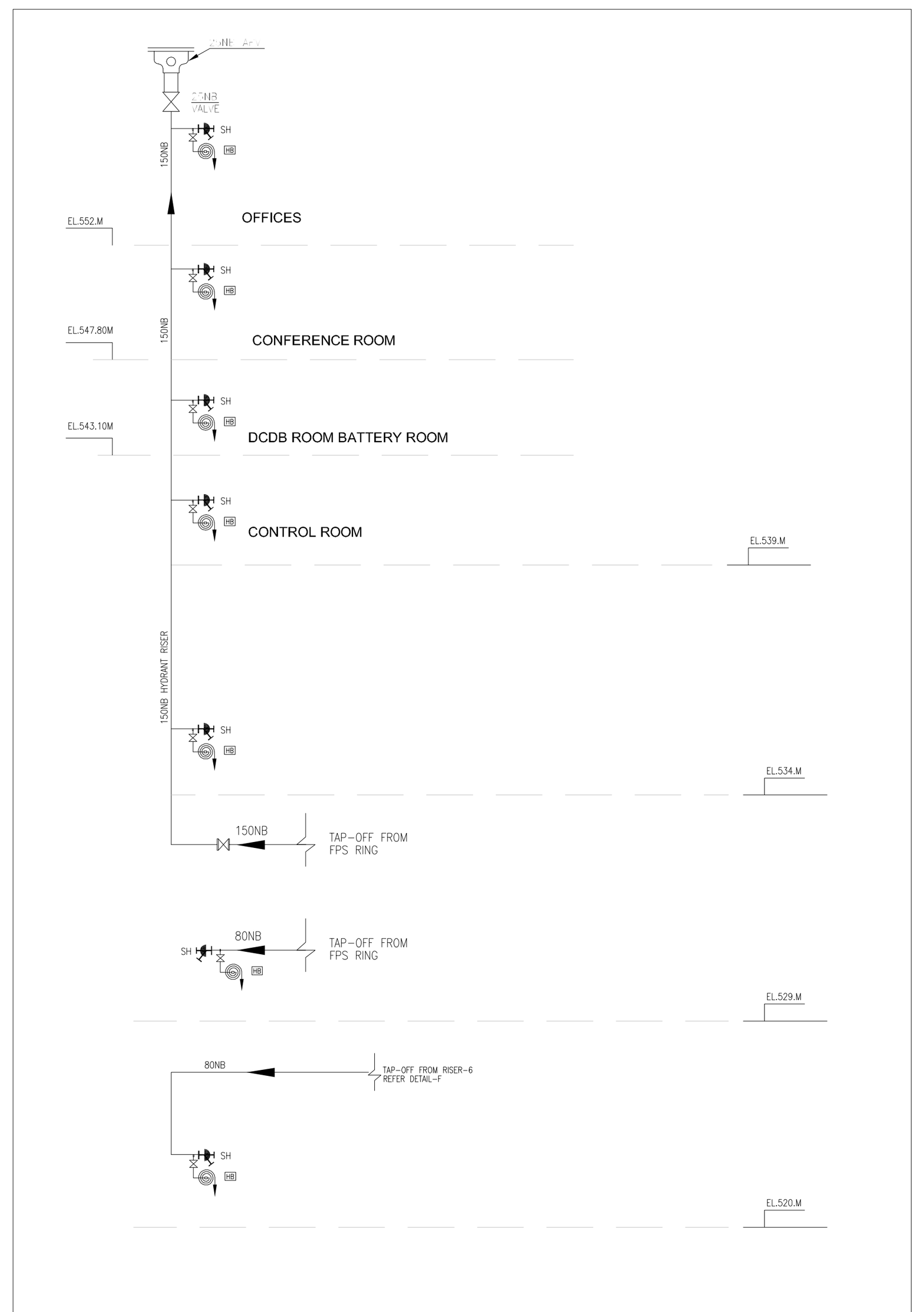
DRG. NO. PY-DP-1-M110-8663-04 SH. 01 OF 01



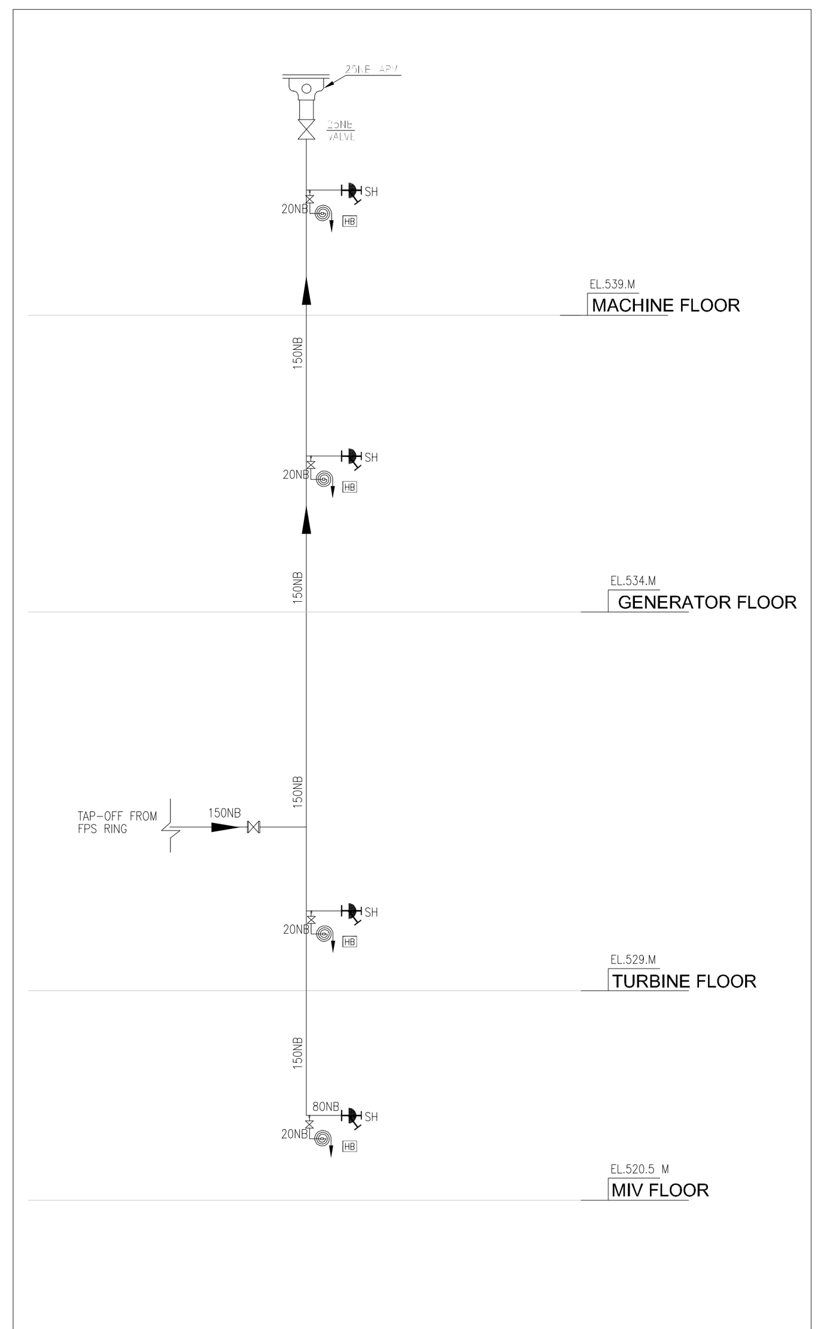
PLAN AT EL.529.00 (TURBINE FLOOR)



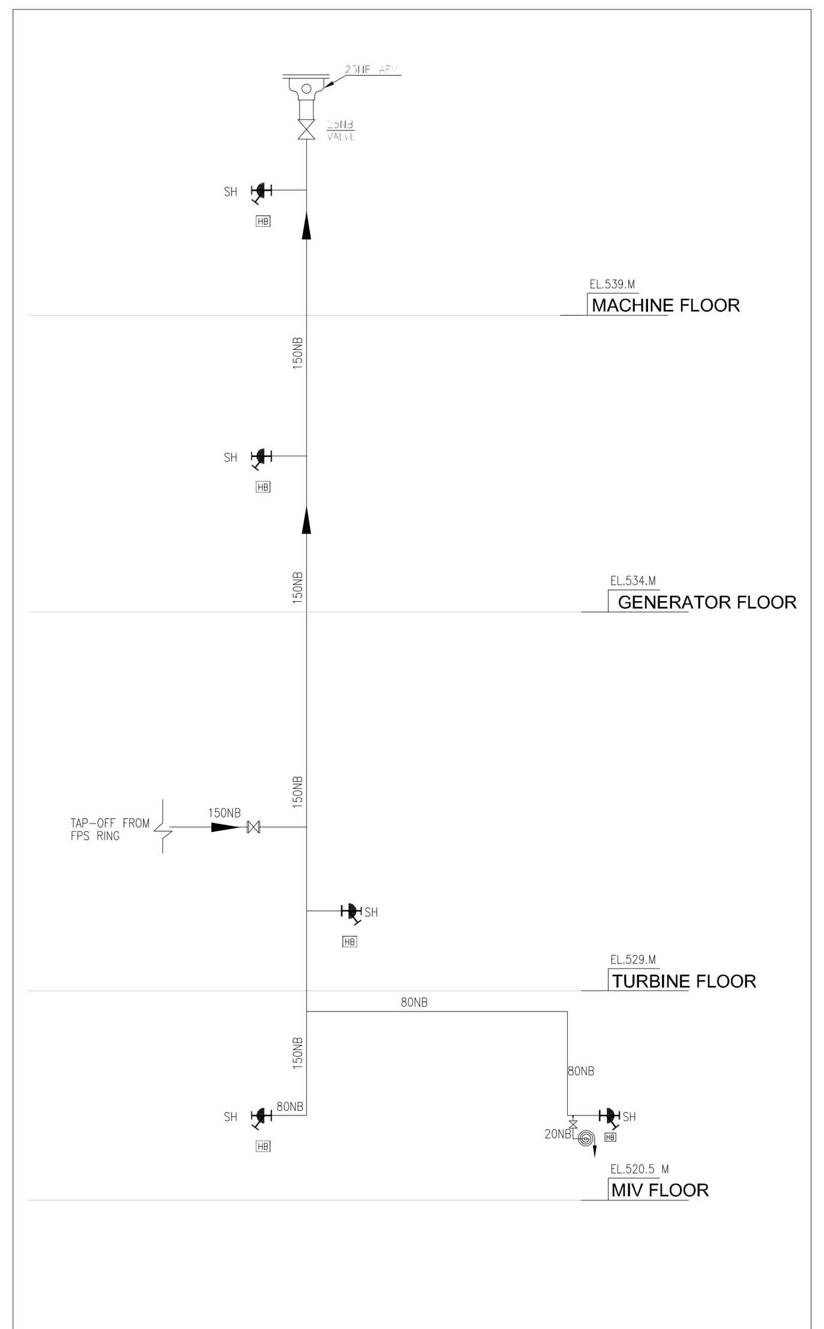
DETAIL-C
TYPICAL DETAIL FOR RISER-2,3,4 & 5
(INSIDE POWER HOUSE)



DETAIL-D
TYPICAL DETAIL FOR RISER-7
(STAIRCASE NEAR UNIT-4)



DETAIL-E
TYPICAL DETAIL FOR RISER-1
(STAIRCASE NEAR UNIT-1)



DETAIL-F
TYPICAL DETAIL FOR RISER-6
(INSIDE POWER HOUSE)

SCHEDULE OF DELUGE VALVE

SL. NO.	DV TAG NO.	AREA OF PROTECTION	LOCATION
1	DV-01	MVWS FOR GOVERNOR/MIV OPU - UNIT-1	POWER HOUSE AT EL. 529.0 (TURBINE FLOOR)
2	DV-02	MVWS FOR GOVERNOR/MIV OPU - UNIT-2	POWER HOUSE AT EL. 529.0 (TURBINE FLOOR)
3	DV-03	MVWS FOR GOVERNOR/MIV OPU - UNIT-3	POWER HOUSE AT EL. 529.0 (TURBINE FLOOR)
4	DV-04	MVWS FOR GOVERNOR/MIV OPU - UNIT-4	POWER HOUSE AT EL. 529.0 (TURBINE FLOOR)
5	DV-05 TO 16	HVWS FOR GEN TRANSFORMER (13 NOS.)	TRANSFORMER CAVERN
6	DV-17 TO 20	MVWS FOR CABLE TRAYS	400 kV XLPE CABLE TRAYS
7	DV-21	MVWS FOR DG FUEL TANK	SWITCHYARD

CUSTOMER	SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC)
PROJECT	4 x 225MW ARUN-3 HYDRO ELECTRIC PROJECT (NEPAL)
CONSULTANT	SJVN LTD.

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD
PROJECT ENGG & SYSTEMS DIVISION

	NAME	SIGN.	DATE
DRN.	AMT	-SD-	05.12.20
CHD.	KD	-SD-	05.12.20
APPD.	PC SEKHAR	-SD-	05.12.20

SCALE: N.T.S — WEIGHT (KG): N.A. — REF. TO ASSY. DRG.: N.A. — NO. OF VAR.: N.A.

TITLE
COMPOSITE LAYOUT OF HYDRANT & SPRAY SYSTEM
(FOR TURBINE FLOOR AT EL. 529.0M)

CARD CODE: NA — DRG. NO. PY-LP-0-M110-8661-01 — REV 00 — SHT. No. 02 — No. OF SHT. 05 — SIZE A1

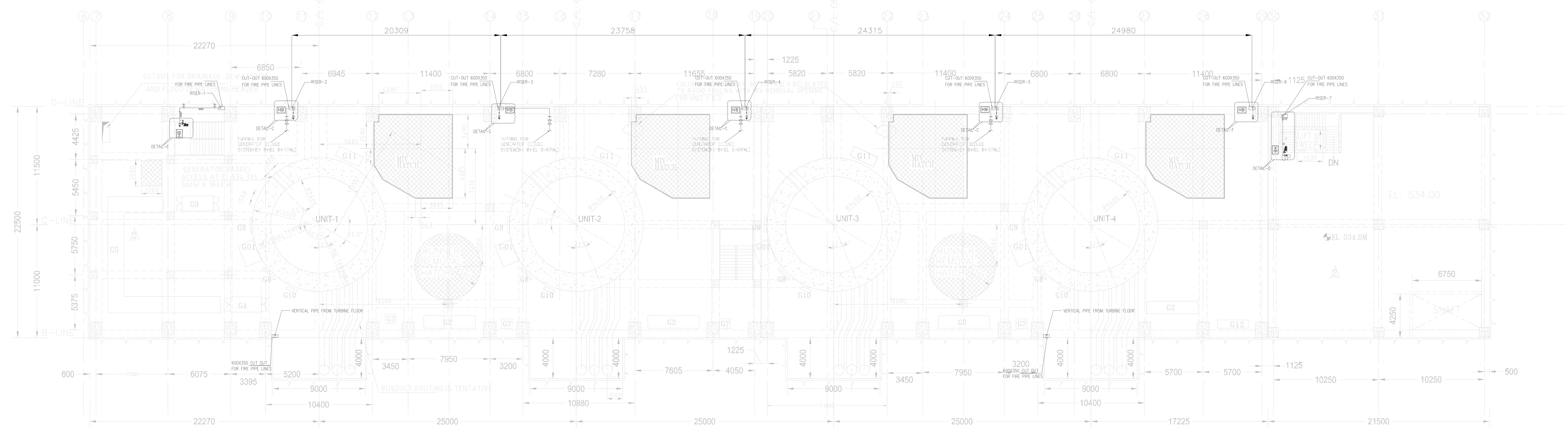
ALTERED	REV.	DATE
CHD/APPD	ZONE	

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. PY-DP-1-M110-8663-04 SH. 01 OF 01

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261



PLAN AT EL.534.0M (GENERATOR FLOOR)

REFERENCE DRAWINGS:-

1. POWER HOUSE: GENERAL ARRG. CROSS SECTION - 1 200 00 20551
2. POWER HOUSE: GENERAL ARRG. PLAN AT EL. 520.5M - 1 200 00 20553
3. POWER HOUSE: GENERAL ARRG. PLAN AT EL. 529.0M - 1 200 00 20554
4. POWER HOUSE: GENERAL ARRG. PLAN AT EL. 534.0M - 1 200 00 20555
5. POWER HOUSE: GENERAL ARRG. PLAN AT EL. 534.0M - 1 200 00 20556
6. P&ID OF FIRE HYDRANT & SPRAY SYSTEM - PY-DP-1-M110-8661-01
7. DESIGN BASIS OF FPS -PY-SZ-4-M110-8315-01

CUSTOMER	SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC)
PROJECT	4 x 225MW ARUN-3 HYDRO ELECTRIC PROJECT (NEPAL)
CONSULTANT	SJVN LTD.

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD
PROJECT ENGG & SYSTEMS DIVISION

	NAME	SIGN.	DATE
DRN.	AMT	-SD-	05.12.20
CHD.	KD	-SD-	05.12.20
APPD.	PC SEKHAR	-SD-	05.12.20

DEPT. PED. CODE 450 | UNITS, DIMS. OR. $\frac{mm}{Kg}$ | SCALE N.T.S | WEIGHT (KG) N.A. | REF. TO ASSY. DRG. N.A. | MOULD VAR. N.A.

TITLE
COMPOSITE LAYOUT OF HYDRANT & SPRAY SYSTEM (FOR GENERATOR FLOOR AT EL. 534.0M)

CARD CODE NA | DRG. NO. PY-LP-0-M110-8661-01 | REV 00 | SHT. No. 03 | No. OF SHT. 05 | SIZE A1

ALTERED	REV.	DATE
CHD/APPD	ZONE	

FIRST ANGLE PROJECTION

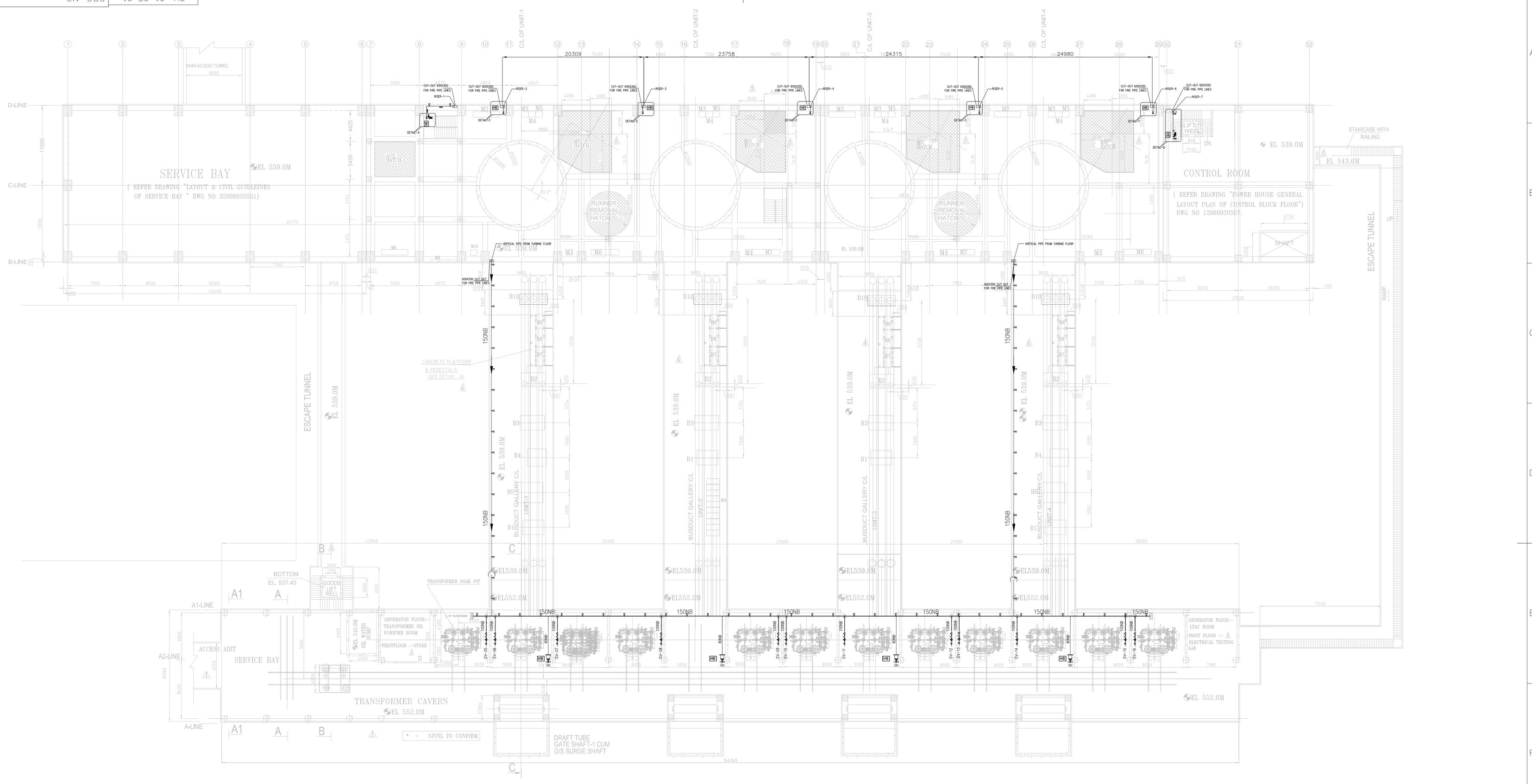
(ALL DIMENSIONS ARE IN mm)

DRG. NO. PY-DP-1-M110-8663-04

SH. 01 OF 01

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

INVENTORY NO | SIGN. AND DATE | REF. DRG. NO. | COMPUTER FILE NAME



PLAN AT EL.539.0M & 552.0M

ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
CHD/APPD	ZONE		CHD/APPD	ZONE		CHD/APPD	ZONE		CHD/APPD	ZONE		CHD/APPD	ZONE		CHD/APPD	ZONE		CHD/APPD	ZONE		CHD/APPD	ZONE		CHD/APPD

CUSTOMER	SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC)
PROJECT	4 x 225MW ARUN-3 HYDRO ELECTRIC PROJECT (NEPAL)
CONSULTANT	SJVN LTD.

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD. PROJECT ENGG & SYSTEMS DIVISION

	NAME	SIGN.	DATE
DRN.	AMT	-SD-	05.12.20
CHD.	KD	-SD-	05.12.20
APPD.	PC SEKHAR	-SD-	05.12.20

NO.OF VAR. N.A.

DEPT. PED. CODE 450	INTOL. DIMS. OR. g/m/f		SCALE N.T.S	WEIGHT (KG) N.A.	REF. TO ASSY. DRG. N.A.

TITLE: COMPOSITE LAYOUT OF HYDRANT & SPRAY SYSTEM (FOR MACHINE FLOOR AT EL 539.0M & TRANSFORMER CAVERN)

CARD CODE NA

DRG. NO. PY-LP-0-M110-8661-01 REV. 00

ASSY. DRG. NO.

SHT. NO. 04 NO. OF SHT. 05 SIZE A1

FIRST ANGLE PROJECTION

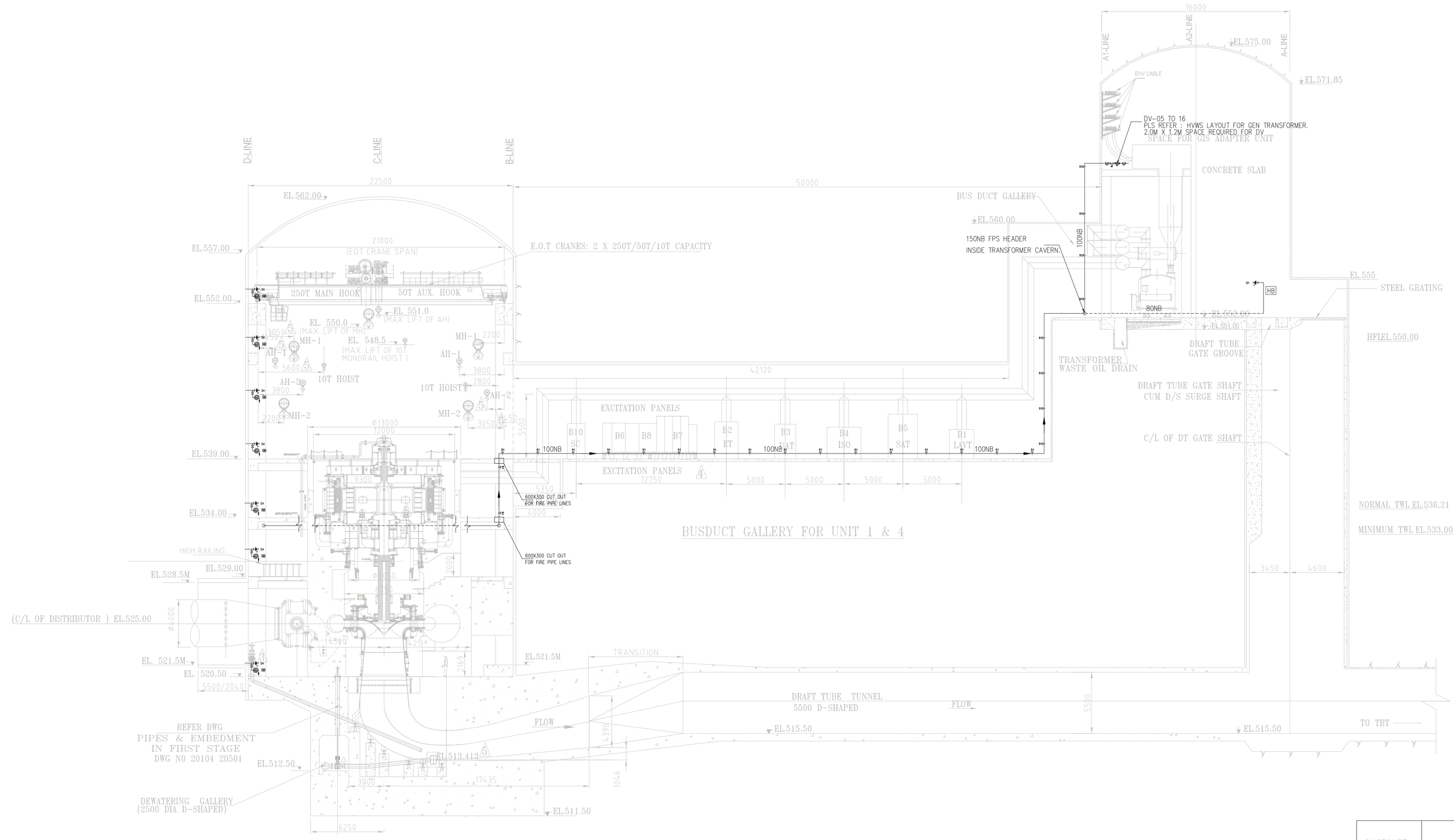
(ALL DIMENSIONS ARE IN mm)

DRG. NO. PY-DP-1-M110-8663-04

SH. 01 OF 01

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

INVENTORY NO | SIGN. AND DATE | REF. DRG. NO. | COMPUTER FILE NAME



CROSS-SECTION OF POWER HOUSE THROUGH C.L OF UNIT

ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD
	ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			

CUSTOMER	SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC)
PROJECT	4 x 225MW ARUN-3 HYDRO ELECTRIC PROJECT (NEPAL)
CONSULTANT	SJVN LTD.

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD
PROJECT ENGG & SYSTEMS DIVISION

	NAME	SIGN.	DATE	NO OF VAR.
DRN.	AMT	-SD-	05.12.20	N.A.
CHD.	KD	-SD-	05.12.20	
APPD.	PC SEKHAR	-SD-	05.12.20	

DEPT. PRD. CODE 450	UNITOL DIMS. CH.	SCALE N.T.S.	WEIGHT (KG) N.A.	REF. TO ASSY. DRG. N.A.

TITLE: COMPOSITE LAYOUT OF HYDRANT & SPRAY SYSTEM (CROSS SECTION)

CARD CODE NA

DRG. NO. PY-LP-0-M110-8661-01 REV 00

CUST. DRG. NO.

SHT. NO. 05 NO. OF SHT. 05 SIZE A1

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. | SH. OF

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME | REF. DRGS. NO. | SIGN. AND DATE | INVENTORY NO

230V AC SUPPLY — SIREN

CM

EL.520.5M (MIV FLOOR) & EL.523.5M(MECHANICAL UTILITY AREA)

EL.529.0M (TURBINE FLOOR & MECHANICAL UTILITY AREA) — DVLCP MVWS

EL.534.0M (GENERATOR FLOOR)

EL. 539.0 M (MACHINE HALL)

240V AC,1PH 50Hz POWER SUPPLY

240V AC,1PH 50Hz POWER SUPPLY (BY BHEL)

PRINTER

COLOUR MONITOR

RS-232

LOC: CONTROL ROOM 1YEAR DATA STORAGE

FAP

LOC: CONTROL ROOM

LCD DISPLAY

EL. 539.0 M (CONTROL ROOM)

EL. 539.0 M (SERVICE BAY)

EL. 539.0 M (BUS DUCT GALLERY)

TRANSFORMER OIL PURIFIER,STORE LTAC ROOM,ELEC. TESTING LAB

TO SCADA

240V AC,1PH 50Hz POWER SUPPLY (BY BHEL)

EL. 543.6 M (BATTERY ROOM)

EL. 547.8 M & EL.552.0 M CONFERENCE / OFFICE ROOM)

EL. 552.0 M (TRANSFORMER CAVERN) — DVLCP HVWS

EXHAUST BLOWER ROOM (EL.552.0M)

EL.539.0M (CABLE TUNNEL) — DVLCP MVWS

FOR TELEPHONE SYSTEM MONITORING

MM

WORKSHOP

VENTILATION ROOM OF POWER HOUSE

FAP

LOC: SWITCHYARD AREA

LCD DISPLAY

NETWORK CABLE

BATTERY CHARGER

+BATTERY-

FIRE ALARM PANEL IN SWITCHYARD AREA SHALL BE IN THE SCOPE OF BHEL-TBG

BATTERY CHARGER

+BATTERY-

NETWORK CABLE

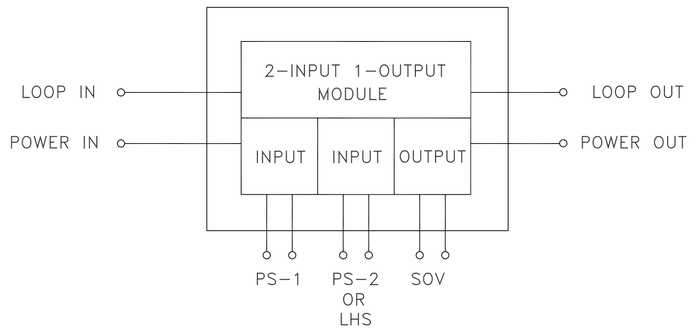
REPEATER PANEL

LCD DISPLAY

LOC: ENTRANCE OF POWER HOUSE

240V AC,1PH 50Hz POWER SUPPLY (BY BHEL)

MODULES IN DVLCP



PS-1 : PRESSURE SWITCH IN DISCHARGE LINE
PS-2 : PRESSURE SWITCH IN DETECTION LINE
LHS : LINEAR HEAT SENSING CABLE
SOV : SOLENOID VALVE

LEGEND:-

SL NO	SYMBOL	DESCRIPTION
1	———	POWER CABLE (2Cx2.5 SQ.MM)
2	- - - - -	CONTROL/LOOP CABLE (2Cx1.5 SQ.MM)
3	⌐	DIGITAL LHS CABLE
4		HOOTER
5	CM	CONTROL MODULE
6	MM	MONITOR MODULE (INPUT MODULE)
7	●	MANUAL CALL POINT
8	M	MULTISENSOR DETECTOR
9	M	MULTISENSOR DETECTOR WITH RESPONSE INDICATOR (ABOVE FALSE CEILING)
10	A	ASPIRATION DETECTOR
11	B	BEAM DETECTOR
12	H	HEAT DETECTOR
13	FAP	FIRE ALARM PANEL
14	DVLCP	DELUGE VALVE LOCAL CONTROL PANEL (FOR HVWS/MVWS)

REV.	DATE	ALTERED	CHD/APPD	ZONE
02	13.03.20	REVISED AS PER CUSTOMER COMMENTS.	CHD/APPD	ZONE
01	29.08.19	REVISED AS PER CUSTOMER COMMENTS.	CHD/APPD	ZONE

CUSTOMER	SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC)
PROJECT	4 x 225MW ARUN-3 HYDRO ELECTRIC PROJECT (NEPAL)
CONSULTANT	SJVN LTD. (AJOINT VENTURE OF GOVT. OF INDIA & GOVT. OF HP)

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD
PROJECT ENGG & SYSTEMS DIVISION

	NAME	SIGN.	DATE
DRN.	RAVITEJA	-SD-	22.01.19
CHD.	PRASHANT	-SD-	22.01.19
APPD.	K GUNJAN	-SD-	22.01.19

NO.OF VAR. N.A.

DEPT.	UNTOL. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PED	CR.	N.T.S	N.A.	N.A.	N.A.	N.A.
CODE 450						

TITLE: SCHEMATIC DIAGRAM OF FIRE DETECTION & ALARM SYSTEM

CARD CODE NA | DRG. NO. PY-FL-3-M110-8663-01 | CUST. DRG. NO. | REV. 03

SHT. No 01 | No. OF SHT. 02 | SIZE - A3

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO.

SH. OF

GENERAL NOTES:–

2 1. FIRE ALARM PANEL SHALL BE PROVIDED WITH 24 V D.C BATTERY BACKUP, COMPRISING OF 2x100% CHARGERS AND 2x100% SMF BATTERIES AS PER OEM RECOMMENDATION.

2. FIRE ALARM PANELS SHALL HAVE A BATTERY BACK UP FOR 24 HRS NORMAL OPERATION AND 30 MIN. OF ALARM CONDITION.

3. ALL FIRE ALARM PANELS AND REPEATER PANELS SHALL BE WALL MOUNTED.

4. DELUGE VALVES ARE INTERFACED WITH THE FIRE ALARM SYSTEM THROUGH MODULES.

5. FIRE ALARM PANELS SHALL BE PROVIDED WITH NECESSARY CONTACTS / INTERFACING MODULES FOR INITIATING REQUIRED ALARM / OPERATION OF DELUGE VALVE AND TRIPPING OF HVAC, PACKAGE AIR CONDITIONER, INERT GAS EXTINGUISHING SYSTEM, ETC.

6. THE NUMBER OF LOOPS AND DEVICES/DETECTORS CONNECTED TO THE FIRE ALARM PANEL ARE INDICATIVE ONLY. ACTUAL DETAILS OF BUILDINGS COVERED BY EACH FIRE ALARM PANEL SHALL BE FURNISHED DURING DETAIL ENGINEERING

1 7. SPACING OF DETECTORS AND MANUAL CALL POINTS SHALL BE AS PER IS 2189. THE NUMBER OF DETECTORS AND THEIR LOCATION SHALL BE FINALISED DURING DETAILED ENGINEERING AS PER PROVISIONS OF THE CONTRACT.

8. OPERATOR WORKSTATION AND PRINTER SHALL BE OF THE FOLLOWING CONFIGURATION:–

(a) 21" MONITOR

(b) I5 PROCESSOR OR EQUIVALENT

(c) ONE 4 GB RAM

(d) ONE 500 GB HARD DISK

(e) ONE DVD(RW) DRIVE

(f) TWO NOS. OF USB PORTS

(g) BLACK & WHITE LASER PRINTER (A4 SIZE), QWERTY KEYBOARD AND OPTICAL MOUSE

9. THE FOLLOWING SIGNALS SHALL BE TAKEN FROM MAIN FIRE ALARM PANEL TO SCADA:–

(a) SYSTEM HEALTHY

(b) SYSTEM FAULT

(c) SYSTEM UNDER FIRE

10. FOR CABLE GALLERIES LHS CABLE SHALL BE LAID IN STRAIGHT LINE FASHION ON THE CENTER OF CABLE TRAY.

11. FIRE ALARM CABLES SHALL BE AS FOLLOWS:

LOOP CABLE : 2C x 1.5 SQ.MM COPPER CONDUCTOR TWISTED, SHIELDED & ARMOURED WITH HRPVC INSULATED, ST–2 OUTER SHEATH

POWER CABLE : 2C x 2.5 SQ.MM COPPER CONDUCTOR ARMOURED WITH HRPVC INSULATED, ST–2 OUTER SHEATH

2 12. CABLE TRAY/TRENCH LAYOUT SHALL BE FINALISED DURING DETAILED ENGINEERING. FIRE DETECTION & PROTECTION SYSTEM SHALL BE DONE AS PER THE FINALISED CABLE LAYOUT CONDITION.

13. FIRE ALARM PANEL IN SWITCHYARD AREA SHALL BE SUPPLIED BY BHEL–TBG.

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

REV.	DATE	ALTERED	CHD/APPD	ZONE
02	13.03.20	REVISED AS PER CUSTOMER COMMENTS.	CHD/APPD	ZONE
01	29.08.19	REVISED AS PER CUSTOMER COMMENTS.	CHD/APPD	ZONE

CUSTOMER	SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC)		
PROJECT	4 x 225MW ARUN-3 HYDRO ELECTRIC PROJECT (NEPAL)		
CONSULTANT	SJVN LTD. (AJOINT VENTURE OF GOVT. OF INDIA & GOVT. OF HP)		
BHARAT HEAVY ELECTRICALS LTD. HYDERABAD PROJECT ENGG & SYSTEMS DIVISION		NAME / SIGN. / DATE	NO.OF VAR.
	DRN.	RAVITEJA –SD– 22.01.19	N.A.
	CHD.	PRASHANT –SD– 22.01.19	
	APPD.	K GUNJAN –SD– 22.01.19	
DEPT. PED / CODE 450	UNTOL. DIMS. CR. ±½/½°	SCALE N.T.S	WEIGHT (KG) N.A.
REF. TO ASSY. DRG. N.A.	ITEM NO. N.A.	NO.OF ITEMS N.A.	
TITLE SCHEMATIC DIAGRAM OF FIRE DETECTION & ALARM SYSTEM	CARD CODE NA	DRG. NO. PY-FL-3-M110-8863-01	REV. 03
		CUST. DRG. NO.	
		SHT. No 02	No. OF SHT. 02 SIZE – A3

COMPUTER FILE NAME

REF. DRG. NO.

SIGN. AND DATE

INVENTORY NO

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

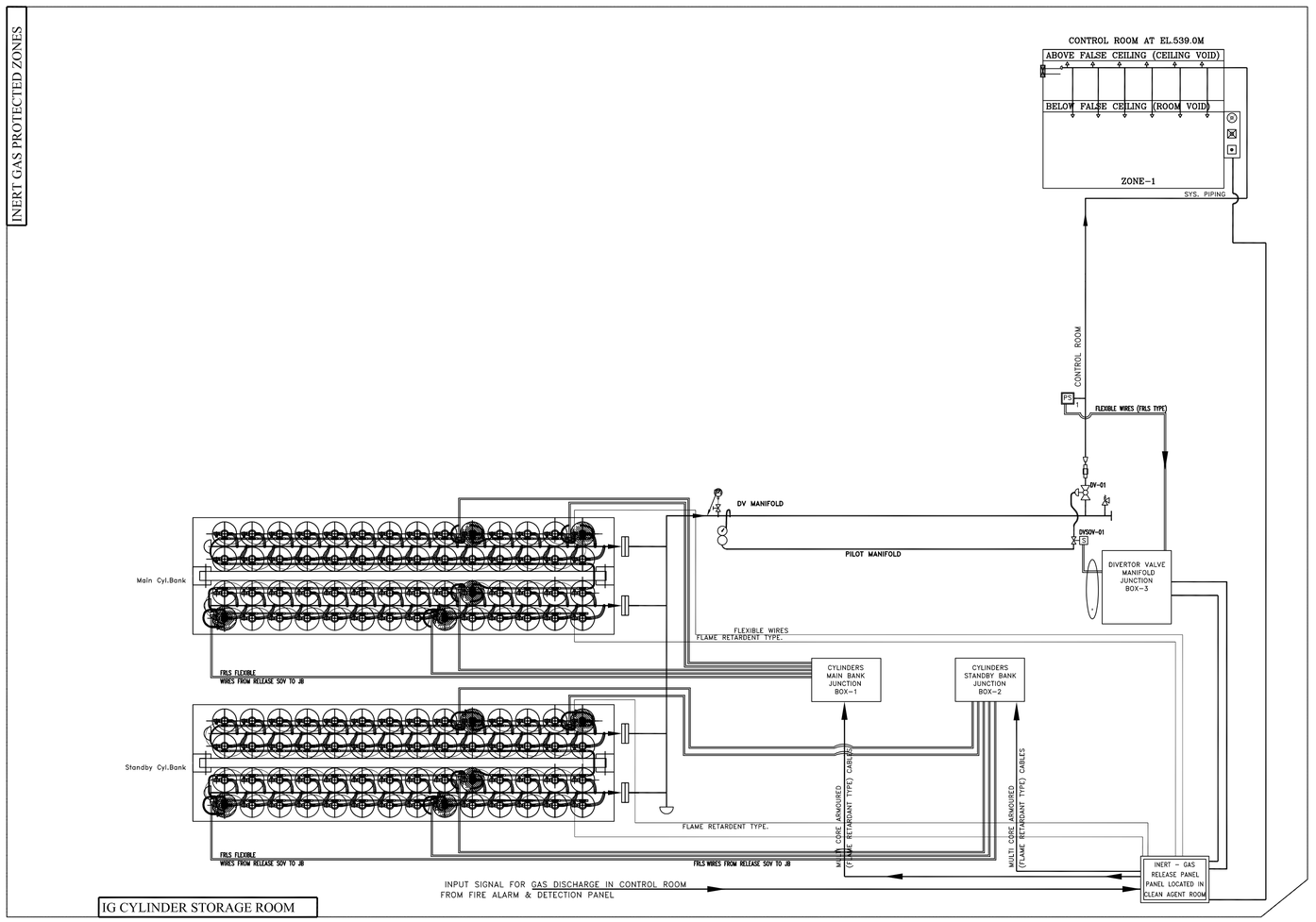
PY-DP-1-M110-8662-01 DRG. NO.

SH. 01 OF 01

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO

INERT GAS PROTECTED ZONES



LEGEND :-

SYMBOLE	ITEM DESCRIPTION
	INERT GAS CYLINDER 200 / 300 BAR
	PNEUMATIC INERT GAS VALVE
	CONTACT PRESSURE GAUGE UNIT
	RELEASE UNIT WITH PRESSURE GAUGE, NORMALLY CLOSED TYPE SOLENOID VALVE, MANUAL RELEASE UNIT & 2 NOS 1/4" HOSE
	DISCHARGE HOSE WITH CHECK VALVE
	T-PIECE FOR PILOT LINE
	CROSS FOR PILOT LINE
	LEAK/BLEEDER UNIT
	NON RETURN VALVE FOR PILOT LINE
	HI-FLEX HOSE
	FLEX HOSE FOR RELEASE UNIT SOV
	FLEX HOSE FOR PILOT LINE
	FLEX HOSE FOR DV SOV
S DVSOV	SOLENOID VALVE 3/2 WAY MAIN OVERRIDE 24V DC
DV	BALL VALVE WITH DUAL ACTION PNEUMATIC ACTUATOR (DIVERTOR VALVE (DV))
	RESTRICTOR (IF APPLICABLE)

SYMBOLE	ITEM DESCRIPTION
	PRESSURE REGULATOR
	PRESSURE RELIEF DEVICE
	PRESSURE GAUGE
	PILOT MANIFOLD
PS	PRESSURE OPERATED SWITCH
	GAS INHIBITOR / GAS RELEASE / GAS DISCH. INDICATOR
JUNCTION BOX	JUNCTION BOX
	INERT GAS - RELEASE PANEL
	FLEXIBLE WIRES (FRLS TYPE)
	MULTI CORE ARMOURED CABLE (FRLS TYPE)
	FLEXIBLE WIRES FRLS TYPE.
2 IG	INERT GAS - IG - 541
CYL	CYLINDER
SD	SMOKE DETECTOR
	DISCHARGE NOZZLE

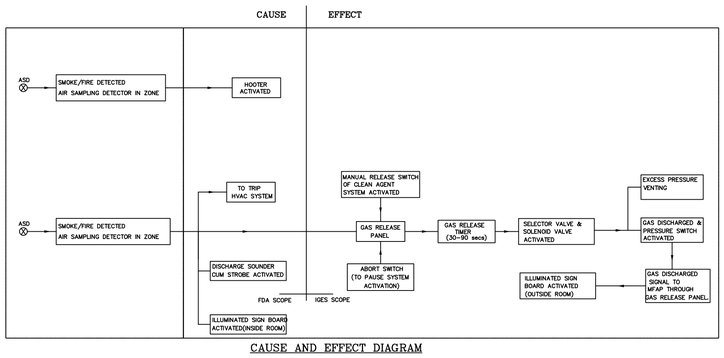
INTERLOCK SUMMARY

EQUIPMENT INVOLVED	CONDITION FOR LOGIC EXECUTION	ACTION
* GAS RELEASE PANEL (GRP) * PRE-DISCHARGE INDICATOR * INHIBIT SWITCH	* FIRE SIGNAL FROM FIRE ALARM PANEL(FAP)/ MANUAL EMERGENCY PUSH BUTTON (EPB) OPERATED * INHIBIT SWITCH NOT OPERATED	* PRE-DISCHARGE ALARM ACTIVATED * DIVERTOR VALVE SOV ACTIVATED
* GAS RELEASE PANEL (GRP) * CYLINDER SOV * WARNING SIGN * INHIBIT SWITCH	* FIRE SIGNAL FROM FIRE ALARM PANEL(FAP)/ MANUAL EMERGENCY PUSH BUTTON (EPB) OPERATED * INHIBIT SWITCH NOT OPERATED * 120 SEC. TIME DELAY	* GAS DISCHARGE WARNING ALARM ACTIVATED * CYLINDER SOV ACTIVATED
* GAS RELEASE PANEL (GRP) * PRESSURE SWITCH * CYLINDER SOV	* CYLINDER SOV ACTIVATED * PRESSURE SWITCH IN CLOSE CONDITION	* GAS RELEASED SIGNAL TO GAS RELEASE PANEL
* GAS RELEASE PANEL (GRP) * INHIBIT SWITCH	* FIRE SIGNAL FROM FIRE ALARM PANEL(FAP)/ MANUAL EMERGENCY PUSH BUTTON (EPB) OPERATED * INHIBIT SWITCH OPERATED	GAS RELEASE INTO RISK ZONE STOPPED

1 NOTES : -

1) THIS IS A CONCEPTUAL P&ID IS FOR FINALISING THE AREAS TO BE PROTECTED WITH INERT GAS EXTINGUISHING SYSTEM.
2) THE PRESSURE AT WHICH THE SYSTEM OPERATES, NO. OF ZONES ETC. WILL BE FURNISHED IN DETAILED P&ID BY VENDOR WHICH WILL BE SUBMITTED LATER.
3) THE RISK ZONES MENTIONED ARE TENTATIVE. EXACT RISK ZONES SHALL BE AS PER PARTITIONS IN CONTROL ROOM & SWITCHGEAR ROOM.
4) GAS REQUIREMENT AND CYLINDER BANK SELECTION IS BASED ON "SINGLE LARGEST RISK" PRINCIPLE AS PER NFPA 2001.
5) SYSTEM DESIGN SHALL BE AS PER NFPA-2001.
6) 100% STANDBY CYLINDERS DULY MANIFOLDED ARE ALSO PROVIDED.
7) INCASE OF FIRE, GAS WILL BE RELEASED IN THE RESPECTIVE ROOM. (INCLUDING FALSE CEILING & FALSE FLOOR VOID SIMULTANEOUSLY.)
8) SYSTEM OPERATIONAL LOGIC ARE FACILITATED THROUGH GAS RELEASE PANEL BY FOLLOWING MEANS:
   * AUTOMATICALLY DUE TO FIRE DETECTION IN THE PROTECTED AREA.
   * OPERATION OF MANUAL RELEASE PUSH BUTTON
   * OPERATION OF MANUAL RELEASE PUSH BUTTON LOCATED ON GAS RELEASE PANEL.
9) ALL IMPORTED COMPONENTS / ITEMS I.E., CYLINDER AND ITS ACCESSORIES SHALL BE UL/FM/VDS APPROVED AND FOR ALL INDIGENOUS ITEMS UL/FM/VDS DOES NOT APPLY.
10) THE EXACT NOS. & LOCATION OF PRESSURE VENTING DAMPERS WILL BE FURNISHED IN INERT GAS PIPING LAYOUT WHICH SHALL BE SUBMITTED LATER.
11) THE NUMBER OF CYLINDERS IN MAIN CYLINDER BANK AND STANDBY CYLINDER BANK ARE INDICATIVE. THE EXACT NOS. OF CYLINDERS IN MAIN AND STANDBY CYLINDER BANKS SHALL BE INDICATED IN THE DETAILED P&ID BY VENDOR WHICH WILL BE SUBMITTED LATER.
12) PIPES & FITTINGS SHALL BE AS PER NFPA-2001 & OEM RECOMMENDATION.
13) THE INERT GAS TO BE USED SHALL BE IG-541.

Risk Zone Nos.	Protected Rooms	Covered Room Void Area
Risk Zone-1	CONTROL ROOM	FALSE CEILING
		MAIN ROOM



CAUSE AND EFFECT DIAGRAM

REV.	DATE	ALTERED
05	11.06.20	CHD/APPD
ZONE		REVISED AS PER CUSTOMER COMMENTS.
04	13.03.20	CHD/APPD
ZONE		REVISED AS PER CUSTOMER COMMENTS.
03	13.02.20	CHD/APPD
ZONE		REVISED AS PER CUSTOMER COMMENTS.
02	29.08.19	CHD/APPD
ZONE		REVISED AS PER CUSTOMER COMMENTS.
01	17.06.19	CHD/APPD
ZONE		REVISED AS PER CUSTOMER COMMENTS.

CUSTOMER	SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC)
PROJECT	4 x 225MW ARUN-3 HYDRO ELECTRIC PROJECT (NEPAL)
CONSULTANT	SJVN LTD.

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD
PROJECT ENGG & SYSTEMS DIVISION

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	RAVITEJA	-SD-	11.01.19	N.A.
CHD.	PRASHANT	-SD-	11.01.19	
APPD.	K GUNJAN	-SD-	11.01.19	

DEPT.	UNTOL. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PED	GR.	N.T.S	N.A.	N.A.	N.A.	N.A.
CODE 450	f/H/f					

TITLE P&ID OF INERT GAS EXTINGUISHING SYSTEM

CARD CODE NA

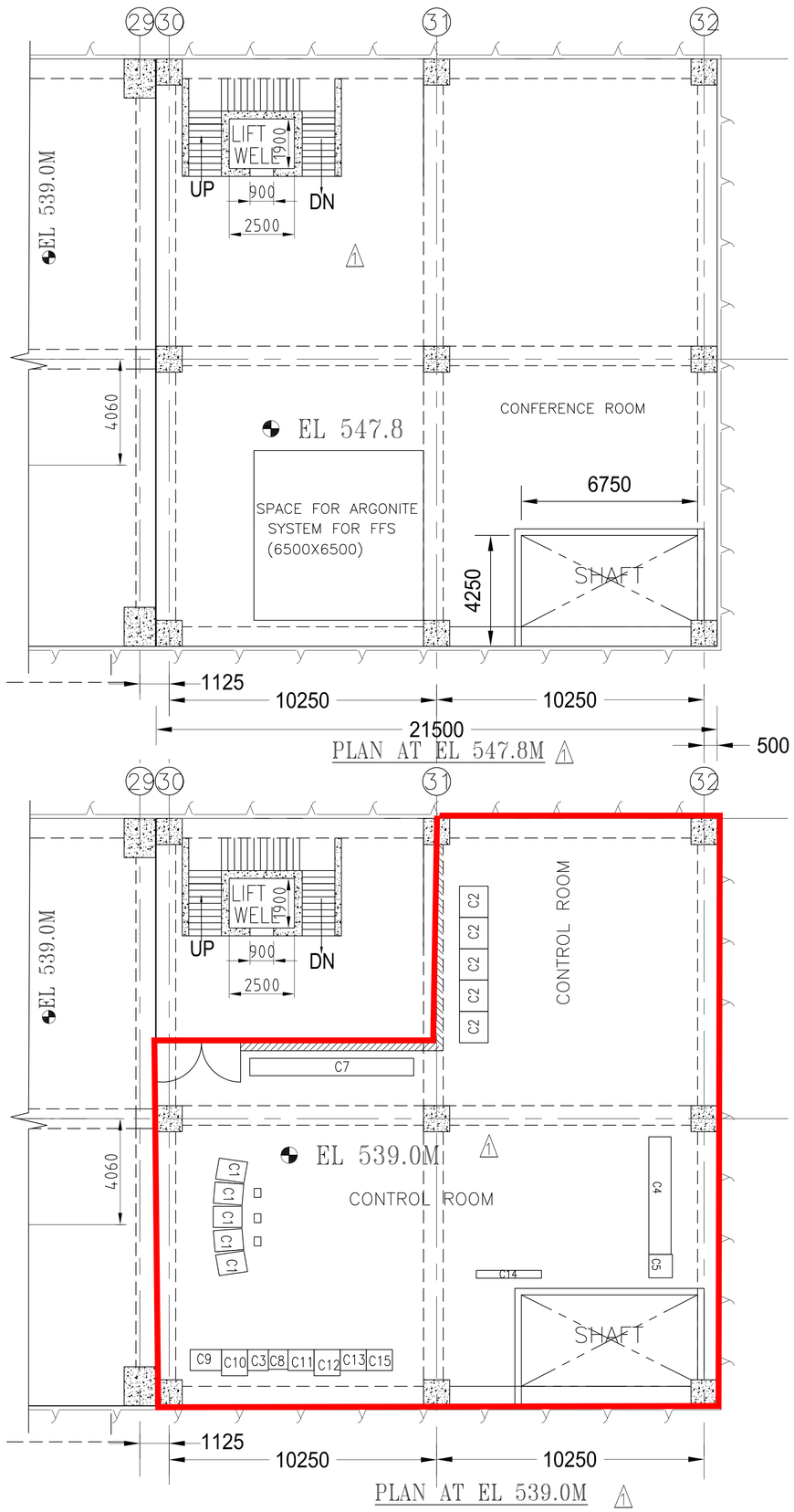
DRG. NO. PY-DP-1-M110-8662-01 REV. 05

CUST. DRG. NO.

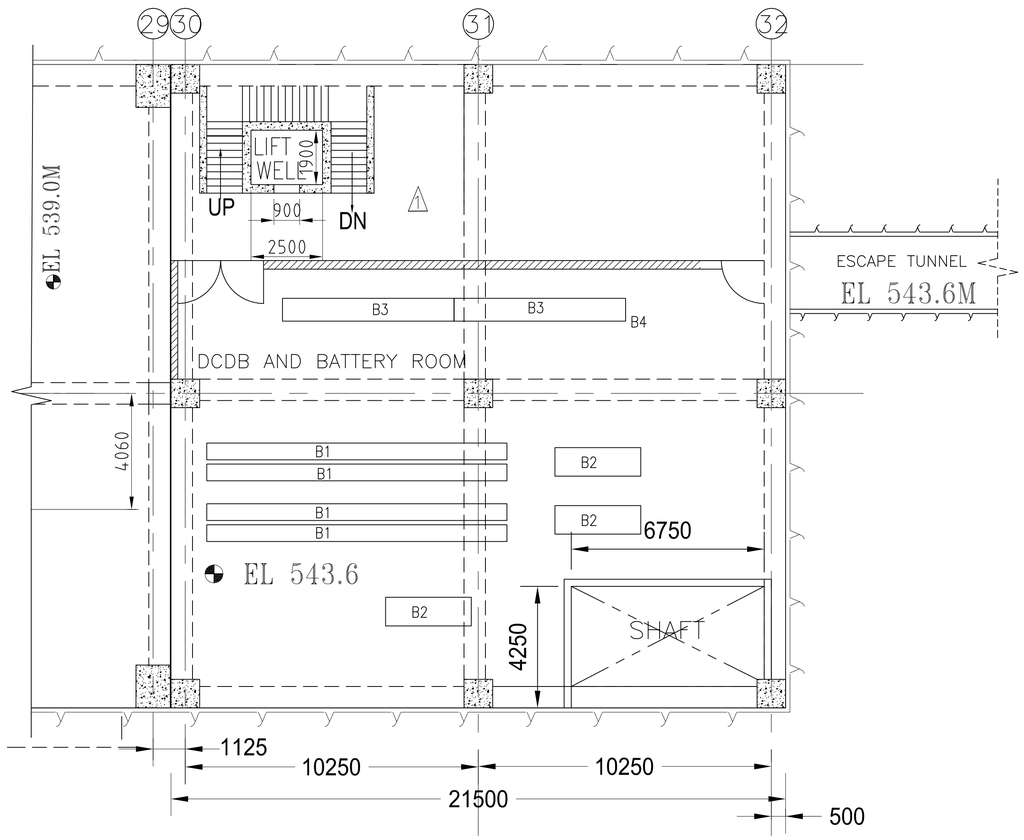
SHT. No 01 | No. OF SHT. 01 | SIZE - A1

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")



PLAN AT EL 547.8M 1



PLAN AT EL 543.6M 1

PLAN AT EL 539.0M 1

CONTROL ROOM EQUIPMENTS (AT EL 539.0M)

S.NO	DESCRIPTION	APPROX. SIZE (MM)			WEIGHT	QUANTITY PER UNIT	TOTAL QUANTITY	DIVISION
		LENGTH	WIDTH	HEIGHT				
C1	OPERATOR WORK STATION DESK	4500	750	1100		–	1	EDN
C2	COMPUTER TABLES (INCLUDING EWS)	1200	1100	750		–	7	EDN
C3	GPS BASED MASTER CLOCK SYSTEM	800	800	2415				EDN
C4	UPS FOR HMI COMPUTERS	4500	850	2000		–	1	EDN
C5	ACDB FOR UPS	900	900	2000		–	1	EDN
C6	PRINTER TABLE	700	600	750		–	2	EDN
C7	LVS	6280	670	2400		–	1	EDN
C8	NETWORK INTERFACE PANEL	750	750	2415		–	1	EDN
C9	FIRE ALARM PANEL	1200	800	2200		–	1	PESD
C10	FIRE ALARM PRINTER	1000	1000	800		–	1	PESD
C11	SECURITY ACCESS CONTROL PANEL	1000	800	2200		–	1	HPE
C12	CCTV PANEL	1000	1000	500		–	1	HPE
C13	CCTV CONTROLLER PANEL	1000	800	2100		–	1	HPE
C14	EPAPX PANEL	2500	300	–		–	1	HPE
C15	HVAC PANEL	1000	800	2100		–	1	PEM

DCDB AND BATTERY ROOM EQUIPMENTS (AT EL 543.6)

S.NO	DESCRIPTION	APPROX. SIZE (MM)			WEIGHT	QUANTITY PER UNIT	TOTAL QUANTITY	DIVISION
		LENGTH	WIDTH	HEIGHT				
B1	220 V BATTERY BANK	10500	1300	2500		–	2	HPE
B2	220 V BATTERY CHARGER	3000	1000	2400		–	3	HPE
B3	MAIN DCDB (DCDB 1&2)	12000	800	2400		–	1	HPE

LIST & SIZES OF EQIUPMENTS ARE TENTATIVE AND MAY BE REVISED DURING DETAIL DETAIL ENGINEERING OF RESPECTIVE SYSTEM

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.

REV.	DATE	ALTERED / CHECKED / APPROVED	ZONE
02	15.03.19	REVISED AS PER SJVNL'S COMMENTS DATED 05.02.19 AT PLACES MARKED 2	
01	26.12.18	REVISED AS PER SJVNL'S COMMENTS DATED 30.11.18 AT PLACES MARKED 1	

DRWN	DK		16.10.18	
CHKD	DK		16.10.18	
APPD	RS		16.10.18	

NAME / SIGN / DATE / NO. OF VAR.

SUB-SUPPLIER / VENDOR

ADDITIONAL INFORMATION

STATUS OF DRAWING: U

DISTRIBUTION OF PRINTS

PROJECT: ARUN-3 HYDRO ELECTRIC PROJECT, NEPAL (4x 225 MW)

CONSULTANT / CUSTOMER: SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC LTD.)

CONSULTANT: SJVN LIMITED (A JOINT VENTURE OF GOVT. OF INDIA & GOVT. OF HP)

CONTRACTOR: भारत हेवी इलेक्ट्रिकल्स लिमिटेड, भोपाल Bharat Heavy Electricals Limited, Bhopal

DEPT	CODE	UNTOL. DIMS. GR.	ANGLE	SCALE	WEIGHT(kg)	REF.TO ASSY.DRG.	ITEM NO.	NO.OF ITEMS
HSE	415			1:200				

TITLE: POWER HOUSE-GENERAL LAYOUT PLAN OF CONTROL BLOCK FLOORS

DRAWING NO. 1 200 00 20557 REV. 02

SHEET NO. 01 NO. OF SHEETS. 01

A1 SIZE

REF. DRG. NO. / SIGN. & DATE / INVENTORY NO.

SECTION-24
FIRE FIGHTING SYSTEM

24.1 SCOPE OF WORK

Scope of work under this section covers the provision of labour, tools, plants, materials and performance of work necessary for the design, engineering, manufacture, quality assurance, quality control, shop assembly, shop testing, packaging & delivery at site including insurance, unloading, site storage and preservation, in plant transportation at site, erection / installation, testing supervision, pre commissioning, successful commissioning, performance and acceptance testing, handing over to Employer and warrantee for two years of Fire Fighting System as per the specifications hereunder, complete with all auxiliaries, accessories, spare parts and warranting a trouble free safe operation of the installation. The scope of work covered under this section shall be read in conjunction with General Technical specifications, Chapter-1.

24.1.1. Detailed Scope of work

The scope of work shall be a comprehensive functional system complete in every respect including but not be limited to following

24.1.1.1 Main Scope

A. Fire Detection System

i) One (1) Set of Fire alarm and detection system consisting of microprocessor based main fire alarm panel and its repeater alarm panels.

ii) One (1) set of smoke detectors, heat detectors, QB detectors, manual pull stations, audio/visual combination devices,.

iii) One (1) set of air sampling smoke detection system for specified areas complete with sampling pipe network, detectors, detector control assembly chart recorder/data log output, remote annunciation display panel, spares and tools etc., as described in the detailed specification.

iv) One(1) set of LHS cable system complete with all associated accessories for all cable trays in power House, Transformer hall, GIS and interconnecting cable tunnels.

v) One(1) set of cabling for various smoke/fire/heat detection systems, control signaling & monitoring system, auxiliary supply for complete fire detection and protection system

B. <u>Fire protection System</u>

i) Automatic High Velocity Water Spray system for fire protection of Thirteen (13) Nos. of 92 MVA single phase generator step up transformers

ii) Automatic High Velocity Water Spray system for fire protection of Four(4) nos. of Shunt Reactor

iii) Medium velocity water sprays system for four (4) nos. Governor/MIV OPU.

iv) Medium velocity water sprays system for 400kV XLPE cable, power cables between SSB and UAB, SSB, and in all cable trays.

v) Medium velocity water sprays system for DG sets.

iv) One(1) set of manual fire hydrant system complete with piping, pressure reducers, accessories, valves, hose pipes, triple purpose branch pipes fitted with nozzles and quick coupling ends and emulsifier branch pipe with fog type nozzles, steel hose boxes, first aid hose reels, spares & tools, suitable number of deration valves(automatic/manual), drain valves at strategic locations etc., in Power house, Transformer house & switchyard as described in detailed specification.

vi) The piping from water storage tank to automatic backwash strainer & strainer to farthest point of fire protection systems, valves, strainers, accessories, pressure reducers, supports, expansion compensators at strategic locations etc. as described in detailed specification.

v) Automatic inert gas fire extinguishing system complete with inert gas cylinders, manifolds, pressure reducing devices, cylinder valves, directional valves, pipes, discharge nozzles, bracket supports, hangers and such other fittings as necessary for the complete installation of the system.

24.1.1.2 Miscellaneous components and auxiliary system

24.1.1.2.1 Portable Fire extinguishers

i) One (1) set of Portable and mobile type chemical fire extinguishers of carbon dioxide, foam, dry powder to be decided during detailed engineering.

ii) One (1) set of sand and water buckets at necessary locations as required as per NFPA/National guidelines.

24.1.1.2.2 Safety Devices

i) One(1) set of Safety kits comprising of safety masks, first aid box, artificial breathing apparatus, resuscitators etc. complete as per NFPA/Equivalent Standards. The kits are required to be placed in Control room, Switchyard, BVH, Dam site and Transformer Hall. .

ii) A Lot of fluorescent directional signals to direct the personnel trapped inside to the escape route and stair cases to be decided during detailed engineering.

iii) Any of the equipment not specifically mentioned but needed to make the system complete as per design and engineering of the system by the supplier as per recommendations of NFPA or any statutory body and good engineering practice shall be treated as though included, supplied and erected unless specifically excluded elsewhere without any financial implication. The system should be designed as per the requirements of NFPA. Design calculations are required to be submitted along with the bid. It will be preferable if the state of art equipment is used for fire detection & protection.

iv) All major civil works like foundations, hume pipes for road crossing, pedestal etc. shall be in the scope of Employer. However, contractor shall supply design calculations, drawings etc. for the above work. Minor civil works like chipping, supply of materials like inserts, clamping, channels, hangers, brackets, supports etc. to be provided by the Contractor for entire fire protection system.

v) The bidder shall ensure a visit of statutory body's authorized representative is arranged at the conception stage, intermediate

stage and at the finalization stage, so as to have the overall design as per NFPA guidelines. If required, necessary for clearance or approval of drawing/design of entire system from any statutory body shall be arranged by the Contractor.

24.1.1.3 Control, monitoring and related items and services

i) Coordination and provision of necessary contacts and/ or ports of the field detectors, audio/visuals devices, MCPs, repeater panel with main Fire Protection panel, Fire protection panel for integration with the the plant SCADA system.

24.1.1.4 Common supplies and services

i) Drawings, documents and design calculations as per clause 24.6.
ii) Shop, assembly, inspection & tests as per clause no. 24.7.
iii) Packaging, handling and site storage as per clause no. 24.8.
iv) Delivery, installation and commissioning as per clause no. 24.9.
v) Tools and instruments as per clause no. 24.10.
vi) Spare parts as per clause no. 24.11
vii) Field/touch-up painting including all painting materials.

24.1.1.5 Completeness of System

Any other item(s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard(s)/best international practices.

24.2 STANDARDS & REGULATIONS

The design, manufacture and testing of the various equipment covered under this specification shall comply with the requirements of the latest edition of the relevant IEC/IS/IEEE/ISO standards only. Preference for latest IEC standards for particular equipment / system shall be governed over IEEE/ IS/ ISO standards. Further rules, guide lines and standard laid down by international/ national agency shall be applicable in this specification.
The relevant abstract (in soft / hard copy) of all referred standards shall be provided free of cost during engineering stage for facilitating review/ approval of submitted drawing/documents.

24.3 PARAMETERS AND GUARANTEES

24.3.1 Special design & Layout Condition

24.3.1.1 System layout

The water requirement for fire protection system shall be met by overhead storage fire water tank. Four tanks of approx capacity of 150 m^3 each and one tank of 100 m^3 capacity shall be erected at EL 640.0 m(tentative) for requirement of firefighting and statutory requirement for drinking water & any other requirement of potable water including ventilation and air conditioning system respectively. This tank shall be filled by booster pump primarily and alternatively from alternate source during prolonged shutdown of power house.

24.3.1.2 System requirement

The fire fighting system shall have smoke sensors, temperature detector bulbs, deluge valves, water sprinkler system, piping, fittings, fire hoses, portable fire extinguishers, control panels etc. to complete the system. All cabling between detectors and panels with conduits and signal cabling between panel etc. with tray or conduits shall also be done by the Contractor.

The fire fighting system shall have suitable extinguishing media, installations and control of fixed systems and extinguishing equipments with suitable fire detectors, alarm and signaling systems with signal initiation, transmission, notification and annunciation along with other items required to complete the system in all respect.

Provision for fire-insulated doors shall be made for the vital areas like record rooms, control room etc.

24.3.1.4 Fire detection, alarm and supervision

The fire alarm and detection system shall be a completely supervised fire alarm reporting system, which shall be activated into the alarm mode by the activation of any of the alarm initiating devices in the event of fire. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. All the connections necessary for making the system functional shall be in accordance with relevant NFPA Standards.

Each fire alarm system shall consist of one central unit receiving the signals from the detectors grouped in lines for each supervised area separately. The supervised area shall be same or part of the corresponding fire fighting zone defined in the Power House Complex.

All alarms coming from the detectors shall be line wise transmitted to the main fire alarm panel for each respective supervised area/zone/sector. The alarms of this system shall be transferred first to the pertaining panels of the respective area/zone/sector for activating the fire suppression systems and then be transferred to the main fire alarm panel for each line. In parallel, each line shall be printed out on a fire alarm printer and indicated at the main mimic control panel. A general mimic with reduced details shall be installed in the main control building.

Smoke detection system, Excitation cubicles, control rooms, computer and communication rooms and offices shall be provided with adequate smoke detection system for the earliest possible warning of a potential fire in incipient stage.

Cable spreading area including cable trays shall also be provided with necessary smoke detectors.

Suitable interfaces shall be provided for supervision of the real time data through plant SCADA. Provision for multiple alarm levels of at least three (3) levels with programmable relays shall be made.

24.3.1.5 Special design considerations

i) A looped conduit system shall be provided so that if the conduit and all the conductors get severed at any point, the initiating device circuit, signal line circuit and notification appliance circuit shall remain functional.

ii) The implementation of the communication technology for fire signaling system shall be such to compensate for any failure to communicate a signal by eliminating the risk of missing even a single fire alarm signal.

iii) Addressable system in the control panel shall be advanced microcomputer based system.

iv) The time delay between the activation of an initiating device and the automatic activation of a local fire safety function shall not exceed ten (10) seconds.

v) Detectors shall be located at strategic position and arranged in zones(as per relevant International Standards) to facilitate proper indication of fire location, transmission of audio-visual signals to fire control panels and actuation of the appropriate fire fighting system.

vi) Detectors installed in concealed areas shall have suitable visual indication in a visibly located area. Smoke detectors shall not be

installed until construction is essentially complete and the building thoroughly cleaned.

vii) All the systems and equipments of the fire fighting system shall be tested and installed in accordance with the relevant standards and specifications.

viii) The equipment and all its components shall be corrosion resistant and all the system devices/ components shall be located and mounted so that accidental operation or failure is not caused by vibration or jarring.

ix) The Contractor shall coordinate with the Ventilation and air conditioning Contractor for designing the ventilation system providing necessary means and pressure to evacuate smoke and toxic particles from the place of origin to the outdoors in a manner that it does not interfere with the operation of plant and to allow for emergency access and exits.

x) Necessary fire barriers of suitable resistance rating and smoke control barriers shall be provided to prevent transmission of the fire and smoke from one area to another in accordance with relevant standards. Vital areas of the control block requiring special protections shall be provided with fire deterrent doors.

xi) Necessary smoke and heat venting shall be planned for areas identified by fire risk evaluation, carried out by the Contractor, where either the heat or smoke or both shall be vented from its place of origin directly to the outdoors. The Contractor shall ensure the necessary co-ordination with ventilation contractor for the same to ensure proper functioning in emergency situations.

24.3.2 Rating and Functional Characteristics

The system and equipment shall be designed, built, tested and installed to the latest revisions of the applicable NFPA standards.

24.3.3 Performance Criteria and Guarantee

The fire fighting system along with all auxiliaries and accessories shall be capable of performing intended duties under specified conditions. It is the responsibility of the Contractor to supply the equipment as per guaranteed technical particulars and shall also guarantee the reliability and performance.

These shall include at least the following:

i) Performance of deluge indicating coverage,

ii) Flow rates at various locations,

iii) Pressure at fire hydrants.

24.4 DESIGN AND CONSTRUCTION

24.4.1 Fire alarm, supervision and signaling system

24.4.1.1 Fire detection, alarm and supervision

The fire alarm and detection system shall be a completely supervised fire alarm reporting system, which shall be activated into the alarm mode by the activation of any of the alarm initiating devices in the event of fire. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal.

All alarms coming from the detectors shall be line wise transmitted to the main fire alarm panel. The alarms of the system shall be transferred first to the respective panels for activating the fire suppression systems. In parallel, each line shall be printed out on a fire alarm printer and indicated at the main mimic panel.

24.4.1.2 Power supplies

Fire alarm systems shall be provided with at least two independent and reliable power supplies, one primary and one secondary (standby), each of which shall be of adequate capacity for the application and performance of the fire alarm system. The Contractor shall coordinate with the plant DC system manufacturer in designing and supplying the necessary cables, connections, interfaces etc. for the secondary power supply of the fire alarm panel. The Contractor shall fully ensure that the changeover from primary supply to secondary supply and vice-versa shall be fully automatic without affecting the transmission of signal via the fire reporting system upon operation of the initiating device.

24.4.1.3 Fire alarm control panels

The main and repeater fire alarm control panels shall provide automatic, supervised, multi zone detection and alarm system. Each fire alarm panel shall be of modular type, installed in a mounted steel cabinet with hinged door and cylindrical lock. The panels shall be clean, uncluttered and orderly assembled containing all necessary operating and supervising elements/ components, using a solid state technique. The start-up shall be automatic after restoration of power either primary or secondary. Signals and LEDs/LCDs together with visual annunciation shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system as an integral part of the control panel with suitable identification.

The operational features of the modules shall have at least the following. Other additional features required to make the system fully functional shall also be incorporated in accordance with relevant standards.

1. Monitoring electrical supervision of different circuits viz. initiating device circuits, circuits used for supervisory signal services viz. sprinkler water-flow, water level indicators etc.,
2. Monitoring electrical supervision of power supply, transmitter tripping circuit integrity etc.,
3. Trouble buzzer and trouble LEDs/LCDs against any fault due to loss of power supply, single break, open, or ground fault condition, panel fault and panel door open etc. impeding the normal functioning of the system,
4. Evacuation alarm signal switch and transmitter disconnect switch,
5. Confirmation or verification of all smoke and heat detectors,
6. Monitoring and control of fire sprinkler system, release of deluge system and other fire extinguishing system,
7. Control panels and field panels shall have suitable software programme enabling expansion and modification of the system without replacement of hardware or firmware viz addition or deletion of zones etc.
8. Suitable number of signals shall be provided in the fire control panel to shut of the air handling unit and air conditioning dampers/louvers of each zone/complete system of ventilation network

An alarm condition in the circuit which shall automatically annunciate in the mimic and shall have at least the following functions to make the system fully functional. These alarms shall also be printed out.

i) Transmission of signals to the plant SCADA system,
ii) Transmission of signal to the station security and surveillance system,
iii) Transmission of signal over the telephonic fire reporting system,
iv) Visual indication of the alarm device on the fire panel control panel display,
v) Continuous operation and sounding of alarm notification appliances as per the applicable standards,
vi) Operation of smoke control system and de-activation of air handling units in the alarmed area,

vii) Automatic discharge of the respective fire suppression system with maximum 15 seconds delay for deluge system and 30 seconds for wet pipe system.

Provision of necessary contacts/ports for control, monitoring, and supervision and alarm functions shall be made in the fire alarm control panels for duplicating these functions in plant SCADA system.

Unacknowledged alarm signals shall not be interrupted if a fault on a fire detector circuit or a signaling line circuit occurs while there is an alarm condition on that circuit.

Fire alarms, supervisory signals and trouble signals shall be distinctively and descriptively annunciated Signs and evacuation signals For deluge areas, the warning signs and releasing signs according to applicable codes may be installed. Fluorescent type exit and evacuation route signs shall be installed throughout the plant.

24.4.1.4 Automatic fire detectors

The detectors spacing and rating shall be in accordance with the applicable standards/codes and shall have UL approval. The smoke detectors shall be designed with minimised effect of environmental conditions like air velocity, altitude, humidity, temperature, colour of smoke, electrical and mechanical influences like abnormal pressure or vibration and the influence of aerosols and any particulate matter. It shall be plug-in type with detector base containing terminals for making connections. The detectors shall be assembled and engineered for flush or surface ceiling mounting with a standard outlet box. Provision of visual indication of detector's alarm condition shall be visible from a distance of six (6) m and visually different from indications of other conditions. The openings of the smoke entry shall be at least thirty (30) mm below the ceiling level assumed to be smooth and flat.

1. Ionization detectors: Ionization type smoke detectors shall be of dual chamber type responsive to both visible and invisible particles of combustion.
A pilot light shall indicate the alarm status of the detectors.

2. Photo-electric detectors:Photo-electric detectors shall have an obscuration rate in accordance with suitable standards. Detectors shall not initiate alarm during failure of its LED light source.

3. Thermal detectors:Thermal/ heat detectors shall be designed to operate when the rate of temperature rise at the detectors exceeds a predetermined value irrespective of the actual temperature. It shall be possible to reset detectors after attending the alarm.

Any other suitable type detectors required can be acceptable subject to acceptance during detailed engineering.

24.4.1.5 Manual pull stations

The manual pull stations shall preferably be located at access ways within a distance of 1.5 m from the exit doorway opening at each exit on each floor and distance to the nearest pull station measured horizontally on the same floor shall normally not to exceed 50 m. The coded manual pull station shall produce at least three (3) repetitions of the coded signal, with each repetition to consist of at least three impulses. The lever of the manual pull stations shall get locked after manual activation till it is reset. The front colour of the station shall be fire red with white inscription as per relevant standards.

24.4.1.6 Fire alarm printing

Fire alarms printing shall be printed in the alarm printer installed in the Central control room. The printers shall have a memory, which enables the printing system to print out the alarms and events in the sequence they occur.

24.4.1.7 Fire alarm bus interface

Signals going to the alarm printer shall also be transferred to the main data logger via a bus coupler system in the sequence they occur.The signals shall be stored in the main data logger for at least one year, shall be reachable via the bus system from the common visual display unit, and be printed out through alarm/ event printer on request.

24.4.1.8 Fire telephone

An emergency fire telephone system shall be installed throughout the plant based on a two-way communication system connecting the individual locations with the central control room.

24.4.1.9 Notification devices

If an alarm in a fire zone occurs, electric hooters/bells/horns/ speakers, light or text splays providing audible, tactile, or visible outputs or any combination thereof shall be actuated. The number of these items shall be sufficient to alert the complete zone. These devices shall have separate screw terminal for each conductor and the sounders/audible appliances

shall generate sound in the range of 500-1000Hz different from the equipments and other devices provided in the area and in the building.

Visual notification appliances shall conform to the applicable standards and shall be surface mounted.

24.4.1.10 Air Sampling Smoke Detection System

The system shall include but not be limited to the following:

1. Sampling Pipe Network
2. Detector
3. Filter
4. Aspirating Fan
5. Detector Control Assembly
6. Chart Recorder/Data Log Output
7. Digital Communication Port
8. Remote Annunciator Display Panel
9. Power Supplies

Each detection system shall have the capacity to analyze samples of air taken from up to 20,000 sq .ft. of floor area and detector shall be capable of continuous sampling of air from sampling ports located as defined by NFPA72, shall provide very early smoke pre-alarm and alarm levels and shall report any fault on the unit by a general fault output relay.

Digital Communication Port of the system shall comply with RS232 Protocol.

The common detector fault relay contacts shall be connected into the appropriate alarm indicating zone on the fire alarm panel in such a way that the detector fault or air flow fault would register a trouble signal on the alarm indicating zone and a common trouble signal on the Fire Alarm Control Panel(FACP).

Air Sampling Network Calculations shall be provided from a registered Computerized sampling pipe aspiration modeling program. The detailed calculations shall also be given.

24.4.1.11 Linear Heat Sensing Cable Module

Each linear heat sensing (LHS) cable control module shall be designed to achieve the following:-

i) To receive signals from each circuit of LHS cable connected to the control module.

ii) To supervise each Linear heat sensing (LHS) cable circuit.

iii) To process the signals and display the alarm/trouble condition on graphic annunciation panel to be supplied with each LHS cable control module. The graphic annunciation panel shall indicate the line mimic diagram of the LHS cables connected to the particular control modules and the cable initiating the alarm signal.

iv) To report the cable control module conditions to the Main FACP. Output signals from the LHS cable, control module shall be compatible with reception system in Main FACP.

The LHS cable control module shall be associated with Digital alarm point locator with 16 zones scanner to give information about the affected LHS cable provided and the distance of the point at which the fault is initiated.

24.4.1.12 Cables

The cable shall be FRLS and screened cables shall be provided wherever necessary to ensure satisfactory operation of the system.

The FRLS cables shall be of 1100V grade, 85 deg.C. rating stranded copper conductor, HRPVC insulations, cores laid up, overall screened with aluminized mylar tape with tinned copper drain wire, extruded FRLS HRPVC inner sheath, round wire/strip armor as per IS 1554 & as specified in the specification and extruded FRLS HRPVC overall sheath.
The size of cable shall be decided during detailed engineering based on the laying conditions.

24.4.2 Fire Protection System

24.4.2.1 Hydrant systems and hose reels

Fire hydrants and its components shall be designed and installed in conformity to relevant code/standards.
Hose reels with shut-off nozzle shall preferably be installed in recesses so that they do not form obstruction on a route of escape and shall be located in accessible positions at each floor level adjacent to exits in corridors on exit routes. A tapping of 20mm dia. shall be taken from water hydrants for water supply to hose reels.

Each hose reel shall be provided with nozzle with shut-off arrangement, stop valve, hose reel, hub with sides, pressure gauge etc. as per IS : 884. It shall be swinging (180 degree) wall mounting type. The length of the hose shall be 30 m having diameter 20 N.B. Material of the hose reel shall be made of rubber conforming to IS: 444. Material of nozzle shall be as per IS: 8090.

The spacing of hydrants shall be in accordance to the relevant national/international standards. The space requirement, location, maximum overall size, component case, water supply for hose reels, materials, appliances etc. shall be in accordance with relevant standards. The hose stations shall be so positioned so that two streams can be directed to any location.

24.4.2.2. Water sprinkler and spray systems

Each of the high velocity water spray system shall consist of a deluge valve, pressure switches, distribution piping, nozzles, thermal/heat detectors and a deluge panel. The deluge panel shall provide a connection point from the deluge system to the powerhouse annunciation and detection system, as well as transferring the signal from the heat detectors to the electrically operated deluge valve.

Each deluge system shall consist of an electrically monitored isolating valve; normal dry/wet distribution piping, flow/ pressure switch and bulb type monitoring system which automatically gets activated at a rated temperature.

The Contractor shall coordinate the system design with all oil filled transformers manufacturer(s) to assure complete transformer protection system and to design the water requirement. Each sprinkler system shall consist of an electrically monitored isolating valve; normal wet distribution piping flow/ pressure switch and glass type sprinklers which automatically get activated at a rated temperature.

All automatic sprinklers shall have temperature-sensitive sealing. The type, size and design of each sprinkler installation used in the system shall be appropriate to the hazards covered by the installation. All exposed metalwork in systems shall be efficiently earthed to prevent the metalwork becoming electrically charged. The temperature rating of a sprinkler shall not be less than 30ºC greater than the highest expected ambient temperature of the location.

Sprinklers shall be suitably coated with corrosion-resistant material. The system design and equipments shall be in accordance with relevant standards. All sprinklers etc. shall be UL approved make.

24.4.2.3 Headers and piping

The fire header and piping shall be looped and of sufficient size to supply the flow requirements at any point in the loop considering the most direct path to be out of service. Fluid velocity in the main header, sub headers and branch pipes shall normally not exceed 2.5 m/s. Pipe sizes shall also be designed to accommodate any future expansion/ water demands.

The piping network shall be designed in such a way by using valves, strainer, and filters etc. for providing 100% redundancy supply for the sectionalized / fire zone in firefighting system. Painting of pipes shall be fire resistant in the required location such as transformer hall, reactor area etc.

Suitable Mechanical protection shall be provided for the pipes passing through public places in the project area as per statutory requirement.

24.4.2.4 **Inert Gas System (Inergen Gas As Per NFPA-2001)**

It may be noted that Inert Gas System to be provided shall meet the requirements of NFPA-2001 (1996). Hence anything specified as mandatory in NFPA-2001, although not mentioned in this specification shall form part of total specification/scope of the work for the job to be executed.

The centralized system shall be designed to protect the largest risk or the total risk in particular area.

The quantity of gas provide shall be sufficient for the risk protected (largest or total as defined) in each area with 100% standby for areas where a centralized system is specified. The inert gas suppression system shall be designed separately for each area. The system for every individual area shall have its own storage, distribution piping, nozzles, fire alarm, detection and actuation system, etc.

Both primary and standby supply shall be permanently connected to the distribution piping through manifold and arranged for easy and auto changeover.

In case the system is designed for the largest risk and there are several risks varying in size in particular area, the system shall permit use of

required number of cylinders for any individual risk involved so that the concentration of gas in that risk does not exceed 43%.

The agent discharge shall be substantially completed in a nominal 60 seconds, or a shorter time. The measured discharge time is considered to be the time when the measuring device starts to record reduction of oxygen until the design oxygen reduction level is achieved.

24.5 AUXILIARY SYSTEM AND MISCELLANEOUS COMPONENTS

24.5.1 Portable fire extinguishers

The type and number of portable fire extinguishers shall be determined on the basis of classification of fires anticipated in the area, the construction and occupancy of the individual property, ambient-temperature conditions etc.

24.6 DRAWINGS, DOCUMENTS AND DESIGN CALCULATIONS

After award of contract, the contractor shall furnish all drawings, documents, design calculations, data, manuals & other necessary literature, pertaining to equipment offered by them & so specified under various clauses, in accordance with requirements stipulated in "clause 1.19 of Section – 1 i.e. General Technical Specification (GTS)". A comprehensive list of all such drawings/documents planned to be submitted for reference/approval shall be provided beforehand for approval of the purchaser as already explained in clause no. 1.19.6 of Section – 1 (GTS). The list of drawings & documents to be furnished for approval / reference shall not be limited to the following:-

i) Drawings, documents, design calculations literatures, manuals etc. as per clause no. 1.19 of Section-1 (GTS)

ii) Drawings, documents, design calculations, literatures, manuals as listed in Annexure – D of Section -1 (GTS) referred under clause no. 1.19.6

iii) Detailed quality assurance plan, giving complete specifications of the materials and specifications relating to inspection and testing of materials and finished components.

iv) All drawings having bearing on civil foundations, equipments foundation details and loads

v) Arrangement, installation, foundation, plan, section, detailing of main equipment and sub-assemblies including piping, control & instrumentation system.

vi) All Electrical, Hydraulic & Control Drawings such as Electrical Panels OGA, Cable Block & Termination Diagram, Schematic Diagram, JB/MB/Kiosk Diagram etc. in respect of this section.

vii) All manufacturing drawings not specifically covered under approval/reference category shall be submitted for record and facilitate inspection of the component in the shop and assembly at site.

Any other drawings, documents, design calculations, literatures, manuals etc. not covered anywhere in the specification, but required to be furnished for approval / reference of employer for suitability of design to fulfill the scope of work.

24.7 SHOP ASSEMBLY, INSPECTION AND TESTS

24.7.1 Shop Tests

The motors, pipes, valves, deluge system, sprinkler system, strainers, inert gas system portable type extinguishers, automatic and manual detectors, control system, etc. to be supplied shall be tested as per relevant IEC/IS/NFPA/other Indian/international standards. These shall include at least the following:

- Verification of motor characteristics/ performance including material of the casing, shaft etc.,
- Verification of performance of suppression system, detectors of all types including aspirator type smoke detectors, notification devices, control system etc. for the specification intended,

Data sheet of all items for approval wherever applicable

24.7.2 Routine tests

These shall at least include the following:

- Routine tests on all the types of motors, air sampling network, filters, all types of detectors, pipes, valves including deluge valves, portable type fire extinguishers, inert gas system etc. as per relevant Indian/ international standards,

- Control system equipment/ components shall be tested in accordance with applicable Indian/international standards including insulation tests

24.7.3 **Type tests**

The type tests shall fall under CAT-II (refer clause no 1.16 of GTS).

Type tests shall verify that motors, filters, all types of pipes, valves and fittings including deluge valves, all type of detectors, control system components including panels perform satisfactorily at the rating assigned. The equipments/ system components proposed according to this specification shall be type tested at typical units in accordance with the relevant Indian/ international standards.

24.7.4 **Field Tests**

All field tests including tests during installation, pre-commissioning, commissioning, performance and field acceptance tests shall be conducted by the Contractor, in the presence of representative of the Employer.
The field tests shall be in accordance with, but not limited to, NFPA Standards. If the system shall be tested in sections, the same applies for each section. Any defects or leaks disclosed in the tests shall be duly mended/ repaired to meet the desired function.
Procedure to be adopted for conducting the operational, pre-commissioning, commissioning, performance and field acceptance tests shall be submitted well in advance, at least six (6) months before start of relevant testing, for approval of the Employer.

24.7.5 **Tests during installation and pre commissioning**

The tests at site should at least include the following. The tests for the piping system shall be completed prior to installation of the equipment in the pipes:

- Hydrostatic pressure tests of the whole piping system,
- Pressure-flow tests on water distribution system and supplies,
- Leakage test,
- Test for value of insulation as per relevant Indian/ international standards,
- Test for sensitivity range of all types of sensors/detectors,
- Calibration of the aspirator/ air sampling type smoke detectors and other detectors,

- Circuits and equipments shall be properly protected against the possibility of induced transients,
- The power supply shall be equipped with locking mechanism and marked in red with proper identification,
- Before installation all system components shall be checked for cleanliness and after installation, the systems shall be effectively flushed out with clean water and filled up for testing before the nozzles and discharge horns are fitted.

24.7.6 Commissioning tests

Powerhouse functions that shall be initiated or controlled during a fire alarm condition and shall have, but shall not be limited to, the following operations in accordance with relevant safety and installation codes/standards:

- Verification of performance of suppression system, detectors of all types including aspirator type smoke detectors, notification devices, control system etc. for the specification intended,
- Elevator operation/recall,
- Operation of exit doors and release of fire and smoke dampers,
- Monitoring and initiation of self-contained automatic fire extinguishing systems and equipment,
- Control of powerhouse HVAC equipment to provide smoke control,
- Control of process, data processing and similar equipment as necessary during fire alarm conditions.

The power plant fire alarm system must be in any case, ready for operation prior to the commissioning of the first generating unit.

24.7.7 Performance testing

After completion of commissioning tests and commissioning of complete system ,the test service period of thirty (30) days shall follow before taking over. During this test service period, the system / installations must perform satisfactorily & if any defects are observed , same shall be rectified by contractor without any financial implication to employer.

24.8 PACKAGING, HANDLING AND SITE STORAGE

The Contractor shall pack all the consignment in sea worthy packaging strong enough to withstand rough handling during transit. Machine surface shall be suitably protected against scratches, corrosion, shocks, impact etc.

Packages shall be suitably and distinctly identified for type of handling and kind of storage**.**

24.9 SITE INSTALLATION AND COMMISSIONING

24.9.1 General

The Contractor has to do all the work related to assembly, erection, testing and commissioning complete in all respects. All necessary tools, plants, labour, materials including consumables for performing installation, testing and pre-commissioning shall be provided by the Contractor.
The Contractor shall submit the necessary data/information, layout and foundation/support drawings well in advance.

The Contractor shall provide and install the concrete inserts/embedment, support steels and/or components for foundation/supports purpose as per approved erection drawings and coordinate the activities with civil contractors to keep his activities in synchronism with civil work. All installation for foundation shall be verified and accepted by the Engineer.

The Contractor shall use anchor fasteners for installation of piping, fixtures, mountings, conduits, cabling, panels etc. Chipping of concrete and/or taking support from reinforcement bars shall not be allowed.

24.10 TOOLS AND INSTRUMENTS

24.10.1 Tools for erection and Installation.

The Contractor shall bring his own tools, devices, testing instruments / equipments to site in order to erect and install the complete equipment delivered under this section. These shall remain the property of the Contractor unless otherwise agreed to take over any / all of these at mutually agreed conditions.

24.11 SPARE PARTS

The spare parts mentioned here under are meant for use by the Employer during operation and maintenance stage and shall not be used as erection spares required during installation.

24.11.1 Mandatory Spare Parts

The Contractor shall supply the mandatory spare parts as per **Schedule-III.**

24.11.2 Recommended Spare Parts

The Contractor shall furnish the list of recommended spare parts at **Schedule-IV.**

ANNEXURE FOR DEVIATION LIST						
LIST OF DEVIATIONS						
Project: ARUN HEP						
Sl. No.	**Part No./ Volume**	**Page no.**	**Clause No.**	**Subject**	**Deviation/Clarification**	**Reason for Deviation**
1						
2						
3						
4						
5						
6						

NOTES:

1. Deviations, if any, shall be clearly brought out only in this format. Deviations mentioned / taken elsewhere or in any other format will be ignored.
2. Additional sheets in the same format can be attached by the vendor, if necessary.
3. Nature of Deviations shall only be of Design / Manufacturing constraints and non-availability of items / components / makes in market.
4. No price implications shall be entertained for deviations withdrawn during the technical scrutiny. If any deviations are accepted by BHEL during technical scrutiny then also there will be no price implication. Hence, in no case there will be consideration of Price implications.
5. Reasons for the deviations shall be specified in the Remarks column.
6. If there are no deviations from the specifications, bidder still has to submit the signed copy of this format by writing "NO Deviations" on this format.
7. If the "Deviation Schedule" is not submitted along with the offer, the bidder's offer is likely to be rejected without any further interaction with the bidder. Only the accepted deviations in conjunction with the original tender shall constitute the contract document for the award of job to the bidder