

Oil & Gas Engineering Training



Dear colleague,

I am glad to share with you this educative material on the Engineering of Oil & Gas facilities.

I developed it for classroom training sessions which I have been conducting since 2009.

This material will give you an overview of the work and deliverables of the different engineering disciplines.

I also thrived to produce workflow visuals to help understand the work sequence of each discipline and how they interface.

I wish you an enjoyable journey within Engineering...

Oil & Gas Engineering Training

- HSE Moment
- Intro, scope & objectives
- Project Engineering
- The Design Basis
- Discipline presentations
- Field engineering
- Schedule
- Quality

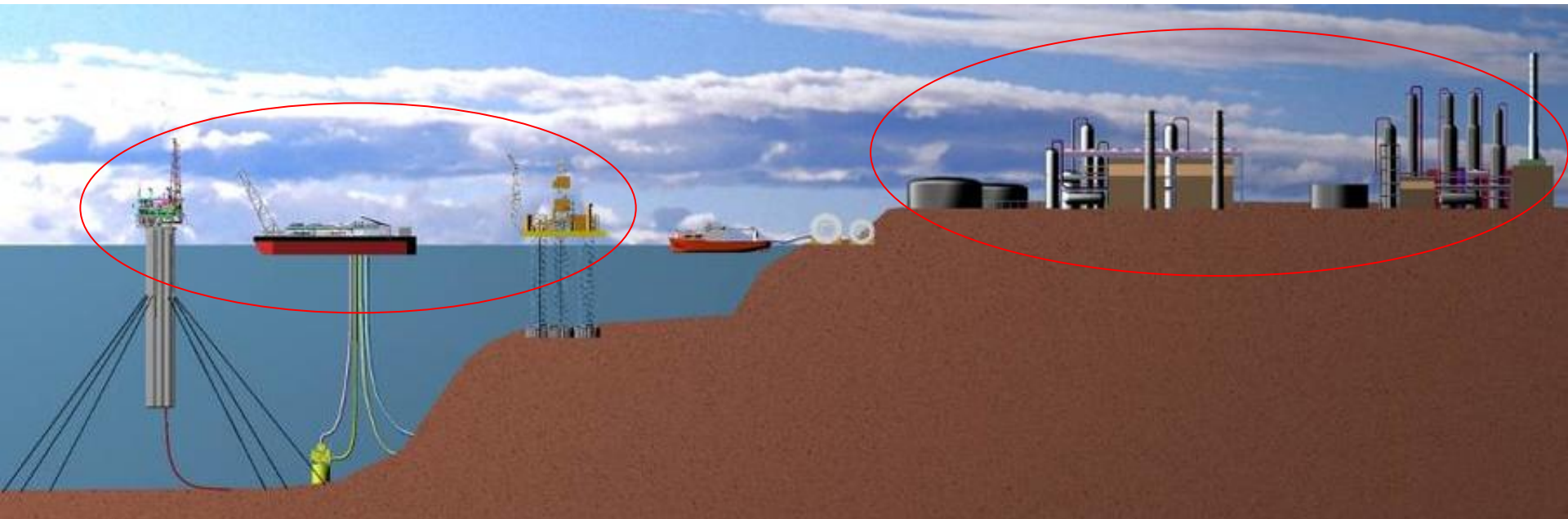
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Training Objectives

- To give a detailed knowledge of what engineering of oil and gas facilities consist of
- To describe the activities and show a sample deliverable in the various disciplines
- To explain the challenges

Scope







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Design



Procurement



Manufacturing



Shipping



Installation



Construction
& erection



Inspection &
tests



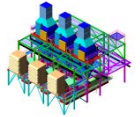
Hand-over





Home office (Paris)

- Project management
- Detail Engineering (part)
- Procurement



Satellite office (Pau)

- Detail Engineering (part)



Fabrication yard (Nigeria):

Fabrication (part)



Offshore (Nigeria):

Installation, commissioning,
start-up



Engineering Sub-Contractor (Delhi)

Detail Engineering (part)



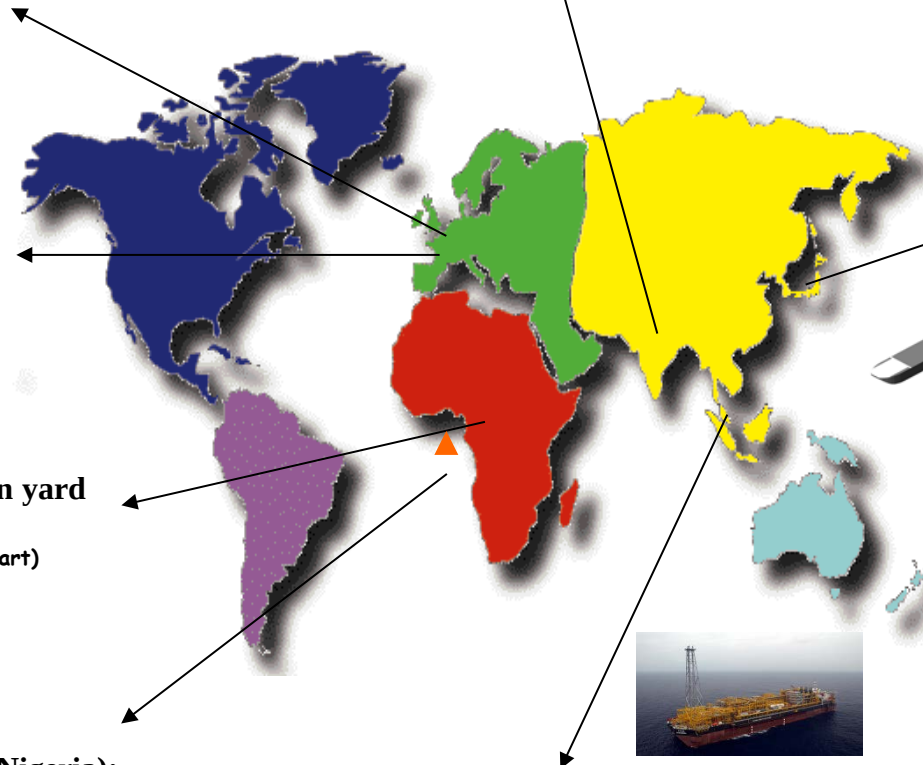
Shipyard (Korea)

Hull Engineering &
Fabrication



Shipyards (Singapore & Malaysia)

Topsides Fabrication &
Integration



Project

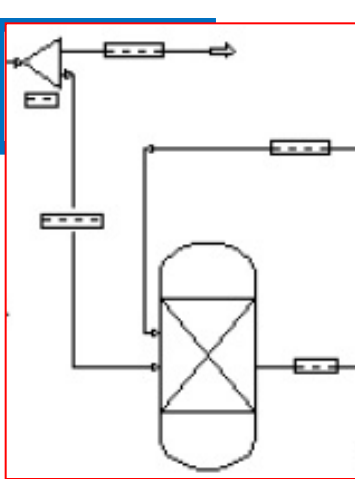
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graph TD; Project[Project] --- Engineering[Engineering]; Project --- Procurement[Procurement]; Project --- Construction[Construction];
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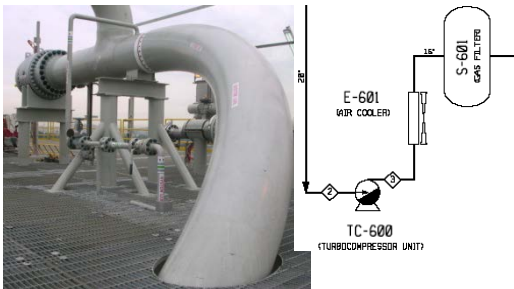
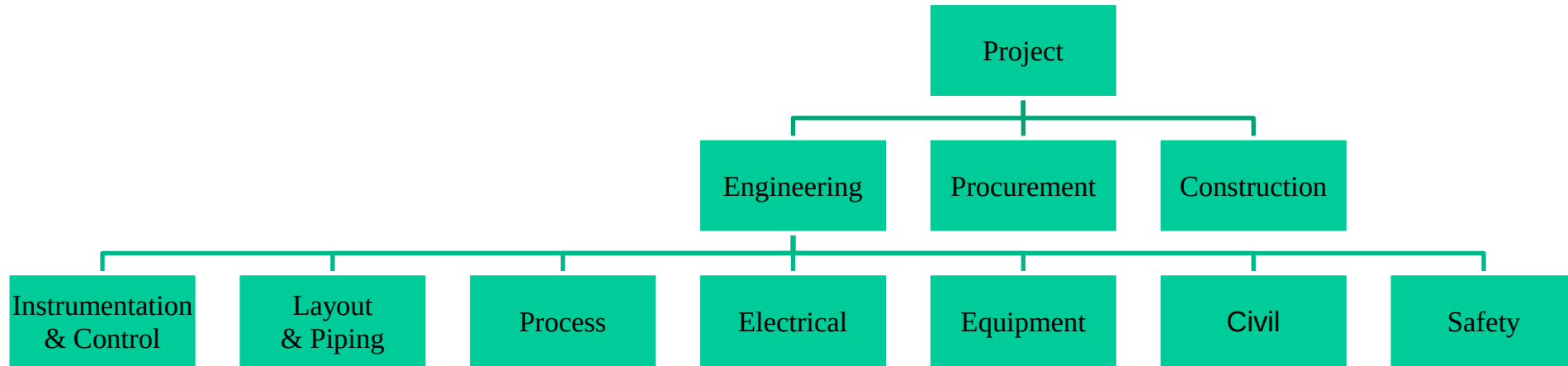
Engineering

Procurement

Construction





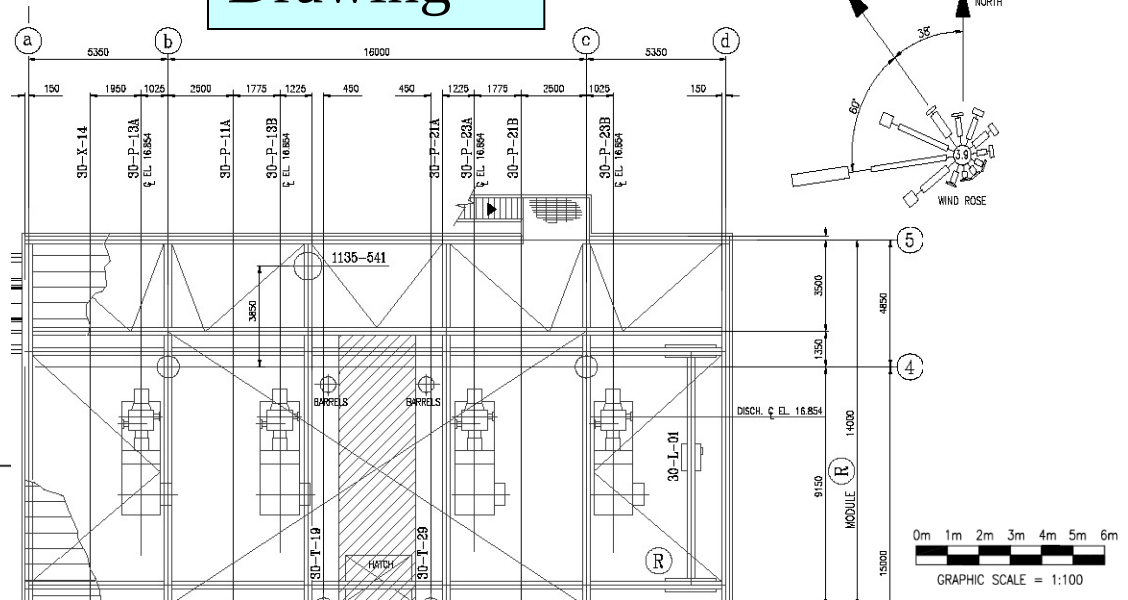
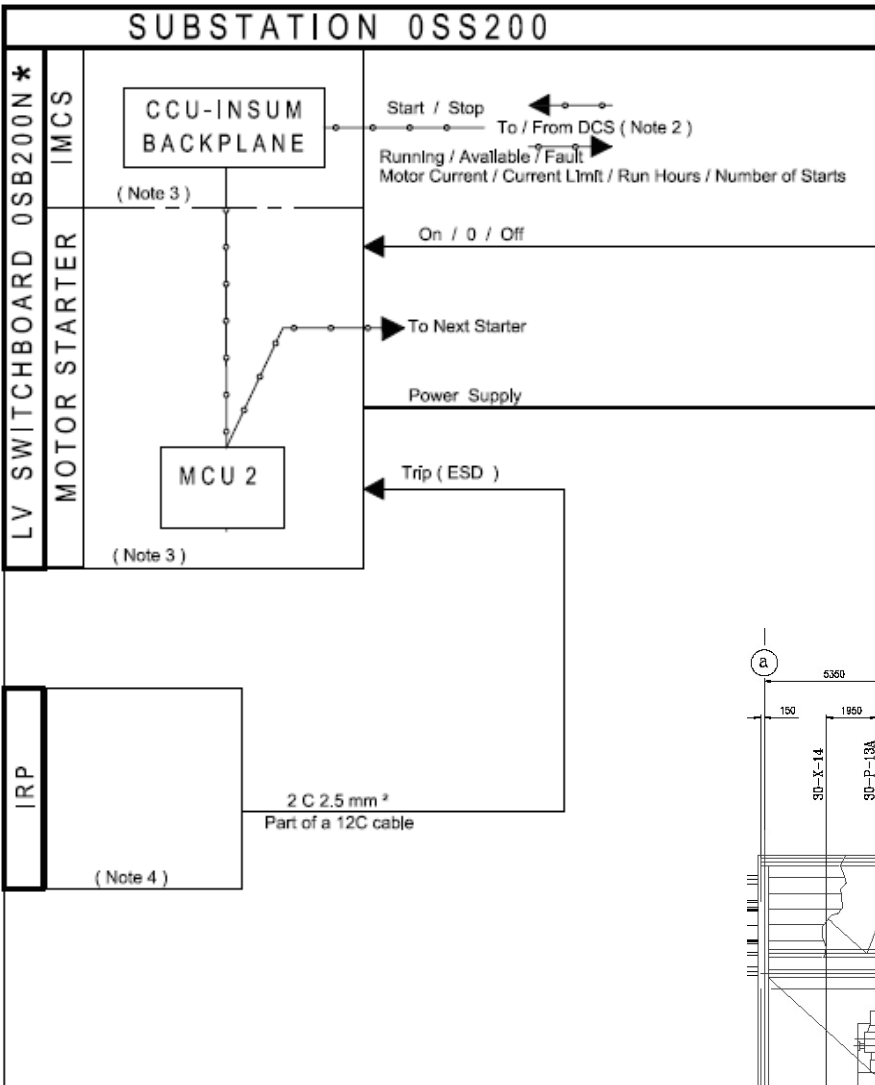


Engineering document register

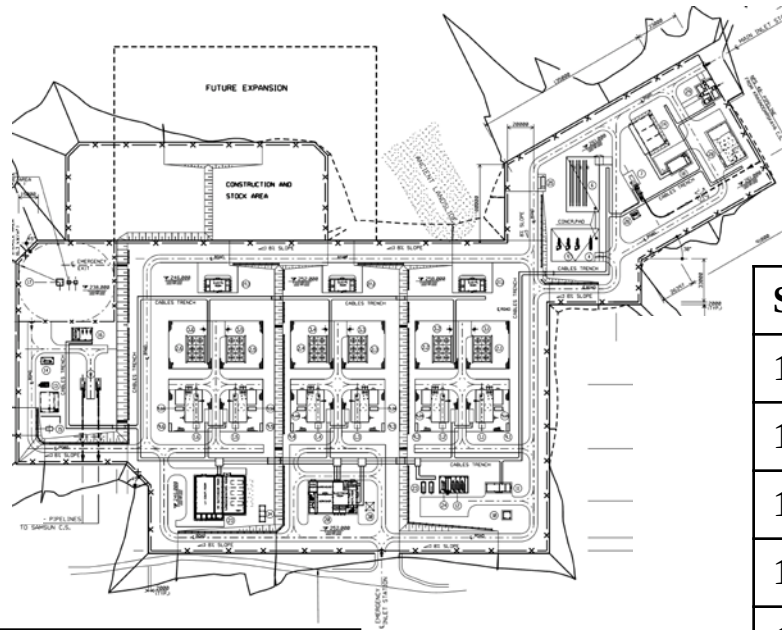
Document number			Document title	Document revision
A	1	48104	Service building instrument. rooms cables routing	B
A	2	48102	Trouble shooting diagrams	D
A	3	48134	F&G system architecture drawing	E
A	4	50100	Instrument index	B
A	7	50003	Spec for instrument installation works and service	C
A	8	50960	Instrument Data sheets for temperature switches	B
A	9	50110	Requisition for pressure relief valves	B
M	1	62059	General plot plan	B
M	2	62020	Piping details standard	C
M	2	62070	Piping general arrangement Area 1	D
M	4	60100	Special items list	D
M	5	62250	Piping isometrics booklet	C
M	6	60000	Pipes and fittings thickness calculation	A
M	6	62351	Calculation note CN1 - piping stress analysis	A
M	7	60001	General piping specification	C
M	8	60103	Data sheets for station piping material	B
M	9	60200	Requisition for pipes	F

Discipline code	
A	Instrumentation & Control
C	Civil engineering
E	Electrical
G	Project general documents
J	Mechanical
K	Safety
M	Piping & Layout
P	Processes
S	Steel Structures
V	Vessels – Heat exchangers
W	Materials – Welding

Document code	
1	Installation drawings
2	Detail drawings
3	Diagrams
4	Lists – Bill of Quantities
5	Isometrics
6	Calculation notes
7	Specifications
8	Data sheets
9	Requisitions



Drawings common sizes & scales



Scale	1m =
1/1000	1 mm
1/500	2 mm
1/250	4 mm
1/100	1 cm
1/50	2 cm
1/33	3 cm

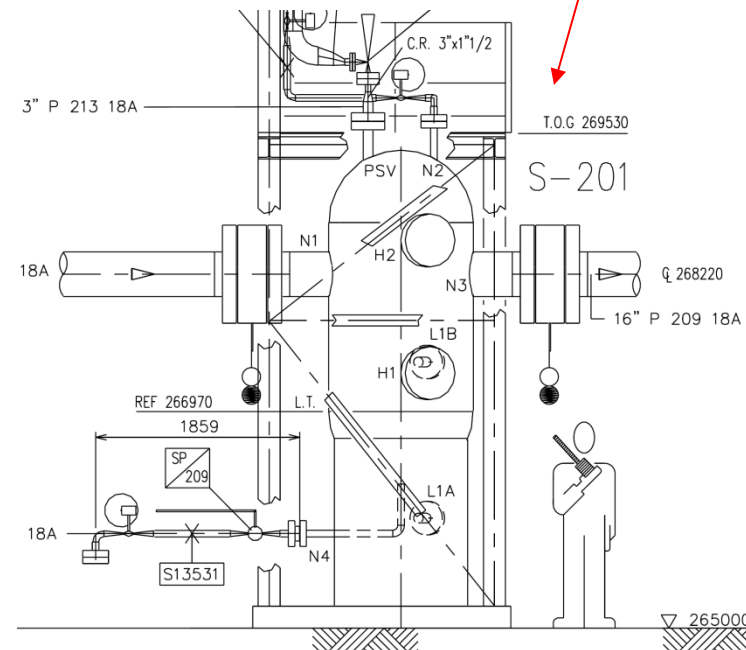
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A1 = 594x840

A2 = 420x594

A4 =
210x
297

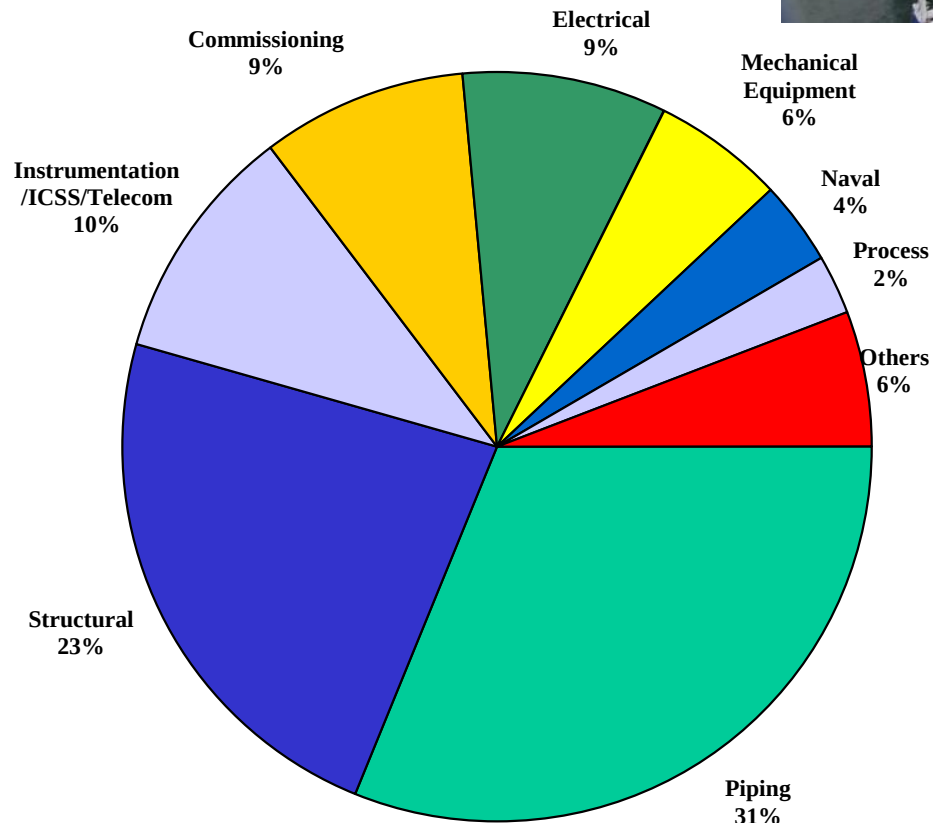
A3 =
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420



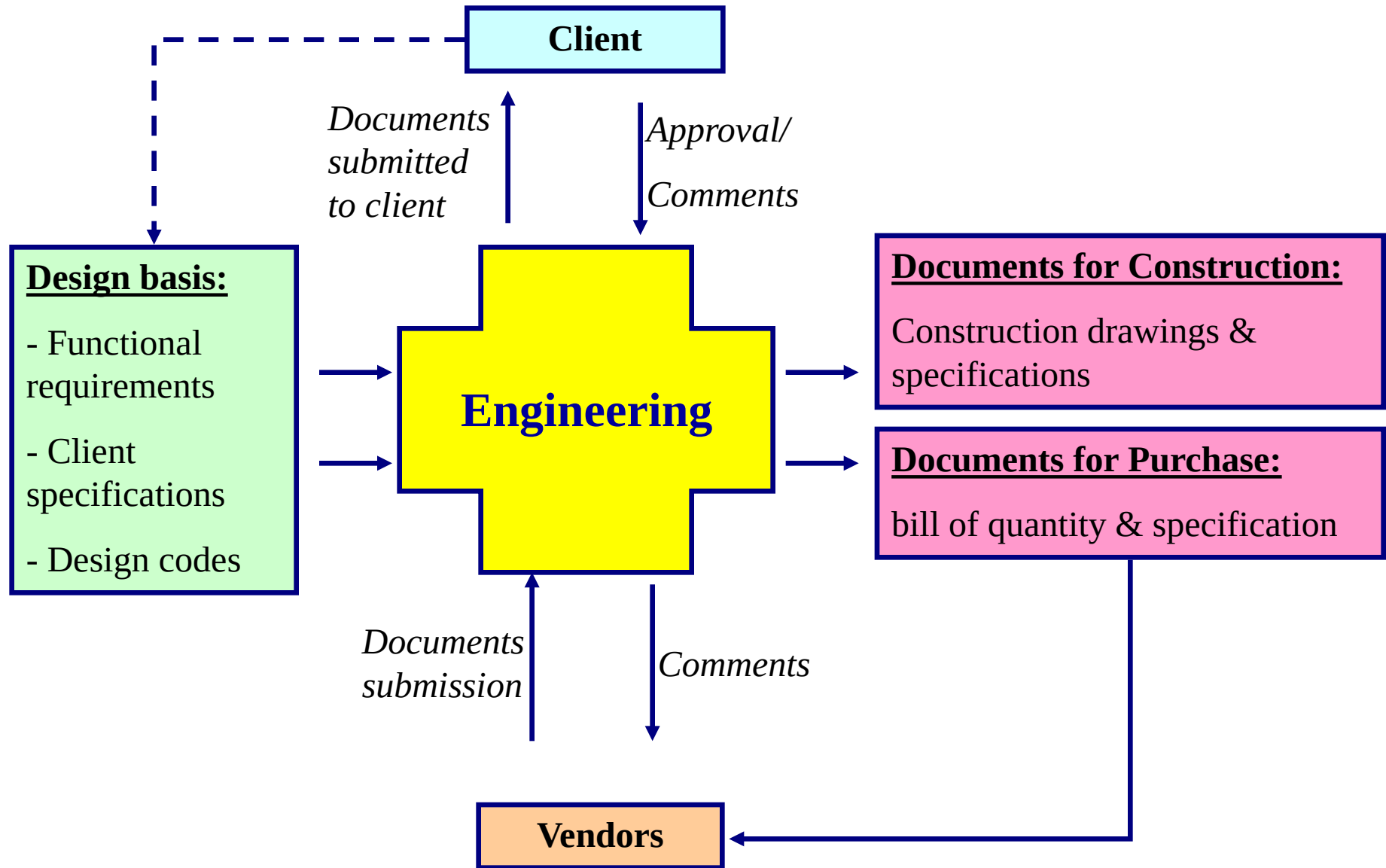
Activity Description	YEAR MONTH	1												2						
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7
<u>PROCESS</u>																				
PFD, Equipment List														Engineering schedule						
Fluid List																				
Main Equipment Process Data Sheet																				
P&IDs & Line List																				
Control & Emergency Shutdown philosophy, HAZOP																				
Operating Manual																				
<u>MECHANICAL</u>																				
Datasheets & Specifications for main Equipment/Package																				
Main Equipment/Packages Purchase Order																				
Datasheets & Specifications for other Equipment/Package																				
Other Equipment/Packages Purchase Order																				
Equipment/Package Vendors Data (GAD/PID's)																				
<u>PIPING/MATERIAL</u>																				
Piping Classes																				
Valves & misc. Data sheets																				
Requisitions for Inquiry																				
Requisitions for Purchase																				
Final Piping Material Requisition																				
<u>CIVIL</u>																				
Foundation Drawings for Main Equipment																				
Foundation Drawings for Other Equipments																				
Building Architectural Drawings																				
Building Civil detailed Design Drawings																				
Civil Area Drawings																				
<u>PIPING/INSTALLATION</u>																				
General Plot Plan																				
Unit Plot Plan																				
Piping Layout Drawings																				
Piping 1st Material-Take-Off																				
Piping 2nd Material-Take-Off																				
Piping General Arrangement Drawing & 3D Modelling																				
Critical Line List																				
Piping Stress Calculations																				
Piping Support Drawings																				
Isometric Drawings																				
Piping MTO final Issue																				

Engineering schedule

Engineering resources



~1,000,000 man-hours



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Design Basis

Process facilities:

Feedstock and products flow

Feedstock composition

Battery limit conditions

Equipment Spare

Performance:

Products specifications

Energy efficiency, emissions

Utilities:

Electric power supply

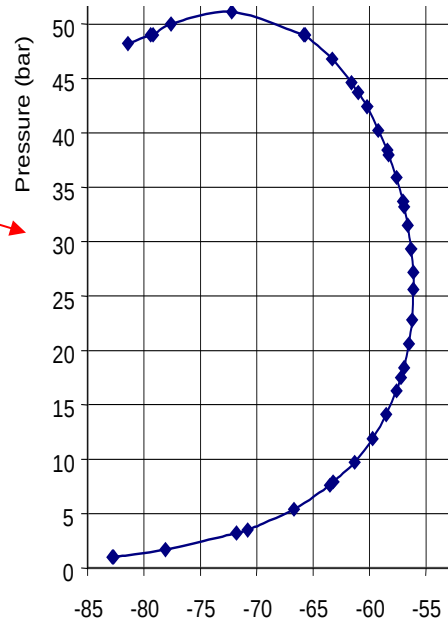
Other utilities

Systems:

Process control

Fire/gas alarm

Public address, LAN, PABX



Infrastructure:

Administrative and technical buildings

Control room

Access road

Site fencing, gates, check point

Design criteria:

% of over design

Environment data:

Min/max temperature

Rain/snow fall

Wind

Geological conditions

Applicable codes and standards:

International standards

Local rules

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Engineering disciplines

- Process
- Equipment
- HSE
- Civil
- Layout
- Piping
- Instrumentation
- Electrical

Functional requirements – example of a gas compression station

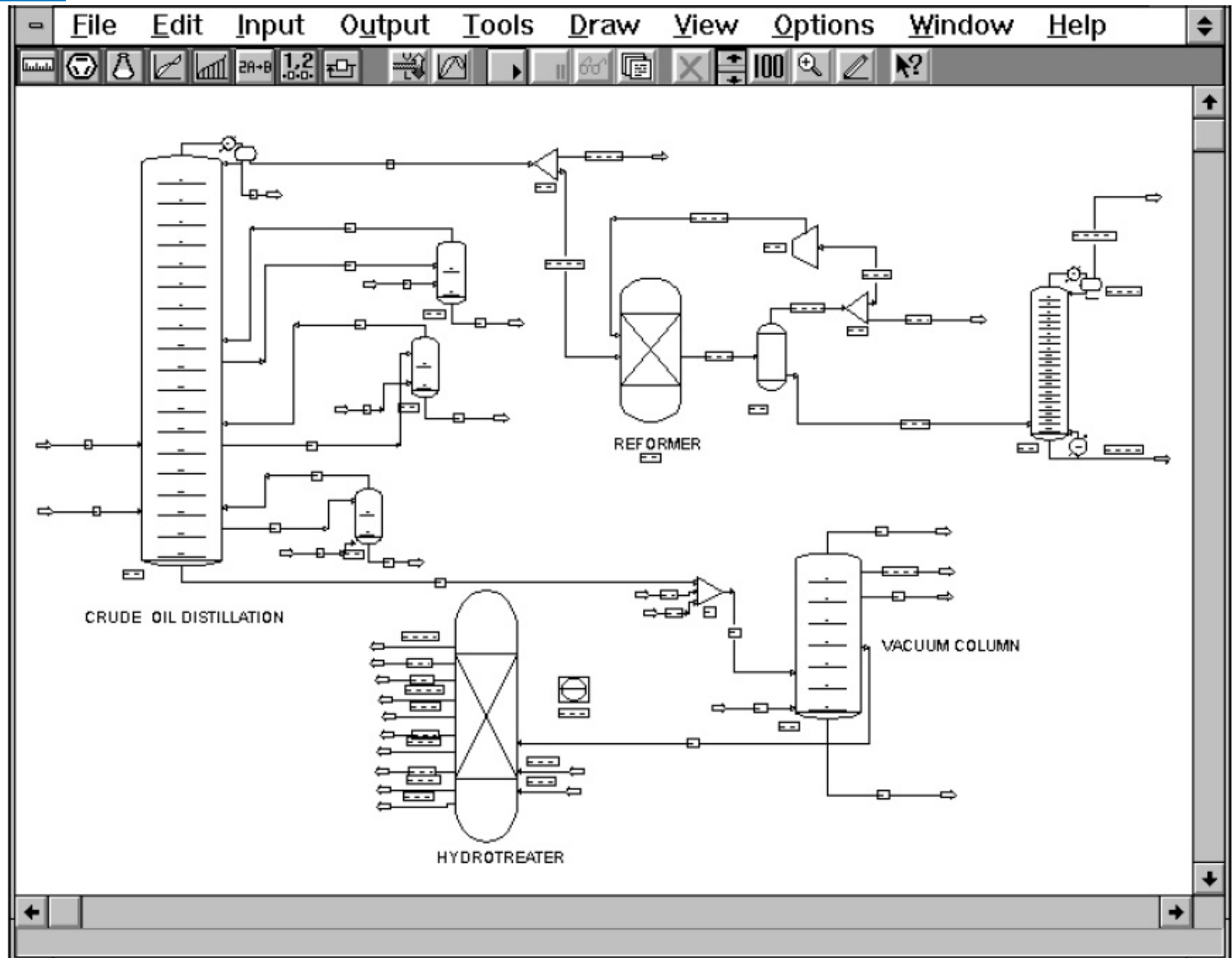
Gas composition

COMPONENT	%
Methane (CH ₄)	97.49378
Ethane (C ₂ H ₆)	0.88
Propane (C ₃ H ₈)	0.14
I-Butane (C ₄ H ₁₀)	0.015
N-Butane (C ₄ H ₁₀)	0.025
N-Pentane (C ₅ H ₁₂)	0.0383
N-Heptane (C ₇ H ₁₆)	0.0617
Nitrogen (N ₂)	0.93
Carbon dioxide (CO ₂)	0.41
Water (H ₂ O)	0.0056
Hydrogen Sulphide (H ₂ S)	0.00035
Mercaptane (C ₇ H ₁₆ S)	0.00027
Molecular weight	16.52

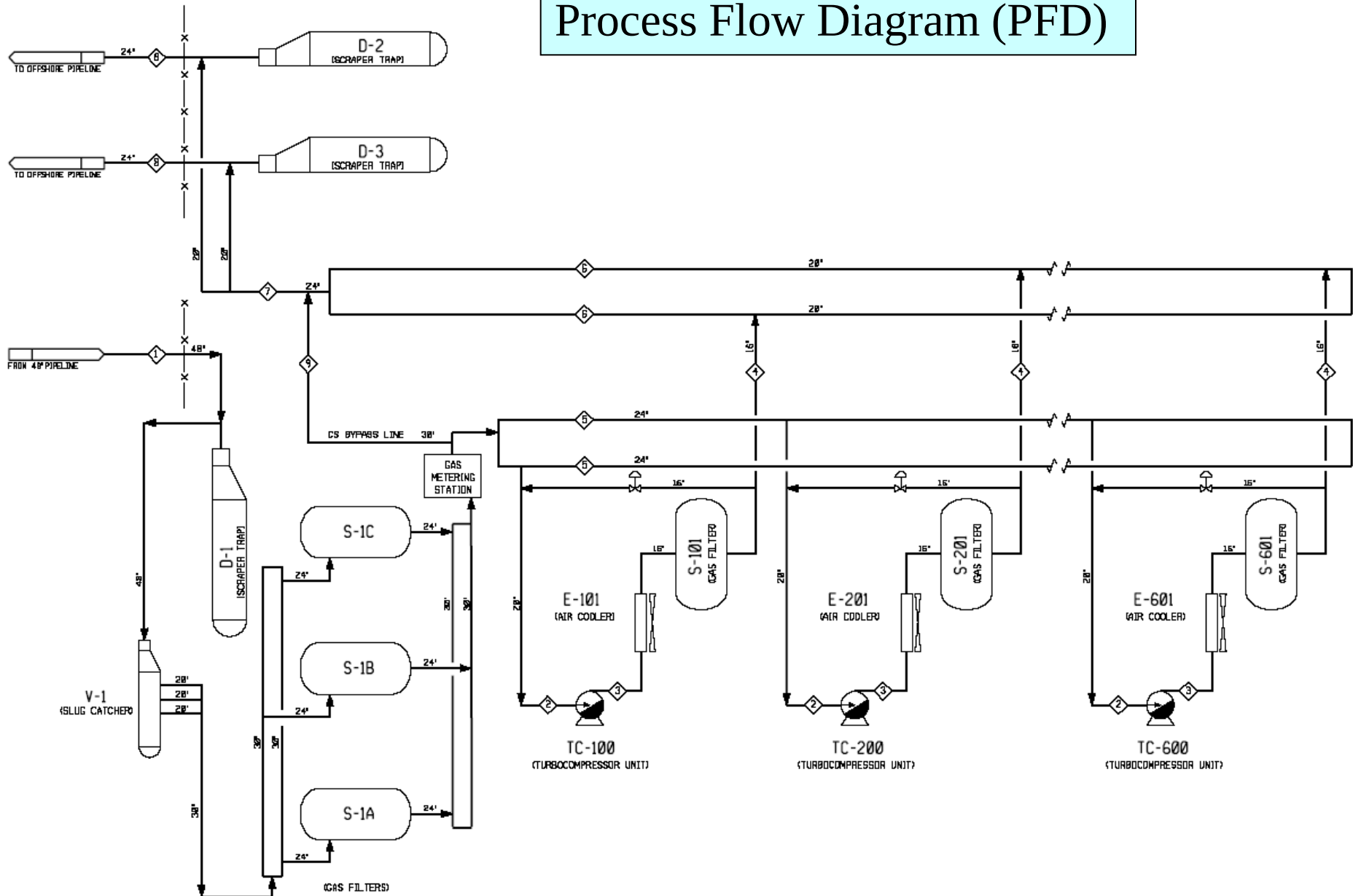
Performance

inlet pressure, MPa (abs)	8.78
outlet pressure, MPa (abs)	25.1
flow rate, Million STD m ³ /day	48.17

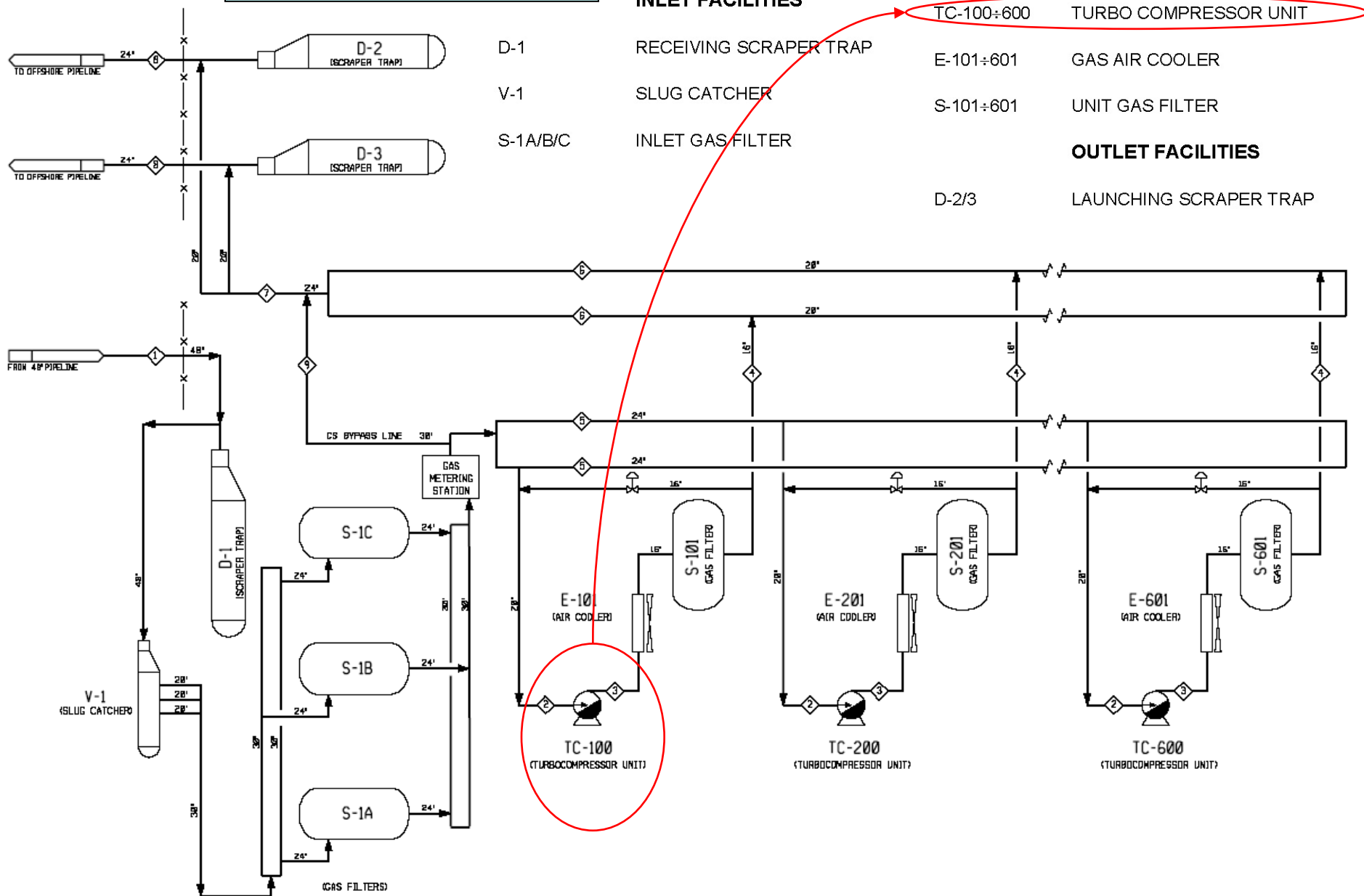


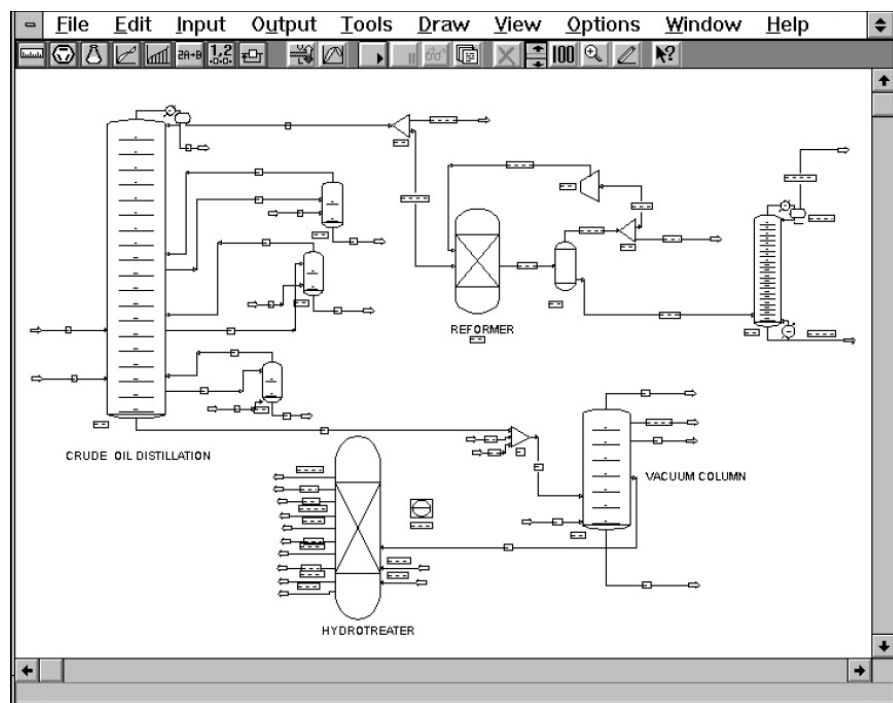


Process Flow Diagram (PFD)

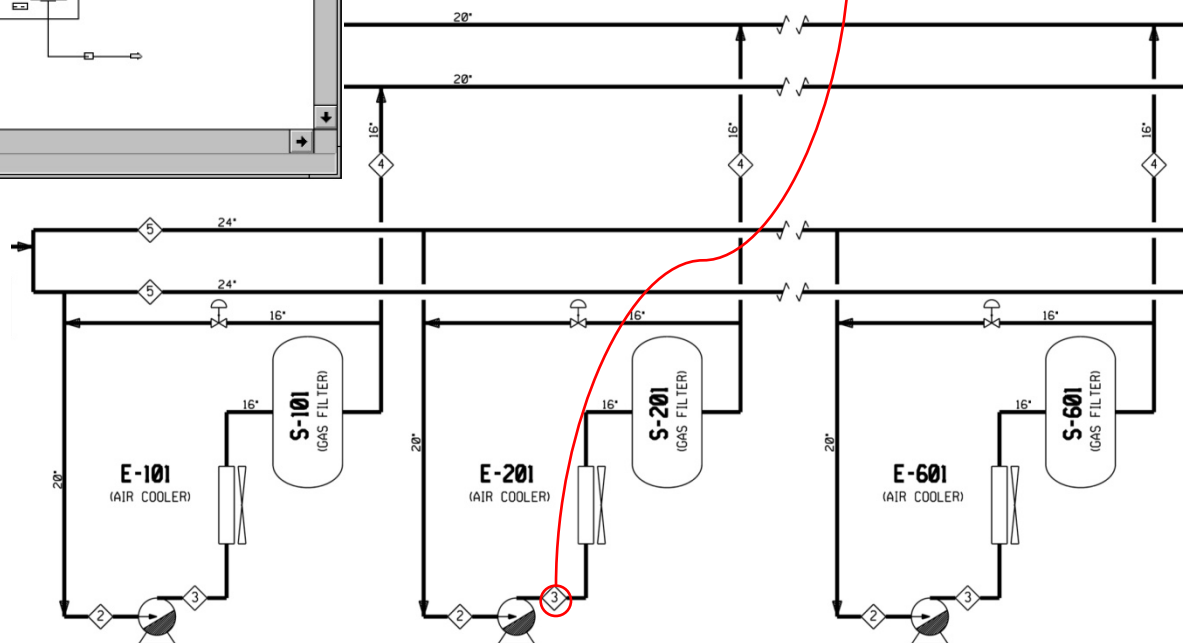


Equipment list

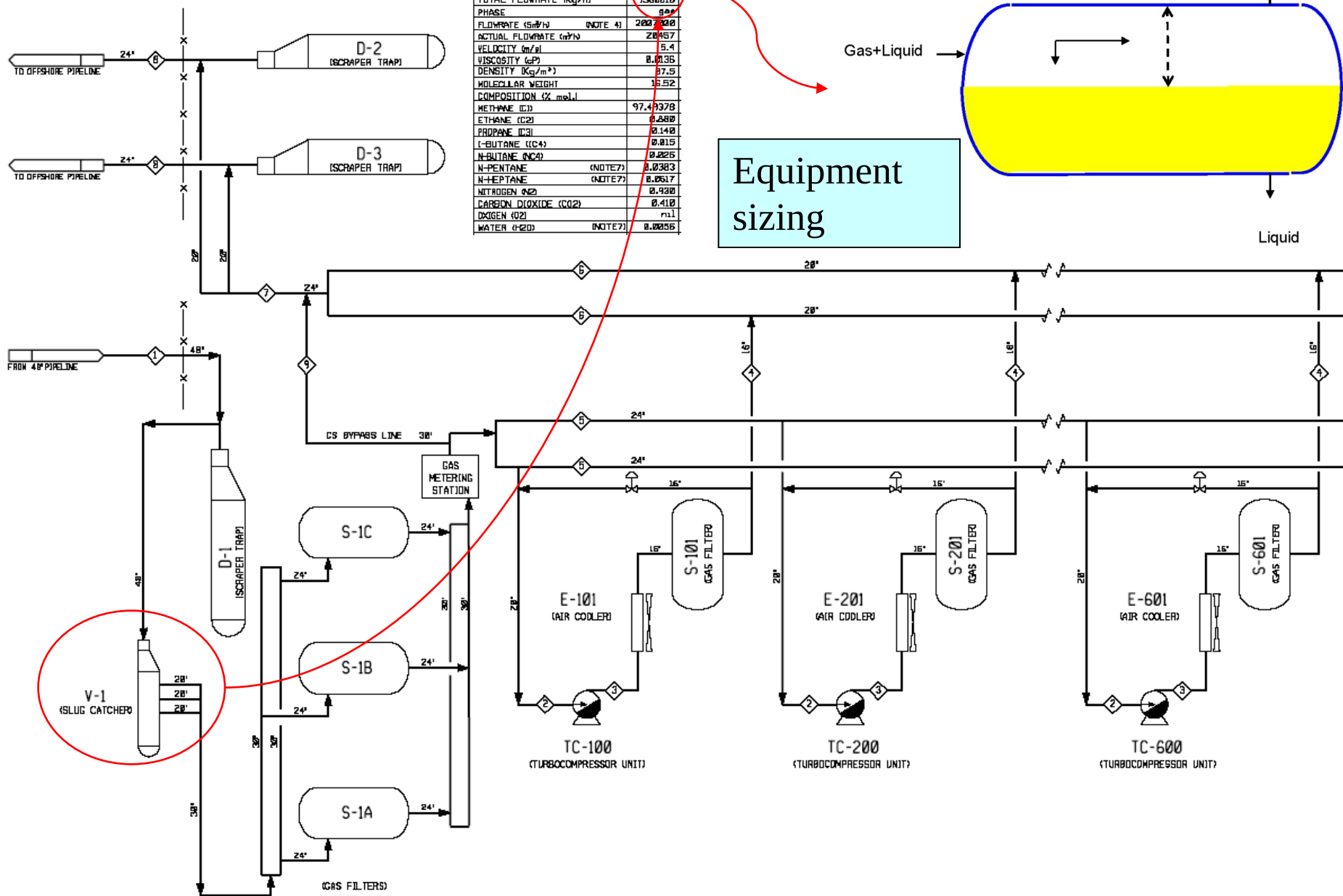




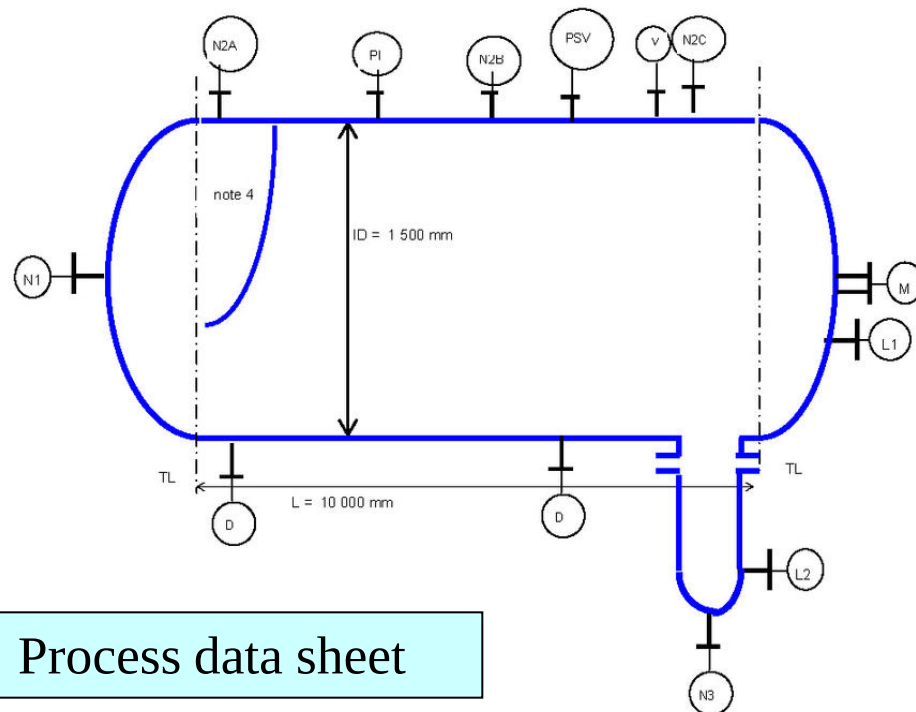
STREAM NUMBER	1	2	3	4	5	6	7	8
PRESSURE (MPa-abs)	9.78	6.52	25.1	25.05	9.52	25.05	24.95	24.95
TEMPERATURE (°C)	27.25	26.4	130	50.8	50.8	50.8	49.6	49.6
TOTAL FLOWRATE (Kg/h)	1388816	345204	345204	345204	690408	690408	1388816	690408
PHASE	gas	gas	gas	gas	gas	gas	gas	gas
FLOWRATE (Sm³/h) (NOTE 4)	2007000	501750	501750	501750	1003500	1003500	2007000	1003500
ACTUAL FLOWRATE (m³/h)	20457	5262	2815	2815	10525	4993	8210	4105
VELOCITY (m/s)	5.4	9.4	7.9	5.7	12.7	7.3	10.2	5.1
VISCOSITY (cP)	0.0136	0.0134	0.0219	0.0219	0.0134	0.0219	0.0216	0.0219
DENSITY (Kg/m³)	87.5	85.6	122.6	106.7	85.8	106.7	106.2	106.2
MOLECULAR WEIGHT	16.52	16.52	16.52	16.52	16.52	16.52	16.52	16.52
COMPOSITION (X mol)								
METHANE (C1)	97.49378	97.49378	97.49378	97.49378	97.49378	97.49378	97.49378	97.49378
ETHANE (C2)	0.580	0.580	0.580	0.580	0.580	0.580	0.580	0.580
PROPANE (C3)	0.148	0.148	0.148	0.148	0.148	0.148	0.148	0.148
ISOBUTANE (IC4)	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
N-BUTANE (NC4)	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
N-PENTANE (NOTE7)	0.0383	0.0383	0.0383	0.0383	0.0383	0.0383	0.0383	0.0383
N-HEPTANE (NOTE7)	0.0617	0.0617	0.0617	0.0617	0.0617	0.0617	0.0617	0.0617
NITROGEN (N2)	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930
CARBON DIOXIDE (CO2)	0.410	0.410	0.410	0.410	0.410	0.410	0.410	0.410
OXYGEN (O2)	nil	nil	nil	nil	nil	nil	nil	nil
WATER (H2O) (NOTE7)	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
HYDROGEN SULPHIDE (H2S) (NOTE8)	0.00035	0.00035	0.00035	0.00035	0.00035	0.00035	0.00035	0.00035
MERCAPTAN SULPHUR (NOTE9)	0.00027	0.00027	0.00027	0.00027	0.00027	0.00027	0.00027	0.00027



HERVE



SERVICE		Slug Catcher		COLONNE / COLUMN	
CONDITIONS OPERATOIRES / OPERATING CONDITIONS					
FLUIDE / FLUID		Natural Gas			
PRESSION DE SERVICE / OPER. PRESSURE		9.7	MPa(a)		
TEMPERATURE DE SERVICE / OPER. TEMPERATURE		30	°C		
MASSE VOLUMIQUE LIQ. / LIQ. DENSITY		1000	kg/m ³		
ABRASION, CORROSION, CAUSE / EROSION, CORROSIVE DUE TO		note 3			
INFLAMMABLE - EXPLOSIF / FLAMMABLE - EXPLOSIVE		Flammable			
DONNEES DE CONSTRUCTION / CONSTRUCTION DATA					
PRESSION DE CALCUL / DESIGN PRESSURE		10.11	MPa(a)		
VIDE : DEPRESSION DE CALCUL / DESIGN VACUUM PRESSURE			MPa(a)		
TEMPERATURE DE CALCUL / DESIGN TEMPERATURE		-20/50	°C		
CAPACITE / CAPACITY		18	m ³		
MATERIAU / MATERIAL		CS			
SUREPAISSEUR DE CORROSION / CORROSION ALLOWANCE		3	mm		
DETENSIONNEMENT / STRESS RELIEVE					
OUI / YES		☐	NON / NO		☐
REVETEMENT INTERNE / LINING					
		note 6			
EPAISSEUR REVETEMENT / LINING THICKNESS			mm		
CALORIFUGE / INSULATION		OUI / YES	☐	NON / NO ☒	
CONSERVATION CHALEUR / HEAT CONSERVATION			☐		
PROTECTION PERSONNEL / PERSONNEL PROTECTION			☐		
EQUIPEMENT INTERNE / INTERNALS					
CODE DE CONSTRUCTION / REFERENCE CODE		ASME VIII div1			
TUBULURES / NOZZLES					
REPERE / MARK	Nb	DN / SIZE	SERVICE		
PSV	1	3"	Relief Valve		
N1	1	48"	Inlet		
N2A/B/C	3	24" (note 7)	Gas Outlets		
N3	1	4"	Liquid Outlet		
V	1	2"	Vent		
D	2	2"	Drains		
PI	1	2"	Pressure Gauge		
L1 / L2	2	3"	Standpipe		
M	1	24"	Manhole		



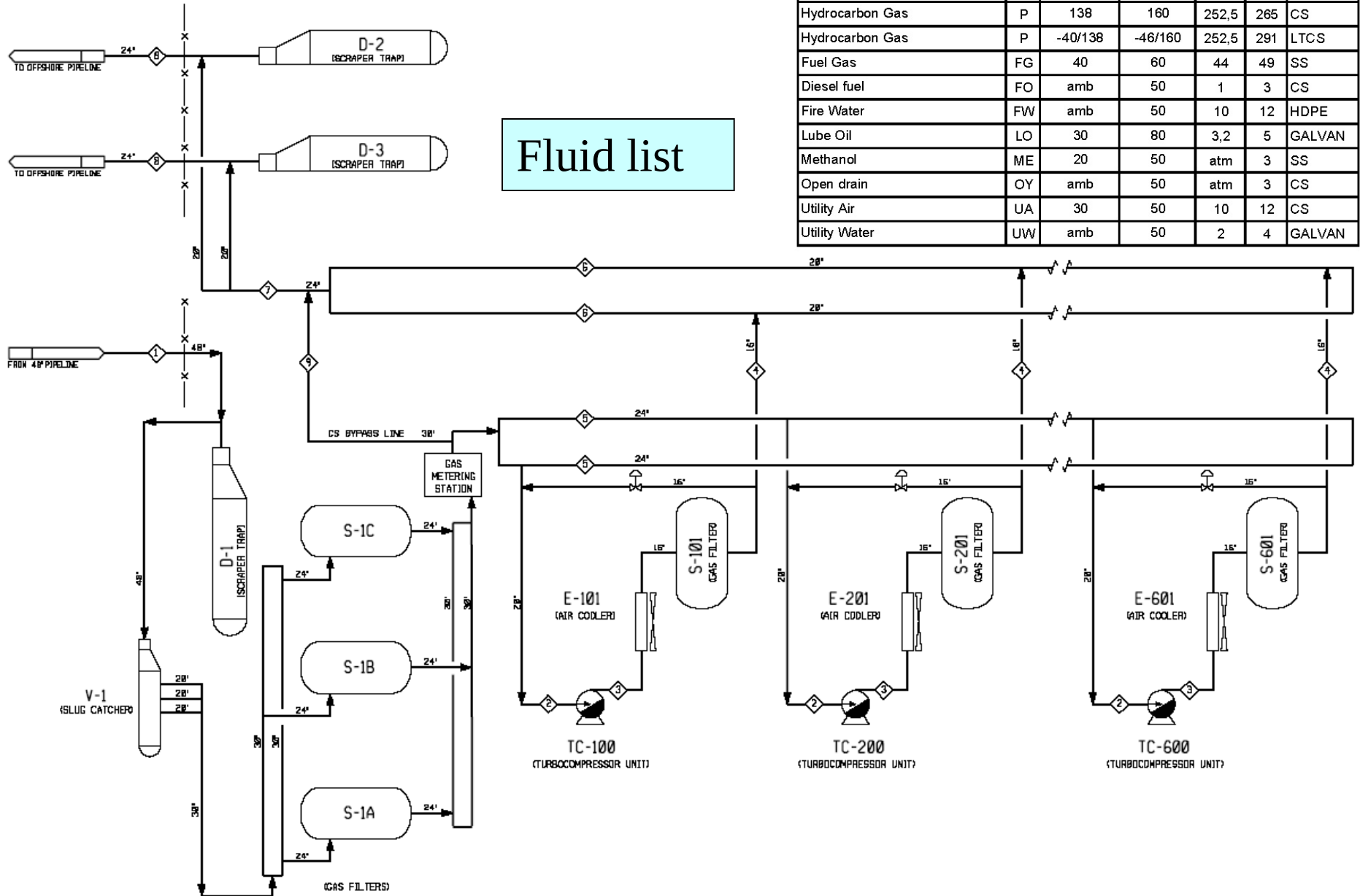
Process data sheet



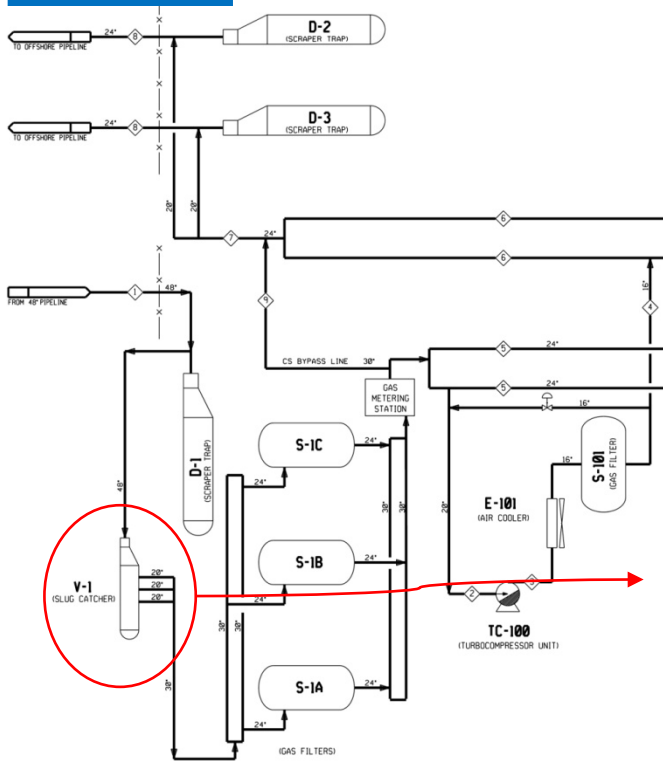
HERVE BARON

Fluid list

FLUID	SYMBOL	OPERATING CONDITIONS				MATERIAL
		T °C		bar(g)		
		MAX/DESIGN		MAX/DESIGN		
Hydrocarbon Gas	P	30	50	97	98,5	CS
Hydrocarbon Gas	P	138	160	252,5	265	CS
Hydrocarbon Gas	P	-40/138	-46/160	252,5	291	LTCS
Fuel Gas	FG	40	60	44	49	SS
Diesel fuel	FO	amb	50	1	3	CS
Fire Water	FW	amb	50	10	12	HDPE
Lube Oil	LO	30	80	3,2	5	GALVAN
Methanol	ME	20	50	atm	3	SS
Open drain	OY	amb	50	atm	3	CS
Utility Air	UA	30	50	10	12	CS
Utility Water	UW	amb	50	2	4	GALVAN



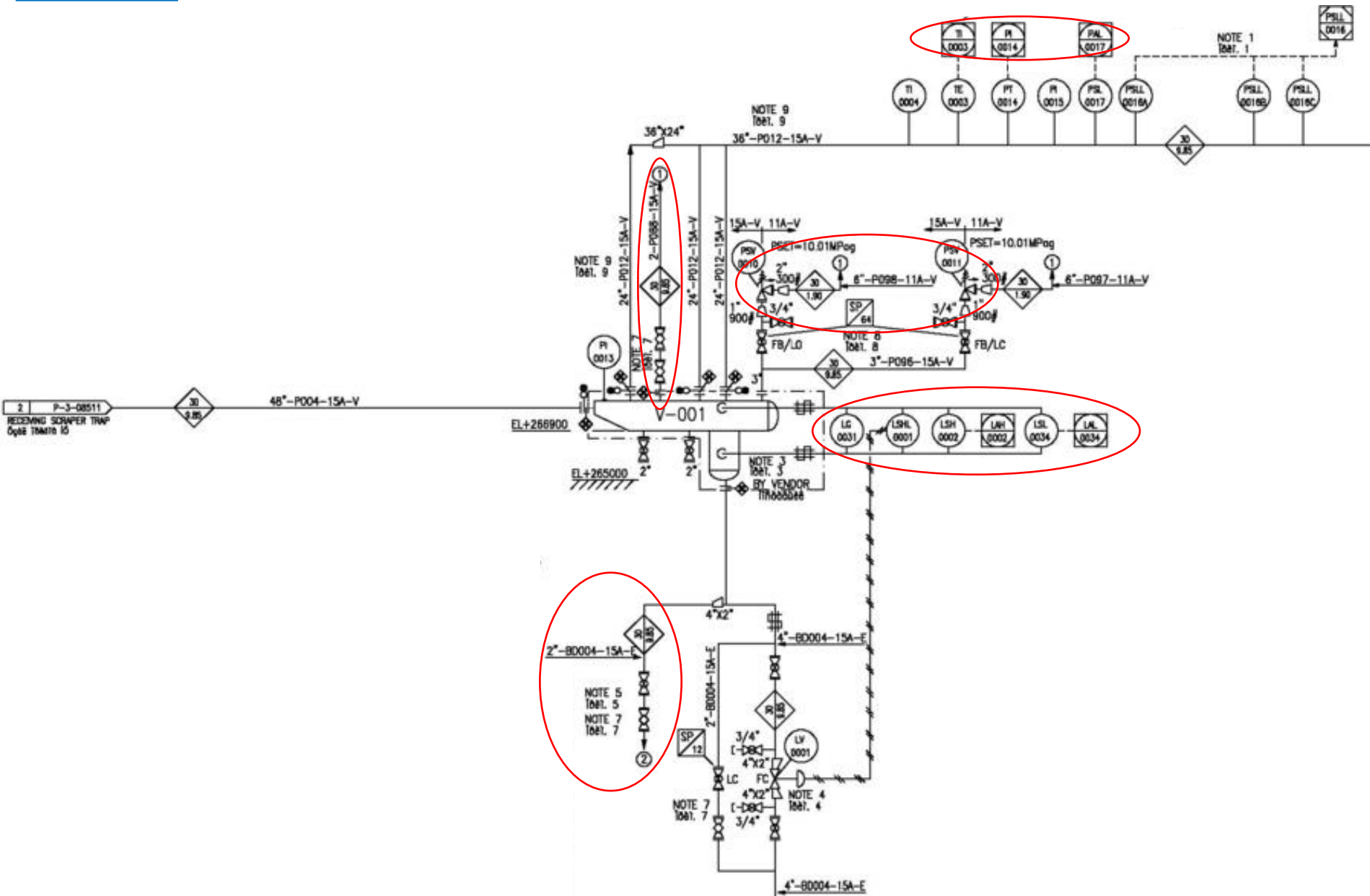
Piping & Instrumentation Diagram (P&ID)



Line List

Line Number			Line Size	Line ID	Class	Insulation		Condition No.	P&ID Dwg. No.	Line Connection		Fluid Phase	Operating Condition		Density	Design Condition		
Fluid Code	Unit Code	Seq No.				Code	Thk.			From	To		Press	Temp		Press	Temp (Max.)	Temp (Min.)
GN	71	61106	22	71GN61106-22	3C3AS1	N	NO	cs	D-80-212	LNG STORAGE	UNIT 93	V	27,6	55	18,2	34,5	100	
GN	71	61106	20	71GN61106-20	3C3AS1	N	NO	cs	D-80-212	LNG STORAGE	UNIT 93	V	27,6	55	18,2	34,5	100	
GN	71	61106	12	71GN61106-12	3C3AS1	N	NO	cs	D-80-212	LNG STORAGE	UNIT 93	V	27,6	55	18,2	34,5	100	
LNG	71	60001	32	71LNG60001-32	3R0JLL	6	180	ss	D-80-302	668-P001 A/B/C	LNG RUNDOWN HEADER	L	11,1	-159	439	30	80	-167
LNG	71	60001	22	71LNG60001-22	3R0JLL	6	170	ss	D-80-302	668-P001 A/B/C	LNG RUNDOWN HEADER	L	11,1	-159	439	30	80	-167
DOW	72	63000	0,75	72DOW63000-0,75	1P1	N	NO	cs	D-72-204	72-P061A	DOW	L	0	48	1000	2	82	
DOW	72	63001	0,75	72DOW63001-0,75	1P1	N	NO	cs	D-72-204	72-P061B	DOW	L	0	48	1000	2	82	
DOW	72	63002	0,75	72DOW63002-0,75	1P1	N	NO	cs	D-72-204	72-P062A	DOW	L	0	48	1000	2	82	
DOW	72	63003	0,75	72DOW63003-0,75	1P1	N	NO	cs	D-72-204	72-P062B	DOW	L	0	48	1000	2	82	

Piping & Instrumentation Diagram (P&ID)



P&IDs legend & symbols

INSTRUMENTS

-  = LOCAL FIELD INSTRUMENT
-  = INSTRUMENT ON PANEL OR HARD CONSOLE IN CENTRAL CONTROL ROOM
-  = INSTRUMENT ON LOCAL PANEL
-  = LOCAL INSTRUMENT FOR MORE THAN ONE FUNCTION
-  = STATION AUTOMATIC CONTROL SYSTEM IN CONTROL ROOM (ACS)

MEASURED VARIABLE INSTRUMENT FUNCTION	ANALYSIS	DENSITY	FLOW	HAND	LEVEL	MOISTURE	PRESSURE
ALARM							
CONTROLLER	AC		FC	HC	LC		PC
CONTROL VALVE	AV		FV	HV	LV		PV
SELF ACTUATED CONTROL VALVE	ACV		FCV	HCV	LCV		PCV
PRIMARY ELEMENT	AE	DE	FE		LE		PE
GLASS			FG		LG		
SWITCH	AS		FS	HS	LS		PS
HIGH SWITCH	ASH		FSH		LSH		PSH
HIGH HIGH SWITCH	ASHH		FSHH		LSHH		PSHH
LOW SWITCH	ASL		FSL		LSL		PSL
LOW LOW SWITCH	ASLL		FSLL		LSLL		PSLL
TRANSMITTER	AT	DT	FT		LT	MT	PT

VALVES

-  = GATE
-  = GLOBE
-  = CHECK
-  = PLUG
-  = BALL
-  = 3-WAY



Line sizing

Service of fluid

CASE

Upstream pressure	bar g	86,7
Temperature	°C	30

VAPOR

Mass flowrate	kg/h	1 401 213,0
MW	kg/kmol	16,5
Z (compressibility)		0,87319
Cp/Cv Ratio		1,2128
Viscosity	cP	0,014
Density	kg/m3	65,756

LINE

Pipe Straight Length	m	
Fittings Total Equiv. Length	m	0,000
Diameter	inch	36
Nominal diameter	DN	900
Internal diameter	mm	870,00
Thickness	mm	22,20
Schedule		30
Material		CARBON
Material designation		
Rugosity (default 45µm)	µm	45

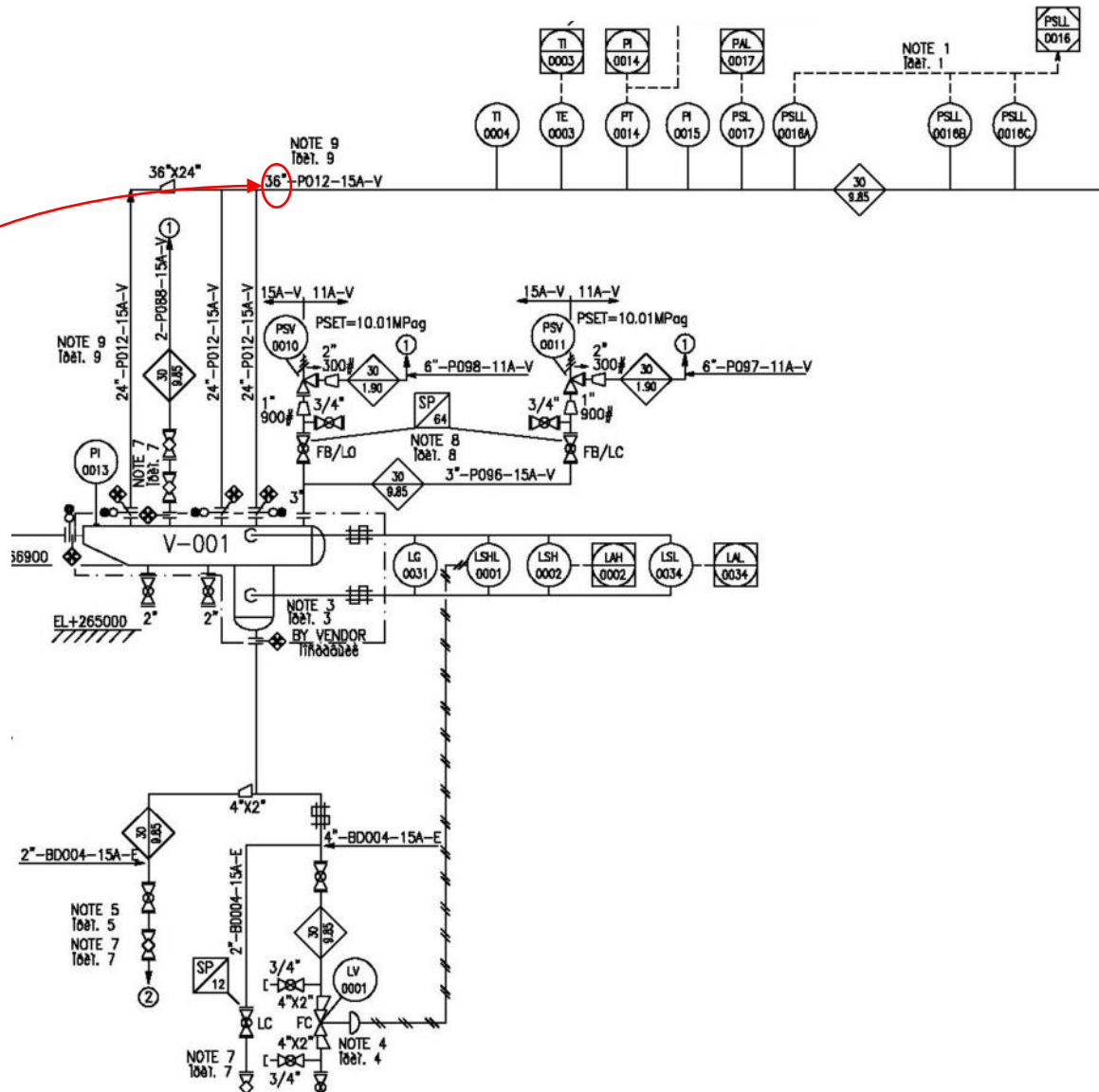
Vapor density	kg/m3	65,76
% vaporised (mass)		100,00
Total mass flow	kg/h	1401213
Total vol. flow	m3/h	21309,28
Fluid density	kg/m3	65,76

Reynolds nbr		4,16E+07
Vapor fictive velocity	m/s	9,96
Liquid fictive velocity	m/s	
Mach nbr (V/VS)		0,02
Velocity	m/s	9,96
$\rho \zeta^2$	Pa	6519,45
$\rho \zeta^3$	kg/s3	64915,59

ΔP	bar/km	0,400
Total Press. Drop	bar	0,000
overdesign		0%

CRITERIA

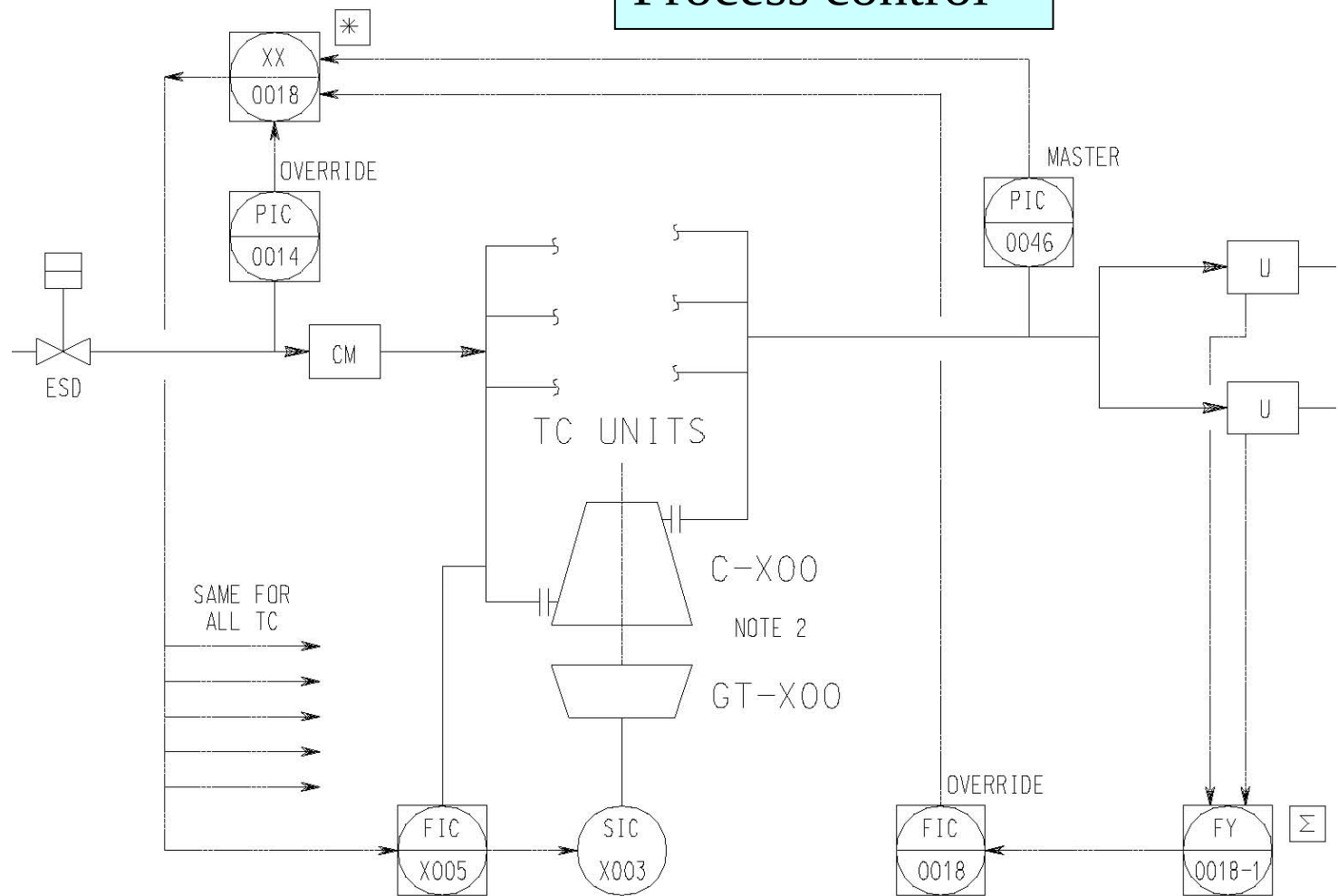
Fittings		NO
Reference		Gas, general P>60 bar g
Correct above diameter of	inch	
Correct below pressure of	bar g	
Max Mach number		
Max rV3 (noise)	kg/s	200000
Max velocity	m/s	15
Max rV2	Pa	15000
Max DP	bar/km	
CHECK		OK





INSTRUMENT TAG No.	DESCRIPTION	VOT ING	SL No.	1	2	3	4
PDSL-8	LOW DIFFERENTIAL PRESSURE (NOTE 3)		1	X			
PDSL-5	LOW DIFFERENTIAL PRESSURE (NOTE 3)		2		X		
LSHL-1	HIGH/LOW LIQUID LEVEL		3			X	
LSH-2	HIGH LIQUID LEVEL		4				X
LSH-4	HIGH LIQUID LEVEL		5				
LSL-5	LOW LIQUID LEVEL		6				
LSHL-33	HIGH/LOW LIQUID LEVEL		7				

	EFFECT	
TAG. No.	DESCRIPTION	ACTION
HSV-1	CS ESD INLET VALVE	PERMISSIVE
SDV-41	PIPELINE SHUTDOWN INLET VALVE	PERMISSIVE
LCV-1	LEVEL CONTROL VALVE	OPEN/CLOSE
LAH-2	HIGH LIQUID LEVEL ALARM	ALARM

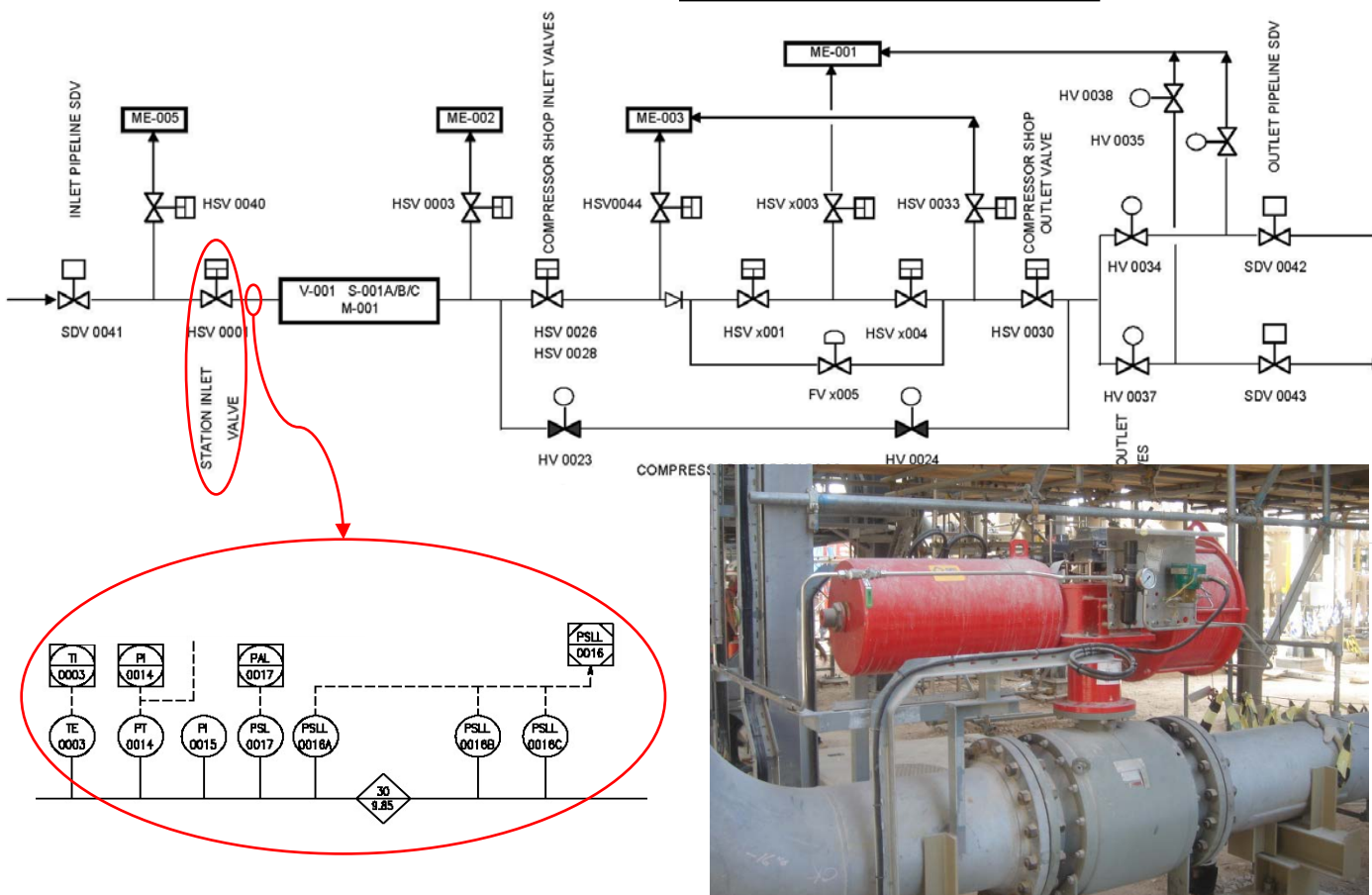


Station Control

Control of the station shall be carried out, manually or automatically, by adjusting the revolutions of the units, controlling the most critical of the following parameters:

- suction gas pressure (override);
- discharge gas pressure (master);
- gas flow rate (override).

Process safety

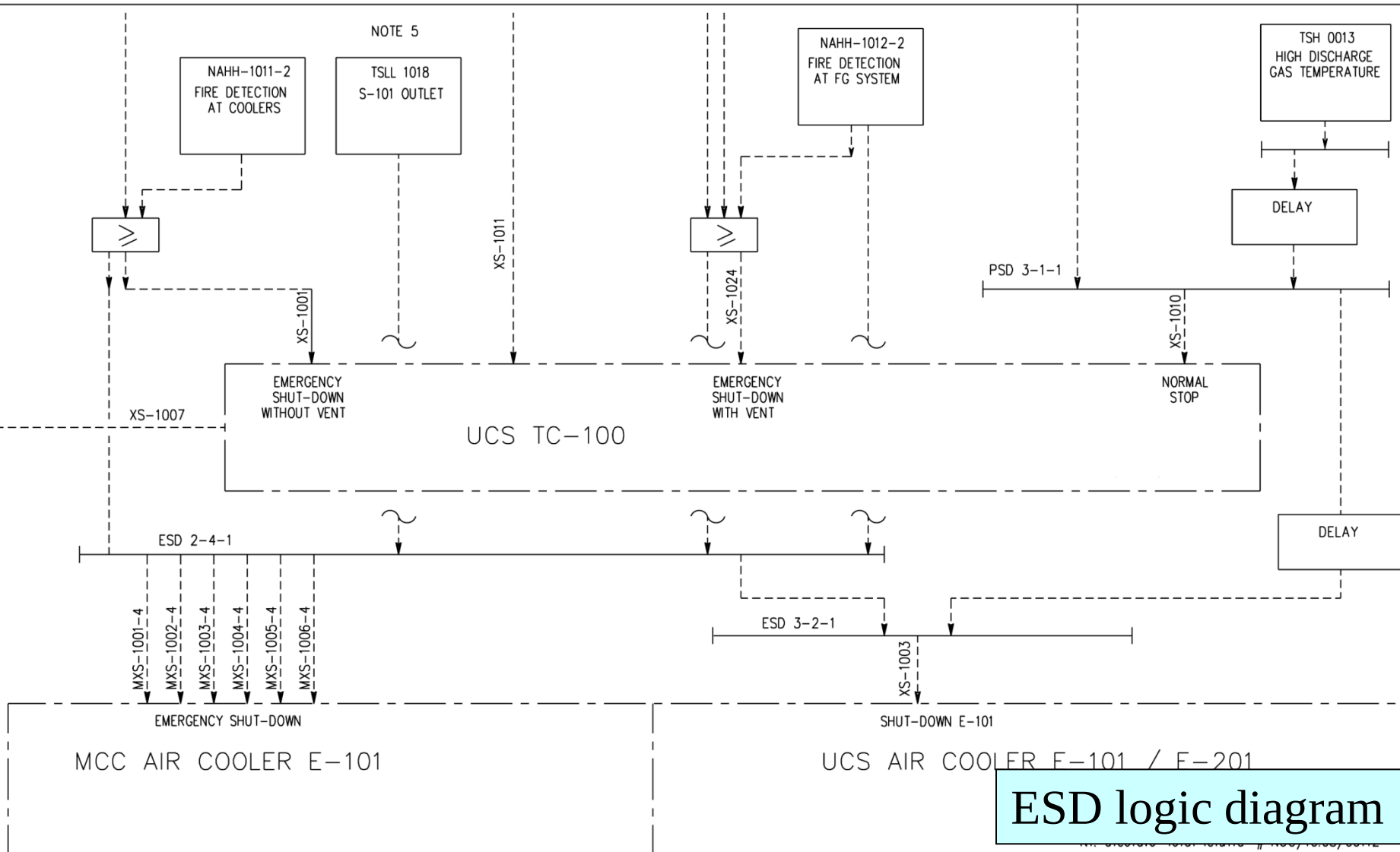


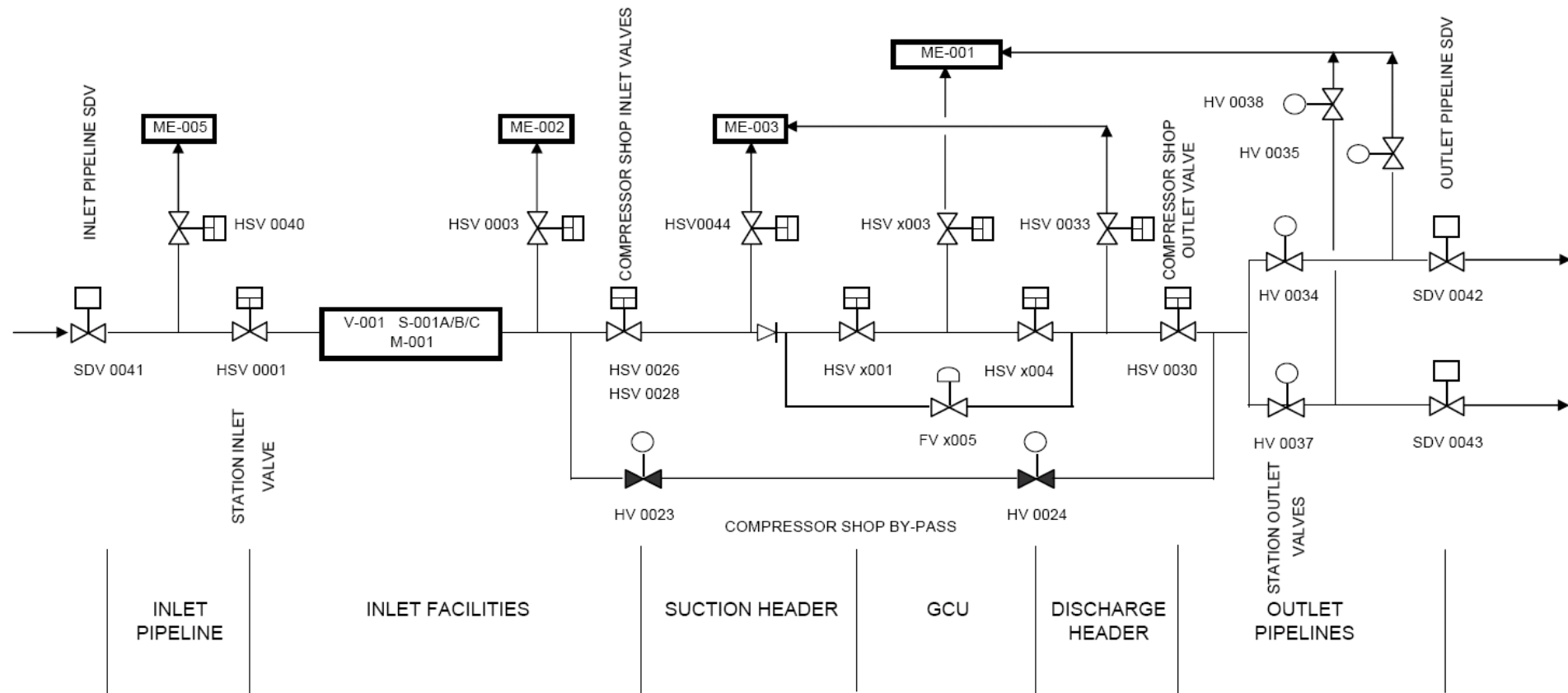
EFFECT

TAG. No.	DESCRIPTION	ACTION
SDV-41	PIPELINE SHUTDOWN INLET VALVE	CLOSE
SDV-42	PIPELINE SHUTDOWN OUTLET VALVE	CLOSE
SDV-43	PIPELINE SHUTDOWN OUTLET VALVE	CLOSE
HSV-1	CS ESD INLET VALVE (NOTE 7)	CLOSE
HSV-3	INLET FACILITIES VENT VALVE (NOTE 3)	OPEN
HSV-26	SUCTION HEADER ESD INLET VALVE	CLOSE

CAUSE

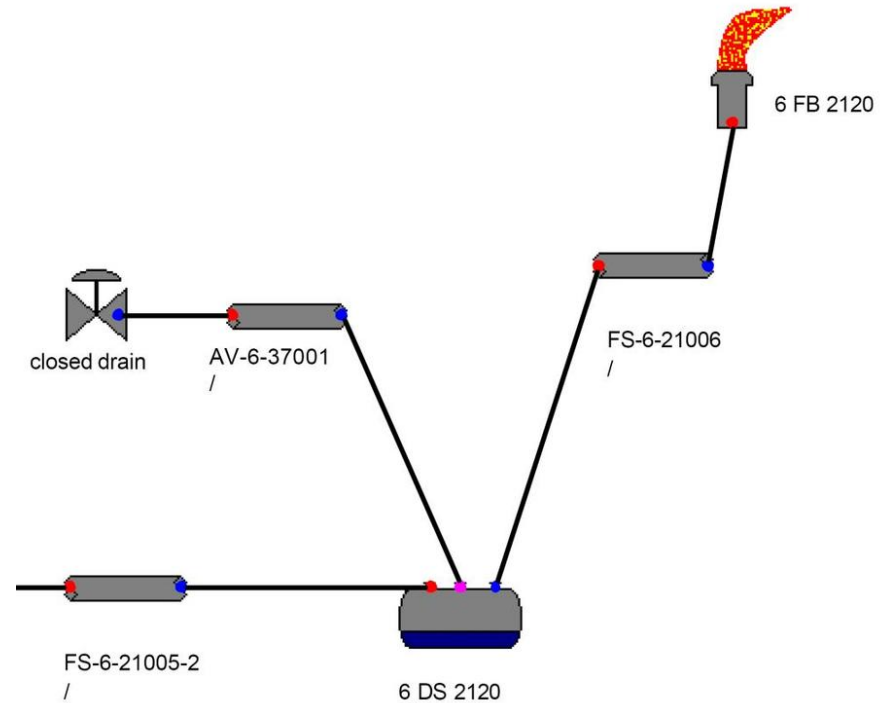
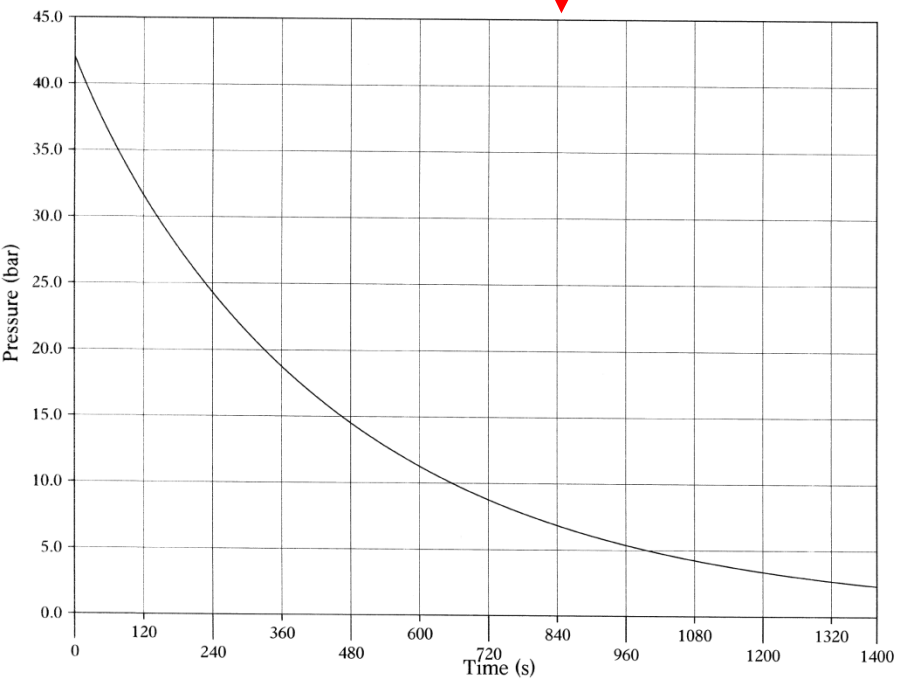
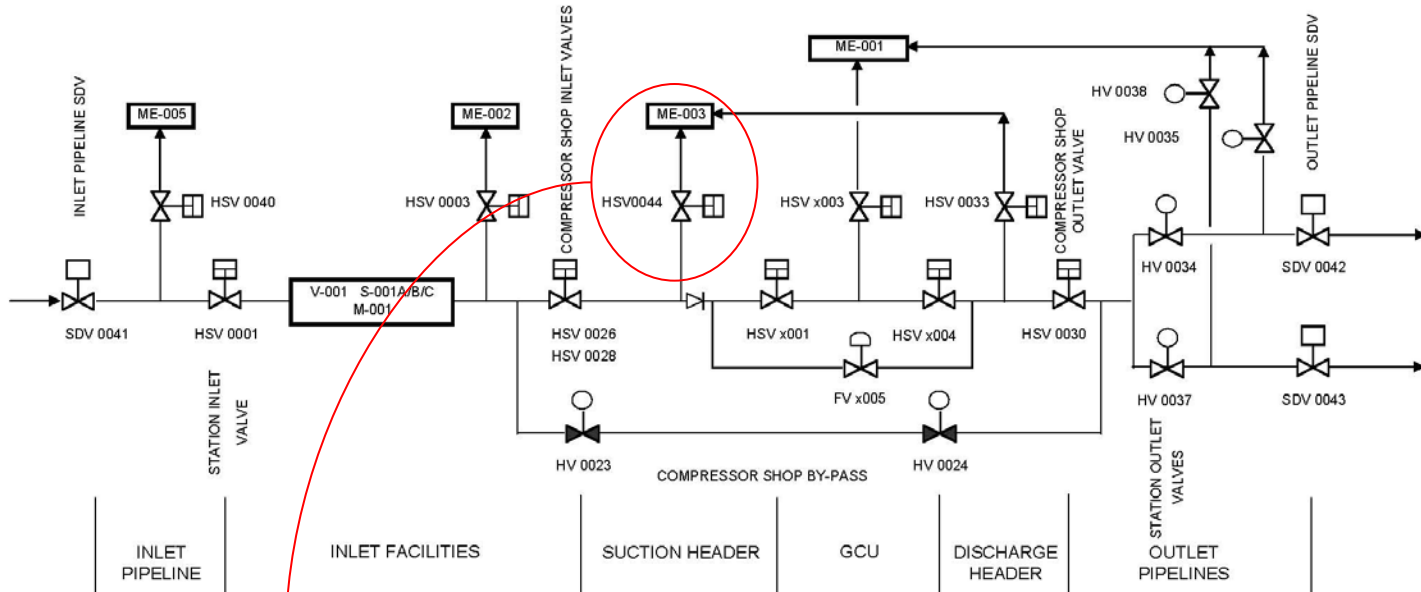
INSTRUMENT TAG No.	DESCRIPTION	VOT ING	SL No.	1	2	3	4	5	6	7	8
LSHH-22	HIGH HIGH LEVEL IN FILTER SEPARATORS		23				X				X
LSHH-26	HIGH HIGH LEVEL IN FILTER SEPARATORS		24				X				X
PSLL-16A/B/C	LOW LOW SUCTION GAS PRESSURE	YES	26				X				X
PSL-17	LOW SUCTION GAS PRESSURE		27								



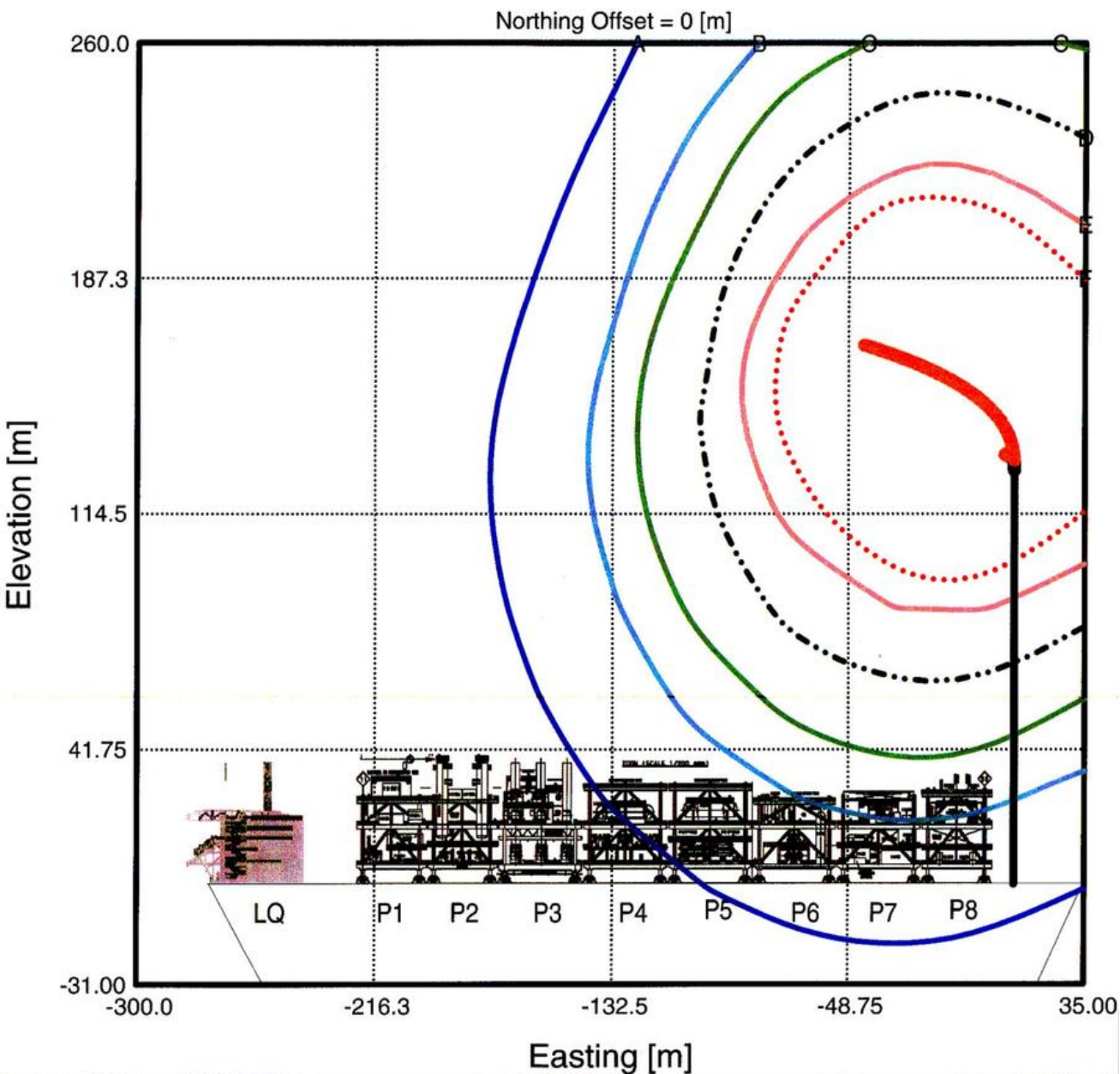


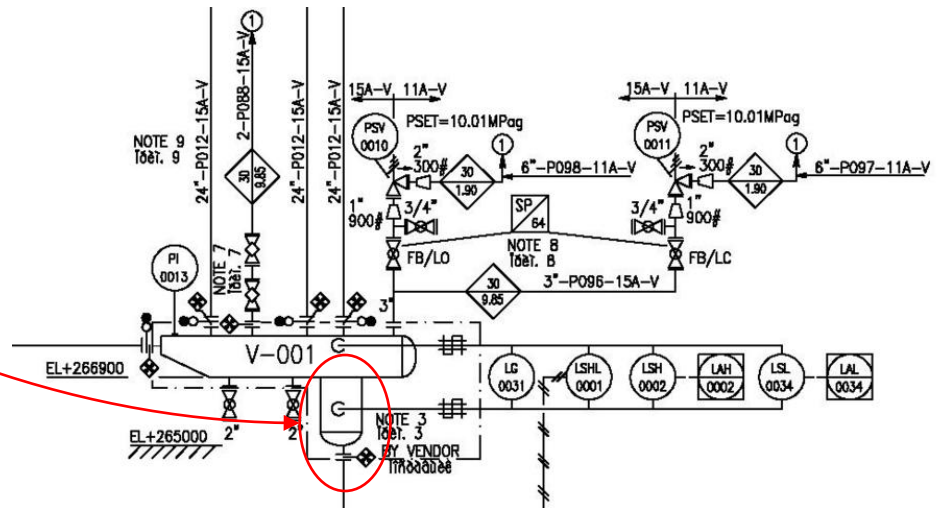
ESD simplified diagram

Flare Report

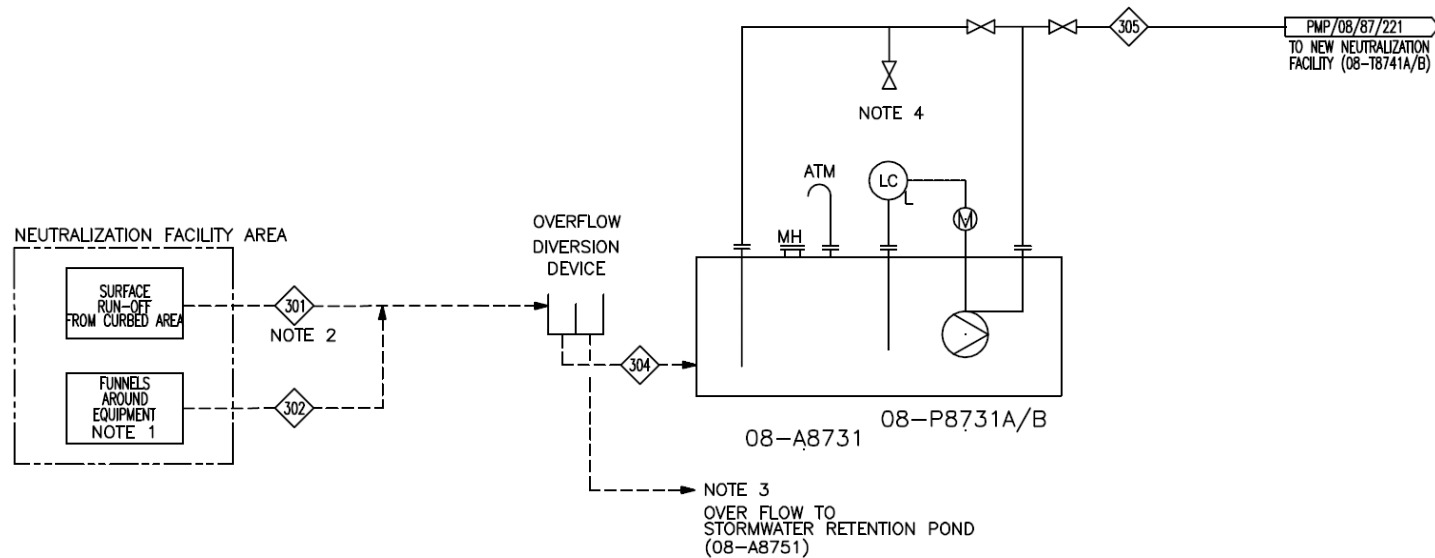


Radiation Isopleth - W/m2





Quiz: Is this a P&ID? a PFD?



Engineering

- Process

- Equipment

- HSE

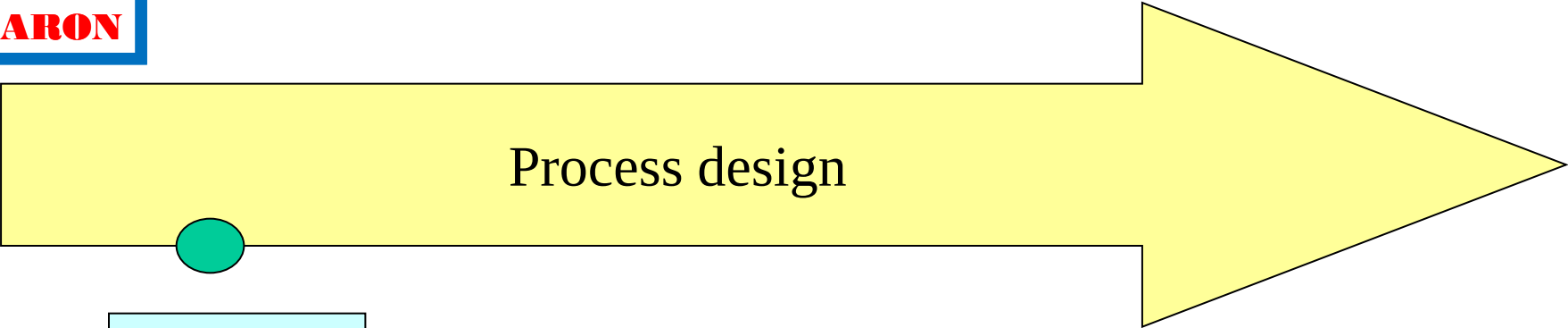
- Civil

- Layout

- Piping

- Instrumentation

- Electrical



Process design

PFDs

H&M balance

*Process
data
sheet*

*Equipment
specification*

Rotating
Pressure vessels
Fired equipment
Heat exchangers
Packages etc.

Equipment list

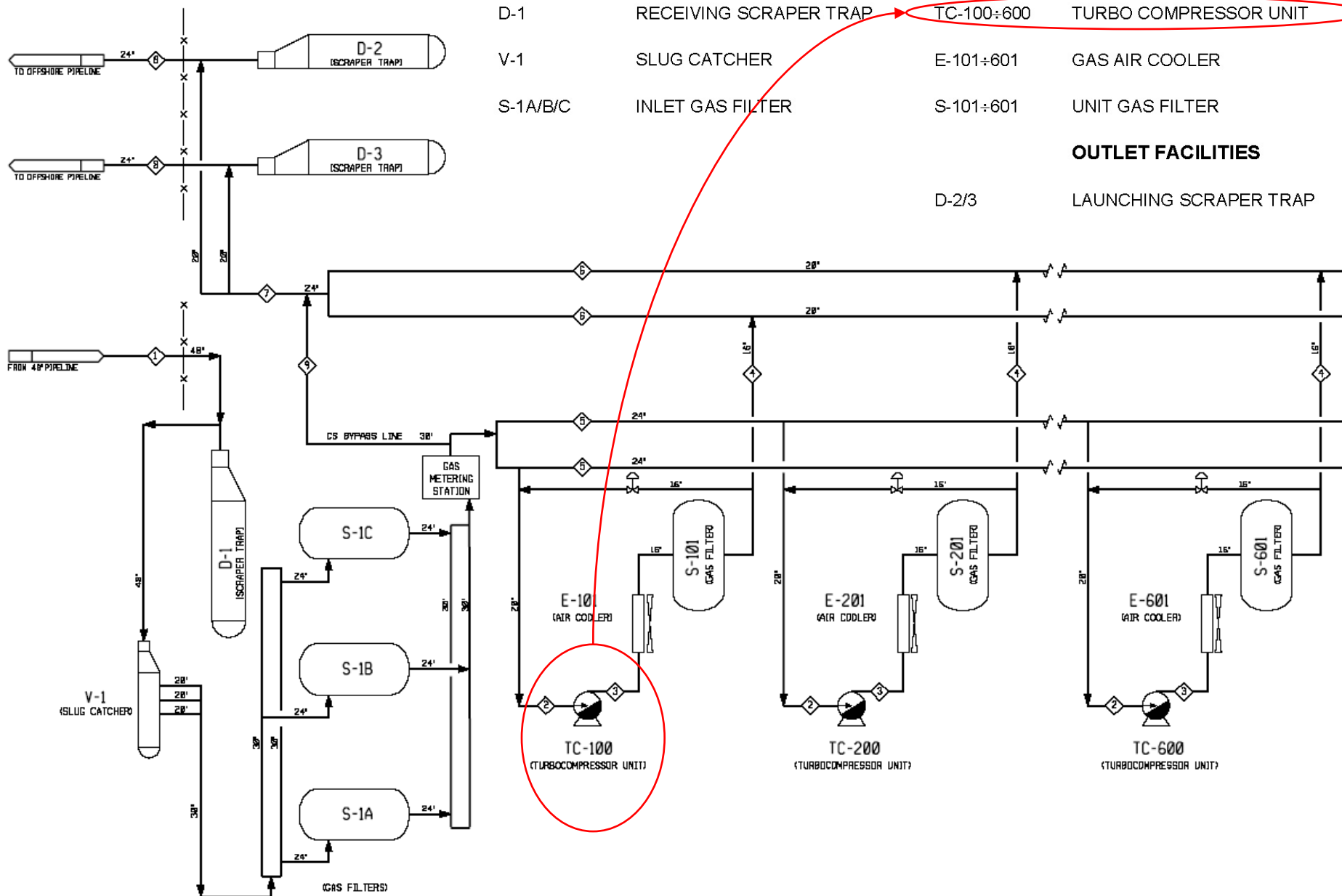
INLET FACILITIES

GAS COMPRESSION SYSTEM

D-1	RECEIVING SCRAPER TRAP	TC-100÷600	TURBO COMPRESSOR UNIT
V-1	SLUG CATCHER	E-101÷601	GAS AIR COOLER
S-1A/B/C	INLET GAS FILTER	S-101÷601	UNIT GAS FILTER

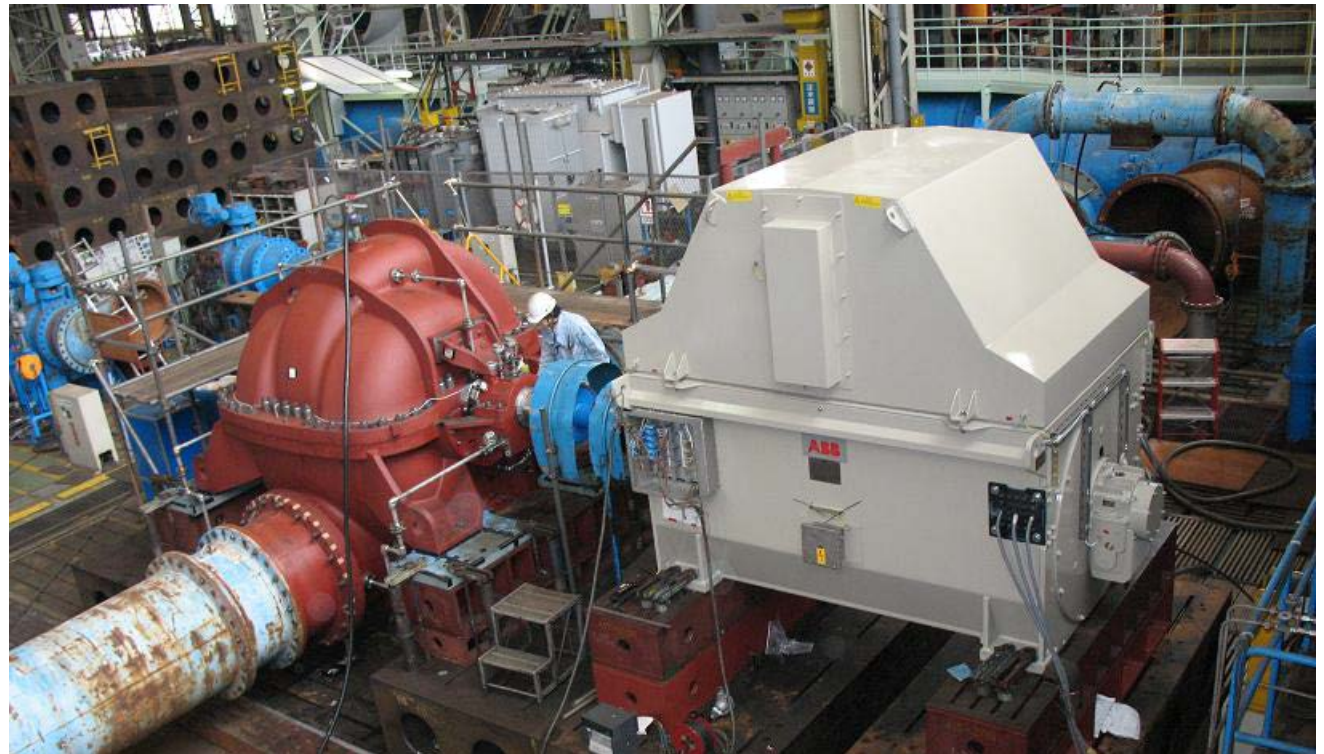
OUTLET FACILITIES

D-2/3	LAUNCHING SCRAPER TRAP
-------	------------------------





Rotating machinery



Pressure vessels





Packages

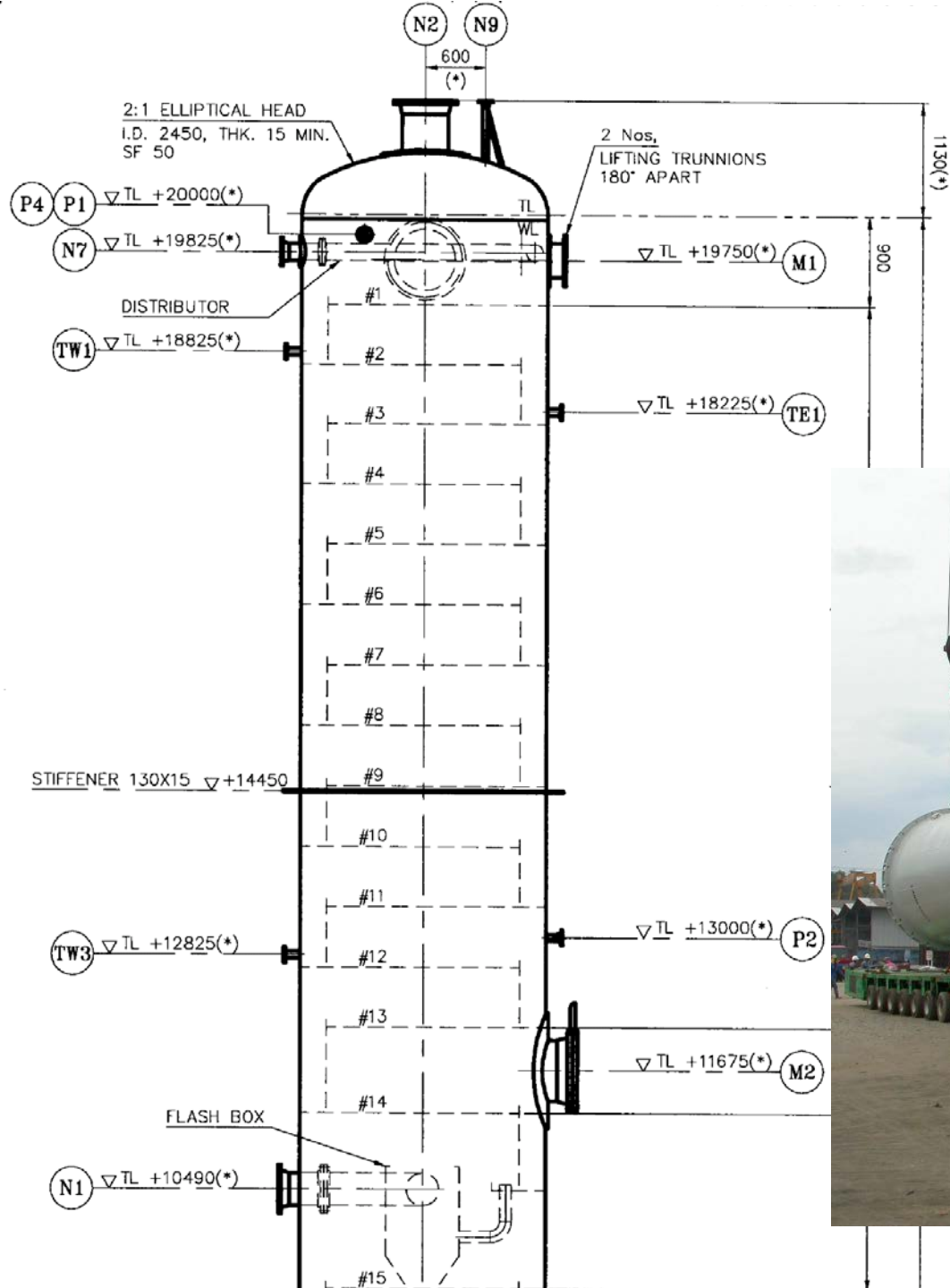


SERVICE :		NATURAL GAS COMPRESSOR	
NOMBRE REQUIS / NUMBER REQUIRED		TOTAL / TOTAL :	6 RUNNING
OPERATION : CONTINUE / CONTINUOUS		X	
PROPRIETES DU FLUIDE / FLUID PROPERTIES			
CAS DE MARCHE / RUNNING CASE		mas.mol	DESIGN CASE
FLUIDE/FLUID	COMPOSANTS / COMPOUNDS	MW	
	MOLAR PERCENT		
COMPONENT	DESIGN	ALTERNATIVE	
Methane CH4	97,528	97,721	
Ethane (C2H6)	0,880	0,095	
Propane (C3H8)	0,140	0,025	
I-Butane (C4H10)	0,015	0,005	
N-Butane (C4H10)	0,025	0,005	
I-Pentane (C5H12)	0,018	0,045	
N-Pentane (C5H12)	0,020	0,050	
Hexane (C6H14)	0,022	0,000	
Heptane + (C7H16)	0,013		
Nitrogen (N2)	0,930	1,746	
Carbon Dioxide (CO2)	0,410	0,290	
Oxygen (O2)	Nil	Nil	
COMPRESS. (Z)/COMPRESSIBILITY ASP/REF / SUCT/DISCH		0.876/1.013	
Cp/Cv ASP/REFOULEMENT / SUCTION/DISCHARGE		1.582/1.485	
TOXIQUE/TOXIC		FLAMMABLE X	
CORROSIF / EROSIF, A CAUSE DE / CORROSIVE / EROSIVE, BECAUSE OF :			
DONNEES DE FONCTIONNEMENT / OPERATING CONDITIONS			
ASPIRATION / SUCTION	PRESSION ABS / ABS. PRESS	MPa(a)	8,52
	TEMPERATURE	°C	30
	MASSE VOLUMIQUE / DENSITY	kg/m³	63,97
	DEBIT VOL. / FLOWRATE VOL		
	NORMAL	m³/s	-
	CALCUL / DESIGN	m³/s	5,99
	DEBIT MASSIQUE, NORMAL	kg/s	383,03
	MASS FLOW, NORMAL		
	TEMPERATURE MAXI SERVICE	°C	note 7
	MAX OPERATING TEMP.		
PRESSION ABSOLUE MAXI	MPa(a)		
ABSOLUTE PRESSURE MAXI			
REFOULT : PRESSION ABS / DISCH. ABS PRESS		MPa(a)	25,5
REGULATION DE DEBIT / FLOW VARIATION		%	

Process data
sheet

Mechanical
data sheet

LOCATION: (2.1.8)		-	
X INDOOR	X HEATED		UNDER ROOF
			PARTIAL SIDES
X OUTDOOR			
X GRADE	MEZZANINE		
X ELEC. AREA CLASSIFICATION (2.1.14)	II A T3		
CL		GR	DIV
	WINTERIZATION REQD.(2.1.8)		
	TROPICALIZATION REQD.(3.4.6.6)		
SITE DATA:			
X ELEVATION (m):	270 m		
BAROMETER (Bar abs):	-		
X RANGE OF AMBIENT TEMPS (°C):	-19/42		
NOISE SPECIFICATIONS: (2.1.9)			
X APPLICABLE TO MACHINE:	95dBA inside, 80dBA outside building		
ACOUSTIC HOUSING:	YES	X	NO
APPLICABLE SPECIFICATIONS:			
API 617, CENTRIFUGAL COMPR. FOR GEN. REFINERY SERV.			
CONSTRUCTION FEATURES			
TYPE FABRICATION		WELDED	
MATERIAL		ASTM A 182F22	
MAX. YIELD STRENGTH (N)		>310 N/mm²	
BRINNEL HARDNESS: MAX./MIN.		207 /	
X SHAFT:	-		
MATERIAL		40 NiCrMo7 (equivalent to AISI 4340)	
DIA. @ IMPELLER (mm)		163 / 182	
DIA. @ COUPLING (mm)		120	
SHAFT END:	X TAPERED		CYLINDRICAL
MAX. YELD STRENGTH (BAR)		7350	
SHAFT HARDNESS (BNH) (Rc)		<=270 HB	
STRESS AT COUPLING (BAR)		-	
PAINTING:			
X MANUFACTURER'S STD.			
OTHER:	SUBJECT TO CLIENT APPROVAL		
SHAFT SEALS:			
X SEAL TYPE (2.8.3)	DRY GAS SEALS		
X SETTling OUT PRESSURE (BARG)	153,7		
SPECIAL OPERATION (2.8.1)	-		
SUPPLEMENTAL DEVICE REQUIRED FOR CONTACT			
SEALS (2.8.3.2)		TYPE:	
X BUFFER GAS SYSTEM REQUIRED (2.8.7)			
X TYPE BUFFER GAS	COMPRESSED AIR		



Vessel guide drawing



Material Requisition

1. LIST OF MATERIALS

ITEM	QUANTITY	TAG N°	DESIGNATION
1	6	TC100/TC200 TC300/TC400 TC500/TC600	TURBO COMPRESSORS
2	1		SET OF STAR-UP & COMMISSIONING SPARE PARTS FOR ITEM1
3	1		SET OF SPECIAL TOOLS FOR ITEM1
4	1		

2. APPLICABLE DOCUMENTS

DOCUMENTS

NUMBER*

REV

2.1. PROJECT GENERAL SPECIFICATIONS

Technical Specification Centrifugal Compressor
Data Sheets Centrifugal Compressor
Data Sheets Gas Turbine
General spec. for L.V. Switchboards for Packaged Unit
Data Sheet for Turbocompressor MCC
Turbocompressor Fuel Gas Functional Specification
Procedure of Acceptance Turbo compressors

J-7-30001 (MA-E-30001) Rev. 2
J-8-30101 (MA-E-30101) Rev. 2
J-8-30102 (MA-E-30101) Rev. 1
E-7-40011 (EA-E-40011) Rev. A
E-8-40044 (EA-E-40044) Rev. 3
P-7-08071 (ZA-E-08071) Rev. 4

3. QA PROGRAM STANDARD AND INSPECTION REQUIREMENTS FOR VENDORS

ITEM DESCRIPTION : TURBO COMPRESSORS TC 100/TC 200/TC 300/TC 400/TC 500/TC 600

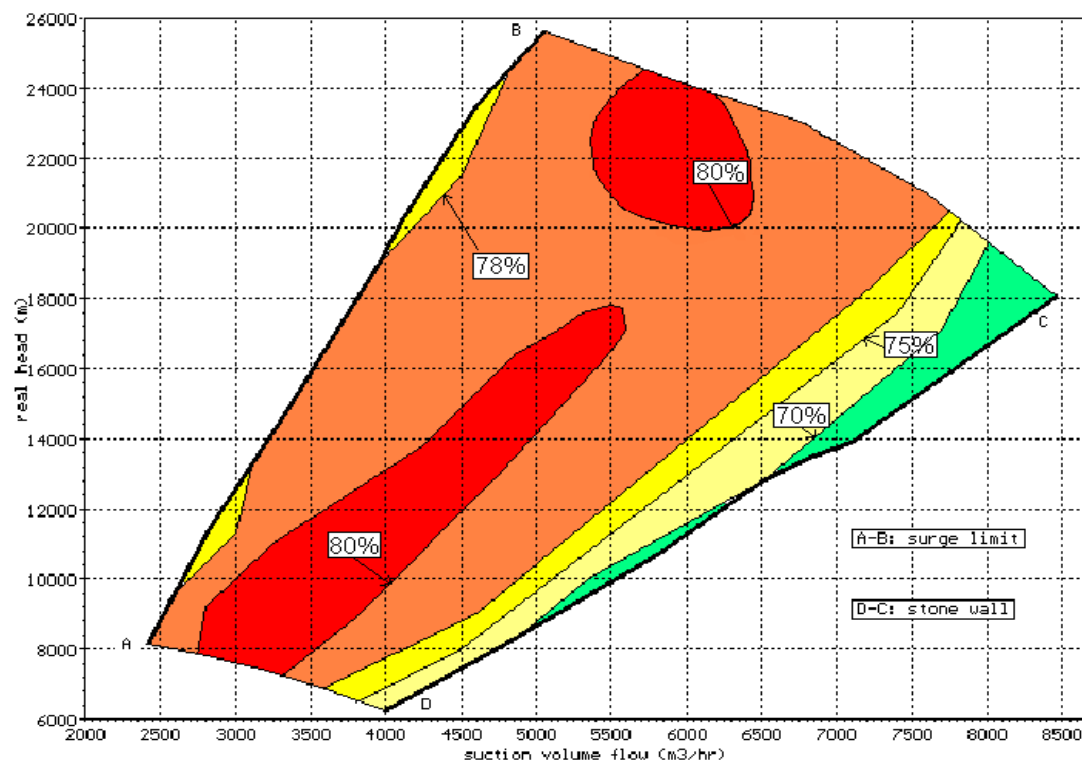
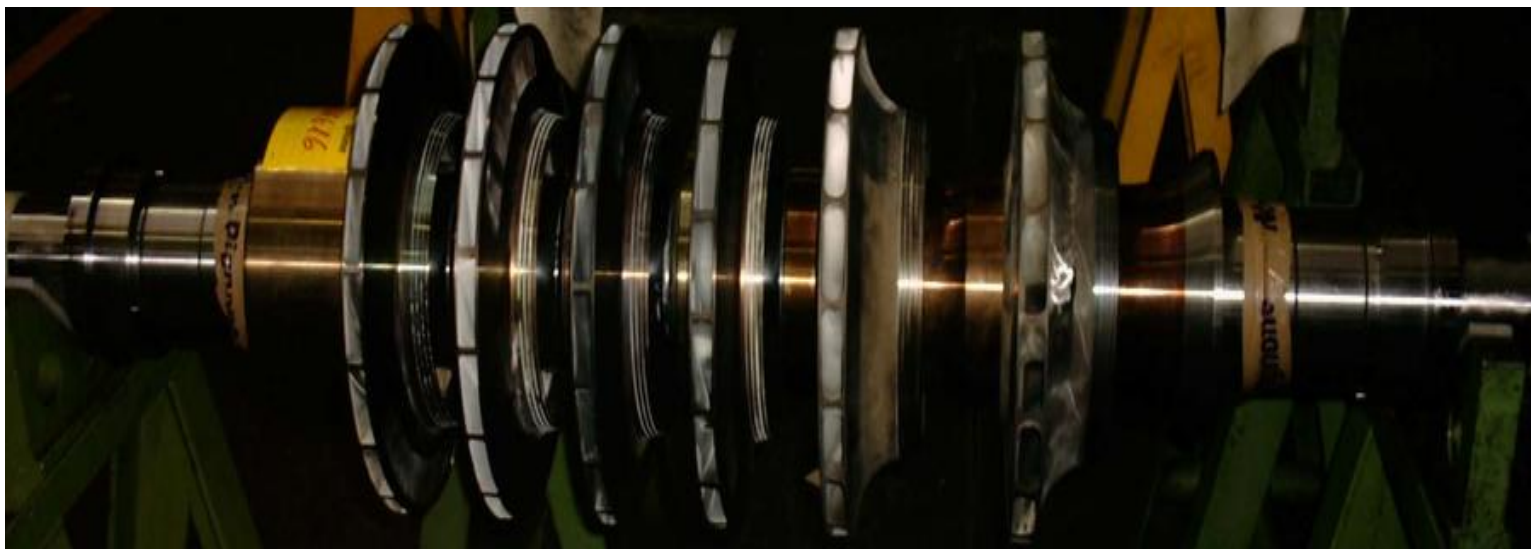
QA PROGRAM

THE FOLLOWING QUALITY ASSURANCE PROGRAM (QA PROGRAM) SHALL BE IMPLEMENTED AND DOCUMENTED IF THE BIDDER IS AWARD

ISO	9001	{ X }
ISO	9002	{ }
ISO	9003	{ }
NONE		{ }

4. SUPPLIER'S DOCUMENTS – REQUIREMENT SCHEDULE

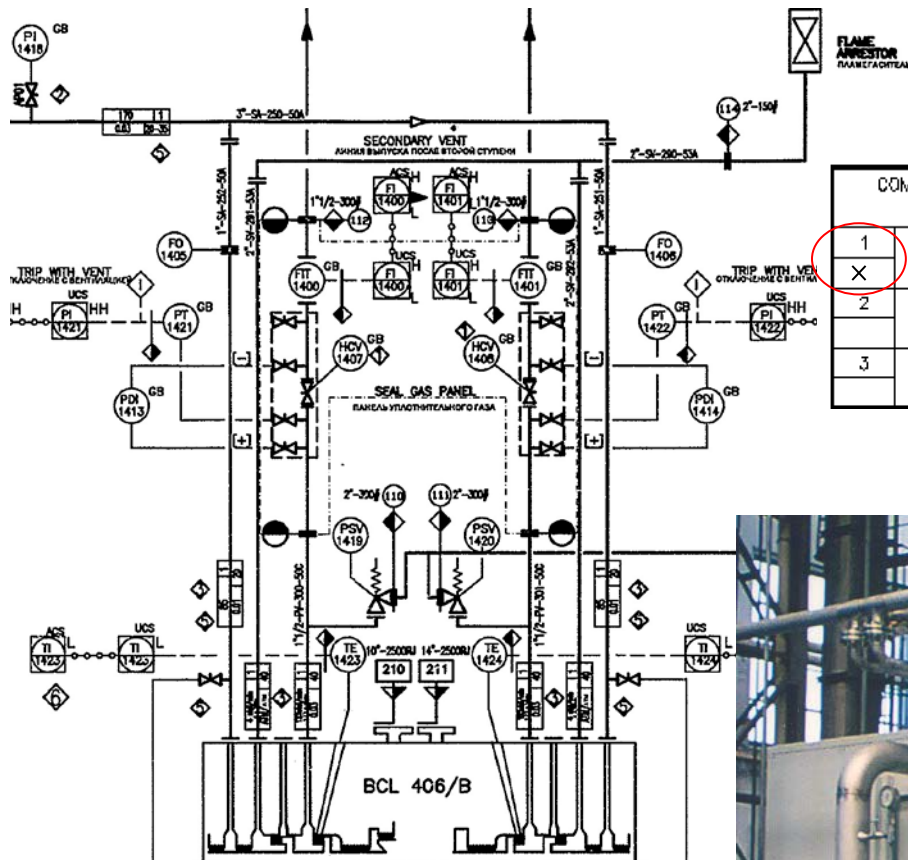
4.2. PROCESS AND PERFORMANCE DOCUMENTS							
TURBO COMPRESSOR		0	1	2	3	4	5
1	DIMENSIONAL OUTLINE DRAWINGS OF TURBOCOMPRESSOR SET*	A		B	C	D	E
2	GENERAL ARRANGEMENT DWG OF TURBOCOMPRESSOR BUILDING WITH INSIDE AND OUTSIDE INSTALLATIONS*	A		B	C	D	E
3	AIR INLET AND EXHAUST SYSTEMS ARRANGEMENT DRAWINGS*	A		B	C	D	E
4	LUBE OIL AIR COOLER ARRANGEMENT DRAWINGS*	A		B	C	D	E
5	TURBOCOMPRESSOR SET FOUNDATION PLAN WITH STATIC AND DYNAMIC LOADS*	A		B	C	D	E
6	FOUNDATION PLAN WITH STATIC AND DYNAMIC LOADS FOR TURBOCOMPRESSOR BUILDING AND OTHER AUX. EQUIPMENT	A		B	C	D	E
7	CUSTOMER MECHANICAL CONNECTIONS LIST AND PLAN WITH MAX. ALLOWABLE LOADS*			B	C	D	



Bid technical evaluation

SUPPLIER ABB GO 132.1625 REV1 STAL + AMENDUM 1			2007 POINT A	DRESSER	DEMAG	THERMODYN	mitsubishi
2.175	Rated Power at Rated Speed	Kw					
2.176	Fuel Consumption at Oper. Power						
2.177	Turbine Efficiency	%					
2.178	Power Margin	%					
2.179	GG and PT Exhaust Temperature	°C					
2.180	Site Temperature and Elevation	°C - m a.s.l.					
2.181	Max Continuous Power at Site	Kw					
2.182							
2.183	Operating Condition YEAR 2007 (A)						
2.184	Inlet Capacity (20°C; 1.013 bar a.)	m3/h	501750	(X)470833		(X)453435	(X)451845
2.185	Suction Pressure	Bar a	85.2	85.2		85.2	85.2
2.186	Suction Temperature	°C		27		27.25	27.2
2.187	Discharge Pressure	Bar a	251	251		250.987	251
2.188	Discharge Temperature	°C		129.96		132.84	133.9
2.189	Polytropic Head	KJ/Kg					
2.190	Polytropic Efficiency	%		80.25		77.60	79
2.191	Absorbed Power at PT. SHAFT	Kw		19882		19890	19795
2.192	Capacity / Capacity at surge Limit	%					
2.193	Speed	Rpm		7672		7706	7478
2.194	N° of Operation Units plus Spare		4+2	4+2		4+2	4+2
2.195	Rated Speed	Rpm					
2.196	Rated Power at Rated Speed	Kw					
2.197	Fuel Consumption at Oper. Power	KJ/Kw.h		10800		10800	10800
2.198	Turbine Efficiency	%					
2.199	Power Margin	%		108.2		108.15	108.67
2.200	GG and PT Exhaust Temperature	°C					
2.201	Site Temperature and Elevation	°C - m a.s.l.					
2.202	Max Continuous Power at Site	Kw		21512		21512	21512
2.203							
2.204	Operating Condition YEAR 2007 (B)						
2.205	Inlet Capacity (20°C; 1.013 bar a.)	m3/h	501750				
2.206	Suction Pressure	Bar a	85.2				
2.207	Suction Temperature	°C					
2.208	Discharge Pressure	Bar a	236.4				
2.209	Discharge Temperature	°C					
2.210	Polytropic Head	KJ/Kg					
2.211	Polytropic Efficiency	%					

Vendor design



COMMENT STATUS: THE APPROVAL OF THIS DOCUMENT DOES NOT RELIEVE THE SUPPLIER OF ITS CONTRACTUAL RESPONSIBILITIES

1

X

2

3

NO COMMENT OR FORMAL COMMENTS
PROCEED WITH FABRICATION, RESUBMIT WITH UPPER REVISION STAMPED
APPROVED FOR CONSTRUCTION
APPROVED AS NOTED
PROCEED WITH FABRICATION IN ACCORDANCE WITH COMMENTS
RESUBMIT CORRECTED DOCUMENTS FOR APPROVAL WITH UPPER REVISION
DISAPPROVED
DO NOT FABRICATE, RESUBMIT CORRECTED DOCUMENT FOR APPROVAL WITH UPPER REVISION

4

FOR INFORMATION

REFERENCE ONLY.

5

FINAL DOCUMENT

CHECKED BY:

DATE:



Equipment summary



Engineering

- Process

- Equipment

- **HSE**

- Civil

- Layout

- Piping

- Instrumentation

- Electrical

HAZOP Review

- [1] Several/Continuous: more than 1 per year
 [2] Single: once between 1 and 10 years
 [3] Likely: once between 10 and 100 years
 [4] Unlikely: once between 100 and 1000 yrs
 [5] Very unlikely: less than once in 1000 yr

RISK MATRIX

F5	I	I	L	L	L
F4	H	I	L	L	L
F3	H	H	I	L	L
F2	H	H	I	L	L
F1	H	H	H	I	L
	S1	S2	S3	S4	S5

RISK LEVEL

FREQUENCY

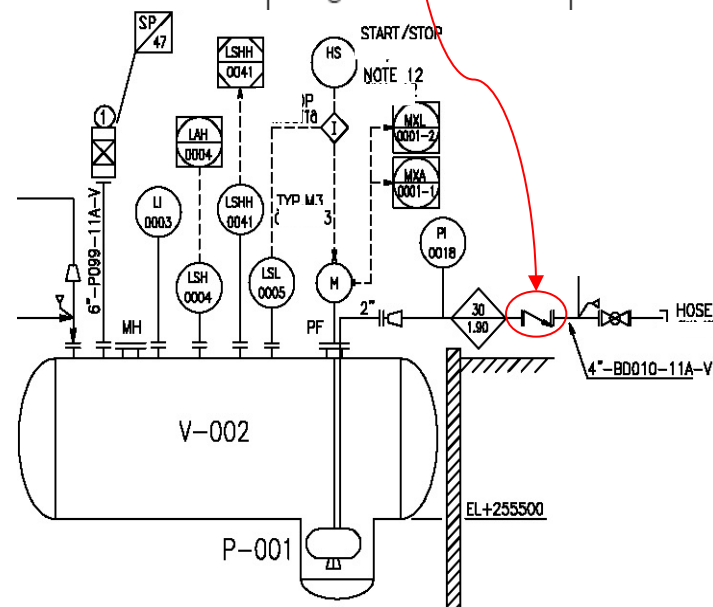
SEVERITY

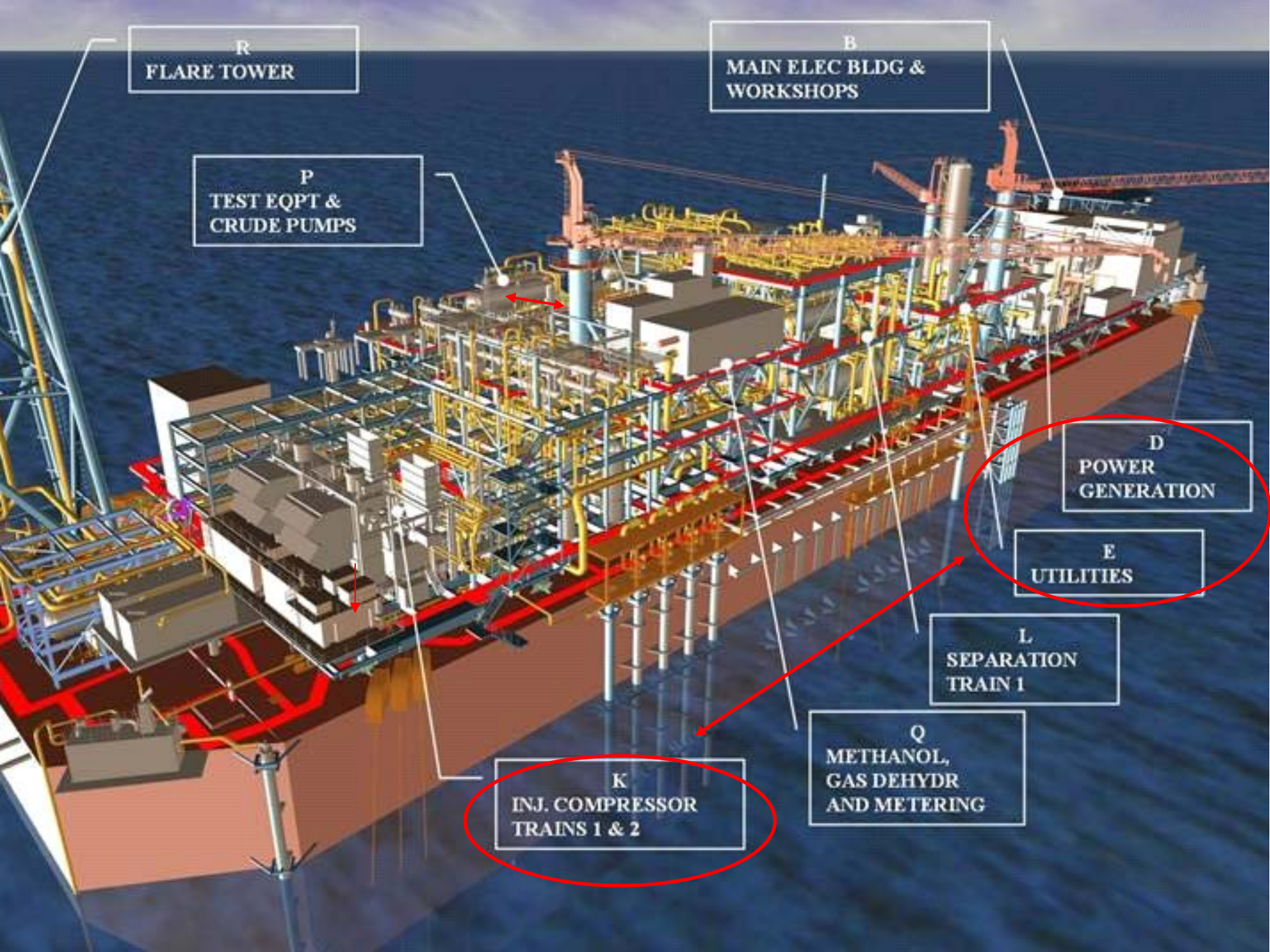
HAZARD CATEGORY

	1 Major	2 Significant	3 Moderate	4 Minor	5 Negligible
1 Personnel	Multiple Fatalities	Single Fatality	Severe injury	Lost Time injury	No Significant Effect
2 Property Damage/ Business Interruption	Major	Significant	Moderate	Minor	Negligible
3 Environmental	Significant/ Long Term	Significant / Short Term	Minor/ Long Term	Minor/ Short Term	No Measurable Effect

DEVIATION	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION
1 9 5	Flow Reverse	2. Reverse flow through the spare pump. Potential polymerization and fouling in the debutanizer T-601 and E-602A/B. Freq: [5] Ctgy: [1] [2] [3] Svrty: [5] [3] [4] Risk: [L] [L] [L]	Operating instructions. Pump technology (positive displacement pump).	No further action required, existing safeguards considered adequate.
1 9 6	Flow Reverse	3. Tank refilling.	Potential nitrogen back-flow through the filling line.	Ensure there is a non-return device either on the tank side hose connection or on the tank TK-542 filling line.

HAZOP Action sheet





R
FLARE TOWER

This is a 3D perspective rendering of an offshore oil platform. The platform is a large, rectangular structure with multiple decks. It is densely packed with yellow and blue piping, structural steel, and various industrial equipment. At the top, there are several tall, thin towers and cranes. The platform is situated in the middle of a dark blue ocean. Several white boxes with black text labels are connected to different parts of the platform by thin white lines. Some of these labels are circled in red. The labels include: 'R FLARE TOWER' (top left), 'B MAIN ELEC BLDG & WORKSHOPS' (top right), 'P TEST EQPT & CRUDE PUMPS' (middle left), 'D POWER GENERATION' (middle right, circled), 'E UTILITIES' (bottom right, circled), 'L SEPARATION TRAIN 1' (bottom right), 'Q METHANOL, GAS DEHYDR AND METERING' (bottom right), and 'K INJ. COMPRESSOR TRAINS 1 & 2' (bottom center, circled). A red double-headed arrow is visible on the upper deck, and a red arrow points from the 'E UTILITIES' area towards the 'L SEPARATION TRAIN 1' area.

B
MAIN ELEC BLDG &
WORKSHOPS

P
TEST EQPT &
CRUDE PUMPS

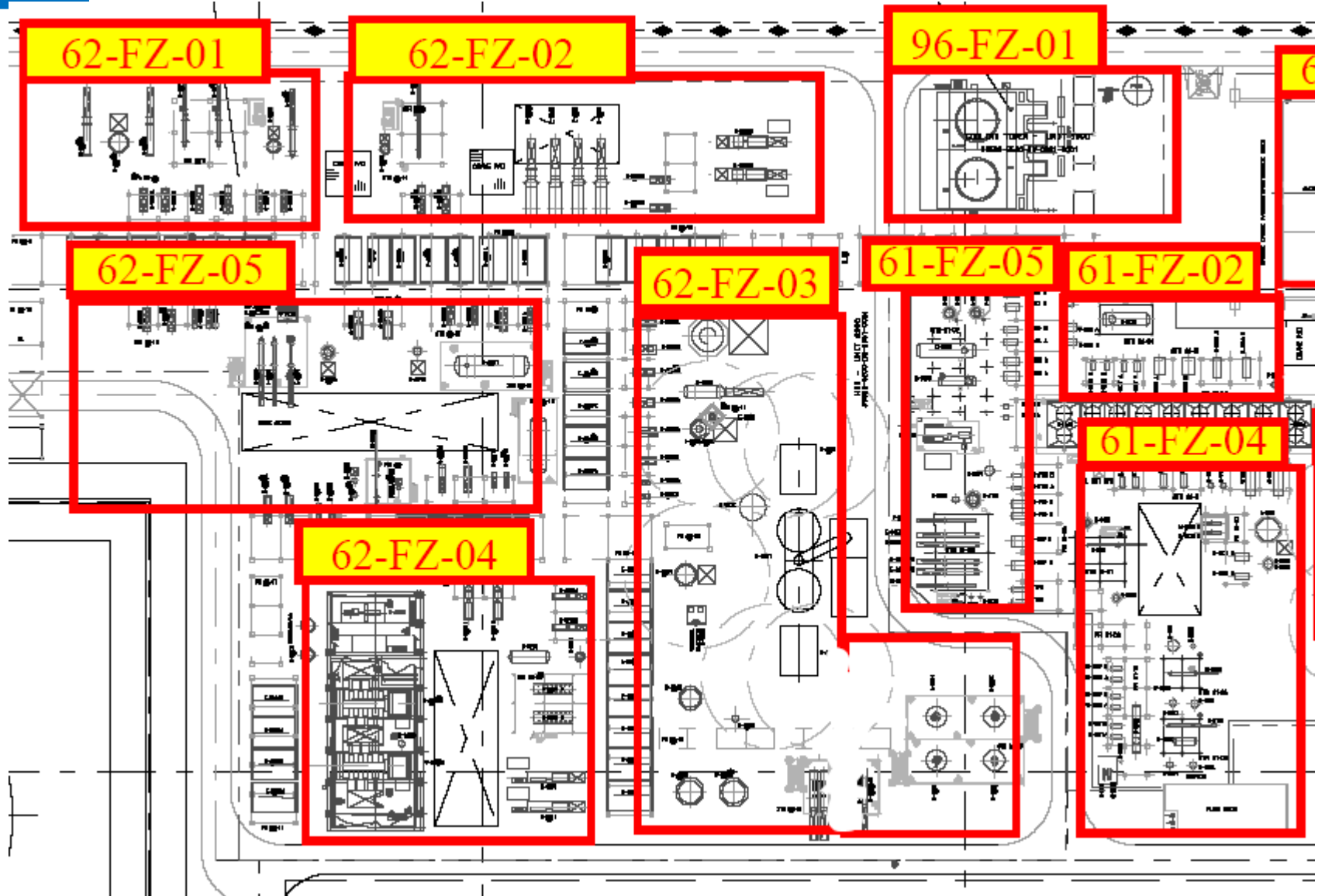
D
POWER
GENERATION

E
UTILITIES

L
SEPARATION
TRAIN 1

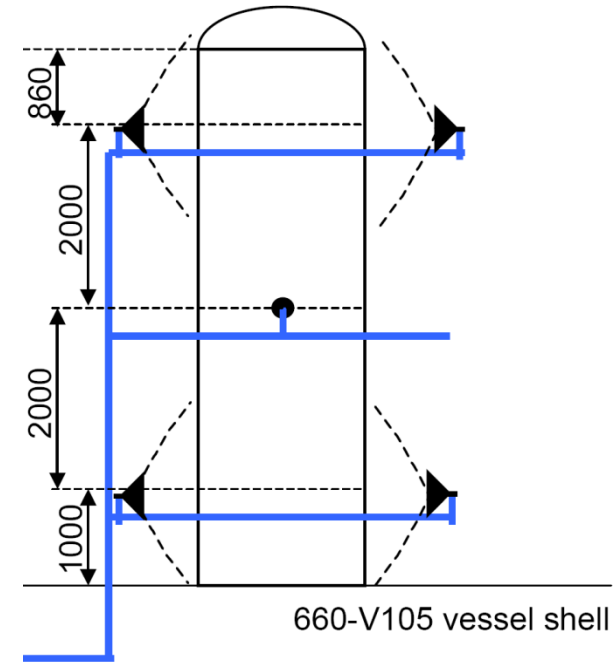
K
INJ. COMPRESSOR
TRAINS 1 & 2

Q
METHANOL,
GAS DEHYDR
AND METERING





Fire Water demand calculation note



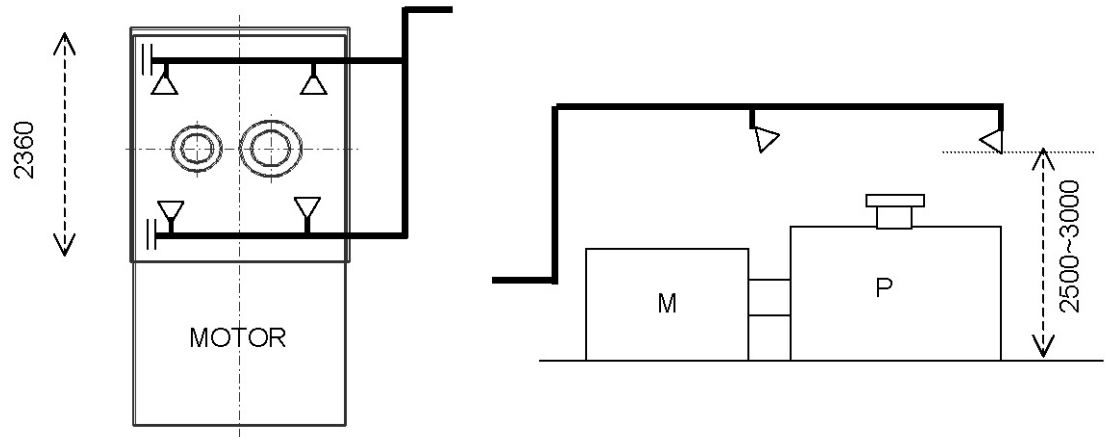
Item	Calculated flow rate
Maximum flowrate for spray and deluge system	141 m ³ /h
Flowrate for monitors (2)	228 m ³ /h
Flowrate for hoses (2)	114 m ³ /h
BOG booster compressor area total firewater demand	483 m³/h



Deluge system arrangement drawings



Nozzle Arrangement



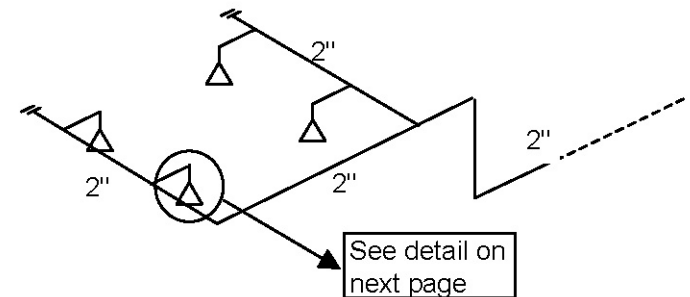
Piping arrangement

(This typical is applicable for each pump)

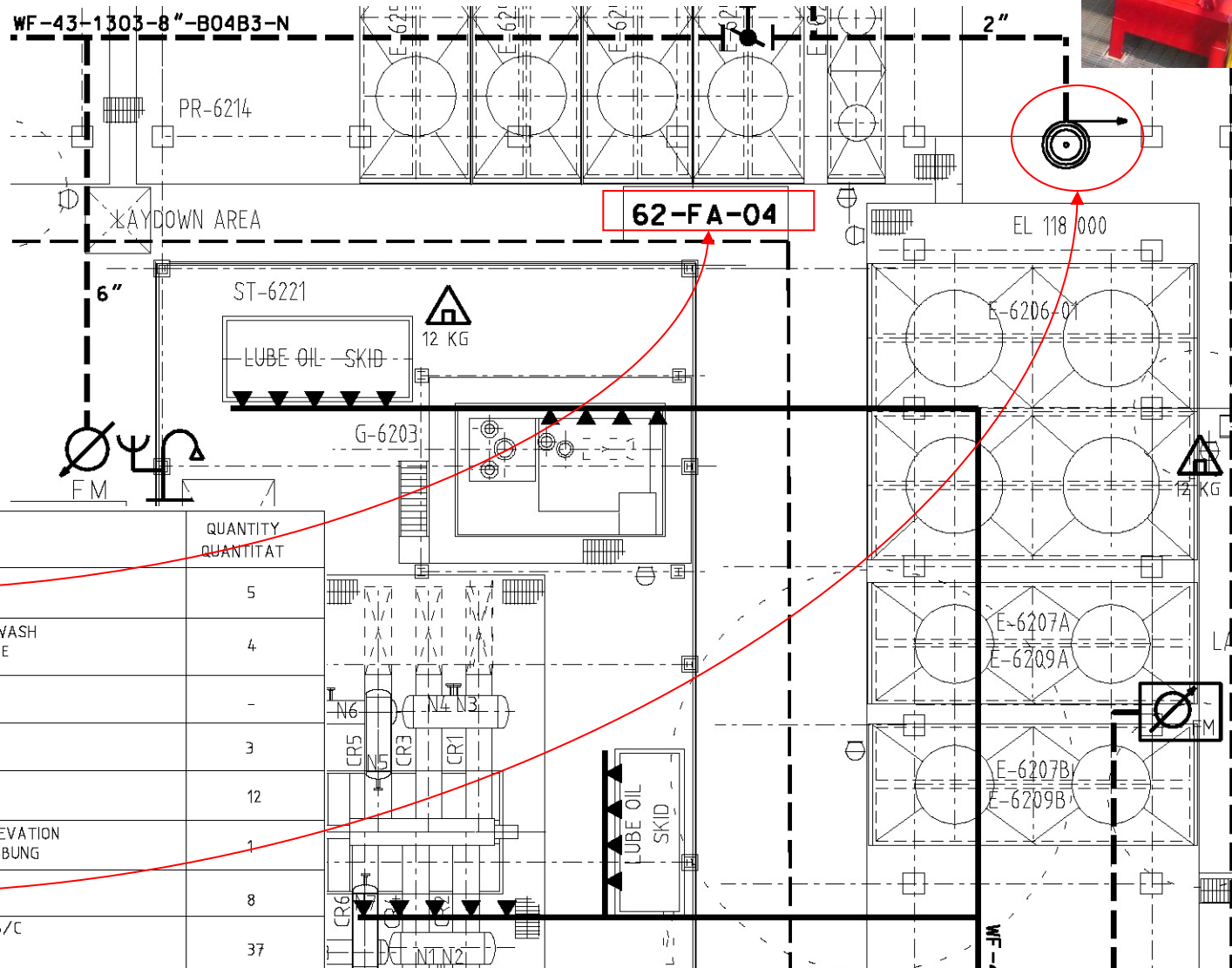
Legend :

△ Spray nozzle

— Pipe



Fire fighting equipment location drawing

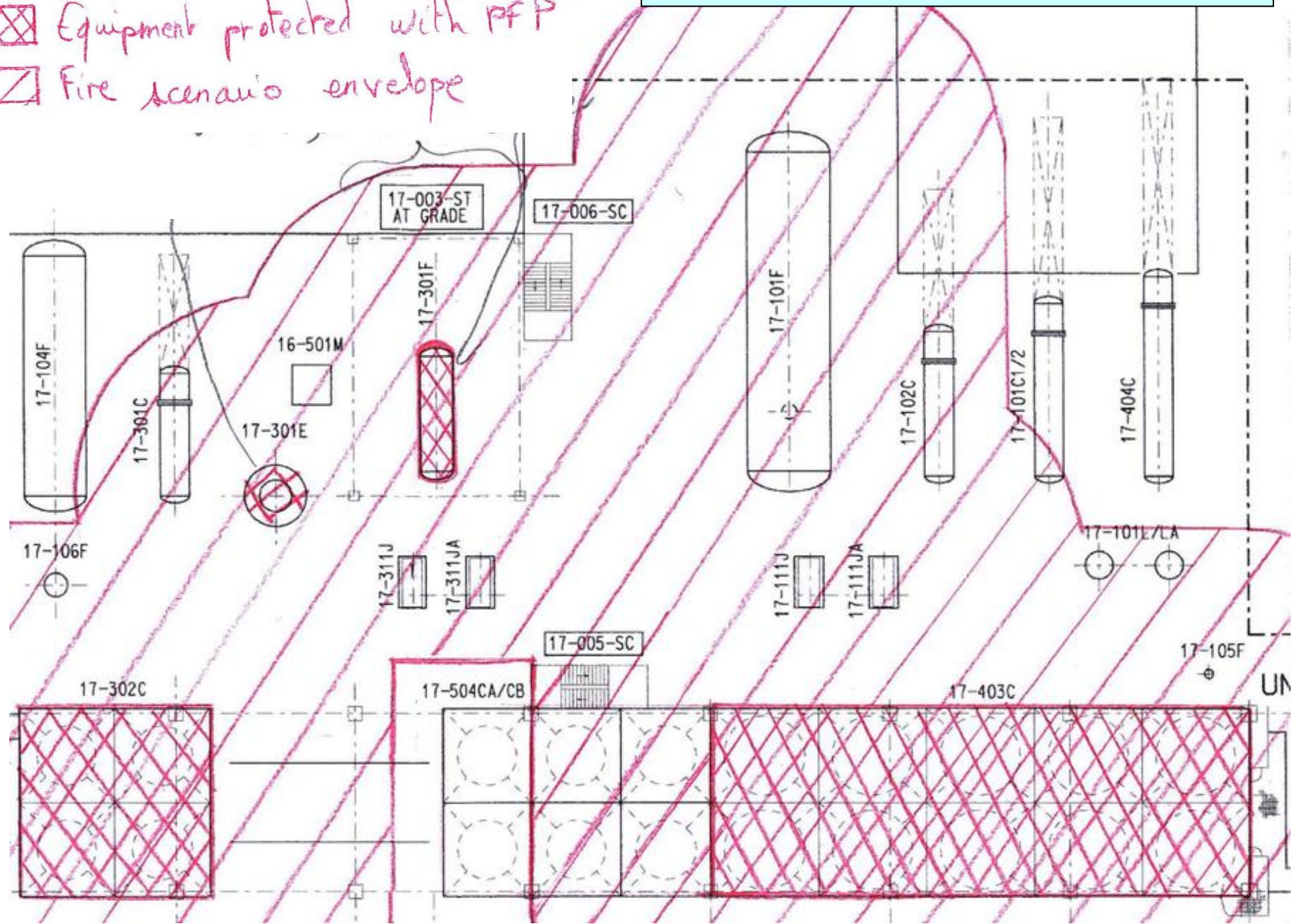


SYMBOL	LEGEND LEGENDE	QUANTITY QUANTITÄT
	FIRE AREA FEUERZONE	5
	SAFETY SHOWER WITH EYE WASH NOTDUSCHE MIT AUGENDUSCHE	4
	PORTABLE EYE WASH AUGENDUSCHE	-
	DELUGE SYSTEM BERIESLUNGS-ANLAGE	3
	FIXED WATER MONITOR WASSER FIXMONITOR	12
	FIXED WATER MONITOR IN ELEVATION WASSER FIXMONITOR IN ERHEBUNG	1
	HOSE REEL SCHLAUCH-HASPEL	8
	PORTABLE DRY POWDER A/B/C EXTINGUISHER(12KG) TRAGBAR PULVER-A/B/C FEUERLOSCHER (12KG)	37

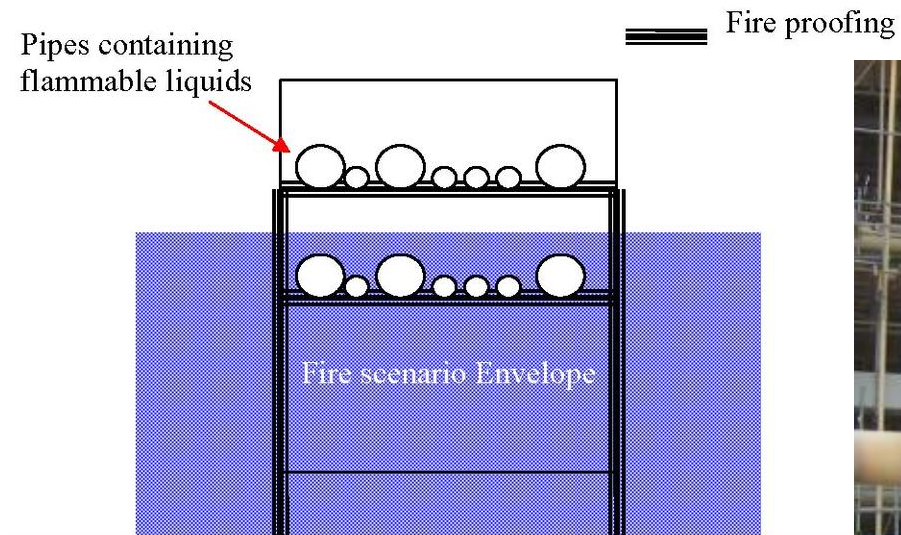
Legend

-  Equipment protected with PFP
-  Fire scenario envelope

Passive fire protection drawing



Passive fire protection



Fire & Gas detection layout



-  INFRARED GAS DETECTOR
-  INFRARED GAS DETECTOR IN HVAC DUCT
-  SMOKE DETECTOR (EX= EXPROOF)
-  SMOKE DETECTOR IN FALSE FLOOR

Hazardous area classification drawing

LEGEND



Zone 1

Flammable atmosphere is likely to occur in normal operation.



Zone 2

Flammable atmosphere is not likely to occur in normal operation, and, if occurs will only exist for a short period.

NOTES :

All electrical LV motors shall be certified for use within a zone 2IIC T3 hazardous area as a minimum.

In battery installations and battery rooms, all luminaires and convenience outlets should be suitable for use in a zone 1IIC T1 as a minimum.



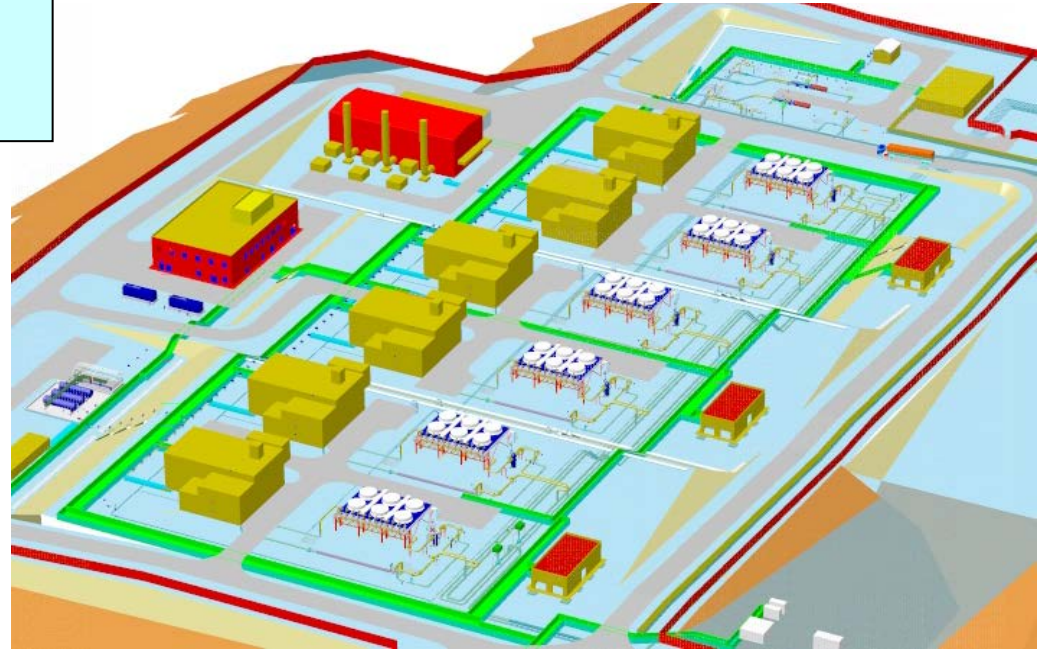
Quantitative Risk Analysis (QRA)

Case study: Gas leak from random piping
component rupture

Cause: installation error, corrosion, material
defect...

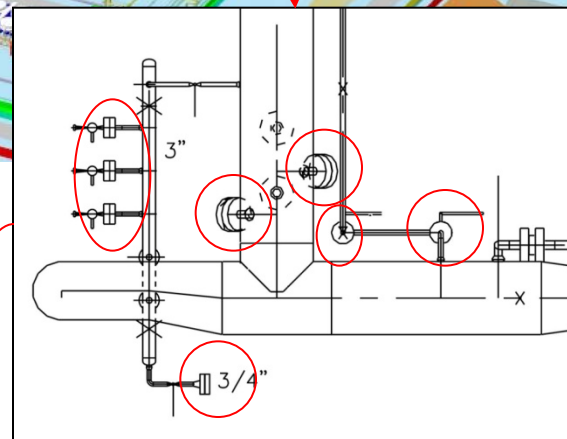
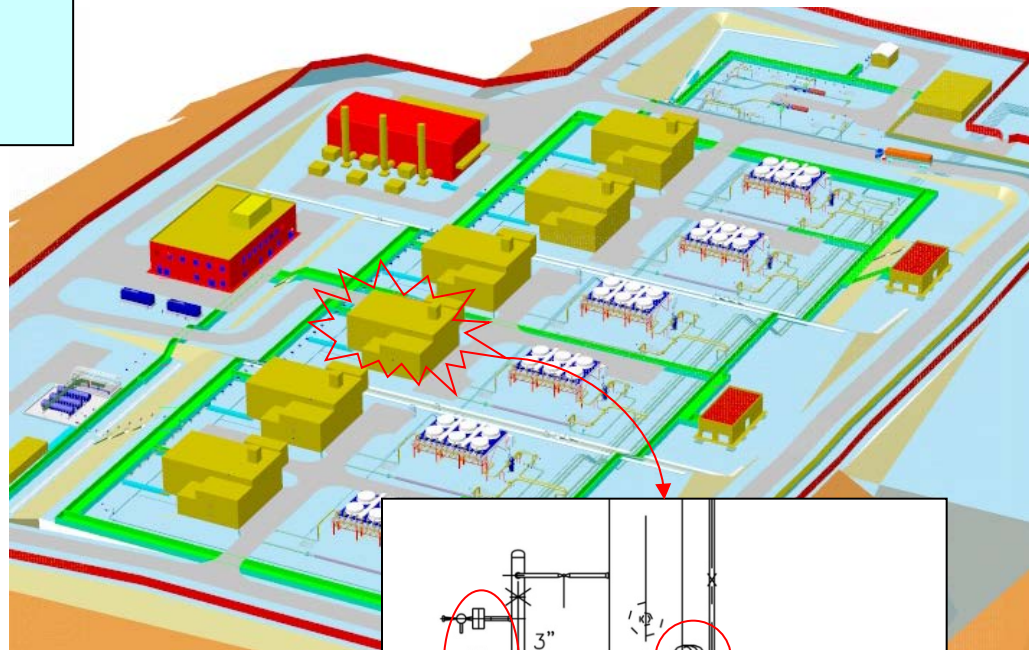
Possible consequence: Dispersion without ignition
/ jet fire / flash fire / explosion

Section considered: Compressor building



Pipe rupture location

Quantitative Risk Analysis (QRA)



Σ risk components
*failure rate
(from statistics)

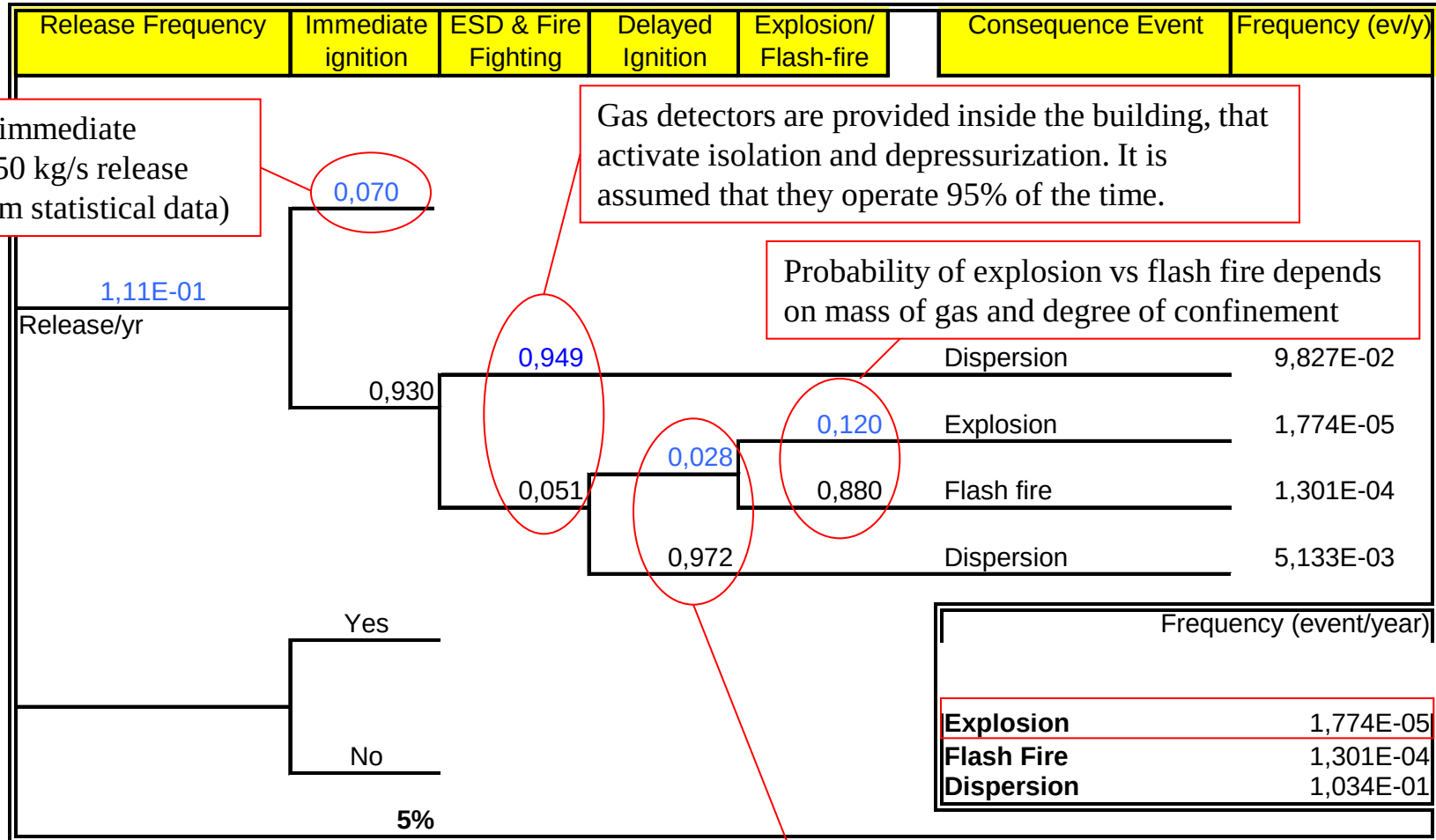
Step 1:

Identification and characterisation of initiating events

Gas leak inside compressor building due to component rupture	Hole size (% of component section)		
	5%	20%	Full
Frequency (event/year)	1,11E-01	5,06E-04	6,83E-05
Outflow rate (kg/s)	5,7	90,8	2270,0

Quantitative Risk Analysis (QRA)

Step 2: Event tree analysis

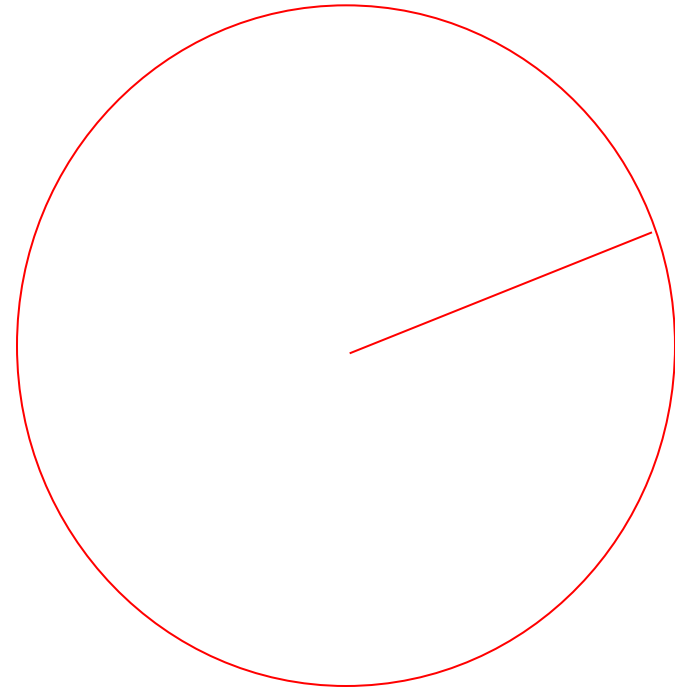


Quantitative Risk Analysis (QRA)

Step 3:

Consequence evaluation

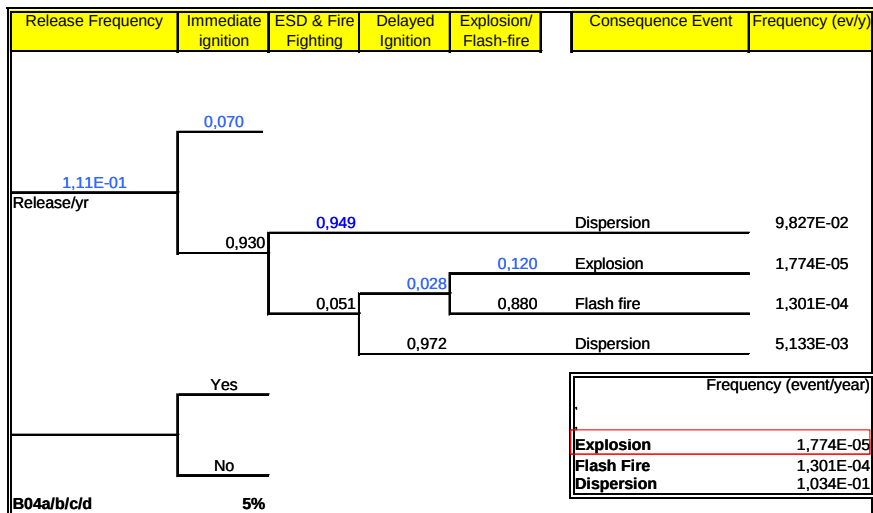
Overpressure (bar)	0.2	0.1	0.01
Distance (m)	96	167	1270



CONSEQUENCE CLASS	QUANTITATIVE CRITERIA	EFFECTS
MINOR	≤ 0.1 bar locally (within 10m)	No effect, no damage
SIGNIFICANT	≤ 0.1 bar locally (within 50m)	Limited damage to plant and operators
SEVERE	> 0.1 bar within plant	Damage to plant and operators
MAJOR	> 0.1 bar on populated areas	Damage to plant, operators & public

Quantitative Risk Analysis (QRA)

Final step: classification of risk



1.0E-02				
1.0E-03				
1.0E-04 Unlikely				
1.0E-05 Rare				
1.0E-06	Minor	Significant	Severe	Major

	Unacceptable risk area– Design change necessary
	As Low As Reasonably Practicable – Plant Management measures
	Acceptable risk area

CONSEQUENCE CLASS	QUANTITATIVE CRITERIA	EFFECTS
MINOR	≤0.1 bar locally (within 10m)	No effect, no damage
SIGNIFICANT	≤0.1 bar locally (within 50m)	Limited damage to plant and operators
SEVERE	> 0.1 bar within plant	Damage to plant and operators
MAJOR	> 0.1 bar on populated areas	Damage to plant, operators & public

Environmental Impact Assessment (Air quality dispersion analysis)

Sources description

Coordinates of the sources

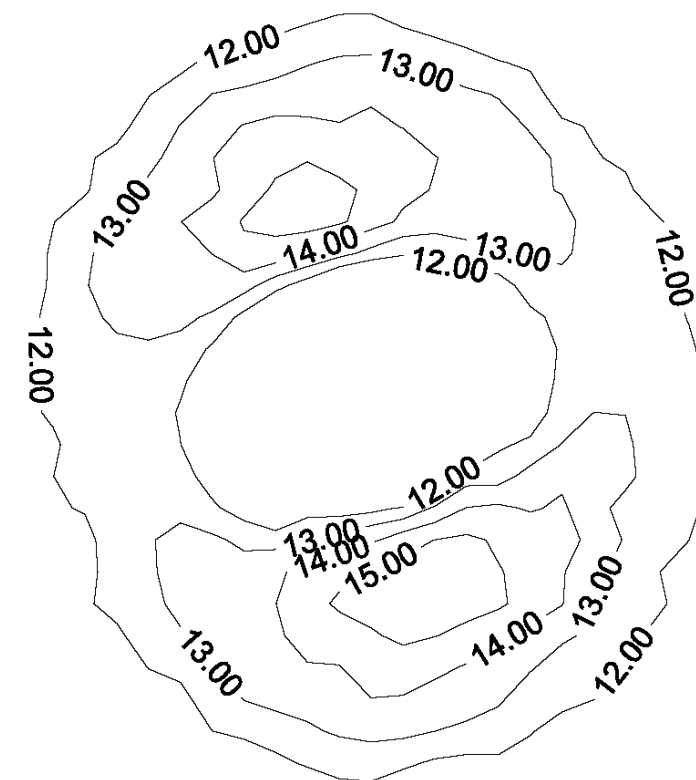
SOURCE NAME	Stack Height (m)	Stack diam. (m)	Flue gas temp. (°K)	Flue gas velocity (m/s)	Q _{WET} (Nm ³ /h)	NO _x (g/s)	CO (g/s)
Turbocompressor TC-100	15	2.9	775	28	206000	2.87	8.60
Turbocompressor TC-200	15	2.9	775	28	206000	2.87	8.60
Turbocompressor TC-300	15	2.9	775	28	206000	2.87	8.60
Turbocompressor TC-400	15	2.9	775	28	206000	2.87	8.60
Turbogenerator TG-001	15	1.38	806	28	45000	0.63	1.88
Turbogenerator TG-002	15	1.38	806	28	45000	0.63	1.88

	X (m)	Y (m)
Turbocompressor TC-100	127	365
Turbocompressor TC-200	127	331
Turbocompressor TC-300	127	268
Turbocompressor TC-400	127	235
Turbogenerator TG-001	182	177
Turbogenerator TG-002	190	177

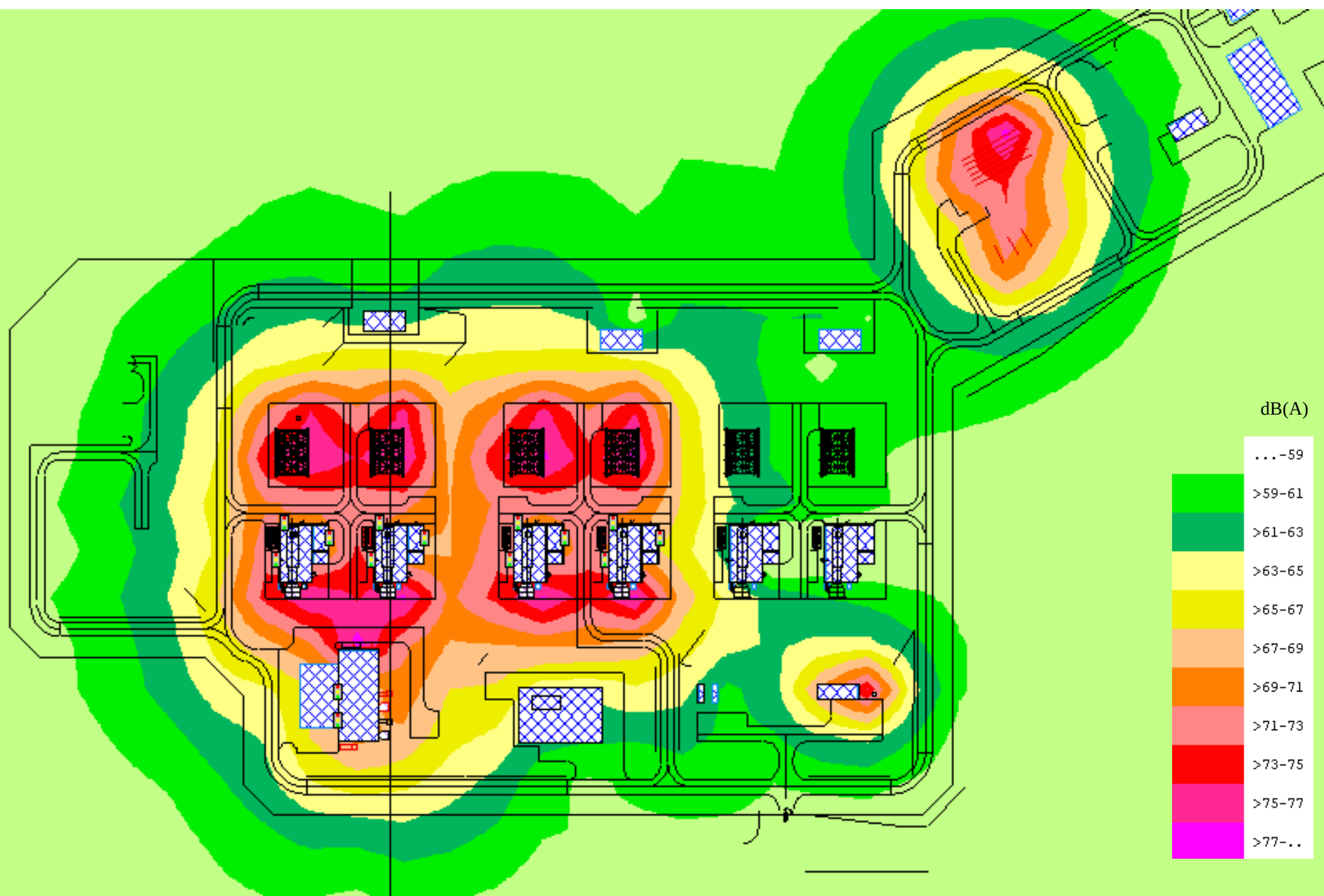


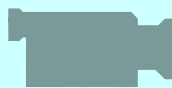
Ground Concentration of NO_x (μg/m³)

3000.00
2000.00
1000.00
0.00
-1000.00
-2000.00



2000.00 -1000.00 0.00 1000.00 2000.00 3000.00





Engineering

- Process

- Equipment

- HSE

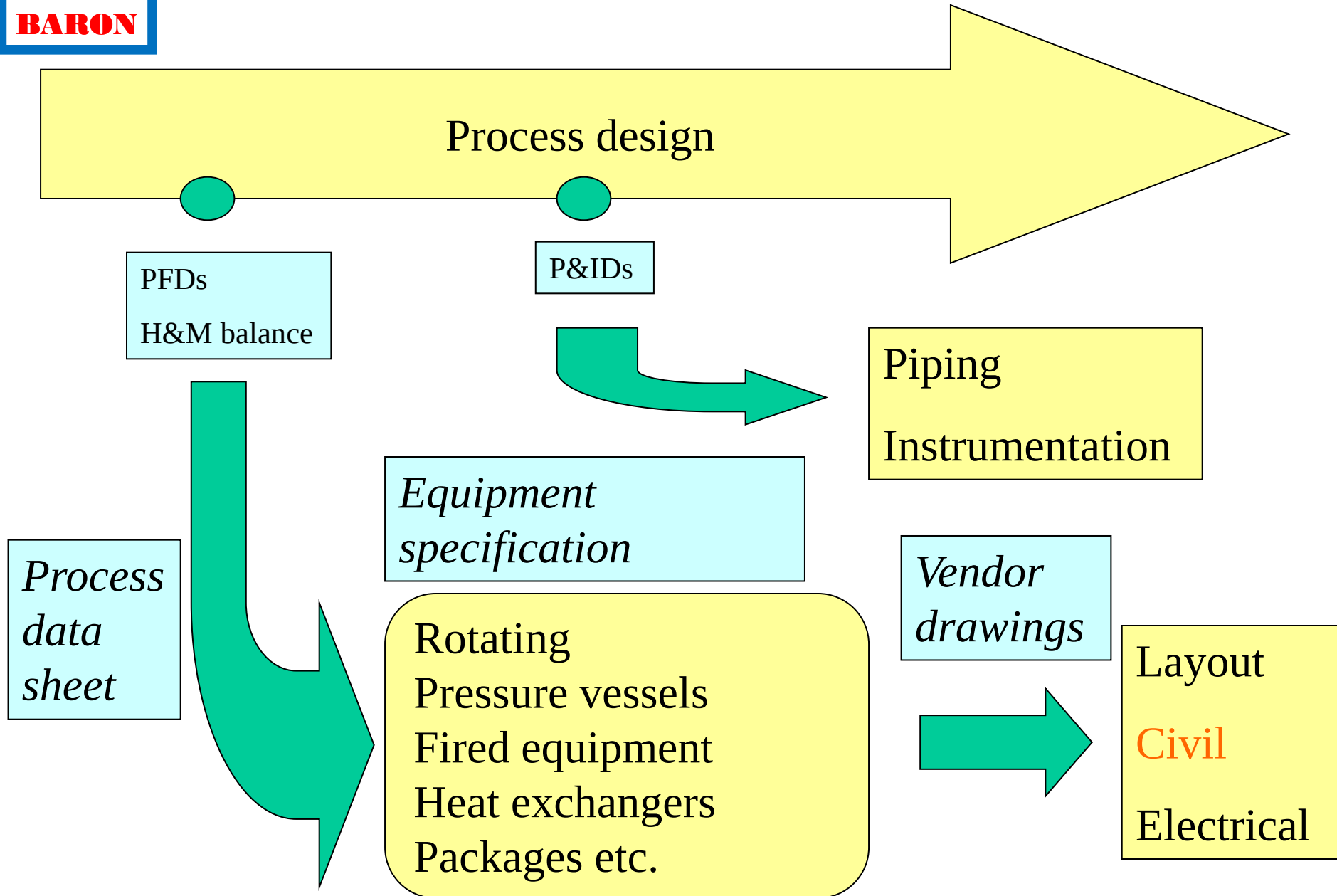
- Civil

- Layout

- Piping

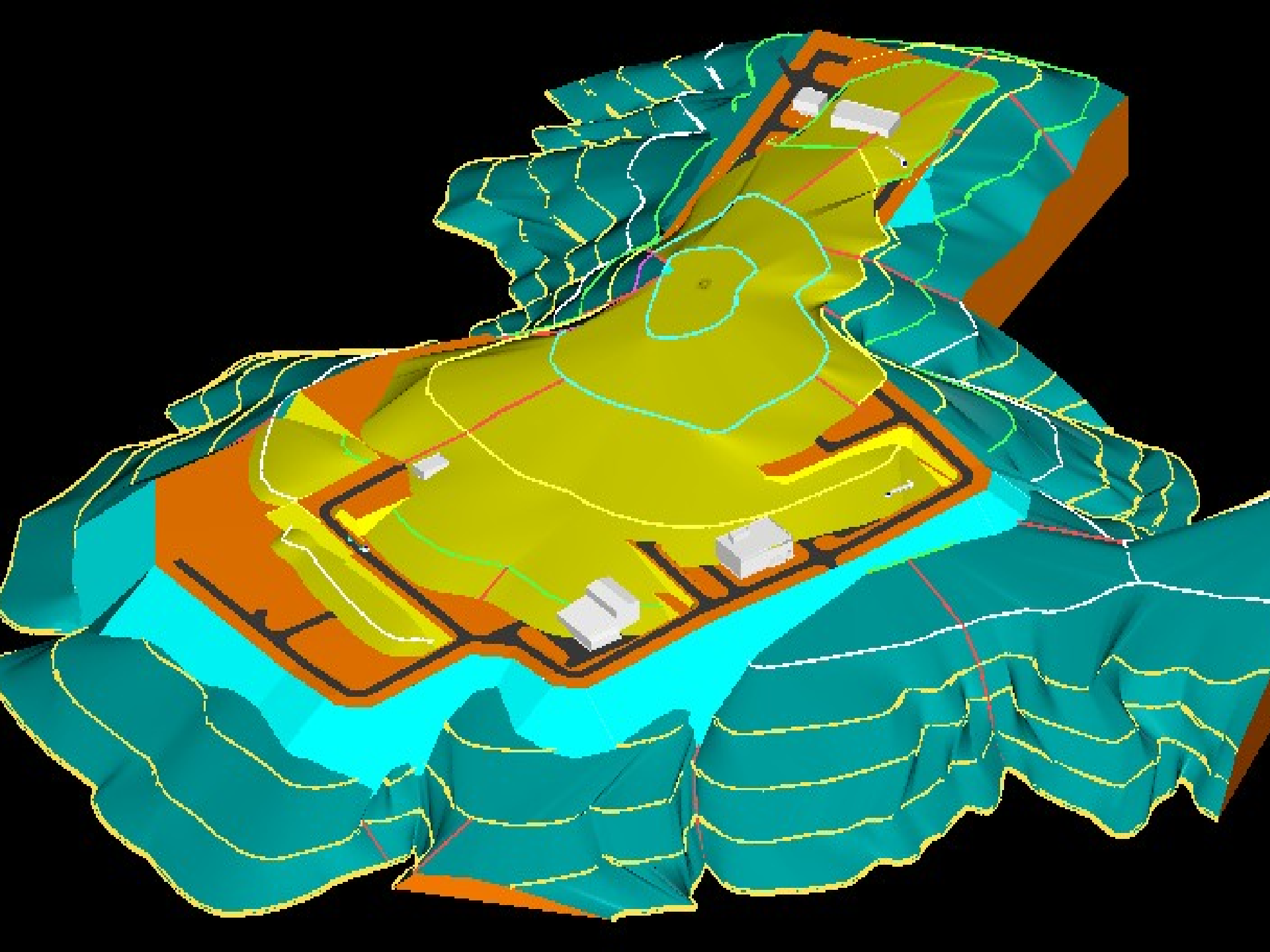
- Instrumentation

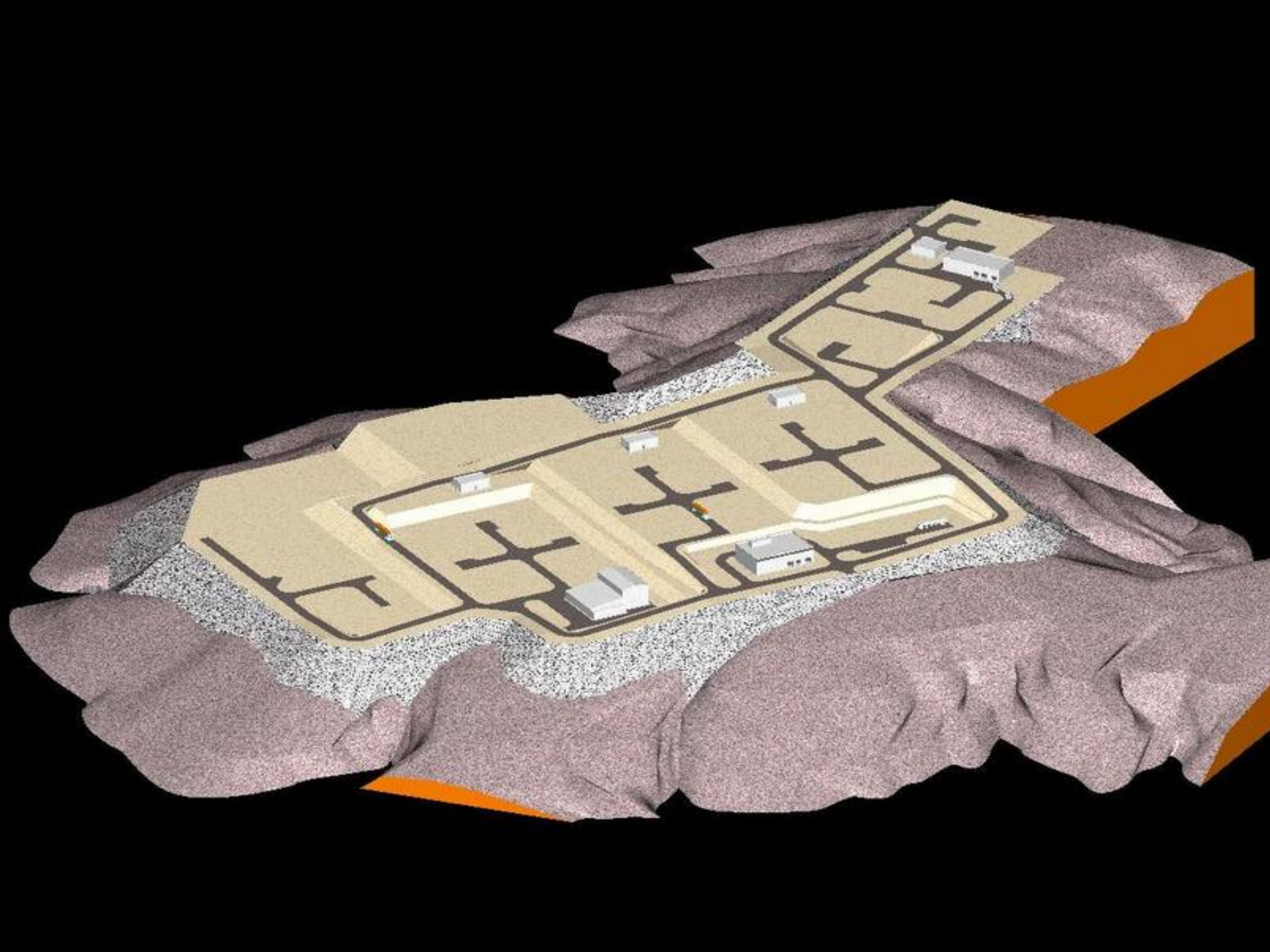
- Electrical



**HERVE
BARON**







Grading plan

Required finish level



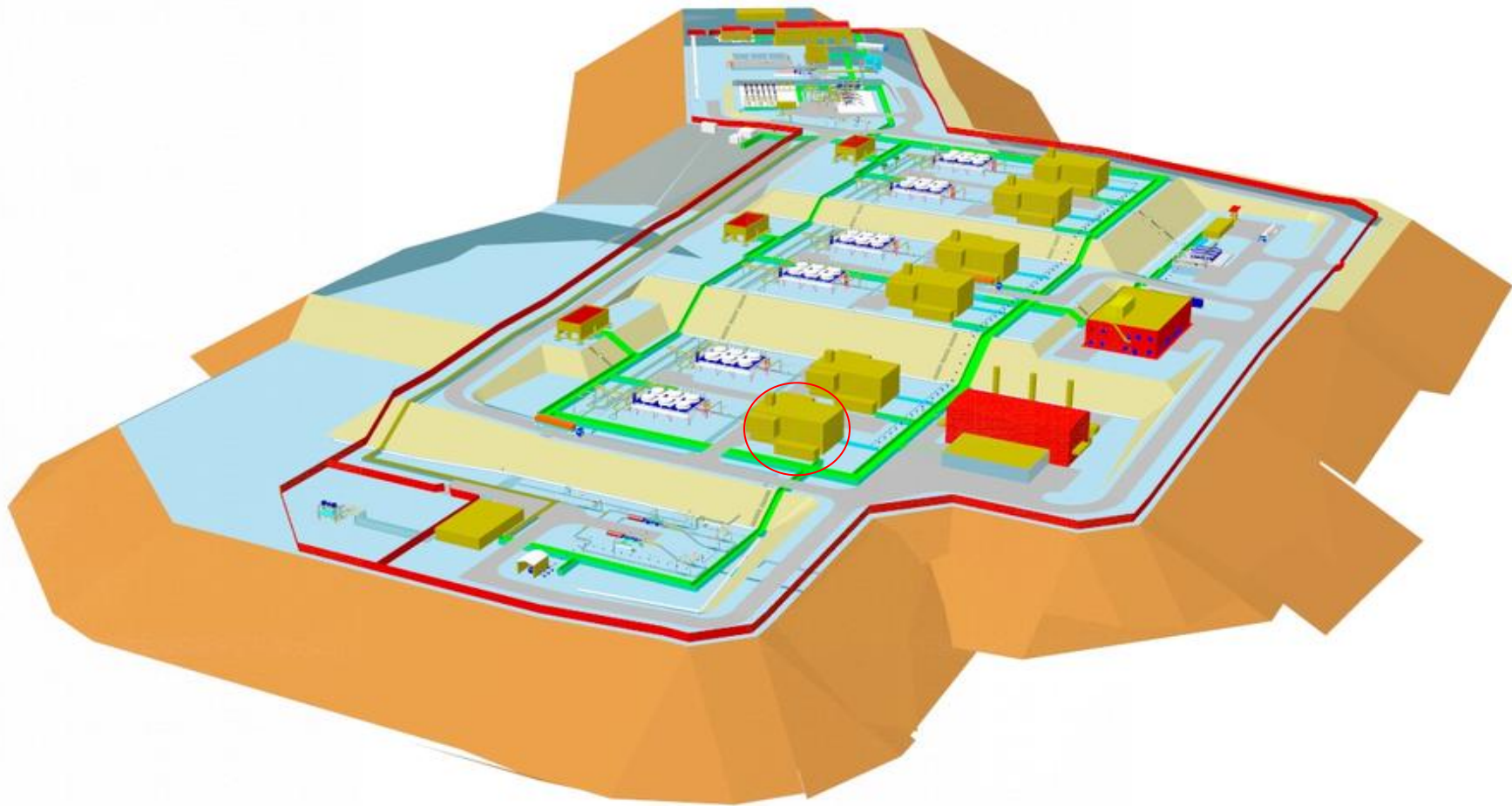
Native soil elevation





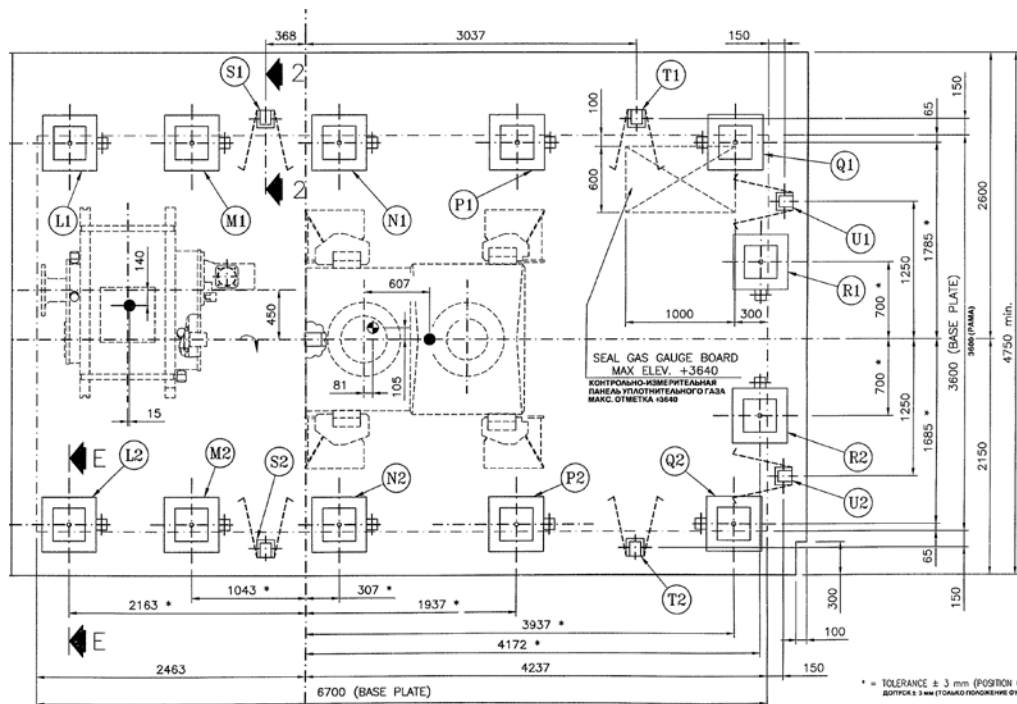
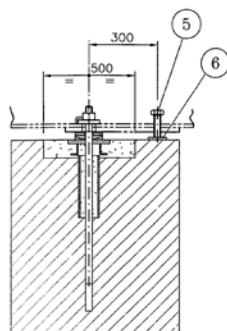
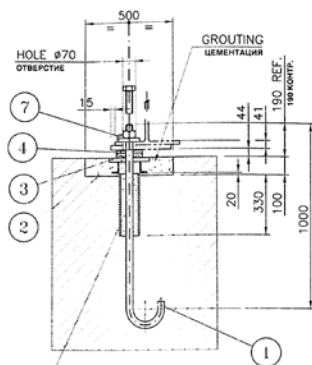








PGT 25 PLUS GAS TURBINE ГАЗОВАЯ ТУРБИНА PGT 25 PLUS	SUB-SOLE PLATE DEFORMATION ОБРАЗОВАНИЕ ПОДЪЕМЫВАЮЩЕЙ ПЛЫТИ	FOUNDATION LOADS (KGS.) EACH SUB-SOLE PLATE НАГРУЗКИ (КТ) НА КАЖДУЮ ИЗ НИЖНИХ ПЛИТ ОСНОВАНИЯ ФУНДАМЕНТА											
		STATIC LOADS СТАТИЧЕСКИЕ НАГРУЗКИ						DYNAMIC LOADS ДИНАМИЧЕСКИЕ НАГРУЗКИ					
		DEAD LOADS ПОСТОЯННЫЕ НАГРУЗКИ	NORMAL TORQUE LOADS НОРМАЛЬНЫЕ МОМЕНТЫ НАГРУЗКИ	FUNCTIONAL FORCES СИЛЫ ТРИБУН	LOADING ACTION AND COLL. SUPP. LOADS НАГРУЗКА ДЕЙСТВИЕ И СТОЛКОВЕНИЯ НА ПОДДЕРЖИВАЮЩИЕ	NORMAL OPERATING LOADS НОРМАЛЬНЫЕ ЭКСПЛУАТАЦИОННЫЕ НАГРУЗКИ	TURBINE ROTOR EMERGENCY LOADS АВАРИЙНЫЕ НАГРУЗКИ НА РОТОР ТУРБИНЫ						
		-Z	±Z	±X	±Y	±Y	±Z	RPM 25 MIN	±Y	±Z	RPM 25 MIN		
A1-A2	4000-4000	/	1200	1200	/	50	50	10100	550	550	50 min		
B1-B2	4500-4500	/	1350	1350	/	/	/	/	/	/	/		
C1-C2	14500-14500	3300	4350	4350	/	160	160	6100	1700	1700	67100		
D1-D2	5000-5000	/	1500	1500	/	/	/	/	/	/	/		
G1-G2	/	/	/	/	11500	/	/	/	/	/	/		
H1-H2	/	/	5400	5400	13000	/	/	/	/	/	/		
E1-E2	6000-6000	/	/	/	/	/	/	/	/	/	/		
F1-F2	9400-9400	/	/	/	/	/	/	/	/	/	/		



Vendor information



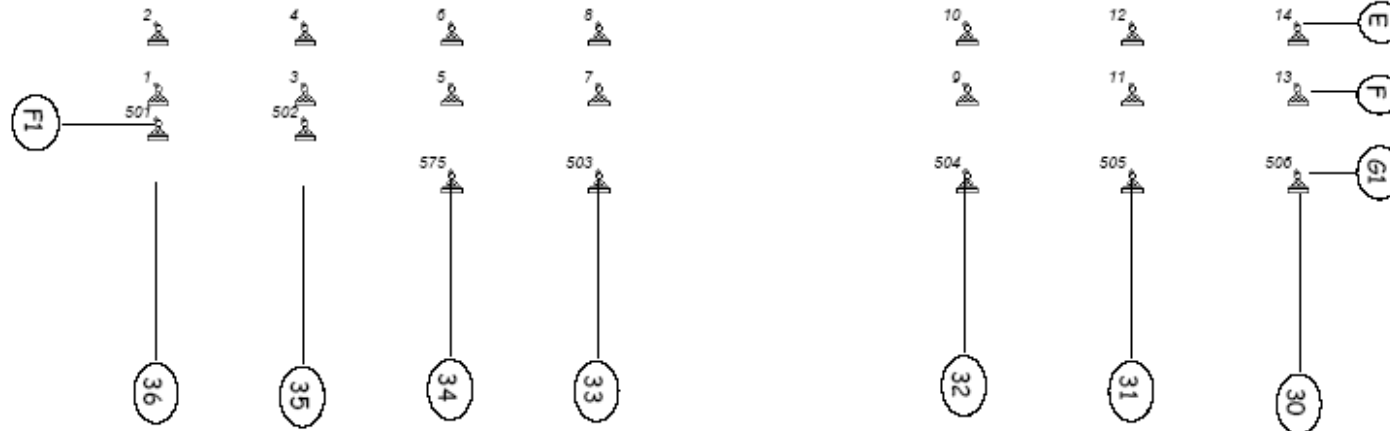
BEARING CAPACITY/STABILITY RATIO

Foundation Description	FOUNDATION	INPUT UNITS	SI	OUTPUT UNITS	SI
DESIGN CODE	ACI 318 - 2002				
CONCRETE PARAMETERS:					
Compressive Strength (N/sq mm)	28.00				
Unit Weight (kN/cu m)	24.00				
REINFORCING STEEL PARAMETERS:					
Yield Strength (N/sq mm)	420.00				
Unit Weight (kN/cu m)	78.50				
Modulus of Elasticity (kN/sq mm)	210.00				
SOIL PARAMETERS:					
Allowable Net Bearing Capacity (kN/sq m)	350.00				
Unit Weight (kN/cu m)	18.00				
MINIMUM FOUNDATION CRITERIA:					
Depth of Footing Below Grade (mm)	1450				
Minimum Soil Cover (mm)	900.00				
Grade Elevation (mm)	3000.00				

APPLIED LOADS P8

Load Case	Axial (kN)	Shear E-W (kN)	Mom N-S (kN m)	Shear N-S (kN)	Mom E-W (kN m)
1 - Dead	63.99	-0.63	0.00	-3.65	0.00
2 - PDL	232.12	-4.64	0.00	-11.98	0.00
3 - POL	123.68	-8.98	0.00	-1.88	0.00
4 - TL	0.00	0.00	0.00	0.00	0.00
5 - PTL	0.00	0.00	0.00	0.00	0.00
6 - TF	166.61	-27.75	0.00	-34.21	0.00
7 - Wind_X	45.48	-0.90	0.00	-20.89	0.00
8 - Wind_Z	167.91	-35.46	0.00	-3.89	0.00

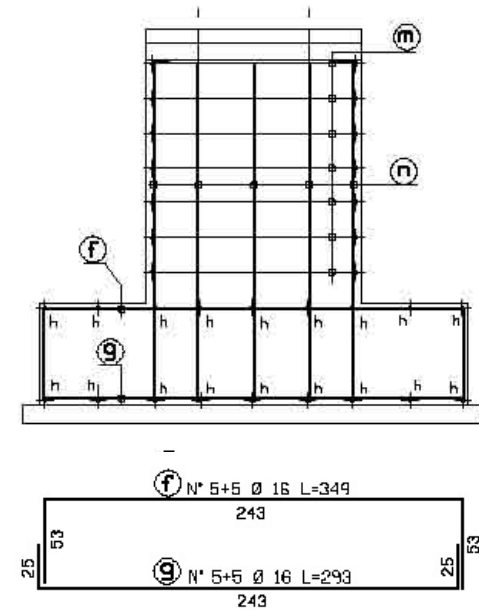
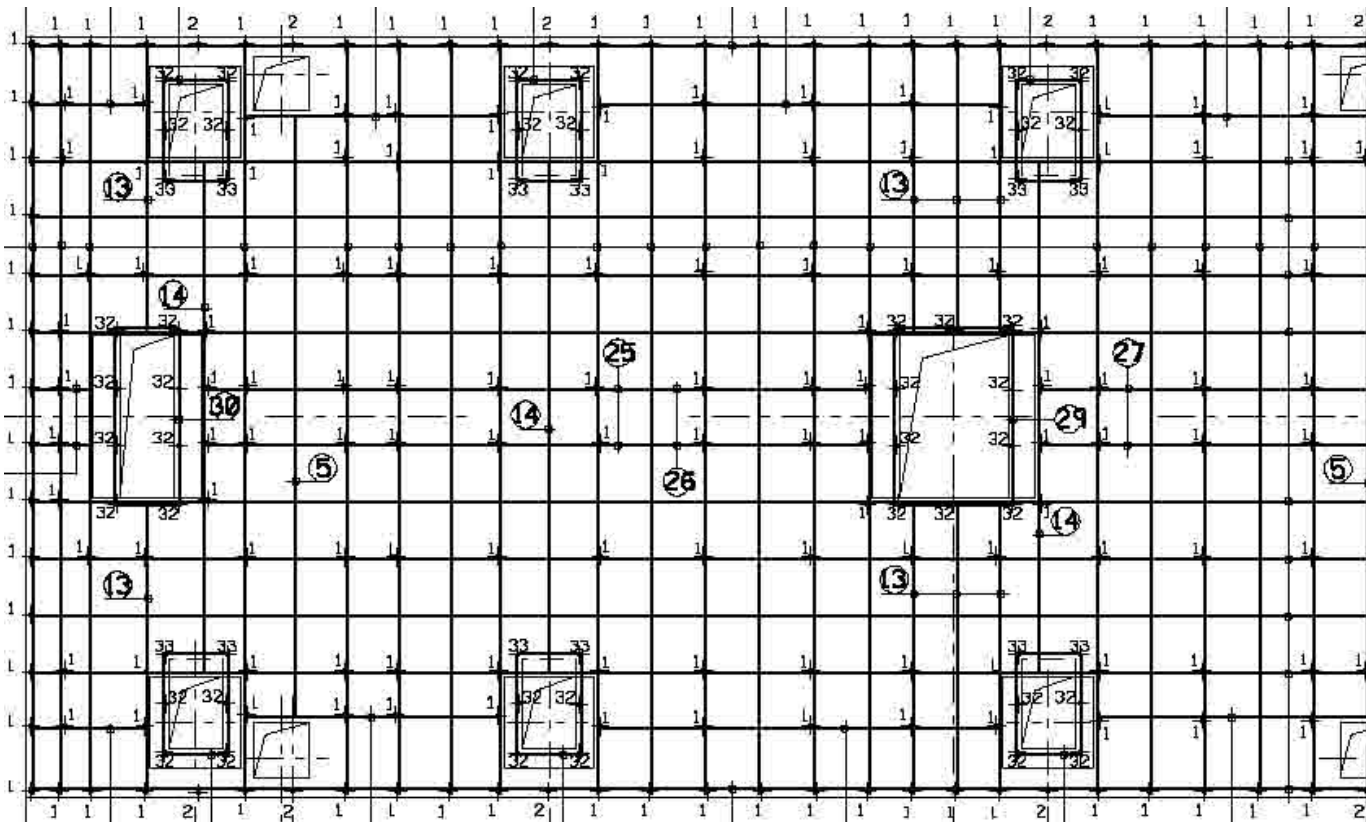
Load Comb	Max Pressure (kN/sq m)	All Pressure (kN/sq m)	S.R. N/S	S.R. E/W	All S.R.
1 - Dead + PDL	84.97	376.09	25.83	76.61	2.00
2 - Dead + PDL + PTL + BL	84.97	376.09	25.83	76.61	2.00
3 - Dead + PDL + 0.3POL + 0.8Wind_X + BL	106.83	492.75	14.08	57.33	2.00
4 - Dead + PDL + 0.3POL + -0.8Wind_X + BL	77.29	492.75	100.00	80.86	2.00
5 - Dead + PDL + 0.3POL + 0.8Wind_Z + BL	128.92	492.75	28.36	15.20	2.00
6 - Dead + PDL + 0.3POL + -0.8Wind_Z + BL	77.88	492.75	24.53	15.46	2.00
7 - Dead + PDL + POL	108.12	376.09	28.80	41.16	2.00
8 - Dead + PDL + POL + TF + BL	166.64	376.09	12.37	15.99	2.00
9 - Dead + PDL + POL + PTL + TF + BL	166.64	376.09	12.37	15.99	2.00
10 - Dead + PDL + POL + TF + Wind_X + BL					
11 - Dead + PDL + POL + TF + -1Wind_X + BL	185.28	492.75	9.32	16.54	2.00
12 - Dead + PDL + POL + TF + -1Wind_X + BL	148.00	492.75	19.55	15.41	2.00
13 - Dead + PDL + POL + -1TF + Wind_X + BL	84.20	492.75	96.86	27.80	2.00
14 - Dead + PDL + POL + TF + Wind_Z + BL	89.97	492.75	8.83	20.24	2.00
15 - Dead + PDL + POL + TF + -1Wind_Z + BL	212.89	492.75	14.01	10.28	2.00
16 - Dead + PDL + POL + -1TF + Wind_Z + BL	120.40	492.75	10.48	110.84	2.00
17 - Dead + PDL + POL + -1TF + -1Wind_Z + BL	110.07	492.75	38.84	25.32	2.00
18 - Dead + PDL + POL + PTL + TF + Wind_X + BL	81.34	492.75	11.40	4.56	2.00
19 - Dead + PDL + POL + PTL + TF + -1Wind_X + BL	185.28	492.75	9.32	16.54	2.00
20 - Dead + PDL + POL + PTL + TF + -1Wind_X + BL	148.00	492.75	19.55	15.41	2.00



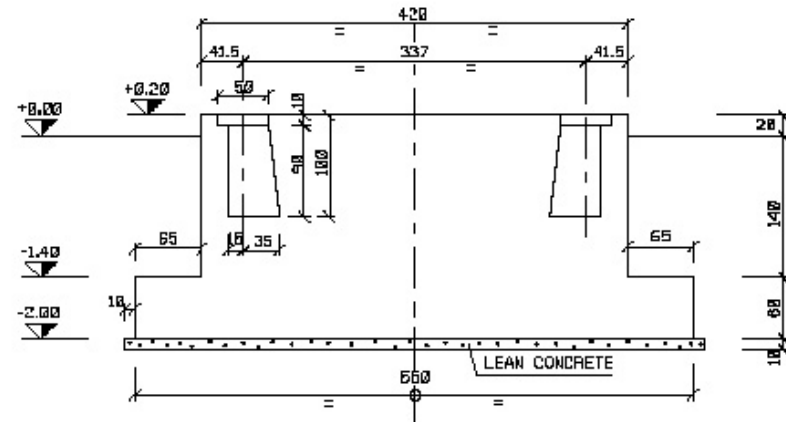
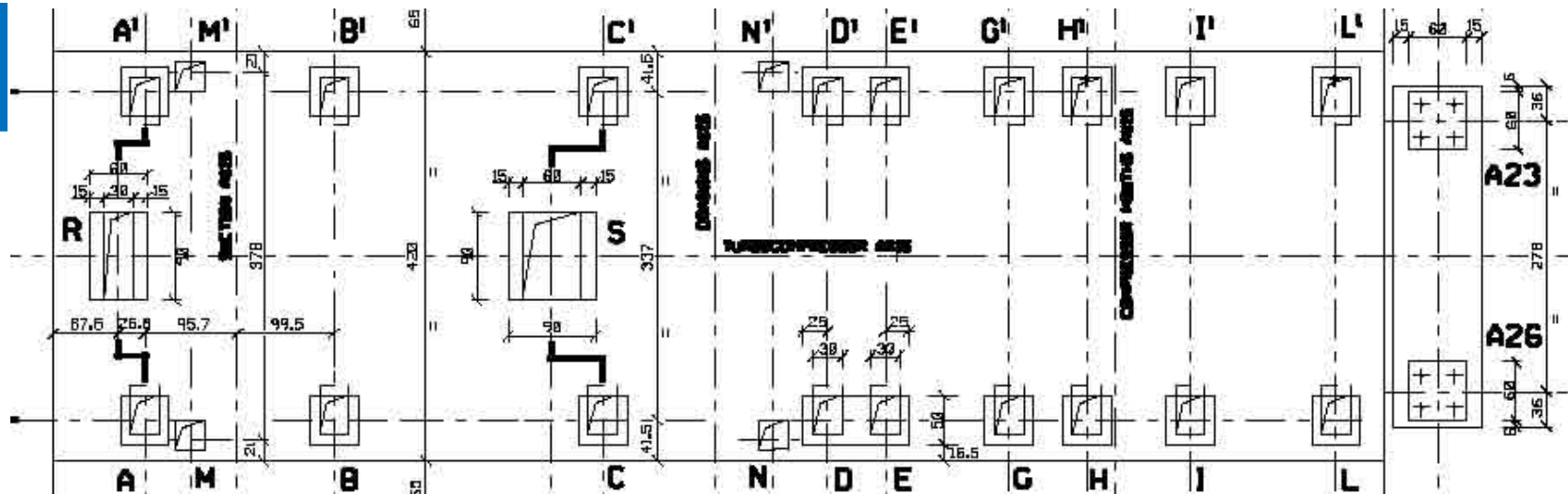
Foundation
Calculation



Foundation drawing/ re-inforcement



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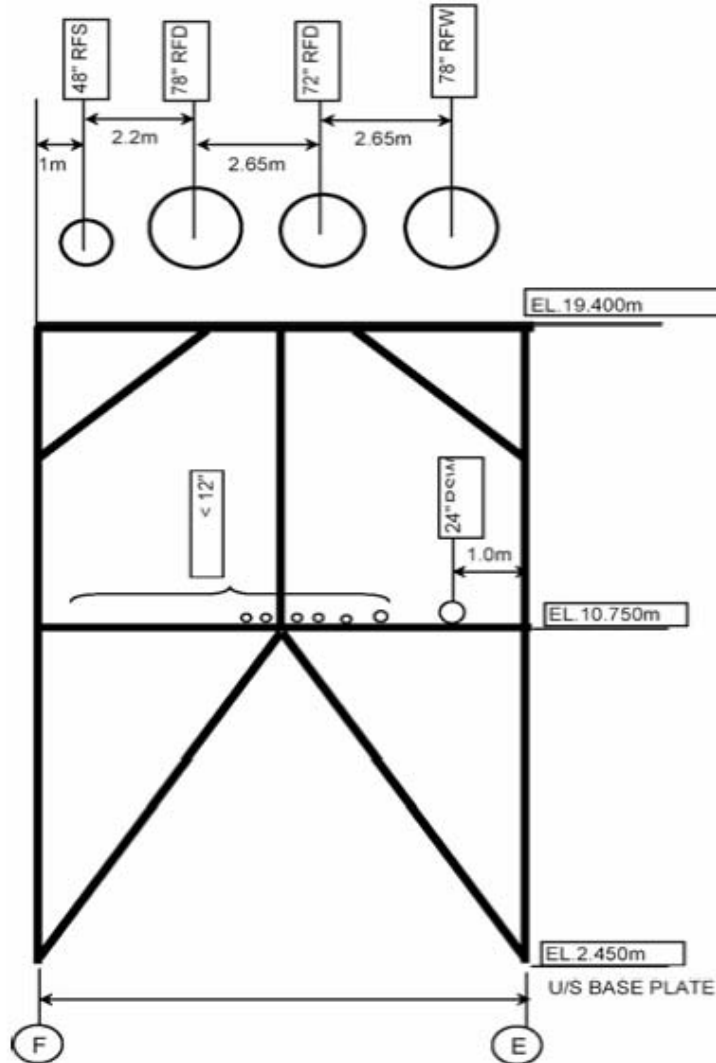
Foundation
drawing/
Formwork

Civil works specification



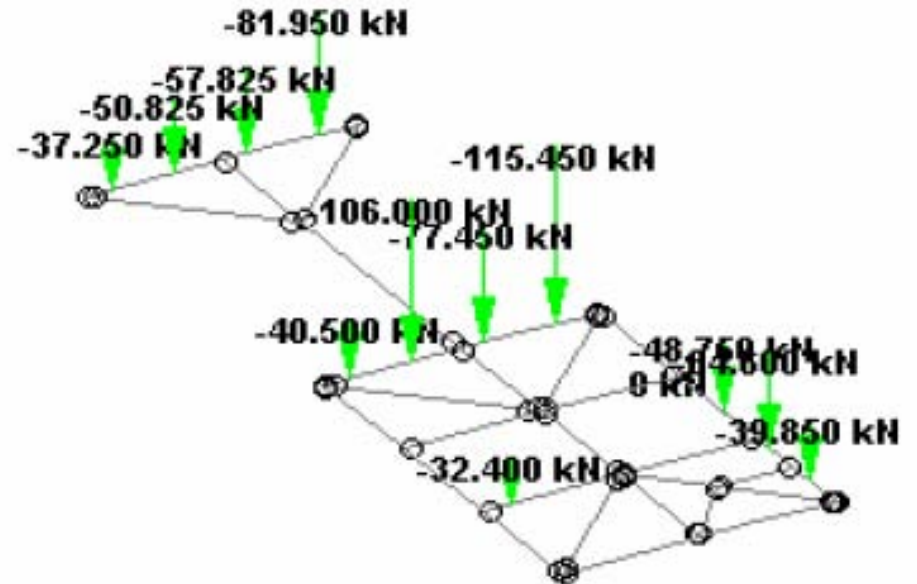


LOADING DATA

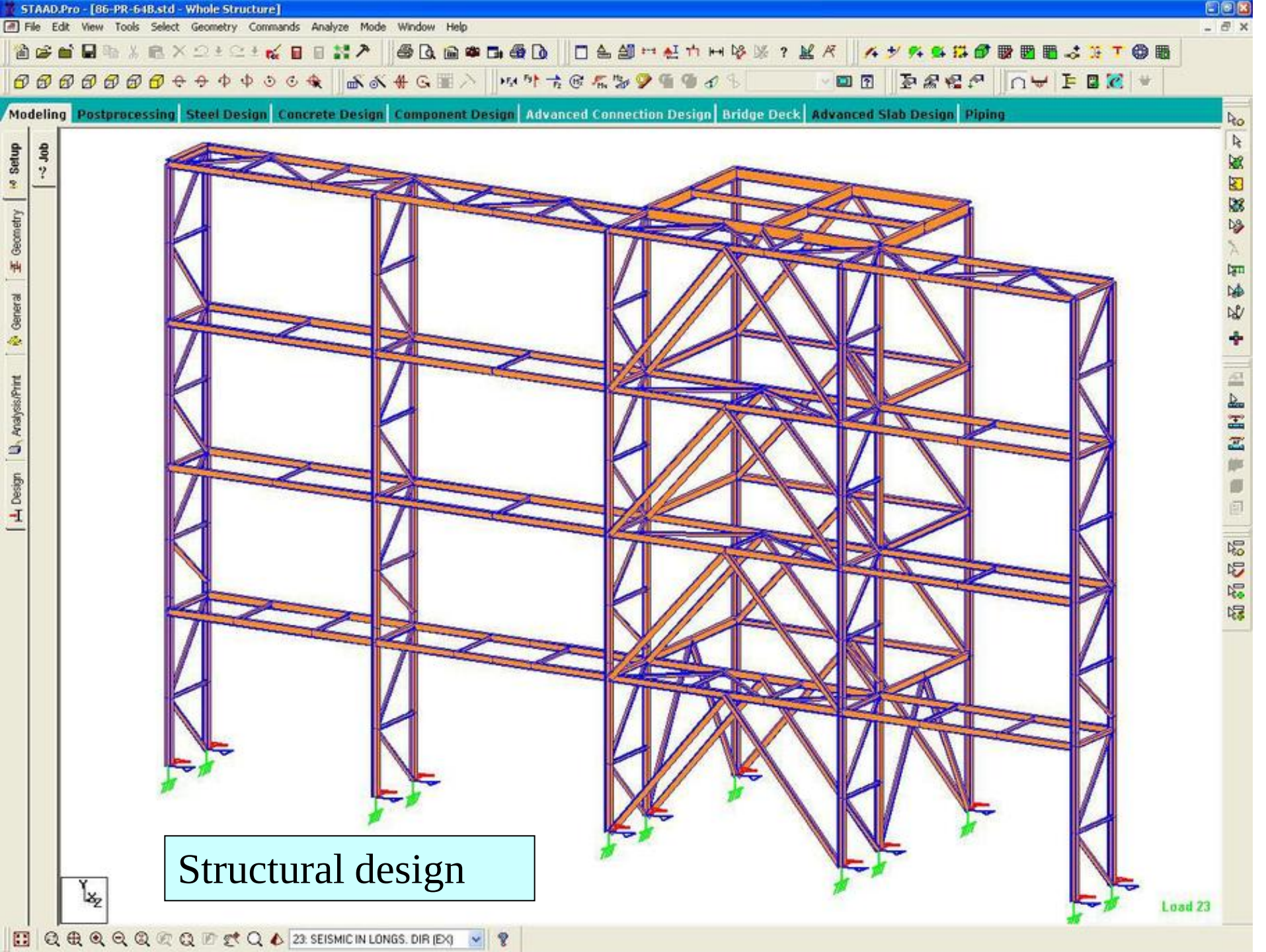


TYPICAL ELEVATION OF TRANSVERSE FRAME

(Showing Size and Spacing of pipes supported by the Rack)



Loading data



Basic Design Data

Grade of Steel = ASTM A36, BS EN 10025;
1993 Grade S275
Yield strength of steel $f_y = 265 \text{ N/mm}^2$
(RG6-S-00-1310-101, Clause 5.1(4))

Anchor Bolts

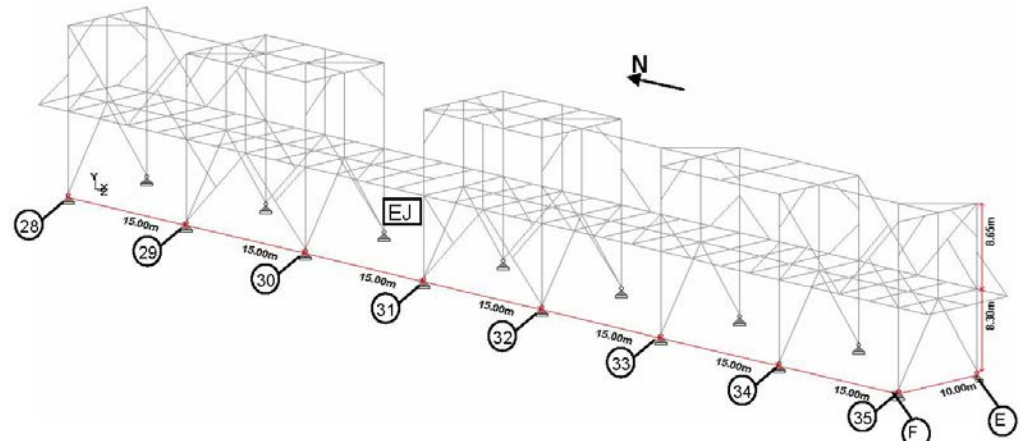
Anchor bolts grade = ASTM A307
Allowable Tensile stress = 138 N/mm^2
Allowable Shear stress = 69 N/mm^2

Wind loads

Basic wind speed $V = 41 \text{ m/s}$
Exposure category = C
Importance factor $I = 1.0$
Topographic factor $K_{zt} = 1.0$

Seismic load

Seismic zone = 1
Seismic zone factor $Z = 0.075$
Soil profile type = S_b
Importance factor $I = 1.0$



7 RESULTS AND CONCLUSION

Maximum lateral displacement of top-most tier at EL19.400m as obtained from "STAAD OUTPUT"

Elevation (m)	Node	Load case	Max. displace. in X- dir. (mm)	Max. displace. in Z- dir. (mm)	Ht. Above Base Pl. (H) (mm)	Allowable Deflection (H/200) (mm)	Ratio : (Ht./Disp.)
19.4	96	913	35.68		16950	84.75	475.06
19.4	60	111		16.122	16950	84.75	1051.4

From above table, It is observed that lateral displacements are well within the allowable limit.

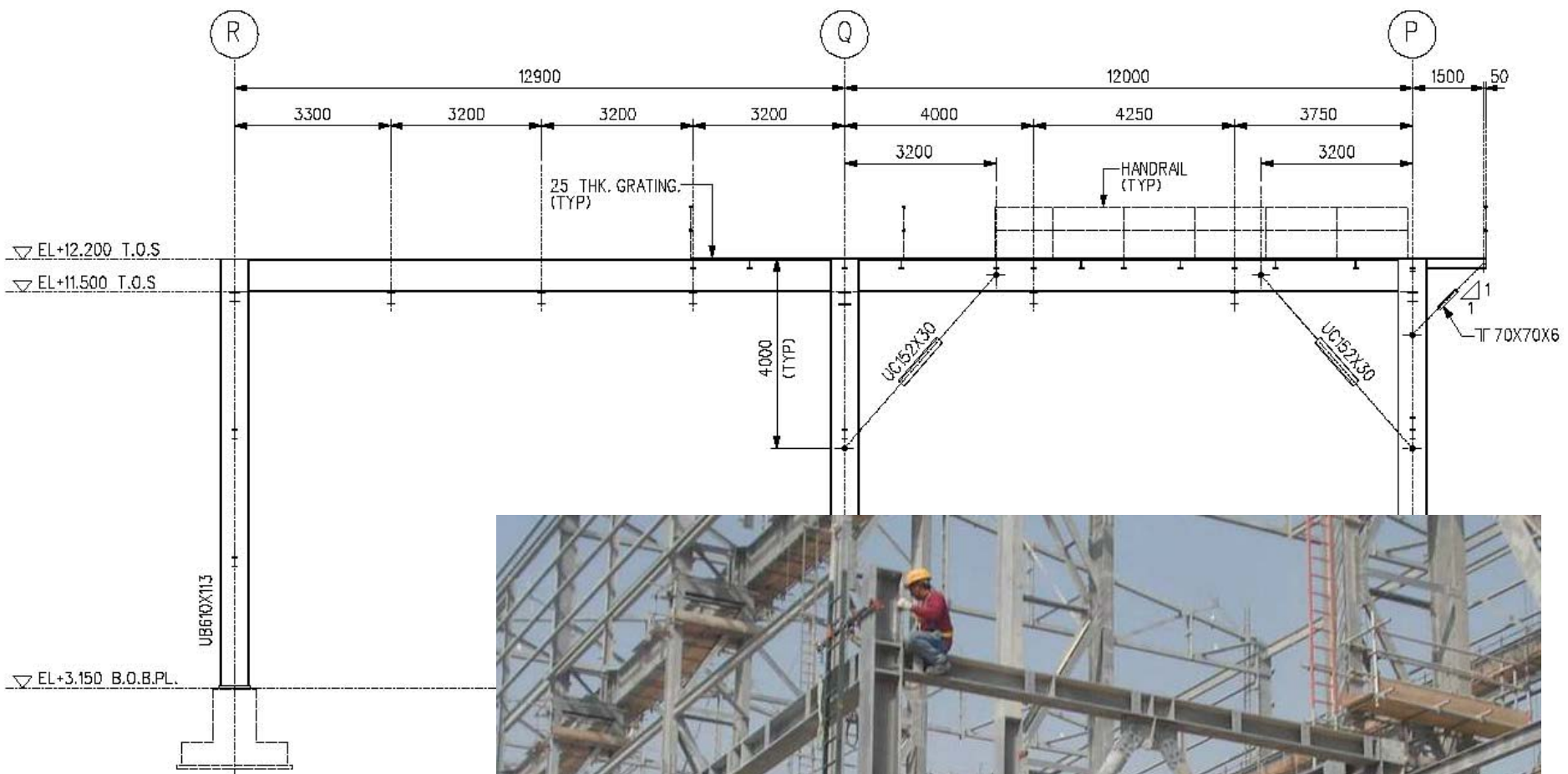
Beams are checked for allowable deflection in "STAAD" by using DFF parameter.

Maximum member deflection for Beams as obtained from "STAAD":

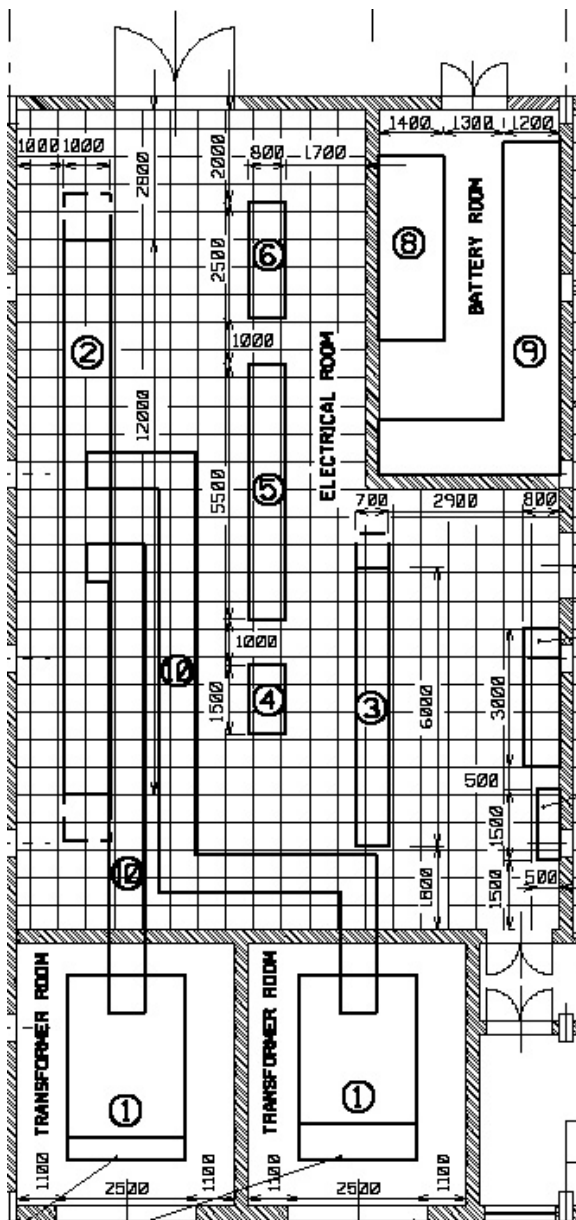
Elevation (m)	Member No.	Load case	Max. Vert. displace. (mm)	Type	Beam Span (L) (mm)	Allowable Deflection (L/200) (mm)	Actual Ratio : (L./Disp.)
10.750	367	205	20.429	Longi. Frame Beams	15000	75	734
19.400	498	912	24.431	Longi. Frame Beams	15000	75	614

Description	Member	Max. Stress Ratio
GRID F - 29 to 30, 31 to 32	UB610X229X113	0.499
GRID E - 29 to 30, 31 to 32	UB914X305X253	0.882
GRID 33 to 34	UC254X254X73	0.415
PLAN BRACINGS AT EL. 19.400	UC203X203X46	0.458
PLAN BRACINGS AT EL. 19.400	2/UA90X90X8	0.538

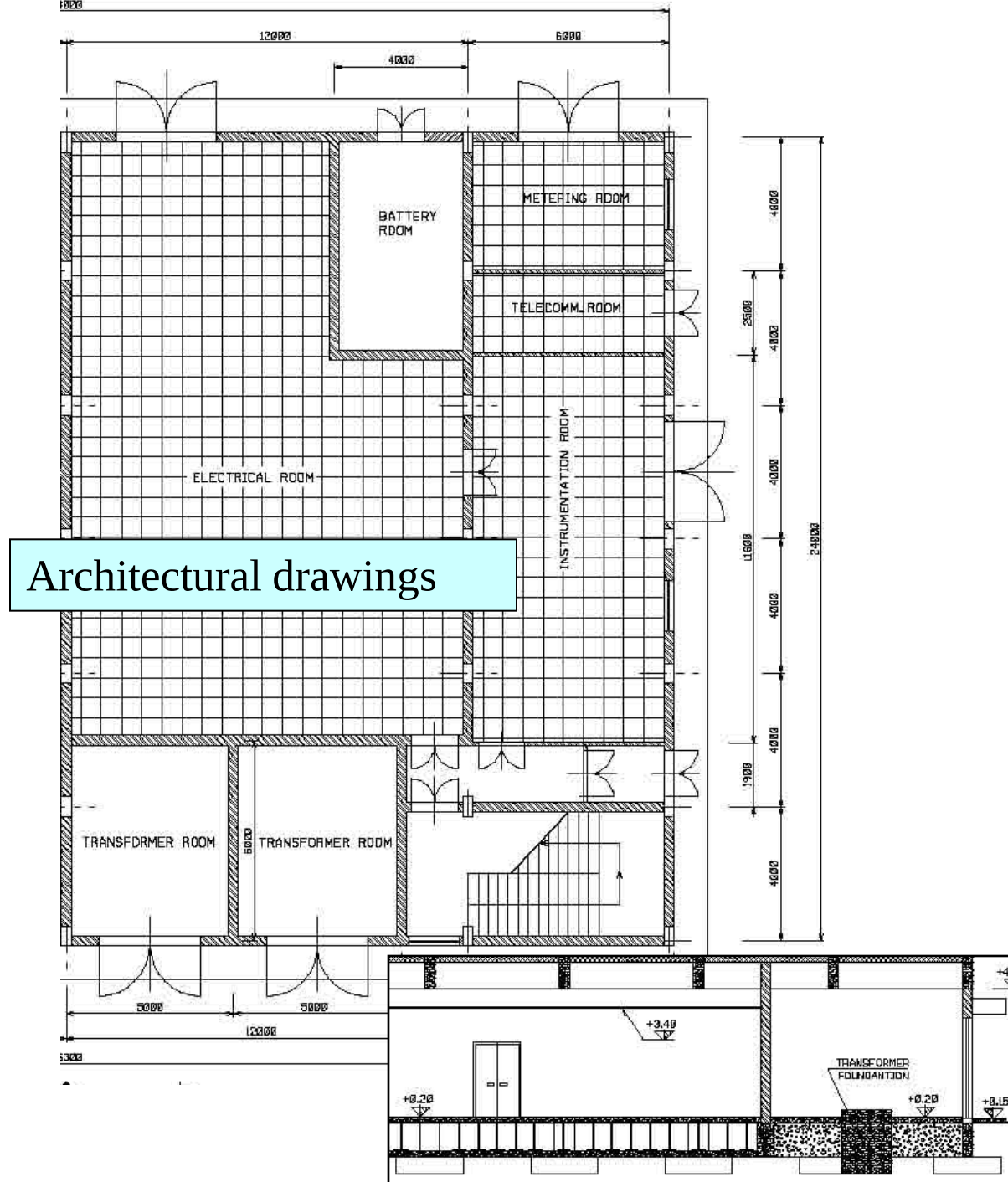
STEEL Pipe Rack Structure 84-PR-65 is thus safe.



Structural
drawings



Equipment layout drawing



Architectural drawings





Heating, Ventilation & Air Conditioning (HVAC)

Climatic Data

Warm season

Design Temperature for Ventilation Systems	+ 26.2 °C
Design Temperature for Air Conditioning Systems	+ 30.8 °C
Absolute Maximum Temperature	+ 41.0 °C
Specific Enthalpy for Air Conditioning System Design	+ 66.8 kJ/kg
Relative Humidity	60 %

Internal Design Condition

Warm season

Rooms with permanent working personnel + 24 °C

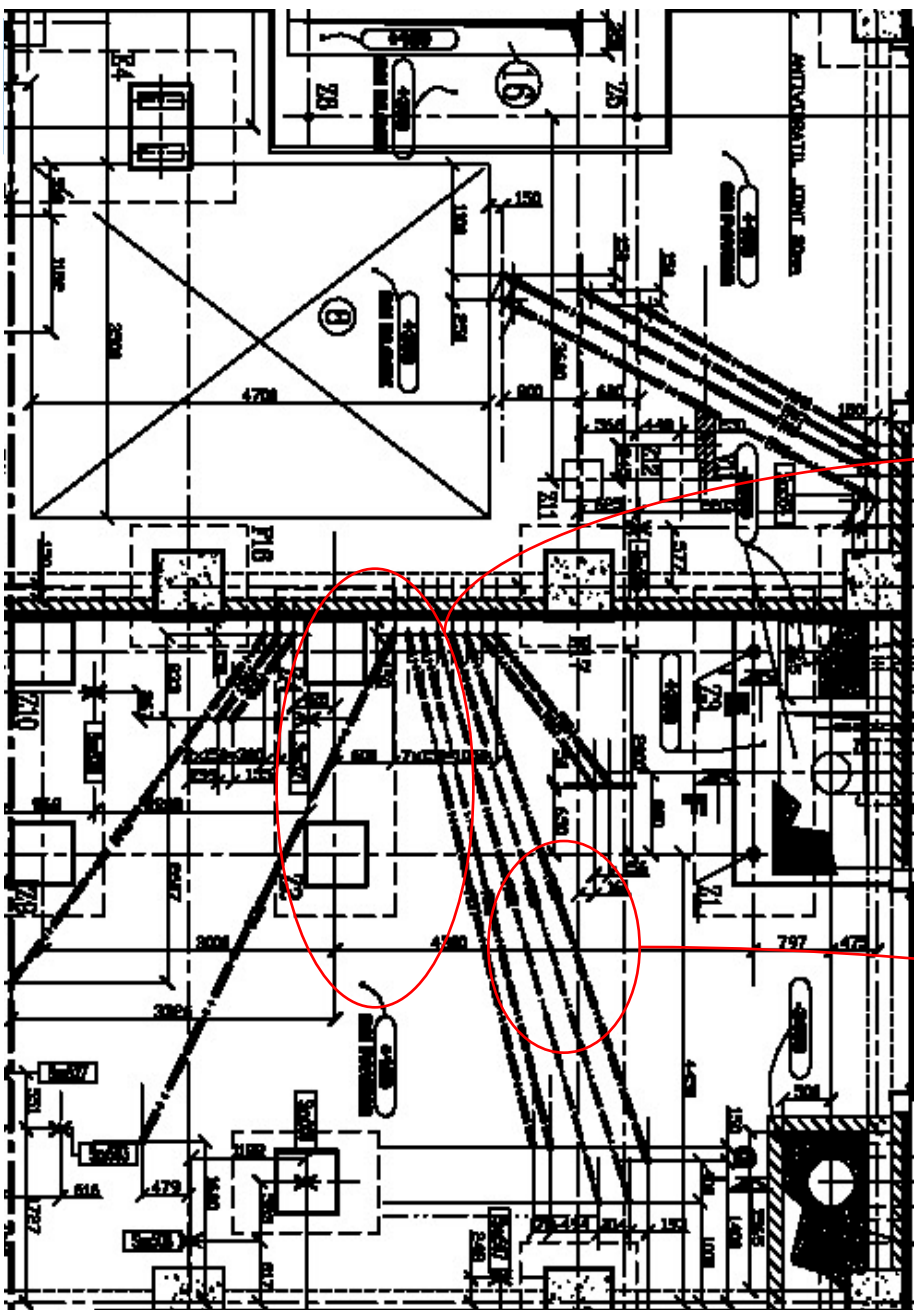
Technological Control Rooms:

Temperature	22 ± 2 °C
Relative Humidity	50 ± 10 %

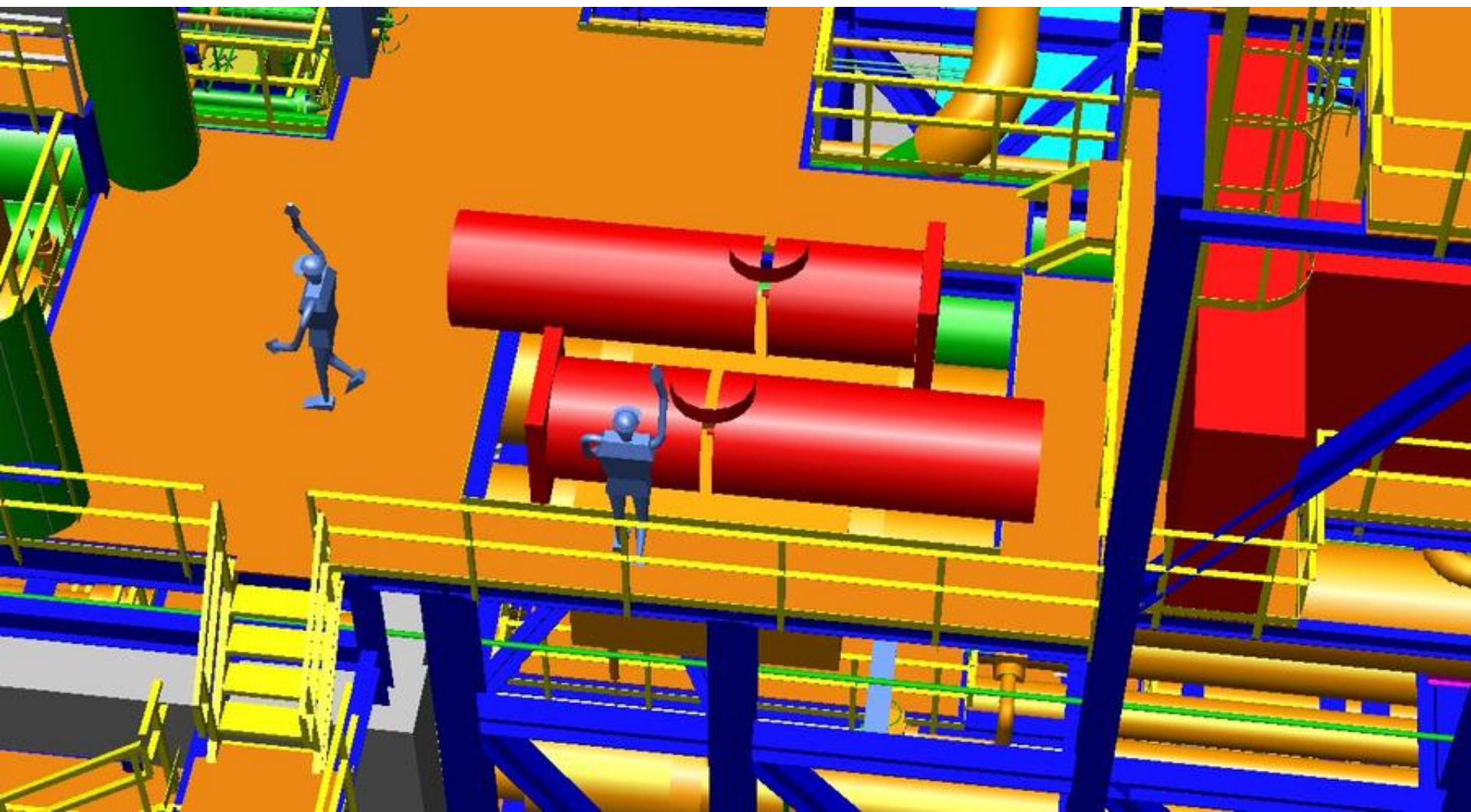
ESTIMATED HEAT EMISSION FROM EQUIPMENT (w/m² OF FLOOR AREA)

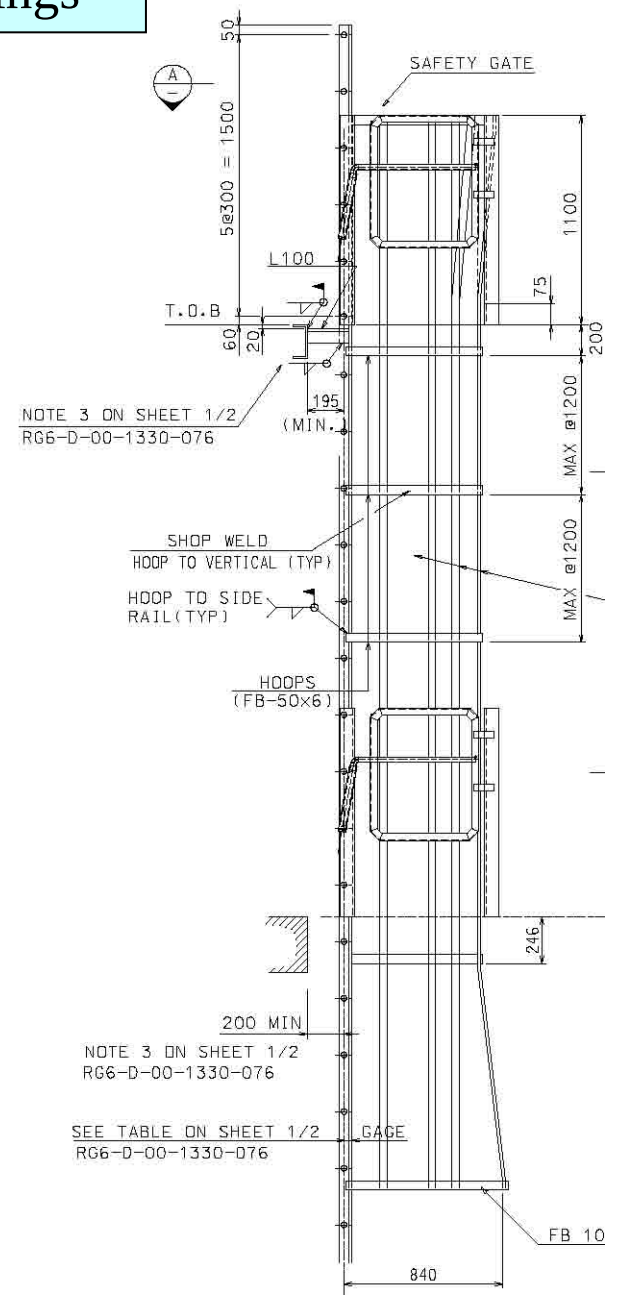
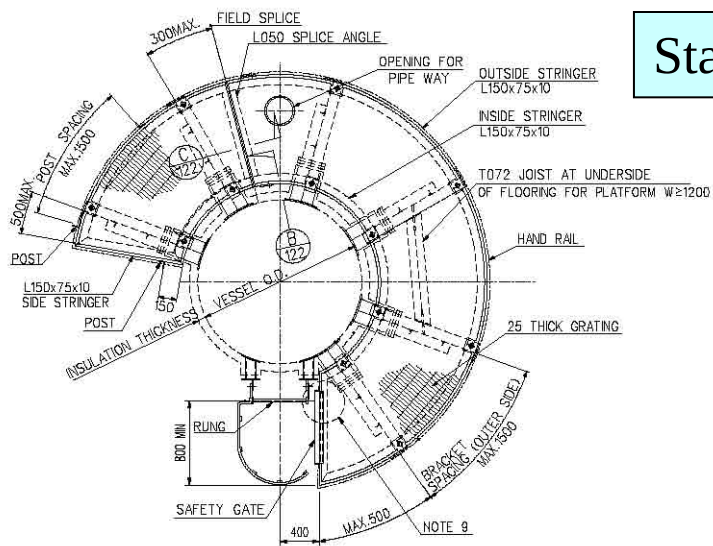
CONTROL ROOMS	350
OFFICES, LABORATORIES, CLINIC	-
ELECTRICAL SWITCH ROOMS	50
KITCHENS	250
DINING AREAS	50
MAINTENANCE AREAS	15





Civil Works Installation Drawings





Engineering

- Process

- Equipment

- HSE

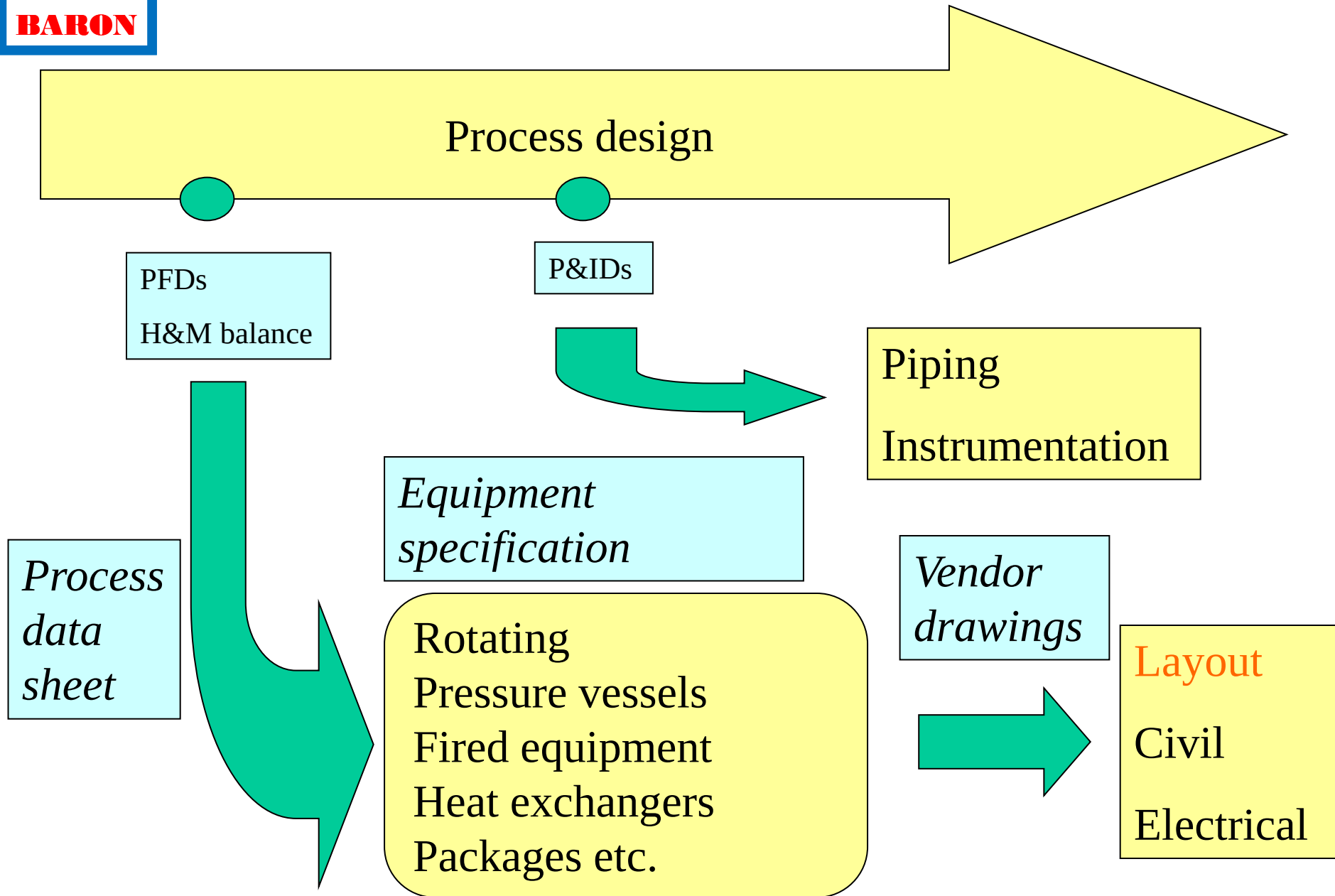
- Civil

- Layout

- Piping

- Instrumentation

- Electrical





R
FLARE TOWER

B
MAIN ELEC BLDG &
WORKSHOPS

P
TEST EQPT &
CRUDE PUMPS

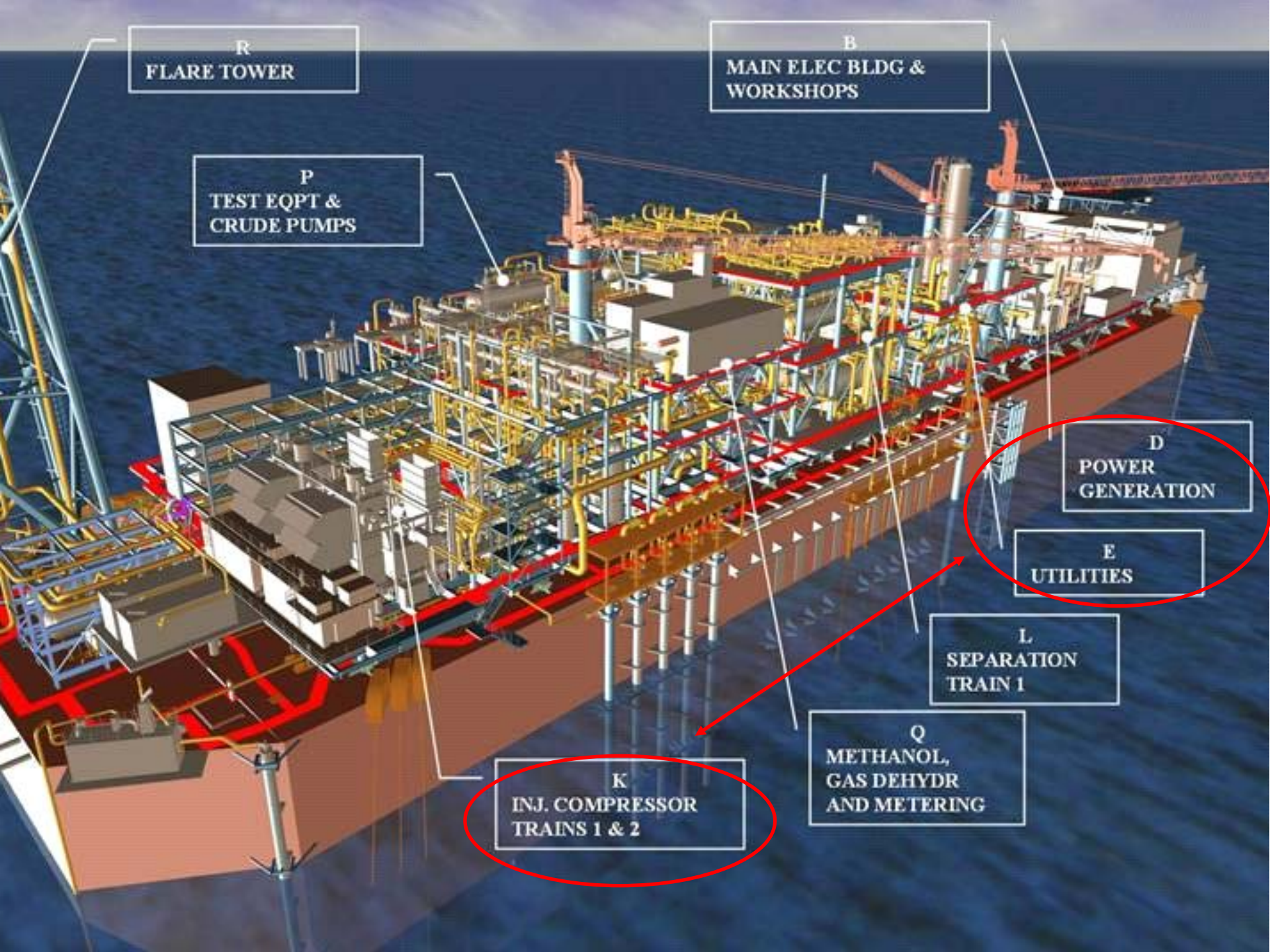
D
POWER
GENERATION

E
UTILITIES

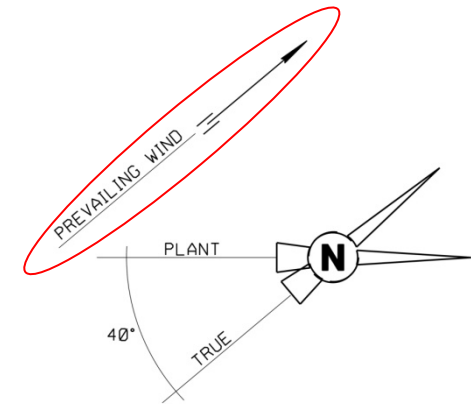
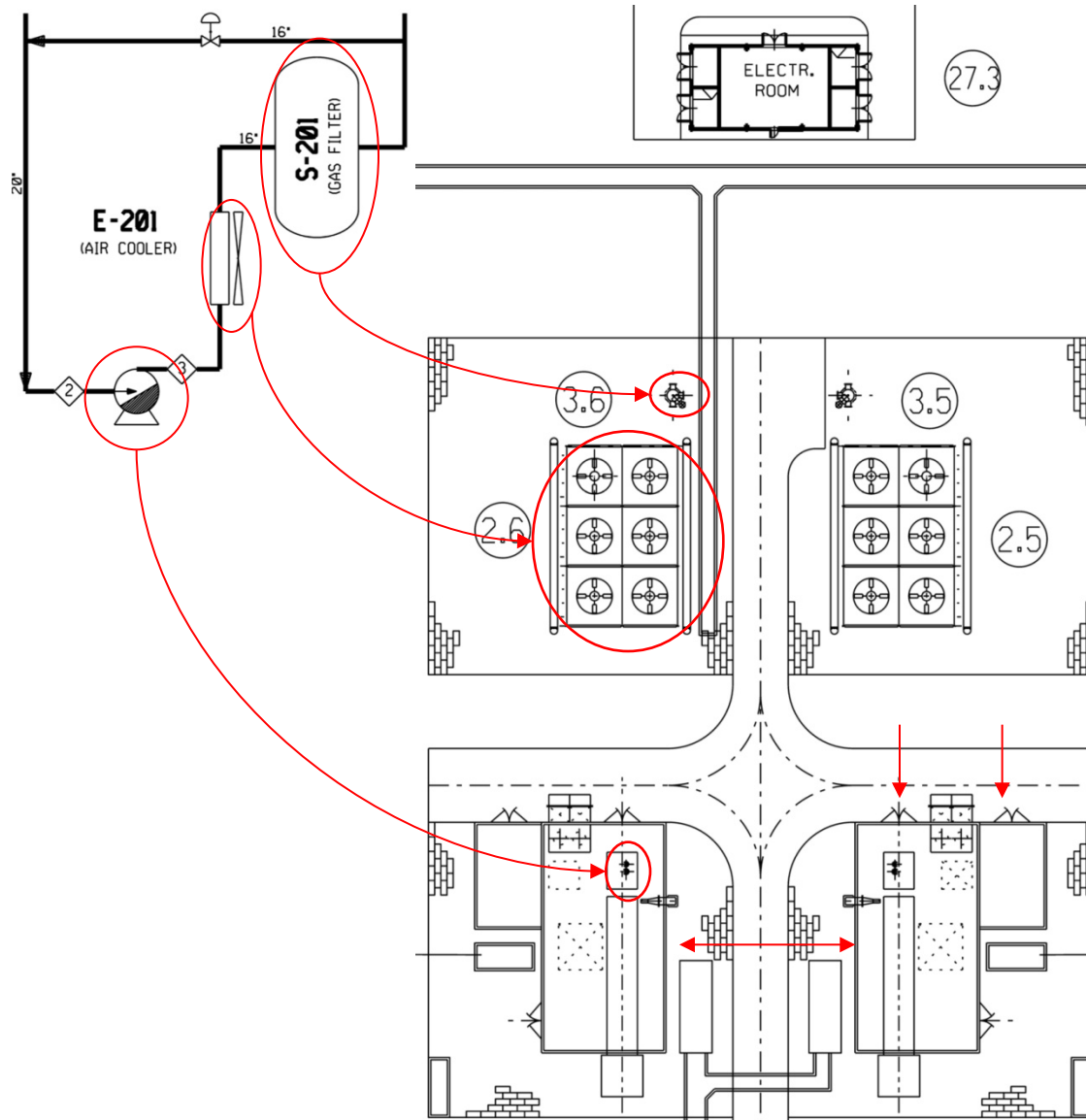
L
SEPARATION
TRAIN 1

K
INJ. COMPRESSOR
TRAINS 1 & 2

Q
METHANOL,
GAS DEHYDR
AND METERING



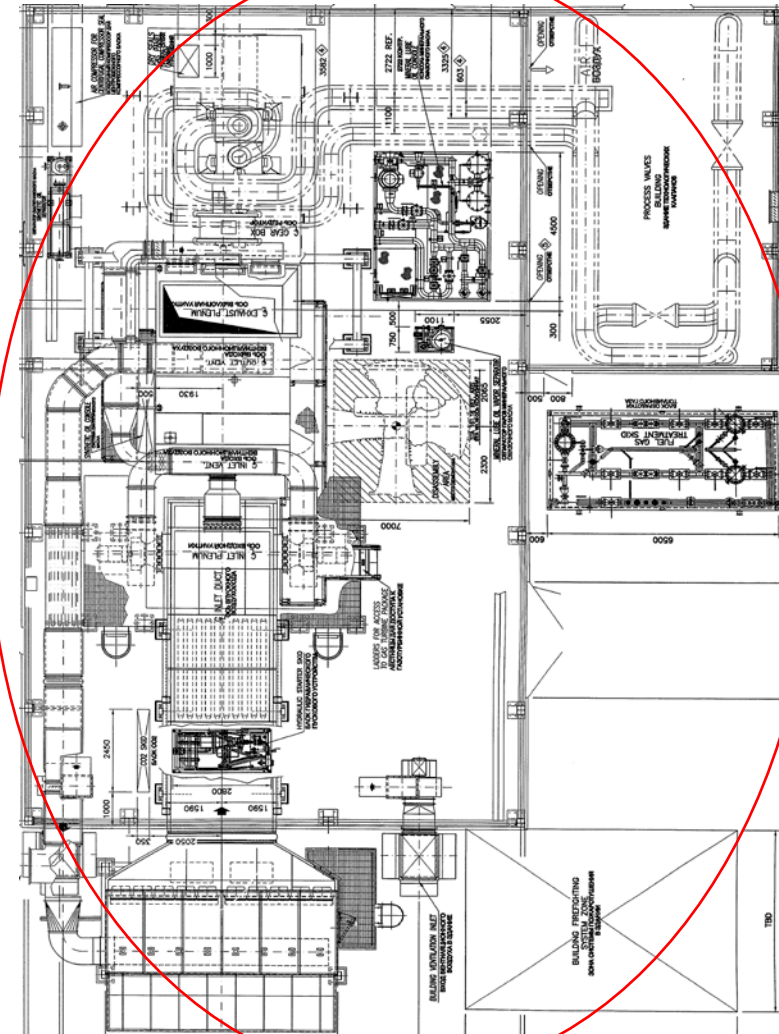
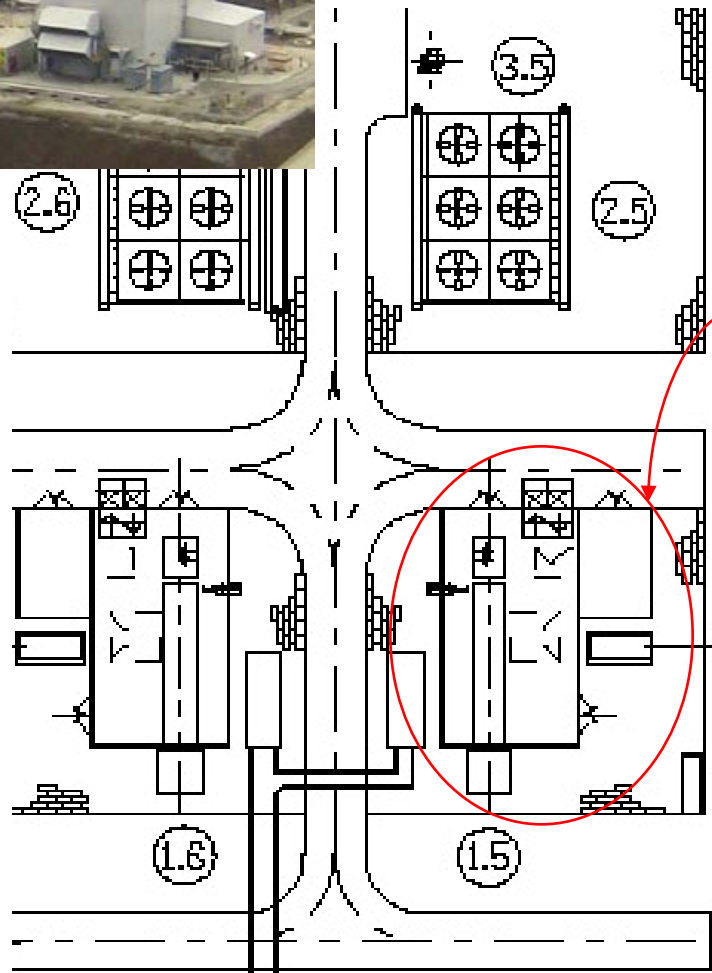
**HERVE
BARON**

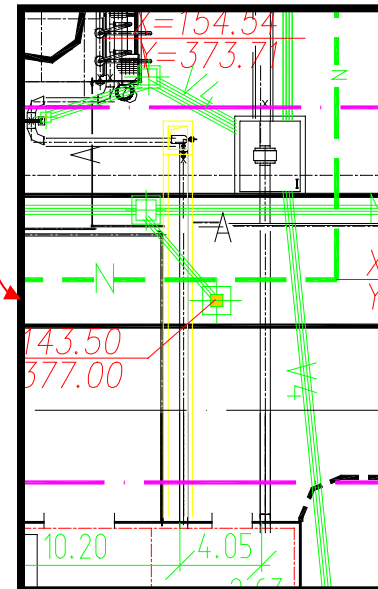
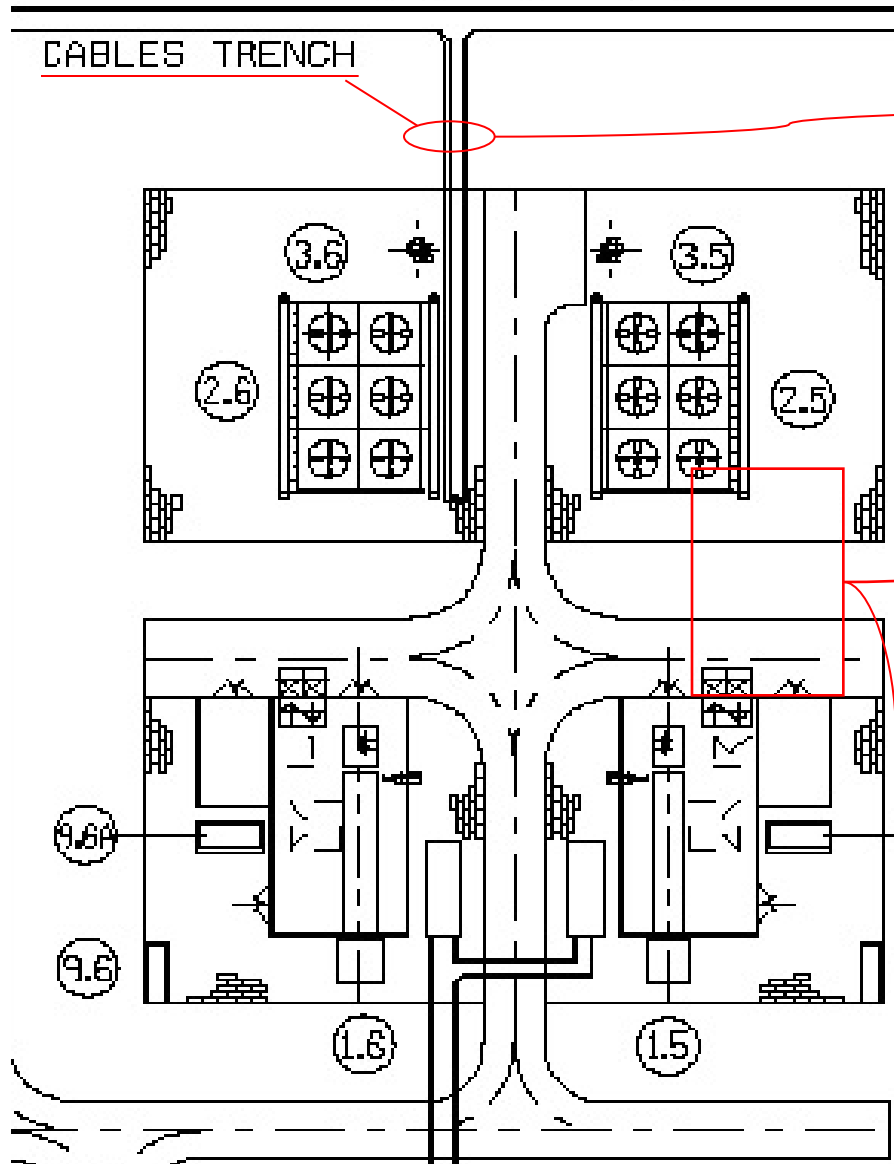


Layout/
principles



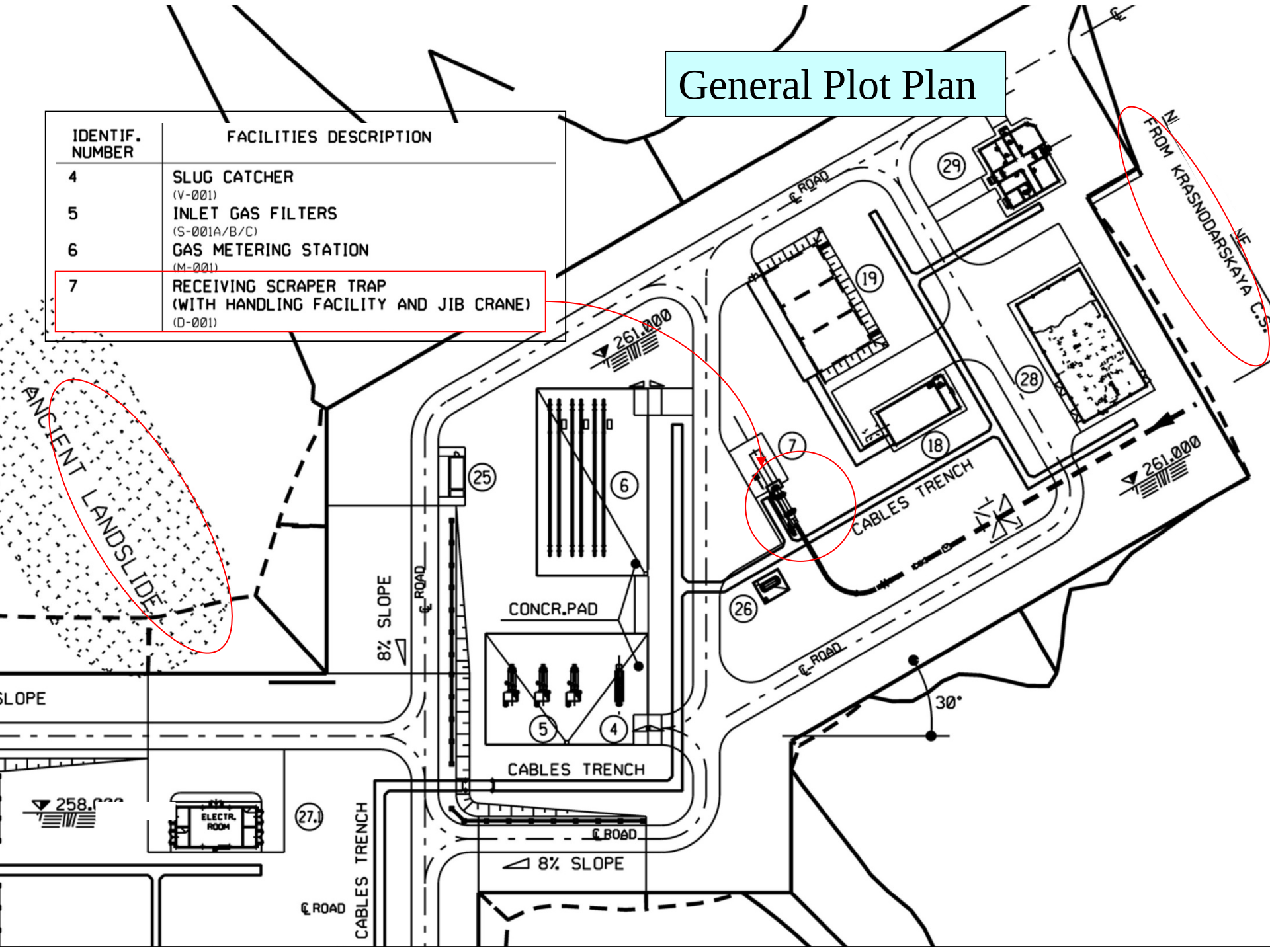
Layout/vendor drawings



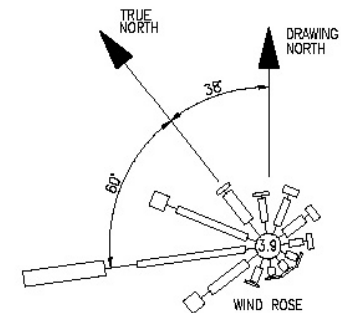
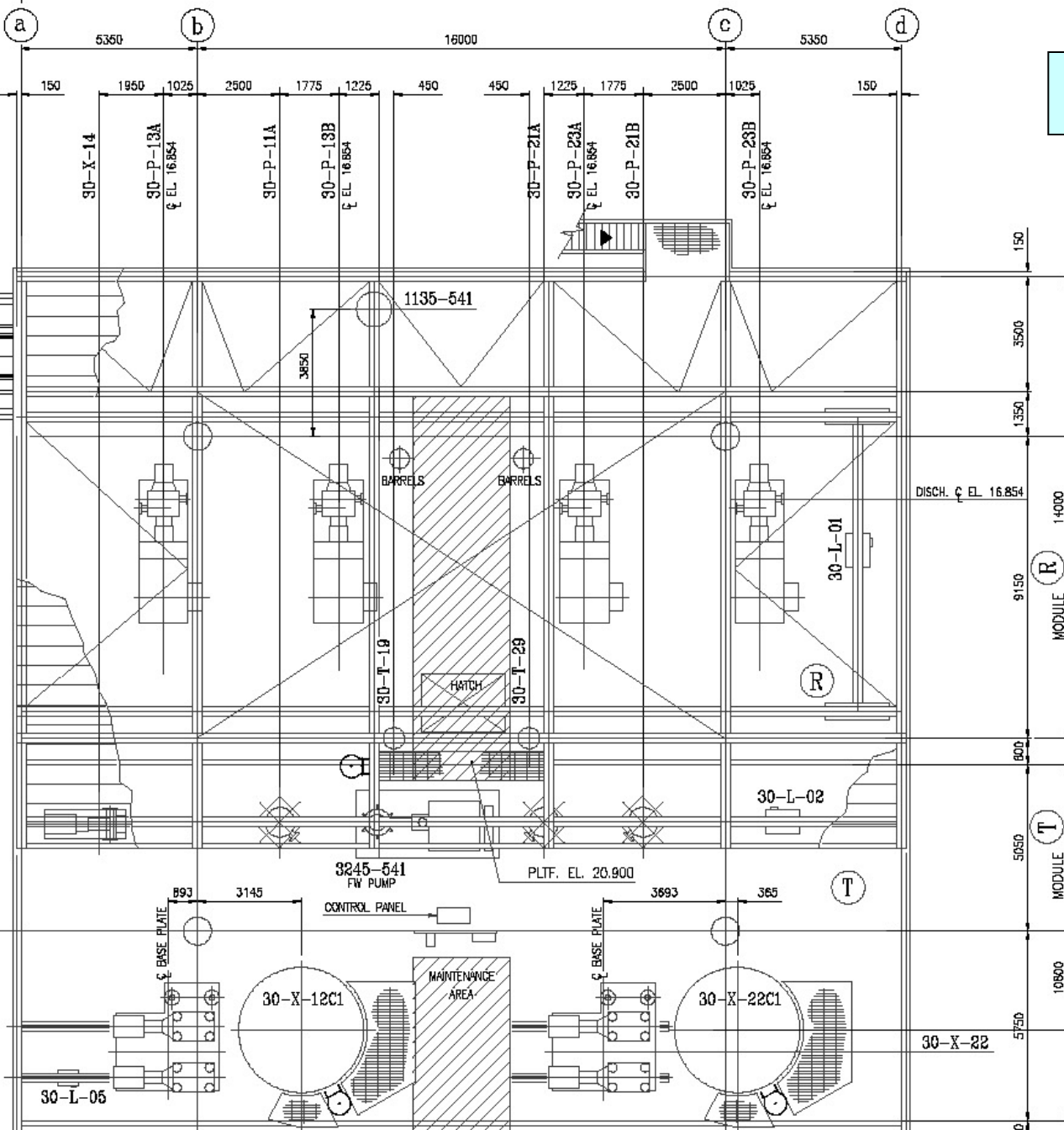


General Plot Plan

IDENTIF. NUMBER	FACILITIES DESCRIPTION
4	SLUG CATCHER (V-001)
5	INLET GAS FILTERS (S-001A/B/C)
6	GAS METERING STATION (M-001)
7	RECEIVING SCRAPER TRAP (WITH HANDLING FACILITY AND JIB CRANE) (D-001)



Unit Plot Plan

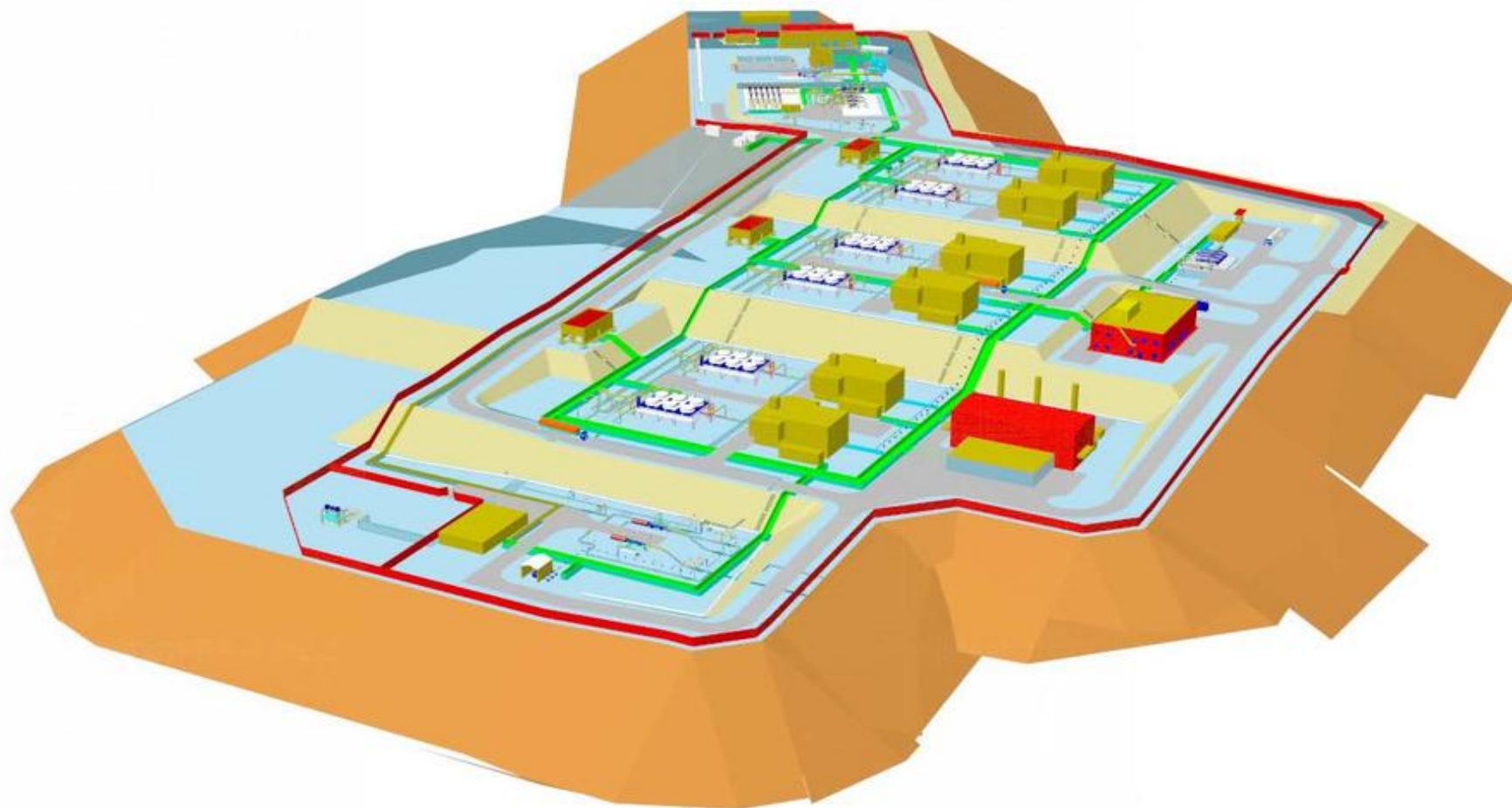


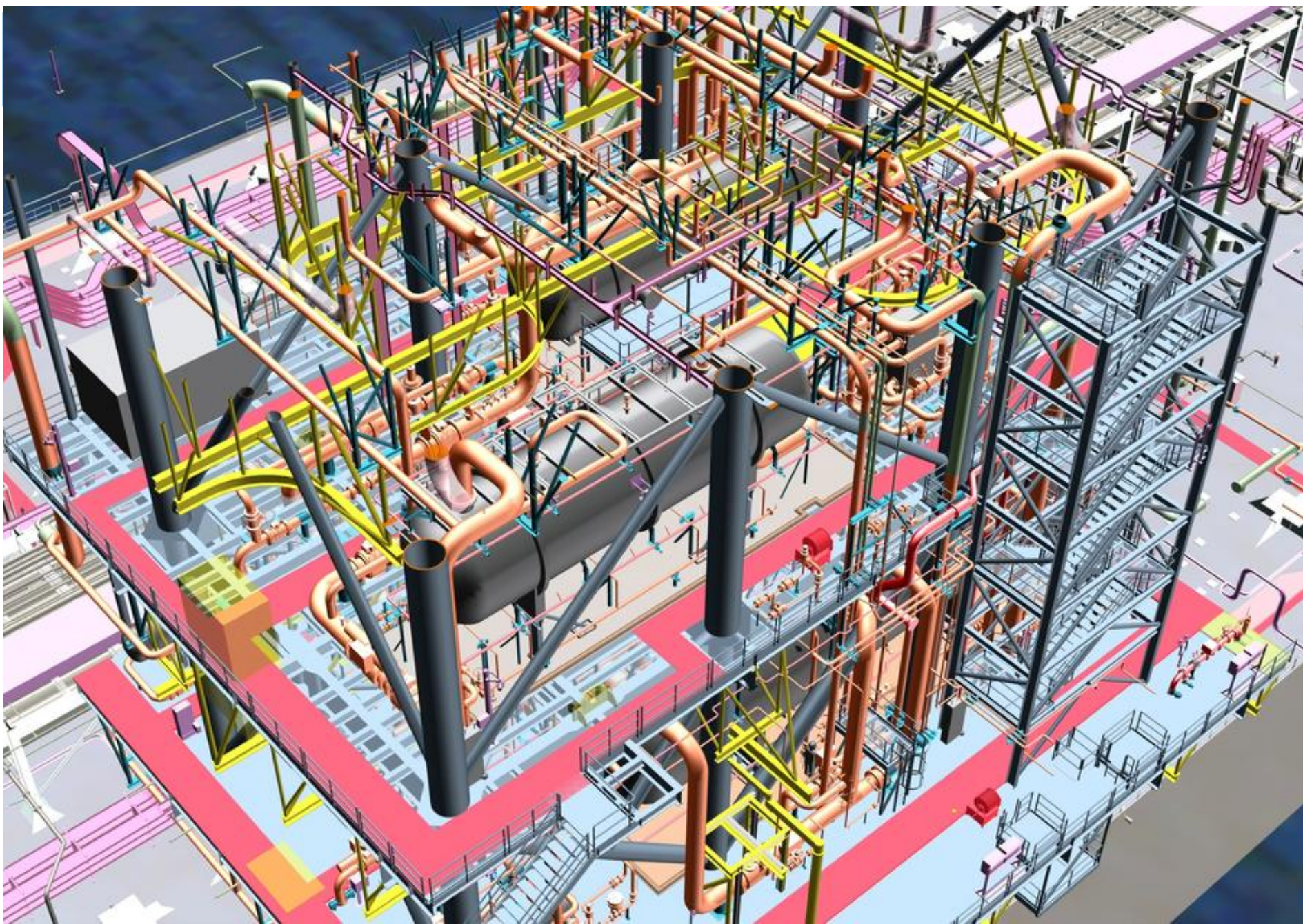
GENERAL NOTES:

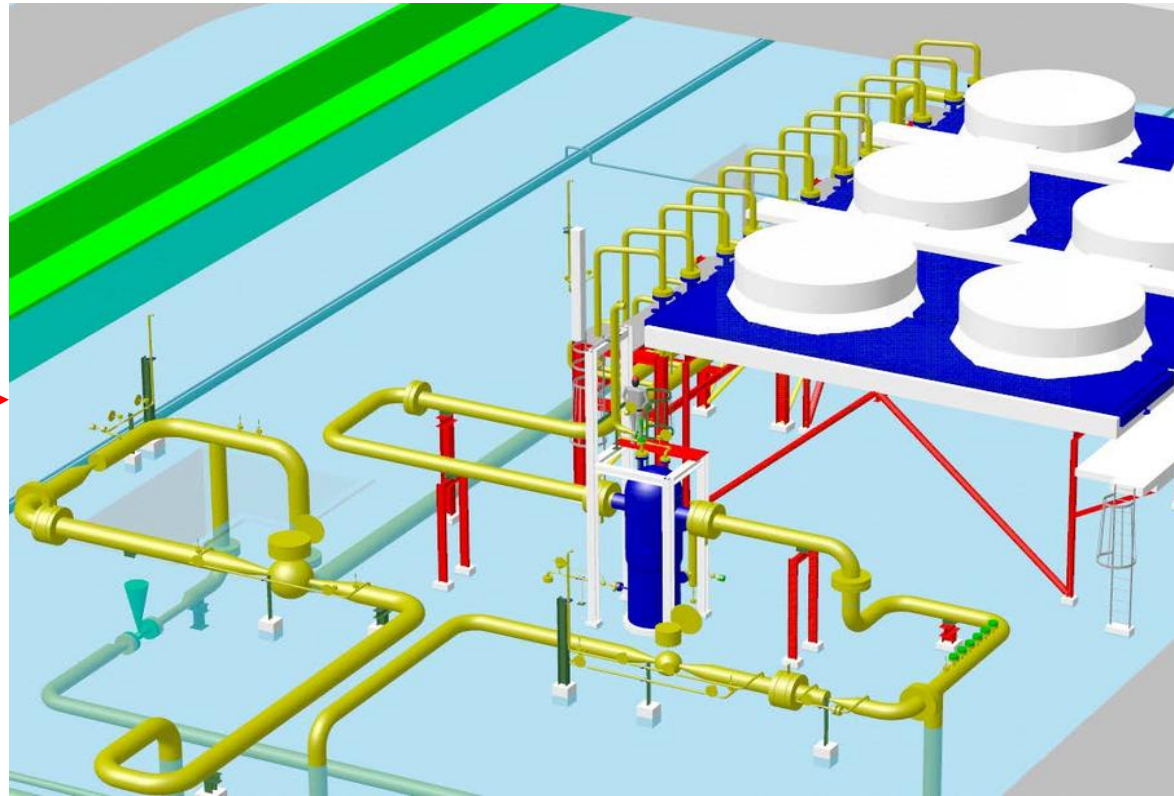
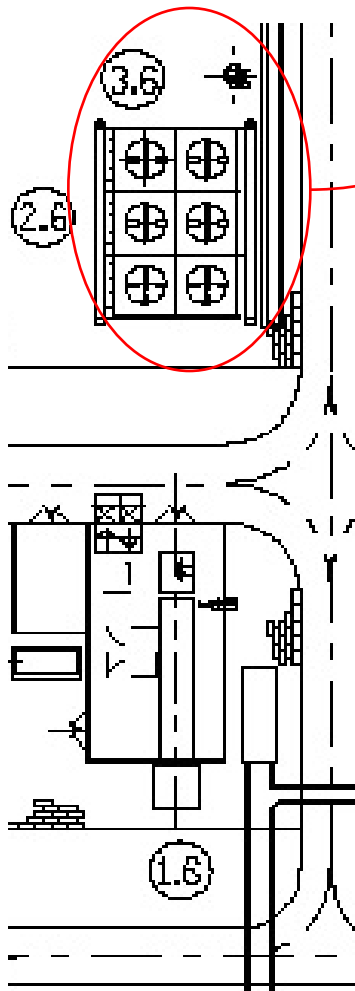
1. ALL DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
2. DECK LEVELS ARE REFERRING TO MEAN SEA LEVEL (M.S.L.) EL. 0.000.
3. PEDESTAL CRANE MUST BE ABLE TO REACH BOTH EXISTING AND NEW SAND FILTERS.

EQUIPMENT LIST (NEW WATER INJECTION PLATFORM)

TAG No.	DESCRIPTION	REMARKS
463-D-2139	DEGASSING TOWER PACKAGE	
463-D-2140	DEGASSING TOWER PACKAGE	
463-F-2136	SAND FILTER PACKAGE	
463-F-2138	SAND FILTER PACKAGE	
463-P-2343	WATER WINNING PUMP	
463-P-2345A	FIRST STAGE WATER INJECTION PUMP	
463-P-2345B	SECOND STAGE WATER INJECTION PUMP	
463-P-2354	WATER WINNING PUMP	
463-P-2356A	FIRST STAGE WATER INJECTION PUMP	
463-P-2356B	SECOND STAGE WATER INJECTION PUMP	
463-P-2364	WATER WINNING PUMP	
463-X-XXXXA/B	POWER GENERATION PACKAGE UNITS	
HOLD	PEDESTAL CRANE	
HOLD	GANTRY CRANE	

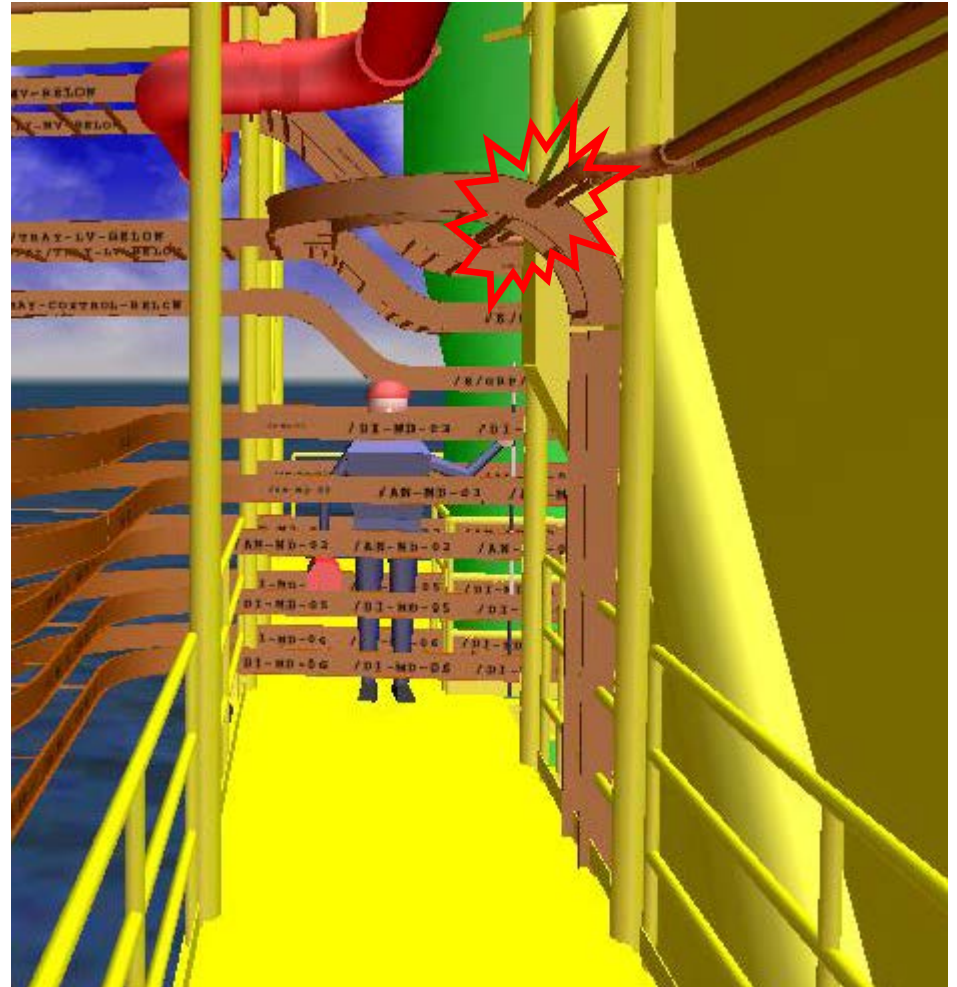
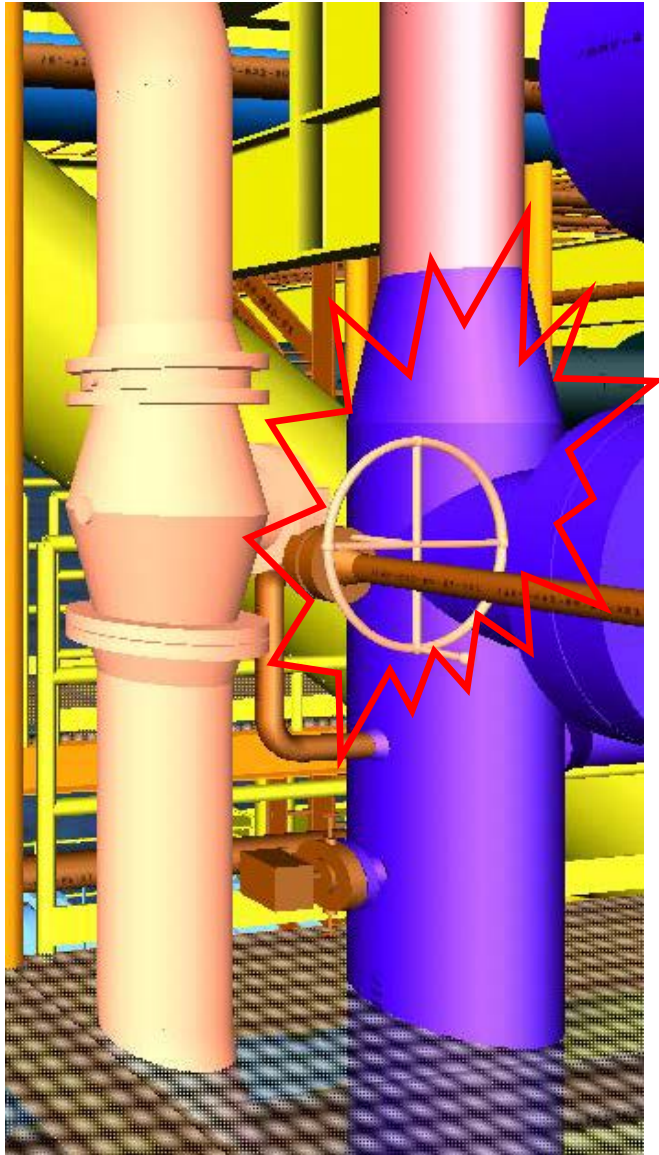


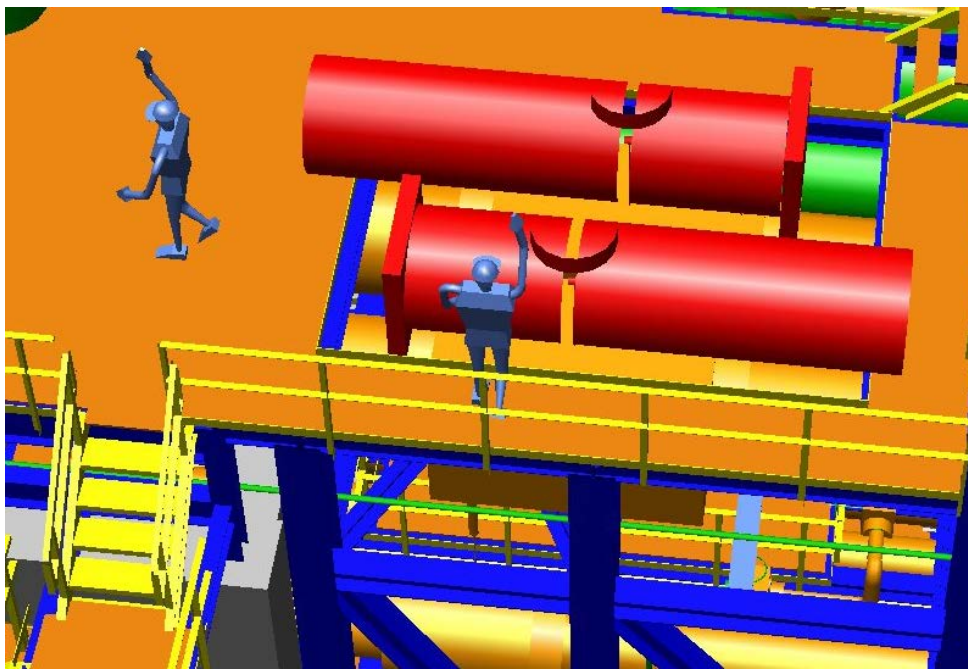




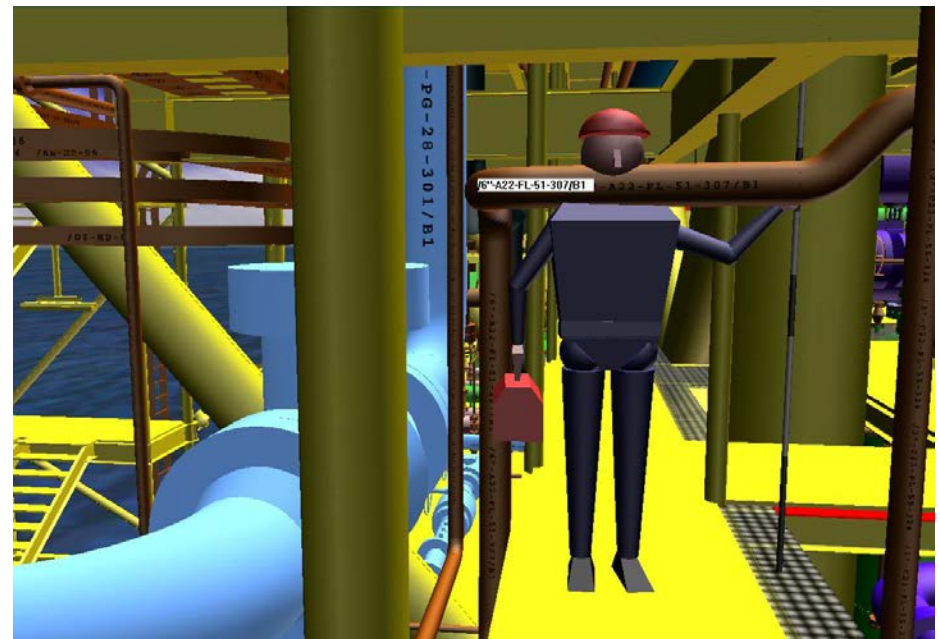
3D modelling

3D model clash check

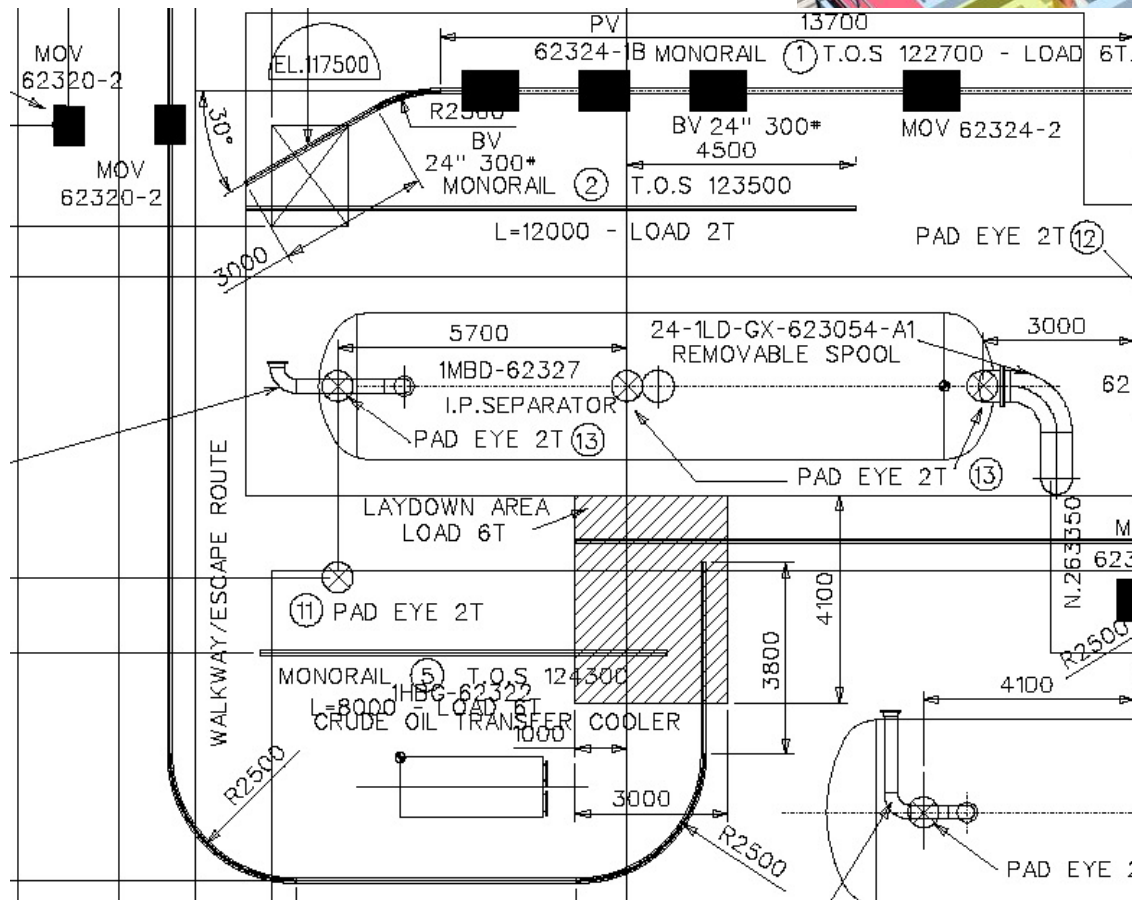
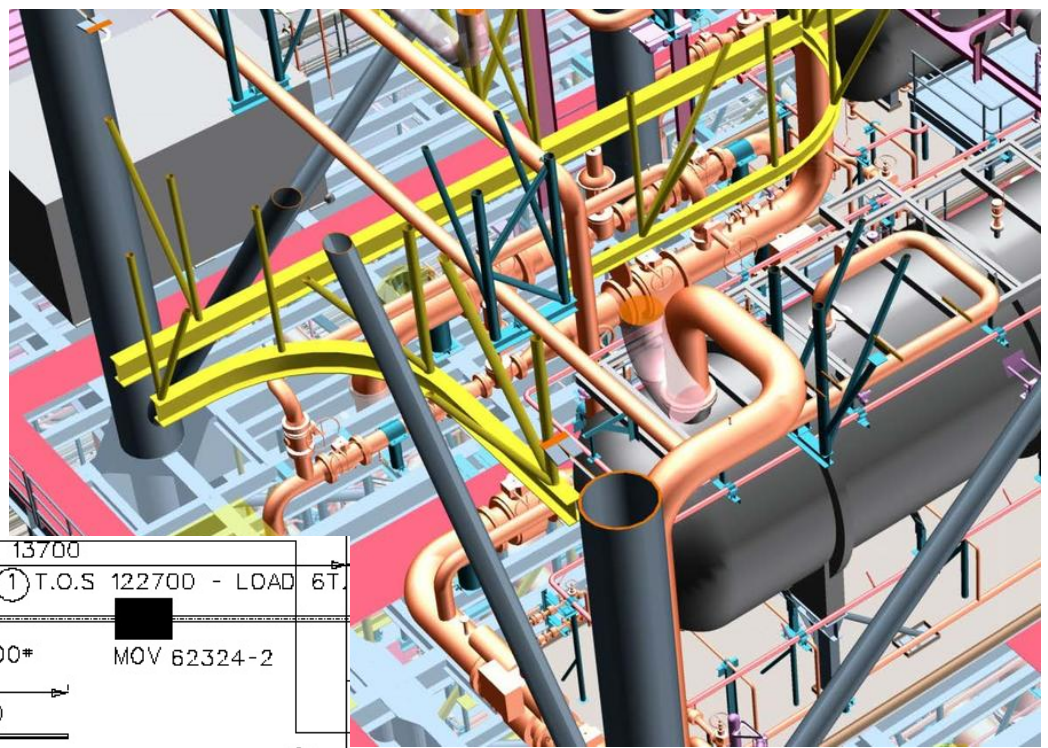




3D model review



Equipment handling



Engineering

- Process

- Equipment

- HSE

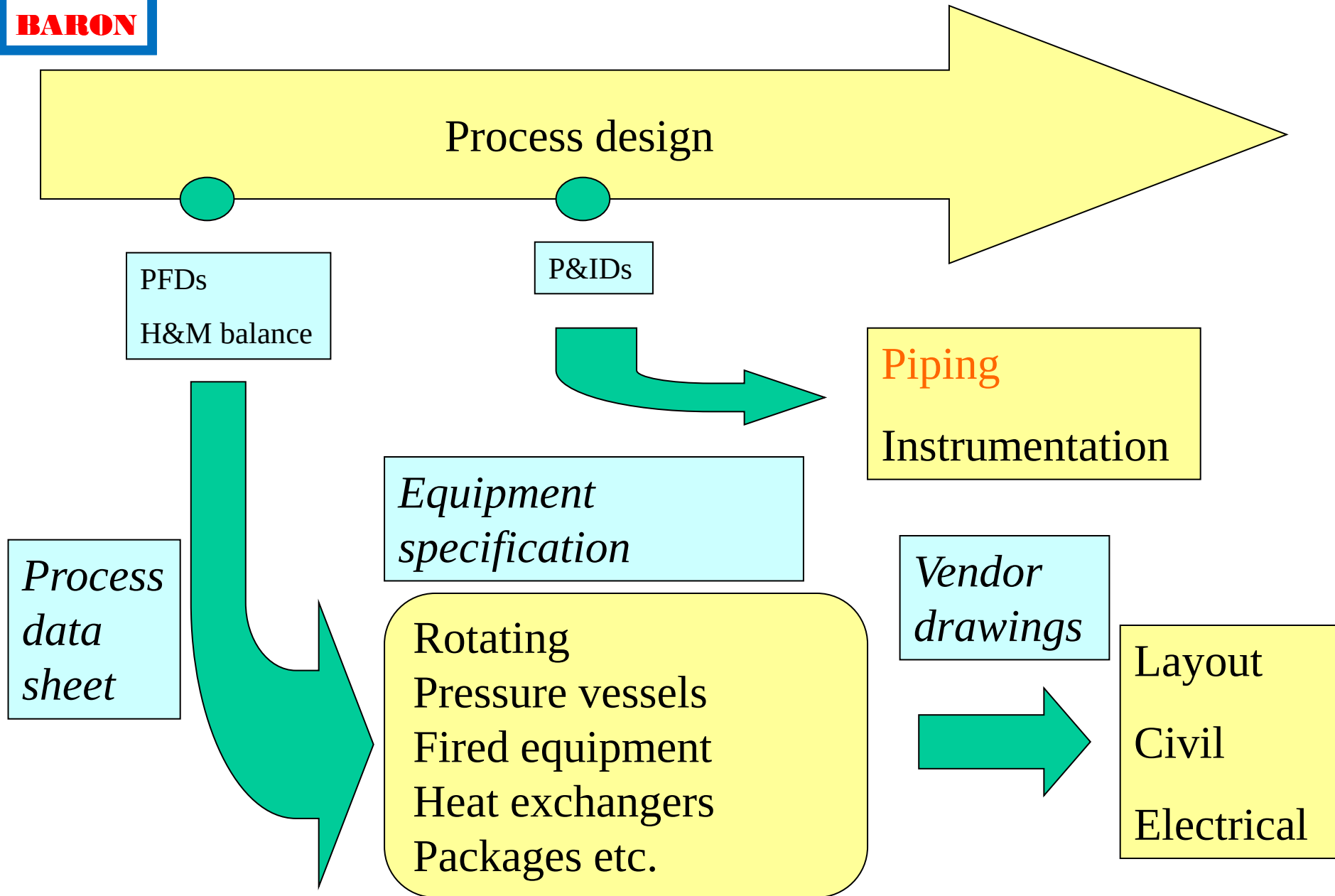
- Civil

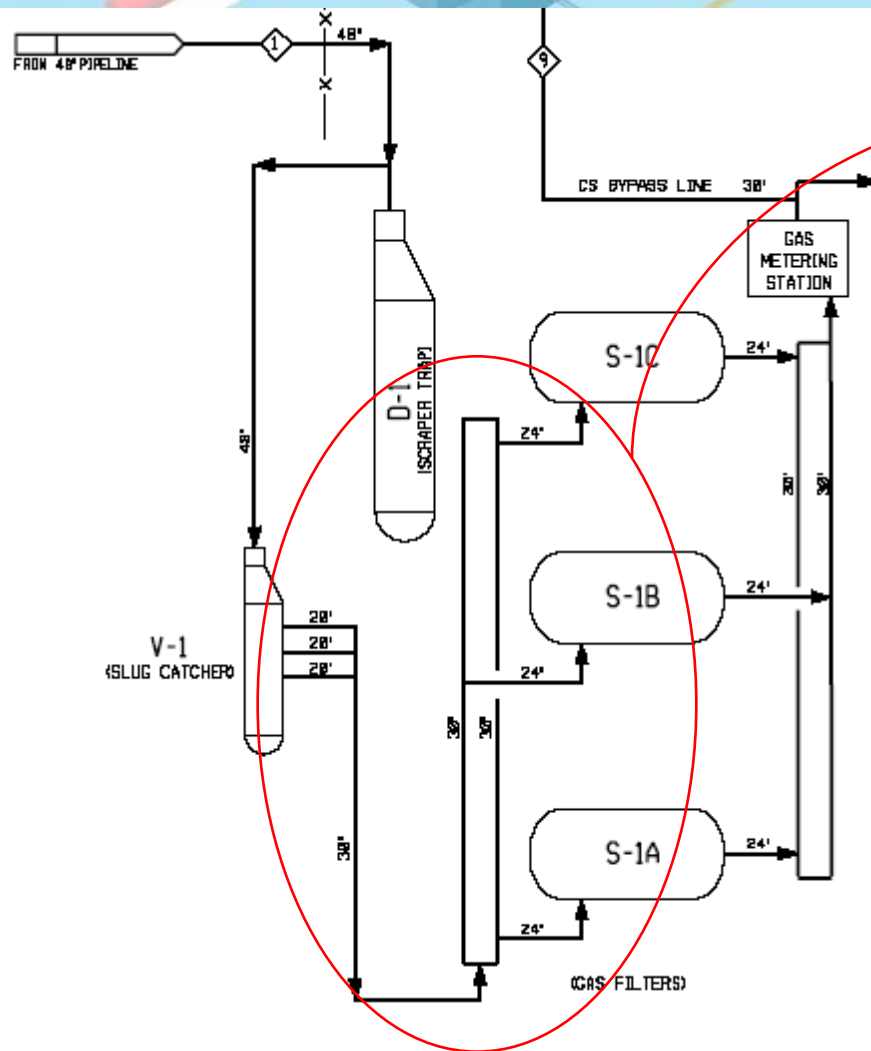
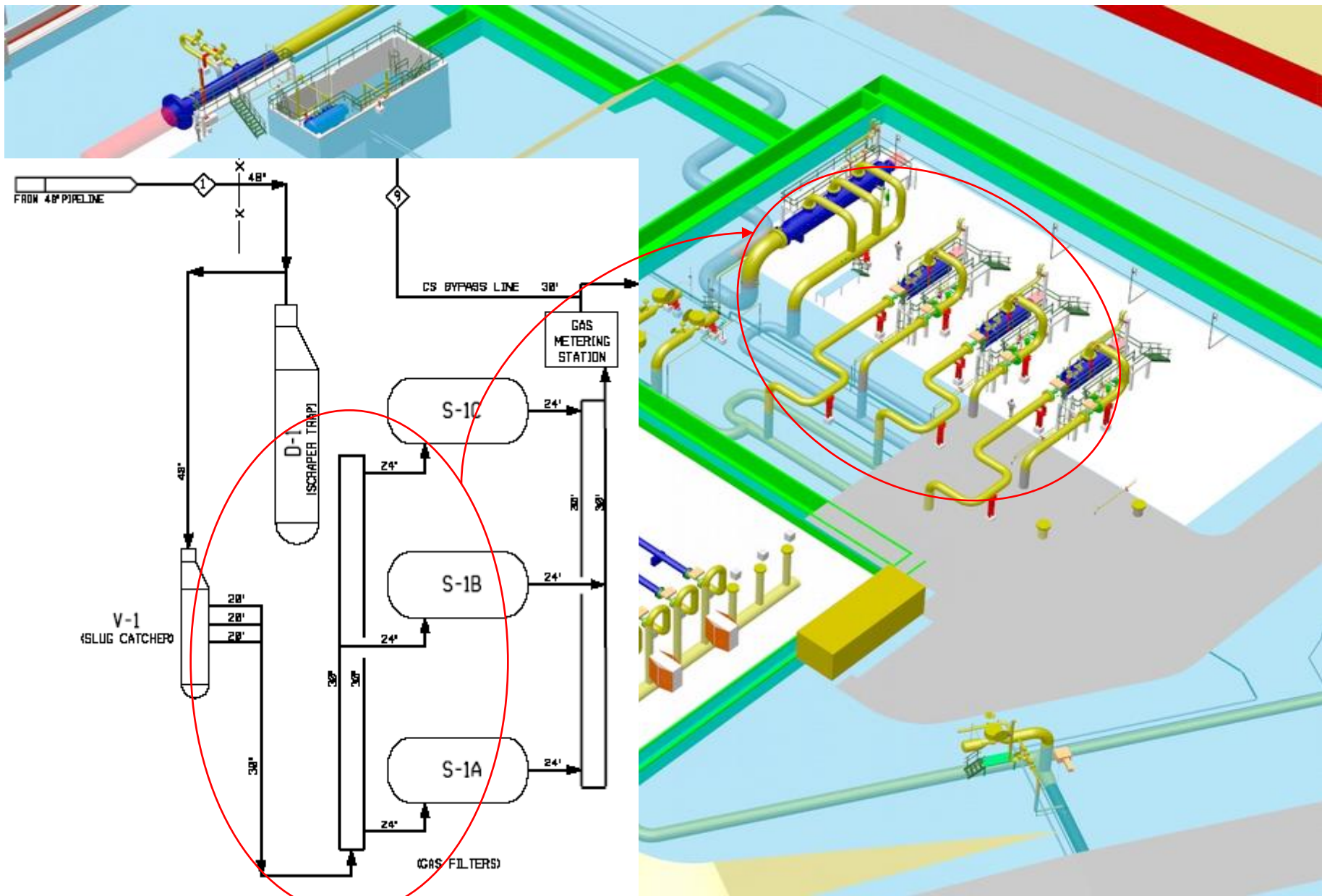
- Layout

- Piping

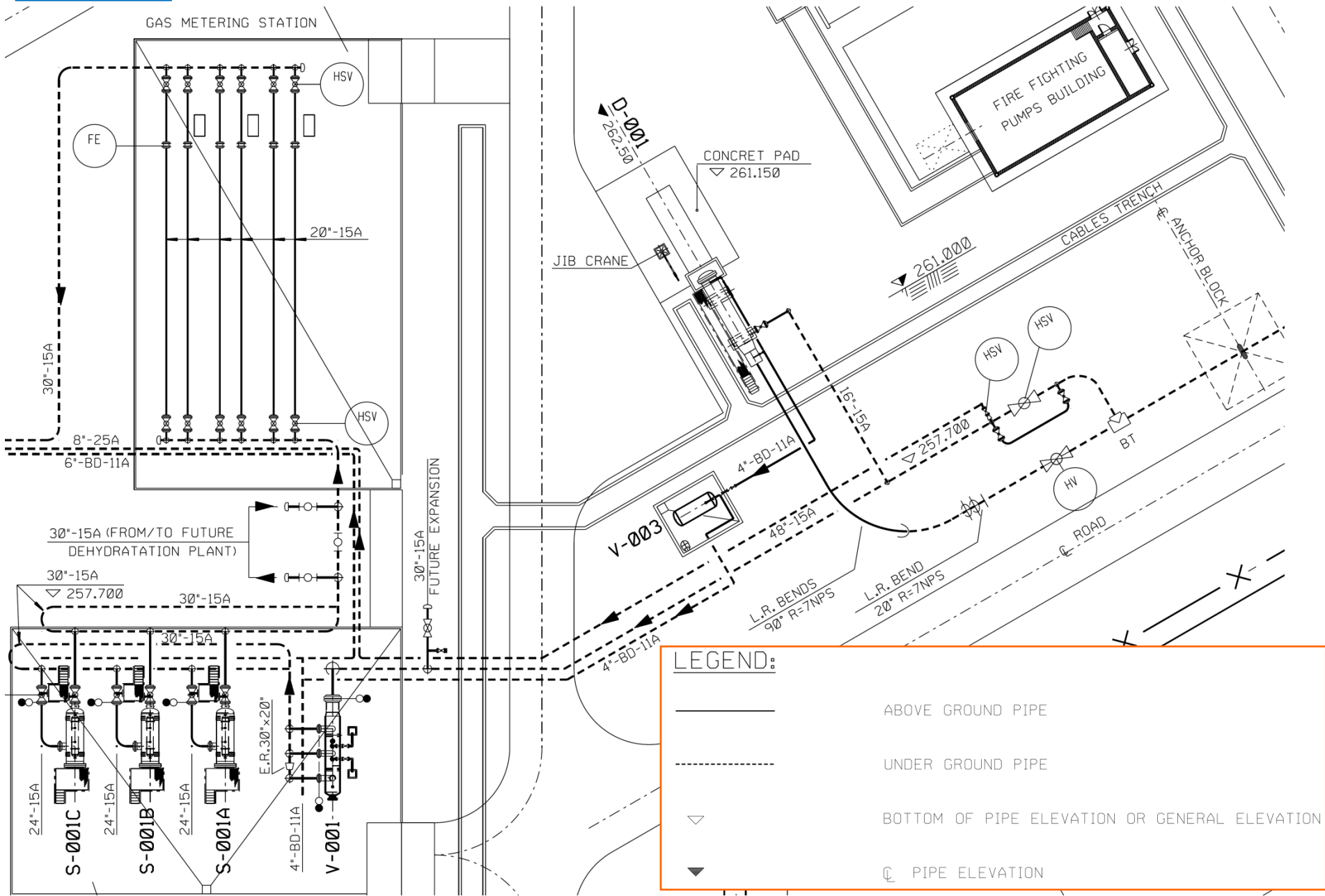
- Instrumentation

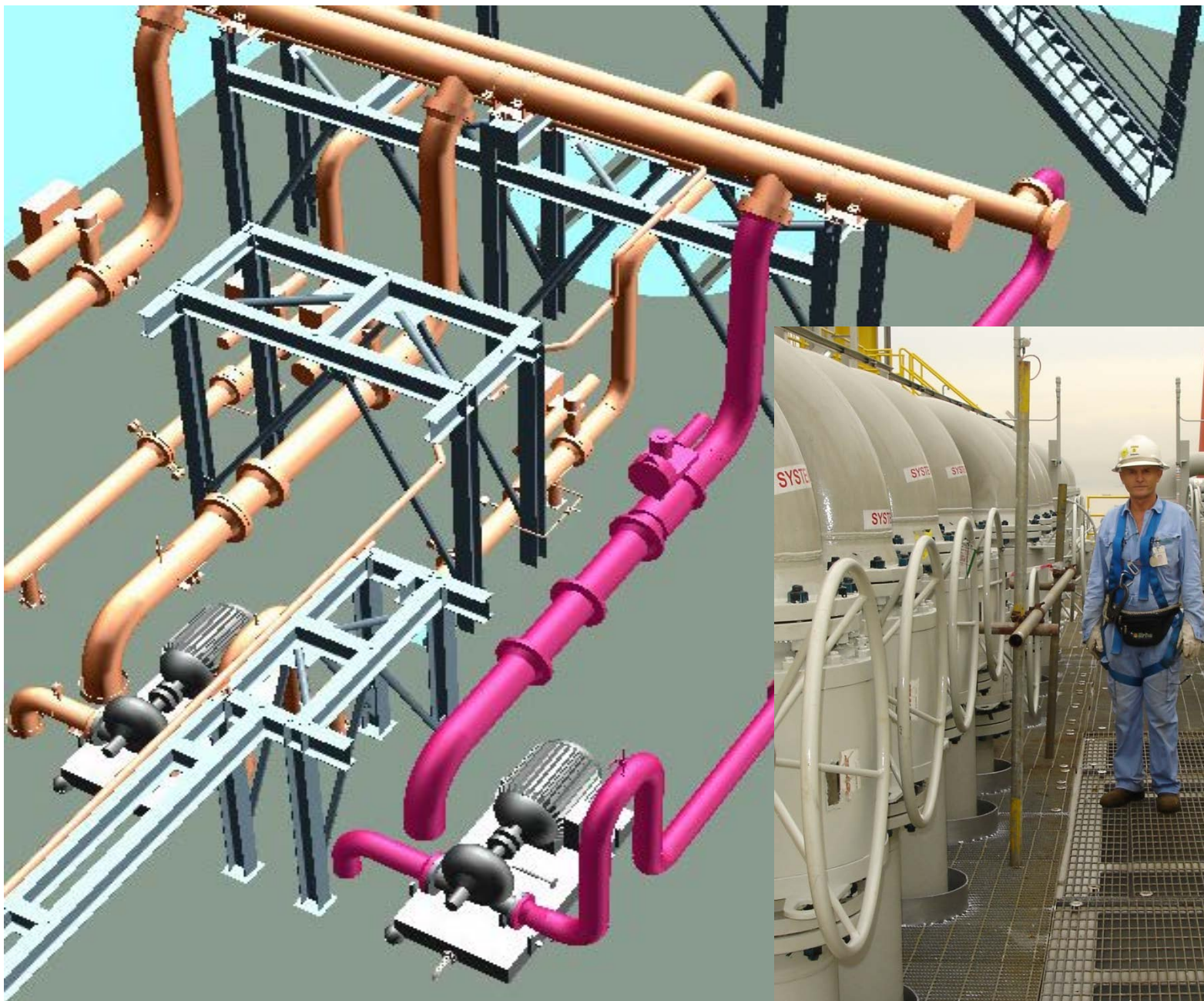
- Electrical

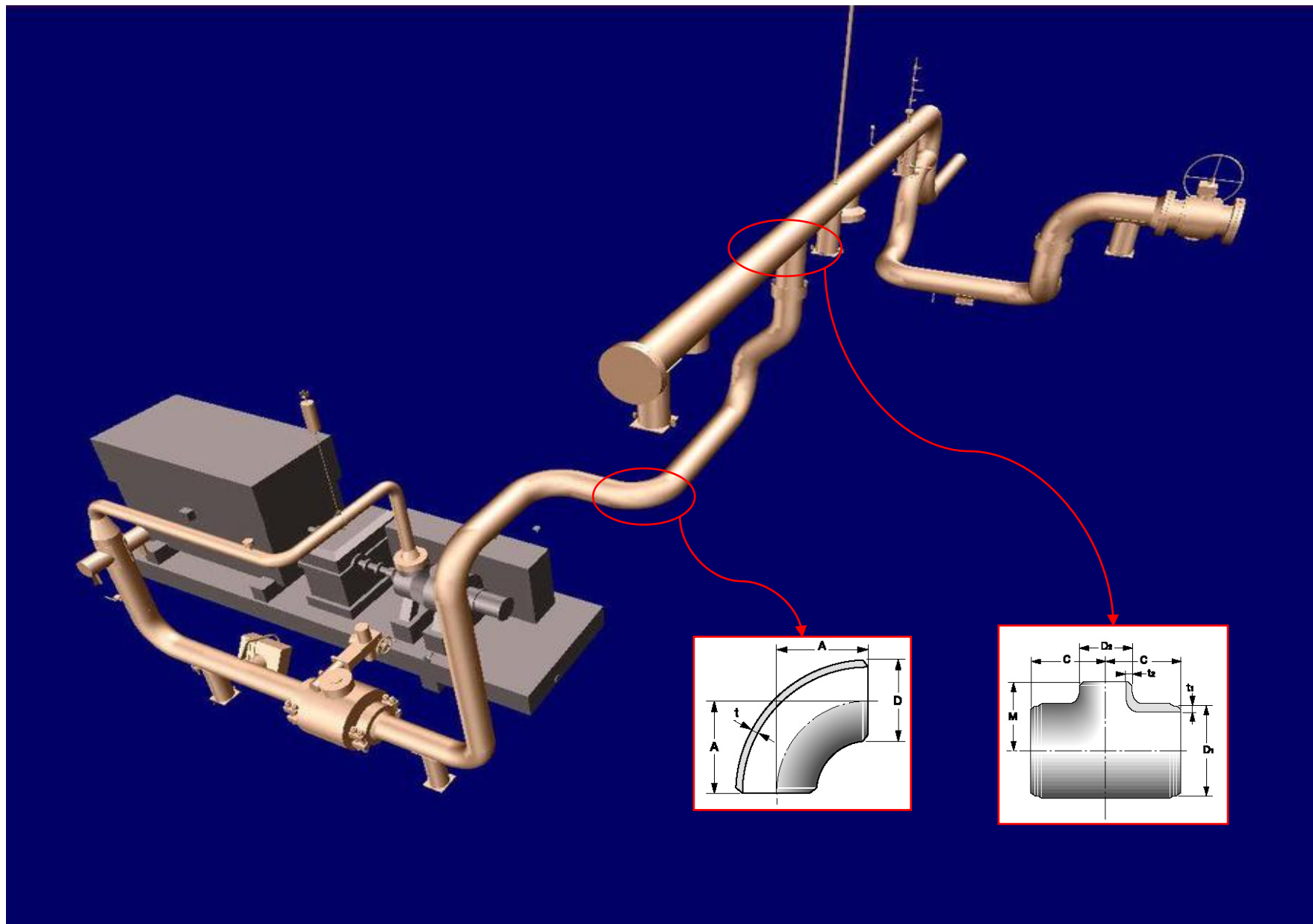


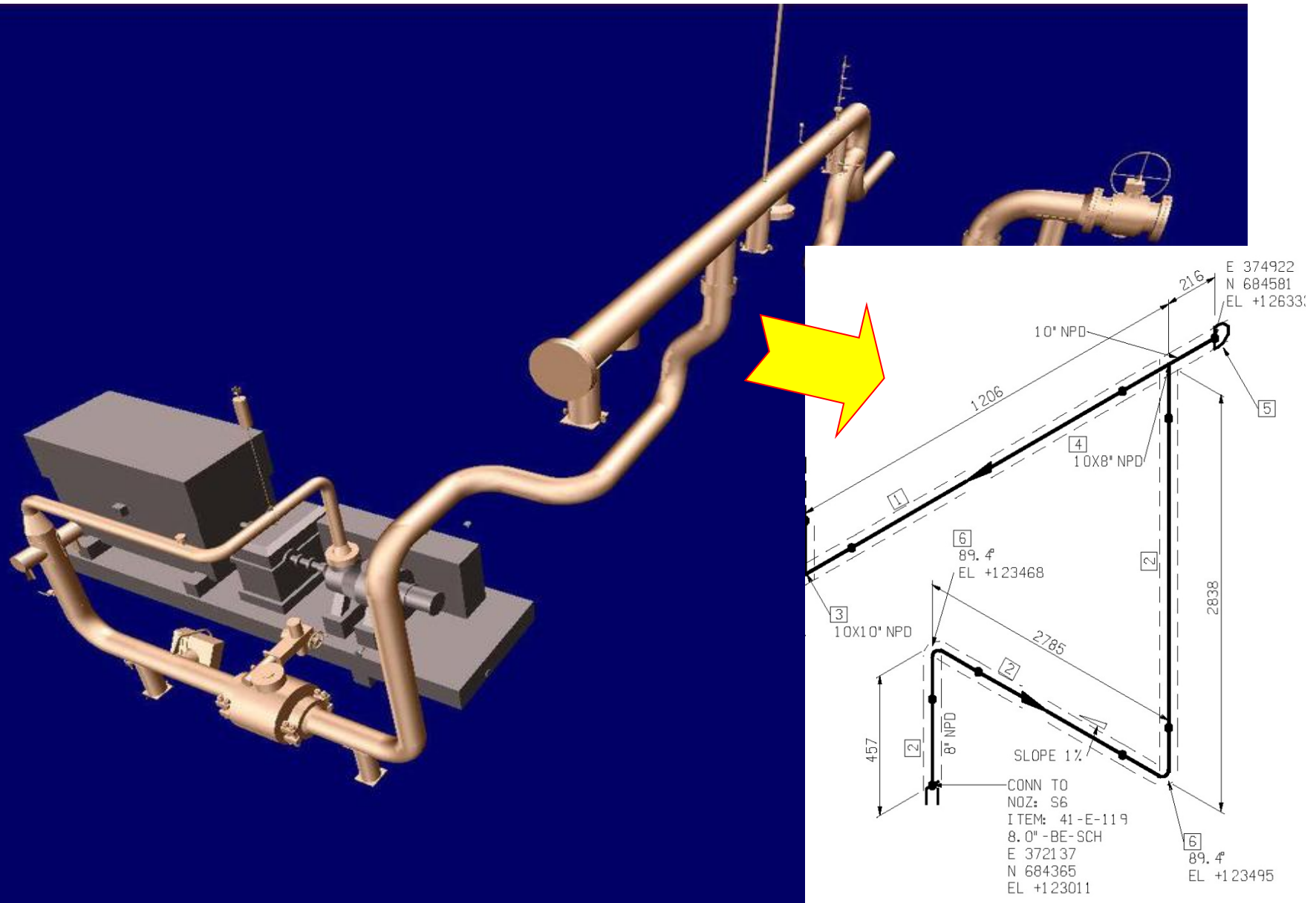


Piping Layout drawing

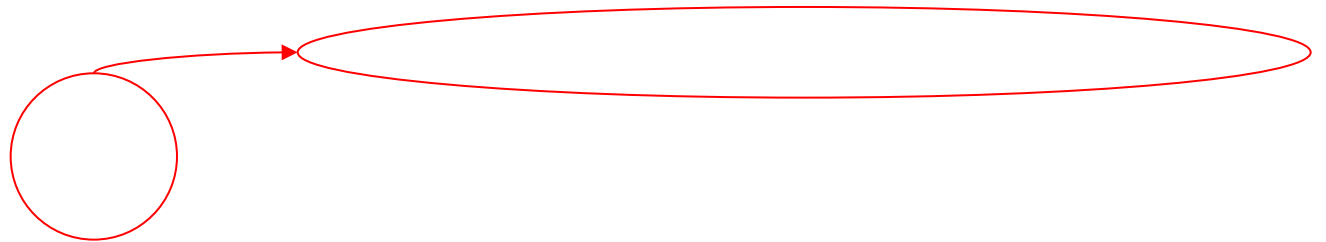




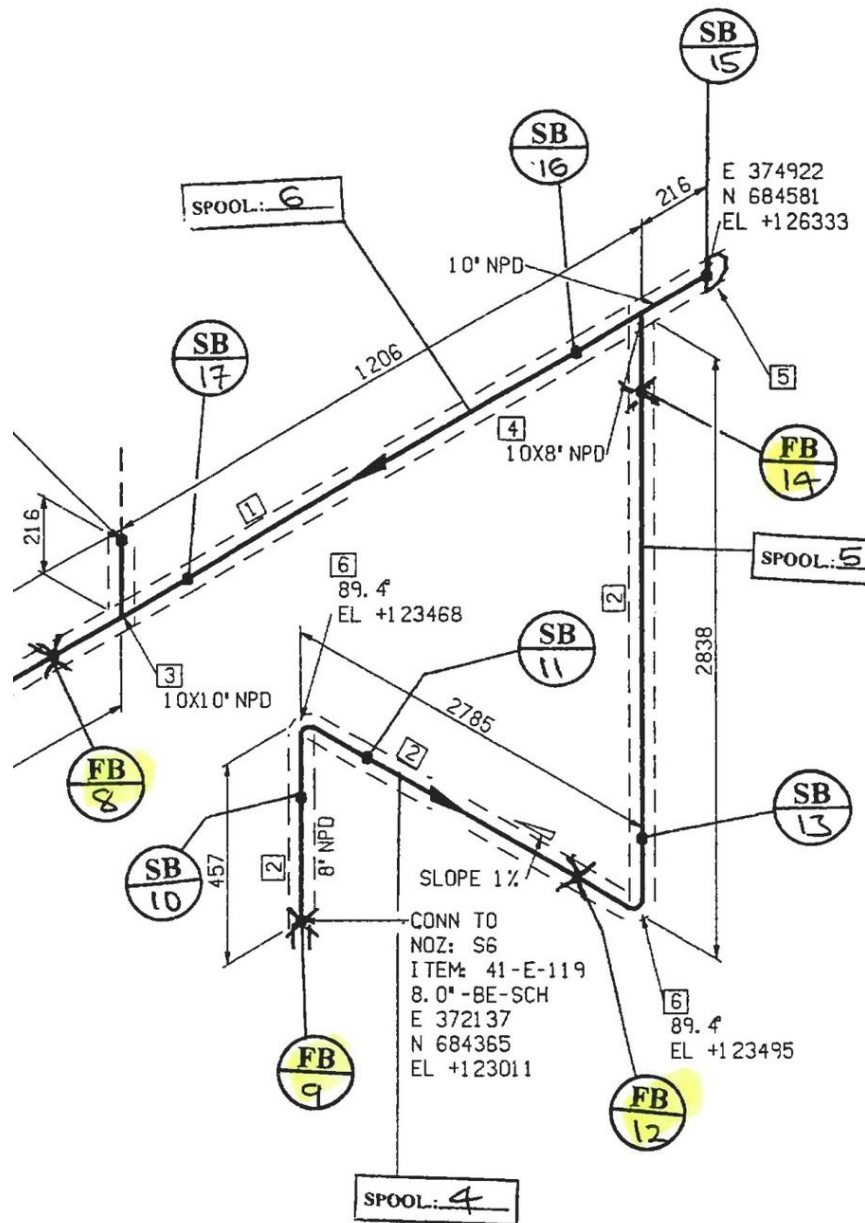




Isometric drawing



Piping Pre-fabrication



POST WELD HEAT TREATMENT REPORT

Report No: P/HT/97/52

Date: 02-04-2009

Unit / Area No.: UTILITY

Recorder Sl. No. C-5002

Material: P4 (AS)

Calibration Date: 10-03-2009

PWHT CYCLE CONDITION

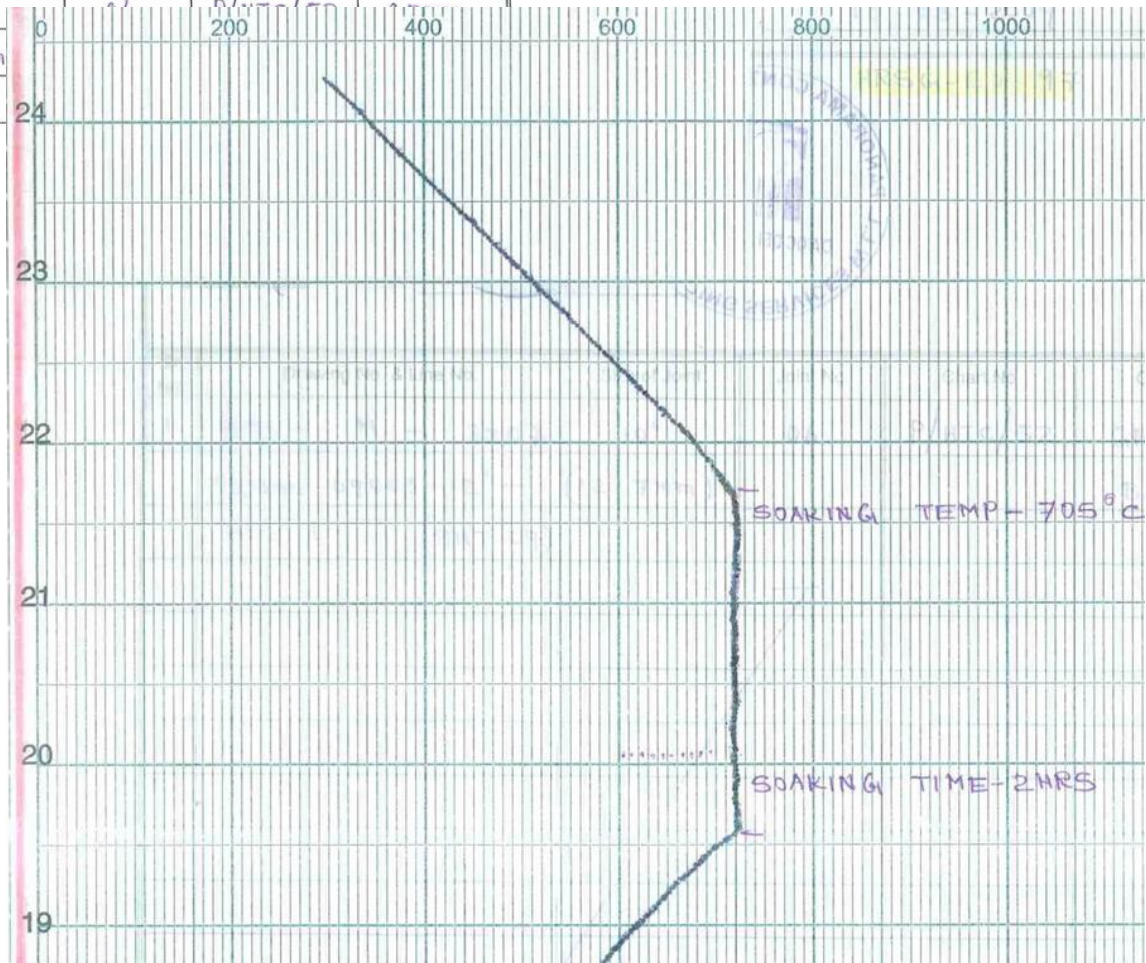
HRSG-E0-97

- 1 Heating Rate : $180^{\circ}\text{C} / \text{HR MAX}$
- 2 Holding Temperature : $705^{\circ}\text{C to } 745^{\circ}\text{C}$
- 3 Holding Time : 2 HRS MIN
- 4 Cooling Rate : $180^{\circ}\text{C} / \text{HR MAX}$
- 5 Chart Speed : 25 mm / HR

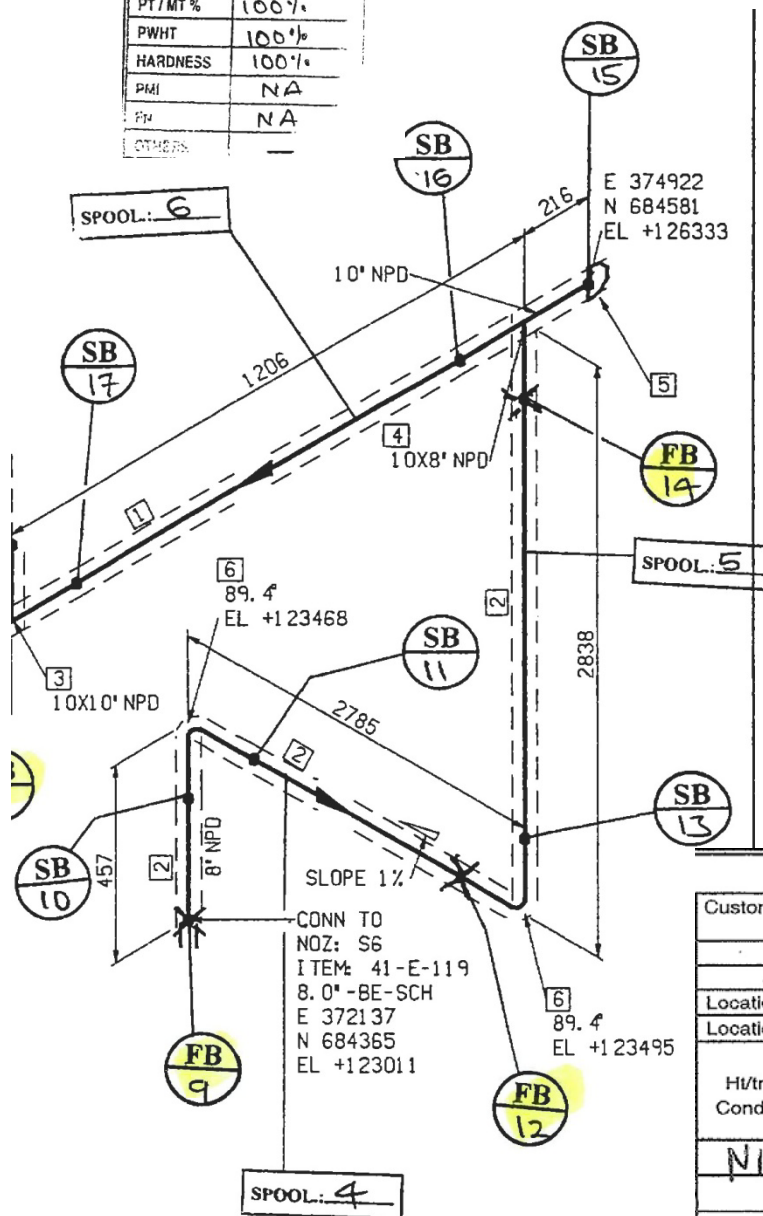
Sr. No.	Drawing No. & Line No.	Size of Joint	Joint No.	Chart No.	Colour
1	893 - M - 320 ϕ	10"			
	92SHH-69003-12" -	(12-7m)			
	-M02-1 (SHT-09)				



Post Weld Heat Treatment



WPS	LAH/ED69-W-01
NDT CLASS	—
VISUAL %	100%
RT %	100%
PT / MT %	100%
PWHT	100%
HARDNESS	100%
PMI	NA
PM	NA
OTHERS	—



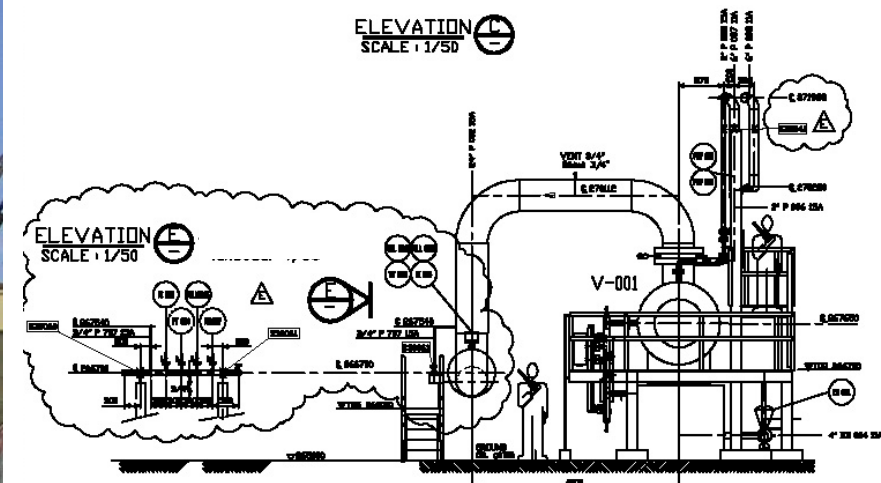
Piping Inspection and testing



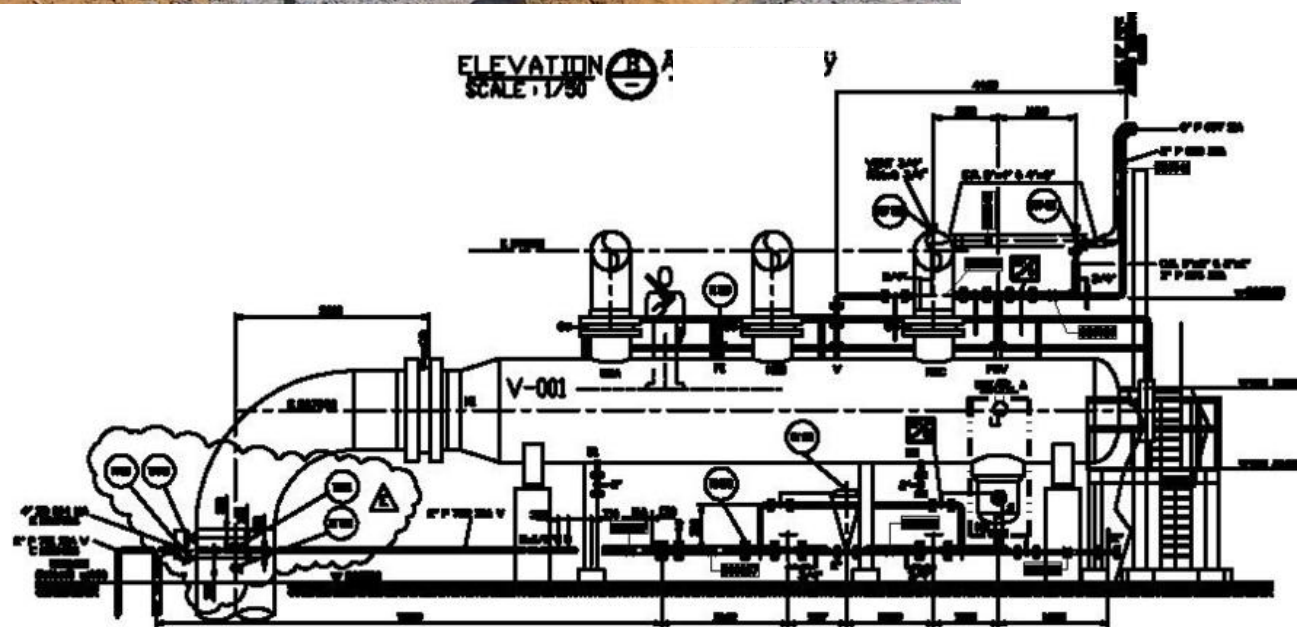
RADIOGRAPHY REPORT

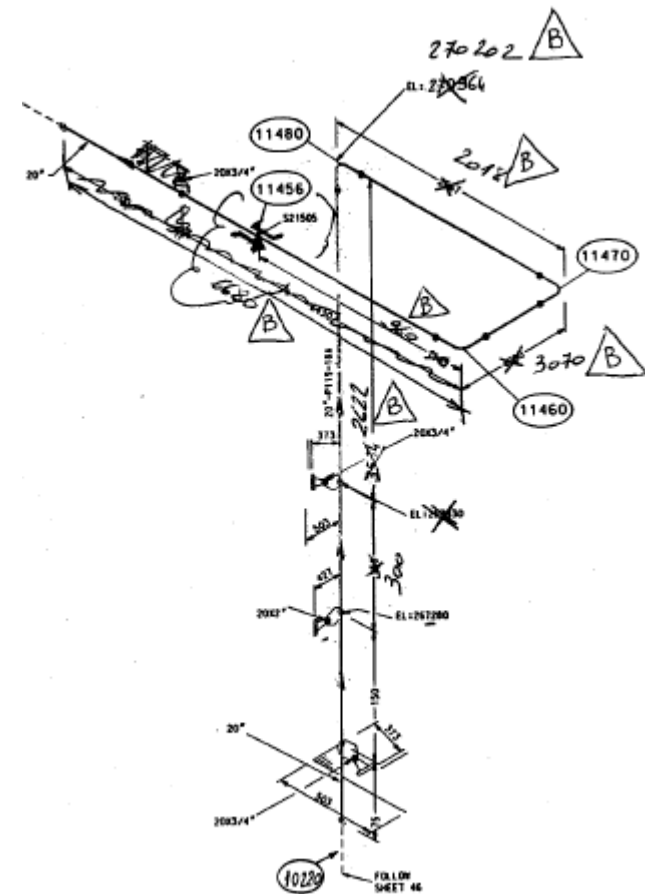
Customer :

Radiographic Technique							Pb Screen Thickness (mm)			Source Isotope			
SWSI		DWSI		DWDI			Front & Back : 0-12.5			Source Strength			
Location of Penetrant		Source Side / Film Side					Film Density : 2-3			Ug : 0.28			
Location of Markers		Source Side / Film Side					Sensitivity : 2%						
Hi/treat Condition	Film Location	Crack	Burn Through	Concave Root	Excess Penetration	Lack of Fusion	Lack of Root Pen.	Slag or El. Defect	Undercut	Porosity	Surface Concavity	Other	Result
NIA	0-12							✓		✓			Acc
	12-24											✓	Acc
	24-0				✓							✓	Acc



Piping General
Arrangement drawing





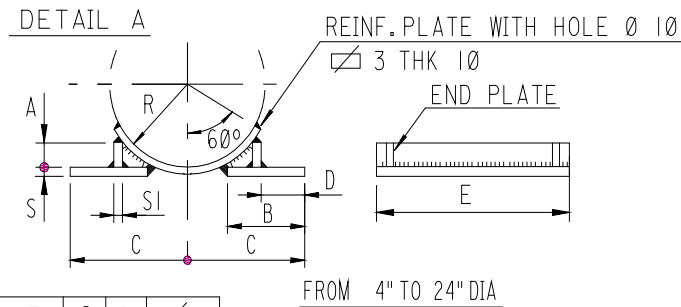
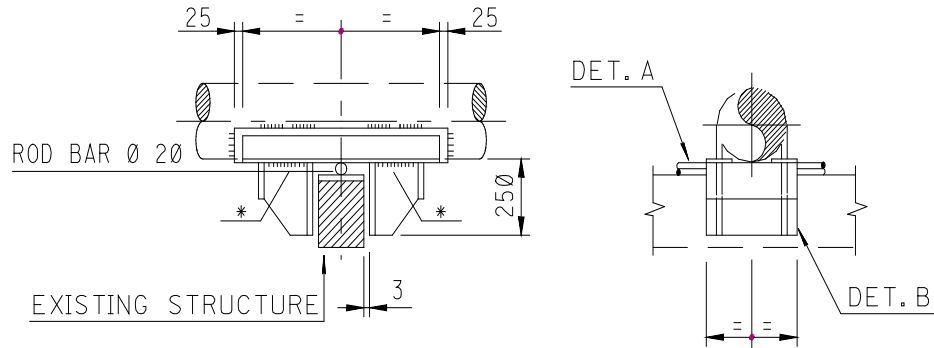
	
SYMBOLISATION DES SUPPORTS Conventional signs for supports	
L - LIBRE / Free O - FIXE / Fixed	
	
	
	
	
	
	
	
	
SUPPORT POUR EPREUVE Support for test	
SUPPORT A RESSORT Spring support	
CROQUIS ISOMETRIQUE POUR CALCUL DE TUYAUTERIES Spool sketch for piping stress calculation	





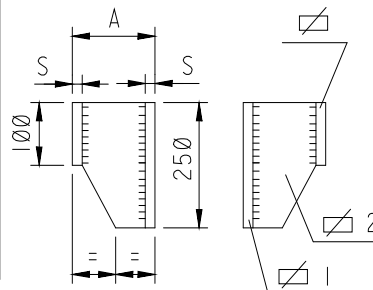
Standard Pipe Support drawings

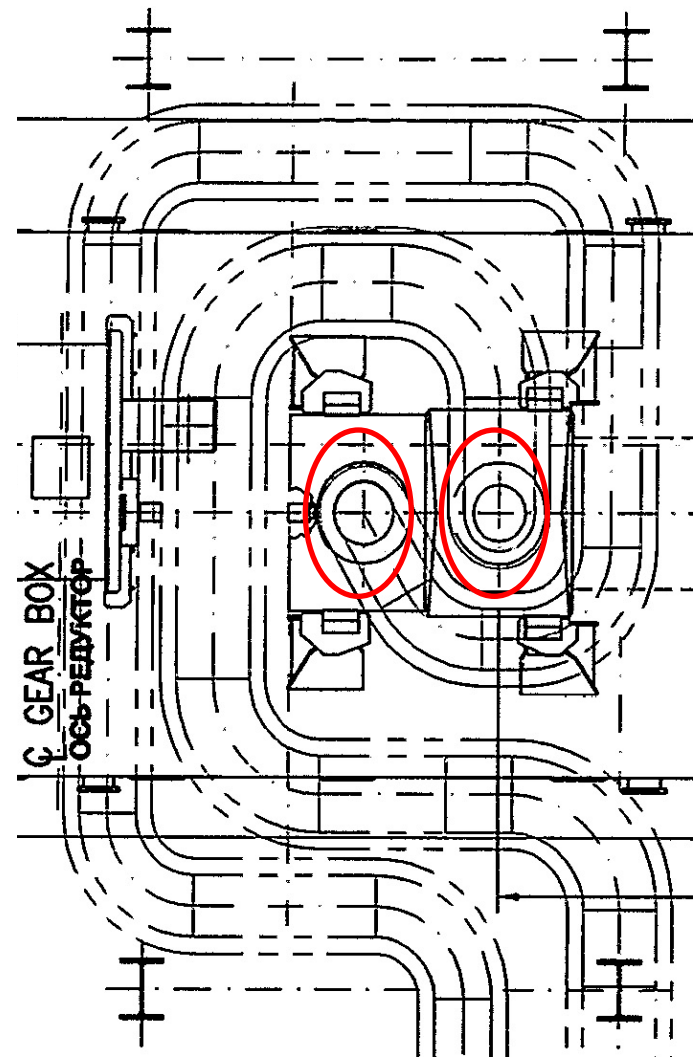
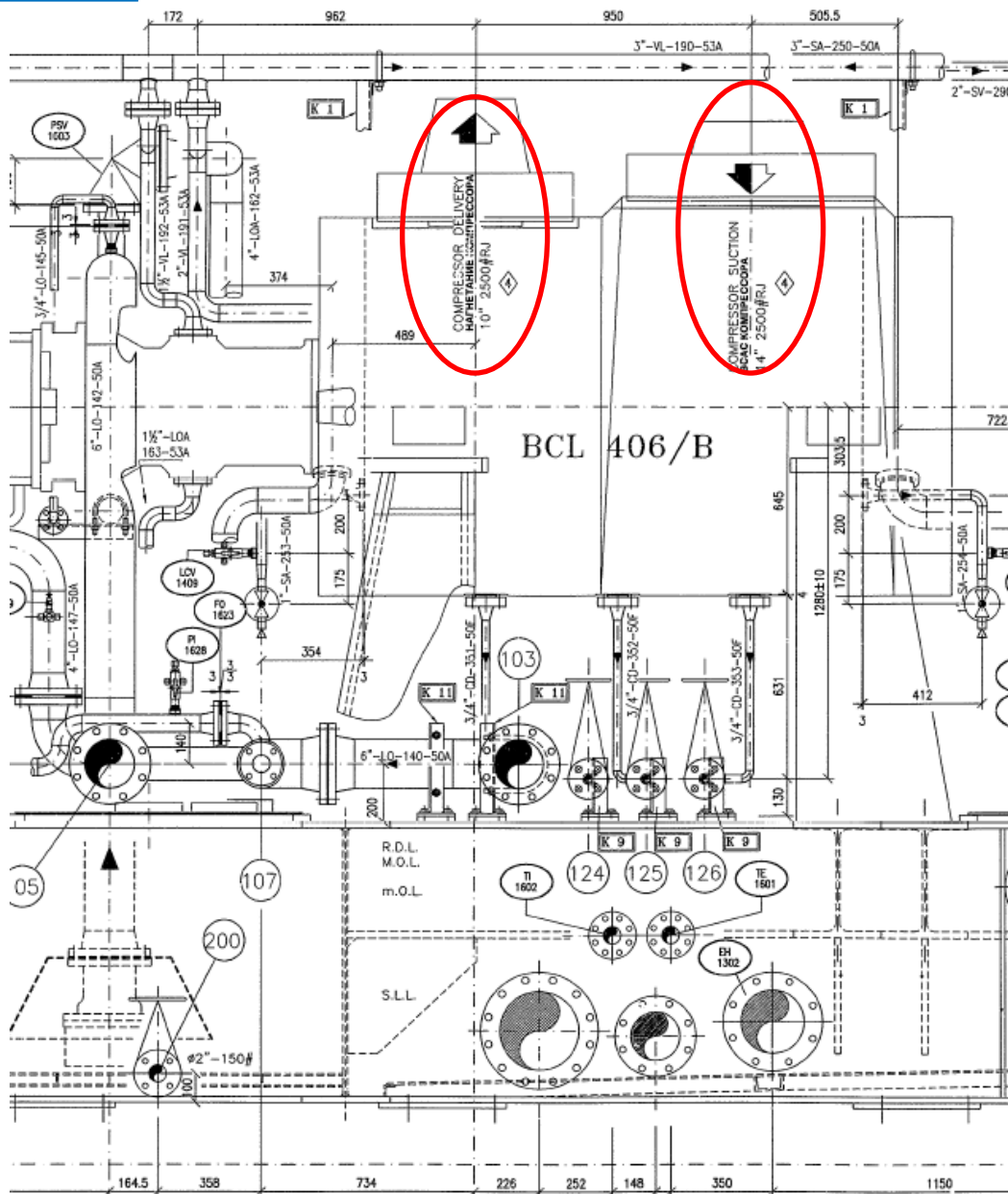
LINE STOP
DETAIL "3"

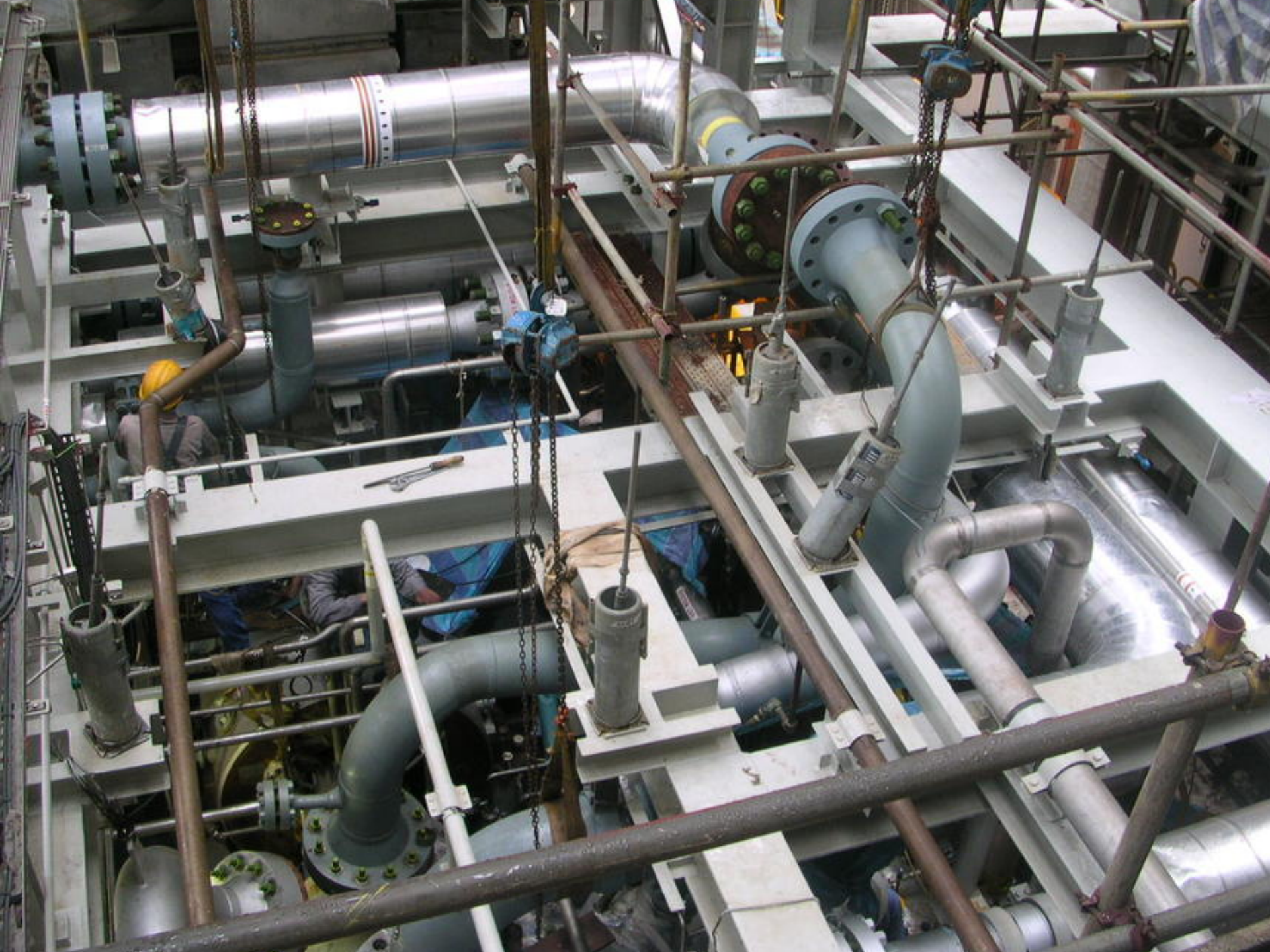


DIA	R	A	B	C	D	E	S	SI	3
4"	57	22	55	80	24	1000	6	6	
6"	84	36	72	103	24	1100	8		
8"	110	47	87	128	24	1200			
10"	136	60	104	150	24	1300			
12"	162	71	119	175	26	1400			
14"	178	79	131	200	27				380
16"	203	91	147	220	25				420
18"	228	58	144	220	41				480
20"	254	64	155	235	37				530
22"	279	72	168	252	37				580
24"	305	79	184	271	37				640

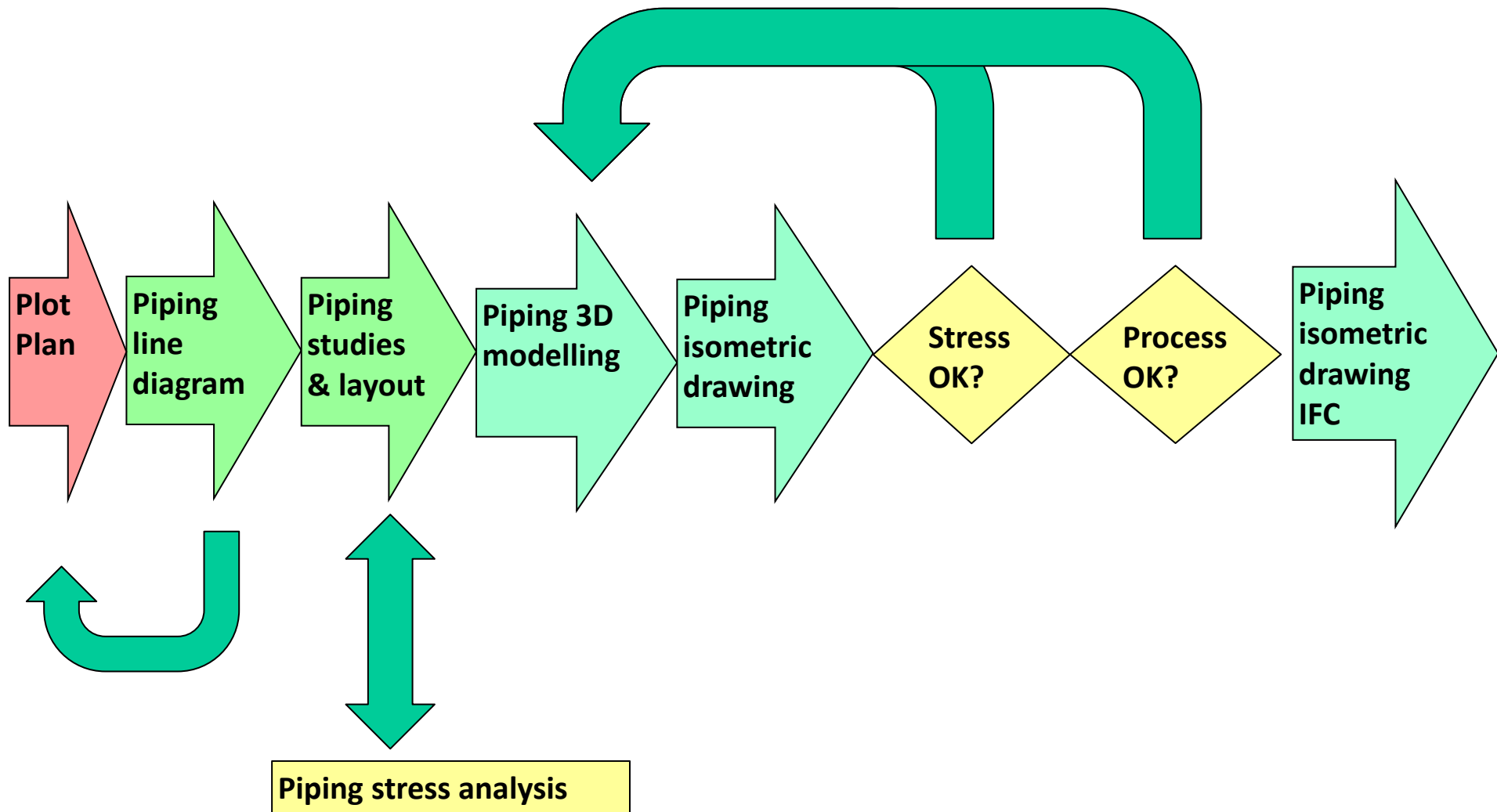
DETAIL B

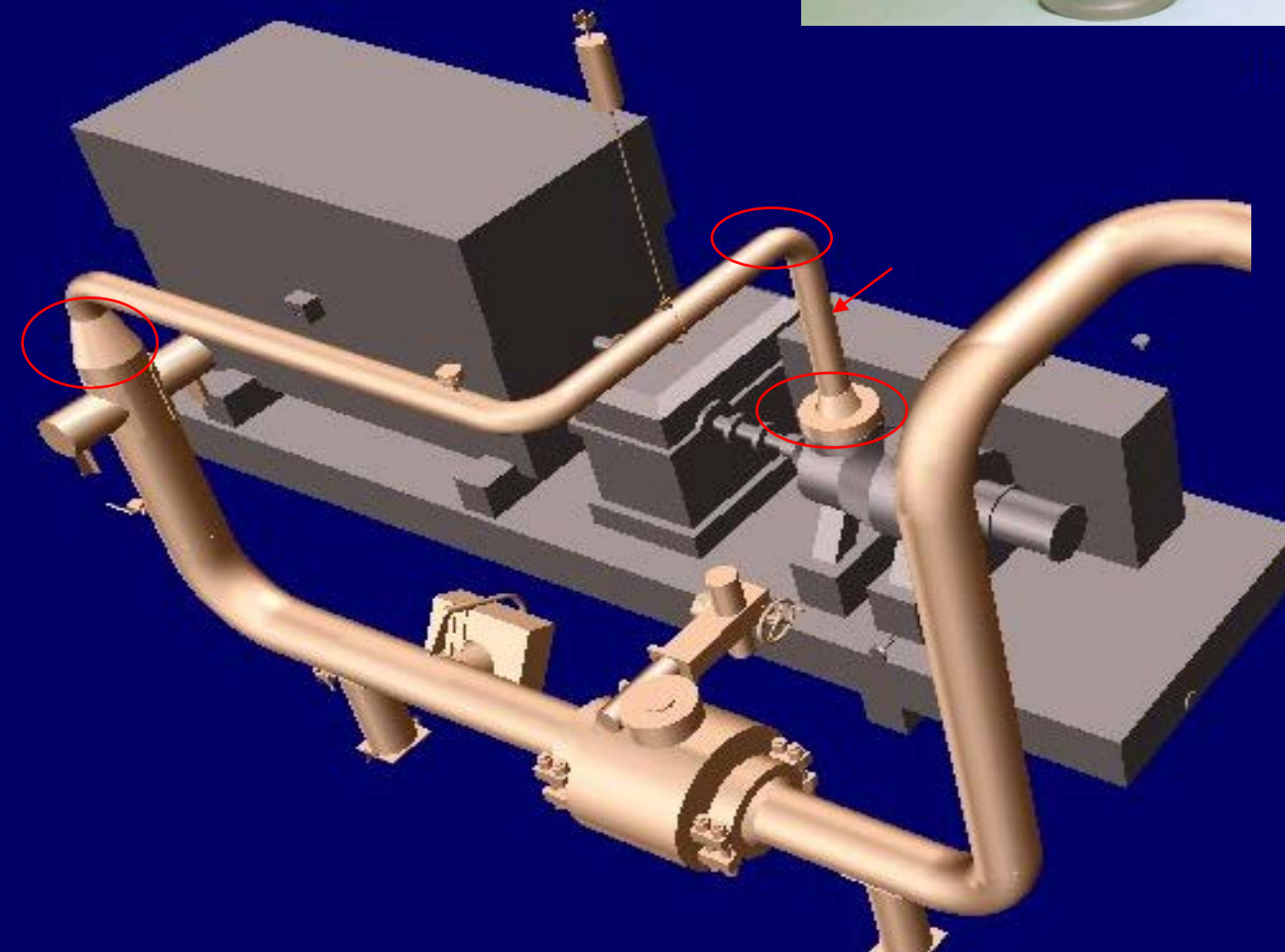




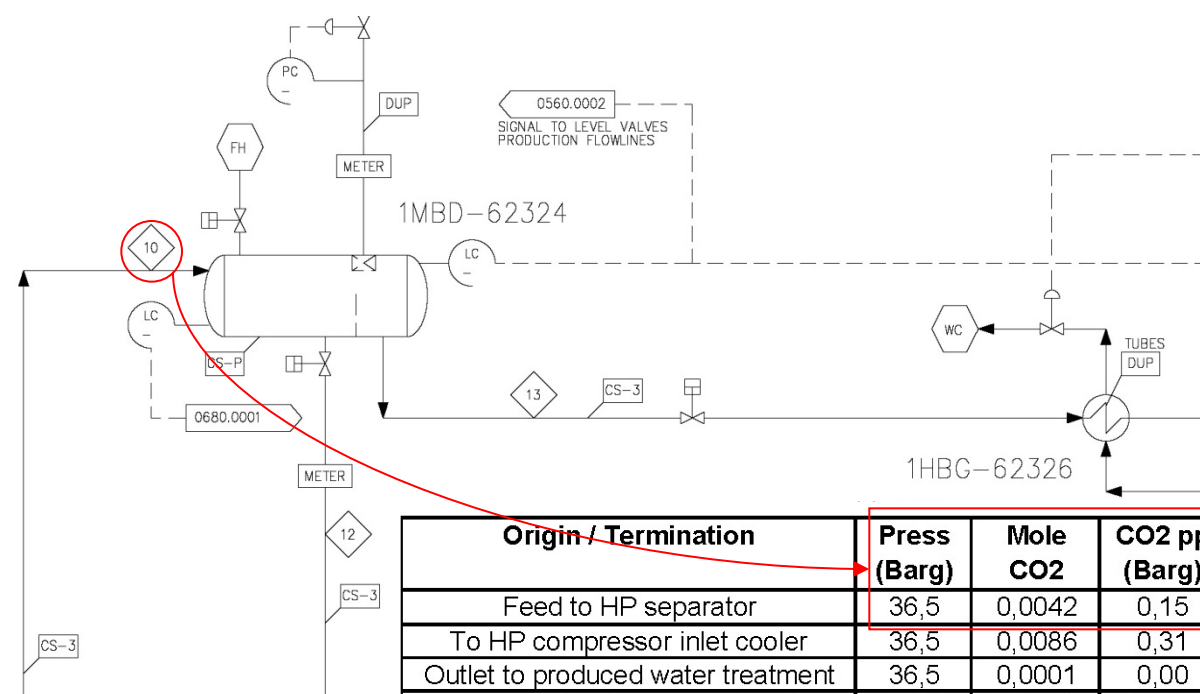


Piping installation work process

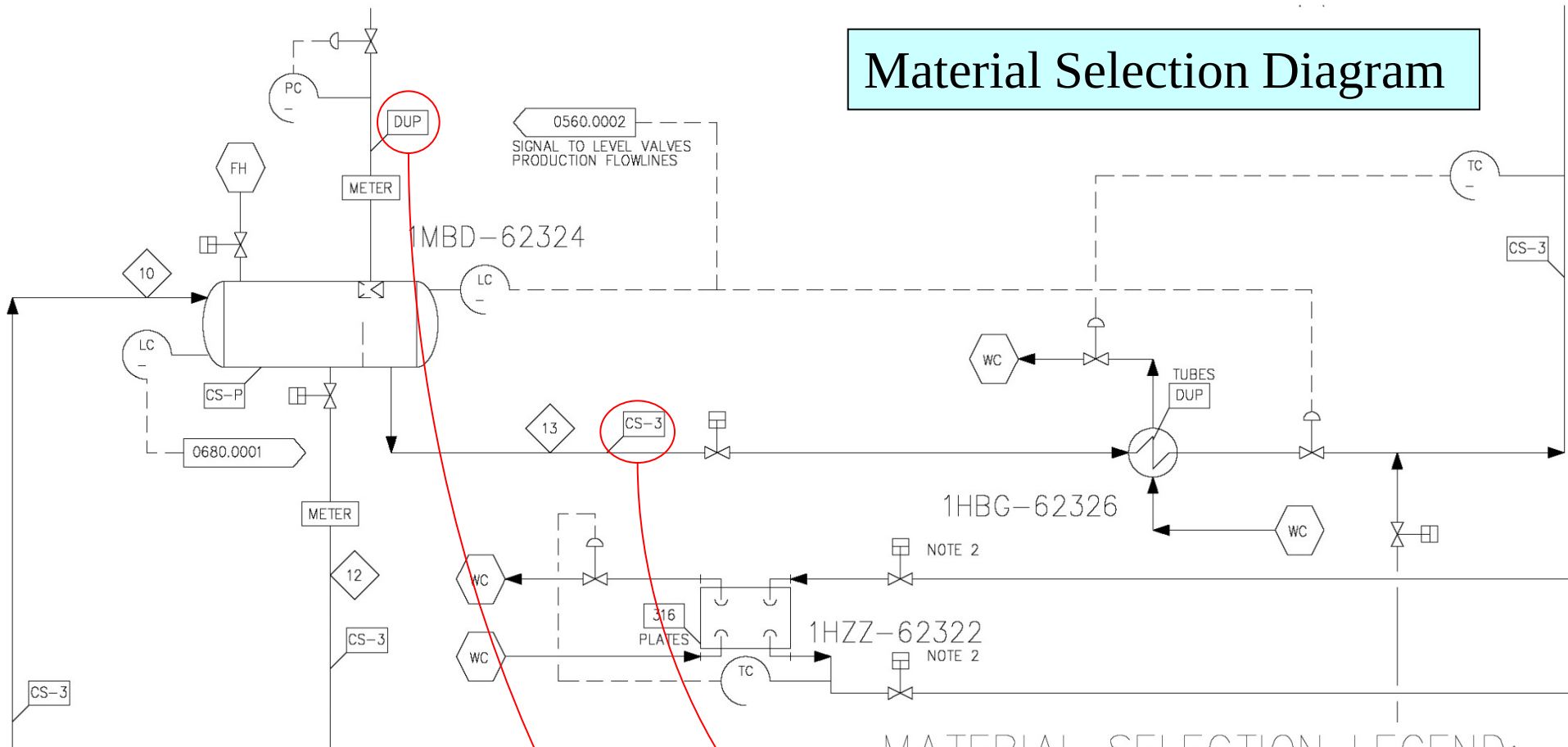




Material Selection



Material Selection Diagram



MATERIAL SELECTION LEGEND:

1. CS-1 DENOTES CARBON STEEL
W/ 0.8 mm CORROSION ALLOWANCE.
2. CS-2 DENOTES CARBON STEEL
W/ 1.6 mm CORROSION ALLOWANCE.
3. CS-3 DENOTES CARBON STEEL
W/ 3.2 mm CORROSION ALLOWANCE.
4. CS-4 DENOTES CARBON STEEL
W/ 6.4 mm CORROSION ALLOWANCE.
5. CS-5 DENOTES 316L CLAD CS-3.
6. CS-P DENOTES CARBON STEEL
WITH PHENOLIC LINED.
7. 316L DENOTES 316L TYPE STAINLESS STEEL.
8. DUP DENOTES 2205 DUPLEX STAINLESS STEEL.



Process Fluids list

FLUID	SYMBOL	OPERATING CONDITIONS				MATERIAL
		T °C		bar(g)		
		MAX/DESIGN		MAX/DESIGN		
Drain	BD	30	50	atm	19	CS
Drain	BD	30	50	atm	98,5	CS
Drain	BD	50	70	atm	265	CS
Fuel Gas	FG	30	50	7	9	SS
Fuel Gas	FG	40	60	44	49	SS
Fuel Gas	FG	55	75	97	98,5	CS
Diesel fuel	FO	amb	50	1	3	CS
Fire Water	FW	amb	50	10	12	HDPE
Fire Water	FW	amb	50	10	12	CS
Lube Oil	LO	30	80	3,2	5	GALVAN
Methanol	ME	20	50	atm	3	SS
Methanol	ME	20	50	253,5	265	SS
Open drain	OY	amb	50	atm	3	CS
Hydrocarbon Gas	P	30	50	atm	19	CS
Hydrocarbon Gas	P	30	50	97	98,5	CS
Hydrocarbon Gas	P	-40/30	-46/50	atm	2	LTCS
Hydrocarbon Gas	P	-40/30	-46/50	97	98,5	LTCS
Hydrocarbon Gas	P	138	160	252,5	265	CS
Hydrocarbon Gas	P	50	70	252,5	265	CS
Hydrocarbon Gas	P	138	160	252,5	291	CS
Hydrocarbon Gas	P	-40/138	-46/160	252,5	291	LTCS
Hydrocarbon Gas	P	-40/50	-46/70	252,5	265	LTCS
Utility Air	UA	30	50	10	12	CS
Utility Water	UW	amb	50	2	4	GALVAN

Piping material classes

Class	Material	Rating	Pbar/T°C Desig	Pbar/T°C Oper
11A	CS	150	19 / 50	ATM / 30
15A	CS	600	98.5 / 75	97 / 55
18A	CS	2500	265 / 160	252.5 / 138
21A	LTCS	150	2 / -46 TO 50	ATM / -40 TO 30
25A	LTCS	600	98.5 / -46 TO 50	97 / -40 TO 30
28A	LTCS	2500	265 / -46 TO 70	252.5 / -40 TO 50
31A	304LSS	150	9 / 50	7 / 30
35A	304LSS	600	49 / 60	44 / 40
38A	304LSS	2500	280 / 50	252.5 / 20
91A	CS GALVA	150	5 / 80	3.2 / 30

Piping material classes

Class	Material	Rating	Pbar/T°C Desig	Pbar/T°C Oper
11A	CS	150	19 / 50	ATM / 30
15A	CS	600	98.5 / 75	97 / 55
18A	CS	2500	265 / 160	252.5 / 138
21A	LTCS	150	2 / -46 TO 50	ATM / -40 TO 30
25A	LTCS	600	98.5 / -46 TO 50	97 / -40 TO 30
28A	LTCS	2500	265 / -46 TO 70	252.5 / -40 TO 50
31A	304LSS	150	9 / 50	7 / 30
35A	304LSS	600	49 / 60	44 / 40
38A	304LSS	2500	280 / 50	252.5 / 20
91A	CS GALVA	150	5 / 80	3.2 / 30

Piping material class specification

SERVICE : DRAIN (BD) HYDROCARBON GAS (P)				GENERAL MATERIAL : CARBON STEEL API 5L Gr. B, X52, X65			RATING : 2500# RTJ		PIPING CLASS : 18A		
				Corrosion Allowance = 0					Page : 1/3		
Limits				CODE: ASME B31-8							
T °C		-29	38	121	160						
P Bar		265	278	278	265						
		DIA		Sched./	End	Material	Dimensions	DESIGNATION		NOTES	
		from	to	WT(mm) Rating		standard	standard				
PIPE		1/2"	3/4"	160	BE	API 5L Gr.B-MDS-C801	ASME B36.10	SEAMLESS PIPE			
		1"	1 1/8"	XXS	BE	API 5L Gr.B-MDS-C801	ASME B36.10	SEAMLESS PIPE			
		2"	2"	160	BE	API 5L Gr.B-MDS-C801	ASME B36.10	SEAMLESS PIPE		4	
		3"	3"	80	BE	API 5L Gr.X52-MDS-C804	ASME B36.10	SEAMLESS PIPE		4	
		4"	14"	120	BE	API 5L Gr.X52-MDS-C804	ASME B36.10	SEAMLESS PIPE		4	
		16"	24"	(*)	BE	API 5L Gr.X65-MDS-C806	ASME B36.10	S.A.W. WELDED PIPE : (*) 16" thk = 25.4, 18" thk = 28.58 20" thk = 31.75 , 24" thk =38.1		4	
FORGED STEEL FITTING	B.W	1/2"	2"		BW	ASTM A105-MDS C801	MSS SP-97	WELDOLET (BW AS PER ASME B16-25)		1	
		3"	14"		BW	A594-F52-MDS C803	MSS SP-97	WELDOLET (BW AS PER ASME B16-25)		1	
		16"	24"		BW	A594-F65-MDS C805	MSS SP-97	WELDOLET (BW AS PER ASME B16-25)		1	
	BUTT WELDING	1/2"	3/4"	160	BW	A234-WPB-MDS C801	ASME B16.9	45°, 90°ELBOW, TEE, RED. TEE, CAP, REDUCER			
		1"	1 1/8"	XXS	BW	A234-WPB-MDS C801	ASME B16.9	45°, 90°ELBOW, TEE, RED. TEE, CAP, REDUCER			
		2"	2"	160	BW	A234-WPB-MDS C801	ASME B16.9	45°, 90°ELBOW, TEE, RED. TEE, CAP, REDUCER			
		3"	3"	80	BW	MSS SP-75 WPHY 52-MDS C803	ASME B16.9	45°, 90°ELBOW, TEE, RED. TEE, CAP, REDUCER			
		4"	14"	120	BW	MSS SP-75 WPHY 52-MDS C803	ASME B16.9	45°, 90°ELBOW, TEE, RED. TEE, CAP, REDUCER			
		16"	24"	pipe thk	BW	MSS SP-75 WPHY 85-MDS C806	ASME B16.9	45°, 90°ELBOW, TEE, RED. TEE, CAP, REDUCER		1	
	FLANGES	1/2"	2"	2500# RTJ	BW	ASTM A105-MDS C801	ASME B16.5	WELDING NECK FLANGE		1	
		3"	12"	2500# RTJ	BW	A594-F52-MDS C803	ASME B16.5	WELDING NECK FLANGE		1	
		14"	14"		BW	A594-F52-MDS C803		HUB CONNECTOR (BW AS PER ASME B16-25)		1-2-3	
		16"	24"		BW	A594-F65-MDS C805		HUB CONNECTOR (BW AS PER ASME B16-25)		1-2-3	
		2"	2"	2500# RTJ	BW	ASTM A105-MDS C801	ASME B16.36	2 ORIFICE WN FLANGE + 1/2"PLUG+JACK SCREW		1	
		3"	12"	2500# RTJ	BW	A594-F52-MDS C803	ASME B16.36	2 ORIFICE WN FLANGE + 1/2"PLUG+JACK SCREW		1	
GASKET	1/2"	12"	2500# RTJ	-	ASTM A105-MDS C801	ASME B16.5	BLIND FLANGE				
	14"	24"		-	A594-F52-MDS C803		BLIND HUB CONNECTOR		2-3		
	1/2"	12"	2500#		SOFT IRON (90 HB max)	ASME B16.5,B16.20	OCTAGONAL RING- JOINT GASKET				
	14"	24"			AISI 4140		SEAL RING FOR HUB CONNECTOR (FOR CLAMP-TYPE DEVICE)		2-3		
BOLTING					A193Gr.B7+ Zn Blchr.	ASME B16.5	STUD BOLT & 2 HEAVY HEX. NUTS				
					A194Gr.2H+ Zn Blchr.	ASME B1.1	DIA<1" COARSE Series, DIA >1" 8 THREADS series				
						ASME B1.1	SPECIAL BOLTING FOR CLAMP-TYPE DEVICE		3		

Piping material classes specification

SERVICE : DRAIN (BD) HYDROCARBON GAS (P)	GENERAL MATERIAL : CARBON STEEL API 5L Gr. B, X52, X65	RATING : 2500# RTJ	PIPING CLASS : 18A
	Corrosion Allowance = 0		Page : 1/3

Limits					CODE: ASME B31-8
T °C	-29	38	121	160	
P Barg	265	278	278	265	

		DIA		Sched./ WT(mm) Rating	End	Material standard	Dimensions standard	DESIGNATION	NOTES
		from	to						
PIPE		1/2"	3/4"	160	BE	API 5L Gr.B-MDS-C801	A8M		
		1"	1 1/8"	XXS	BE	API 5L Gr.B-MDS-C801	A8M		
		2"	2"	160	BE	API 5L Gr.B-MDS-C801	A8M		
		3"	3"	80	BE	API 5L Gr.X52-MDS-C804	A8M		
		4"	14"	120	BE	API 5L Gr.X52-MDS-C804	A8M		
		16"	24"	(*)	BE	API 5L Gr.X65-MDS-C806	A8M		
FORGED STEEL FITTING	B.W	1/2"	2"		BW	A8TM A105-MDS C801	M8S		
		3"	14"		BW	A694- F52-MDS C803	M8S		
		16"	24"		BW	A694- F65-MDS C805	M8S		
	BUTT WELDING	1/2"	3/4"	160	BW	A234-WPB-MDS SC01	A8M		
		1"	1 1/8"	XXS	BW	A234-WPB-MDS SC01	A8M		
		2"	2"	160	BW	A234-WPB-MDS SC01	A8M		
		3"	3"	80	BW	M8S SP-75 WPHY 52-MDS C803	A8M		
		4"	14"	120	BW	M8S SP-75 WPHY 52-MDS C803	A8M		
		16"	24"	pipe thk	BW	M8S SP-75 WPHY 65-MDS C806	A8M		
	FLANGES	1/2"	2"	2500# RTJ	BW	A8TM A105-MDS C801	A8M		
		3"	12"	2500# RTJ	BW	A694-F52-MDS C803	A8M		
		14"	14"		BW	A694-F52-MDS C803			
16"		24"		BW	A694-F65-MDS C805				
2"		2"	2500# RTJ	BW	A8TM A105-MDS C801	A8M			
3"		12"	2500# RTJ	BW	A694-F52-MDS C803	A8M			
1/2"		12"	2500# RTJ	-	A8TM A105-MDS C801	A8M			
14"		24"		-	A694-F52-MDS C803				
GASKET	1/2"	12"	2500#		SOFT IRON (90 HB max)	A8M			
	14"	24"			AISI 4140				
BOLTING					A193Gr.B7+ Zn Blchr.	A8M			
					A194Gr.2H+ Zn Blchr.	A8M			
						A8M			

CHEMICAL REQUIREMENTS FOR HEAT ANALYSIS

Type of pipe	Grade	C
seamless		max
	Non-expanded or cold expanded	A
Non-expanded	X42	
	X46(4), X52(4),	
Cold expanded	X42(4), X46(4), X52(4),	
	X56(3,4), X60(3,4)	
Non-expanded or cold expanded	X65, X70, X80	

CHEMICAL REQUIREMENTS FOR HEAT ANALYSIS

Type of pipe	Grade	C
seamless		max
	Non-expanded or cold expanded	A
Non-expanded	X42	
	X46(4), X52(4),	
Cold expanded	X42(4), X46(4), X52(4),	
	X56(3,4), X60(3,4)	
Non-expanded or cold expanded	X65, X70, X80	

TENSILE REQUIREMENTS (Section 6)

Grade	Yield strength minimum		Ultimate tensile strength minimum	
	ksi	MPa	ksi	MPa
A	30.0	207	48.0	331
B	35.0	241	60.0	414
X42	42.0	289	60.0	414
X46	46.0	317	63.0	434
X52	52.0	358	66.0	455
X56	56.0	386	71.0	488



API 5L specification

Forty-first edition – APRIL 1995

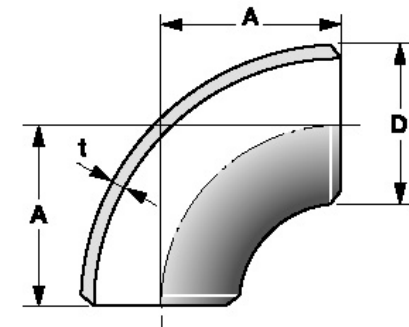
CHEMICAL REQUIREMENTS FOR HEAT ANALYSES (Section 6)

Type of pipe	Grade	Carbon	Manganese	Phosphorus	Sulfur
		maxi % {1}	maxi % {1}	maxi %	maxi %
seamless					
Non-expanded or cold expanded	A	0.22	0.90	0.030	0.030
	B(4)	0.27	1.15	0.030	0.030
Non-expanded	X42	0.29	1.25	0.030	0.030
	X46(4), X52(4)	0.31	1.35	0.030	0.030
Cold expanded	X42(4), X46(4), X52(4)	0.29(2)	1.25	0.030	0.030
Non-expanded or cold expanded	X56(3,4), X60(3,4)	0.26	1.35	0.030	0.030
	X65, X70, X80	(by agreement)			

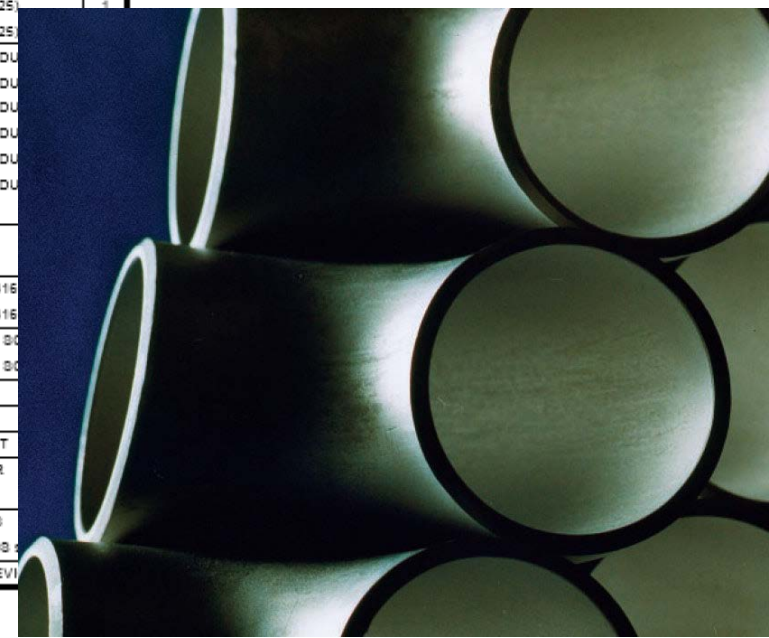
TENSILE REQUIREMENTS (Section 6)

Grade	Yield strength minimum		Ultimate tensile strength minimum		Ultimate tensile strength maximum		Elongation minimum percent in 2 in. {50.8 mm}
	ksi	MPa	ksi	MPa	ksi	MPa	
A	30.0	207	48.0	331			See note (1)
B	35.0	241	60.0	413			
X42	42.0	289	60.0	413			
X46	46.0	317	63.0	434			
X52	52.0	358	66.0	455			
X56	56.0	386	71.0	489			
X60	60.0	413	75.0	517			

Piping material classes specification



SERVICE : DRAIN (BD) HYDROCARBON GAS (P)					GENERAL MATERIAL : CARBON STEEL API 5L Gr. B, X52, X65			RATING : 2500# RTJ		PIPING CLASS : 18A	
					Corrosion Allowance = 0					Page : 1/3	
Limits					CODE: ASME B31-8						
T °C	-29	38	121	160							
P Barg	265	278	278	285							
		DIA		Sched./ WT(mm) Rating	End	Material standard	Dimensions standard	DESIGNATION	NOTES		
		from	to								
PIPE	1/2"	3/4"	160	BE	API 5L Gr.B-MDS-C801	ASME B36.10	SEAMLESS PIPE	4			
	1"	1 1/8"	XXS	BE	API 5L Gr.B-MDS-C801	ASME B36.10	SEAMLESS PIPE				
	2"	2"	160	BE	API 5L Gr.B-MDS-C801	ASME B36.10	SEAMLESS PIPE				
	3"	3"	80	BE	API 5L Gr.X52-MDS-C804	ASME B36.10	SEAMLESS PIPE				
	4"	14"	120	BE	API 5L Gr.X52-MDS-C804	ASME B36.10	SEAMLESS PIPE				
	16"	24"	(*)	BE	API 5L Gr.X65-MDS-C806	ASME B36.10	SEAMLESS PIPE				
							S.A.W. WELDED PIPE :		4		
							(") 16" thk = 25.4, 18" thk = 28.58				
							20" thk = 31.75, 24" thk = 38.1				
FORGED STEEL FITTING	B.W	1/2"	2"	BW	A8TM A105-MDS C801	MSS SP-97	WELDOLET (BW AS PER ASME B16-25)	1			
		3"	14"	BW	A694-F52-MDS C803	MSS SP-97	WELDOLET (BW AS PER ASME B16-25)	1			
		16"	24"	BW	A694-F65-MDS C805	MSS SP-97	WELDOLET (BW AS PER ASME B16-25)				
	BUTT WELDING	1/2"	3/4"	160	BW	A234-WPB-MDS SC01	ASME B16.9	45°, 90° ELBOW, TEE, RED. TEE, CAP, REDU			
		1"	1 1/8"	XXS	BW	A234-WPB-MDS SC01	ASME B16.9	45°, 90° ELBOW, TEE, RED. TEE, CAP, REDU			
		2"	2"	160	BW	A234-WPB-MDS SC01	ASME B16.9	45°, 90° ELBOW, TEE, RED. TEE, CAP, REDU			
		3"	3"	80	BW	M88 SP-75 WPHY 52-MDS C803	ASME B16.9	45°, 90° ELBOW, TEE, RED. TEE, CAP, REDU			
		4"	14"	120	BW	M88 SP-75 WPHY 52-MDS C803	ASME B16.9	45°, 90° ELBOW, TEE, RED. TEE, CAP, REDU			
		16"	24"	pipe thk	BW	M88 SP-75 WPHY 65-MDS C806	ASME B16.9	45°, 90° ELBOW, TEE, RED. TEE, CAP, REDU			
	FLANGES	1/2"	2"	2500# RTJ	BW	A8TM A105-MDS C801	ASME B16.5	WELDING NECK FLANGE			
		3"	12"	2500# RTJ	BW	A694-F52-MDS C803	ASME B16.5	WELDING NECK FLANGE			
		14"	14"		BW	A694-F52-MDS C803		HUB CONNECTOR (BW AS PER ASME B16			
		16"	24"		BW	A694-F65-MDS C805		HUB CONNECTOR (BW AS PER ASME B16			
		2"	2"	2500# RTJ	BW	A8TM A105-MDS C801	ASME B16.36	2 ORIFICE WN FLANGE + 1/2" PLUG+JACK SC			
		3"	12"	2500# RTJ	BW	A694-F52-MDS C803	ASME B16.36	2 ORIFICE WN FLANGE + 1/2" PLUG+JACK SC			
		1/2"	12"	2500# RTJ	-	A8TM A105-MDS C801	ASME B16.5	BLIND FLANGE			
		14"	24"		-	A694-F52-MDS C803		BLIND HUB CONNECTOR			
	GASKET	1/2"	12"	2500#		SOFT IRON (90 HB max)	ASME B16.5, B16.20	OCTAGONAL RING-JOINT GASKET			
		14"	24"			AISI 4140		SEAL RING FOR HUB CONNECTOR (FOR CLAMP-TYPE DEVICE)			
	BOLTING					A193Gr.B7+ Zn Blchr.	ASME B16.5	STUD BOLT & 2 HEAVY HEX. NUTS			
						A194Gr.2H+ Zn Blchr.	ASME B1.1	DIA ≤ 1" COARSE Series, DIA > 1" 8 THREADS			
						ASME B1.1	SPECIAL BOLTING FOR CLAMP-TYPE DEVI				



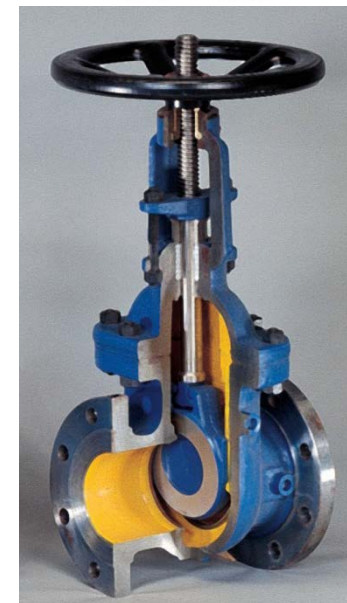
Piping material classes specification

SERVICE : DRAIN (BD) HYDROCARBON GAS (P)					GENERAL MATERIAL : CARBON STEEL API 5L Gr. B, X52, X65			RATING : 2500# RTJ		PIPING CLASS : 18A	
					Corrosion Allowance = 0						
Limits					COD						
T °C		-29	38	121	160						
P Barg		265	278	278	265						
		DIA		Sched./ WT(mm) Rating	End	Material standard	Dimensions standard	DESIGNATION			
		from	to								
PIPE		1/2"	3/4"	160	BE	API 5L Gr.B-MDS-C801	ASME B36.10	SEAMLESS PIPE			
		1"	1 1/8"	XXS	BE	API 5L Gr.B-MDS-C801	ASME B36.10	SEAMLESS PIPE			
		2"	2"	160	BE	API 5L Gr.B-MDS-C801	ASME B36.10	SEAMLESS PIPE			
		3"	3"	80	BE	API 5L Gr.X52-MDS-C804	ASME B36.10	SEAMLESS PIPE			
		4"	14"	120	BE	API 5L Gr.X52-MDS-C804	ASME B36.10	SEAMLESS PIPE			
		16"	24"	(")	BE	API 5L Gr.X65-MDS-C806	ASME B36.10	S.A.W. WELDED PIPE (") 16" thk = 25.4, 18" 20" thk = 31.75, 22"			
FORGED STEEL FITTING	B.W	1/2"	2"		BW	ASTM A105-MDS C801	MSS SP-97	WELDOLET (BW AS PER ASM			
		3"	14"		BW	A694-F52-MDS C803	MSS SP-97	WELDOLET (BW AS PER ASM			
		16"	24"		BW	A694-F65-MDS C805	MSS SP-97	WELDOLET (BW AS PER ASM			
	BUTT WELDING	1/2"	3/4"	160	BW	A234-WPB-MDS C801	ASME B16.9	45°, 90° ELBOW, TEE, RED. TEE, C			
		1"	1 1/8"	XXS	BW	A234-WPB-MDS C801	ASME B16.9	45°, 90° ELBOW, TEE, RED. TEE, C			
		2"	2"	160	BW	A234-WPB-MDS C801	ASME B16.9	45°, 90° ELBOW, TEE, RED. TEE, C			
		3"	3"	80	BW	MSS SP-75 WPHY 52-MDS C803	ASME B16.9	45°, 90° ELBOW, TEE, RED. TEE, C			
		4"	14"	120	BW	MSS SP-75 WPHY 52-MDS C803	ASME B16.9	45°, 90° ELBOW, TEE, RED. TEE, C			
		16"	24"	pipe thk	BW	MSS SP-75 WPHY 65-MDS C806	ASME B16.9	45°, 90° ELBOW, TEE, RED. TEE, C			
	FLANGES	1/2"	2"	2500# RTJ	BW	ASTM A105-MDS C801	ASME B16.5	WELDING NECK FLAN			
		3"	12"	2500# RTJ	BW	A694-F52-MDS C803	ASME B16.5	WELDING NECK FLAN			
		14"	14"		BW	A694-F52-MDS C803		HUB CONNECTOR (BW AS PER A			
		16"	24"		BW	A694-F65-MDS C805		HUB CONNECTOR (BW AS PER A			
		2"	2"	2500# RTJ	BW	ASTM A105-MDS C801	ASME B16.36	2 ORIFICE WN FLANGE + 1/2" PLUG			
		3"	12"	2500# RTJ	BW	A694-F52-MDS C803	ASME B16.36	2 ORIFICE WN FLANGE + 1/2" PLUG			
		1/2"	12"	2500# RTJ	-	ASTM A105-MDS C801	ASME B16.5	BLIND FLANGE			
		14"	24"		-	A694-F52-MDS C803		BLIND HUB CONNECT			
GASKET	1/2"	12"	2500#		SOFT IRON (90 HB max)	ASME B16.5, B16.20	OCTAGONAL RING- JOINT				
	14"	24"			AISI 4140		SEAL RING FOR HUB CONN (FOR CLAMP-TYPE DEV				
BOLTING						A193Gr.B7+ Zn Blchr.	ASME B16.5	STUD BOLT & 2 HEAVY HEX			
						A194Gr.2H+ Zn Blchr.	ASME B1.1	DIA<1" COARSE Series, DIA >1" 8 T			
							ASME B1.1	SPECIAL BOLTING FOR CLAMP-T			

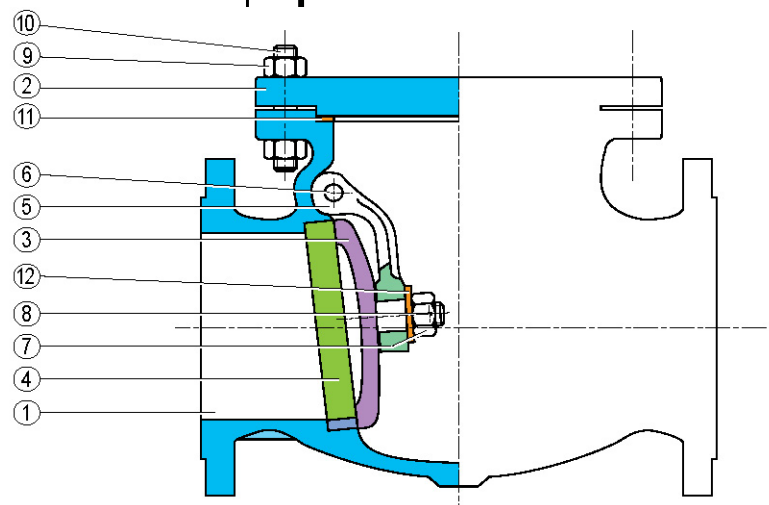
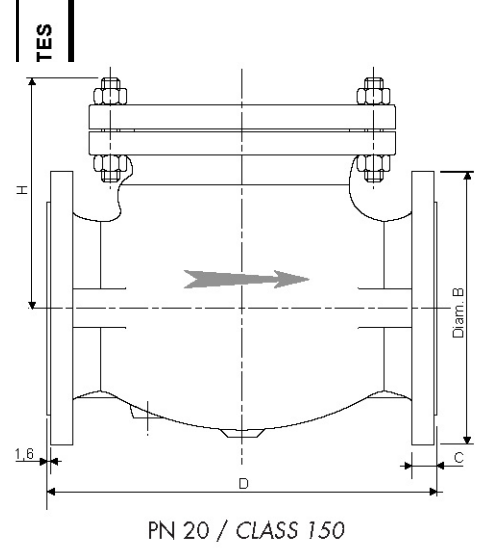


SERVICE: -DRAIN SYSTEM (BD) -HYDROCARBON GAS (P)						GENERAL MATERIAL : CARBON STEEL API 5L Gr. B		RATING : 150# RF	PIPING CLASS : 11A	
						Corrosion Allowance = 0			Page : 2/3	
		DIA		Rating	End	DESIGNATION	Standard	Valve data sheet / Comments		NOTES
		from	to							
VALVES	GATE VALVE	2"	20"	150#	RF	Bolted bonnet ,OS & Y Body: C.Steel Trim : 13% Cr.	API 600 ASME B16-34	VS 01-2-11A		1-3
	GLOBE VALVES	1/2"	1"1/2	800#	SW	Straight Pattern ,Bolted bonnet ,OS & Y Body: C.Steel Trim : 13% Cr.	ASME B16-34	VD 01-1-11A		1
		2"	6"	150#	RF	Straight Pattern ,Bolted bonnet ,OS & Y Body: C.Steel Trim : 13% Cr.	ASME B16-34	VD 01-2-11A		1-3
	CHECK VALVE	1/2"	1"1/2	800#	SW	Ball or Piston-type Body: C.Steel Trim: F6	BS 5352 ASME B16-34	VDR-10-1-11A		1-3
		2"	20"	150#	RF	Dual plate-type Wafer Lug / Double flanged body Body : C.Steel Trim: 13% Cr.	API 594 ASME B16-34	VDR 10-2-11A		1-3
	BALL VALVE	1/2"	1"1/2	800#	SW	Full bore, Floating ball-type, with PE Nipples. Body: C.Steel Trim: 13% Cr. Seats/Seals: PTFE / Viton	BS 5351	VB 01-1-11A		1
		2"	20"	150#	RF	Full bore, 2 or 3 -piece body Bore dia.<=6": Floating ball Bore dia.>=8": Trunnion ball Material:same as above exept trim:13%Cr or CS+ENP	API 6D ASME B16-34	VBF 01-2-11A		1-2 3
		2"	20"	150#	RF	Reduced bore, 2 or 3-piece body Bore dia.<=6": Floating ball Bore dia.>=8": Trunnion ball Material:same as above	API 6D ANSI B16-34	VB 01-2-11A		1-2 3

SERVICE:						GENERAL MATERIAL : CARBON STEEL		GLOBE VALVE		GATE VALVE	
-DRAIN SYSTEM (BD)						API 5L Gr. B					
-HYDROCARBON GAS (P)						Corrosion Allowance = 0					
		DIA		Rating	End	DESIGNATION	Stan				
		from	to								
VALVES	GATE VALVE	2"	20"	150#	RF	Bolted bonnet ,OS & Y Body: C.Steel Trim : 13% Cr.	API 600 ASME E				
	GLOBE VALVES	1/2"	1"1/2	800#	SW	Straight Pattern ,Bolted bonnet ,OS & Y Body: C.Steel Trim : 13% Cr.	ASME E				
		2"	6"	150#	RF	Straight Pattern ,Bolted bonnet ,OS & Y Body: C.Steel Trim : 13% Cr.	ASME E				
	CHECK VALVE	1/2"	1"1/2	800#	SW	Ball or Piston-type Body: C.Steel Trim: F6	BS 5352 ASME B16-34	VDR-10-1-11A	1-3		
		2"	20"	150#	RF	Dual plate-type Wafer Lug / Double flanged body Body : C.Steel Trim: 13% Cr.	API 594 ASME B16-34	VDR 10-2-11A	1-3		
	BALL VALVE	1/2"	1"1/2	800#	SW	Full bore, Floating ball-type, with PE Nipples. Body: C.Steel Trim: 13% Cr. Seats/Seals: PTFE / Viton	BS 5351	VB 01-1-11A	1		
		2"	20"	150#	RF	Full bore, 2 or 3 -piece body Bore dia.<=6": Floating ball Bore dia.>=8": Trunnion ball Material:same as above exept trim:13%Cr or CS+ENP	API 6D ASME B16-34	VBF 01-2-11A	1-2 3		
		2"	20"	150#	RF	Reduced bore, 2 or 3-piece body Bore dia.<=6": Floating ball Bore dia.>=8": Trunnion ball Material:same as above	API 6D ANSI B16-34	VB 01-2-11A	1-2 3		

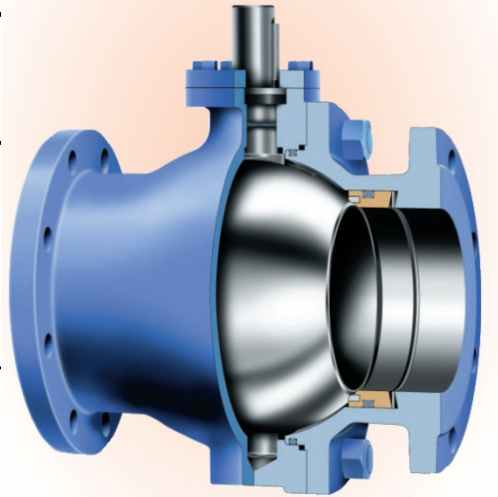


		DIA		Rating	End	DESIGNATION	Standard	Valve data sheet / Comments
		from	to					
VALVES	GATE VALVE	2"	20"	150#	RF	Bolted bonnet ,OS & Y Body: C.Steel Trim : 13% Cr.	API 600 ASME B16-34	VS 01-2-11A
	GLOBE VALVES	1/2"	1"1/2"	800#	SW	Straight Pattern ,Bolted bonnet ,OS & Y Body: C.Steel Trim : 13% Cr.	ASME B16-34	VD 01-1-11A
		2"	6"	150#	RF	Straight Pattern ,Bolted bonnet ,OS & Y Body: C.Steel Trim : 13% Cr.	ASME B16-34	VD 01-2-11A
	CHECK VALVE	1/2"	1"1/2"	800#	SW	Ball or Piston-type Body: C.Steel Trim: F6	BS 5352 ASME B16-:	
		2"	20"	150#	RF	Dual plate-type Wafer Lug / Double flanged body Body : C.Steel Trim: 13% Cr.	API 594 ASME B16-:	
	BALL VALVE	1/2"	1"1/2"	800#	SW	Full bore, Floating ball-type, with PE Nipples. Body: C.Steel Trim: 13% Cr. Seats/Seals: PTFE / Viton	BS 5351	
		2"	20"	150#	RF	Full bore, 2 or 3-piece body Bore dia.<=6": Floating ball Bore dia.>=8": Trunnion ball Material:same as above expt trim:13%Cr or CS+ENP	API 6D ASME B16-:	
		2"	20"	150#	RF	Reduced bore, 2 or 3-piece body Bore dia.<=6": Floating ball Bore dia.>=8": Trunnion ball Material:same as above	API 6D ANSI B16-34	VB 01-2-11A



SERVICE: -DRAIN SYSTEM (BD) -HYDROCARBON GAS (P)	GENERAL MATERIAL : CARBON STEEL API 5L Gr. B		RATING : 150# RF	PIPING CLASS : 11A
	Corrosion Allowance = 0			Page : 2/3

		DIA		Rating	End	DESIGNATION	Standard	Valve data sheet / Comments		
		from	to							
VALVES	GATE VALVE	2"	20"	150#	RF	Bolted bonnet ,OS & Y Body: C.Steel Trim : 13% Cr.	API 600 ASME B16-34	VS 01-2-11A		
	GLOBE VALVES	1/2"	1"1/2	800#	SW	Straight Pattern ,Bolted bonnet ,OS & Y Body: C.Steel Trim : 13% Cr.	ASME B16-34	VD 01-1-11A		
		2"	6"	150#	RF	Straight Pattern ,Bolted bonnet ,OS & Y Body: C.Steel Trim : 13% Cr.	ASME B16-34	VD 01-2-11A	1-3	
	CHECK VALVE	1/2"	1"1/2	800#	SW	Ball or Piston-type Body: C.Steel Trim: F6				
		2"	20"	150#	RF	Dual plate-type Wafer Lug / Double flange Body : C.Steel Trim: 13% Cr.				
	BALL VALVE	1/2"	1"1/2	800#	SW	Full bore, Floating ball-type, with PE Nipples Body: C.Steel Trim: 13% Cr. Seats/Seals: PTFE / Viton				
		2"	20"	150#	RF	Full bore, 2 or 3 -piece body Bore dia.<=6": Floating ball Bore dia.>=8": Trunnion ball Material:same as above except trim:13%Cr				
		2"	20"	150#	RF	Reduced bore, 2 or 3-piece body Bore dia.<=6": Floating ball Bore dia.>=8": Trunnion ball Material:same as above				



Piping material requisition

REV	Item	SIGMA CODE CLIENT CODE	large diam.	small diam. /length	QUANTITIES TO BE SUPPLIED		BALANCE TO BE SUPP. A - B
					New A	Old B	
S E A M L E S S P I P E							
005	34	TE04170	API5LGRB	-ANSI B36-10 -BW -SCH40 -			
			P 2		1248	1212	36
004	37	TE04900	API5LGRB	-ANSI B36-10 -PLAIN END -SCH80 -			
004	36		P 3/4		6	6	0
004	42		P 1		6	6	0
			P 11/2		6	6	0
005	44	TE14795	API5LGRB	-ANSI B36-10 -PLAIN END -SCH80 -MDS CS01 -			
005	25		P 1/2		138	0	138
004	24		P 3/4		12	6	6
004	43		P 1		6	6	0
			P 11/2		6	6	0
005	16	TE14796	API5LGRB	-ANSI B36-10 -BW -SCH40 -MDS CS01 -			
			P 2		372	336	36
005	27	TE14797	API 5L GR.X52	-ANSI B36-10 -BW -SCH40 -MDS CS04 -			
005	15		P 3		12	12	0
			P 4		12	6	6
005	33	TE15011	API5LGRB	-ANSI B36-10 -BW -SCH160 -MDS CS01 -			
005	20		P 3/4		72	12	60
			P 2		306	282	24
005	19	TE15012	API5LGRB	-ANSI B36-10 -BW -XXS WALL -MDS CS01 -			
			P 1		126	126	0
005	38	TE15013	API 5L GR.X52	-ANSI B36-10 -BW -SCH80 -MDS CS04 -			
			P 3		36	0	36



Engineering

- Process

- Equipment

- HSE

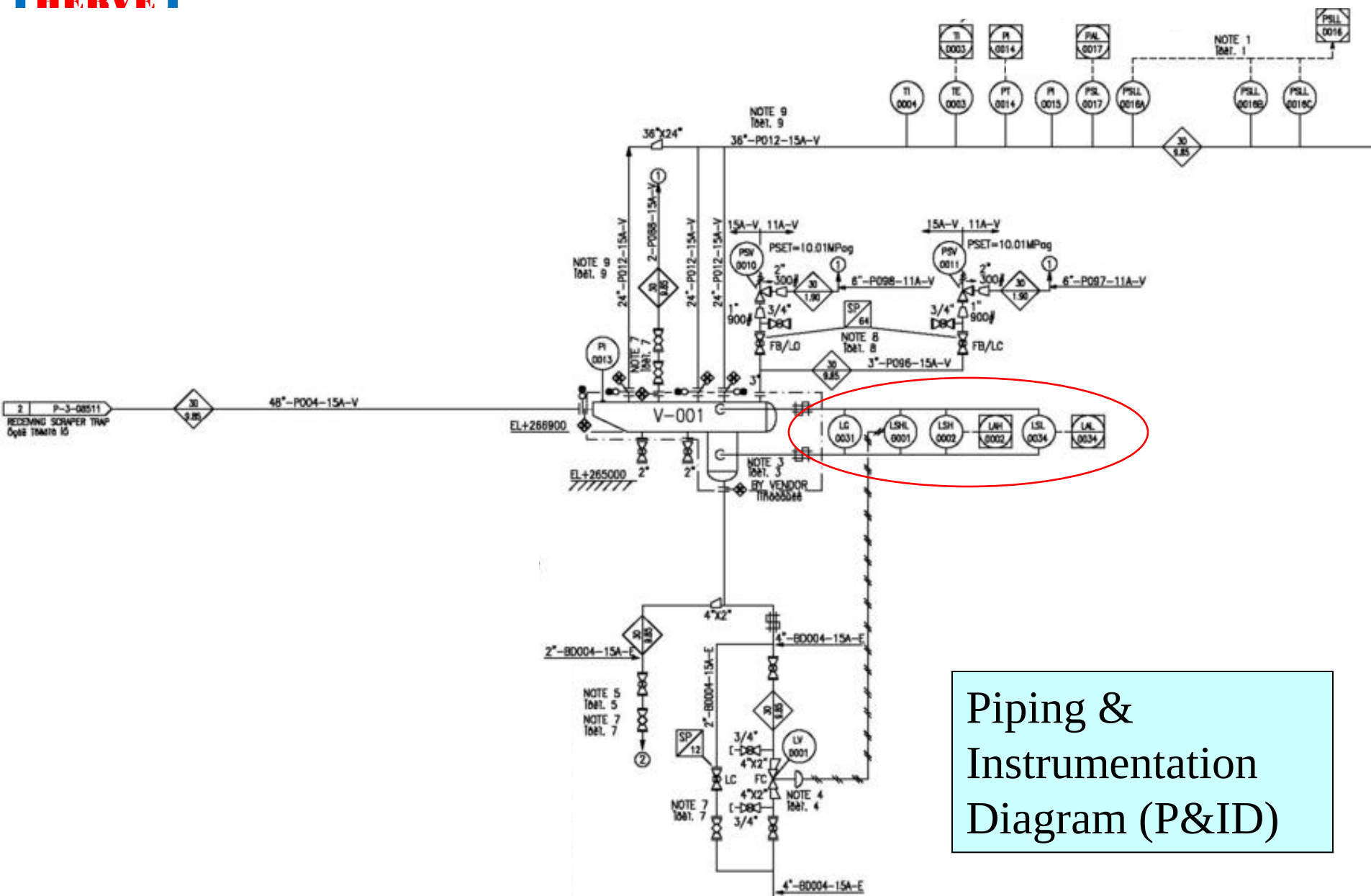
- Civil

- Layout

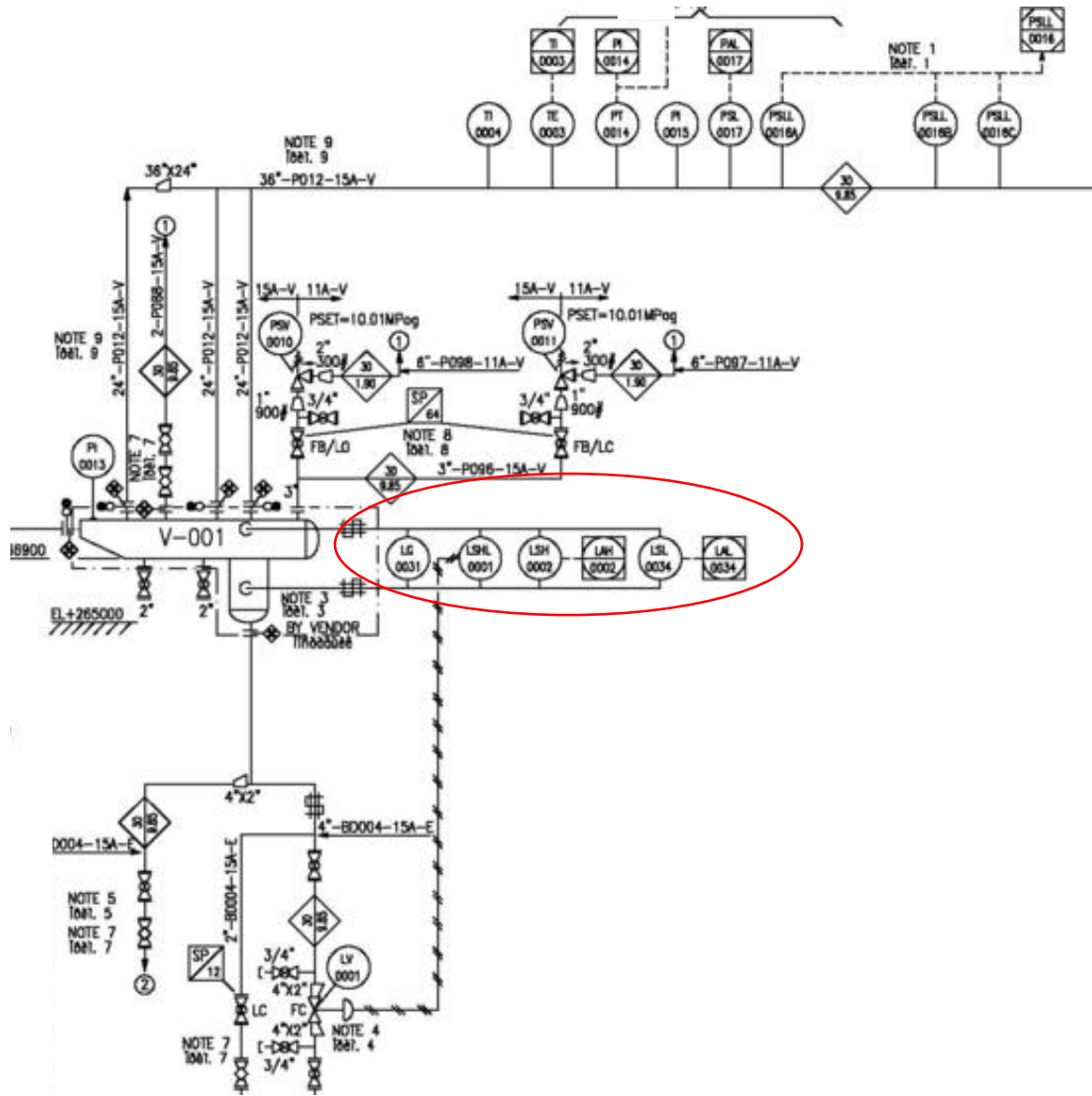
- Piping

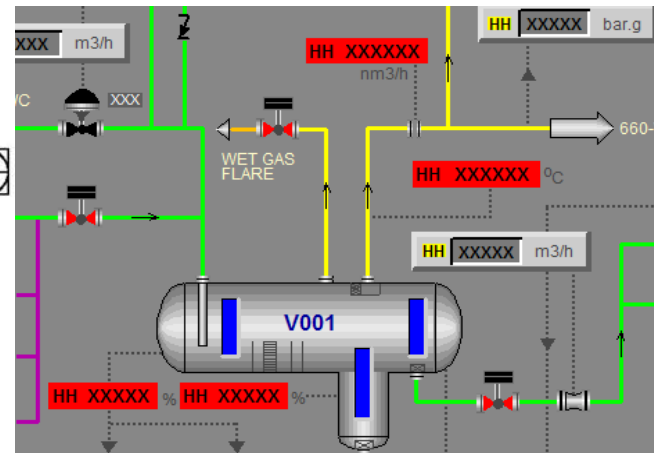
- Instrumentation

- Electrical

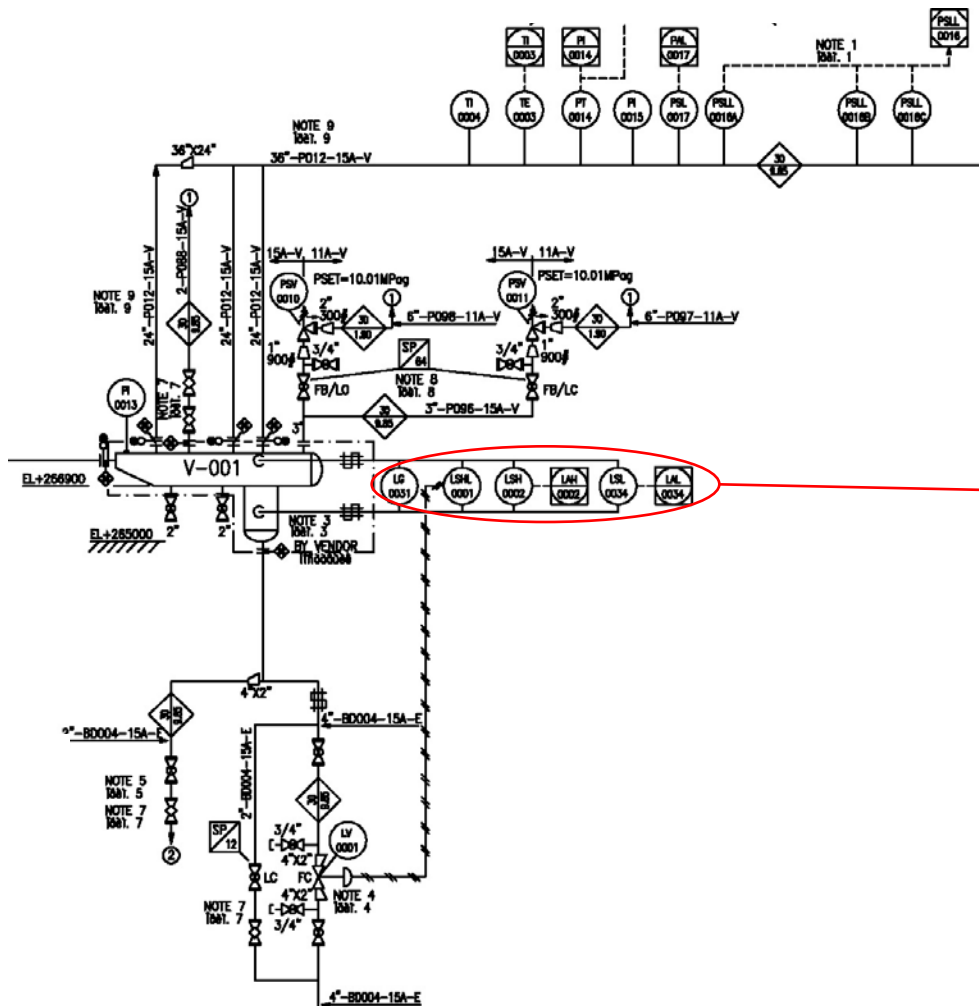


Piping & Instrumentation Diagram (P&ID)



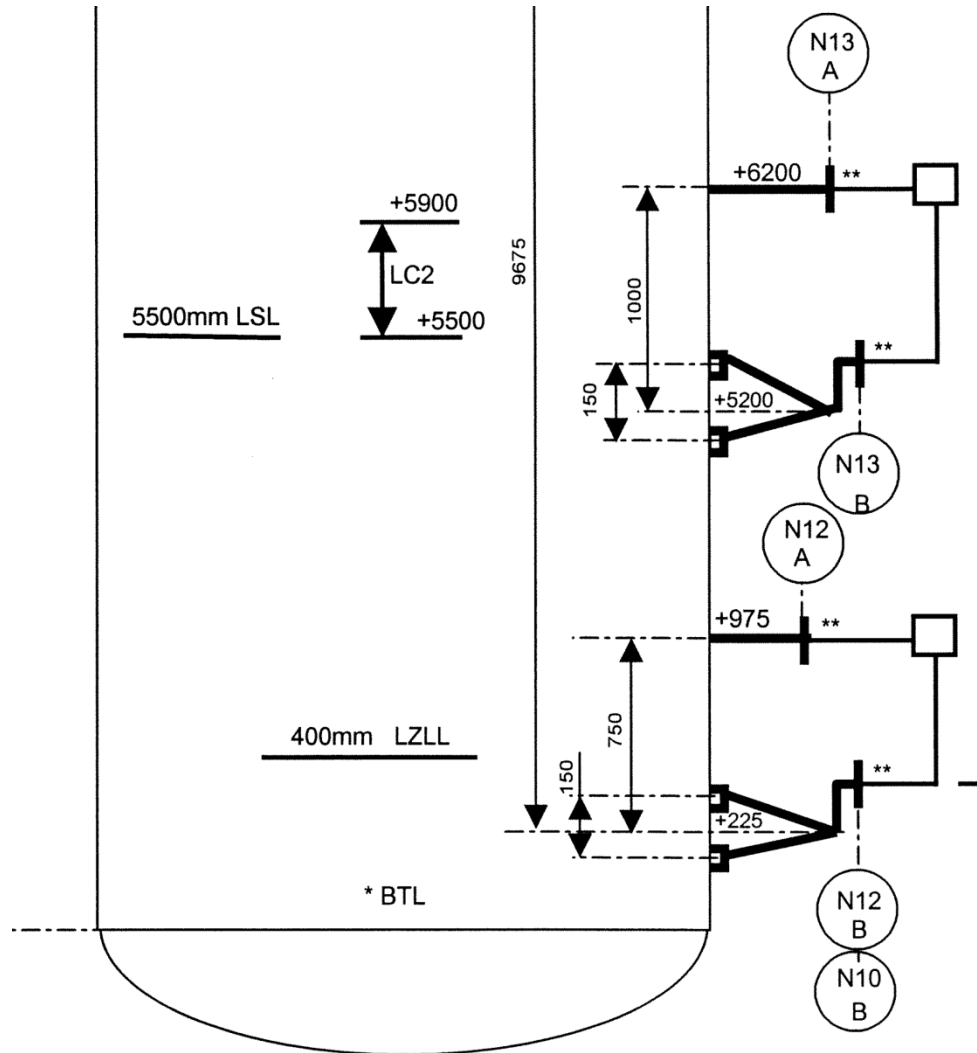


Instrument list

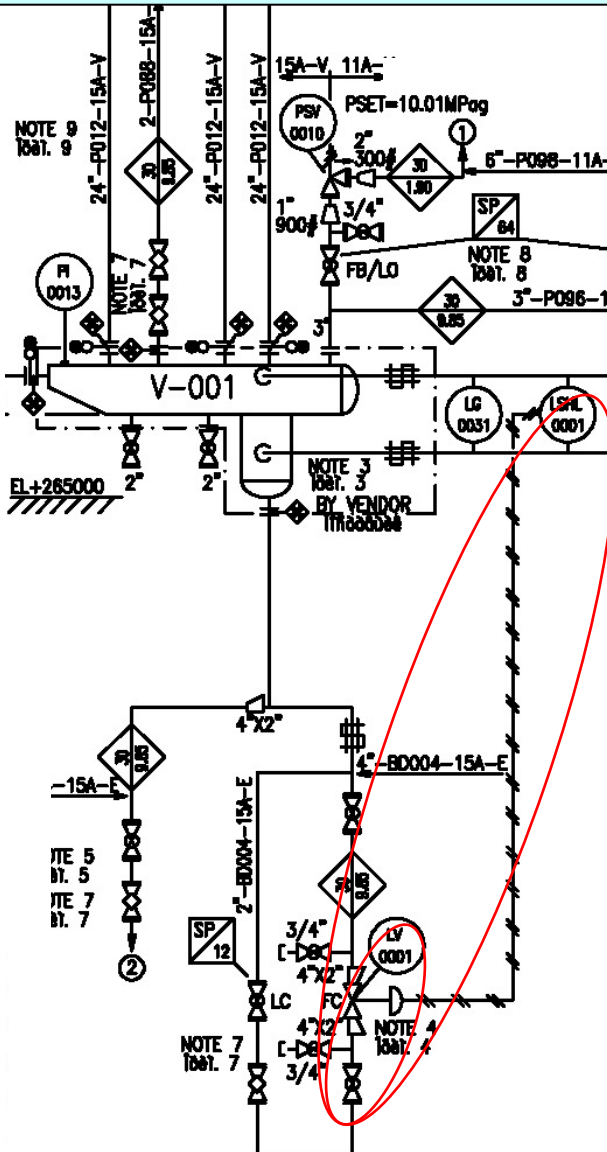


Tag Number	Instrument Type	I/O Type	Signal	System
AE -0701-1	Analyse measure	AI	4-20 mA	-
AT -0701-1	Analyser transmitter	AI	SL	GMS
AI -0701-1	Analysis indicator	-	Soft	GMS
AXA -0703-6	Apparatus failure alarm	DO	24 Vdc	GMS
ASHH -0703-2	Very High dew point switch	DO	24 Vdc	ESD
AT -1061	Moisture analyser	-	-	-
BE -1201-1	Flame detector	AI	UV	UCS (TC-100)
BL -1201-1	Flame indicator	-	Soft	UCS (TC-100)
BXA -1201-1	Flame detector fault alarm	-	Soft	UCS (TC-100)
FT -0013	Flow transmitter	AI	4-20 mA	PCS
FO -1003	Restriction orifice	-	-	-
FE -1005	Orifice plate	-	-	-
FT -1005	Flow transmitter	AI	4-20 mA	PCS
FY -1005-1	Computing device	-	Soft	PCS
GD -0108	Gas detector (IRGD)	AI	4-20 mA	CF-001
GAH -0108	Gas alarm (10%LEL)	-	-	CF-001
HZLH -2002-1	Status valve opened	Hold	Soft	UCS (TC-200)
JQ -0737	Energy flowrate totalizer	-	Soft	GMS
JL -0738	Energy flowrate indicator	-	Soft	GMS
LSHL -0001	Pneum. level switch	-	3-15 psi	-
LV -0001	Control valve	-	3-15 psi	-
LSH -0002	High level switch	DI	24 Vdc	PCS
LAH -0002	High level alarm	-	Soft	PCS
LG -0031	Level gauge	-	-	-
MXS -0730-3	Remote position switch	DI	24 Vdc	CF-004
MXL -0730-3	Local/remote status	-	24 Vdc	CF-004
MXS -0730-4	Start order	DO	220Vdc	CF-004
MXS -0731-1	Electrical fault switch	DI	24 Vdc	CF-004
ND -0034	Fire detector (UV/IR)	DI	24 Vdc	CF-001
NAH -0034	Fire detection alarm	-	-	CF-001
PSLL -0049-C	Very low pressure switch	DI	24 Vdc	ESD
PALL -0049	Very Low pressure alarm	-	Soft	ESD
PSH -0050	High pressure switch	DI	24 Vdc	PCS
PAH -0050	High pressure alarm	-	Soft	PCS
ST -4602	Speed transmitter	AI	Analog	BNR
SI -4602	Speed indicator	AO	Analog	TDS
TT -0707	Temperature transmitter	AI	Hard	GMS
TI -0707	Temperature indicator	-	Soft	GMS
TAL -0707	Low temperature alarm	-	Soft	GMS
TAH -0707	High temperature alarm	-	Soft	GMS
VT -1201-2	Vibration transmitter	AI	Analog	BNR
VI -1201	Vibration indicator	-	Hold	UCS (TC-100)
WI -1102-1	Torque indicator	-	Soft	UCS (TC-100)
WI -1102-2	Torque indicator	-	Soft	UCS (TC-100)
ZAHH -2602	Very high displacement alarm	-	Soft	UCS (TC-200)
ZE -2604-1	Displacement detector	Hold	Hold	-

Level sketch



Instrument data sheet



GENERAL DESIGN DATA

Tag No.:	V, 11A-V
PID No.:	
Service:	
Line No.:	
Process (	
Process (	
Case Des	
Phase	
Fluid Nam	
Flow Rate	
Upstream	
Downstre	
Temperat	
Density @	
Molecular	
Viscosity	
Specific H	
Compress	
Superhea	
Critical Pr	
Vapour P	
Flash Rat	
FL(Liquid	
Xt(Pressu	
Calculate	
Required	
Travel of v	
Predict Si	
Allowable	

Max. Shut Off Pressure	19
Design Pressure	18 /
Design Temperature	270 /

Manufacturer Name : FISHER	53
Model No : ET	54
Ser No. : 17982719	55
Air Failure Action : FC	56
Max. Shut Off Pressure : 19 bar	57
Leakage Class : IV (standard)	58
Material Corrosion Requirement :	59
Line	60
Line No. : 84SM-60020-8"-3S1-1	61
Line Size 8 in	62
Schedule: 30	63
ServiceClass: 3S1	64
Insulation Thickness :	65
Design Pressure : 18 / bar-g	66
Design Temperature : 270 / °C	67
Notes for Line :	68
Instrument Air Supply	69
Mechanical Design Pressure : 10.8	70
Operating Pressure(Max/Min) : 12.6 / 11.6 bar-g	71
Dew Point Temperature : -40 °C	72
Enclosure	73
Electrical Hazardous Protection	74
Class : Zone 2, IIB T3	75
Type : Ex n (SOV: Ex d)	76
Certificate : ATEX	77
Weather Protection : IP65/NEMA 4X	78
Notes:	79
Positioner Type : Electropneumatic Smart (HART)	80
Manufacturer : Fisher	81
Model :	82
Input Signal Type : 4-20mA DC	83
Gauges : Supply/Output	84
Bypass :	85
Notes : Tag No: 84FVY-6703A	86
Body Size : 6 in	87
Rating : 300#	88
Conn Type : RF Flange	89
Flange Face Finish : 125-250 Ra	90
Face to Face Dimension : 472.9	91
Body/Bonnet Material : A216-WCC	92
Type of Bonnet : Plain	93
Flow Direction : Up	94
Corrosion Allowance : 1.2 mm	95
Gasket Material : Single graphite	96
Packing Mat.: laminated	97
Notes : packing flange material: 316 SST	98
Trim Type : Metal 301	99
Size : 5 3/8	100
Trim Construction :	
Rated Cv : 129	
Rated Travel : 3"	
Characteristic : Whisper3-C1/Linear	
Material	
Plug / Ball / Disc : 17-4PH SST	
Seat : 410 SST	
Cage / Guide : 416 SST	
Stem : 316 SST	

Instrument Type : Air Actuated CV (Globe) E/P positioner	53
Valve Type : Control Globe	54
Valve Service :	55
Quantity Tags : 1	56
Manufacturer : FISHER	57
Model : 667-4	58
Type of Actuator : spring & diaphra	59
Size : 70	60
Material	61
Case : Yoke : Stem :	62
Mechanical Design Pressure : 4.1 barg	63
Actuator Force Design Pressure :	64
Required Air Supply Pressure : 4.5 barg	65
Stroke Speed : within 10 seconds	66
Travel Indicator : Yes	67
Orientation : vertical up	68
Painting System : as per RG6-S-00-13A0-004	69
Colour	70
Body : Primer	71
Yoke : Green	72
Actuator : Green	73
Handwheel : Green	74



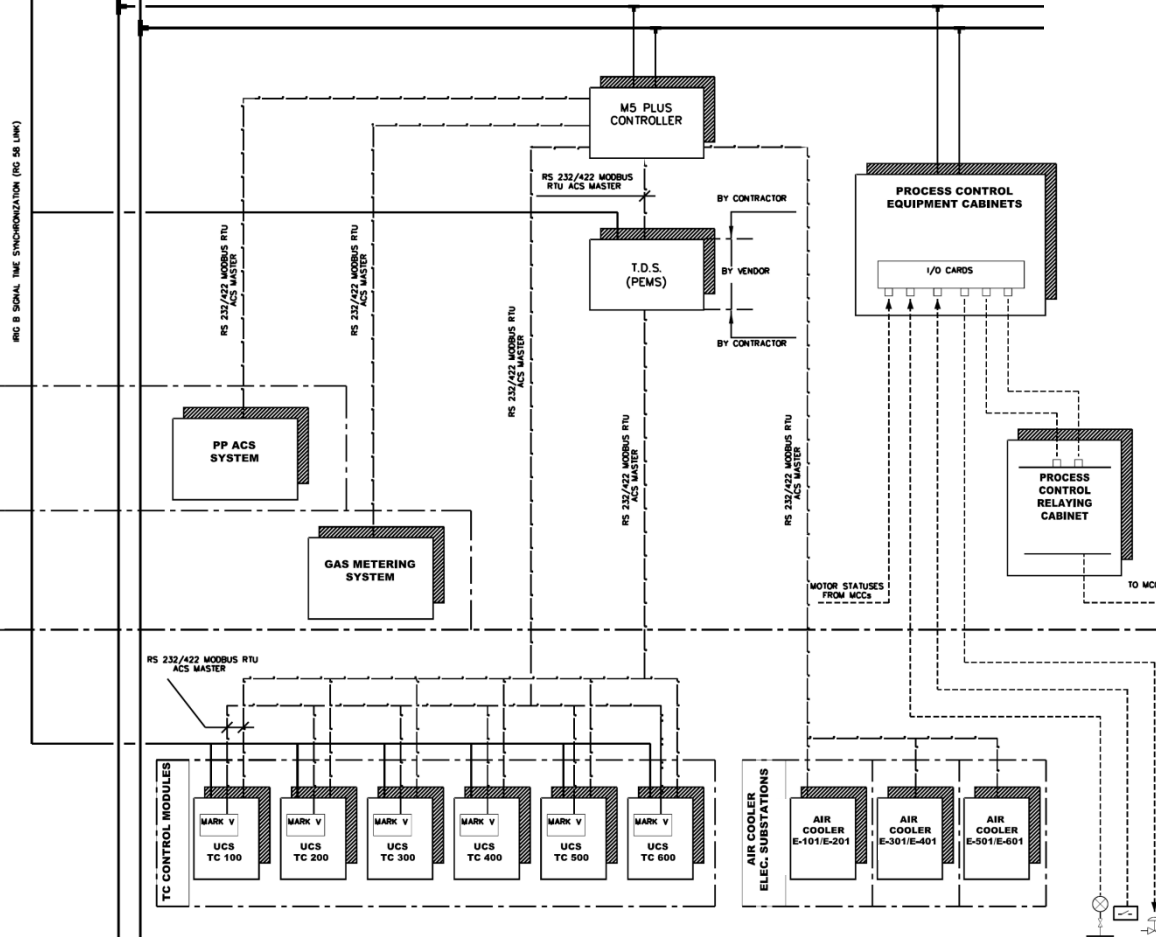
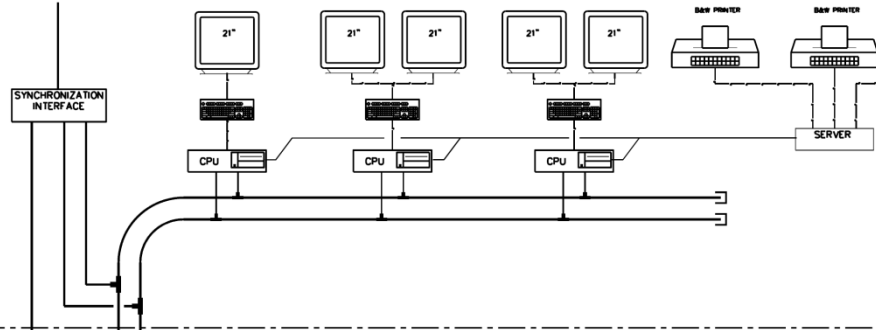


OPERATORS ROOM

INSTRUMENTATION ROOM

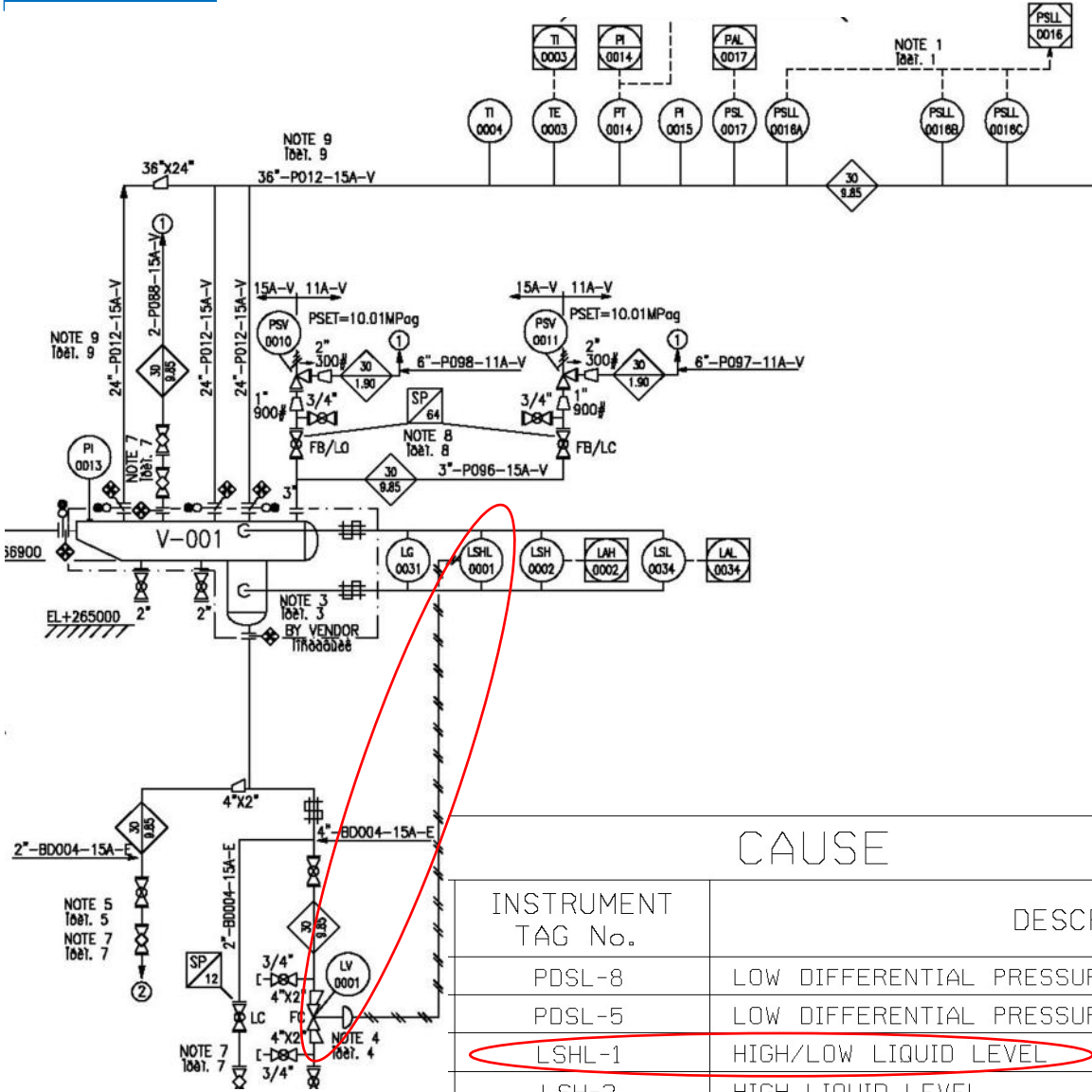
ELECTRICAL ROOM

METERING ROOM



System
Architecture
drawing

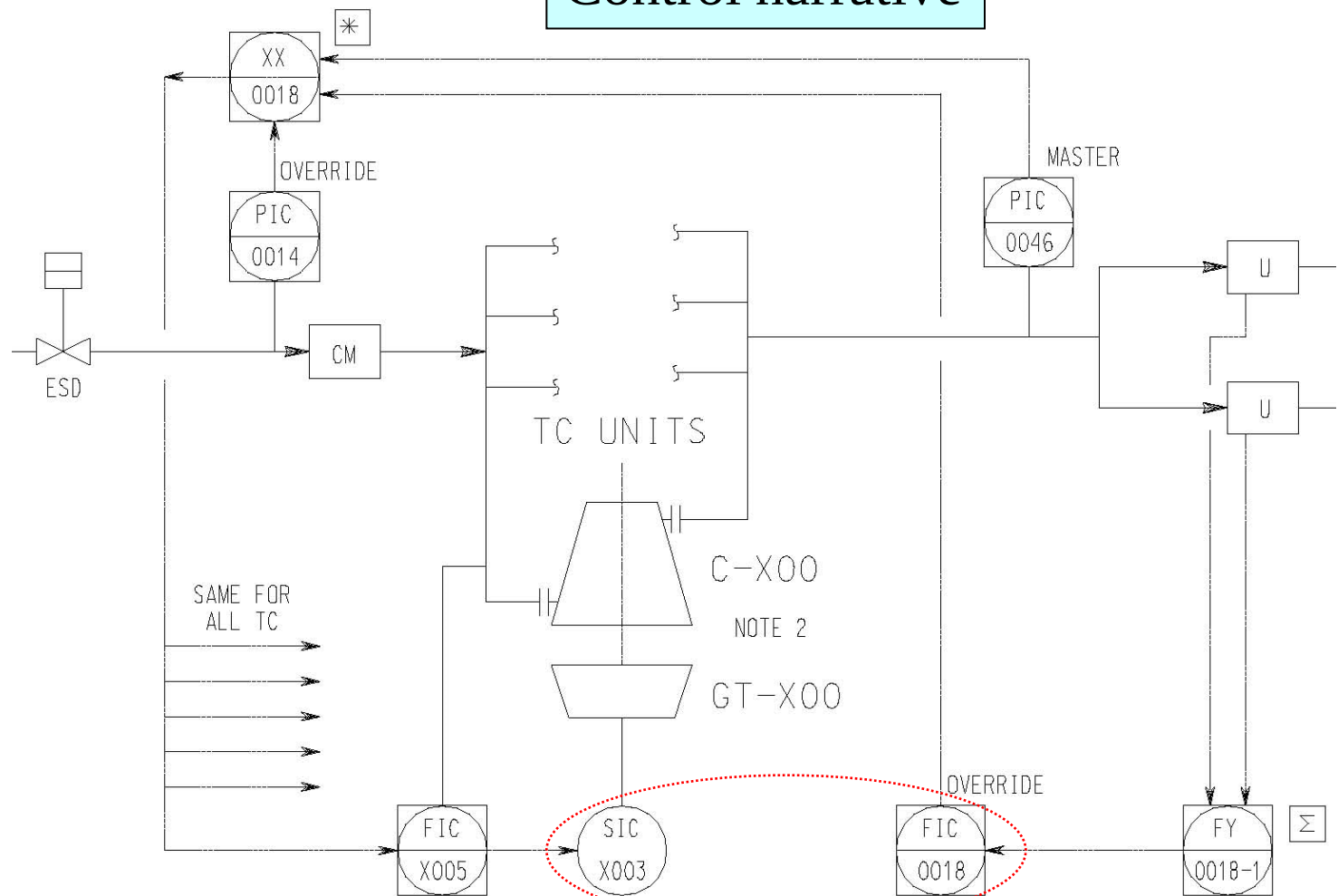
Process automations



INSTRUMENT TAG No.	DESCRIPTION	VOT ING	SL No.	1	2	3	4
PDSL-8	LOW DIFFERENTIAL PRESSURE (NOTE 3)		1	X			
PDSL-5	LOW DIFFERENTIAL PRESSURE (NOTE 3)		2		X		
LSHL-1	HIGH/LOW LIQUID LEVEL		3			X	
LSH-2	HIGH LIQUID LEVEL		4				X
LSH-4	HIGH LIQUID LEVEL		5				
LSL-5	LOW LIQUID LEVEL		6				
LSHL-33	HIGH/LOW LIQUID LEVEL		7				

	EFFECT	
TAG. No.	DESCRIPTION	ACTION
HSV-1	CS ESD INLET VALVE	PERMISSIVE
SDV-41	PIPELINE SHUTDOWN INLET VALVE	PERMISSIVE
LCV-1	LEVEL CONTROL VALVE	OPEN/CLOSE
LAH-2	HIGH LIQUID LEVEL ALARM	ALARM

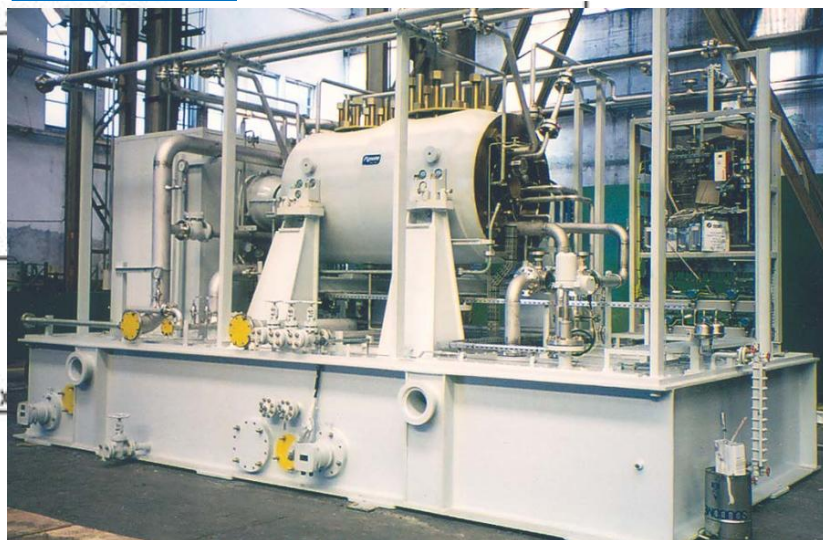
Control narrative



Station Control

Control of the station shall be carried out, manually or automatically, by adjusting the revolutions of the units, controlling the most critical of the following parameters:

- suction gas pressure (override);
- discharge gas pressure (master);
- gas flow rate (override).



FIRE
IN THE GAS TURBINE
ENCLOSURE
ПОЖАР В УСТРОЙСТВЕ
ГАЗОВОЙ ТУРБИНЫ (45FTX1)

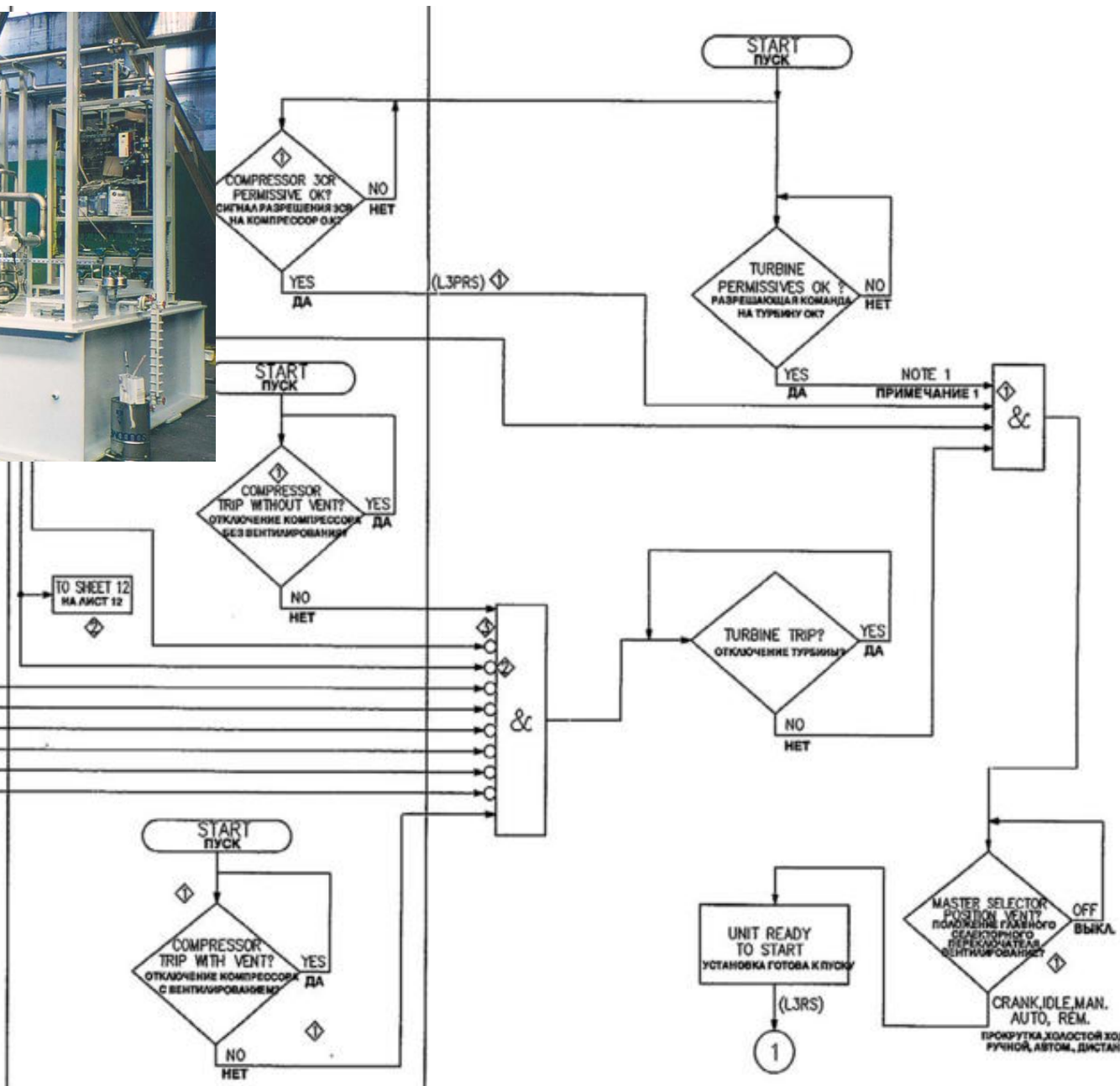
FIRE
IN THE UNIT BUILDING
ПОЖАР В ЗДАНИИ
УСТАНОВКИ (45FTX2)

FIRE IN THE
CONTROL CAB
ПОЖАР В КАБИНЕ
УПРАВЛЕНИЯ (45FTCC)

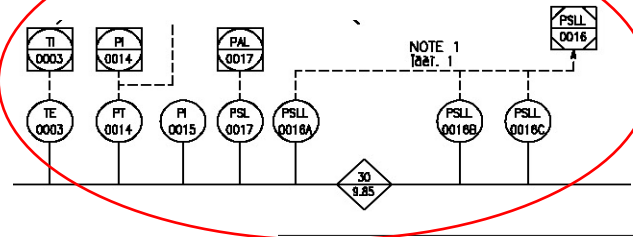
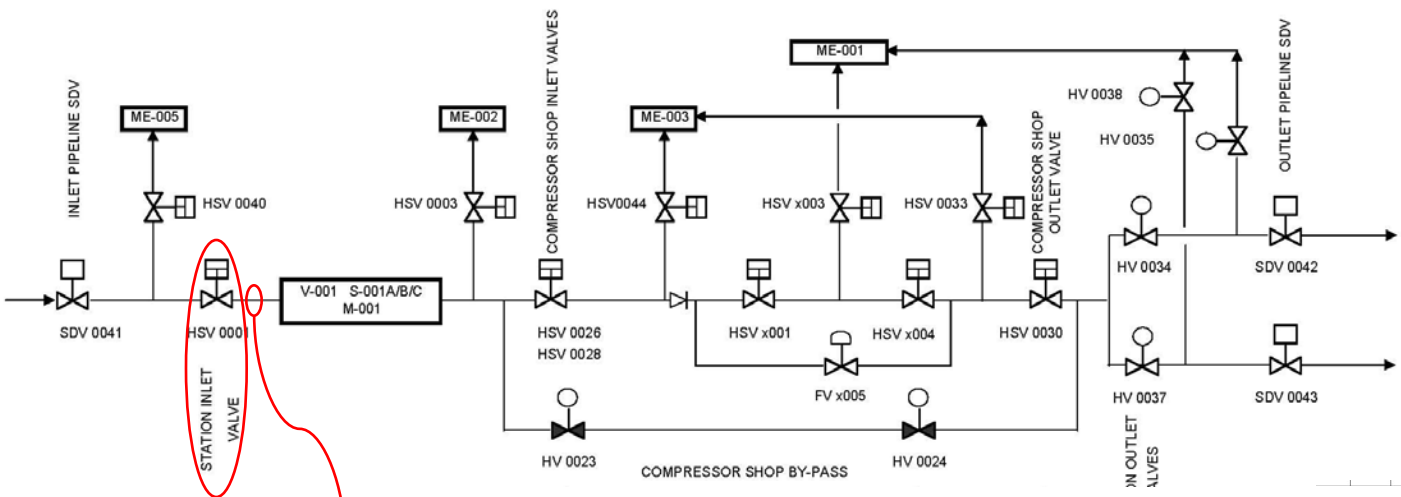
GAS DETECTED
INTO GAS TURBINE
ENCLOSURE
ЗАГАЗОВАННОСТЬ В УСТРОЙСТВЕ
ГАЗОВОЙ ТУРБИНЫ (45HE)

GAS DETECTED
INTO THE UNIT
BUILDING
ЗАГАЗОВАННОСТЬ В ЗДАНИИ
УСТАНОВКИ (45HB)

GAS DETECTED IN
HVAC VENTILATION
CONTROL CAB
ЗАГАЗОВАННОСТЬ В КАБИНЕ
УПРАВЛЕНИЯ СИСТЕМОЙ
ВЕНТИЛЯЦИИ ОБЩ. (45HVAC)



Emergency shutdown



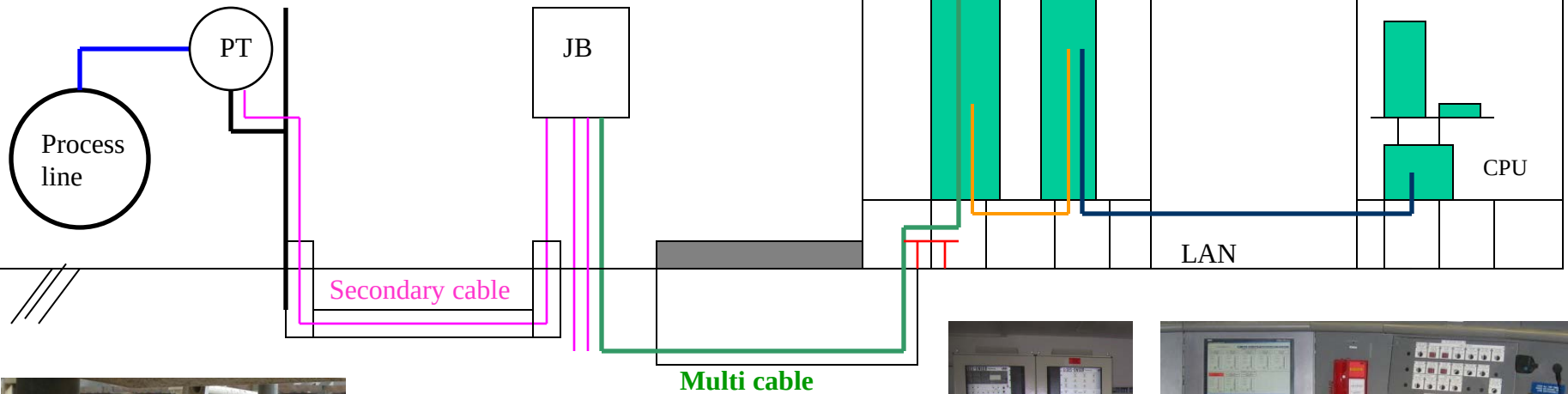
CAUSE

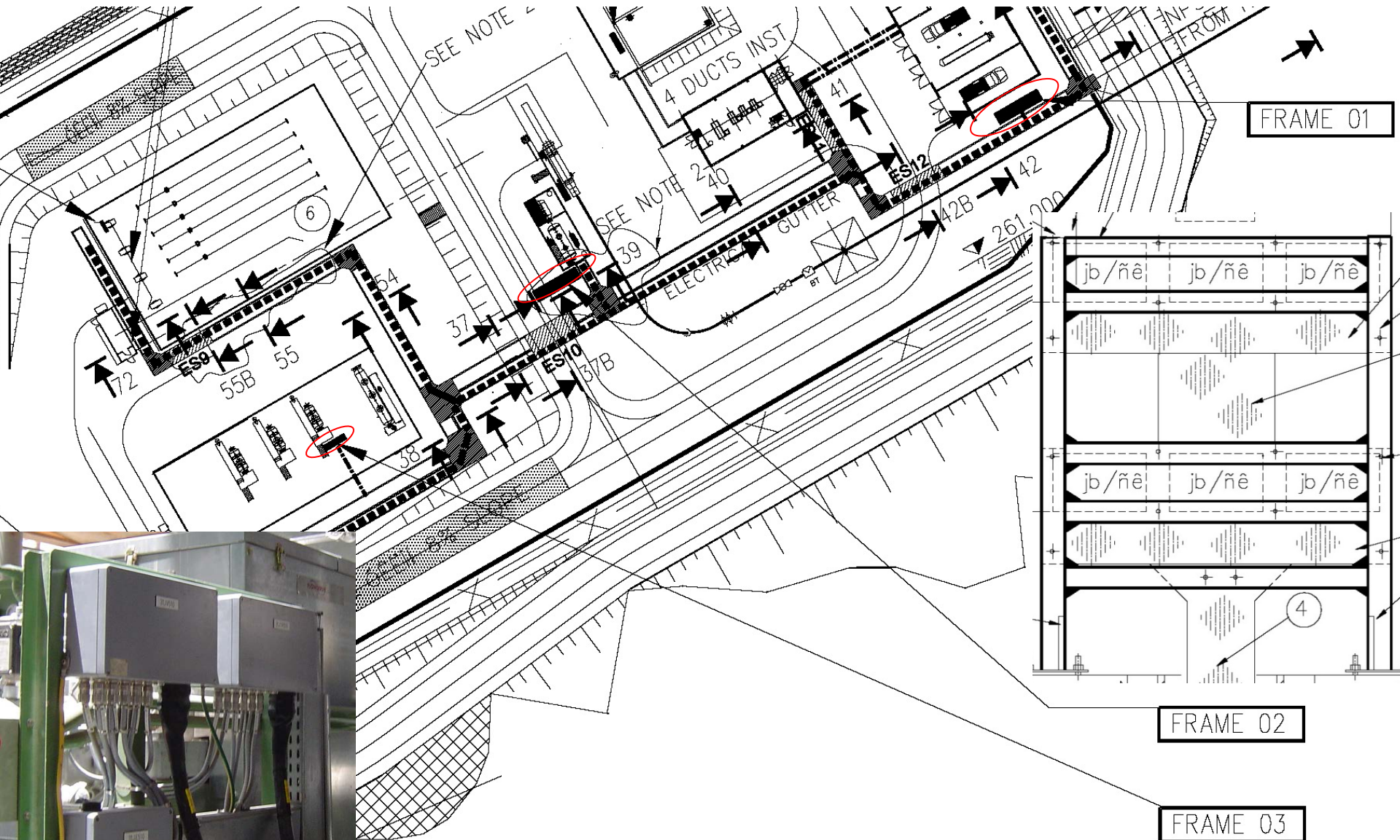
INSTRUMENT TAG No.	DESCRIPTION	VOT ING	SL No.	1	2	3	4	5	6	7	8
LSHH-22	HIGH HIGH LEVEL IN FILTER SEPARATORS		23				X				X
LSHH-26	HIGH HIGH LEVEL IN FILTER SEPARATORS		24				X				X
PSLL-16A/B/C	LOW LOW SUCTION GAS PRESSURE	YES	26				X				X
PSL-17	LOW SUCTION GAS PRESSURE		27								

EFFECT

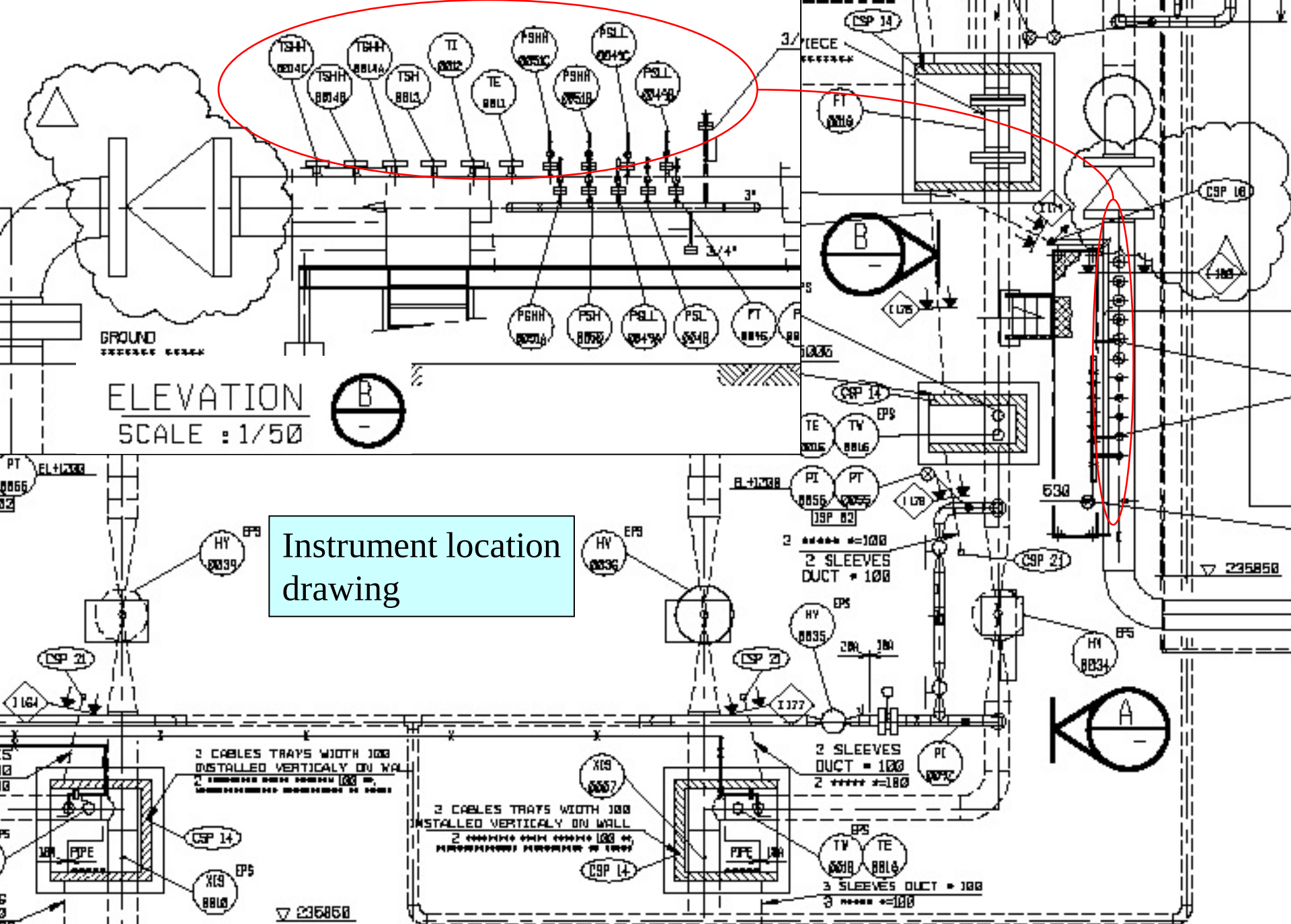
TAG. No.	DESCRIPTION	ACTION
SDV-41	PIPELINE SHUTDOWN INLET VALVE	CLOSE
SDV-42	PIPELINE SHUTDOWN OUTLET VALVE	CLOSE
SDV-43	PIPELINE SHUTDOWN OUTLET VALVE	CLOSE
HSV-1	CS ESD INLET VALVE (NOTE 7)	CLOSE
HSV-3	INLET FACILITIES VENT VALVE (NOTE 3)	OPEN
HSV-26	SUCTION HEADER ESD INLET VALVE	CLOSE

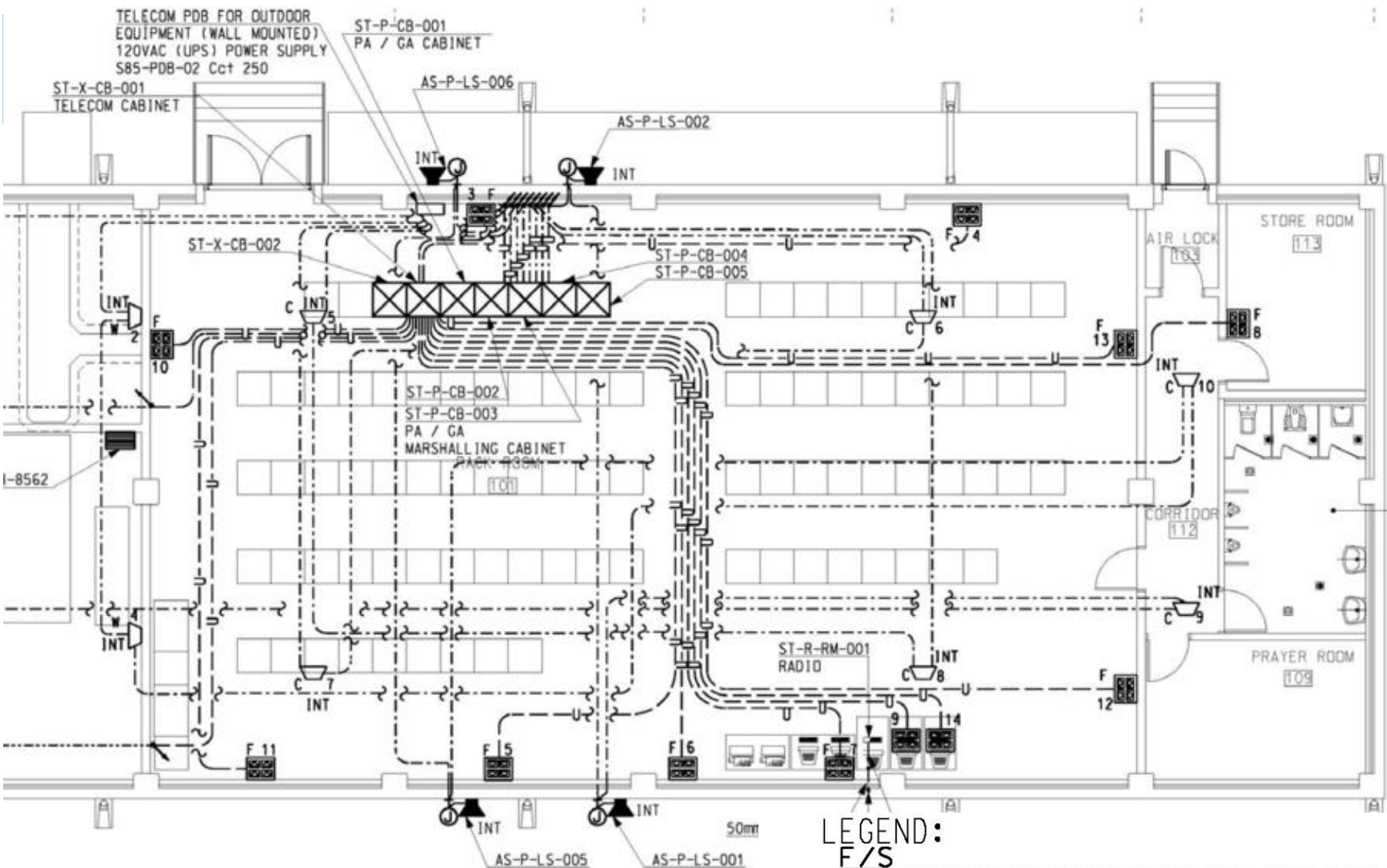
The instrument hardware





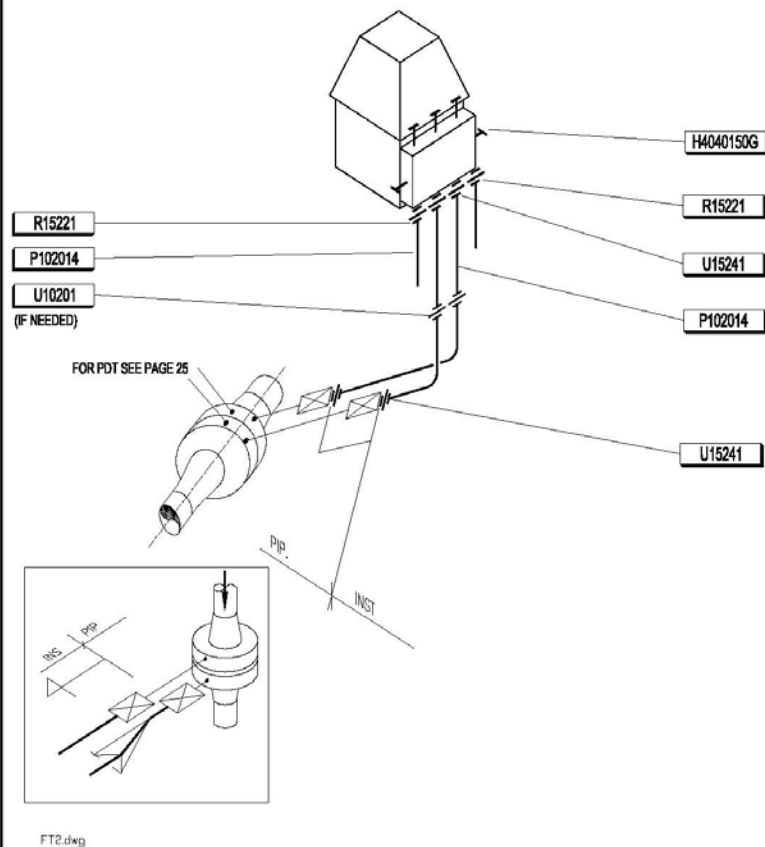
Junction Box
drawing





Building detail drawing/
Telecom and PAGA layout

FLOW -GAS SERVICE PIPING CLASS : 18 A



TAG NUMBER

FT-1005
FT-2005
FT-3005
FT-4005
FT-5005
FT-6005

Note : Block manifold supply with transmitter
(H4020150G)

R15221	2	Reducer	12 mm x 1/4"		OD x NPT M	AISI 316 SS
U15241	4	Male connector	12 mm x 1/2"		OD x NPT M	AISI 316 SS
U10201	2	Union	12 mm		OD	AISI 316 SS
P102014	6m	Tubing	12 mm OD x 1.5 mm			AISI 316 SS
H4040150G	0	Block manifold 5 valves (Gas)/D	1/2" (Proc.) / 1/4" (Drain)	6000 psi	NPT F	AISI 316 SS
ITEM	QTY	DESIGNATION	SIZE	RATING	CONNECT.	MATERIAL

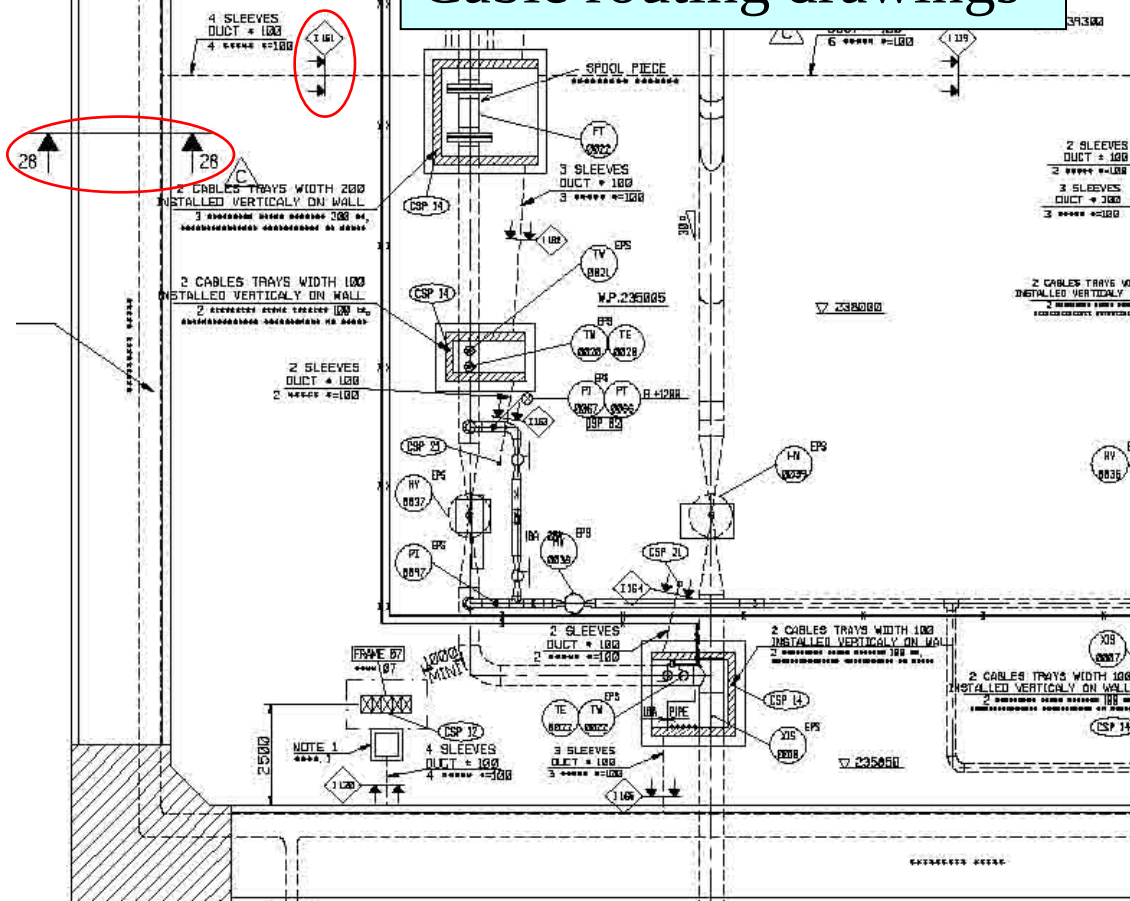
Instrument standard installation drawings



Junction box wiring



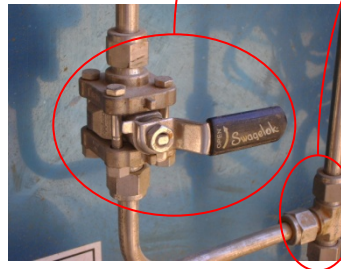
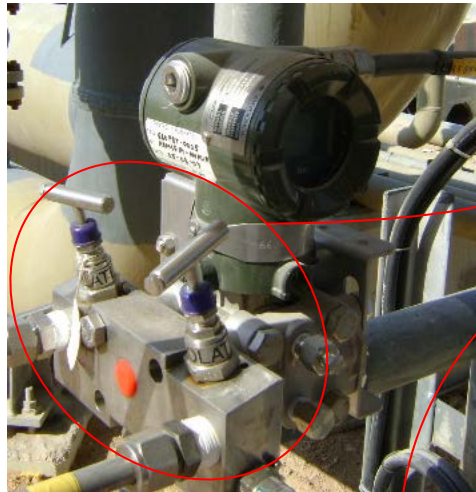
Cable routing drawings



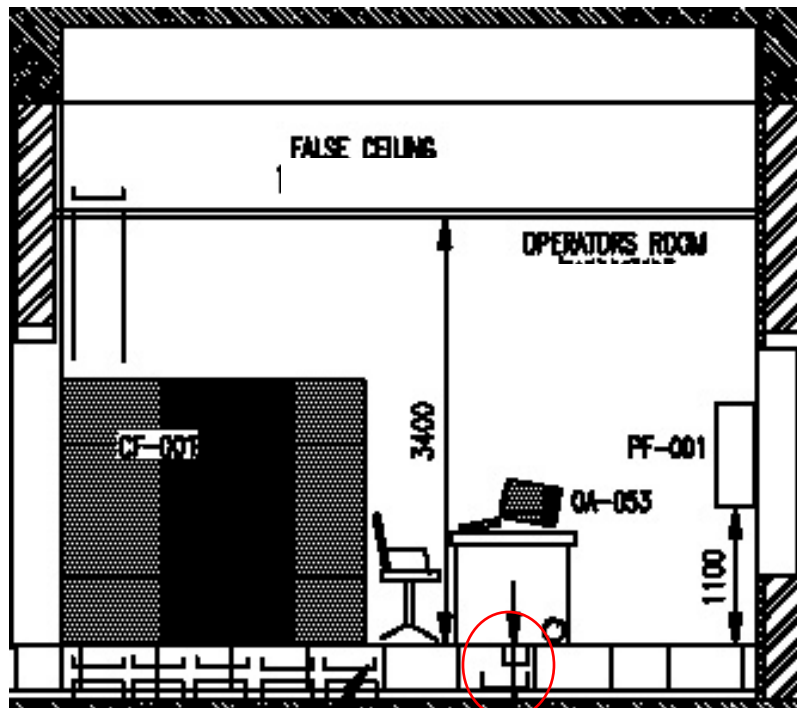
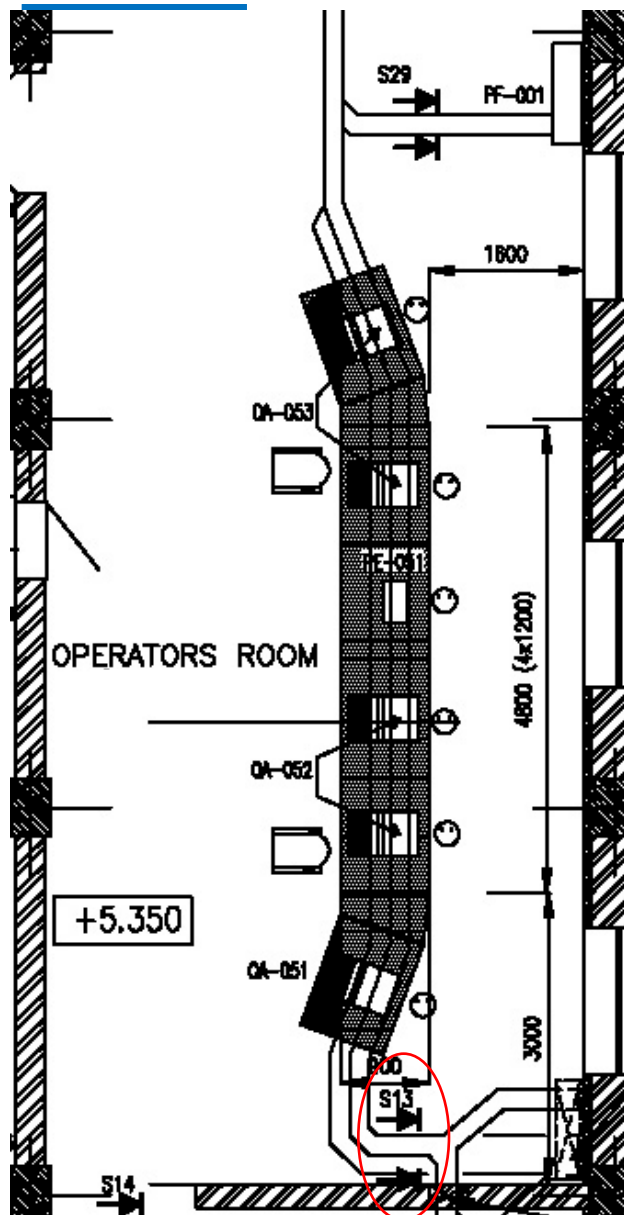
CABLES TAG	CABLES TYPE	SUPPLY BY (1)	FROM	LOCATION FRAME or OTHER	TO	LOCATION FRAME or OTHER	LENGTH m	ROUTING CROSS SECTIONS
CC-004	A-T-1-19-P-2-0	CONTRACTOR	JC-004	PIG D-002	CA-052	INSTRUM. ROOM	370	I121-I111-1161-28-1B-11-0-44-4-2-1-96
CC-005	A-T-1-12-P-2-0	CONTRACTOR	JC-005	FILTER-SEPARATOR	CA-052	INSTRUM. ROOM	440	I127-36B-36-36A-71-35-35B-65-34-3-1-96
CC-006	A-T-1-12-P-2-0	CONTRACTOR	JC-006	FILTER-SEPARATOR	CA-052	INSTRUM. ROOM	440	I127-36B-36-36A-71-35-35B-65-34-3-1-96
CC-007	A-T-1-7-P-2-0	CONTRACTOR	JC-007	STATION INLET VALVES	CA-052	INSTRUM. ROOM	370	I193-I190-35A-71-35-35B-65-34-3-1-96
CC-008	A-T-1-7-P-2-0	CONTRACTOR	JC-008	DIESEL GENERATOR	CA-052	INSTRUM. ROOM	120	I350-30-70B-70
CC-009	A-T-1-7-P-2-0	CONTRACTOR	JC-009	FIRE WATER	CF-004	FIRE BUILDING	100	
CC-101-1	A-T-1-19-P-2-0	CONTRACTOR	JC-101	AERO E-101	UA-101	S/S ELECTRICAL 27-1	160	

Cable list

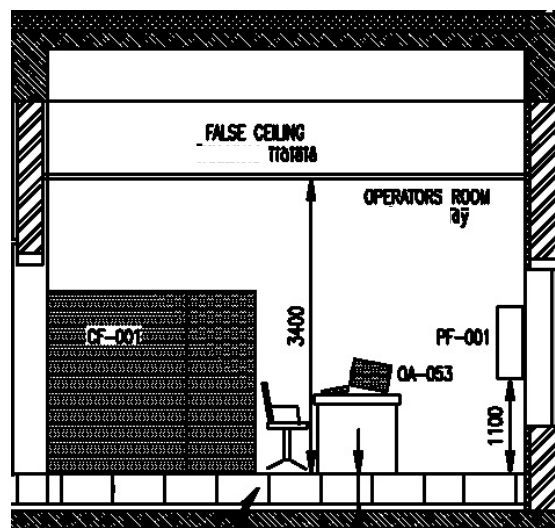
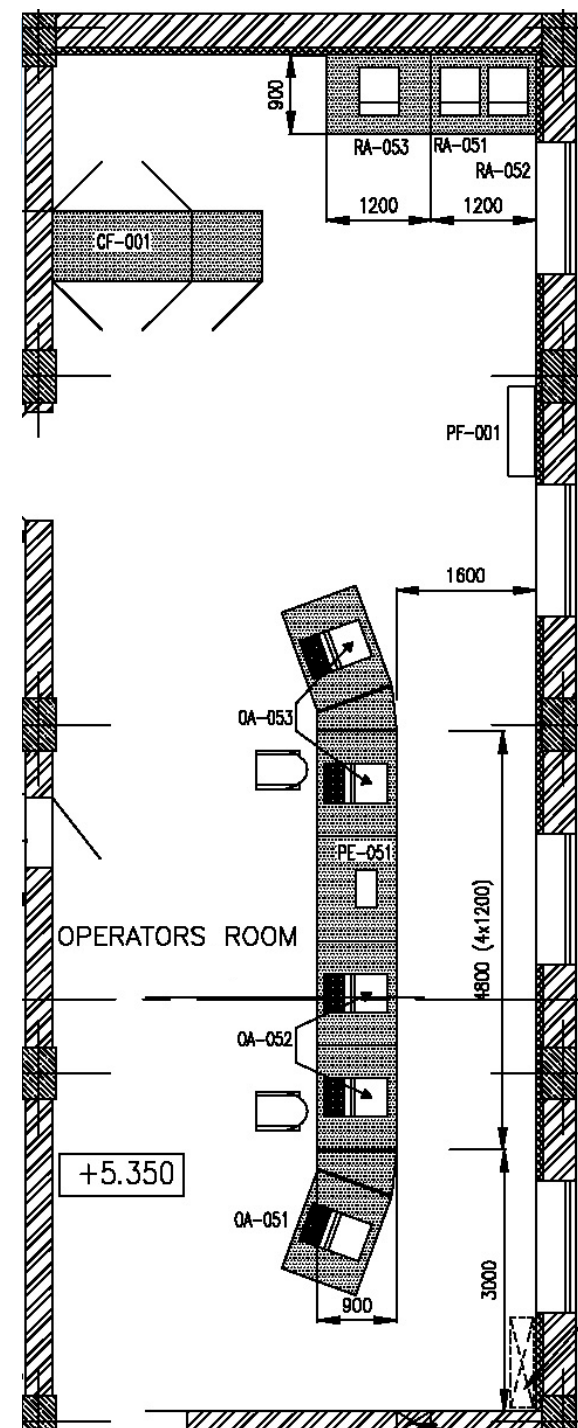
Instrument bulk Material Take-Off



ITEM	QUANTITY	DESIGNATION
1	195	Gauge adapter – ½" x ½"
2	37	Block manifold 2 valves (Gas) – ½"
3	23	Block manifold 5 valves (Gas) – ½"
4	0	Ball valve ½" – 12mm
5	300m	Tubing – 12mm OD x 1mm
6	200	Reducer – 12mm x ¼"
7	50	Union tee – 12 x 12 x 12mm
8	50	Female connector – 12mm x ½"
9	350	Male connector – 12mm x ½"
10	9	Plug – ½" NPTF
11	8	Plug – ½" NPTM

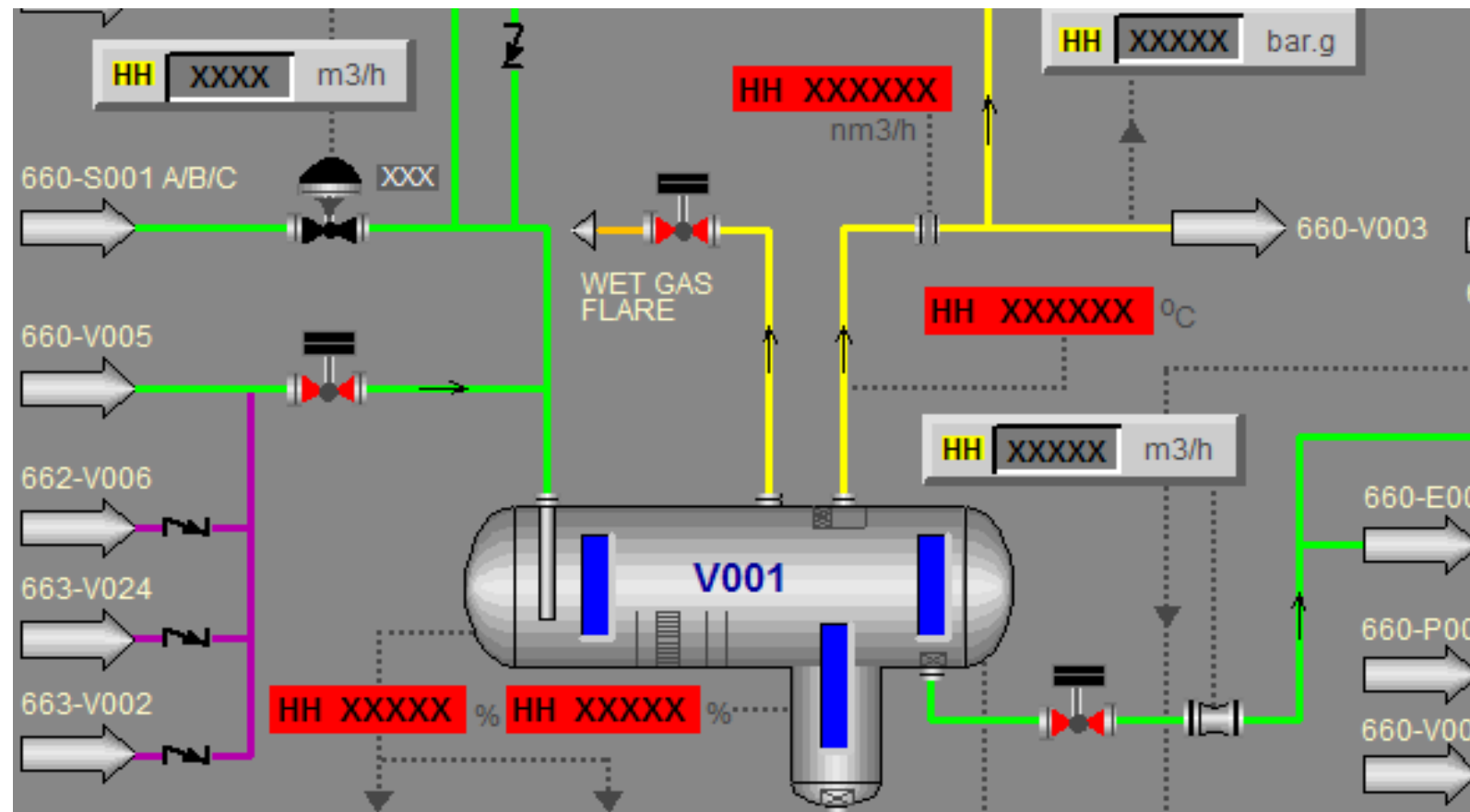


Cable routing inside technical room



Instrumentation & control rooms layout

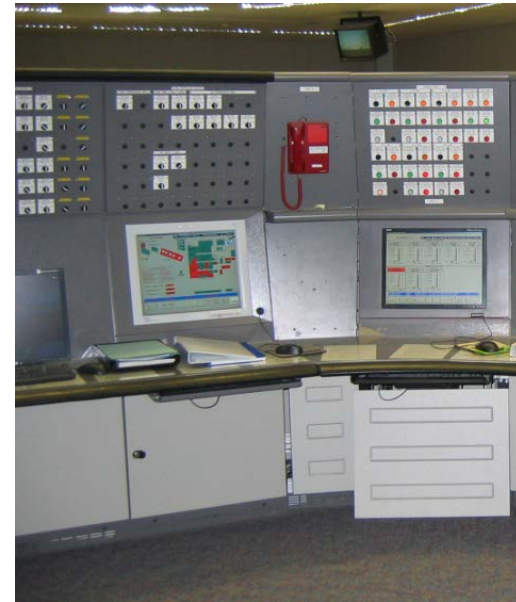




Screen displays



Instrument loop diagram



Engineering

- Process

- Equipment

- HSE

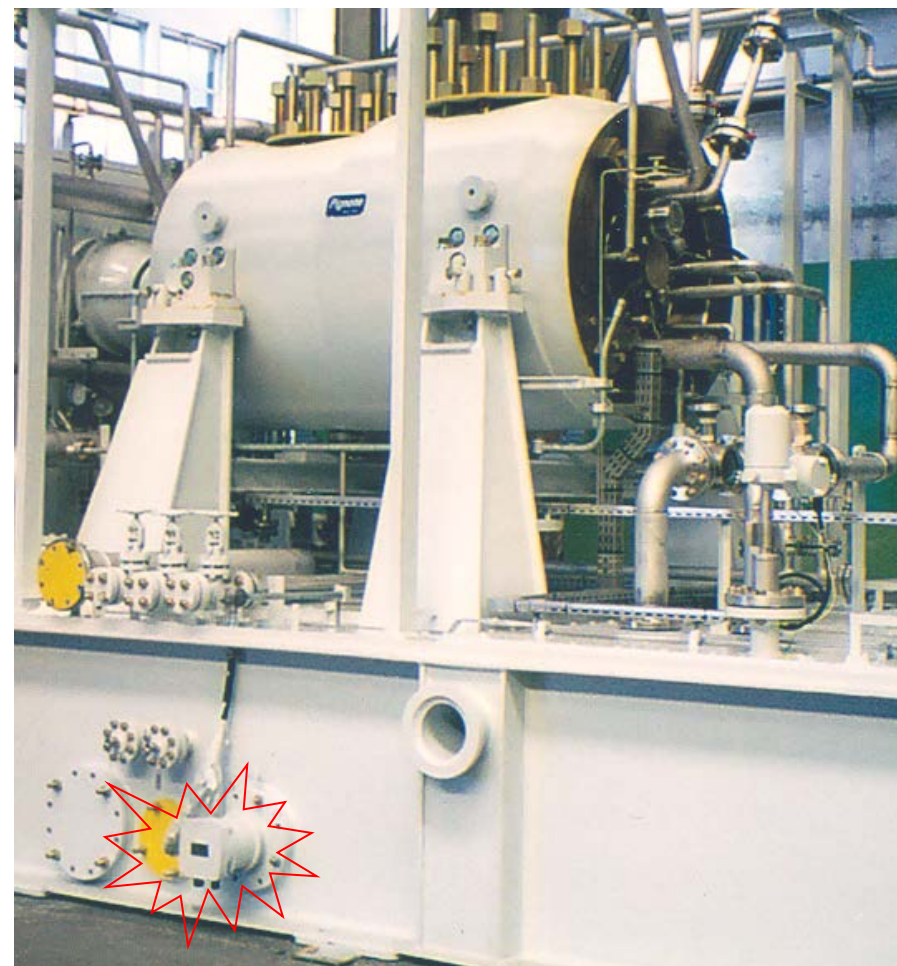
- Civil

- Layout

- Piping

- Instrumentation

- Electrical



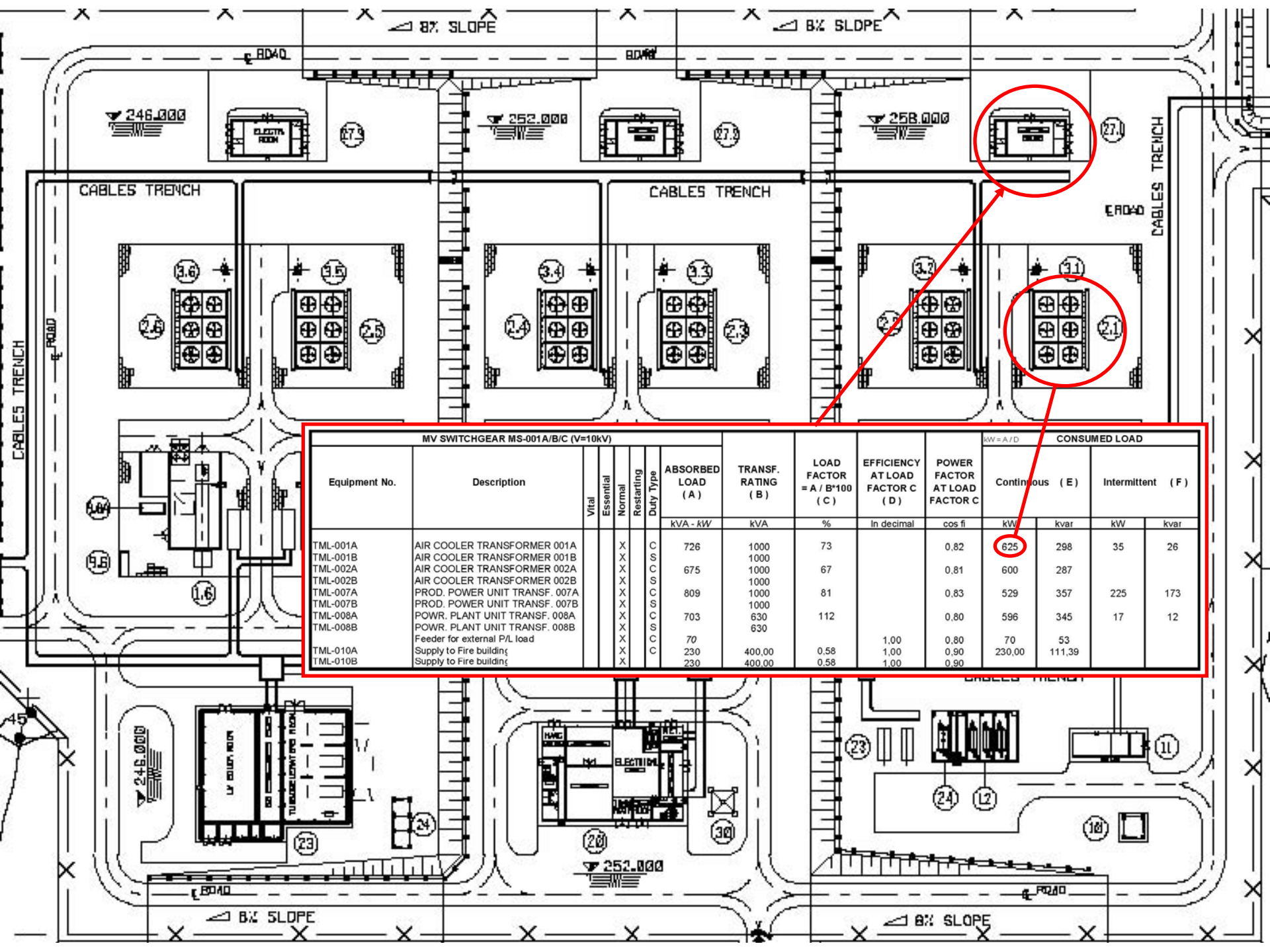
LV Motor Control Center TG-MCC-002 (V=400/230V)

Equipment No.	Description	Vital	Essential	Normal	Restarting	Duty Type	ABSORBED LOAD (A)
							kVA - kW
TG-002	Turbo Gen. (starting)						
88CR	Turb. Gen. Start. Motor					C	160
23QT-1	Lube Oil tank heater					C	7,50
23QT-2	Lube Oil tank heater					C	7,50
23FG-1	Fuel Gas Electric Heater						60
88BA-1	Turbine enclosure Ventilation duty fan					C	13,50
88BA-2	Turbine enclosure Ventilation duty fan						13,50
88FC-1	Oil Cooler Fan Motor						3,10
88FC-2	Oil Cooler Fan Motor						3,10
88FC-3	Oil Cooler Fan Motor						3,10
23WK-1	Heater OFF-LINE washing skid						4,00
88TW-1	Water wash pump motor OFF-LINE skid						2,20
88QA	Aux. Lube Oil Pump Moto					D	10,00
88QV	Lube Oil vapour separator motc					C	1,50
DCP-A	Direct current supply panel side /					C	25,00
DCP-B	Direct current supply panel side E					C	6,50

Electrical consumer list

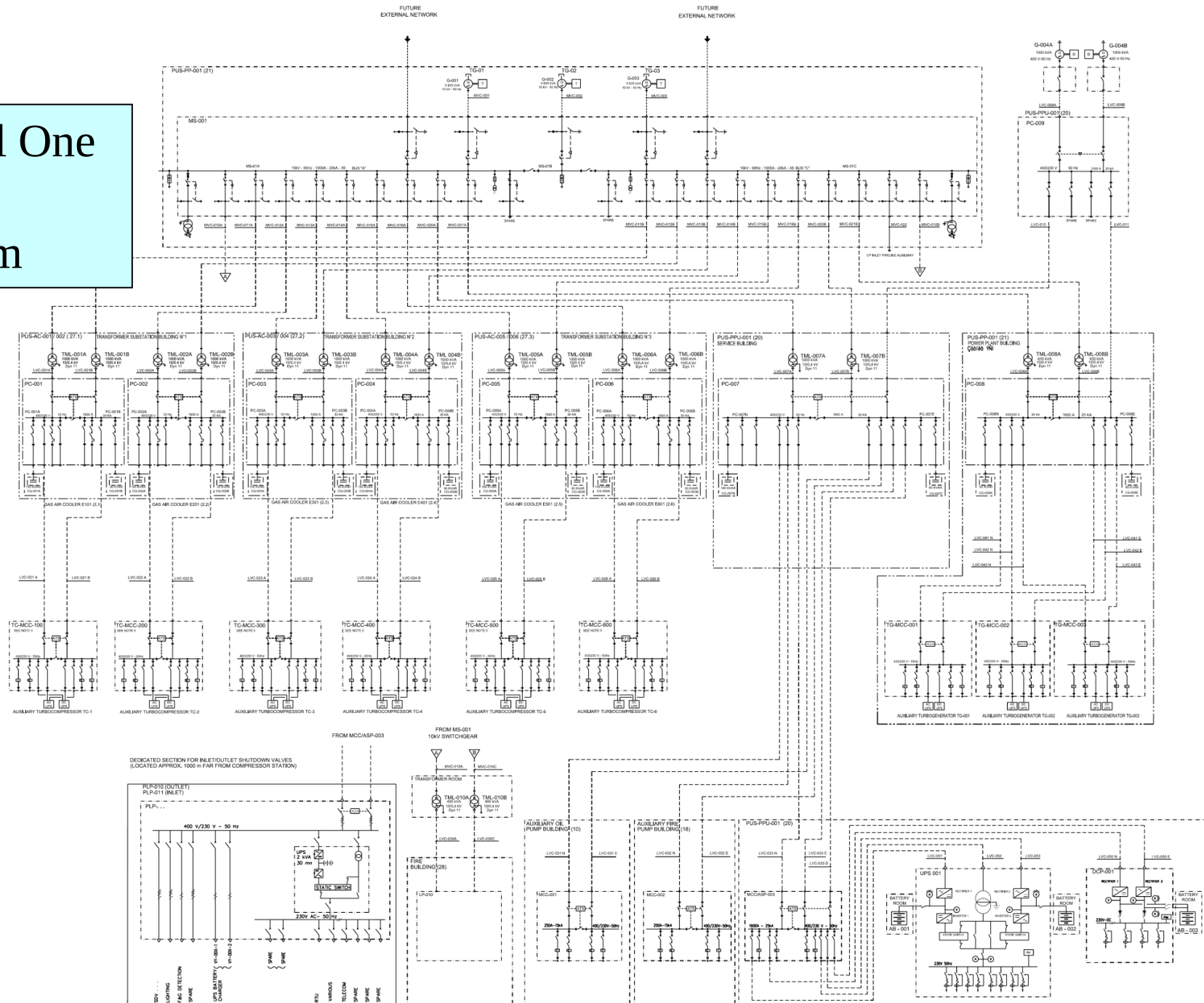


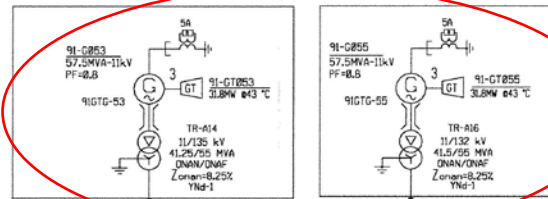
Electrical Load
Summary



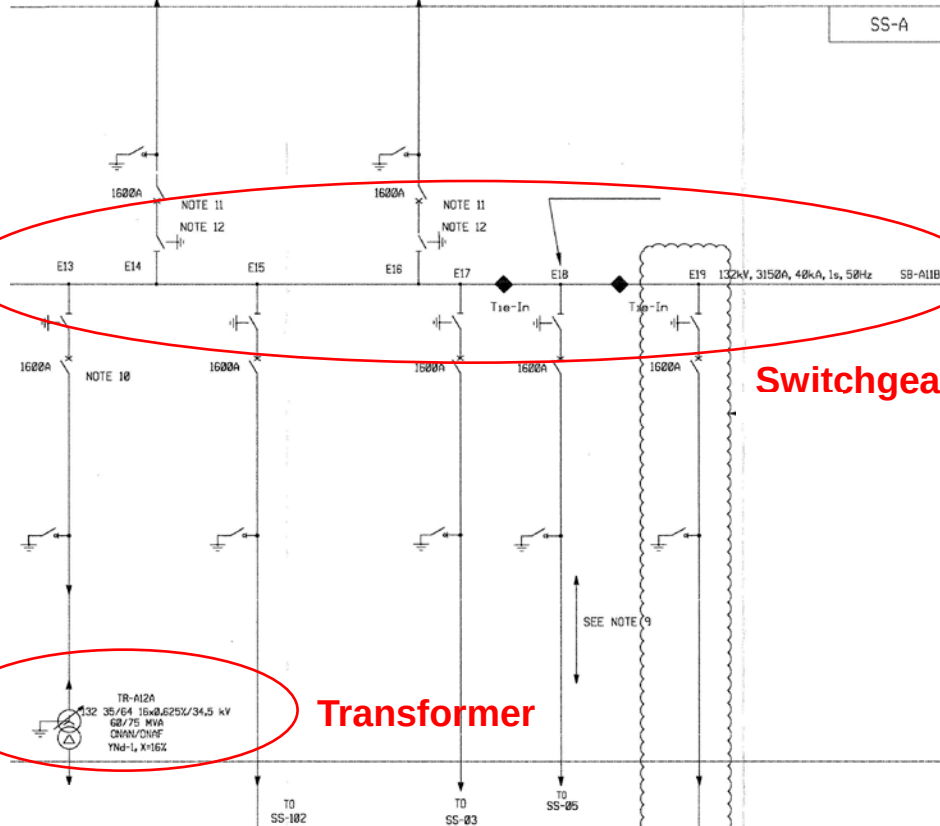
MV SWITCHGEAR MS-001A/B/C (V=10kV)							TRANSF. RATING (B)	LOAD FACTOR = A / B*100 (C)	EFFICIENCY AT LOAD FACTOR C (D)	POWER FACTOR AT LOAD FACTOR C	CONSUMED LOAD				
Equipment No.	Description	Vital	Essential	Normal	Restarting	Duty Type					ABSORBED LOAD (A)	Continuous (E)		Intermittent (F)	
												kVA - kW	kVA	%	In decimal
TML-001A	AIR COOLER TRANSFORMER 001A			X	X	C	726	1000	73		0.82	625	298	35	26
TML-001B	AIR COOLER TRANSFORMER 001B			X	X	C		1000							
TML-002A	AIR COOLER TRANSFORMER 002A			X	X	C	675	1000	67		0.81	600	287		
TML-002B	AIR COOLER TRANSFORMER 002B			X	X	C		1000							
TML-007A	PROD. POWER UNIT TRANSF. 007A			X	X	C	809	1000	81		0.83	529	357	225	173
TML-007B	PROD. POWER UNIT TRANSF. 007B			X	X	C		1000							
TML-008A	POWR. PLANT UNIT TRANSF. 008A			X	X	C	703	630	112		0.80	596	345	17	12
TML-008B	POWR. PLANT UNIT TRANSF. 008B			X	X	C		630							
	Feeder for external P/L load			X	X	C	70			1.00	0.80	70	53		
TML-010A	Supply to Fire building			X	X	C	230	400.00	0.58	1.00	0.90	230.00	111.39		
TML-010B	Supply to Fire building			X	X	C	230	400.00	0.58	1.00	0.90				

General One Line Diagram





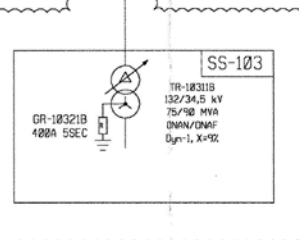
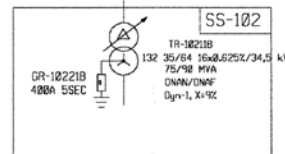
Generators



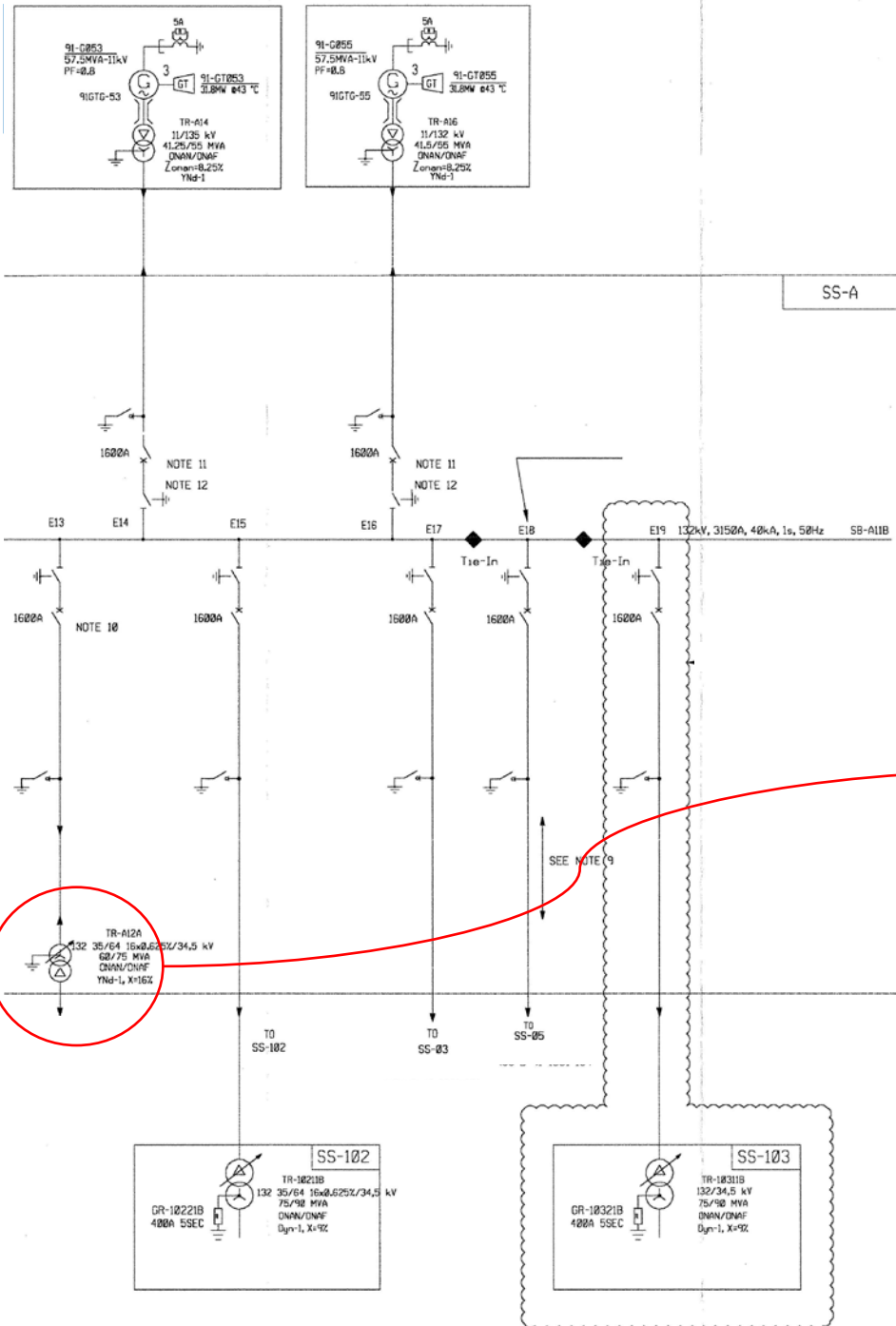
Switchgear



Transformer



Equipment data sheet



POWER TRANSFORMERS DATA SHEET

Tags : TML08A/08B

Quantity: N° 2

DESIGN DATA

TYPE Dry type ☒ - Oil immersed type ☐ Resin-cast ☒ IP-31
Separate windings ☒ - Auto-transformer ☐ -

Rated power: 630 kVA

Rated voltage ratio: 10/0.4 KV

Connection symbol: Dyn 11

N. of phases: 3

Frequency: 50 Hz

Short circuit voltage (Ucc%) : 4 at 630 kVA -

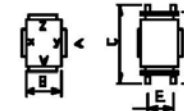
Cooling : AN ☒ - ONAN ☐ - ONAF ☐ -

Oil : Mineral ☐ -

Execution : With oil conservator ☐ - Sealed type ☐ -

Supply Short circuit power / duration: MVA/s 150 / 3

WINDINGS	MV	LV	INT
Primary winding	☒	☒	☐
Insulation type	CAST- RESIN	CAST- RESIN	
Rated voltage (Un) kV	10	0.4	
Maximum voltage (Um) kV	14	0.6	
Power-frequency withstand volt. kV	28	3	
Winding exposed to lightning over vol.	☐	☐	☐



Transformer front on side : X
HV terminals side : X

Lighting impulse w

State of neutral

N. of terminals

TAP CHANGER

Location : Indo

Overall noise level

Painting : Colour

EXTERNAL

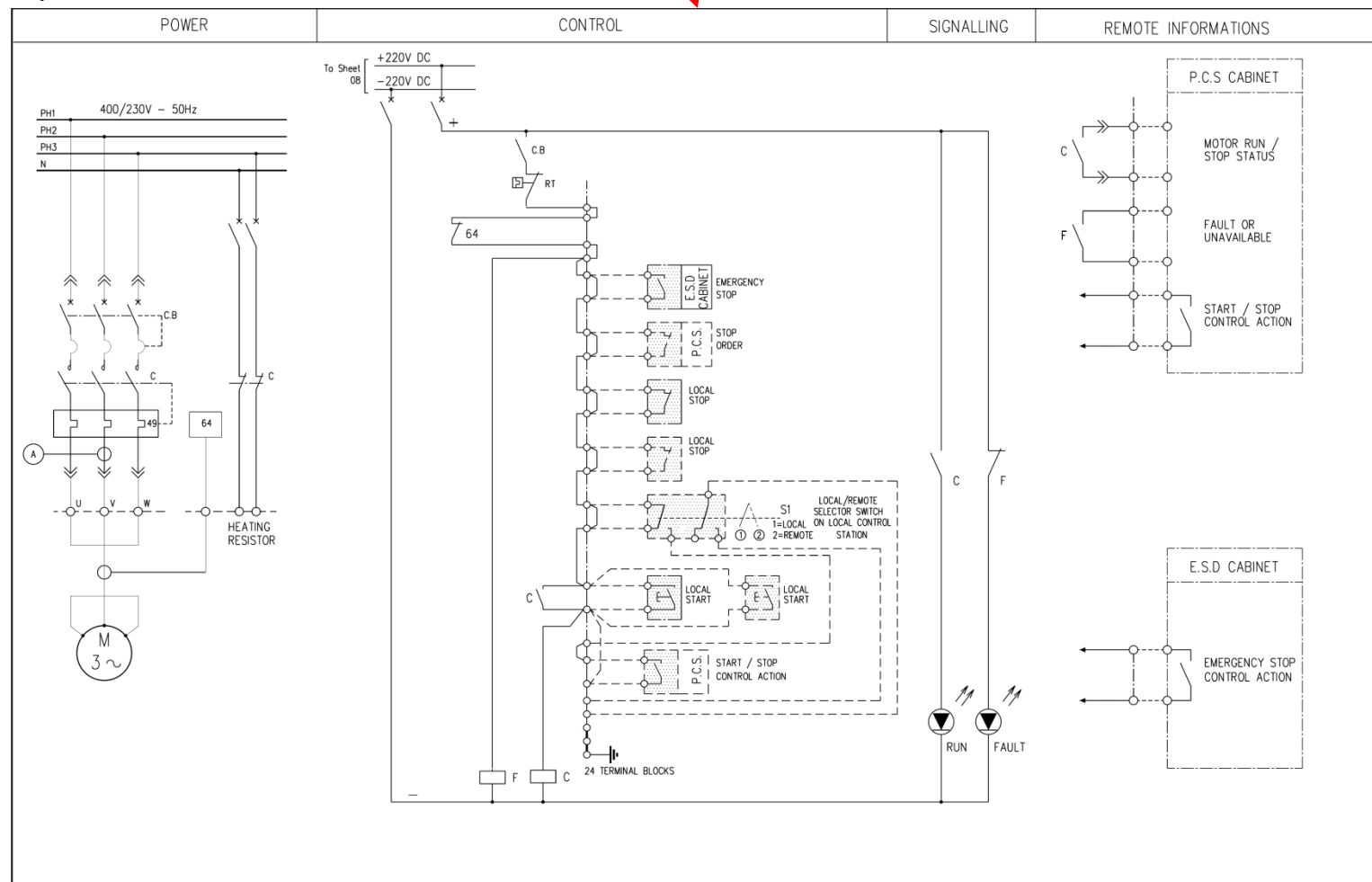
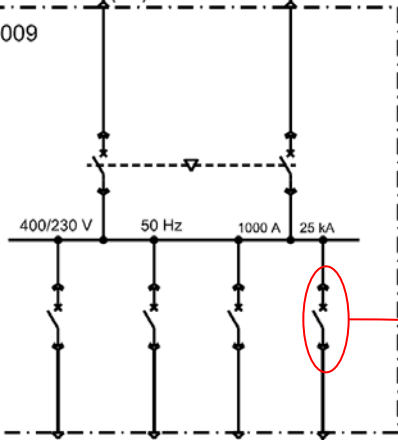
CONNECTIONS DATA

AUXILIARIES AND ACCESSORIES

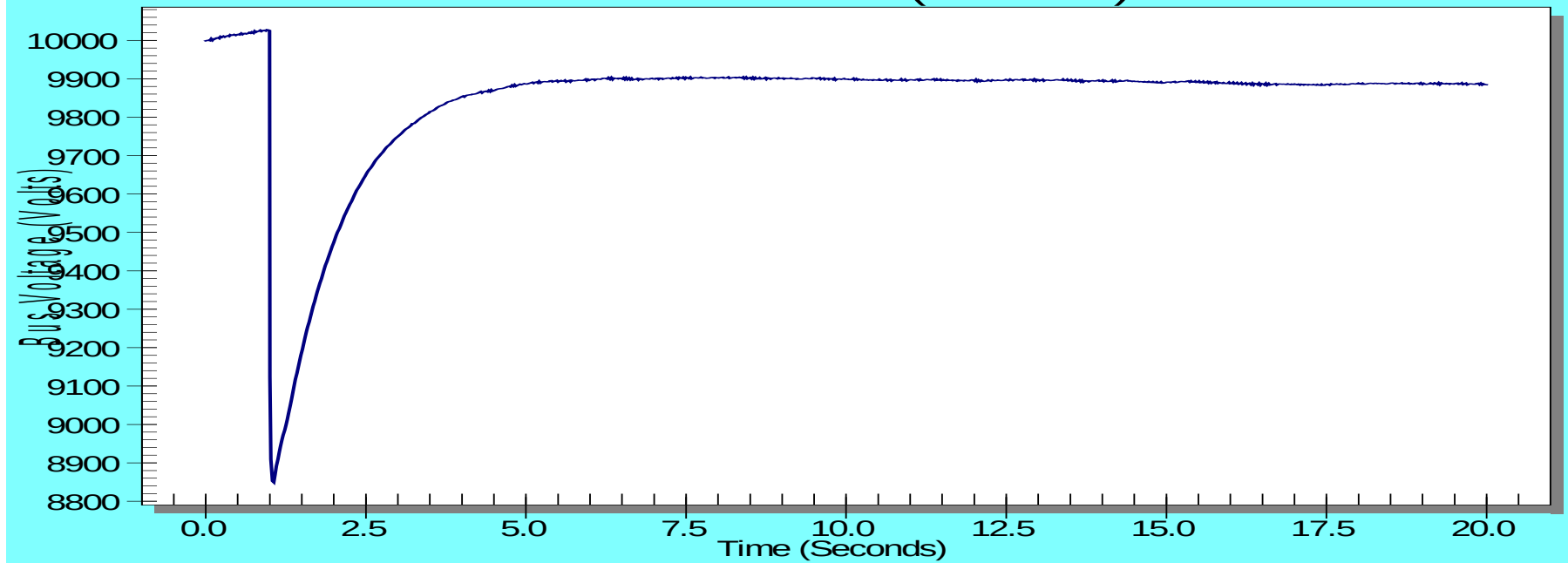


PC-009

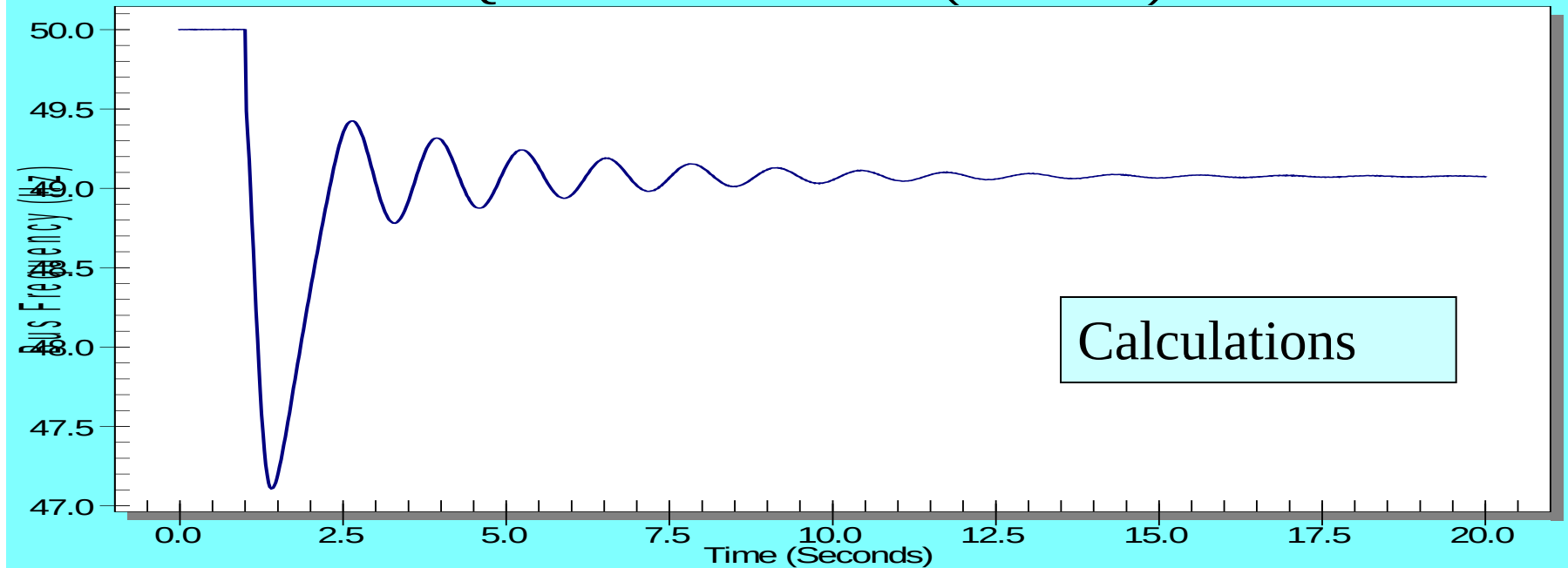
Switchgear Typical Diagram



VOLTAGE OF MS-001 (STUDY1)

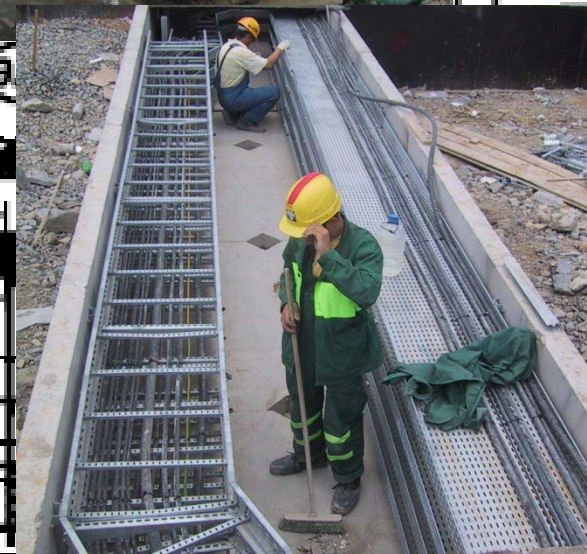
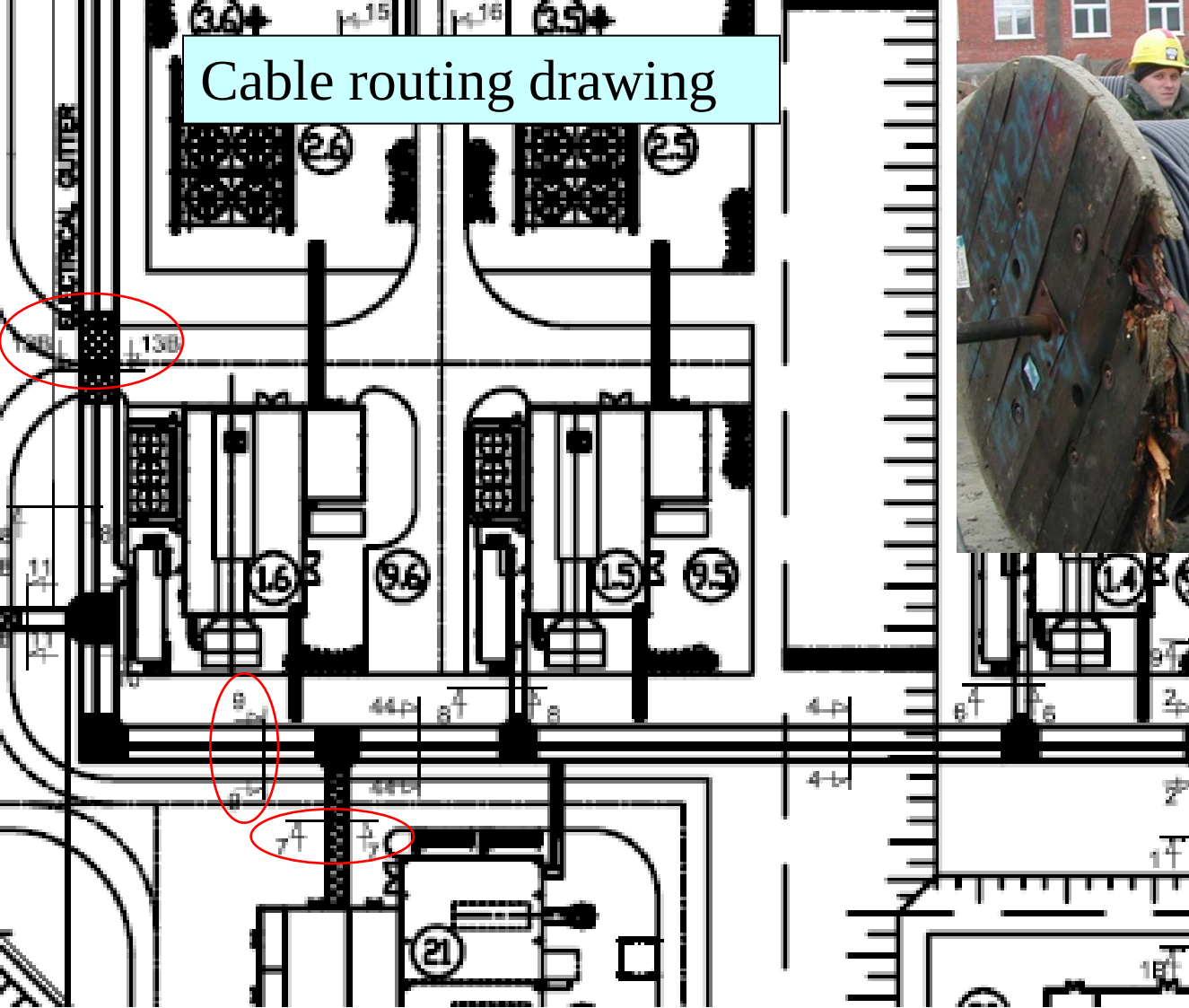


FREQUENCY OF MS-001 (STUDY1)



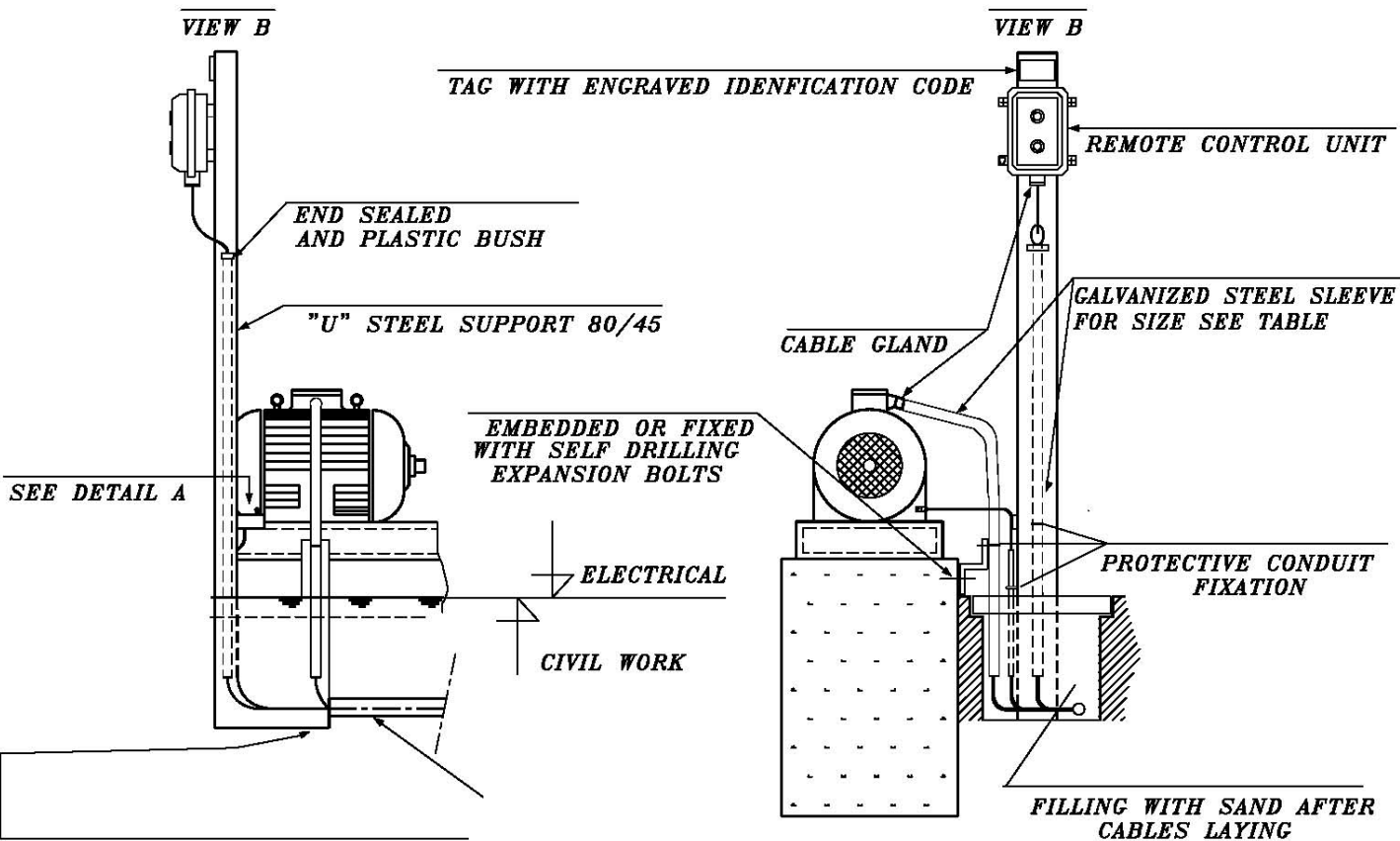
Calculations

Cable routing drawing



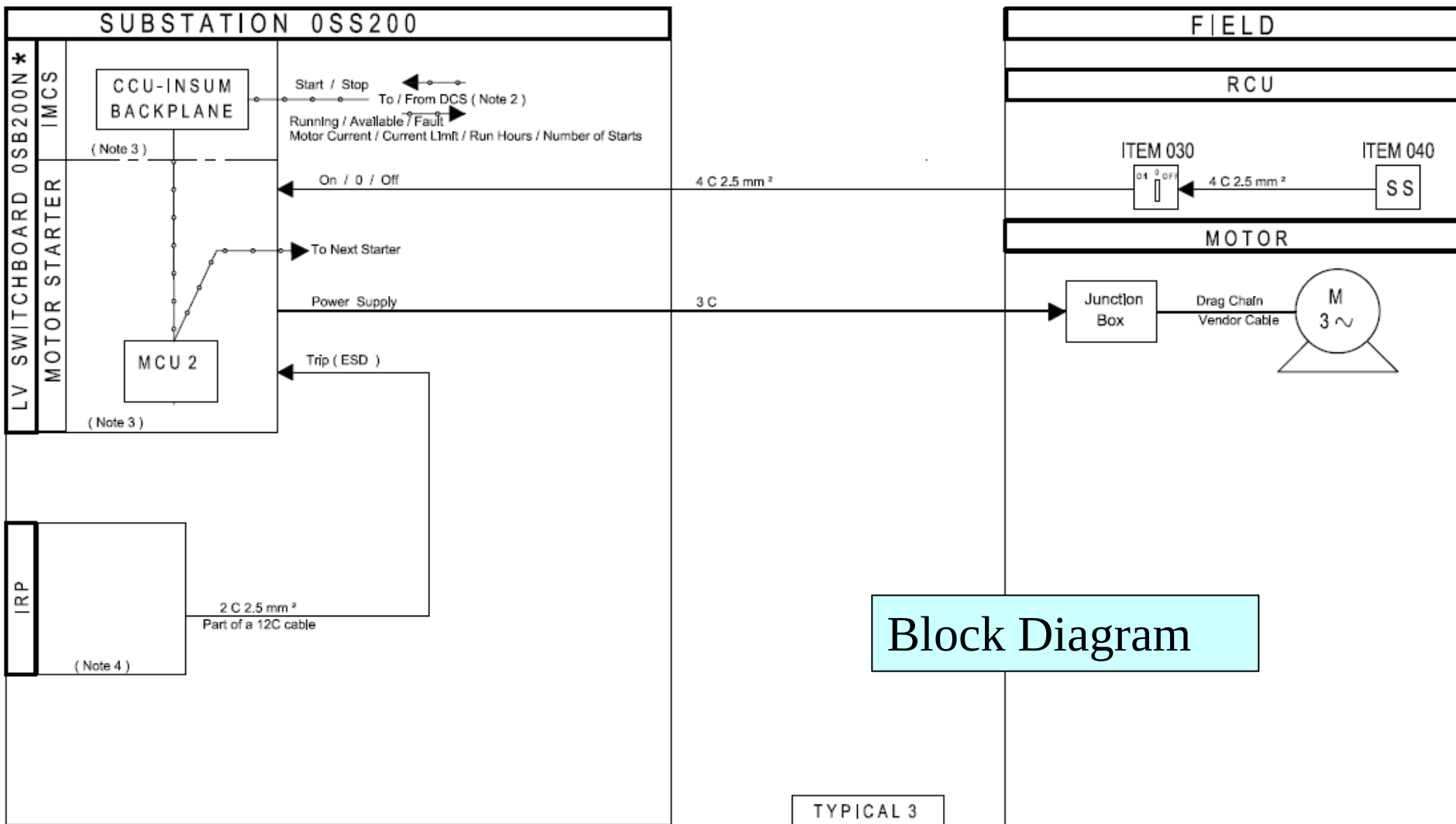
Cable schedule

Cable N°	Coming from	Going to	Voltage (V)	Type (sheet 3)	N° of Cores	Cross section (sqmm)	Length (m)	cable routing
MVC-011A	MS-001A	TML-001A	10 000	2	3	50	520	-7-9-13B-13B-13-60-18-61-23-62-27-
MVC-011B	MS-001C	TML-001B	10 000	2	3	50	520	-7-9-13B-13B-13-60-18-61-23-62-27-
MVC-012A	MS-001A	TML-002A	10 000	2	3	50	520	-7-9-13B-13-60-18-61-23-62-27-
MVC-012B	MS-001C	TML-002B	10 000	2				-7-9-13B-13-60-18-61-23-62-27-
MVC-013A	MS-001A	TML-003A	10 000	2				-7-9-13B-13-60-18-61-22-
MVC-013B	MS-001C	TML-003B	10 000	2				-7-9-13B-13-60-18-61-22-
MVC-014A	MS-001A	TML-004A	10 000	2	3	50	430	-7-9-13B-13-60-18-61-22-
MVC-014B	MS-001C	TML-004B	10 000	2	3	50	430	-7-9-13B-13-60-18-61-22-



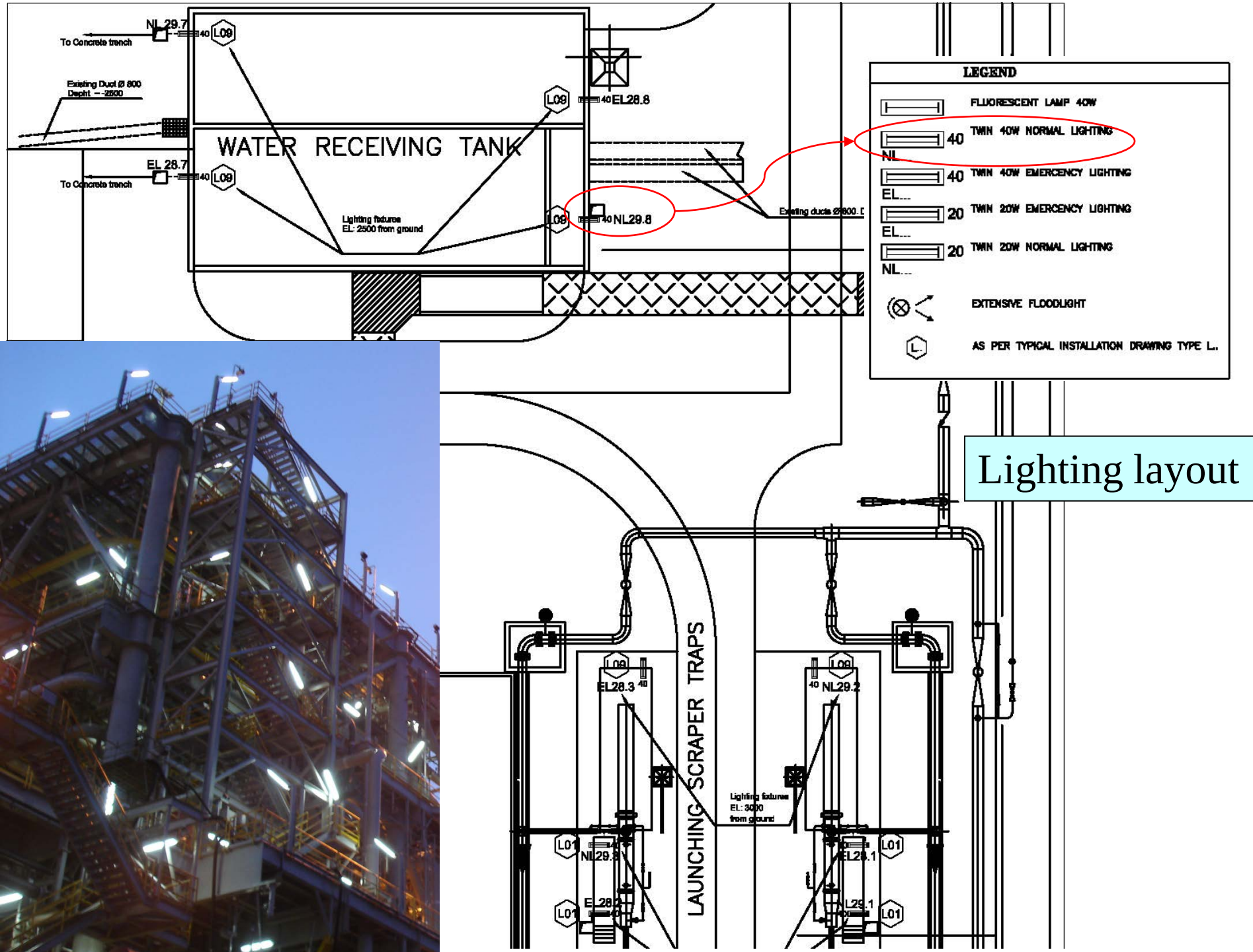
Typical
installation
drawings

FOR EXACT DIMENSIONS AND POSITION
OF THE PULL PIT SEE CIVIL WORK
GENERAL LAYOUT DRAWING



**HERVE
BARON**

Trouble shooting
diagrams

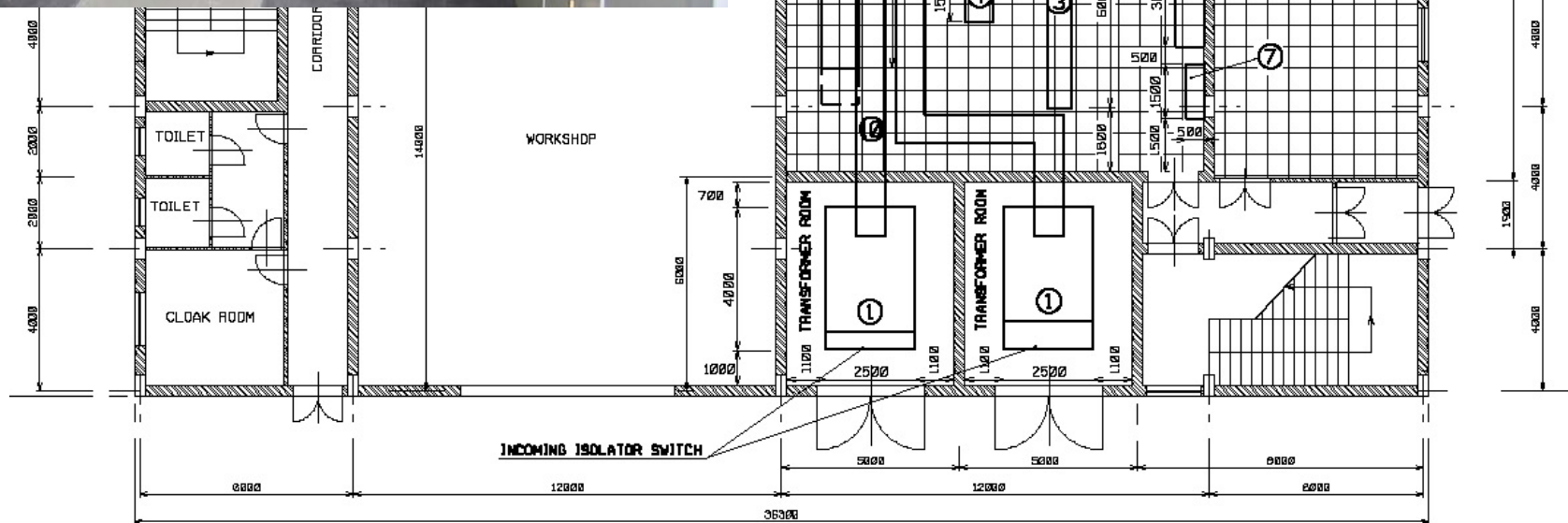


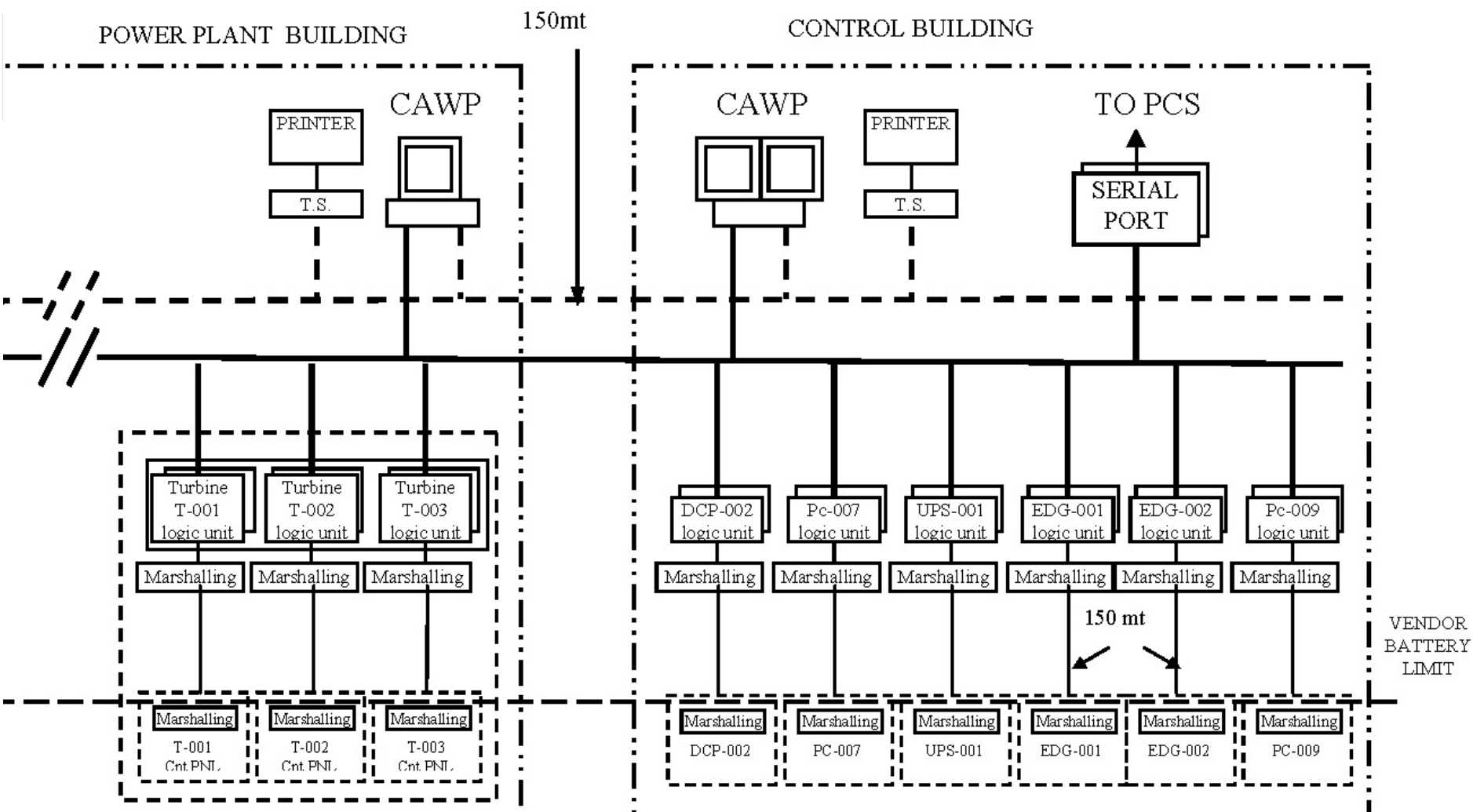
Lighting illumination level

Iso lux
curves



Electrical equipment layout



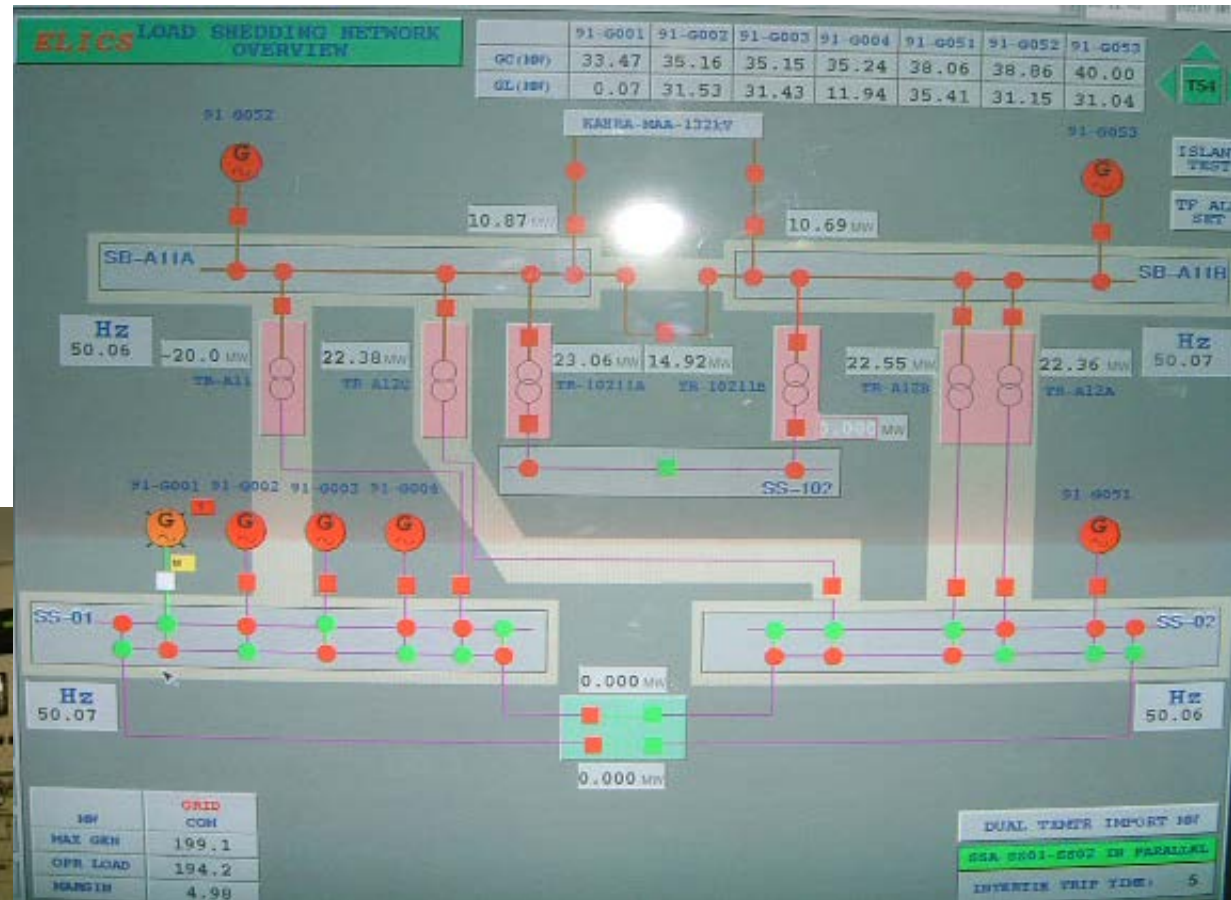


Electrical Control System

I/O	Power Plant Building									Control Building						
	MS-001	T-001	T-002	T-003	TG-001	TG-002	TG-003	PC-008	DCP-001	EDG-001	EDG-002	PC-007	PC-009	UPS-001	DCP-002	Serial Link to PCS
DI hardwired	348	33	33	33	5	5	5	23	5	10	10	23	23	5	5	
DO hardwired										4	4	6	6	10	10	
AI hardwired	64	9	9	9	10	10	10	6	5	15	15	6	6	5	5	
DI via serial link	348	33	33	33	5	5	5	23		10	10	23	23	5	5	600

**HERVE
BARON**

Electrical Control System



**HERVE
BARON**

From main
power
generators

From emergency
(diesel)
generators



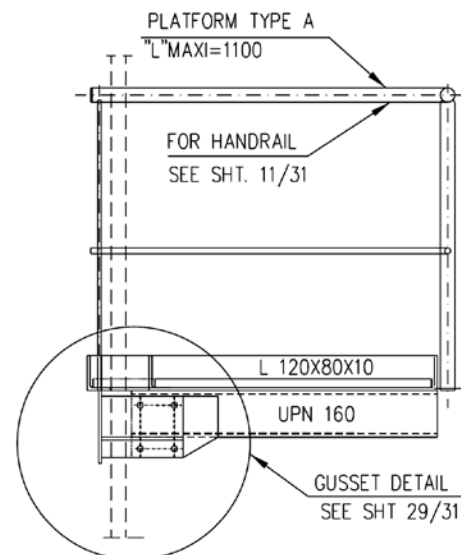
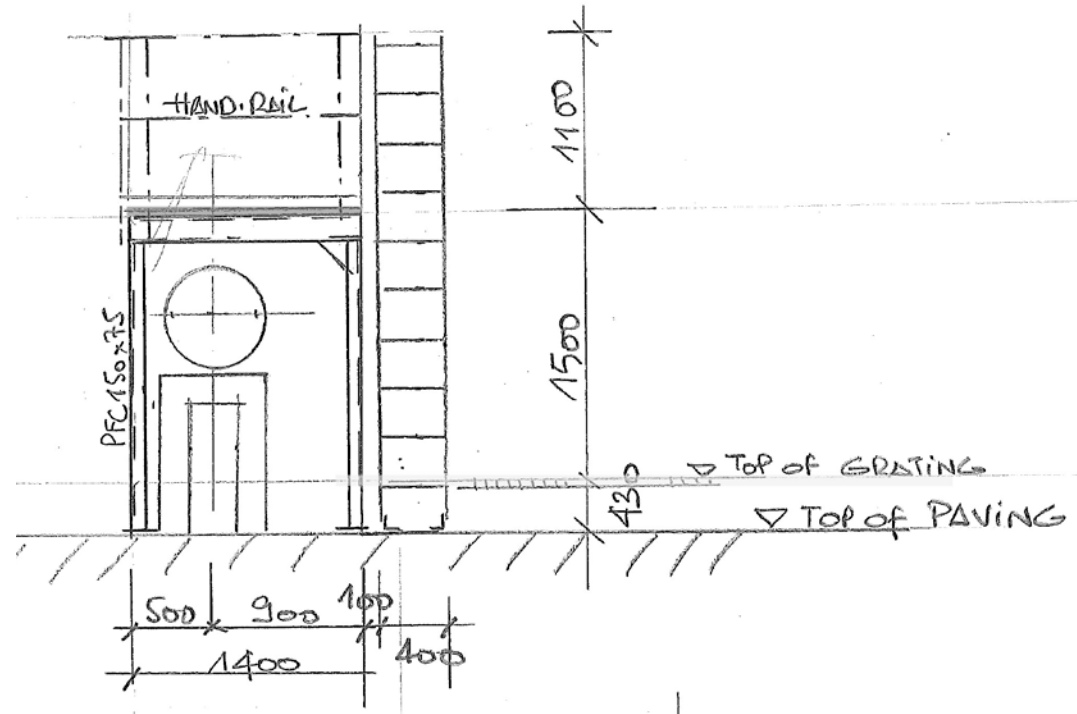
Electrical load shedding

To normal consummers
e.g. pumps in process
and utility units

To essential
consummers e.g. fire
water pump

Oil & Gas Engineering Training

- HSE Moment
- Intro, scope & objectives
- Project Engineering
- The Design Basis
- Discipline presentations
- Field engineering
- Schedule
- Quality



Site Query



FROM: Construction Sub-Contractor		SITE QUERY NO.:		Rev.:		
TO: Contractor		DISCIPLINE: Piping		SYSTEM: -		
SUBJECT: Penetration clash with beams						
REF.: drawing #...						
DESCRIPTION: Pipe penetration found to clash with the beams on the above drawing Module-P, line HN-647074. Contractor to advise on the alternative.						
Module	Pipe number	Pipe size(Inch)	Sleeve Size (mm) [F... OD + 100 + Insulation from PDMS]	Sleeve Location		
				East	North	Elevation
P	LA1PD-HN-647074	12"	424	115617	285494	106000

ORIGINATOR:		POSITION:	Engineer	DATE:	
CHECKED BY:		POSITION:	Snr. Engineer	DATE:	
AGREED BY:		POSITION:	Proj. Manager	DATE:	
ANSWER:		ANSWER REQUIRED BY:			
ANSWER BY:		SIGNATURE:	POSITION:	DATE:	
ANSWER APPROVED BY:		SIGNATURE:	POSITION:	DATE:	

PESD 94-Y061A

EFFECT

1: immediate stop when alarm appears
1C: immediate close when alarm appears
1O: immediate open when alarm appears

CAUSE

94UZ-6866A

Rev	ALARM				Inhibition	Timer	DESCRIPTION																Item tag	94-Y061A-P001A
	TAG ALARM	SENSOR	Description	Signal																				
4	94LAHH-6868A	94LIT-6868A	BR LVL CELL 5 VERY HIGH	HIGH	-	10 s	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	94PAHH-6875A	94PIT-6875A	94Y061A DSCN PRES OVR	HIGH HIGH	-	10 s	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	94FALL-6890A	94FIT-6880A	94Y061A SWTR CLG RJCT FL LOW	LOW	-	10 s	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	94FALL-6895A	94FIT-6895A	94Y061A DW FL OUT BL	LOW LOW	-	10 s	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	94FALL-6896A	94FIT-6896A	94Y061A BR FL OUT BL	LOW LOW	-	10 s	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	94PALL-6884A	94PIT-6884A	94Y061A INSTRUMENT AIR VERY LOW LEVEL	-	-	10 s	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

* INHIBITIONS : 94YP-061A1AR OR 94YP-061A1BR
94YP-061A2AR OR 94YP-061A2BR
94YP-061A3AR OR 94YP-061A3BR

Notes :

- Analogic values and timers to be adjusted on site.
- Inhibition alarms bits will be set or reset in Start and Stop Sequences.
- Stop Sequence is described in §6.6 of Control System Description (RG6-V-W1-0037B6-039)
- Motor faults are sent by MCC and processed in the DCS as Digital Inputs

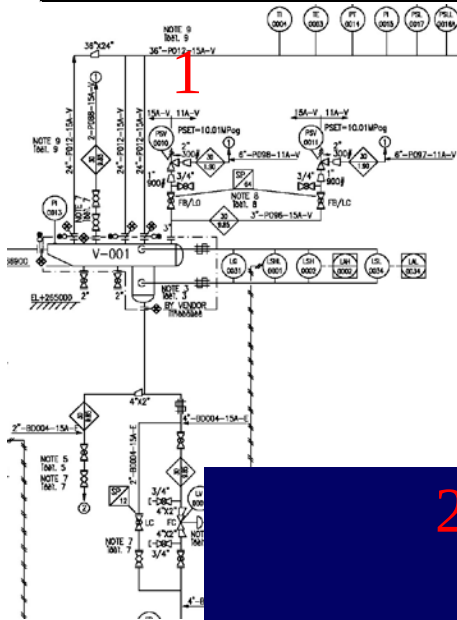
- For 94LAHH-6868A and 94PALL-6884A, specific startup override will be implemented
- For 94PAHH-6875A, operation override will be implemented in order to do the acid cleaning.

SITE MASTER

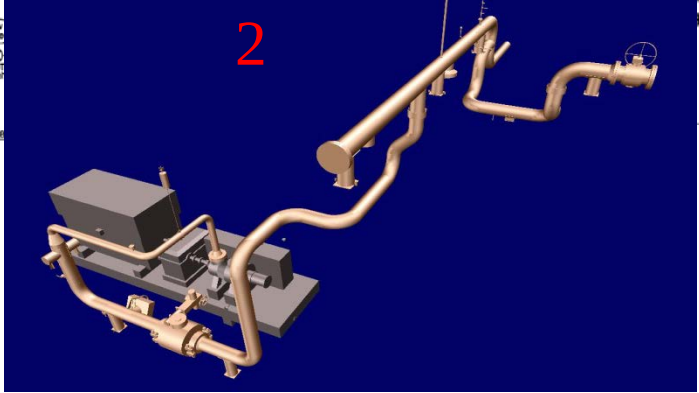
Oil & Gas Engineering Training

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PROJECT SCHEDULE	MONTH																																			
	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	5	2	33	34	35	36						
PLANT START-UP																																▼				
PIPING PRE-FABRICATION & INSTALLATION																4				X	X	X	X	X	X	X	X	X	X	X						
PIPING MATERIAL & DRAWINGS AT SITE																			▼																	
PIPING MATERIAL MANUFACTURING & SHIPPING													X	X	X	X	X	X																		
PURCHASE OF PIPING MATERIAL												▼																								
TECHNICAL & COMMERCIAL CLARIFICATIONS								3		X	X																									
CALL FOR TENDER FOR PIPING MATERIAL					2				▼																											
PREPARE PIPING MATERIAL TAKE-OFF			1						X																											
PIPING ROUTING STUDIES				X	X	X																														
PIPING & INSTRUMENTATION DIAGRAMS (PIDs)			▼																																	



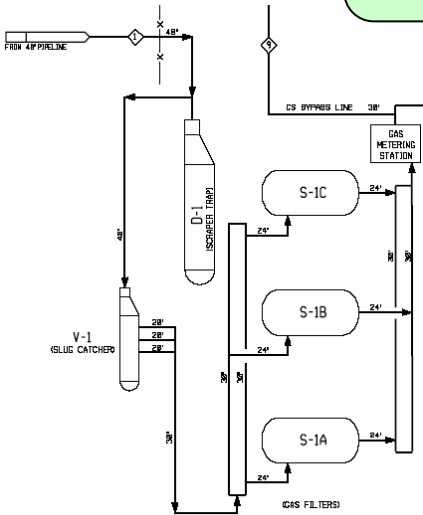
REV	Item	SIGMA CODE CLIENT CODE	large diam.	small diam. /length	QUANTITIES TO BE SUPPLIED		BALANCE TO BE SUP A - B
					New A	Old B	
SEAMLESS PIPE							
005	34	TE04170	API5LGRB -ANSIB36-10 -BW -SCH40 -		1248	212	34
			P 2				
004	37	TE04900	API5LGRB -ANSIB36-10 -PLAIN END		6	6	0
004	36		P 3/4		6	6	0
004	42		P 1		6	6	0
			P 11/2				



Process simulations

Process data sheet

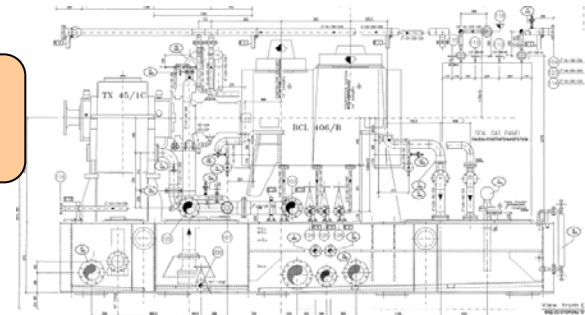
NATURAL GAS COMPRESSOR			
SERVICE :	NOMBRE REQUIS / NUMBER REQUIRED	TOTAL / TOTAL :	6 RUNNING
OPERATION :	CONTINUE / CONTINUOUS	X	
PROPRIETES DU FLUIDE / FLUID PROPERTIES			
CAS DE MARCHÉ / RUNNING CASE		mas.mol	DESIGN CASE
FLUIDE/FLUID	COMPOSANTS / COMPOUNDS	MW	
		MOLAR PERCENT	
COMPONENT	DESIGN	ALTERNATIVE	
Methane (CH ₄)	97.628	97.721	
Ethane (C ₂ H ₆)	0.890	0.085	
Propane (C ₃ H ₈)	0.140	0.025	
I-Butane (C ₄ H ₁₀)	0.015	0.005	
N-Butane (C ₄ H ₁₀)	0.025	0.005	
I-Pentane (C ₅ H ₁₂)	0.018	0.045	
N-Pentane (C ₅ H ₁₂)	0.020	0.050	
Hexane (C ₆ H ₁₄)	0.022	0.000	
Heptane + (C ₇ H ₁₆)	0.013		
Nitrogen (N ₂)	0.930	1.746	
Carbon Dioxide (CO ₂)	0.410	0.290	
Oxygen (O ₂)	N8	Nil	
COMPRESS. (Z)/COMPRESSIBILITY ASPIREF / SUCTION/DISCH		0.876/1.013	
Cp/Cv ASPIREFOULEMENT / SUCTION/DISCHARGE		1.582/1.485	



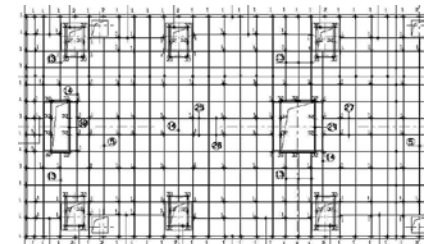
Equipment selection & purchase

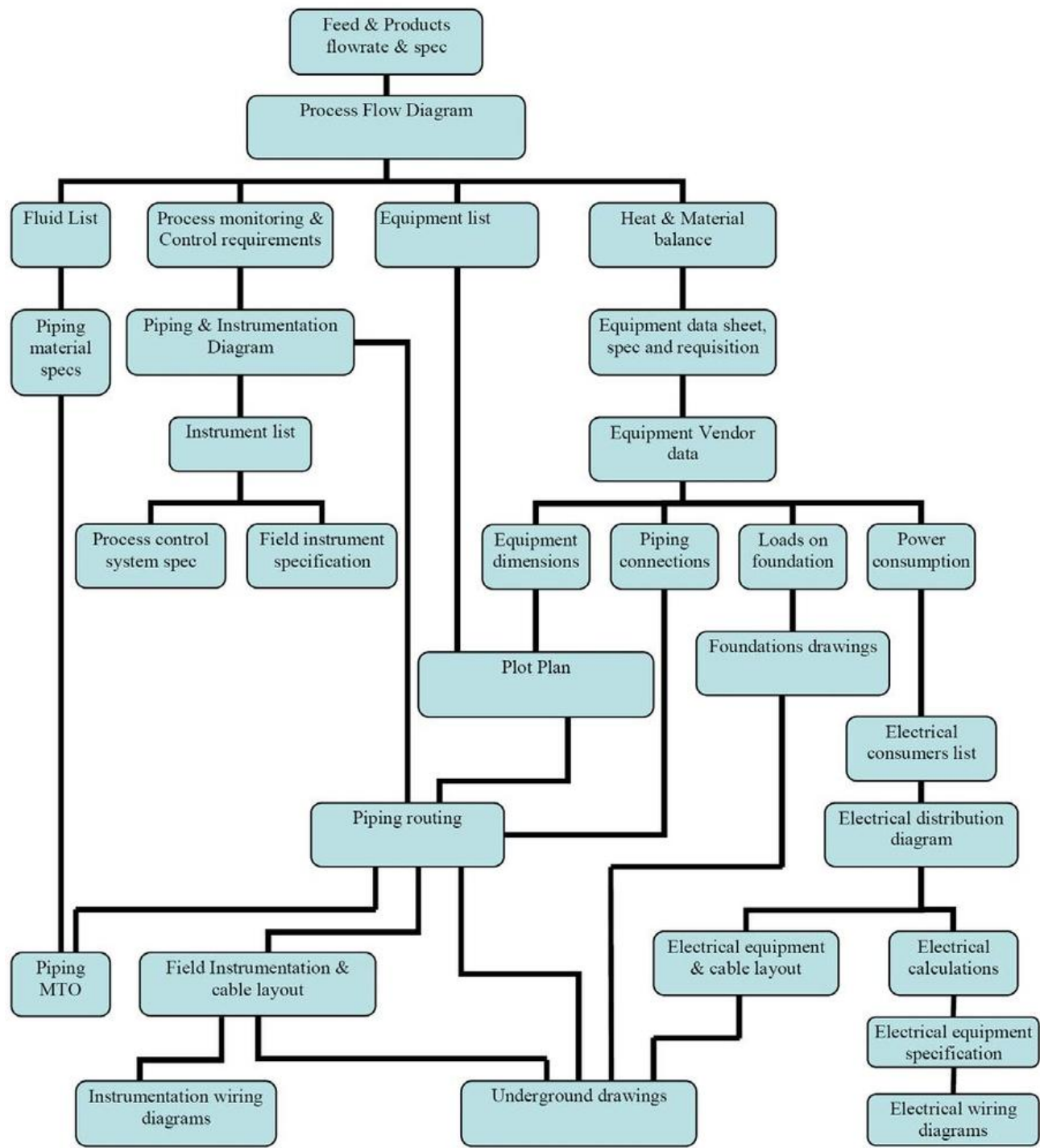


Vendor data



Foundation drawings





Engineering schedule

Safety valves
duty & data
sheet (Process)

Safety valves
inquiry and
purchase
(procurement)

*Estimates must be done
to meet the schedule*

Safety valves
sizing & drawings
(vendor)

*Size
& weight
estimates*

Safety valves
location & piping
routing
(piping/layout)

Piping calcs &
supports
(piping/stress)

*Supports
& loads estimates*

Steel structure
design and
drawings (civil)

Purchase steel
(manufacturer)

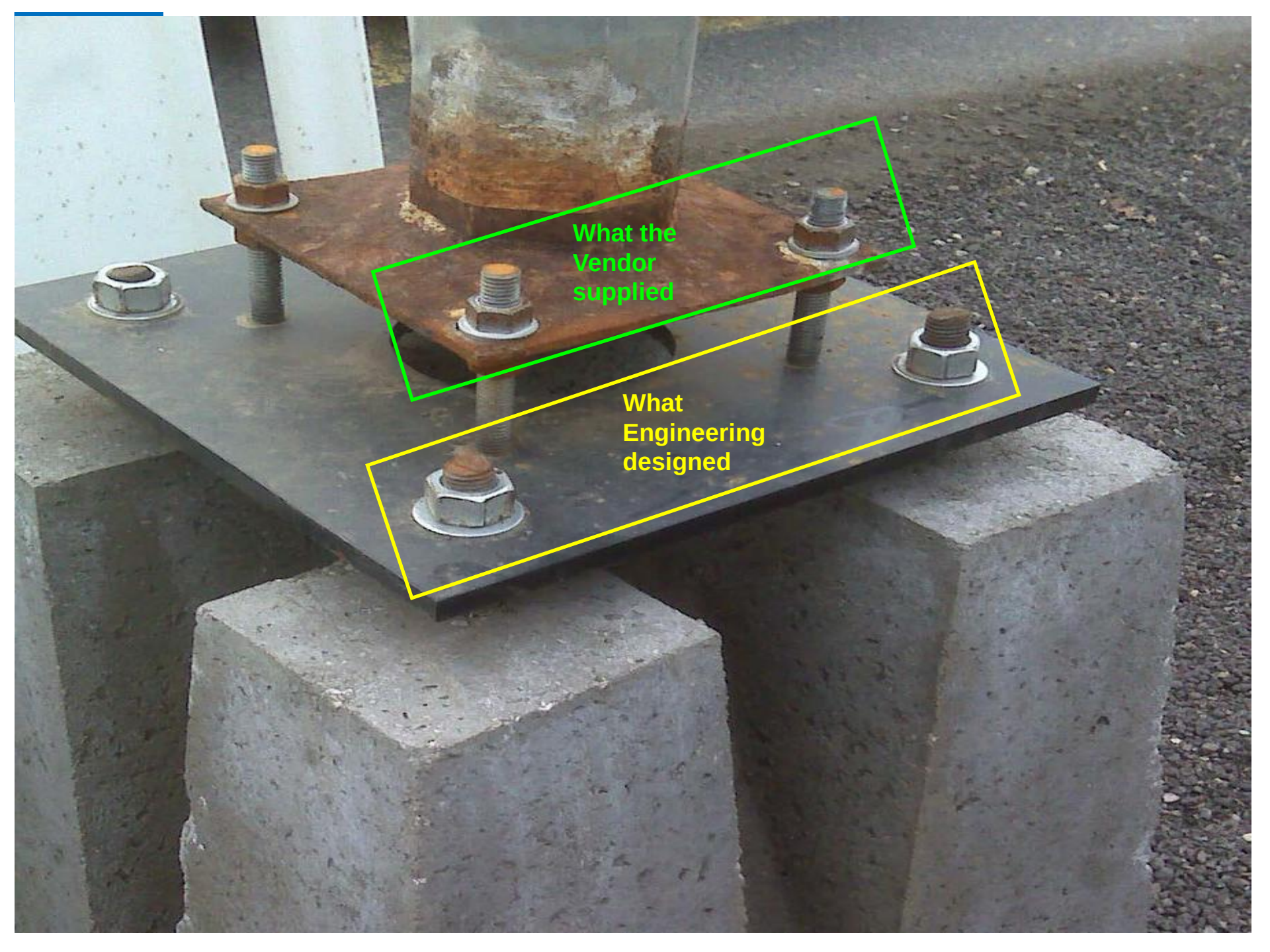
Fabrication
(manufacturer)

Shipping

Structure
at Site







What the
Vendor
supplied

What
Engineering
designed

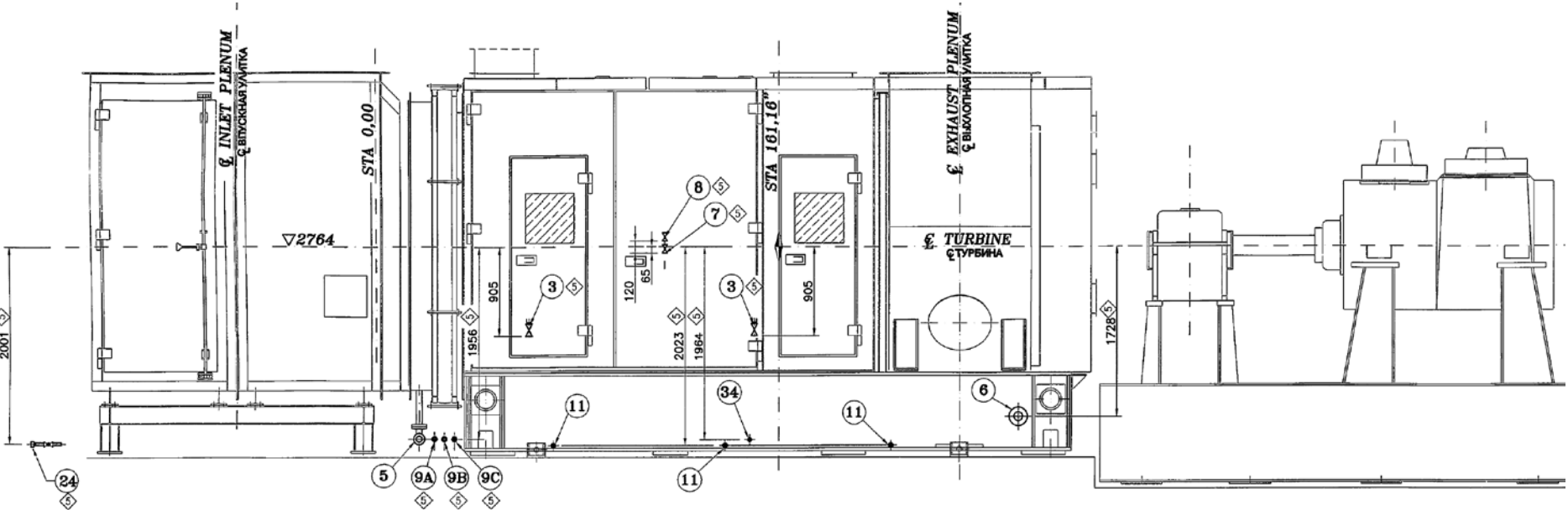
SUPPLIER’S DOCUMENTS – REQUIREMENT SCHEDULE

DOCUMENT STATUS

ITEM	DESIGNATION	FOR APPROVAL	APPROVED FINAL, COMMENTS INCORPORATED
1	DIMENSIONAL OUTLINE DRAWINGS OF TURBOCOMPRESSOR SET*	D + 45 DAYS	D + 60 DAYS
2	GENERAL ARRANGEMENT DWG OF TURBOCOMPRESSOR BUILDING WITH INSIDE AND OUTSIDE INSTALLATIONS*	D + 45 DAYS	D + 60 DAYS
3	AIR INLET AND EXHAUST SYSTEMS ARRANGEMENT DRAWINGS*	D + 45 DAYS	D + 60 DAYS
4	LUBE OIL AIR COOLER ARRANGEMENT DRAWINGS*	D + 45 DAYS	D + 60 DAYS
5	TURBOCOMPRESSOR SET FOUNDATION PLAN WITH STATIC AND DYNAMIC LOADS*	D + 45 DAYS	D + 60 DAYS
6	FOUNDATION PLAN WITH STATIC AND DYNAMIC LOADS FOR TURBOCOMPRESSOR BUILDING AND OTHER AUX.EQUIPMENT	D + 45 DAYS	D + 60 DAYS
7	CUSTOMER MECHANICAL CONNECTIONS LIST AND PLAN WITH MAX. ALLOWABLE LOADS*	D + 45 DAYS	D + 60 DAYS

D : EFFECTIVE DATE OF PURCHASE ORDER

*NON-SUBMITTAL OF THESE DOCUMENTS WITHIN SPECIFIED TIME DELAY WILL ENTAIL PENALTIES



Oil & Gas Engineering Training

- HSE Moment
- Intro, scope & objectives
- Project Engineering
- The Design Basis
- Discipline presentations
- Field engineering
- Schedule
- Quality

Engineering Quality Assurance:

Engineering document register

Document number			Document title	Document revision
A	1	48104	Service building instrument. rooms cables routing	B
A	2	48102	Trouble shooting diagrams	D
A	3	48134	F&G system architecture drawing	E
A	4	50100	Instrument index	B
A	7	50003	Spec for instrument installation works and service	C
A	8	50960	Instrument Data sheets for temperature switches	B
A	9	50110	Requisition for pressure relief valves	B
M	1	62059	General plot plan	B
M	2	62020	Piping details standard	C
M	2	62070	Piping general arrangement Area 1	D
M	4	60100	Special items list	D

Issuing engineering discipline	Document			Distributed to														
	Type of document	Document code	Safety and Environment	Process	Piping/layout	Piping/material	Piping/stress	Drafting office	Civil	HVAC	Structure	Electrical	Instrumentation & telecom	Vessels & Heat exchangers	Pipelines	Mechanical	Materials, coating, painting & welding	Cathodic protection
PIPING	LAYOUT DRAWING, PLOT PLAN	M1	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
	GENERAL ARRANGEMENTS DRAWING	M2	x	x	x		x	x	x		x	x	x	x	x	x		x
	LIST, MATERIAL TAKE-OFF	M4		x	x	x	x	x										
	ISOMETRIC DRAWING	M5			x			x										
	CALCULATION	M6			x		x	x										
	SPECIFICATION	M7			x	x	x	x					x				x	x
	DATA SHEET	M8			x	x	x	x					x				x	

Engineering Integrity: Site Query from Construction



FROM: Construction Sub-Contractor		SITE QUERY NO.:		Rev.:		
TO: Contractor		DISCIPLINE: Piping		SYSTEM: -		
SUBJECT: Penetration clash with beams						
REF.: drawing #...						
DESCRIPTION: Pipe penetration found to clash with the beams on the above drawing Module-P, line HN-647074. Contractor to advise on the alternative.						
Module	Pipe number	Pipe size(Inch)	Sleeve Size (mm) [F... OD + 100 + Insulation from PDMS]	Sleeve Location		
				East	North	Elevation
P	LA1PD-HN-647074	12"	424	115617	285494	106000

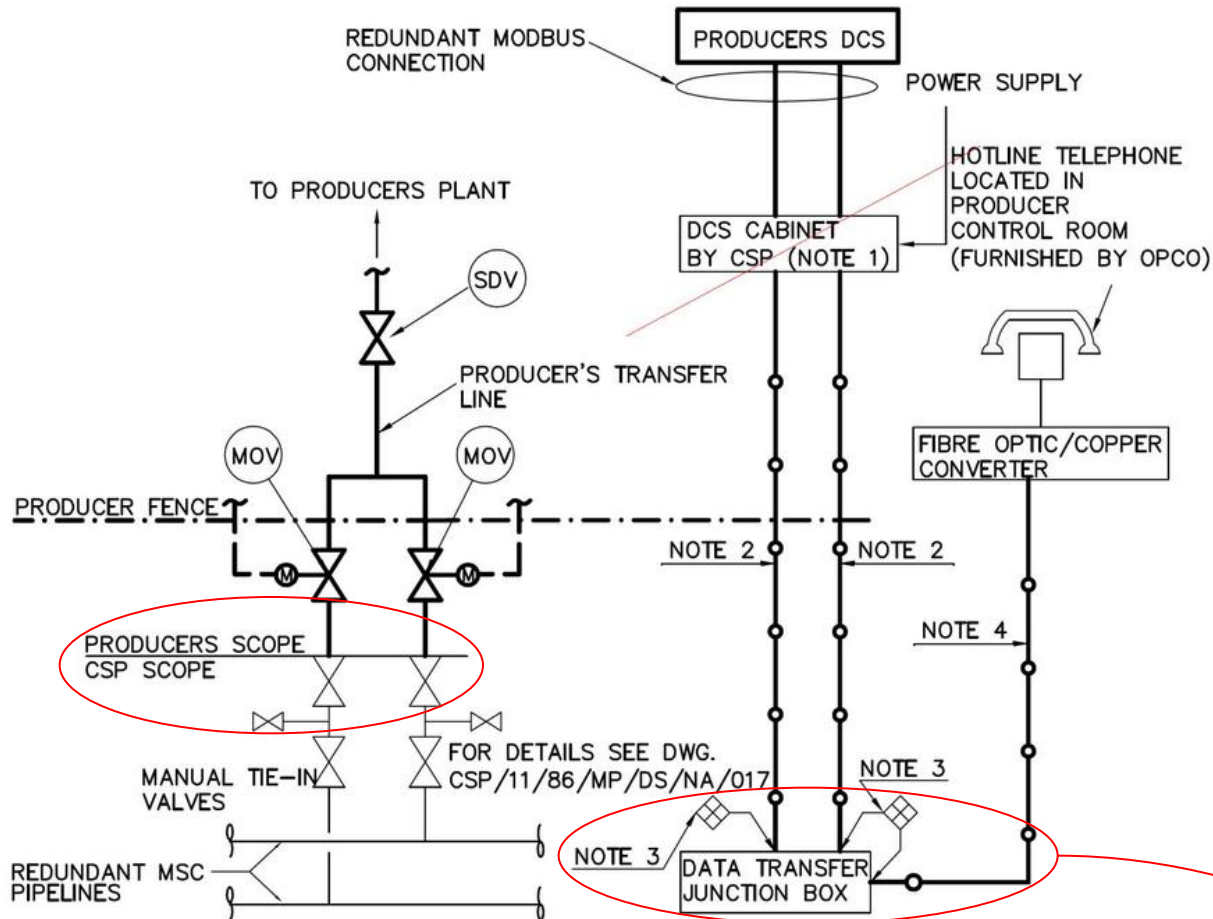
ORIGINATOR:		POSITION:	Engineer	DATE:	
CHECKED BY:		POSITION:	Snr. Engineer	DATE:	
AGREED BY:		POSITION:	Proj. Manager	DATE:	
ANSWER:		ANSWER REQUIRED BY:			
ANSWER BY:		SIGNATURE:	POSITION:	DATE:	
ANSWER APPROVED BY:		SIGNATURE:	POSITION:	DATE:	

**HERVE
BARON**

Interface Agreement

Section/Step 1

Section/Step 2



Interface definition

NOTES:

1. DCS HARDWARE PROVIDED BY CSP.
PRODUCER IS RESPONSIBLE FOR HOOKUP, TESTING,
COMMISSIONING AND MAINTENANCE. CSP TO SUPPORT
TESTING AND COMMISSIONING.
2. REDUNDANT FIBER OPTIC DATA HIGHWAY CABLES
PROVIDED AND TERMINATED BY PRODUCER.
3. PRODUCER PERFORMS FIBER OPTIC TIE-IN
TO JUNCTION BOX PROVIDED BY CSP.

Do you want to know more... Much more?

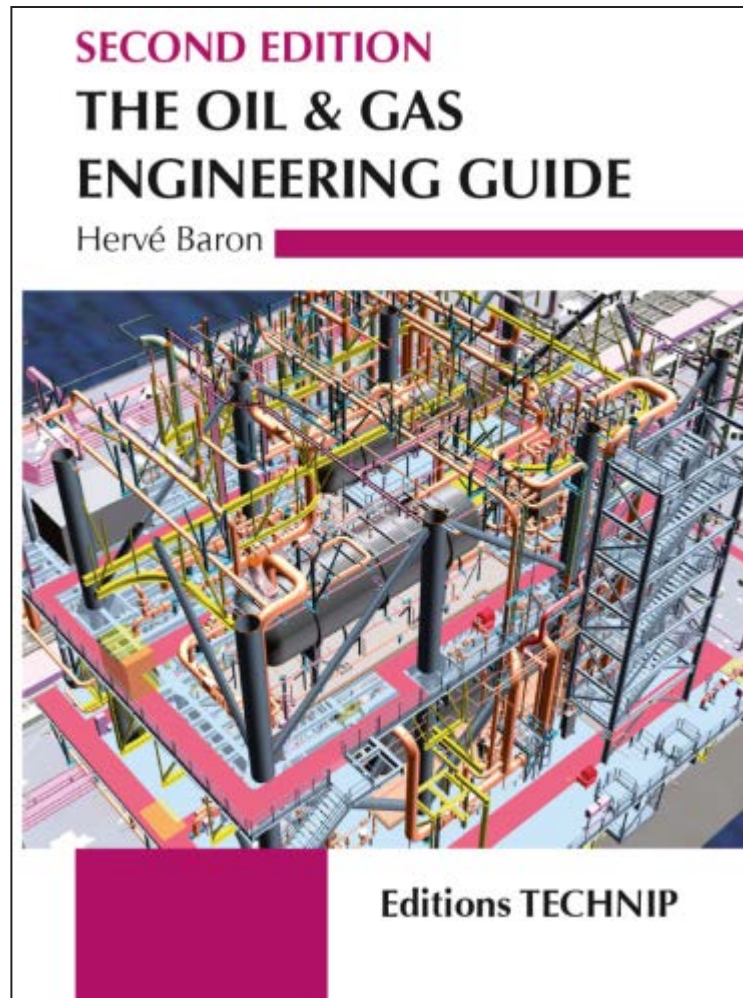


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1. Project Engineering	5
2. The design basis	11
3. Process	13
4. Equipment/Mechanical	37
5. Plant Layout.....	49
6. Safety & Environment.....	61
7. Civil Engineering.....	83
8. Materials & Corrosion.....	107
9. Piping	115
10. Plant model.....	141
11. Instrumentation and Control	151
12. Electrical.....	175
13. Off-Shore	193
14. The overall work process	205
15. BASIC, FEED and Detail Design	215
16. Matching the Project Schedule	219
17. Engineering Management.....	235
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SECOND EDITION

THE OIL & GAS ENGINEERING GUIDE

Hervé Baron

**Editions TECHNIP**

Table of Contents

**Discipline
presentation:
activities and
deliverables**

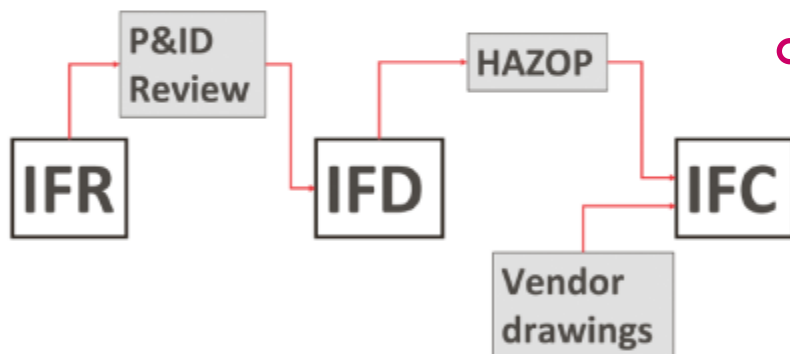
1. Project Engineering	5
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19. Field Engineering	257
20. Revamping.....	261

Following the review of the P&IDs with the Client and incorporation of the required changes, the P&IDs are submitted to an Audit related to the Process Safety, called **HAZard and OPerability (HAZOP)** review. The main purpose of the HAZOP is to check that all required Process ShutDown devices, to protect against deviation of process parameters outside their acceptable range, are provided.

Even though the HAZOP is purely related to the safety of the process, the HAZOP session is usually organized by Safety discipline. Please refer to chapter 6 for details.

The P&IDs are revised, further to the HAZOP, to incorporate the design changes required following the HAZOP and information from Vendors: Equipment/packages piping connections, control system interfaces with equipment/packages, precise limits of supply, utility lines for packages, etc.

**The work of each
Engineering discipline is
described**

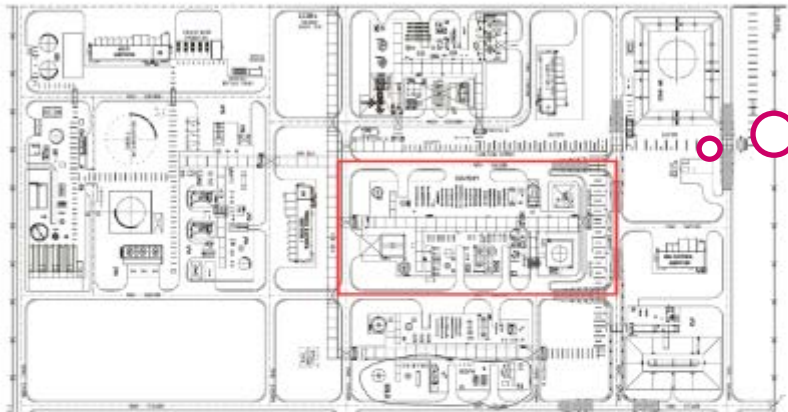


Contents of P&ID revisions

IFR	IFD	IFC
➤ Exercised contract option(s) ➤ Diameter of process lines	➤ Client comments ➤ Diameter of utility lines	➤ HAZOP actions ➤ Finalized interfaces with equipment and packages ➤ Size, number of PSVs and control valves

The General Plot Plan is reviewed during the HAZID (refer to Chapter 6 for details). The results of this review might include the relocation of some units, e.g., product storage upwind of process units, etc.

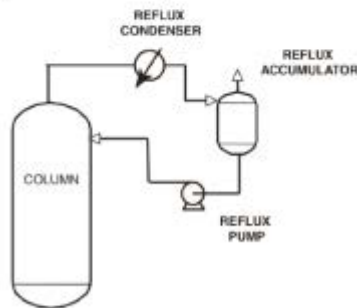
Once the locations of Process and Utility units within the Plant, i.e., the General Plot Plan, is defined, the positions of equipment within units, i.e., the **Unit Plot Plan**, is prepared.



Design activities are explained, e.g., Plant Equipment layout

Positions of equipment are set following a number of requirements:

- Equipment are grouped by Process functional sub-units,
- Lengths of equipment interconnections are minimized, to reduce cost, particularly for expensive lines (large diameter, alloy steels),
- Exclusion area are kept around open flame furnaces,
- Operator access to instruments and valves is enabled,



Action is required for any event falling in the "Intolerable Risk Area" of the matrix. Its frequency or consequences must be reduced to bring it into the "ALARP (As Low As Reasonably Practicable)" or "Acceptable" risk areas, through risk reduction measures.

The first step of the QRA is to perform a hazard identification. In the example that follows, the hazard reviewed is that of an explosion due to leak from piping. The cause could be material defects, construction errors, corrosion, maintenance overlook, etc.

The section considered here is the building housing a compressor.

The inventory of each component from which the leak could originate (flanges, pumps, valves, instruments...) is made. Frequency of leak of individual components is taken from statistical data found in the literature, for various leak size, e.g., 5% of component bore size, etc.

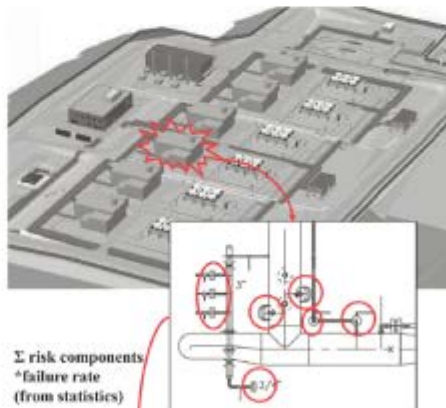
The sum of the individual component leak frequencies and sizes give the overall leak frequency and size.

Case study: Gas leak from random piping component rupture

Cause: installation error, corrosion, material defect...

Possible consequence: Dispersion without ignition / jet fire / flash fire / explosion

Section considered: Compressor building



Σ risk components
"failure rate
(from statistics)

Step 1:

Identification and characterisation
of initiating events

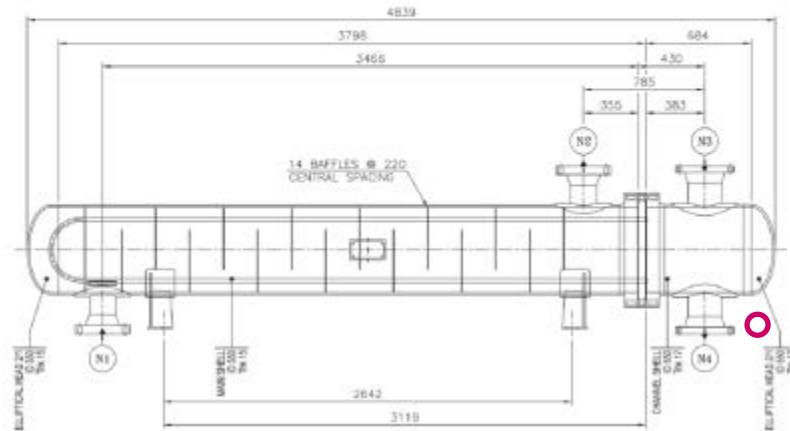
Gas leak inside compressor building due to component rupture	Hole size (% of component section)		
	5%	20%	Full
Frequency (event/year)	1,11E-01	5,06E-04	6,83E-05
Outflow rate (kg/s)	5,7	90,8	2270,0

Complex activities, such as QRA, are explained through a practical example.

4. Equipment/Mechanical

39

The mechanical design output is a **Mechanical Data Sheet** comprising an **Engineering Drawing**.



A sample of all common Engineering documents is included

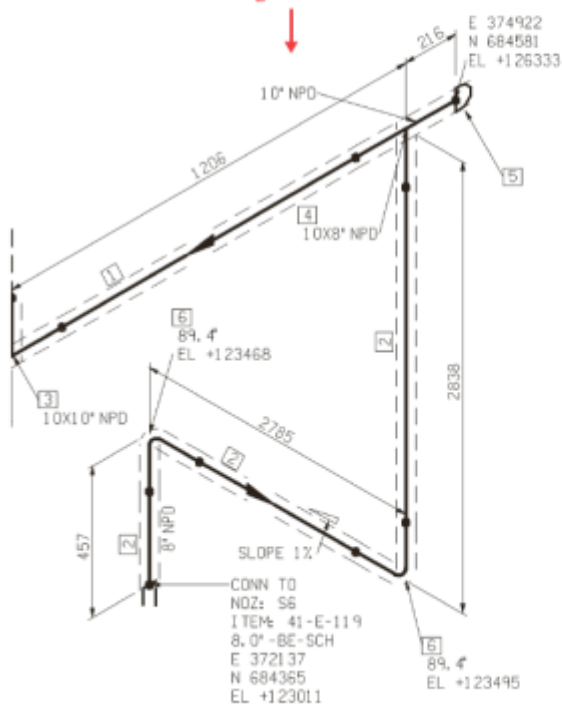
MATERIALS		DESIGN CONDITIONS	
SHELL / HEADS	SATISGRON	SHELL SIDE	RECYLE GAS PREHEATER
CHANNEL FLANGES	SATISGRON	FLUID	H2+H2S+HC
BOLTS-NUTS FOR CHANNEL COVER	SATISGRON/SATISGRONM	OPERATING PRESSURE	40.6/-
BOLTS-NUTS FOR COVER	-	OPERATING TEMPERATURE	125.5/168.1
NOZZLE FLANGE	SATISGRON	DESIGN CODE	UG-31.8 INT 3001X 4038HBM DAB V
NOZZLE BECK	SATISGRON	INTERNAL DESIGN PRESSURE	54.447 V
NOZZLE WELD	SATISGRON	AT DESIGN TEMPERATURE	SE
CLADDING / OVERLAY	N/A	EXTERNAL DESIGN PRESSURE	7.5
TE BOPES	SATISGRON	AT DESIGN TEMPERATURE	AMB
LEG. RAIL/ROD. STEEL	SATISGRON	WELD (AT DESIGN PRESSURE)	4
BRAZES/SUPPORT PLATES	SATISGRON	CORROSION ALLOW./CLADDING	3/-
SPACERS	SATISGRON	CORROSION ALLOW. FOR INTERVALS	AS PER TEMA
TUBES	SATISGRON	JOINT EFFICIENCY	1.0
TUBESHEET	SATISGRON	RADIATION	YES
		POST WELD HEAT TREATMENT	YES
		INSULATION	YES
		EXCHANGER TYPE	SHU

LIFTING WEIGHT (KN) : 27.9		BUNDLE WEIGHT (KN) : 12.16			
LOADING DATA (**)					
	LIFTING	ERECTION	OPERATING+WIND	OPERATING+SEISMO	TEST
WEIGHT (KN)	27.91	27.91	37.65	37.65	37.65
SHEARING LOAD LEFT SADDLE (KN)	-	-	6.34	5.42	8.71
SHEARING LOAD RIGHT SADDLE (KN)	-	-	5.22	8.97	5.16
MOMENT LEFT SADDLE (KN.m)	-	-	3.96	2.04	1.55
MOMENT RIGHT SADDLE (KN.m)	-	-	6.31	6.23	6.16

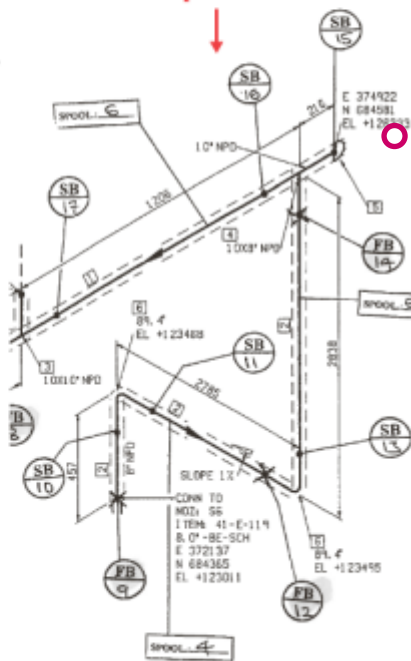
The Engineering drawing indicates the equipment dimensions, required by Plant Layout discipline to prepare the Plot Plan, the positions of nozzles, required by Piping to route the connecting lines, as well as the number, position and loads on supports, required by Civil to design the equipment support foundation.

The Isometric drawing produced by Engineering is not directly used for construction. Indeed, as the line is pre-fabricated in parts, called spools, drawings must be issued showing how the line is divided into spools. **Shop isometric drawings** are issued to this end by the Construction contractor. They are also used to identify welds, each of which will be associated with inspection and test records.

Design isometric



Shop isometric

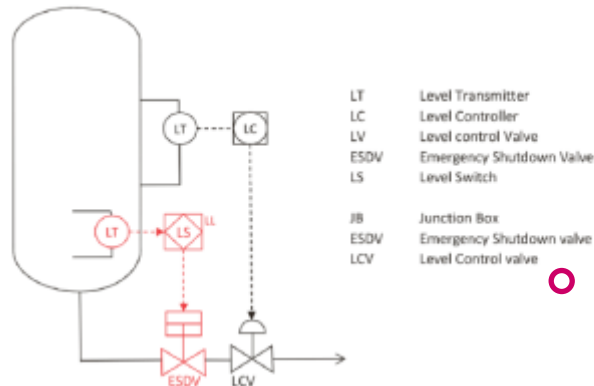


SB = Shop (Butt) Weld, FB = Field (Butt) Weld.

Difference between
Engineering and Shop
drawings

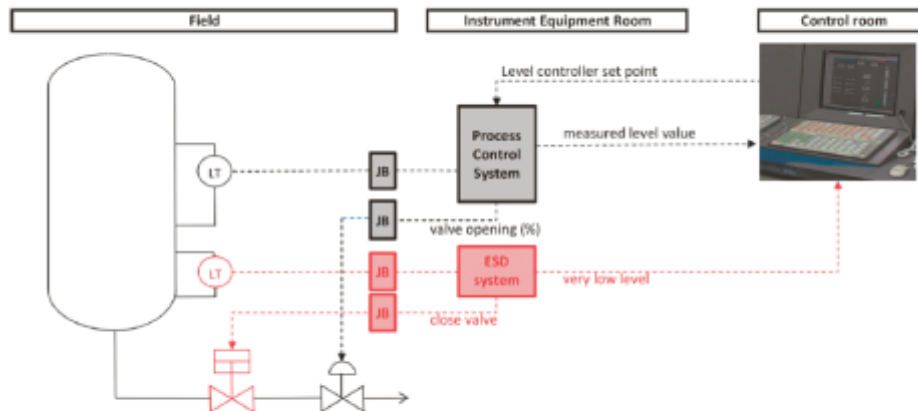
Process and emergency shutdown is performed by the **Emergency ShutDown (ESD)** system, also called the Safety Instrumented System (SIS). The ESD system is a separate system from the Process Control system. This ensures redundancy and independence.

Depiction on the P&ID



Understand the main technical aspects, e.g.,
DCS vs ESD

Corresponding hardware



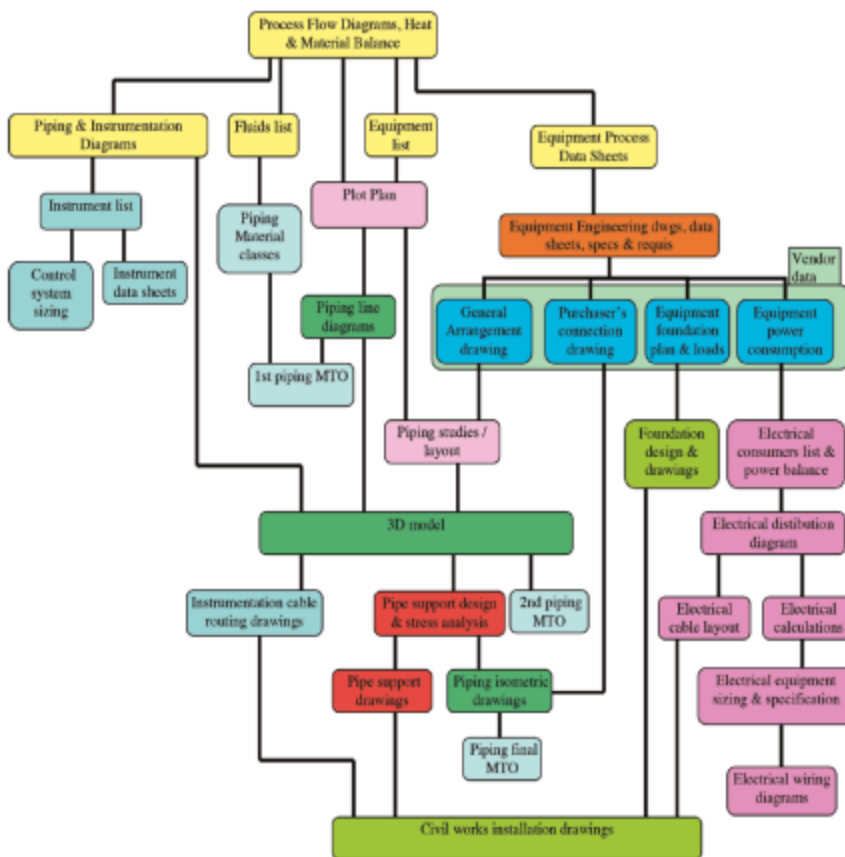
The ESD system initiates process equipment shutdown and closure of isolation valves in an emergency. The shutdown logic is implemented in the ESD system as defined by Process on the ESD Cause & Effects diagrams.

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The overall process

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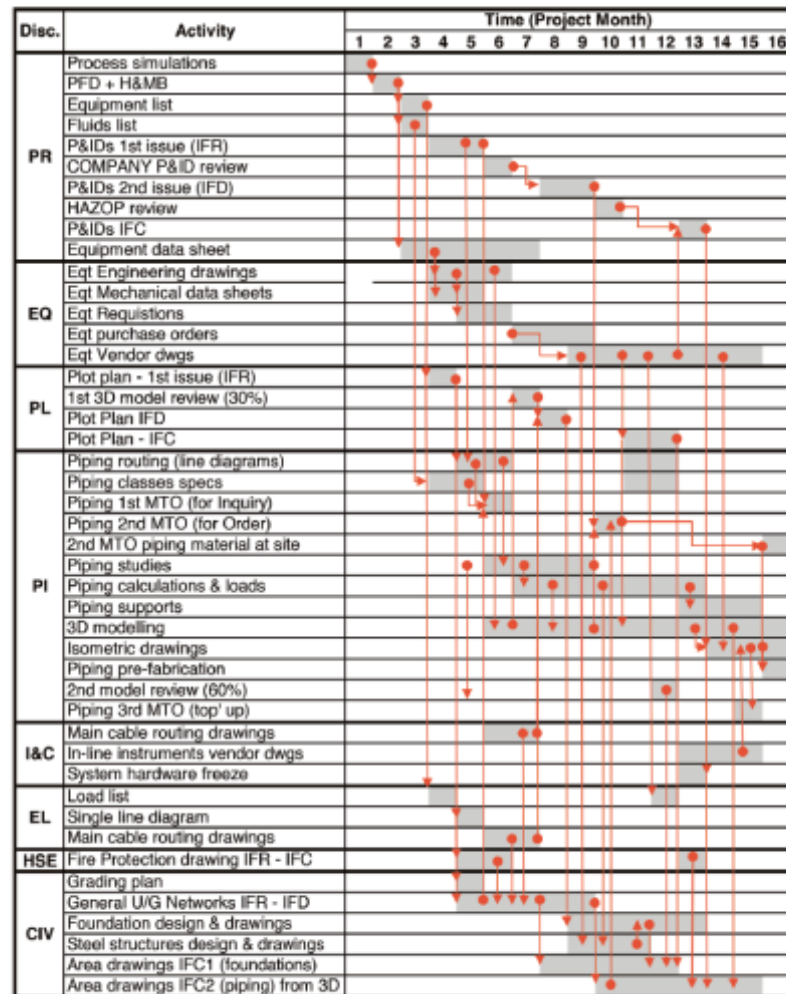


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14. The overall work process

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Even though the Engineering schedule at Detail Engineering stage is less standard than at FEED stage, as it depends on the Project execution plan, a typical one would look as shown here below.



PR = Process, EQ = Equipment, PL = Plant Layout, PI = Piping, I&C = Instrumentation & Control, EL = Electrical, HSE = Safety & Environment, CIV = Civil

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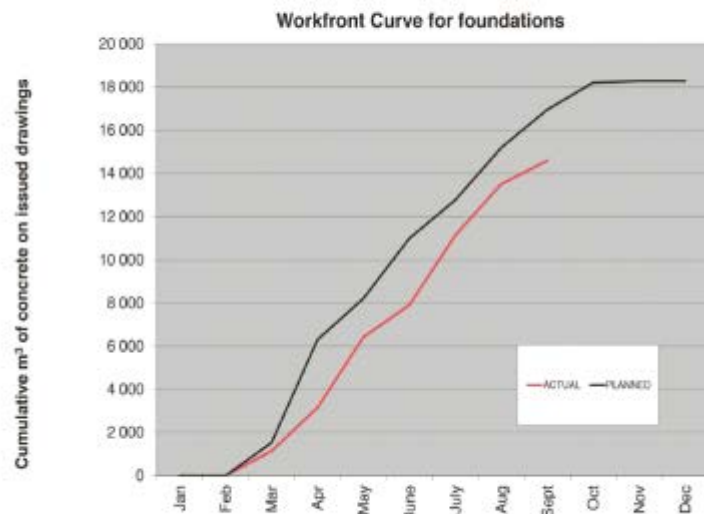
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large number of individual drawings which open varying amount of *workfront* to Site. The drawing of a small foundation, for instance, opens significantly less workfront to Site than that of a large and complex one.

Controlling the progress of issue of construction drawings on large project is not easy. Indeed, there is a large number of individual drawings. In addition, not all drawings have the same value for Site, that of a small foundation and that of a large and complicated one bring significantly different work volume to Site.

What is important is that Engineering provides enough *workfront* to Site, i.e., enough quantity of work on issued drawings to fully employ manpower and equipment.

This is best monitored using a **Workfront Curve**. For foundations, the Workfront Curve shows the cumulative number of cubic meters of concrete on issued-to-date foundation drawings versus plan. The plan is the construction foundation casting schedule, translated by the typical production cycle time, e.g., 3 weeks between receipt of drawing and completion of works.



Cumulative m³ on issued foundation drawings	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
PLANNED	0	0	1 529	8 303	8 213	10 990	12 781	15 196	16 954	18 213	18 276	18 276
ACTUAL	0	0	1 143	3 147	6 420	7 903	11 132	13 512	14 582			

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