طرح نگهداشت و افزایش تولید 27 مخزن

PIPING DESIGN CRITERIA

نگهداشت و افزایش تولید میدان نفتی بینک

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IDC: Inter-Discipline Check
IFC: Issued For Comment
IFA: Issued For Approval
AFD: Approved For Design
AFC: Approved For Construction
AFP: Approved For Purchase
AFQ: Approved For Quotation
IFI: Issued For Information
AB-R: As-Built for CLIENT Review
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REVISION RECORD SHEET

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1.0 INTRODUCTION

Binak oilfield in Bushehr province is a part of the southern oilfields of Iran, is located 20 km northwest of Genaveh city.

With the aim of increasing production of oil from Binak oilfield, an EPC/EPD Project has been defined by NIOC/NISOC and awarded to Petro Iran Development Company (PEDCO). Also PEDCO (as General Contractor) has assigned the EPC-packages of the Project to "Hirgan Energy - Design and Inspection" JV.

GENERAL DEFINITION

The following terms shall be used in this document.

CLIENT:	National Iranian South Oilfields Company (NISOC)
PROJECT:	Binak Oilfield Development – General Facilities
EPD/EPC CONTRACTOR (GC):	Petro Iran Development Company (PEDCO)
EPC CONTRACTOR:	Joint Venture of : Hirgan Energy – Design & Inspection(D&I) Companies
VENDOR:	The firm or person who will fabricate the equipment or material.
EXECUTOR:	Executor is the party which carries out all or part of construction and/or commissioning for the project.
THIRD PARTY INSPECTOR (TPI):	The firm appointed by EPD/EPC CONTRACTOR(GC) and approved by CLIENT (in writing) for the inspection of goods.
SHALL:	Is used where a provision is mandatory.
SHOULD:	Is used where a provision is advisory only.
WILL:	Is normally used in connection with the action by CLIENT rather than by an EPC/EPD CONTRACTOR, supplier or VENDOR.
MAY:	Is used where a provision is completely discretionary.

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2.0 SCOPE

This specification covers the minimum requirements for general aspects to be considered in design of above ground and underground piping. This Specification also includes basic requirements of the plant layout and spacing to ensure safety and fire prevention together with ease of construction, operation and maintenance in Preservation and Production Increase in this PROJECT.

3.0 NORMATIVE REFERENCES

The latest revision of following code and standards shall be applied besides the documents mentioned in purchase order or material requisition.

3.1 LOCAL CODES AND STANDARDS

- IPS (IRANIAN PETROLEUM STANDARD)

- Engineering Standard for Piping Material Selection	IPS-E-PI-221
- Engineering Standard for Plant Piping Systems	IPS-E-PI-240
- Engineering Standard for Layout and Spacing	IPS-E-PR-190
- Material and Equipment Standard for Valves	IPS-M-PI-110
- Material Standard for Flanges and Fittings	IPS-M-PI-150
- Engineering Standard for Process Design of Liquid &Gas Transfer and Storage	IPS-E-PR-360
- Typical Unit Arrangement & Pipe rack Layout	IPS-D-PI-102
- Pipeline Spacing	IPS-D-PI-103
- Engineering standard for flexibility analysis	IPS-E-PI-200
- Construction standard for plant piping system pressure testing	IPS-C-PI-350
- Construction standard for inside pipe chemical cleaning	IPS-C-PI-410
- Construction standard for welding of plant piping systems	IPS-C-PI-290
- Engineering standard for machinery piping	IPS-E-PM-385
- Engineering standard for corrosion consideration in material selection	IPS-E-TP-740
- Engineering standard for corrosion consideration in design	IPS-E-TP-760
- Valve & fittings dimension for piping design	IPS-D-PI-106
- Engineering standard for pipe supports	IPS-G-PI-280
- Engineering standard for piping material selection	IPS-E-PI-221
- application standard for safety boundary limit	IPS-C-SF-550
- General standard for safety portable ladders	IPS-G-SF-355
- Material and equipment standard for metric type fasteners (screws, bolts, stud, nuts and washer)	IPS-M-GN-130
- Relief valve installations and relief system	IPS-D-PI-123
- Standard Pipe supports	IPS-D-PI-130

3.2 INTERNATIONAL CODES AND STANDARDS

• Process piping	ASME B 31.3
• Gas Transmission and Distribution Piping Systems	ASME B 31.8
• Pipeline Transportation Systems for Liquids and Slurries	ASME B 31.4
• Pipes	
- Welded and Seamless Wrought Steel Pipe	ASME B36.10M
- Stainless Steel Pipe	ASME B36.19M
- Line Pipe	API Spec. 5L
• Fittings	
- Factory Made Wrought Steel Butt Welding Fittings	ASME B16.9
- Forged Fittings, Socket Welding and Threaded	ASME B16.11
-Buttwelding Ends	ASME B16.25
-Swage(d) Nipples and Bull Plugs	MSS SP-95
-Integrally Reinforced Forged Branch Outlet Fittings-Socket Welding, Threaded and Buttwelding Ends	MSS SP-97
• Bolts, Nuts, Screw, Pipe, Threads	
-Unified Inch Screw Threads	ASME B1.1
-Pipe Threads, General Purpose (Inch)	ASME B1.20.1
-Square and Hex Nuts (Inch Series)	ASME B18.2.2
-Square and Hex Bolts and Screws (Inch Series)	ASME B18.2.1
• Flanges	
-Pipe Flanges and Flanged Fittings (Up to 24")	ASME B16.5
-Large Diameter Steel Flanges (26" and larger)	ASME B16.47 Series B
-Line Blanks	ASME B16.48
-Orifice Flanges	ASME B16.36
• Ferrous Pipe Plugs, Bushings, and Lock Nuts with Pipe Threads	ASME B16.14
• Gasket	
-Metallic Gaskets for Pipe Flanges-Ring Joint Spiral-Wounded, and Jacketed	ASME B16.20
-Nonmetallic Flat Gaskets for Pipe Flanges	ASME B16.21
• Valves	
-Wafer and Wafer-Lug Check Valves	API Std. 594
-Valves-Flanged, Threaded and Welding End	ASME B16.34
-Face to Face and End to End Dimensions of Valves	ASME B16.10
-Valve Inspection and Testing	API 598
-Steel Gate Valves-Flanged and Butt Welding Ends Bolted Pressure Seal Bonnets	API 600
-Compact Steel Gate Valves-Flanged, Threaded, Welding and Extended	API 602
-Class 150, Cast, Corrosion Resistant Flanged – End Gate	API 603

Valves	
-Butterfly Valve, Double Flanged, Lug-Type and Wafer-Type	API 609
-Specification for Pipeline and Piping Valves	API 6D
-Metal ball valves, flanged, threaded and welding ends	API 608
-Rubber seated Butterfly valves	AWWA C504
-Flanged steel check valves	BS 1868
-Flanged steel globe valves and check valve	BS 1873
-Cast iron wedge and double disc gate valves	BS EN 1171 (BS 5150)
-Cast iron globe and globe stop and check valves	BS EN 13789 (BS 5152)
-Cast Iron check valves	BS EN 12334 (BS 5153)
-Copper alloy globe, globe stop and check and Gate valves	BS EN 12288 (BS-5154)
-Cast iron and carbon steel butterfly valves	BS EN 593 (BS 5155)
-Screw down diaphragm valves	BS EN 13397 (BS 5156)
-Steel ball valves	BS EN ISO 17292 (BS 5351)
-Forged steel gate, globe, check valves	BS EN ISO 15761 (BS 5352)
-Test methods and definitions for mechanical testing of steel Products	ASTM A370
-Practice for ultrasonic examination of heavy steel forgings	ASTM A388/A388M
-Test methods for adhesion of metallic coatings	ASTM B571
-Guide for radiographic testing	ASTM E94
-Practice for ultrasonic pulse-echo straight-beam examination by the contact method	ASTM E114
-Test method for liquid penetrate examination	ASTM E165
-Guide for magnetic particle examination	ASTM E709
-Safety relief valves	API RP 520 / 527, ASME Sec. VIII or Sec. I
-Metallic Products – Types of Inspection Documents	EN 10204
-Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments	NACE MR0103
-Standard Test Method - Evaluation Of Pipeline And Pressure Vessel Steels For Resistance To Hydrogen-Induced Cracking	NACE TM-0284
-Laboratory Testing Of Metals For Resistance To Sulfide Stress Cracking And Stress Corrosion Cracking In H2s Environments	NACE TM-0177
-Petroleum and natural gas industries - Materials for use in H2S-containing environments in oil and gas production	NACE MR 0175/ISO 15156
-Standard for the Installation of Stationary Pumps for Fire Protection	NFPA 20

3.3 THE PROJECT DOCUMENTS

Process Basis of Design	BK-GNRAL-PEDCO-000-PR-DB-0001
Piping Material Specification Pipeline Material Specification	BK-SSGRL-PEDCO-110-PI-SP-0001 BK-SSGRL-PEDCO-110-PL-SP-0001 BK-PPL-PEDCO-320-PI-SP-0001 BK-PPL-PEDCO-320-PL-SP-0001 BK-GCS-PEDCO-120-PI-SP-0001
Specification For Painting	BK-GNRAL-PEDCO-000-PI-SP-0006
Specification For Insulation	BK-GNRAL-PEDCO-000-PI-SP-0019
Specification For Coating Of Underground Piping	BK-GNRAL-PEDCO-000-PI-SP-0013
Standard Drawing For Roads	BK-GNRAL-PEDCO-000-CV-DW-0003
Specification For Piping Design & Plant Layout	BK-GNRAL-PEDCO-000-PI-SP-0016
Specification For Metallic Pipes	BK-GNRAL-PEDCO-000-PI-SP-0004
Specification For HDPE Pipes	BK-GNRAL-PEDCO-000-PI-SP-0018
Specification For Fittings, Flanges, Gaskets and Bolts	BK-GNRAL-PEDCO-000-PI-SP-0005 BK-GNRAL-PEDCO-000-PL-SP-0005
Specification For Manual Valves	BK-GNRAL-PEDCO-000-PI-SP-0009
Specification For the Design of Piping in Mechanical Packages	BK-GNRAL-PEDCO-000-PI-SP-0003
Specification For Material Requirements in Sour service	BK-GNRAL-PEDCO-000-PI-SP-0008
Specification For Flexibility Analysis	BK-GNRAL-PEDCO-000-PI-SP-0012
Specification For Pipe Support	BK-GNRAL-PEDCO-000-PI-SP-0014
Specification For Piping Construction, Fabrication & Erection	BK-GNRAL-PEDCO-000-PI-SP-0015
Specification For Welding of Plant Piping System	BK-GNRAL-PEDCO-000-PI-SP-0011
Specification For Plant Piping Systems Pressure Testing	BK-GNRAL-PEDCO-000-PI-SP-0010
Standard Pipe Support Drawings	BK-SSGRL-PEDCO-110-PI-DW-0001 BK-GCS-PEDCO-120-PI-DW-0001
Piping Assembly Drawing	BK-SSGRL-PEDCO-110-PI-DW-0002 BK-GCS-PEDCO-120-PI-DW-0002

3.4 ENVIRONMENTAL DATA

Refer to “Process Basis of Design; Doc. No. BK-GNRAL-PEDCO-000-PR-DB-0001”

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3.5 ORDER OF PRECEDENCE

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In case of any conflict between the contents of this document or any discrepancy between this document and other project documents or reference standards, this issue must be reported to the CLIENT. The final decision in this situation will be made by CLIENT.

4.0 PLANT LAYOUT

4.1. GENERAL

The layout would be developed using the basic criteria of flow sequence, functionality and successive optimizations according to the development of the available information, taking also into consideration the requirements of all the disciplines involved.

4.2. PLANT LAYOUT REQUIREMENT

To achieve the best optimized plant layout solution, all the elements that constitute the Plant shall be located to meet the requirements described in the following paragraphs.

4.2.1 Safety

Safety shall be referred to population, the staff working inside the plant, the environment, and the equipment of the Plant. From the viewpoint of layout solutions this requirement is met by taking preventive measures such as:

a) provide adequate space between risk sources, and between the hazardous components and other components inside or outside the plants, in order to prevent the possibility of involvement in case of accident and/or to minimize the damage.
b) locate the hazardous components to prevent or minimize the effects of their operation on other components both inside and outside the plants.
c) provide clearance and access to allow installation and operation of fixed and mobile safety equipment and escape routes for the personnel in case of accident.
d) Provide suitable design features such as: tank dikes, protection walls, and difference in height, curbs and slopes to prevent or minimize consequences in case of accident.
e) For the purpose of personnel protection, all surfaces with operating temperatures above 55℃ accessible from normal working areas and access ways platform shall be insulated.

4.2.2 Functionality

It is intended as the ability of the Plant to perform the required functions and production processes. From the point of view of layout it is then necessary to arrange the blocks, plants and equipment so as to comply with the requirements defined in the specifications and process diagrams. In particular:

- Minimum and maximum lengths of connections and differences in elevations. Special attention shall be given to the definition of the plant elevation and to the structural arrangement, based on the impact of large earthworks and structural works on the Plant costs;
- flexibility during startup and full or partial operation of the Plant;
- Location of the components to permit correct execution of all the connections (piping and relevant fittings, etc.)

The Plant shall also be so arranged to minimize the overall costs both of internal connections of any type and of connections with the delivery points of raw materials, the dispatch of semi-finished and finished products, and with transport, distribution and collection systems of energy, industrial fluids and effluents to which the Plant is related.

4.2.3 Operability

From the point of view of layout solutions, the operability requirements are met by placing the components so that personnel have access to all the locations of the elements for control, operation and inspection of the Plant during normal operation. For this purpose it may be necessary to provide structures, fixed and/or mobile auxiliary operating floors and access ladders. It is also recommended to group, as far as possible, the control and operation devices for certain components, or the functionally homogeneous groups of components. Clearances for access and operability would be according to the BEDD references and are aimed to provide the operating staff with a suitable degree of access.

4.2.4 Maintainability

Maintainability requirements are satisfied, from the point of view of layout, by the following arrangements:

- Roads, having a width and free crossing clearance sufficient for access of the mobile maintenance equipment needed for the Plant;
- Clearance around the components to be maintained, sufficient for: operation of the equipment, disassembly and replacement of the removable parts (for example: rotors of large machines);
- Fixed equipment, as required, such as: hoists, bridge cranes, elevators, in accordance with the maintenance requirements.

4.2.5 Constructability

This requirement is satisfied from the point of view of layout by providing:

- Sufficient clearance and access for transport within the site of both plant components and construction equipment;

- Sufficient clearance for the temporary installations required for construction. Special attention shall be paid to the location of large size/mass components and long lead items, to avoid inflicting compulsory construction restraints, sequences and bottlenecks in erection schedules. Additional constraints in the locating of large and heavy components derive from the need to provide more than one piece of hoisting equipment (normally 2, one for lifting and one for holding or tailing). If possible, the location of such components near access and/or clearance should coincide, taking into consideration the fact that these components shall be laid horizontally adjacent to their foundations. If several components are located in the same area, the space allowed shall be optimized according to the lifting sequence and, in some cases, components may be assembled at job location.

4.2.6 Minimum Distances between individual equipment and to boundaries and facilities:

- Drum to drum 2 meters
- Exchanger shell to exchanger shell 1 meter
- Pump to pump (foundation) for;
  - Small pumps, 3.7 kw & less mount on common foundations with suitable center to center distances.
  - Medium pumps, 22.5 kw & less 1 meter
  - Large pumps, above 22.5 kw 1.5 meters
- Exchangers to other equipment 1 meter minimum clear aisle
- Driver end of pumps to truck 3 meters access (if required)

4.3. LOCATION OF INDIVIDUAL COMPONENTS

This Section covers the instructions regarding the location of the Plant components, particularly with regard to problems of installation, access for operation and maintenance, and functionality.

4.2.1 Pipe ways

Pipe ways are the corridors where the above ground piping will run, supported on sleepers, to connect the off-site areas and the process plants and utilities where there are no elevation constraints. Pipe ways are normally located near connection roads to permit easy access to the piping for maintenance and operation.

4.2.2 Control Room

- Control room shall normally be located in areas that are not subjected to the consequences of possible accidental releases such as: explosion, toxic clouds, flammable spillage (see the area classification documents issued by the HSE Department). Where this is not possible, it is necessary to adopt pressurization, explosion-proof construction, etc., according to the case. Special attention shall be paid to the safety of access/escape ways.

- The control room shall be located, as far as possible, in a bar centric location with regard to the connected users, and oriented (provided that this does not hinder the action of the operators) with the cable inlet/outlet side towards them, to permit optimization of the cable run and uniformity of operation time on the various Units of the Plant.

- The control room shall also be located near roads and provided with parking and operating areas to permit access (both during normal operation and for maintenance), quick action in case of emergency and rapid evacuation.

- The control room shall be positioned so that the operator can command a view of the whole system which is under control. Large buildings or equipment shall not be placed in front of the control room.

4.2.3 Electrical substation

- It is normally located near roads and areas for operation and parking to permit access both during normal operation and for maintenance, quick action in case of emergency, and rapid evacuation. In any case, the location of the main electrical substation shall avoid crossing the Plant by long-distance lines (decentralized location is therefore to be preferred).

- Electric power distribution substations shall normally be located in areas that are not subjected to the consequences of possible accidental releases such as: explosion, toxic clouds, and flammable spillage. Where this is not possible, it is necessary to adopt pressurization, explosion-proof construction, etc., according to the case. Special attention shall be paid to the safety of access/escape ways.

4.2.4 Furnaces, Accessories and Stacks

- Furnaces and their accessories are normally grouped in appropriate areas inside the battery limits of the Plant unit to which they belong, and shall be kept separate from other equipment. These areas are selected according to the direction of prevailing winds, to prevent possible leaks of combustible gas from the plant area from reaching the naked flame of the burners.

- Inside the area, the distance to be met between furnaces shall permit access for operation and maintenance. The distance to be met from the furnace wall surface to the nearest equipment shall be minimum 15m. Within this range it is possible to locate only the equipment that is strictly connected to the furnace, such as high pressure exchangers of the same units, and decoking vessels.

- Stacks may be single (one for each furnace) or by grouping the effluents from more than one furnace, depending on the amount and composition of the flue gas conveyed. This choice is also affected by environmental conditions, if any. Stacks and outlets shall normally be positioned to avoid causing risks to the personnel on nearby structures (for example: 3m above the nearest walkways within a radius of 15m, or similar criteria).

- The set of valves controlling the feeding of smothering steam shall be located in a safe location at least at a distance of 15 meters from the furnace

4.2.5 Vessels

- Vessels and drums shall principally be laid out as close as possible to the related equipment.
- Where horizontal drums are arranged near a pipe way, the horizontal centerline of the drums shall be located at right angles to the pipe way.
- Small vertical vessels, such as containers of chemical additives, shall be grouped on the layout in one area in order to consolidate the filling operation.

4.2.6 Centrifugal and Reciprocating Compressors

- If possible compressors shall be located in one area (the compressors of one or more plant Units may be grouped) in order to facilitate the work of operators and the maintenance personnel), to group high electric power motors and to utilize only one building and one bridge crane (if this is a requirement). Unless otherwise specified, compressors are normally installed outdoor.
- All operating valves in compressor piping, where possible, shall be accessible from compressor slab, walkway or grade, and grouped together for maximum ease of operation.

- Discharge check valves on air compressors shall be installed as near to the compressor as possible.

- Generally, compressors shall be installed outdoors. In case a shelter is required, the ventilation of room shall be taken into consideration.

- Minimum spacing between gas compressor and open flames shall be 30 m.

- When positioning reciprocating compressors on a layout, clearance for the following shall be provided:

a) removal of pistons (the removal elevation is normally indicated on the machine drawing);
b) pulsation dampeners, if required;
c) intercoolers etc., if required;
d) Local panels, if required.

- When sizing the layout of a compressor room, the following shall be taken into consideration:

a) Leave sufficient clearance around the machine (about 1.5m) in addition to the space already provided between heads for removal of pistons;
b) Leave sufficient clearance, in addition to a) above, for the construction of reinforced concrete foundations to be properly spaced to avoid the transmission of vibrations.
c) use the clearance below the working level to position any pulsation dampeners, intercoolers, etc., which need to be located as near as possible to the respective machines;

d) Leave sufficient clearance for positioning steam turbine, when required, with the related condenser (located below the operating level). The clearance to be provided around the turbine and the relevant driver shall be 1.5m as a minimum;
e) align the building pillars, as far as possible, such that they do not coincide with those of the machines bases; this is for easier support, related to the foundation, of the operating floor, which shall normally be supported independently of machine bases to avoid transmission of mechanical vibrations;
f) provide access for transport means and loading/unloading bay inside the room;
g) do not place any equipment or tube bundle on compressors;
h) K.O. drums shall be located outside the compressor room.

4.2.7 Pumps

- Aisles between rows of pumps shall be 3 meters minimum (clear).

- The suggested spacing for pumps requiring a 0.5 meters to 1.0 meter wide foundation is 2 meters center to center. (A range of 1.5 to 3.0 meters is acceptable).

- When positioning the pumps on the layout, the following shall be provided:

a) leave sufficient clearance (3m as a minimum) behind the motors or turbines for the passage of connection cables and for access and transit of personnel with the relevant equipment, for both normal operation and maintenance;
b) orientate the hydraulic part of all pumps towards the Plant equipment from where most of the suctions come;
c) leave sufficient space between pumps for easy access of operators and maintenance personnel of the Plant, this space shall normally be about 0.8/1m minimum net clearance;
d) Install a fixed monorail for handling removable parts if it is not possible to have access to the machine (including motor or turbine) for maintenance by means of mobile hoisting equipment.

- In addition to the provisions of the previous paragraph, the following safety constraints shall be met when positioning the pumps:

a) the pumps that convey light hydrocarbons with P > 3.5 MPa (gauge) must not be placed below air coolers;
b) The pumps that convey hydrocarbons with T ≥ T (ai-auto ignition) must not be located below air coolers but not below pipe rack frame. Moreover, they must be placed at a distance of at least 4 – 5 m from the pumps that convey flammable products with T < T(ai);
c) The pumps that convey flammable products with T < T (ai) may be located below air coolers.
d) All the pumps that convey hydrocarbons must be placed, as far as possible, at a distance of 4 – 5 m from equipment that contains flammable or combustible liquids. If this is not feasible, suitable precautions must be taken to provide proper fire protection and firefighting systems.
e) Pumps must not be installed within storage tank dikes or retaining walls.

4.2.8 Air Coolers

- Unless otherwise required, air coolers are normally installed above the pipe rack, preferably in a bar centric position with respect to the equipment to which they are connected, avoiding the proximity to equipment and/or structures that may interfere with their performance.
- To permit sufficient passage of air and efficient thermal exchange, the following requirements shall be taken into account for the layout:

a) Sufficient clearance between the floor of the service walkways to the motors and the top floors of the pipe rack. This requirement is normally met be leaving a minimum distance of 1.6m measured from the greatest dimension point, for example from the outer surface of the greatest diameter pipe on the pipe rack floor (including insulation, if any).
b) Do not place any kind of equipment directly on coolers.

- In addition to the provisions of the previous paragraphs, the following safety constraints shall be met when positioning the air coolers:

a) equipment containing lethal or toxic products must not be installed below the coolers (within a radius of 5m as a minimum);
b) The coolers that contain flammable liquids must not be installed directly above control rooms, electrical substations, transformers, compressors.

- When arranging the Plant Unit components on the layout, take into consideration the fact that air coolers require access roads and operating areas for mobile hoisting means. Layout shall be based on the following requirements:

a) installation of the coolers during construction;
b) replacement of fans (motors, propellers, hoods);
c) removal of tube bundles;
d) Replacement of parts of the cooler and/or of the connected piping.

4.2.9 Hydrocarbon Storage Tank (Atmospheric)

- The tanks in question may be, depending on their construction, fixed roof (TF) and/or floating roof (TG). The former will store less volatile products (asphalt, oil, gas oil, diesel oil, kerosene, etc.), while the latter will store light and volatile hydrocarbons (gasoline, crude oil, naphtha, etc.).

In the layout of a Plant tank farm, the following shall be considered:

- The crude oil tank farm shall be located, if possible and unless booster pumps are present in the tank area, at the highest part of the Plant site, for easier suction by the distillation unit feed pumps. For the same reason the tank farm shall be as near as possible to this Unit;

a) the tank farm for semi-finished products and feed to the other units of the Plant shall be located near the area of the Units, in order to shorten the connection between the tanks and the units concerned;

b) The finished products tanks are normally adjacent to the previous one (semi-finished products) and, if possible, towards the area where dispatch points are provided.

- The topographical profile of the ground shall also be taken into consideration in the layout definition, in order to minimize the use of pumping stations.
- The minimum distance between tanks, the configuration and location of tank dikes, the dimensions and capacity of the relevant basins, shall be defined in accordance with the NFPA 30.
- Failing precise information, the following can be assumed:

a) the volume of the tank dike shall be equal to the tank volume (plus a 10 cm margin on each side) if the tank dike contains more than one tank, the volume shall be equal to the greatest tank capacity plus any submerged volume of the other tanks;
b) elevation above ground of the dikes shall not exceed 4m;
c) the height of the tank shall not exceed the height of the retaining walls by more than 12m;
d) The size of the retention pond shall be defined in compliance with the following requirement: any straight line passing through the periphery of the tank proof (or of its top edge for floating roof tanks) and forming a 45° angle with the vertical must fall within the internal perimeter of the retention pond.

- Tank dikes are normally constructed of earth or concrete walls. On the top of the dike there shall be a passage at least 1m wide; access ladders, spaced not more than 80m from one another, shall be provided outsides the dike.

- The following shall also be provided:

a) direct access walkways between the dike and the tank, in order to permit access to the top without going down to the retention pond;
b) Access roads for vehicles and/or other connection means between the outside and the inside of the tank dike.

4.2.10 Pumping Stations (Off-site Area)

- Pumping stations are normally the areas where are grouped the pumps for shipping the products from/to the storage tanks.

- Unless there are special constraints, the shipping pumps are grouped on the basic of the product conveyed and the tank farm concerned. Unless otherwise required, these pumps are installed outdoor in a paved and curbed area.
- If roofing is required for the pumping stations, monorails shall be provided for sliding the hoist to be used for maintenance.

- When positioning the pumping stations on the layout, the following requirements shall be taken into account:

a) the elevation of the pump suction nozzle shall avoid positive pockets (upwards) on the lines, these pockets affect negatively the pump performance and prevent complete emptying of the connected tanks;
b) the pumping stations shall be located near roads, and operating and parking areas shall be provided to permit access (both during normal operation and for maintenance), quick action in case of emergency and rapid evacuation;
c) the route of the connected piping shall be optimized (from/to pipeway and from/to tanks).

4.2.11 Flares

- The distance from the flares the process Units and the hydrocarbon storage tanks depends on the height of the take-offs and on the heat released by the flame, in order to avoid damaging the equipment or jeopardizing the personnel safety.
- **K.O. drum of flares shall be installed, as far as possible, at lower elevations than the Plant Unit areas and flare stack location shall take into consideration the environmental impact, preferably:**

a) windward, if regarded as a possible ignition source;
b) leeward, if regarded as a radiation source.
The location of the flares shall be established after a general safety analysis.

- The areas near the flares where personnel may be present shall be handled in accordance with API RP 521.

5.0 PIPING

5.1. DRAWINGS

5.2.1 Piping and Instrument Diagrams (P&IDs)

The piping would be engineered on the basis of the P&IDs contents. The following identifies the minimum information that shall be shown on a P&I Diagram:

- Outline of all equipment and connecting piping;
- Equipment numbers, title and data where relevant
- Piping line numbers including line size, fluid identity and piping class;
- Valves – types, sizes and tag numbers as applicable;
- Piping class changes;
- Spectacle blinds;
- Temporary strainers;
- Sample connections, corrosion probes and coupon connections;
- Process vents and drains;

- Pipe size changes;
- Insulation – extent and type;
- Heat tracing – extent and type;
- Instrumentation;
- Special items;
- Control valve sizes;
- Relief valves, sizes, set pressure and service e.g. thermal.
- Battery limits.

5.2.2 General Arrangements

Piping General Arrangements shall convey as much detail as necessary to identify the location of all pipe work, equipment, cable trays, ducting, pipe supports, etc. Whichever scale is used it is essential that small details are clearly visible and understood. Normally, Plant process and utilities pipes are installed above ground, gathering them, as far as possible, in orderly bundles resting on appropriate support structures.

The above ground piping layout shall have a simple and well-organized arrangement providing a network configuration in compliance with the Mechanized P&I diagrams, assuring proper access for operability and maintenance.

Exceptions to this rule are the drainage pipes and/or the large cooling water or fire-fighting pipes which are installed below the Plant grade Level.

Lines under railroad tracks or roadways shall be installed in steel pipe sleeves. The sleeves for these lines shall be vented and shall conform to the requirements of local regulations.

All steel lines and pipe sleeves located underground shall be coated for external corrosion protection. As a rule the underground piping shall not be installed on two levels and same route.

5.2. ISOMETRICS

Isometrics are piping drawings designed without using scale and prepared, by line or piping arrangement areas, to a degree of detail suitable for shop prefabrication and, together with the erection drawings, for the relevant assembly on site.

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AG Isometrics are prepared for sizes 2” & above for all materials, and for sizes 1 ½” & above for Stainless Steel material.

6.0 PIPING GENERAL

6.1. Selected Nominal Sizes

- For all types of piping components the following limitations are imposed:

a) Nominal pipe sizes 1¼", 2½" 3½", 5", 7", 9", 22" and 26" shall not be used for carbon or stainless steel piping.
b) Pipe smaller than ½" shall not normally used, except for instrumentation.

- These rules may not be applicable where equipment must be connected, e.g., pumps, compressors, the flanges of which sometimes deviate from the selected sizes, but form an integral part thereof. If in Supplier's scope of supply there are any termination points that fall into this category for connection by Plant piping, Supplier shall provide a suitable counter weld neck flange with his equipment.

6.2. Clearances

- The minimum overhead clearances shall be as follows:

a) Over exchangers at ground, shell cover end: 1500 mm
b) Headroom below structural steel & piping: 2100 mm
c) For passage of truck: 4000 mm
d) Over fork-lift truck access: 2700 mm

- Piping

Item No.	Description	Distance
1	Clearances between diameter of flange (or insulation, if insulated) and the outside diameter of adjacent pipe or insulation	25mm+ calculated movement
2	Clearances between outside diameter of pipe or insulation and adjacent structural member	50mm+ calculated movement
3	Clearance between bottom of pipe or insulation/flange to top of deck floor	300 mm
4	Space around orifice installations, control valves strainer and thermo wells	Sufficient for removal and replacement of elements

- Minimum widths of access:

a) Vehicular access ways within units: 4000 mm
b) Pedestrian access ways and elevated walkway: 1200 mm
c) Stairways and platforms: 800 mm
d) Footpaths in tanks areas: 600 mm
e) Maintenance access around equipment: 1000 mm
f) Fire truck access way: 6000 mm

6.3. Tie-ins

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In case of modification or expansion of existing plants, the tie-in diagram(s) shall be prepared to clarify piping connection points and their tie-ins between the existing plant and its expansion parts. This diagram shall be as detailed as P&ID. The tie-in diagram shall show the location points and procedure of tie-in.

7.0 SUPPORTING OF PIPE WORK

7.1. Strength (Robustness and Operability)

a) All piping component, fittings and their interconnecting piping and associated supports shall be substantial enough or so protected that they can both perform their normal duty and be pulled or stood on by a man without causing either breakage or permanent deformation. In case of dispute a static load of 250 kgf will be applied on any direction to the component concerned.

b) Piping, attachments and supports shall comply in all cases with the minimum strength requirements above. This requirement effectively prohibits the use of unsupported pipe and/or unprotected runs of small bore pipework, and the use of unreinforced vents, drains and branch connections on all pipework and equipment.

7.2. Piping Vibration

a) Piping components and pipework shall be designed and installed so that their natural vibration frequencies in operation are not excited by a regular forcing frequency from other system equipment such as pumps or fans.

b) In case of dispute about the principal natural frequency of a suspect piping installation as determined by calculation or measurement and vibration frequency analysis on the fabricated system, at least 20% of forcing frequency shall be removed from any significant connection exciting frequency.

7.3. Flexibility

-Pipework shall be designed with sufficient flexibility so that it will not overload terminating nozzles or flanges either on the main equipment or ancillary components. Overload shall be interpreted as a load sufficient to cause unacceptable high stress or strain in the pipe or mating equipment, or a load which causes unacceptable indirect distortion such as may be caused by a pipe load on a bearing housing which results in detectable shaft misalignment.

-Pipework flexibility shall be achieved by judicious design or by the use of expansion or flexibility loops wherever possible. Expansion joints typically liable to fatigue failure or leakage shall not be used to obtain the necessary flexibility. Metallic hose with braided stainless steel wire exterior casing may only be used to provide flexibility on relatively large diameter low pressure drain piping.

-Factors which shall be taken into account when considering pipework flexibility shall include but not be limited to the following:

1. Temperature differences causing relative thermal expansion.
2. Relative strains due to contained pressures.
3. Normal fabrication tolerances.

8.0 PIPING ADJACENT TO EQUIPMENT

- The Piping adjacent to equipment shall be designed taking in consideration the following:

a) Minimum size pipework for drains connecting to equipment shall be 2".
b) When more than one pump is installed on a common suction and/or discharge header, each pump shall be isolated in such a manner that, when shutdown for maintenance occurs, one pump can be isolated without affecting the operation of the other pump(s).
c) Connections in equipment casings intended for venting, draining, cooling, flushing, warming up, etc., shall, when connected, be provided with a branch nipple, schedule 160, to which a valve is to be connected.
d) All piping shall be installed in a neat and orderly fashion. Piping immediately adjacent to a machine shall be adapted to the contours of the machine and shall not obstruct bolting or access for normal operation and maintenance.
e) Set-on branches shall be properly designed with the appropriate branch reinforcement and shall be attached by full penetration welds. For small piping sizes, the minimum wall thickness and branch components required shall not be less than those specified in the Piping Material Specification. Wherever possible, threaded connections shall not be used for either pipework joints or for connection of pipework to the equipment. They may only be used with the specific approval of the Engineering Dept. and where other more satisfactory connections are impractical and the contained material is non corrosive.

9.0 PIPING COMPONENTS

9.1. GENERAL

- Selected materials in accordance with Piping Specification Classes are to be used.

- All pipe threads (when permitted) shall be taper threads in accordance with ASME B1.20.1.

9.2. PIPE

- Wherever it is practical, metallic pipe shall be specified by reference to the nominal size and schedule number as per ASME B36.10M for carbon steel and B36.19M for stainless steel.

- Since ASME B36.19M (stainless steel pipe) is limited to only four schedule numbers (5S, 10S, 40S and 80S) stainless steel pipe may also be indicated by schedule reference to ASME B36.10M (carbon steel pipe) if required.

9.3. FITTINGS (EXCEPT BRANCH FITTINGS)

- Butt welding fittings shall generally be in accordance with ASME B16.9M.
- Reducing elbows, straight crosses, reducing outlet crosses and short radius 45 or 90 elbow shall be considered as special fittings. Such specials shall be used only to suit process or piping requirements if no other design is feasible. Fabricated fittings, employing intersection welds shall be designed in accordance with the rules established in the relevant design codes or regulations.
- For sulfur lines crossing shall be used instead of elbows.

- For continuous jacketing lines across piece shall be provided normally in case of direction change to permit lines cleaning out for fluid subject to solidification (e.g. liquid sulfur lines). Tee piece is allowed only for nearby ground level lines or when cleans out is not requested.

- Dimensions of flanged fittings shall generally be in accordance with ASME B16.5 for size 1/2” to 24” or B16.47-Series B for sizes above 24”.
- Threaded fittings shall be used only if specified in the Piping Material Specification.
  DELETED.
- For sizes below 2" socket weld fittings and for sizes 2" and above Butt Weld fittings shall be used.

9.4. BRANCH FITTINGS

- Branch fittings are understood to be all fittings which are intended to connect a branch pipe to a run pipe.

- Unless required for process or flow reasons branch connections shall be at an angle of 90º to the run pipe.

- Branch connections should generally be in accordance with applicable piping class from the Piping Material Specification to avoid any additional calculations or reinforcing. Branch connections not covered by piping classes shall be calculated in accordance with ASME B31.3.

9.5. FLANGES, SPECTACLE BLINDS AND SPADES, ETC.

- In general flanges shall be in accordance with ASME B16.5. Flanges not covered by ASME B16.5 shall be calculated in accordance with the requirements of the relevant code for Pressure Piping.

- Bolted joints developed for special applications shall at least meet with requirements and service rating of the lowest rated component in the relevant piping system.

- Spectacle blinds shall have the pressure/temperature rating of the connecting piping.

- Permanent blanks and spade-type blinds shall have the pressure/ temperature rating of the connecting piping, except for the spade type blinds which are used for pressure testing only.
- Welding Neck flanges shall be used for diameter 2” and larger.
- Class 400 flanges shall not be used.
- All welding neck flanges 12” and larger matching blinds or spacers shall be supplied with jack screw.

9.6. VALVES

- For maintenance and cost reduction, types of standard valves to be selected should be restricted as much as possible.

9.7. BOLTING

- Bolting shall conform to the following specifications:

a) Threading for pressure bolting shall conform to the ASME B1.1, Unified Inch Screw Threads.
b) Bolting materials for pressure joint shall be in accordance with ASTM-A193, A-194, and A-320 whichever is applicable and shall be based on the actual bolting temperature as defined by ASME B31.3 subject to minimum material specifications as follows:

Stud bolts	ASTM A193, Grade B7
Nuts	ASTM A194, Grade 2H

- For CS lines in sour service, bolting grades shall be B7M/2HM.
- For SS lines in sour service bolting grades shall be B8M/8M.
- For Galvanized lines the bolting shall be Hot Dip Galvanized.
- Stud bolts shall be generally used unless otherwise specifically requested by Piping Class.
- Studded connections on piping components shall have the stud holes drilled no deeper than to allow a maximum tapping depth of 1½ times the major thread diameter. Studs shall have the first 1½ threads removed.
- Clearance shall be provided around bolting to permit the use of socket wrenches, spanners and where applicable, bolt torque tensioning equipment.

10.0 PIPING INSTALLATION

This Section gives the criteria covering the installation of piping connected to individual components of the Plant, particularly as regards the problems concerning positioning, accessibility for operation and maintenance, and functionality.

10.1. DISTANCES BETWEEN CENTERS

Minimum spacing between pipe centerlines shall be in accordance with, “Typical Unit Arrangement and Pipe way Layout", and "Pipeline Spacing" Drawings. (Appendix NO.1)

10.2. BRANCH PIPES

- Generally the header branch pipes are positioned:

- In the lower part, in the case of lines conveying liquids. This allows self-drainage, eliminating the risks deriving from stagnation of the product in piping (corrosion, hammering, etc.);
- In the upper part, in the case of lines conveying gas. This eliminates the Possibility of circulation of the related condensates liable to cause erosion phenomena not taken into account when selecting the material for the fluid in question.

- The branch pipes from the cooling water header with lines having a ND ≤ 1-1/2" are to be positioned in the upper part of the same in order to avoid plugging due to dirt, which would prevent the water from flowing to the equipment concerned.

- The coupling of the discharge piping to the blow-down headers are to be positioned in the upper part of the same, and shall be made at 90°, for lines having a ND equal to or smaller than 3", or with an inclination of 45° in the direction of the flow for lines having a ND equal to or greater than 4".

This configuration is necessary for the following reasons:

- Pressure drops have to be limited as far as possible due to the low pressure inside the line;
- The stresses due to pulsations on the couplings shall be reduced to the greatest possible extent.

10.3. POSITIONING

- Large diameter lines (ND > 12") shall be positioned as close as possible to the columns in order to reduce the stresses of the support.

- If for process or stress reasons pipes having ND smaller than 2" are required they should be grouped in bundles with a single support for each bundle.

- It is good working practice to provide a flange/blind flange at the end of the distribution headers of utilities (cooling water, and instrument air, nitrogen) in order to permit the cleaning and blowing of the lines.

10.4. ELEVATIONS

- The blow down headers shall have a minimum slope towards the KO Drums of 1: 500, avoiding pockets. Should this be impracticable, all the necessary measures shall be taken (e.g.: tracing, traps, etc.) to avoid stagnant liquid in the headers.

- In any case these measures shall be agreed upon with Process Dept.

- For economic reasons, when there are changes of elevation and/or direction the following should be provided:
- Piping with ND 4" and less: 2 elbows at 90°;
- Piping with ND 6" and over: 1 elbow at 90° and 1 elbow at 45°.

- In the case of large diameter piping it is necessary to verify that there is no interference between lines.

10.5. PIPE WAYS

- Piping is installed on pipe ways in case of connection between different areas of off-site and process areas where elevation restraints do not exist.

- On pipe ways, the distances between centers for pipes with a ND greater than 30" is calculated considering the possibility of access between them (about 300 mm of net clearance).

10.6. ELEVATIONS

- In addition to what is set out above, the pipes shall be installed with a pipe bottom elevation of 400 mm. This elevation is to be maintained for all process and utility lines, regardless of their Diameter.
- The minimum elevation described above is required to permit the installation (in the lower part of the pipes) of condensate recovery and drain pockets.
- It shall be possible to install the above mentioned pockets at least at some distance from the ground so as permit operations and the relevant maintenance.

10.7. VESSELS

- In order to optimize, from an economic and operating standpoint, the routing of the associated piping, it may be advisable to group the nozzles to which a connection is to be made. To obtain this configuration it is normally necessary to relocate one or more of the equipment nozzles.
- If the relocations should involve nozzles placed under constraint by Process Dept. it is necessary to inform the Department concerned for them to make the proper verifications.

- In general, nozzles can be relocated provided the following constraints of functionality are met:

a) The product inlet nozzle shall be positioned as far as possible from the outlet nozzle;
b) The levels shall preferably be positioned in a calm zone and therefore far from the zone of turbulence created by the product inlet.

10.8. STORAGE TANKS – ATMOSPHERIC AND/OR LOWPRESSURE

- When installing the piping for the subject tanks it is necessary to avoid making direct connections between the tanks and the pipe way (direct connections do not guarantee the flexibility required to solve stress problems of the lines).
- The nozzles concerned must therefore be offset, in respect of the corresponding joint point on the pipe way, to the extent required to assure an elastic connection.
- Suction piping from tanks shall be installed at the minimum elevation, if possible on sleepers or in trenches. It is therefore necessary to avoid the use of stanchions, etc., whose height

exceeds that of the tank suction nozzles, to avoid creating positive pockets on the line which will affect the operation of the pump and prevent the total emptying of the tank.

- Fire-fighting piping conveying mixtures of water and foam liquid shall be installed inside the basin at ground level. This is to limit as far as possible the damage causes to such piping in the event of fire.

- Piping connected to inlet/outlet nozzles for product to/from tanks shall be grouped, as far as possible, in a single manifold. The relevant valves shall be positioned on both sides of the operating walkway, which in turn will be provided close to the foot of the spiral stairway.

- The distance between centers to be maintained between the manifold pipes shall be sufficient to allow access for assembly and maintenance of the valves.

- Piping connected to nozzles for tank bottom drainage shall be positioned taking into account both the need to optimize the route of the buried drain pipes and that of having the related valves within easy reach of the inlet/outlet manifold (see the paragraph above).

10.9. HIGH PRESSURE STORAGE VESSELS

- For safety reasons, only piping that is directly connected to the associated vessels shall be installed in the area assigned for high pressure storage. The above mentioned piping shall be adequately supported considering expansion, contraction, and vibrations requirements.

- Normally, connection to vessels shall be made by means of a single line positioned on the bottom of the tanks. It will be used both for filling, emptying and drainage. When, for particular operating conditions, a return vapor line is required, this shall be connected to the top of the vessel.

- The inlet/outlet piping to products to/from vessels shall be grouped, as far as possible, in a single manifold which, for safety reasons, shall be positioned outside the protection wall.
- In order to reduce as much as possible the risk of leaks, no expansion joints shall be installed on the piping, threaded connections shall not be utilized and the number of flanged connections shall be kept to a minimum.

- A drain shall be provided on the filling and discharge piping. It shall be positioned after the first block valve in the section orientated towards the manifold. The relevant discharge, from which there can be an outlet of inflammable vapors, shall be located in a safe position far from roads, work areas, etc.

- In the case of particular projects requirements (e.g.: drain connections on vessels) not addressed in the previous paragraphs, Process Dept should be consulted in order to agree upon an acceptable solution from the point of view of safety and operability.

10.10. PUMPS

- **Minimum straight length on suction lines of pumps shall be provided according to IPS-E-PM-385.**

- Suction, delivery and auxiliary piping of the pumps shall be installed in such a way as to leave sufficient space for the access of the personnel and lifting equipment needed during maintenance operations. This space shall be, at least, 0.9 m. Moreover, sufficient space shall be left above each pump for removal of the electric motor.

- When installing the pump piping it is necessary to take into consideration the need for periodical maintenance of the hydraulic part and its possible removal. Therefore, connecting the valve directly to the pump nozzle should be avoided, inserting if possible a removable flanged spool. In the case of a line of a piping class that does not permit the use of flanged valves, it should be checked, before inserting the flanged spool, that there are no leakages that might be a source of hazard.

- In the case of vertical installation of suction and delivery pipes, position the relevant shut-off valve so that the elevation of the stem center line is at a minimum elevation of 1800 mm from ground (or working floor) so as not to impair the access to the pump. Should this elevation be exceeded (e.g.: due to the elevation of the nozzle of large pumps) the valves shall be positioned at the minimum possible elevation.

- Independent of the type of assembly used, the maximum operating height of a block valve used for plant operation, must not exceed 2100 mm from ground (or working floor) and for valves located above this height will be operated by chain operated hand wheels (see chapter 10.1).

- In the case of centrifugal pumps with top-top nozzles and with vertical pipe assembly, it is sometimes necessary, for clearance reasons, to ensure a greater spacing for the piping and valves than that provided by the nozzles. In this case the space is achieved by providing an offset on the delivery piping, which is usually a smaller diameter than that of the suction piping.
- Main pumps (defined by Process) suction piping layout and routing with overall dimensions shall be sent to Process Dept. to check the pressure drops.

- In order to avoid the formation of gas/vapor pockets, even small ones, which could impair pump operation, the relevant suction line shall always be as short as possible orienting the eccentric reducer, if required, and installed horizontally, with the flat side upwards.

- A strainer shall always be installed on all the suction lines, positioned between the block valve (gate valve) and the pump nozzle. The type of strainer to be installed is defined in the

relevant P&I D. and will be permanent or temporary type. In the case of temporary strainers the section of piping shall be designed such that it can be easily removed (flanged), avoiding the attachment of fixed supports to the ground or structures.

- Permanent type strainers ("Y" or "T" types) with ND 2" and over shall be installed, if possible, on horizontal sections of pipe and orientated with the removal flange turned downwards to facilitate cleaning and removal of the strainer mesh. If there is not sufficient space under the strainer for such installation, an inclined installation is permissible to a maximum of 45º from the bottom upwards. Moreover, in order to permit disassembly, a drain (to be indicated on P&I D. and on the relevant assembly drawing) shall be provided on the flange.

- A straight section of pipe shall be provided on suction lines of pumps, especially if they have a large delivery (e.g.: large cooling water circulation pumps) to avoid problems of pump cavitations. The length of this straight section is defined by Machinery Dept and by the pump Vendor.

- When the piping arrangement uses, for reasons of space, a 90º elbow directly connected to the suction nozzle connection flange, it should be checked with Machinery Dept whether it is necessary to insert a vortex breaker (cross type) or a baffle, in order to avoid "pre-rotation" of the fluid.

- In case of pumps with double suction, the connection lines to the relevant nozzles should be arranged so as to assure an equal distribution of the fluid.

- In case of pumps conveying liquid gas (LPG, etc.) suitable vents should be provided on the suction lines with long horizontal sections, so as to avoid the gas pockets that would inevitably be formed and that could result in a malfunctioning of the pump. For this purpose, a suitable slope should also be provided, in compliance with that established by Process and Machinery Dept.

- The route of pumps suction pipes from vessels or tanks shall have an elevation that is at least 500 mm lower than that of the nozzles of the relevant tanks, in order to avoid the formation of pockets that prevent the emptying of the tanks and can affect the efficiency of the pumps. In Plant Units, this route shall be preferably maintained at a minimum elevation of 3 m from the ground to allow the passage of personnel and equipment. In this case it should be verified that the nozzle of the connected equipment is positioned at least at this elevation. If the nozzle is found to be at a lower elevation, it is necessary to change the height of the supporting skirt, if possible, or the height of the relevant foundation.
- The check valve that is normally installed on the delivery lines can be provided either in a vertical position, with the flow upwards, or in a horizontal position. The latter solution is adopted when:

  a) It is desired to reduce the elevation of the block valve;

b) The type of valve utilized offers greater operating guarantees when installed horizontally.

- If the check valve is installed in a horizontal position it is also necessary to consider the need to leave sufficient space around the pump for access during maintenance. Therefore, the assembly should be made bearing this requirement in mind, moving the piping outside the pump base plate section.

- A check valve shall be installed on the closed drain piping from the lines and casings of pumps treating hazardous fluids when the related vents and/or drains cannot be discharged into the atmosphere but have to be conveyed to a collection vessel or into the blow-down header. This valve shall be installed at the highest point of the line and as close as possible to the suction equipment or to the blow-down header so as to avoid columns of liquid in the line as these would cause vibrations during product discharge with possible damage to the line and leakage of the fluid.

- A pressure gauge shall be connected to the delivery piping, using the appropriate piping assembly drawing, in a horizontal section between the nozzle and the check valve. This connection can be made directly onto a reducer for lines with a ND equal to or greater than 8" otherwise a pipe spool must be inserted.
- Drain funnels shall be provided at the front of the pump base plate, on the hydraulic side, into which the following will discharge: leakages, drains, water from the frame gutter, cooling water from the bearings (if it has not been recovered), oily discharges, drainages from piping, etc.
- When auxiliary lines are required for the cooling water, flushing, etc., the installation of the related piping should be made on the side of the pump, leaving free space around the same for maintenance and assembly. The primary valves shall be installed near the headers, while the operational valves shall be installed close to the pump. The latter are normally supplied together with the pump.
- Vent pipes connected to blow-down shall be joined into upper section of the header to avoid the possibility of liquids present in the header should drain into the vent lines.

10.11. COMPRESSORS

- Piping in a compressor room shall have the operation valves of the machines aligned on a single bank which, as far as possible, will face the inside of the unit. The alignment shall be made adjacent, or even just outside the walkway, so as to leave sufficient space between the valves and the machines for the passage of personnel. In order to obtain this space without increasing the span of the shelter, a walkway can be installed outside the support columns.
- All the main valves shall be installed at a height that permits easy operability (chapt.11.1) so as to allow rapid action on the Operators part.

- When designing the piping, space shall be left for a compressor local panel board, if required, which shall be located such that it can be viewed whilst the valves are in operation.

- Suction and delivery piping shall be installed at the lowest possible elevation so as to leave the machine as free and accessible as possible. The supports of piping should not be directly connected to centrifugal compressor base plates, in order to avoid possible fracture due to vibration. For the same reason piping connected to reciprocating compressors should not be supported by support structure.

- The suction pipes of each compressor shall be as short as possible so as to avoid the formation of condensate. Therefore, the suction vessel (or surge drum) shall be located, whenever possible, close to the machine, generally next to the compressor room. Pipes are therefore connected to the machine ensuring a slope back towards the separators.

- The recycle valve shall be installed on the working floor (machine operating floor) without creating pockets in the piping. If the shelter is an enclosed one, this valve will be installed on an external platform (at working floor elevation) due to its high noise level.

- Any gas vents provided with valves that discharge into the atmosphere shall be installed outside the shelter.
- Check, the compressor drawings, specification and, if necessary, with Machinery Dept, the need for connection to utilities, such as:

a) Cooling water for cylinder jackets;
b) Cooling water for packing;
c) Cooling water for lubrication system;
d) Seal oil system;
e) Steam for auxiliaries (lubricating and seal oil) turbines;
f) Balance gas;
g) Buffer gas.

10.12. AIR COOLERS

- Unless otherwise indicated, the inlet/outlet manifolds shall be installed vertically so that the lines are self-draining, do not obstruct the upper part of the air cooler (avoid passing over bundles, etc.) and allow the disassembly of the various components (hoods, tube bundles, etc.). Moreover, sufficient clearance shall be left for disassembly of the bundles.

- The length, route and support of the lines between the main header and the cooler nozzles shall be checked in order to avoid not acceptable loads on the nozzles.

11.0 PIPING COMPONENTS INSTALLATION

This section furnishes instructions covering the installation of piping components (valves, orifice flanges, traps, hoses, sample connections, etc.) that have particular positioning requirements to assure safety, functionality, and accessibility for operation and maintenance.

11.1. OPERATION/SHUT-OFF VALVES, MANUALLY ACTUATED

- The subject valves shall be installed so as to assure easy access for operation and maintenance. The recommended installation considers that the valves shall be reached from the ground level or platform. Valves with a ND of 1-1/2" or smaller may also be operated using a ladder.

- In order to avoid possible product leaks and to assure correct functionality, valves will be oriented with the hand wheel upwards. The optimal range for installation goes from a valve with a vertical stem (hand wheel upwards) to a valve with a horizontal stem. The inclination is defined considering that both the hand wheel and the stem shall not obstruct access ways and platforms. The exception to this rule is blow-down lines for which the optimal installation of valves is a valve mounted vertically with the hand wheel downwards. This is to avoid possible plugging of the line due to breakage of internal parts of the valves.

- To assure hand wheel maneuverability, valves with a horizontal stem axis will have an elevation ensuring that the hand wheel bottom is not more than 2 m above the ground or platform level.

- If this value is exceeded, various installation criteria can be followed, such as:

  - Valves with ND 2" and larger: the hand wheels are provided with a chain. In this case the valves will be orientated so that the chain is not in the way. The chain shall reach up to 1 m from the ground or platform level;

  - Valves with ND 1-1/2" and smaller: the valves will be made operable by positioning them close to stairs or ladders, if available, or by means of portable ladders.

- In areas where personnel access is foreseen, the installation of valves provided with chains shall be avoided as much as possible in order not to be in the way and preference shall be given to alternative solutions (e.g.: changing the piping route).
- When a group of valves are operated from a platform, the latter shall be at an elevation that permits access to the hand wheels of the large diameter valves (therefore higher), providing appropriate extensions for any valves whose hand wheels are not accessible.

- Valves provided with a chain or extension will be identified on piping layout in order to allow, from the beginning, easy identification for the relevant Material Take-Off.

- In case of valves that are rarely operated (e.g.: only for unit shutdown) permanent accessibility is not required, and it is sufficient to assure the possibility of access by means of portable ladders or temporary scaffolding (check with Process Dept. which valves fall within this category).

- In order not to jeopardize their functionality, when valves are used at termination points (e.g.: vents, drains, purges, etc.) they will be provided with blind flanges or plugs.

- Valves located underground shall be provided with extension stems or post indicator operators: however, such hand wheels shall not be located in walkways or aisles. Additional requirements are:

  - NRS (non-rising stem) and ISRS (inside screw rising stem) gate valves, along with ball and butterfly valves not in open trenches, but located below grade, shall be provided with service boxes and extension stems which extend a minimum of 1.0 m above grade or above access platform.

  - OS&Y (outside screw and yoke) gate and globe valves not in open trenches, but located below grade, shall be provided with concrete valve boxes or equivalent means to protect the stem threads, packing gland bolts, and flange bolting.

11.2. CHECK VALVES

DELETED

- check valves will preferably be installed horizontally. Check valves can be installed vertically in the case of ND ≤ 6" valves provided the flow is directed upwards. For valves with a ND ≥ 8", installation in a vertical position must be subjected to verification that the pressure inside the line can open the valve clapper.
- Installation in a horizontal or in a vertical position is determined, not only according to the pipe route optimization requirements, but also on the basis of the type of valve construction.

11.3. CONTROL VALVES

- Normally control valves require a control valve set.

This group, in addition to the control valve, comprises:

- The shut-off valves of the control valve;
- The by-pass with the relevant valve;
- Drains with the relevant valves;
- All the components (pipes, flanges, elbows, etc.) necessary for the connection.

- Several installations of control valve sets as well as different solutions for the arrangement of the relevant valves are possible. In all cases the following should be borne in mind:

a) Prefer installations with the control valve mounted on the lower part (which is more accessible);
b) Prefer installations with minimum overall dimensions;
c) Avoid, especially when RJ type flanges are used, installation with the control valve in line between two shut-off valves, which will impair their easy dismounting.

- The control valve sets are installed on a line considering that:

a) all control valves, and the related valves of the group, shall preferably be located on the ground floor so as to make access and control easier for Operators, also to facilitate maintenance work and the use of mobile lifting equipment;
b) when the development of the piping layout makes installation on the ground uneconomic, or when Process Dept has set some constraints for the elevations, the control group shall be positioned so as that the relevant valves are easily accessible from the working floor (structure platforms or slabs);
c) For load capacity reasons, the control groups shall not be installed on columns platforms, except when there are elevation constraints (point b); in this case the loads bearing on the platforms shall be checked.

- The control valve sets will be installed, as far as possible, adjacent to walls, hand rails, pillars, sides of equipment, in order to:

  - interfere as little as possible with the passage ways, maneuvering areas and clearance for maintenance;
  - Protect the control valve and the related actuator.

- When installing valves in control valve sets it is necessary to consider that:

a) The handwheels of shut-off and by-pass valves will be orientated so as not to be in the way of access to front of the set;
b) The control valve shall always be positioned at a pipe bottom elevation of 500mm. This space is required to remove the bottom and actuator without disassembling the valve.
Check in any case with Instrument Dept., on the basis of valve dimensions, that a clearance of at least 300 mm is left from the bottom of the control valve;
c) The control valve sets that are part of an interacting instrumentation system will be grouped so as to concentrate the area of control for Operators and to reduce the lengths of the controls and connections between the various groups;
d) The sizing of the shut-off and by-pass valves, according to the line diameter, shall be those specified on the relevant P&I D.;
e) It is necessary to provide, upstream and downstream of the control valve, two pair of flanges to allow disassembly of the valve when it has been supplied with threaded or socket-welding ends.
In case of reduction nipples, these are positioned between the flanges and the valve so that the smaller threaded end is inserted directly into the valve;
f) It is preferable to install eccentric reducers, when they are required, directly downstream and upstream of the control valve, in order to facilitate drainage of the line and to avoid the formation of deposits;

g) A drain, as shown on the P&I D., shall always be installed upstream of each control valve, more precisely between the first shut-off valve and the control valve. This drain is used to empty the line after the hydraulic test and to depressurise the line whenever it is necessary to disassemble the valve while the unit is in operation;

h) In addition to what is stated in point b), the control valve requires, above the actuator, a clearance of at least 300 mm to permit disassembly of the actuator and of the support bonnet. This space shall be checked with Instrument Dept.

- Pipes connected to control valves shall be supported so as to remain in place in the event of valve disassembly.

- Normally, angle control valve shall be installed with the product inlet in the opposite side to the plug. In some cases (e.g.: injection valves, etc.) the valves are installed with the inlet in the same side as the plug (laterally in relation to the cap). In any case the type of installation required shall be checked with Instrument Dept.

- Three-way control valves shall be installed so that they can be easily removed. Insert, if necessary, a pair of flanges in one of the two horizontal pipes, to be installed after the elbow closest to the control valve.
- Control valves with a local level controller shall be installed so that the indicator instrument is clearly visible.

- In the case of control valves without control sets, a hand wheel for manual operation is normally provided. In this case:

  - check the position of the hand wheel with Instrument Dept;
  - Orientate the valve so that the hand wheel is easily accessible.

- In the case of particular control valves (Mokveld, Ball, Camflex, etc.) the orientation of the valve and of its accessories shall be defined with Instrument Dept.
- When a control valve is installed with a bypass, the upstream isolating valve and the bypass valve must be in the higher class if there is a change of class.

11.4. SAFETY VALVES

- Safety valves will be installed so as to assure easy access for periodical checks, maintenance, or disassembly. Valves will be accessible for fixed or mobile lifting equipment (hoists, monorails, cranes, etc.).
- Spring type valves will be installed with stem in vertical position.

- When the valve discharge is connected to a closed circuit (blow-down), discharge into the header shall be from the top so as to create natural drainage.

- Safety valves will be located as close as possible to the equipment or lines they have to protect. When this is not possible (a distance of more than 3 m), it is necessary to send a sketch with the approximate dimensions of the line route to Process Dept. who will check the need to increase the diameter of the inlet line to the safety valve in order to avoid malfunctioning of the valve due to pressure drops (see API RP 520).

- The pipe spool at the outlet of a safety valve that discharge directly into the atmosphere shall be extended at least 3 m above the floor level of the highest platform or of the highest equipment located within a radius of 15 m, or at 30 m in the case of inflammable products or in presence of naked flames. The pipe spool at the outlet of a safety valve that discharge process liquids, or in any case contaminated liquids, shall be routed to the closest drain funnel.

- Each pipe discharging into the atmosphere shall be provided with a drain hole (ф 10 mm) at the lowest point. In case of hazardous fluids drainage shall be ensured by a ND 3/4" connection extending the relevant pipe to the ground.
- The terminal part of pipes discharging into the atmosphere shall be cut at 45º. If necessary this discharge can be curved so as to direct the discharge away from any equipment located close-by and to send it in the right direction.

- The layout of discharge piping from the safety valve to the blow-down header shall be sufficiently flexible to prevent excessive stress on the valve. Connection to the blow-down header shall be made from the top and have an inclination of 45º in the flow direction.

- Install a thermal expansion relief valve (generally ND 3/4" x 1") in each circuit subject to heating which can be shut-off. This valve shall be provided on each pipe length installed on pipe ways, etc., where there is the possibility of the product, at the liquid state, remaining trapped, for instance, between two block valves. This valve shall discharge into the atmosphere in a safety location. Besides the example above mentioned, a thermal expansion valve is generally provided on branch pipes from tanks that can be shut-off or between the inlet and outlet of an exchanger when both the lines are provided with block valves. In any case, the installation methods, the relevant conditions and compliance with the requirements of the applicable Codes and Standards shall be checked with Process Dept.

- To reduce as far as possible vibrations which can damage the piping, assembly should be designed to anchor the valve to a platform or structure.

- When shut-off valves are involved, these will be installed with the hand wheel horizontal or orientated downwards. Moreover, a drain shall be provided between the shut-off valve and the safety valve. In some cases, when dual safety valves are provided (one spare to the other), the Shut-off valves will be provided with an interlock system (mechanical or with keys) so as a shut-off valve is closed and the other one open (Trans flow type).

11.5. ORIFICE FLANGES AND ANNUBARS

- When installing orifice flanges on piping, always leave sufficient straight lengths upstream and downstream of the orifice flanges to avoid flow turbulence which affects measuring

efficiency. To identify the straight lengths upstream and downstream of a calibrated flange, it is necessary to comply with that indicated in the relevant Instrument Data Sheet.

- When installing an orifice flange it is necessary to have sufficient space to assemble (or disassemble) the connecting pipes to the instrument and for removing the disc. If the fluid conveyed is gas phase the measurement connections in relation to the axis of a horizontal pipe shall be upward, in case of liquid phase they shall be downward. In any case the connections shall be oriented not at 90° as for the horizon but at 45° to avoid settling obstructions.

- An orifice flange can be installed in a vertical pipe, provided there is an upward flow. In case of liquid the flow could be downward; both the cases are to be checked with Instrument Dept.

- Orifice flanges for flow rate control (FIC or FRC) shall be located as close as possible to the related control valve.

- In case of "Annubar" and "Pitot tubes" type instruments, the fittings for connection to the line (as well the coupling to be welded on the line) are supplied together with the instruments. Therefore, the types of connections and sizes should be specified with Instrument Dept.

11.6. SERVICE HOSES

- Service hoses are provided for cleaning and maintenance operations. They are connected by appropriate quick couplings to lines, generally with a ND 1" (25), conveying: (utility air), water (utility water) and, where required, nitrogen (utility nitrogen).

- These lines are generally grouped in a bundle called utility station. This is to allow both a concentration of the necessary utilities and to allow a single support.

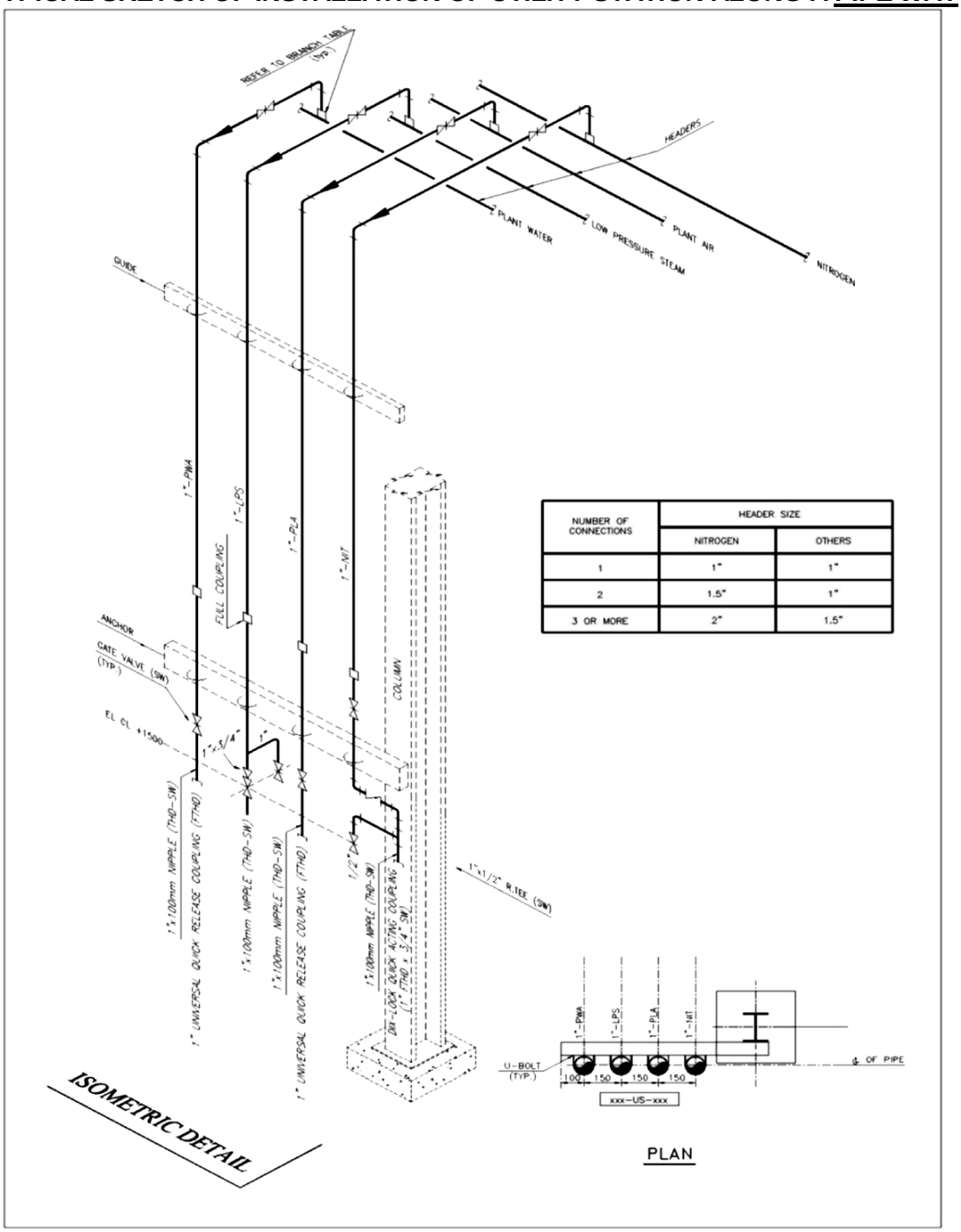
- The utility stations are normally provided in the following areas of the Plant:

  - Off-site area: pump rooms, loading bays, effluent treatment, etc.
  - On-site area: compressor houses, etc.

- The utility stations are positioned so as to be able to cover the required area with hoses whose length (radius of action) is normally 15 m.

- In case nitrogen is needed, the connector shall have different size and facing with the air connector.

TYPICAL SKETCH OF INSTALLATION OF UTILITY STATION ALONG A PIPE WAY



NUMBER OF CONNECTIONS	HEADER SIZE	
	NITROGEN	OTHERS
1	1"	1"
2	1.5"	1"
3 OR MORE	2"	1.5"

11.7. SAMPLE CONNECTIONS

- Sample connections can be normal or cooled type. The type is normally specified on the relevant P&I D.

- Branches from the main line can be made on both vertical and horizontal sections of the same. In the case of a branch pipe from a horizontal section, this can be made from the top or side, preferably the former, branch pipes from the bottom are not acceptable as they could convey deposits and condensates, thus distorting the results of measurements and jeopardizing the functionality of apparatus. For the same reason branch pipes cannot be made on dead end sections, and the length of connection to the sample point shall be as short as possible.

- Whenever possible, try to group the sample connections as far as allowed by the permissible pressure drops for the reasons given in the previous paragraph.

11.8. LEVELS AND INSTRUMENTS

- Level gauges shall preferably be positioned and orientated so that they are visible and accessible from the ground or from permanent platforms. If the valves or level instrument stand pipe are higher than the working floor or the operating elevation by 2100 mm, a fixed vertical ladder shall be provided. In this case the maximum distance to be considered between the ladder and instrument axes, or the valve hand wheel axis, is 800 mm. Level gauges shall never be installed outside walkways.

- All pressure and temperature taps shall be operable, visible and accessible from the ground, permanent platforms or, if the taps are above an elevation of 2100 mm, a portable vertical ladder shall be provided.

- When establishing the orientation of a temperature tap, it should be borne in mind that it is necessary to leave a free space of about 600 mm (or more if required) for pulling off the thermocouple.

- About the location of the instruments (pressure, temperature, level, flow rate), consideration is given to the requirement of being able to read the related values from the associated control valve.
- For all the other instruments installed on line (meters, rotameters, etc.) there are no particular piping installation requirements. However the instruments shall always be accessible and visible from the ground or from permanent platforms.

12.0 MISCELLANEOUS

12.1. PIPING

- Piping routes shall be as short as possible and contain the smallest number of connections, particularly in the following cases:

  a) Large diameter lines in alloy and/or stainless steel;

  b) Pump suctions;

  c) Suction and delivery of compressors;

  d) Transfer line;

  e) Vapor line;

  f) Manifold of air coolers.

- Whenever possible, piping shall be installed so as to be self draining to the equipment, avoiding the formation of pockets and dead points.

- When structures are utilized, lines shall be positioned as close as possible to these structures so as to facilitate their support.

- Provide suitable points either flanges or couplings so as to allow easy assembly.

- Vents and drains shall be installed in the high points (named positive pockets) and in the low points (negative pockets) of lines, respectively. The type of the vents and drains are defined in the Project Typical Assemblies Specification.

- When designing piping (especially when weld heat treatment is required) ensure that, between two circumferential welds, a minimum distance equal to four times the pipe thickness. However ideally the spool thus obtained should not be less than 100 mm.

- When designing plastic (PVC) or fiberglass (RTR) piping it should remembered that all the components are prefabricated with sizes defined by the Manufacturer and therefore the routes and lengths shall take these requirements into account. Moreover, it is necessary to consider the particular requirements for performing the connections/joints to equipment and instrumentation, because it is not possible to manufacture on site any special parts necessary which should have been defined (and purchased) during the development of the detailed engineering.

- In case of internal coated piping, the pipe route shall to define bearing in mind that the pipes shall be prefabricated in flanged spools of a suitable length for oven annealing. For this reason, after defining the layout complete with dimensions and elevations, it is necessary to

prepare the isometrics of the lines under consideration (with all dimensions, connections to equipment/machines and with the relevant instruments).

- When a pipe of a given class is connected to a pipe of a higher class, the portion of line extending from the connection up to and including the first valve installed shall be made in the higher class.

12.2.1 Crossings

- Pipes that penetrate walls, tank dikes or building roofs shall pass through appropriate sleeves, which shall be large enough for seal filling.

- Wall penetrations in the case of tanks, basins, etc. for pump suction pipes, etc., are normally performed by providing a spool pipe to be grouted in concrete and provided with a flange insert. In this case appropriate stress analysis of connected piping shall be performed.

- Piping road crossing can be made by:

  a) Concrete Culvert.

  b) Steel or concrete bridge.

  b) Pipe sleeves.

- Crossing with concrete bridges are provided when the pipe track is of considerable size (e.g.: pipe ways, unit battery limits, etc.). In this case there is no particular piping design requirement except that if the bridge is too wide it will be necessary to provide intermediate piers which should be taken into account in the definition of the pipe way width.

- Crossing with pipe sleeves are defined for each particular project. The sleeves shall have an adequate diameter to permit the erection and sliding of the line. The distance between centers is to be verified each time leaving a maximum distance of 25 mm between the external surfaces of the sleeves. Moreover, it is necessary to check the thickness of the ground cover according to the loads that will transit, in order to avoid possible crushing.

12.2.2 Utilities distribution

- Utilities distribution (water, air, nitrogen) to the users is made according to the type of utility station required, as specified in the following points.

- When a service is required, for process reasons, continuously, the connection between the utility lines and the process lines and/or equipment shall be permanent and shall be made with the shut-off and check valves installed close to the branches, in the case of process lines, or connected directly to the nozzles, in the case of equipment and/or machines. Moreover, the following should be borne in mind when installing the above mentioned lines:

a) The need to ensure easy access (for operation and maintenance of valves);
b) Functionality requirements (valves shall be positioned below the process product level);

c) Operating requirements (for emptying purposes, a drain positioned upstream of the valves shall be provided).

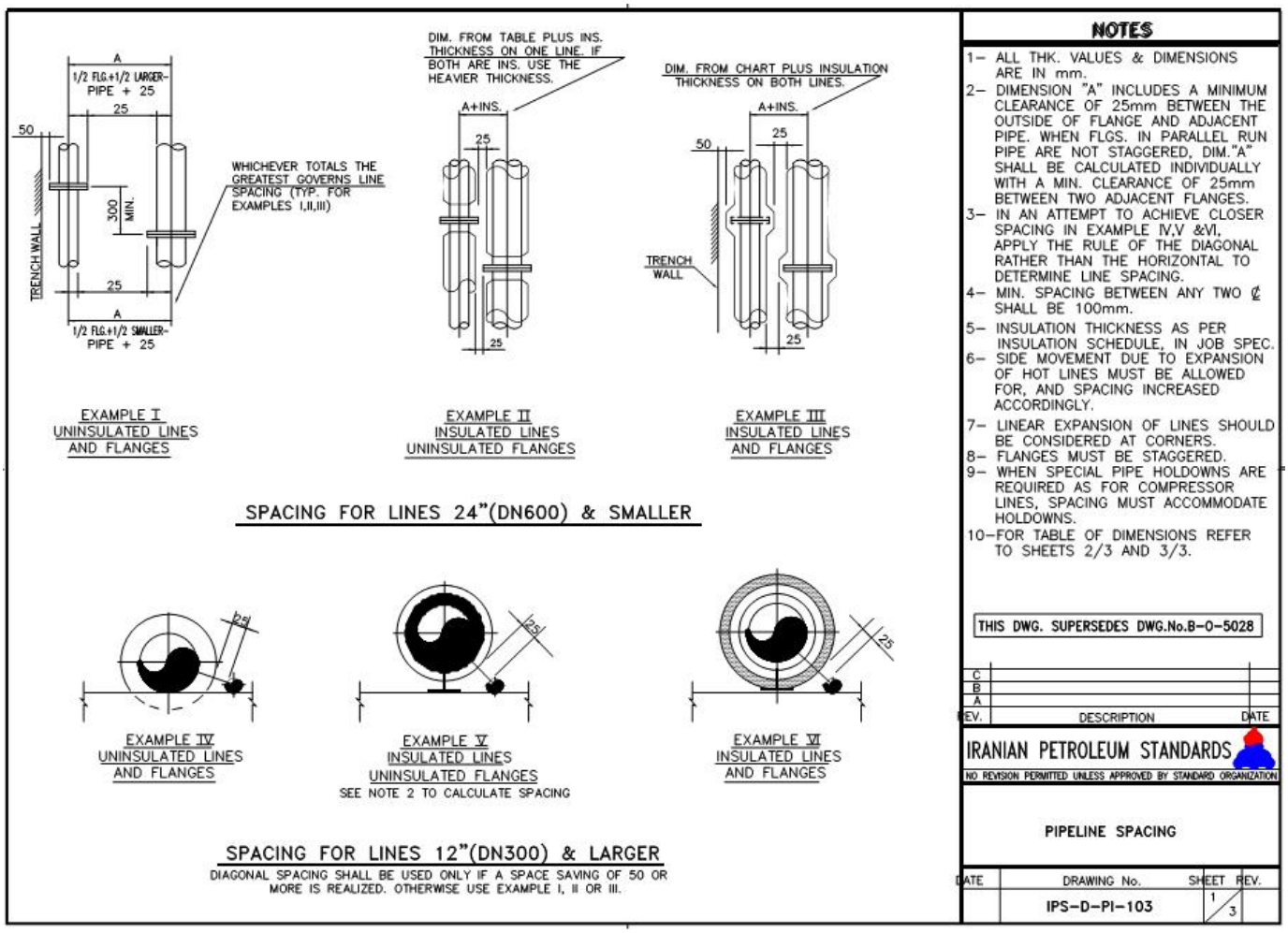
- However, when utilization is discontinuous, the connection between the utility lines and the process lines and/or equipment shall not be permanent and shall be made by flexible hoses, or by flanged spools, or by rotating flanged elbows, between the shut-off valves and the users. If, even in this case, a permanent connection is requested by P&ID, this shall be made according to the method described in previous point.

12.2. EYE BATHS AND SAFETY SHOWERS

- The layout arrangement of eye baths and safety showers is derived according to the possible sources of contamination present in a Plant (e.g.: in the proximity of acids and chemical handling areas, in the proximity of ammonia pumps, etc.). In any case the detailed definition is checked by HSE and Process Dept.

Appendix NO.1

PIPELINE SPACING



NOTES

1- ALL THK. VALUES & DIMENSIONS ARE IN mm.
2- DIMENSION "A" INCLUDES A MINIMUM CLEARANCE OF 25mm BETWEEN THE OUTSIDE OF FLANGE AND ADJACENT PIPE. WHEN FLGS. IN PARALLEL RUN PIPE ARE NOT STAGGERED, DIM."A" SHALL BE CALCULATED INDIVIDUALLY WITH A MIN. CLEARANCE OF 25mm BETWEEN TWO ADJACENT FLANGES.
3- IN AN ATTEMPT TO ACHIEVE CLOSER SPACING IN EXAMPLE IV,V &VI, APPLY THE RULE OF THE DIAGONAL RATHER THAN THE HORIZONTAL TO DETERMINE LINE SPACING.
4- MIN. SPACING BETWEEN ANY TWO ℄ SHALL BE 100mm.
5- INSULATION THICKNESS AS PER INSULATION SCHEDULE, IN JOB SPEC.
6- SIDE MOVEMENT DUE TO EXPANSION OF HOT LINES MUST BE ALLOWED FOR, AND SPACING INCREASED ACCORDINGLY.
7- LINEAR EXPANSION OF LINES SHOULD BE CONSIDERED AT CORNERS.
8- FLANGES MUST BE STAGGERED.
9- WHEN SPECIAL PIPE HOLDOWNS ARE REQUIRED AS FOR COMPRESSOR LINES, SPACING MUST ACCOMMODATE HOLDOWNS.
10- FOR TABLE OF DIMENSIONS REFER TO SHEETS 2/3 AND 3/3.

THIS DWG. SUPERSEDES DWG.No.B-0-5028

REV.	DESCRIPTION	DATE
C		
B		
A		

IRANIAN PETROLEUM STANDARDS

NO REVISION PERMITTED UNLESS APPROVED BY STANDARD ORGANIZATION

PIPELINE SPACING

DATE	DRAWING No.	SHEET	REV.
	IPS-D-PI-103	1/3	

NPS	DN	RATING	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	PIPE SIZE / FLANGE SIZE
1"	25	150#	100														
		300#	110														
		600#	110														
1 1/2"	40	150#	110	110													
		300#	120	130													
		600#	120	130													
2"	50	150#	120	130	140												
		300#	130	140	140												
		600#	130	140	140												
3"	80	150#	140	150	150	170											
		300#	150	155	160	180											
		600#	150	155	160	180											
4"	100	150#	160	170	170	190	200										
		300#	170	180	190	200	210										
		600#	180	190	195	210	220										
6"	150	150#	190	190	200	210	230	250									
		300#	200	210	220	230	245	270									
		600#	220	230	235	250	260	290									
8"	200	150#	220	230	230	245	255	285	310								
		300#	240	240	250	270	280	300	330								
		600#	255	260	265	280	295	320	345								
10"	250	150#	250	255	260	280	290	320	340	370							
		300#	270	280	280	295	305	335	360	390							
		600#	300	305	310	325	340	365	390	420							
12"	300	150#	285	295	300	315	325	355	380	410	435						
		300#	305	310	320	330	345	370	395	425	450						
		600#	325	330	335	350	365	390	415	445	470						
14"	350	150#	310	320	325	340	355	380	405	435	460	470					
		300#	335	345	350	365	380	405	430	460	485	495					
		600#	345	355	360	375	385	410	440	470	495	505					
16"	400	150#	345	350	355	370	385	410	435	470	495	505	530				
		300#	370	375	380	395	410	435	460	495	520	530	555				
		600#	385	395	400	415	425	455	480	510	535	550	575				
18"	450	150#	360	370	375	390	400	430	455	485	510	520	550	575			
		300#	400	410	415	430	440	465	495	525	550	560	585	610			
		600#	415	425	430	445	455	480	510	540	565	575	600	630			
20"	500	150#	395	400	405	420	435	460	485	515	540	555	580	605	630		
		300#	430	440	445	460	470	500	525	555	580	590	620	645	670		
		600#	450	460	465	480	490	515	545	575	600	610	635	665	690		
24"	600	150#	450	460	465	480	490	515	545	575	600	610	635	660	690	740	
		300#	500	510	515	530	540	565	590	625	650	660	685	710	740	790	
		600#	515	520	525	540	555	580	605	635	660	675	700	725	750	800	
FLANGE SIZE			25	40	50	80	100	150	200	250	300	350	400	450	500	600	DN
PIPE SIZE			1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	NPS

DIMENSION "A"

NPS	DN	RATING	FLANGE SIZE
1"	25	150#	1"
		300#	
		600#	
1 1/2"	40	150#	1 1/2"
		300#	
		600#	
2"	50	150#	2"
		300#	
		600#	
3"	80	150#	3"
		300#	
		600#	
4"	100	150#	4"
		300#	
		600#	
6"	150	150#	6"
		300#	
		600#	
8"	200	150#	8"
		300#	
		600#	
10"	250	150#	10"
		300#	
		600#	
12"	300	150#	12"
		300#	
		600#	
14"	350	150#	14"
		300#	
		600#	
16"	400	150#	16"
		300#	
		600#	
18"	450	150#	18"
		300#	
		600#	
20"	500	150#	20"
		300#	
		600#	
24"	600	150#	24"
		300#	
		600#	
RATING	DN	NPS	

FIGURE "2"

FIGURE "1"

NOTES

1-SEE NOTES ON DRAWING No. IPS-D-PI-103 SH.1 OF 3

REV.	DESCRIPTION	DATE
C		
B		
A		

IRANIAN PETROLEUM STANDARDS

NO REVISION PERMITTED UNLESS APPROVED BY STANDARD ORGANIZATION

PIPELINE SPACING
150#, 300# & 600#

DATE	DRAWING No.	SHEET	REV.
	IPS-D-PI-103	2/3	

DIMENSION "A"

NPS	DN	RATING	25 (1")	40 (1 1/2")	50 (2")	80 (3")	100 (4")	150 (6")	200 (8")	250 (10")	300 (12")	350 (14")	400 (16")	450 (18")	500 (20")	600 (24")
1"	25	900#	120													
		1500#	120													
		2500#	125													
1 1/2"	40	900#	135	140												
		1500#	135	140												
		2500#	145	150												
2"	50	900#	150	160	165											
		1500#	150	160	165											
		2500#	160	170	175											
3"	80	900#	165	170	175	190										
		1500#	175	185	190	205										
		2500#	195	205	210	225										
4"	100	900#	190	195	200	215	230									
		1500#	200	205	210	225	240									
		2500#	220	230	235	250	260									
6"	150	900#	235	240	245	260	275	300								
		1500#	240	245	255	270	280	305								
		2500#	285	290	300	315	325	350								
8"	200	900#	280	285	290	305	320	345	370							
		1500#	285	290	300	315	325	350	380							
		2500#	320	325	335	350	360	385	415							
10"	250	900#	315	325	330	345	355	385	410	435						
		1500#	335	340	350	365	375	400	430	455						
		2500#	375	380	390	405	415	440	470	495						
12"	300	900#	350	355	360	375	390	415	440	470	495					
		1500#	380	385	395	410	420	445	475	500	525					
		2500#	425	430	435	450	465	490	515	555	570					
14"	350	900#	365	370	375	390	405	430	455	485	510	525				
		1500#	420	425	430	445	460	485	510	540	565	580				
16"	400	900#	400	405	410	425	435	465	490	515	540	555	580			
		1500#	455	465	470	485	495	525	550	575	600	615	640			
18"	450	900#	440	445	450	465	475	505	530	555	580	600	625	650		
		1500#	500	505	515	530	540	565	595	620	645	660	685	710		
20"	500	900#	475	480	485	500	510	540	565	590	615	635	660	685	710	
		1500#	535	540	550	565	575	600	630	655	680	695	720	745	770	
24"	600	900#	565	570	575	590	605	630	655	685	710	725	750	775	800	850
		1500#	625	635	640	655	665	695	720	745	770	790	815	840	865	915
FLANGE SIZE / PIPE SIZE		DN	25	40	50	80	100	150	200	250	300	350	400	450	500	600
		NPS	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"

PIPE SIZE NPS	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	RATING	DN	NPS (FLANGE SIZE)
DN	25	40	50	80	100	150	200	250	300	350	400	450	500	600			
	120	125	130	145	160	185	210	240	265	280	305	330	335	405	900#	25	1"
	120	125	130	145	160	185	210	240	265	280	305	330	355	405	1500#		
	125	130	135	150	165	190	215	245	270	285	310	335	360	410	2500#		
		140	145	160	175	200	225	255	280	295	320	345	370	420	900#	40	1 1/2"
		140	145	160	175	200	225	255	280	295	320	345	370	420	1500#		
		150	160	175	185	210	240	265	290	305	330	355	380	435	2500#		
			165	180	190	220	245	270	295	310	335	365	390	440	900#	50	2"
			165	180	190	220	245	270	295	310	335	365	390	440	1500#		
			175	190	200	230	255	280	305	320	345	375	400	450	2500#		
				190	205	230	255	285	310	325	350	375	400	450	900#	80	3"
				205	215	245	270	295	320	340	365	390	415	465	1500#		
				225	235	265	290	315	340	355	380	410	435	485	2500#		
					230	255	280	310	335	350	375	400	425	475	900#	100	4"
					240	265	290	320	345	360	385	410	435	485	1500#		
					260	290	315	340	365	380	405	435	460	510	2500#		
						300	325	355	380	395	420	445	470	520	900#	150	6"
						305	335	360	385	400	425	450	475	530	1500#		
						350	380	405	430	445	470	495	520	575	2500#		
							370	400	425	440	465	490	515	565	900#	200	8"
							380	405	430	445	470	495	520	575	1500#		
							415	440	465	480	505	530	555	610	2500#		
								435	460	475	500	530	555	605	900#	250	10"
								455	480	495	520	545	570	625	1500#		
								495	520	535	560	585	610	665	2500#		
									495	510	535	560	585	635	900#	300	12"
									525	540	565	590	615	670	1500#		
									570	585	610	635	660	710	2500#		
										525	550	575	600	650	900#	350	14"
										580	605	630	655	705	1500#		
											580	610	635	685	900#	400	16"
											640	670	700	745	1500#		
												650	675	725	900#	450	18"
												710	735	790	1500#		
													710	760	900#	500	20"
													770	825	1500#		
														850	900#	600	24"
														915	1500#		

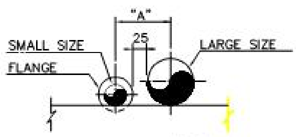


FIGURE "2"

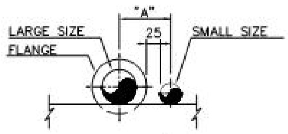


FIGURE "1"

NOTES

1-SEE NOTES ON DRAWING No. IPS-D-PI-103 SH.1 OF 3

REV.	DESCRIPTION	DATE
C		
B		
A		

IRANIAN PETROLEUM STANDARDS

NO REVISION PERMITTED UNLESS APPROVED BY STANDARD ORGANIZATION

PIPELINE SPACING
900#,1500# & 2500#

DATE	DRAWING No.	SHEET	REV.
	IPS-D-PI-103	3/3	