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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.

COMPANY:	National Iranian South Oilfields Company (NISOC)
PROJECT:	Binak Oilfield Development – General Facilities
EPD/EPC CONTRACTOR:	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 EPC CONTRACTOR and approved by GC & COMPANY (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 COMPANY rather than by an EPC/EPD CONTRACTOR, supplier or VENDOR.
MAY:	Is used where a provision is completely discretionary.

2.0 SCOPE

This Specification is intended to govern the Layout, Design, and development of process and utility piping system. The number and extent of piping system to be provided in the plan shall be as per the engineering P&ID and plot plan.

It shall be recognized that this specification shall not cover for every requirements which may arise in plant design and operation, therefore cases not specially covered in this specification

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shall be addressed in line with good engineering practices. It shall be used in conjunction with data/requisition sheets for present document subject.

3.0 NORMATIVE REFERENCES

3.1 LOCAL CODES AND STANDARDS

- IPS (IRANIAN PETROLEUM STANDARD)
- IPS-E-PR-190(1) Engineering Standard for Layout and Spacing
- IPS-E-PR-200 Basic Engineering Design Data
- IPS-E-PR-230(1) Piping & Instrumentation Diagrams
- IPS-E-PI-240(2) Engineering Standard for Plant Piping Systems
- IPS-D-PI-103 Pipe line spacing
- IPS-D-PI-102 Typical unit arrangement and pipe rack layout
- IPS-D-PI-129 Miter bends

3.2 INTERNATIONAL CODES AND STANDARDS

- B16.5 Steel Pipe Flanges and Flanged Fittings
- B16.9 Factory-Made Wrought Steel Butt-welding Fittings
- B16.10 Face-to Face and End-to-End Dimensions of Ferrous Valves
- B16.11 Forged Steel Fittings, Socket-Welding and Threaded
- B16.20 Metallic Gaskets for Pipe Flanges-Ring Joints, Spiral-wound and Jacketed
- B16.21 Non-Metallic Gaskets for Pipe Flanges
- B16.34 Valves, Flanged and Butt-welding End-Steel, Nickel Alloy and Other Special Alloys
- B31.3 Process Piping
- B31.1 Power Piping
- B16.47 Large diameter steel flange NPS26 through NPS 60
- B16.36 Orifice flanges class 300, 600, 900, 1500, and 2500.
- B36.10 Welded and seamless wrought steel pipe

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- B36.19 Stainless steel pipe
- **API** The following standards shall be added:
API 6A
- API 6 IPS-C-SF-550 Application Standard for Safety Boundary Limit and end
- API 6 NISOC S5L-9002 5000/3000 API OIL WELL PRODUCTION
- API 6 WELLHEAD FITTINGS- 6"
- API 6 welding ends.
- API 610 Centrifugal pumps for petroleum heavy duty chemical and gas industries.
- API 617 Centrifugal compressor for petroleum, chemical and gas industries.
- API 661 Air cooler heat exchanger
- API 594 Check valves wafer, wafer-lug and double flanged type.
- API RP-520 Sizing, selection and installation of pressure relieving devices on refineries
- API RP-521 Guide for pressure, relieving and depressurizing
- API 5L Specification for line pipe
- NFPA
- NFPA-30 Flammable and combustible liquid code
- NFPA-56 Natural gas and combustion liquid air and ventilation of gas fired appliances.
- **AWWA**
- C-207 Steel pipe flanges for water works services sizes 4" through 44"
- C-504 Rubber seated butterfly valves.
- **ASME/NEMA**
- SM-23 Steam turbine for mechanical drive series
- **NACE**
- MR-0175 Sulphuric stress cracking resistant metallic materials for oil fields equipment's

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- TM-0177 Laboratory testing of metals for resistance of sulphuric stress cracking in H2S environment

3.3 THE PROJECT DOCUMENTS

- BK-GNRAL-PEDCO-000-PR-DB-0001 Process Basis of Design

3.4 ENVIRONMENTAL DATA

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

4.0 DESIGN PROCEDURE

The Design of Piping is characterized by two successive phases as follows:

4.1 BASIC ENGINEERING DESIGN

The following documents are minimum requirements for piping design in this stage.
(Reference shall be made to IPS-E-PR-200)

- Plot Plan and/or Equipment Layout (IPS-E-PR-190)
- Piping and Instruments Diagram (IPS-E-PR-230)
- Piping Specifications Relating to individual project.
- Line Identification List (IPS-E-PR-308)

4.2 DETAIL ENGINEERING DESIGN

4.2.1. Layout for erection and detailed piping drawings for construction shall be produced during this stage. (Reference is made to IPS-E-PR-260, Clause 6.4.4, Piping).

4.2.2. Detail design of piping shall include but not limited to the following:

- a) Final (detailed) P&ID (Piping & Instrument Diagram).
- b) General plot plan
- c) Unit plot plan or equipment layout
- d) Above ground piping layout.
- e) Underground piping and foundation layout.
- f) Piping plans (erection drawings)
- g) Isometric drawings.

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- h) Line identification list.
- i) M.T.O. (Material Take Off).
- j) Piping material specification.
- k) Pipe support schedule
- l) Stress analysis calculation.
- m) Tie-in diagrams

4.2.2.1. Piping and instrumentation diagram (P&ID)

The P&ID shall be completed in accordance with IPS-E-PR-230.

The following items shall be considered and shown in the P&ID.

- i) Data and information of equipment.
- ii) Line identification.
- iii) Nozzle's position and size, for vessels and towers.
- iv) Type of valves.
- v) Vents, drains and relief systems for lines and equipment.
- vi) Insulation and tracing on lines.
- vii) Pipe class (wall thickness and material).
- viii) Control systems and loops (Instrumentation).

The Utility Flow Diagram (UFD) is the type of P&ID that represents the utility systems within a plant and shows all equipment and piping in respect of utilities (water, air, steam,).

4.2.2.2. Overall plot plan

Overall plot plan shall be based on the following:

- Safety distance between two blocks/Unit as per NFPA
- Approach around the plant by road or open area.
- Units/Process block to be arrange with process sequence.
- Process and storage unit to be planed separately with construction and safety requirement.

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- Flare location should be finalized on the base of prevailing wind direction and preferably should be at the boundary of the plot.
- Construction and erection for heavy equipment's.
- Arrangement of main pipe rack which meets requirement of the all units.

The following items shall be shown in plot plan:

- Battery limits of complex (Area boundary).
- Geographic, conventional or plant north.
- Coordinates of main roads, process units, utility units,
- Buildings, storage tanks and main pipe rack.
- Location of flares and burn pit.
- Direction of prevailing wind.
- Plant elevation.

The arrangement of unit's areas, storage areas, buildings and access for shipment to be provided within the plant, shall be decided on the base of the following factors:

- Soil characteristics.
- Main road or rail access ways.
- Location of pipelines to and from plant.
- Direction of prevailing wind.
- Local law and regulation which may affect the location of units and storage facilities.
- Natural elevation for location of units and equipment (such as storage tanks, waste water unit, oil/water separator, etc.).

The units shall be separated by roads. Major roads shall have minimum width of 6m with maximum length of 400 m and the minor roads shall have a minimum width of 4m. Minor roads shall not be in an area classified as zone 0 or 1.

A plant may contain one or several process units. Where any unit processing flammable fluids and may be operates independently (i.e. one unit may be shut down with others in operation). The minimum spacing between equipment on the two adjacent units shall be at least 20m.

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For units processing flammable fluids, the central control building shall be located adjacent to the road. This building shall not be located in any area classified as zone 0 to 1.

Piping system shall be designed to provide possibility of replacement of corrosion monitoring devices by "retriever" without any clash with other piping or equipment elements. All required preparations such as stairs, platforms and so on shall be considered for safe replacements of mentioned devices.

Minimum 10 meters distance shall be considered between chemical injection point and corrosion monitoring devices of a line pipe.

5.0 DESIGN PHILOSOPHY / CRITERIA GENERAL

5.1 EQUIPMENT LAYOUT

5.1.1 BASIS OF EQUIPMENT LAYOUT

Equipment layout shall be based on the following data.

1. P & ID'S
2. Equipment Data sheets
3. Prevailing Wind direction
4. Overall Plot Plan/Site plan
5. Site Data

5.1.2 BASIC OBJECTIVE

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The basic objective of the spacing design criteria given in this specification are as follows.

1. To minimize involvement of adjacent facilities in fire.
2. To permit access for fire fighting.
3. To ensure that critical emergency facilities shall be accessible for operation to perform emergency shutdown action in the event of a fire or explosion.
4. To segregate high risk facilities or equipment from less hazardous operation.
5. To permit by plant personnel or normal operation and maintenance of Equipment.
6. To minimize equipment damage from fire or explosion to the immediate area.

5.1.3 DEVELOPMENT OF EQUIPMENT LAYOUT

The following aspects shall be considered during development of equipment layout.

- a. Process Requirement – i.e. proper interconnection between equipments is as per the P&ID's to achieve the intended process parameters.

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- b. Economy of Piping material – Minimize the quantity of costly piping.
- c. Erection and construction requirements.
- d. Erection scheme and schedule of all equipment shall be considered during equipment layout to have smooth erection mainly in case of tall columns, heavy equipments like Compressors and reactors, approach roads for cranes / derrick for lifting and positioning the columns & reactors.
- e. Pumps shall be located as close as possible to the suction vessels in order to realize short test possible run of the suction lines.
- f. For heat exchangers located under the steel structure or pipe rack, overhead clearance shall be provided for maintenance by mobile crane, however if the mobile crane dose not have access , maintenance beam with lifting hook shall be provided above the exchanger.
- g. Operation and Maintenance Requirement.
 - Overhead and Side clearances for exchangers and pumps
 - Provision of exchangers tube bundle pulling area
 - Horizontal & overhead clearances for easy movement of working personnel.
 - Provision of crane for compressors.
 - Provision of catalyst loading / unloading facilities.
 - Provision of crane approach for air coolers / cooling towers.
- h. Similar equipment grouping – All exchangers, pumps etc shall be grouped together for convenience of maintenance and safety wherever feasible taking process requirement in account.
- i. The technological structures shall be interconnected for easy movement of operational personnel.
- j. Turning radius for roads shall allow adequate space for mobile equipments to clear supports and equipments.

5.1.4 PIPE RACK

In general, equipment layout shall be prepared considering straight pipe rack, however other shapes also can be considered.

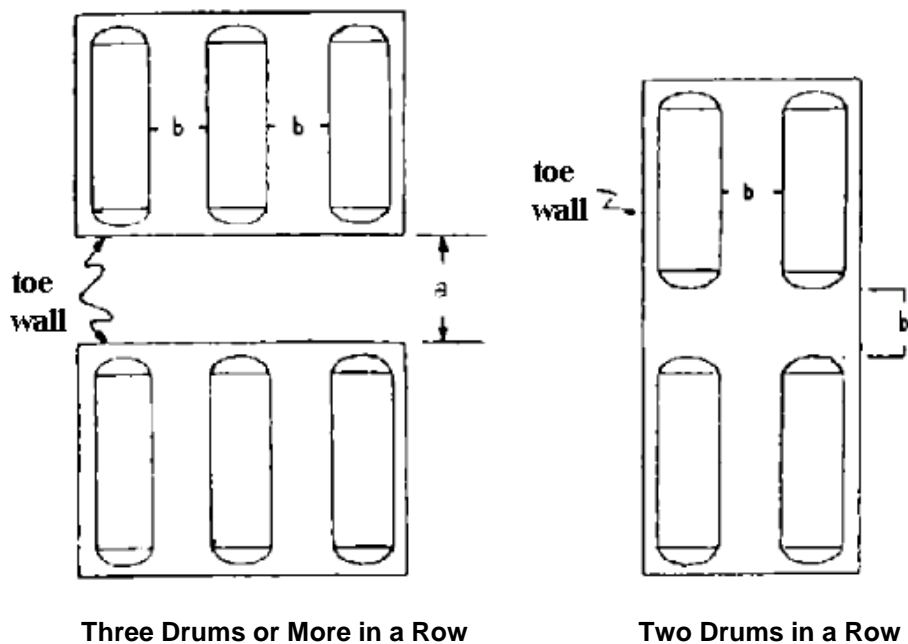
Except for special cases minimum width of pipe rack shall be 6 m. The width of pipe rack shall be designed to accommodate all pipes involved plus 20% space for future expansion or modification. Where the pipe rack support air coolers, the preferred width shall be the width of air cooler.

5.1.5 HORIZONTAL VESSELS

The horizontal vessels shall be laid perpendicular to pipe rack. For clearance between horizontal vessel shells refer to figure below.

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a = Sufficient distance to permit access
by fire fighting equipment
b = One shell diameter of larger vessel



SPACING BETWEEN HORIZONTAL VESSELS/DRUMS

5.1.6 PUMPS

Wherever practicable pumps shall be arranged in rows, with the common center line of the discharge away from the centerline of the rack column. In general pumps shall be kept in open. Pumps shall be located outside the pipe rack with motor towards the centerline of the rack and motor cable entry shall be on the same side. For large pumps(above 22.5 kw), 1.5 m should be considered.

Pump casing and base drain shall be as per respective P&ID.

Pumps which are susceptible to fire and pumps for which specific notes are given in P&ID shall be housed accordingly.

All pumps not open to sky with motor rating ≥ 55 kw shall be provided with monorail. No monorail should normally be provided for pumps outside rack and sufficient space below rack shall be available for pump maintenance.

5.1.7 EXCHANGERS

Shell and tube type exchangers may have a removable shell cover with flanged head.

Tube pulling or rod cleaning area must be allowed at the channel end, this shall be minimum tube length plus 2000mm from the channel head

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and a minimum clearance of 1000 mm between heat exchanger shells shall be considered.

5.1.8 COMPRESSOR

In general compressors are kept under shed. When compressors are kept under shed, side are fully open for the low shed or partially closed from top for high shed to avoid accumulation of heavier gases in the shed. Layout of the compressors shall facilitate maintenance space for removal of motor, piston etc.

Intercoolers, knockout pots and after coolers may be kept outside the shed, but near to compressor house.

5.2 CLEARANCE AND ACCESSIBILITY

5.2.1 CRANE ACCESS & TUBE BUNDLE PULLING

Equipment, structures shall be arranged to permit crane access to service air coolers, compressors and exchangers. All exchanger tube bundles shall be "jacked out" against shell, a clear space for tube bundle removal shall be provided.

5.2.2 ACCESS TO PUMPS

Clear access of 3500mm vertically and 4000mm horizontally shall be provided centrally under main pipe ways for small mobile equipment to service pumps, wherever these are put under pipe ways with prior specific approval pumps outside rack shall be approachable by crane.

5.2.3 LAYOUT & ACCESS REQUIREMENTS FOR PLATFORMS (LADDERS & STAIRS)

Two means of Access shall be provided for large elevated structures.

Platforms, ladders and stairways shall be minimum consistent with access and safety requirements.

Minimum clearance shall be as indicated in APPENDIX-A

Platforms will be provided for manhole access when the centre line of manhole above 3.6 M from grade, else shall be accessed by mobile ladders or stool.

5.2.4 STAIR ACCESS TO PLATFORMS

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The stair access shall be provided in the following cases:

- The top platform of the structure is located 10M and over above the ground.
- The platform for equipment which require frequent opening or and closing of some part once or more per day.

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- The platform on which equipment or instrument requiring operation at everyday.

5.2.5 LADDER ACCESS TO PLATFORMS

Ladder access is required if:

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- The platform with stair requires other escape way.
- Platform height is 1500mm and above wherever though frequent operation is required.
- Platform attached directly to equipments.

5.3 DESIGN CRITERIA

5.3.1 Operating Conditions

Normal design conditions of pressure and temperature will be most severe conditions expected to co-exist under usual long term operating conditions. Design temperature will be usually the maximum fluid temperature.

Usual operation conditions do not include more severe temporary conditions such as those incidentals to start up steam out or abnormal operation.

The thickness of pipe and other components not having specific pressure rating shall be determined using the piping design conditions as per IPS-E-PI-240(2) and ASME B31.3.

The manufacturers will allowance as well as mechanical allowance for thread or groove depth shall be included in determining the minimum required thickness for pressure containment.

5.4 BASIS OF PIPING

5.4.1 BASIS OF UNIT PIPING

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- Piping & Instrument diagram(P&ID)
- Equipment layout/Unit plot plan
- Equipment data sheet & setting plan
- Line list
- Instrument data sheet
- Structural & building drawing
- Topography of the plant
- Piping material Specification
- Overall plot plan

	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض و ابنیه تحت الارض</p> <p>عمومی و مشترک</p>							
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5.4.2 PIPE WAYS/RACK PIPING

Pipes shall be designed to give the piping shortest possible run and to provide clear head rooms over main walkways, secondary walkways and platforms.

Predominantly process lines are to be kept at lower tier and utility & hot process lines on upper tier.

Generally the top tier is to be kept for electrical and instrument cable tray.

Generally the hot line and cold line shall be kept apart in different groups on a tier.

Generally the bigger size line shall be kept nearer to the column.

Spacing between adjacent lines shall be decided based on OD of the bigger size flange, OD of the smaller pipe, Individual insulation thickness and additional 25mm clearance preferably.

For hot lines 16" and above clear gap between two pipes shall be 100 mm taking consideration of displacement due to temperature.

Anchors shall be provided in the anchor bay if the concept of anchor bay is adopted.

Otherwise anchors shall be distributed over two three consecutive bays.

Anchors shall be provided with in unit on all hot lines leaving unit.

Process lines crossing units (with in the unit or from unit to main rack) are normally provided with block valve, how ever this shall be decided by as per PID's. The access platform for valve operation shall be provided.

5.4.3 EXCHANGER PIPING


Exchanger piping shall not run in the way of built in or mobile handling facilities. Piping around exchangers shall be arranged so that enough space is provided for operation of valves and instruments and for walkway as well.

Wrench clearance to be provided at exchanger flanges.

Piping shall be arranged so that they do not hinder removal of shell end and channel cover and withdrawal of tube bundle. Space for maintenance works, such as removal of channel cover, shell cover and tube bundle shall be considered.

5.4.4 PUMP PIPING

Pump drains shall have the clear access for operation point.

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Suction lines to pumps shall be designed for supports in a manner to avoid traps and pockets.

Horizontal suction lines shall be designed to avoid pockets resulting from thermal expansion.

To avoid cavitations in horizontal centrifugal pumps of the double suction type, the suction line shall be arranged so, that equal flow distribution to both impeller entrances is warranted.

Vertical lines may be connected to an elbow directly fitted to the suction nozzle, provided this elbow is perpendicular to the pump shaft of double suction type.

The line diameter shall be provided immediately upstream the suction nozzle of the pumps of double suction type.

Valves in pump suction lines shall be line size.

Reduction in valve size, if desired, shall be shown on the flow diagram / P&ID.

The discharge line from centrifugal or rotary pumps shall be provided with a check valve between the pump and the block valve as per the P&ID.

For vertical discharge pumps, the check valve shall be located in the vertical line whenever practical.

Suction and discharge lines of pumps shall be drained through drains located at the low point of the pump casing whenever possible.

Gland and sealing oil systems and cooling water piping shall be furnished in accordance with the pump manufacturer's recommendations.
Before start up of the unit, screens shall be provided at the largest flange between the pump suction nozzles and the first valve in the suction line.

Strainers for centrifugal preferably shall be in line welded "Y" or "T" type with flanged cleanout nozzle.

The piping design shall provide spools to permit easy screen removal without cutting the line.

As per good engineering practice minimum 3D straight length for small pump suction nozzle shall be considered.

Eccentric reducers immediately connected to the pump suction shall be eccentric type flat side up to avoid the accumulation of gas pocket.

All small bore piping connected to pump drain to OSW & CDH, seat and gland leak drain shall have provision for break up flanges for removal of pumps.

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5.4.5 COMPRESSOR PIPING

Suction line shall be short as possible.

Suction line shall have adequate flanged for ease of erection and maintenances.

Locate the lube oil cooler to facilitated tube bundle removal.

All operating valves on main suction and discharge piping shall be lined on one side as far as possible.

A minimum straight length is to be provided as per the requirements of manufacturer.

Compressor suction lines between knockout drum and compressor shall be as short as practicable & shall be with out pocket.

Where the line between knockout drum and compressor cannot be routed without pocket, low point in compressor line shall be provided with drain to remove any possible accumulation of liquid.

5.4.6 UTILITY STATION

- General Remarks**

Fluids:

For maintenance and repair works, utility stations are to be installed within the plant.

The utility stations are connected with following fluids:

Nitrogen

Utility Air/Plant Air

Service Water

- Location of Utility Stations**

The utility stations are to be installed in such a position that area to be served within a reach of 15m hose length.

The utility connection shall be grouped together as much as possible in the same sequence namely N2, Air & Water.

- Valves**

All connections of utility are furnished with valves acc. to the relevant pipe class. P&ID valves size shall be NPS 3/4.

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Hose couplings have to be supplied separately acc. to purchaser specifications. Different designs of hose coupling have to be used for each fluid.

- **Arrangement of utility station at steel columns**

Utility stations are to be fitted preferably at pipe rack columns. In this case, the pipe routing has to be performed acc. to the APPENDIX B.

- **Eye wash & shower**

Eye wash and shower stations shall be installed at location conveniently accessible in case of emergency. Water shall be tapped from DW system.

5.4.7 OFFSITE & YARD PIPING

In general the piping shall be laid at grade level on sleepers of concrete 500mm high from grade level or Pipe rack portals may be used depending upon requirement. The exact level shall be decided during detail engineering depending on requirements.

Pipe at road crossing shall be under culverts in general or Overhead pipe bridges may be used for areas where pipe racks are provided.

Clearance between lines shall be minimum "C" as given below.

$$C = (d_o + D_f)/2 + 25\text{mm} + \text{Insulation Thickness.}$$

Where, d_o – Outside diameter of smaller pipe in mm

D_f - Outside diameter of flange of bigger pipe in mm

Adequate clearance as per stress analysis to be provided for very long & high temperature lines to avoid clashing at the bends.

Expansion loops for all line shall generally be kept at the same location.
Vent shall be provided at high point & drains to be provided at low points.
Drain valves shall be suitably located for ease of operation.

5.4.8 FLARE PIPING

Flare header shall be sloped as per P&ID towards flare knockout drum. Only horizontal loops shall be provided as per requirement to accommodate thermal expansion. The desired slope shall be ensured throughout including flat loop. Flare headers shall be supported on shoe.

Generally Flare piping to offsite provided with guide on all around the pipe to prevent it falling off from the flare trestles.

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5.4.9 LINED PIPING

All lined piping shall be flanged with minimum spool length maintained as per the manufacturers recommended length.

Necessary air pin holes shall be provided in the piping to release any entrapped gases.

All lined pipes branches shall be of flanged type fittings, Use of reducing flanges shall be avoided.

Thickness of liner to suit the service conditions, all branch connections uses tees or reducing tees to regular sizes only.

5.4.10 UNDERGROUND PIPING

Under ground piping generally consists of the following services.

- a) Cooling water Supply/return.
- b) Process waste water system.
- c) Sewer in unit area.
- d) Potable water
- e) Fire Water

5.4.11 REQUIREMENTS FOR PROCESS PIPING SYSTEMS

Sample connections and sample coolers shall be supplied to the extent shown on the P&I diagrams.

All connections for sampling may normally be ¾".

For pipe in a horizontal or inclined plane, the sample connection shall be located at the side of the pipe unless otherwise indicated on the P&I diagrams.

Piping for pumping out towers and equipment shall be provided to the extent shown on the P&I diagrams.

Such piping shall be a part of the regular process piping of the unit and shall be designed with minimum possible additional piping not regularly required for normal startup and operation of the units.

Relief valves shall be connected to a flare or other disposal system only when so indicated on the applicable P&I diagrams.

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Relief valves shall have a minimum of piping between the protected line or equipment and the valve inlet.

The low point of the outlet piping when discharging to atmosphere shall be provided with a 10mm (3/8") minimum weep hole.

5.4.12 FIRE-PROTECTION SYSTEM

The design of the fire fighting system shall be based on the following assumptions:
Control and extinguishments of only one fire at a time occurring through the whole plant area.

Fire Protection shall be defined as a set of passive measures and precautions taken to avoid the development of Fire.

A Hazard is defined as a situation or event which shall be considered to bear a certain amount of danger and risk to People, Installations, and Environment and Plant surroundings.

Layout and distances between Fire Hazardous equipment shall be arranged so that at the event of fire, the possibility of escalation is minimized.

Fixed fire water hydrant & monitors shall be installed at strategic locations throughout the plant, generally along the roads.

System shall consist of

- Fixed hydrant and monitors.
- Hand appliances for extinguishments of different types of fires.
- Hose reels.
- Fire alarm & Detection system
- Foam System
- Inert Gas System

Firewater monitors, hydrants and nozzles shall be installed as indicated on the applicable firewater system P&I diagrams and Fire protection specification.

5.4.13 SYSTEM DESIGN

All process and utility piping systems shall be designed in accordance with the requirements of this specification and unless indicated otherwise, in accordance with the requirements of IPS-E-PI-240, IPS-E-PI-221 ANSI / ASME B31.3.

5.4.14 GENERAL ARRANGEMENT

All piping shall be routed for the shortest practical run and have minimum number of fittings consistent with provision for expansion and flexibility.

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All lines inside battery limits, except acid and caustic lines and lines with pulsating flow, shall preferably be run side by side on overhead pipe supports.

Lines that cannot be run overhead shall be run on sleepers.
Lines outside battery limits and all acid and caustic lines and lines with pulsating flow shall preferably be laid on sleepers.

Large thin-walled lines in non-flammable service, such as cooling water lines, shall be buried and continuously supported on sand cushions and suitably coated and wrapped.

Piping insulated for "hot service" shall not be supported directly on structural steel sections and shall be provided with pipe shoes with the bottom of the pipe minimum 100mm (4") above the top of supporting steel.

All lines, insulated or uninsulated, with operating temperatures of 121°C (250°F) and over, which run on concrete members shall be provided with shoes with the bottom of pipe minimum 100 mm (4") above the top of concrete support.

Where possible, all lines shall be run at levels which would enable them to be supported on structural steel at a common elevation.

All piping shall be arranged to facilitate support.

Piping arrangement shall also be planned to facilitate removal of equipment for inspection or servicing.

Maintenance areas shall be clear of piping as far as possible.

Control valves, relief valves and other valves requiring operation shall be accessible from platforms or grade and grouped at main operating levels, if practical.


Lines, carrying materials of high viscosity, shall be designed with a continuous slope and drain into a vessel and be so indicated on the P&I flow diagrams.

All lines shall be designed to avoid dead ends.

High point vent and low point Drains shall be provided for all lines. Hydro test vents and drains shall be shown on isometrics.

PVC pipe located under buildings, slabs, and road ways shall be sleeved with casing. Under ground steel pipes used for casing shall be coated and wrapped.

Expansion bellows shall be provided wherever piping connection of Graphite and glass lined are connected with equipments and Pump nozzles.

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5.5 CLEARANCES (APPENDIX A)

The minimum overhead clearances to the underside of flanges, insulation or structural supports and members required over roads, platforms and access ways shall be in accordance with the values as shown in Appendix A.

To permit access for the removal or maintenance of a pipeline, a minimum side clearance of 25mm shall be provided between parallel lines, outside of insulation, or between flange and pipe (insulation).

Thermal movements shall be taken into consideration in determining side clearances.

Clearance for maintenance personnel shall be allowed for removal of interior lines in multiple pipeline racks.

The lowest point of all flanges or insulation on lines run in trenches shall be a minimum of 75mm above the floor of the trench.

5.6 MATERIALS

Materials of construction for individual piping systems and specific operating conditions shall conform to the requirements of the Piping Material Specification (BK-SSGRL-PEDCO-320-PI-SP-0001 & BK-PPL-PEDCO-320-PI-SP-0001 & BK-GCS-PEDCO-120-PI-SP-0001).

5.7 DESIGN PRESSURE & TEMPERATURE

The design pressure and temperature to be used as basis for the design of piping systems and the selection of the standard piping material components shall be in accordance with the requirements of the IPS-E-PI-240, ASME B31.3, ASME B16.5 and other codes, with the maximum operation conditions shown on the applicable P&ID or piping line list or piping stream list.

Piping shall be designed to the most severe coincidental conditions of pressure and temperature. When they exceed the allowance for variation from normal operation conditions as out lined in IPS-E-PI-240 and ANSI/ASME B31.3 carried on the basis of the following conditions:

- a) Design pressure of the equipment to which the piping is connected.
- b) Set pressure of safety relief valve, which protects the system.
- c) Pressures not lower than the shut off pressure or that resulting from the sum of the maximum. Suction pressure plus 1.2 times the design differential pressure, for discharge lines of pumps and/or compressors not protected by a relief valve.

The piping subject to vacuum shall be designed for a negative pressure of 100 KPa (1 bar) or as per respective P&ID unless a vacuum breaker or similar device is provided.

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The design temperature shall be either the maximum fluid temperature or the most severe temperature.

Condition produced by heat exchangers and equipment manufacture has guaranteed temperature tolerance or other maximum allowable variation from the normal.

In case exterior of components are thermally insulated, the lowest metal temperature shall be taken to be the minimum temperature of the contents of the pipe.

5.8 DESIGN DETAILS

5.8.1 LINE AND CONNECTION SIZES

Pipe sizes 1¼", 2½" and 3½" and all odd number sizes such as 5" and 7", 9", 22" and 26" shall not be used except where required for connections to mechanical equipment of standard design or where specific velocities must be maintained. Pipe size 2½" may be used for fire hydrant and /or control valve connection.

In general, the minimum pipe sizes shall be ¾" for utility lines; 1" for process lines, with no size limitations for instrument connections and steam tracing lines; 4" for underground sewer lines; and 2" for underground lines other than sewer lines. However, running lines on outdoor racks and sleepers shall preferably be not less than 2".

Cooling water lines to pump and compressor in size less than 1" shall have the take – off connection from top of water main header to prevent plugging during the operation

Uses of pipe nipples (threaded) in piping class where socket weld fittings are specified may be made but the nipple shall be one schedule higher than specified in the class.


5.8.2 MATERIAL AND SPECIFICATION CHANGES

When a line of one material specification or pressure rating is connected to a line of higher material specification or pressure rating, the connecting line shall be constructed of the higher material specification or pressure rating up to and including the first valve in the connecting line. Non metallic gasket should be considered for galvanic reaction.

The higher material specification or pressure rating shall be used up to and including the valve on the bypass around equipment or pressure reducing valve.

Block valves after the reducing valves shall be of the lower material specification or pressure rating.

Where vessels have higher design ratings than the connecting lines, the valves at the vessels shall equal the pressure rating of the vessels.

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5.8.3 PIPES

All pipes threads shall confirm to American standard taper as per ANSI B1.20.1 unless otherwise specified.

Butt welding ends shall be confirmed to ASME B16.25

Pipe thickness for the sizes not covered in this specification shall be calculated as per IPS-E-PI-240(2), IPS-E-PI-221 and ASME B31.3

Tolerances shall be as IPS-E-PI-240, IPS-E-PI-221 and ASME B31.3.

5.8.4 FITTINGS

Pipe bends used for changing direction shall confirm to IPS-M-PI-150(2) , IPS-E-PI-240(2) and ASME B31.3.

Miter bends and reducers shall be used if specified in respective piping class. 90° miter bends shall be four piece construction up to 16" and five piece construction for 18" and above. 45° miter bends shall be three piece constructions for all sizes. Miter bends shall be in accordance with IPS-D-P-129.

Their use in other systems shall be only with the permission of buyer and as limited in IPS-E-PI-240(2) and ASME B31.3.

Welding elbows shall be long radius $R=1.5D$. Short radius elbows $R=D$ shall not be used.

Thickness of fittings at ends to match pipe thickness for BW fittings. SW fittings shall be 3000#, 6000#, and 9000 # depending on pipe thickness respectively.

Reduction in line sizes shall be made by threaded for galvanized pipes and welding reducing fittings and swages for other metallic pipes. Use in principle eccentric reducers in horizontal and concentric in vertical.


All carbon steel and ferritic alloy steel-threaded nipples shall be of schedule 80 minimum thickness, unless otherwise noted.

Austenitic stainless steel and non-ferrous alloy-threaded nipples shall be schedule 40 S minimum.

Plugs or nipples and threaded cap assemblies in insulated lines, operating at above ambient temperature, shall be long enough to extend through the insulation.

5.8.5 FLANGES

The use of flanges in piping shall generally be limited to connections at flanged equipment and valves.

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Flanges shall also be provided in special cases such as:

- Where frequent dismantling of piping is required for maintenance and operation requirements.
 - Where plastic or non-metallic piping systems cannot be welded shall otherwise be joined except by flanges.
- To provide clearance for dismantling of equipment such as compressors, reactor heads, etc.

5.8.6 VALVES

Valves of the type and number shown on the P&I diagrams shall be provided.

Double block valve and bleeder installations shall be provided as shown on the P&I diagrams where necessary to avoid product contamination or a hazardous condition. The type of valves shall be in accordance with the Piping Material Specification and Piping Material Classifications.

Face-to-face dimensions of valves shall be in accordance with ANSI B16.10 and the MSS standards to the extent covered.

In general, block valves shall be gate, ball, butterfly or non-lubricated plug valves.

Each plug, ball or butterfly valve shall be furnished with its own operating wrench or lever arm. Extension stems shall be required when the insulation or other interferences hinder the operation with a wrench or lever. The following factors shall be considered in determining when a hand wheel, lever or wrench may be used on a valve, or when a gear operator is required.

Hand wheel diameter shall not exceed 800 mm and lever length shall not exceed 500mm on each side.

General requirements for gear operators are specified in the piping material specification.

Valves shall be provided with pressure-equalizing bypasses with a globe valve as indicated in valve spec. When the differential pressure may exist across the closed valve approximately equal to the pressure rating of the valve at the operating temperature.

The valves, for which by passes are to be furnished shall be indicated on the applicable P&I diagrams.

Additional requirements for integral bypasses shall be as specified in the the Valve Material Specification .

Swing check valves shall be suitable for installation in vertical lines with flow upward as well as for installation in horizontal lines.

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Check valves shall be used in cases where reversal of flow may occur.

Stem positions of all valves shall be indicated on the drawings.

Pipelines containing hazardous solutions (such as acids and caustics) shall not have valve stems below the horizontal.

When block and bypass valves are required for control valves, they shall be as per Instrument Design Basis and respective P&ID.

5.9 VALVE INSTALLATIONS

Frequently-operated valves, on which the centerline of the stem is more than 2200 mm above the pavement or platform levels, shall be provided with operating devices such as chain wheels (for sizes 2" and larger) or extension stems to permit ease of operation.

Chains shall hang to within 900 mm of the operating level and they shall be attached to columns or walls so as not to obstruct passageways.

Frequently-operated valves in trenches shall be provided with extension stems extending to within 100mm (4") below the cover plate if the hand wheels are more than 300mm (12") below the cover plate.

Valves shall not be located inside vessel skirts.

All valve outlet ends in process services which do not connect to a piping system shall be provided with an appropriate end closure.

- Threaded ends shall use a plug.
- Socket weld ends shall use a nipple and a threaded cap.
- Flanged ends shall use a blind flange.

Manually-operated valves, which are used in conjunction with locally-mounted flow indicators, shall be placed at the same operating level for the indicators and located where the instrument can be readily observed.

Where a valve is locked or car sealed open, a metal tag shall be securely attached to the valve. The tag shall read: "This valve must not be closed without permission from responsible authority". The same applies to lock or car-sealed closed valves with the tag reading "This valve must not be opened without permission from responsible authority".

Generally, where block valves are used in branches at headers, they shall be located in horizontal runs at high points to ensure that lines drain both ways.

Valves above roads should be avoided. The number and types of valves in piping systems shall be kept as per the process design basis and P&ID's.

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Valves in overhead pipe tracks should be avoided, but if valves are required platforms and ladders shall be provided for access.

5.10 BLINDS

Blind flanges shall be supplied only to the extent required for normal operations and as shown on the P&I diagrams.

Spacers and/or spades shall normally be installed on all process lines at battery limits and where required to facilitate testing, inspection or maintenance of equipment however this shall be decided as per the process design basis & P&ID's.

5.11 GENERAL REQUIREMENTS

i. STRESS ANALYSIS

For information refer to "Specification for Flexibility Analysis" (BK-GNRAL-PEDCO-000-PI-SP-0012).

ii. SUPPORTS AND ANCHORS

For information refer to "specification for Pipe Supports" (BK-GNRAL-PEDCO-000-PI-SP-0014)

iii. 3D MODELING

All equipments shall be modeled with exact geometry on manholes with davits, pipe davits on top platforms, nozzles, stiffeners rings, bellows, break flanges, platforms, ladders, handrails, lifting leg etc. for all equipment like vessels, columns, pumps with motors, compressors, air coolers with motors, etc.

All piping with in the unit battery limit above ground/under ground, big bore & small bore, except tubing for all piping materials shall be modeled. Details shall include all pipes, pipe racks, valves, valve boxes, flanges, fittings, reducers, spectacle blinds, drains, temperature and pressure connections, sample points, drip legs, supports such as hangers, shock absorbers, rigid struts, clips of equipments, structure braces, emergency showers, eye washes etc.

Modeling will be done using ver 12.1 of PDMS software.

All inline instruments like control valves, safety valves, rotameters, orifice plates, etc.

Steam supply, condensate recovery stations up to the first valves in tracer lines.

Tagging of all lines numbers, instrument numbers, special items, and equipment numbers shall be marked as in P&ID's.

Complete underground piping including break flange, funnels, manholes, manhole vent piping to atmosphere, catch pits, etc shall be modeled.

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Envelopes shall be modeled to check for interference on maintenance and operating conditions.

Piping isometrics shall cover the following.

- Complete line from start to end with all components with full dimensions.
- Complete bill of materials
- Information on type and thickness of insulations
- Information on design, operating and testing pressure ,medium and temperatures.
- Information on whether line is stress analysed , stress relieved or not.
- Information on pipe supports.
- Information on reference drawings
- Information on P&ID's.

add "information on Weld NDT and PWHT"

iv. JOINTS AND CONNECTIONS

Jointing and all piping systems 2" and larger pipe size shall be accomplished by butt welding.

Jointing in piping 1½" and smaller shall be accomplished by socket welding, ~~butt welding~~ or threaded connections.

Delete

Generally, flanged connections shall be used at connections to vessels and equipment unless governed by P&ID and piping specification requirements.

Steel flanges used for the attachment to flat-faced ~~cast iron~~ flanges shall be flat faced.

Delete

v. BRANCH CONNECTIONS

Welded pipe-to-pipe connections shall be designed such that the angle between the branch and the run shall be 90°. ~~Welded pipe to pipe connections only permitted for drains.~~

The types of branch connections permitted are listed in the Piping Material Specification and Piping Material Classifications.

vi. VENTS AND DRAINS

In general, venting and draining shall be accomplished through vessel and / or equipment connections.

Vessel vents and drains may be located in overhead or bottom piping provided that no valves or blinds are located between vent or drain connections and vessels. High-point vents on liquid lines should be valved. On gas lines the vent points may be plugged / capped.

Low-point drains of all pipe lines should be valved.

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Process vents and drains will be as per P&IDs.

Drains emptying into open receptacles shall terminate 50mm (2") above the top of the drain receptacle and the discharge shall be visible from the location of the drain valve.

Unless otherwise noted on piping drawings or P&I diagrams, the minimum size of vent and drain connection shall be ¾".

The minimum vent and drain connection sizes for vessels shall be in accordance with equipment data sheets.

vii. INSULATION

The Insulation being identified as per the process requirements shall be carried out with recommended insulating materials and the thickness are as per process design basis.

Insulation shall be identified as per the project Insulation Specification (BK-GNRAL-PEDCO-000-PI-SP-0019).

viii. PAINTING

Painting shall be identified as per the project Painting Specification (BK-GNRAL-PEDCO-000-PI-SP-0006)

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Appendix A

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A) Spacing

Equipment shall be spaced taking into consideration the following prescriptions:

1.	Small Pumps (3.75 KW and less)	Mounted on common foundations Suitable centre to centre distance.
2.	Medium pumps (3.75 ~ 22.5 KW) Large Pumps (+ 22.5 KW)	1000 mm. clear aisle. 1500 mm. clear aisle.
3.	Other equipment on structures	900 mm. clear aisle.
4.	Clearance in front of channel or bonnet flange of horizontal exchanger	1200 mm.
5.	Heat exchanger tube bundle removal space	Tube bundle length plus 2000 mm
6.	Minimum clearance of exchanger shell flange.	600 mm.
<p>These requirements are not applied to the inside of packaged equipment assembled on the skid.</p>		
7	Plinth heights	
	ii Columns – structural (open area)	300 mm. min.
	iii Columns – structural	200 mm. min.
	iv Control panels	300 mm. or as required.
	v Compressors	300 mm. or as required.
	vi Exchangers (enclosed)	200 mm. or as required.
	vii Exchangers (open)	300 mm. or as required.
	viii Motor control centres	: As required.
	ix Transformers	: As required.
	x Pumps	: 300 mm. or as required.
	xi Tank (on pier)	: 1000mm.or as required.
	xii Tank (on pad)	: As required.
	xiii Vessels supported on legs	:200 mm. or as required.

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		(closed area)	
	xiv	Vessels on skirt (open area)	:300 mm. or as required.
	xv	Miscellaneous	: As required.
	xvi	Pads, stairs	: 200 mm. or as required.
	Xvii	Pads, ladder	: 300 mm. or as required.
	Xvii	Pipe racks	: 300 mm. or as required.
	xix	Structural	: 300 mm. or as required.
	xx	Grouting for	: 25 mm or as required by equipment & structure vendor.

B) Clearances

The following clearances shall be observed:

1	Equipment	
	a.	From edge of equipment to wall : 750 mm.
	b.	Equipment parts removal :Vendors recommendation.
	c.	Electrical motors from wall 750 mm. min. or as Vendor's recommendation
2	Platforms	
	a.	Towers, vertical and horizontal vessels Distance of platform below center line of man-hole : 900 – 1050 mm.
	b.	Width of manhole platform from manhole cover to edge of platform : 900 mm.
	c.	Platform extension beyond

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		center line of manhole – side platform	: 900 mm.	
	d.	Distance of platform below under-side of flange-head	: 175 mm.	
	e.	Width of platform on three sides of man-hole head platform	: 750 mm.	
3	Control panels access platform			
	a.	Control panels, front	: 2000 mm.	
	b.	Control panels, rear	: 1500 mm.	
4	Operating aisles			
	a.	At grade	: 900 mm. min.	
	b.	On structures	: 750 mm. min.	
	c.	On vessels	: 750 mm. min.	
	d.	Communicating	: 600 mm. min.	
5	Operating switchgears			
			Front	Rear
	a.	High voltage	:1500 mm.	1500 mm.
	b.	Low voltage	:1200 mm.	1000 mm.
	c.	Motor starters	:1000 mm.	-----
	d.	Motor control centers.	:1000 mm.	1000 mm.
6	Pipe berthing			
	a.	Underground piping	300 mm. min. clear gap between pipes carrying clear fluids : 750mm. clear gap between sewer lines and	

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			lines carrying contaminated fluids
	b.	Above ground piping	: 50 mm Normal – flange to bare pipe or Insulation : 50 mm Minimum – pipe to pipe 150 mm min. clearance between finished pavement level and lowest piping item. 75 mm min. clearance between bottom of flange or insulation to the highest point of the trench for lines routed in pipe trenches.
7	Overhead Clearances		
	Equipment, structures, platforms, piping and its supports shall be arranged to provide the following Overhead clearances:		
	a.	Over rail roads, top of rail to bottom of any obstruction	7000 mm.
	b.	Over main PLANT roads for major mobile equipment	7000 mm.
	c.	Over secondary roads (bottom of pipe) and access ways for mobile equipment	5000 mm.
	d.	Over ground and bottom of pipe (inside battery limits) at pump row access-way	3500 mm.
	e.	Over walk-way, pass-way and platform to nearest obstruction, and inside buildings	2500 mm.
	f.	Over exchangers at ground, shell cover channel end.	1500 mm.
	g.	Headroom below structural and piping	2200 mm.

	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض و ابنیه تحت الارض</p> <p>عمومی و مشترک</p>																									
شماره پیمان: ۰۵۳ - ۰۷۳ - ۹۱۸۴	<table><tr><th colspan="8">SPECIFICATION FOR PIPING DESIGN & PLANT LAYOUT</th></tr><tr><th>پروژه</th><th>بسته کاری</th><th>صادر کننده</th><th>تسهیلات</th><th>رشته</th><th>نوع مدرک</th><th>سریال</th><th>نسخه</th></tr><tr><td>BK</td><td>GNRAL</td><td>PEDCO</td><td>000</td><td>PI</td><td>SP</td><td>0016</td><td>D00</td></tr></table>	SPECIFICATION FOR PIPING DESIGN & PLANT LAYOUT								پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GNRAL	PEDCO	000	PI	SP	0016	D00	شماره صفحه : ۳۵ از ۳۷
SPECIFICATION FOR PIPING DESIGN & PLANT LAYOUT																										
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه																			
BK	GNRAL	PEDCO	000	PI	SP	0016	D00																			

8	Horizontal Clearances		
a,	Between exchangers (aisles between piping)	900 mm.	
b.	Around pumps (aisles between piping)	900 mm.	
c.	At driver end of pumps, where truck access required	3000 mm.	
d.	At driver end of pumps, where track access not required	1800 mm.	
e.	At shell cover end of exchangers at ground, for access way	1300 mm.	
f.	Between shells of adjacent horizontal vessels	1200 mm.	

	<p>نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض</p> <p>عمومی و مشترک</p>								
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	BK	GNRAL	PEDCO	000	PI	SP	0016	D00	

Appendix B

