طرح نگهداشت و افزایش تولید 27 مخزن

FLARE, BLOW DOWN AND RELIEF PHILOSOPHY

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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.

As a part of the Project, New Gas/Condensate Pipelines (from Binak New GCS to Siahmakan GIS/Binak PU) shall be constructed

GENERAL DEFINITION

The following terms shall be used in this document.

CLIENT:	National Iranian South Oilfields Company (NISOC)
PROJECT:	Binak Oilfield Development – Surface Facilities; Gas & Gas-Condensate Pipelines
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.

2.0 SCOPE

The purpose of this document is to implement the methods employed for protecting the facilities against over pressuring, pressure relief systems, blow down and flaring system for Pipelines from Binak New GCS to Siahmakan GIS/Binak PU.

3.0 NORMATIVE REFERENCES

3.1 LOCAL CODES AND STANDARDS

- IPS -E-PI-140 — Engineering Standard for Onshore Transportation Pipelines
- IPS (NIOC) E-PR-460 — Engineering Standard for Process Design of Flare and Blowdown Systems

3.2 TERNATIONAL CODES AND STANDARDS

- ASME B 31.4 — Pipelines Transportation Systems for Liquids and Slurries
- ASME B 31.8 — Gas transmission and distribution piping systems
- API STD 521 — Pressure-relieving and Depressuring Systems, 6th Edition
- API STD 520, Part 1 — Sizing, Selection, and Installation of Pressure-relieving Devices, Part I - Sizing and Selection, 9th Edition
- API STD 520, Part 2 — Sizing, Selection, and Installation of Pressure-relieving Devices-Part II, Installation, 6th Edition
- API RP 553 — Refinery Valves and Accessories for Control and Safety Instrumented Systems, 2nd Edition

3.3 THE PROJECT DOCUMENTS

For each plant defined by NISOC within project scope of work, corresponding documents:

- PROCESS BASIS OF DESIGN — BK-GNRAL-PEDCO-000-PR-DB-0001

- Process Design Criteria — BK-GNRAL-PEDCO-000-PR-DC-0001
- Process Flow Diagram For pipelines — BK-PPL-PEDCO-320-PR-PF-0001
- P&ID - Gas Pipeline (to Siahmakan G.I. Station) — BK-PPL-PEDCO-320-PR-PI-0001

shall be used as reference for using this document.

3.4 ENVIRONMENTAL DATA

Refer to "Process Basis of Design; Doc. No. BK-00-HD-000-PR-DB-0001".

4.0 PIPELINE PRESSURES

4.1 PRESSURE SOURCES

When operating and incidental pipeline pressures are determined, pressure sources should be categorised as:

(i) well pressure; or

(ii) pressure from pressure boosting facilities such as pumps and compressors; or

(iii) pressure from pressure controlled process vessels; or

(iv) operating pressure from a feeding pipeline; or

(v) hydrostatic head due to change in pipeline elevation; or

(vi) surges as a result of operational activities, e.g. valve closure, pump start-up/shutdown; or

(vii) thermal expansion of blocked-in fluids; or

(viii) failure of the pressure control/trip of pumps, compressors, pressure controlled process vessels or feeding pipelines; or

(ix) incidental pressures from a feeding pipeline; or

(x) accumulation pressure during the activation of the overpressure protection safety relief or isolation valves.

4.2 OPERATING PRESSURE

In most cases, the pipeline operating pressure, i.e., the pressure at which the pipeline operates under steady state conditions, is the pressure resulting from a category (i) to (iv) source. When no pressure limiting or overpressure protection is provided, these pressures are:

- for category (i), the closed-in tubing head pressure for pipelines conveying fluids directly from a naturally flowing well. If the pipeline is also to be used for well servicing duties like through-flowline-operations and killing, its operating pressure during such operations will be higher;
- for category (ii), the highest pressure which can be generated under steady state conditions by pumps, compressors and artificially lifted wells over the possible flow range;
- for category (iii), the upper pressure level of the range in which the pressure is controlled;
- for category (iv), the operating pressure of the feeding pipeline determined in accordance with this Section.

In the case of multiple pressure sources, the highest pressure shall be taken.

Pipeline operating pressures are normally highest where the fluid enters the pipeline and decrease along the line due to friction loss. This may, however, not be true when highdensity fluids are transported in pipelines with an elevated inlet position, e.g.

Thermal pressures, source (vii), are included in the operating pressure only if blocking-in is a regular operational activity and occurs for a significant period of time.

4.3 INCIDENTAL PRESSURE

The incidental pressure is the pressure which may occur anywhere in the pipeline at any time and is calculated from the combined effect of the operating pressure (4.3), incidental pressures of feeding pipelines determined in accordance with this Section and the other source pressures (4.1, paras vi to x).

4.4 MAXIMUM ALLOWABLE PRESSURES

Gas pipelines designed in accordance with ASME B31.8.

5.0 METHODS FOR OVERPRESSURE PROTECTION

Designing a pipeline for the maximum source pressures without the need for overpressure

Overpressure protection of pipelines may be achieved by means of the following:

- mechanical devices e.g. pressure safety relief valves, etc.; or
- instrumented devices (Instrumented Protective Function).

Pressure safety relief equipment has commonly been installed to protect pipelines against

- This protection method may be selected instead of the above

More recently, pipelines have also been protected against overpressure with Instrumented Protective Functions. Instrumented Protective Functions consist of a fail-to-close valve(s) activated to close at the set pressure by a redundant and highly reliable instrumented pressure sensing and transmitting system. Activation of the overpressure protection equipment by incidental pressure during normal operations should be avoided by providing a sufficient margin between the MOP of the pipeline and the equipment set pressures. Besides overpressure protection, a pressure control and alarm system shall be installed for applications where the operating pressure of the source may exceed the MOP of the pipeline.

NOTE: PSV and Instrumented Protective Function activation during normal operations should be avoided in order to maintain the integrity of the valve seals.

Pipeline entry pressures shall be monitored when overpressure protection is provided to alarm the operator for corrective action when operating pressures exceed the predicted range. Pressures in excess of MAOP SHALL be recorded with duration and pressure value.

5.1 THERMAL PRESSURES

Unallowable thermal pressures may be avoided by the installation of thermal relief valves. These valves should be set to release thermal pressures before activation of the overpressure protection equipment. Even if thermal relief valves are installed, operating procedures should be prepared to avoid thermal pressures where possible.

6.0 ENGINEERING REQUIREMENTS

6.1 LOCATION

The components of a pipeline overpressure protection system SHALL be installed between the source and the pipeline or included in the source facilities.

6.2 NUMBER OF RELIEF VALVES

The PSV system may comprise one relief valve or, for higher capacities, multiple valves, always with the total relief capacity matching or exceeding the maximum possible throughput from the source.

6.3 PSV INSTALLATION

The following rules shall apply for isolation of PSV (Refer to API STD 520, Part2 for more detail guideline and instruction):

- Gate valve to be provided upstream of the PSV for a pipe class rating of up to 150 # and for diameter lower than or equal to 8” and for non-sour service or non-toxic.
- Valve located downstream of PSV to be gate valve type for non-sour service and ball valve type for sour service or toxic service.
- If feasible, and assuming this does not create interference with other process systems, the relief discharge lines from a process unit and/or fire zone shall be routed to a common sub-header. In such a case no isolation valve shall be provided on each individual relief discharge line and a single isolation valve shall be fitted on the sub-header, upstream of its connection with the main header.
- Where sub-header downstream isolation valves are unavoidable, they shall locked- open in normal operating conditions. A single valve without positive isolation is considered as acceptable even for toxic gas services.
- Full bore ball valves shall be used for service where design temperature ≤ 200°C

6.4 RELIEF SYSTEM PIPING

- Block valves shall be avoided on flare header and sub header. However, full bore ball valves with position indicator are required for maintenance at each battery limit.
- Flare header shall be self-draining towards the flare drum.
- All connections shall be done with no low point and preferably on the top of the header. Connection to the header should be at an angle of 45°. Relief lines with diameters below 4” NB may enter the header at an angle of 90°.
- Flow orifice or flow meter (except annubar type or equivalent) which can be blocked by foreign matters shall not be installed in flare header and sub-header.
- The fitting of check valves downstream of relief devices is prohibited.
- Adequate systems shall be installed to separate liquids before the vent or flare tip. Where a significant quantity of liquid is expected, a K.O. drum shall be provided with its own liquid evacuation devices. The design of the network and, in particular, of the drain points, shall be such that the ingress of air under vacuum conditions is avoided.
- The relief piping shall be selected from material suitable for lowest expected discharge temperature. If water may be present, the risk of ice or hydrate formation shall be assessed, and methanol injection (or any other suitable mitigation measure), such as segregated headers to the flare K.O. drum, should be considered to avoid blockage.
- Adequate supports shall be provided upstream and downstream of relief devices.

7.0 EMERGENCY DEPRESSURIZATION

7.1 GENERAL CONSIDERATION

The purpose of the Emergency Depressurization (EDP) is to unstress equipment under fire by releasing pressure to limit the quantity released through a leak to minimize hydrocarbon inventory. The purpose of the Emergency Depressurization (EDP) is:

- To avoid escalation of initial event by preventing release of other isolated flammable inventories
- To unstress equipment under fire by releasing pressure
- To limit the quantity released through a leak
- To minimize hydrocarbon inventory.

In case of a large liquefied hydrocarbon inventory, a liquid emergency blowdown will not be provided to achieve the required reduction of pressure in the allowable period of time.

In order to limit the wall temperature and therefore possible damage of the capacities exposed to fire, liquid will be kept inside the vessel.

Blowdown Valve Specification is as follow:

- TSO, Full Bore
- FO, de-energized to open (except for slug catcher, XV energized to open)
- No fire proofing required
- Minimum diameter greater than or equal to 2”.

7.2 CRITERIA USED FOR BDV INSTALLATION

The criteria that shall be used to decide whether a Blowdown Valve (BDV) is required are summarized in the following table:

		BDV Required
PIPING	That cannot be isolated	No
	That can be isolated but not exposed to fire	No (1)
	That can be isolated and exposed to fire (5): • Flammable gas • Liquefied HC (4) • Liquid HC • Two-phase • Toxic gases	 • P > 17 barg and PV_{gas} > 100 bar. m^3 (6) • M_{gas} or M_{liq} > 2 tons of C_4 and more volatile (6) • No (3) • P > 17 barg and PV_{gas} > 100 bar. m^3 • As required for protection of personnel
VESSELS	That cannot be isolated	No
	That can be isolated but are not exposed to fire	No (2)
	That can be isolated and are exposed to fire (5): • Flammable gas • Liquefied HC (4) • Liquid HC • Two-phase • Toxic gases	 • P > 17 barg and PV_{gas} > 100 bar. m^3 (6) • M_{gas} or M_{liq} > 2 tons of C_4 and more volatile (6) • No (3) • P > 17 barg and PV_{gas} > 100 bar. m^3 • As required for protection of personnel

Notes:

(1). Except piping interconnecting equipment subject to EDP within one process unit, regardless of pressure and volume.

(2). Except vessels between other vessels or piping within the same process unit and subject to EDP.

(3). TSV or PSV fire cases are regarded as sufficient protections.

(4). Both refrigerated or under pressure.

(5). Piping or vessels shall be considered as being possibly exposed to fire if their external surface (more than 10%) can be engulfed in a pool fire likely to last more than 3 minutes.

(6). The presence of pressurized fluid “trapped” in the network after EDP shall be avoided. The position of check valves and/or control valves failing to close shall be carefully contemplated in this respect.

(7). BDV protecting an equipment with mesh will be installed upstream the mesh

(8). Depressurization to be avoided through plate and frame exchanger.

Legend:

P: Maximum operating pressure (PSHH)

V: Internal vessels (or piping or vessel + piping) volume Vgas: Gas phase volume

Vliq/Vgas: Maximum liquid/gas volume inside vessel or piping or both (LAHH/LALL)

Mliq / Mgas Maximum: Mass of liquefied hydrocarbon liquid phase/gaseous phase inside vessel (or piping or both)

7.3 SYSTEM VOLUME DETERMINATION

Volume of the system to be depressurized shall be determined by the isolation block valves considered here above which are ESDV, SDV and control valve FC. The volume will not take into account the possibility of non-closing of the SDV or control valve. Purge and drain lines are neglected in the total volume.

7.4 INDIVIDUAL BLOWDOWN CALCULATIONS

Three different depressurization procedures are considered within the PROJECT:

- Depressurization in case of external pool fire (“Hot fluid depressurization”)
- Depressurization after prolonged shutdown (“Cold fluid depressurization”)
- Spurious Depressurization

Depressurization in case of external pool fire

The flow is assumed to be critical through the Restriction Orifice and designed according to the followed considerations:

a) Initial conditions :

Pressure = Initial pressure is in any case the network design pressure (unless it differs more than 15% from operating pressure) or PSHH (taken as 90% of design pressure)

Temperature = Maximum operating (it is assumed that heat exchanges are stopped) Liquid Level = NLL for vessel with auto level control

LSH for vessel with ON/OFF control

Liquid Level corresponding to piping hold up for piping LSH for relief K.O. drum or flare vessel

b) Final Conditions:

7 bar g or 50 % of PSHH (or design pressure) whichever is lower.

c) Depressurization time

As a general rule, for vessels whose smallest wall thickness is equal to or greater than 25 mm, time to achieve the final pressure level after an EDP has been initiated shall be, by default: within 15 minutes or less for piping and vessels containing hydrocarbon, both gas or liquid; within 8 minutes or less for storage vessels containing LPG's or light condensate to avoid the risk of BLEVE; For wall thickness smaller than 25 mm, the following rule shall be applied: Wall thickness < 25 mm: 15 minutes minus 3 minutes for each 5 mm decrease in thickness;

d) Heat input

Pool Fire: This shall be considered only in the fire zone corresponding to a cylindrical volume of about 18 m diameter/8 m height. In the case of equipment and/or piping elevated at 8 meters or higher, heat input will only be considered if a retention structure appears. The heat input will be specified as per API:

$q = 21000\ F\ A^{-0.18}$

$Q = 21000\ F\ A^{0.82}$

Where:

q = average unit heat absorption, in BTU/h.ft² of wetted surface

Q = total heat absorption (input) to the wetted surface, in BTU/h

F = environment factor to be taken equal to 1 for EDP - insulation shall be considered as non-fire resistant

A = total wetted surface, in ft² (The expression $A^{-0.18}$ is the area exposure factor or ratio. This ratio recognizes the fact that large vessels are less likely than small ones to be completely exposed to the flame of an open fire)

Heat exchanges by natural convection with the ambient shall be based on:

- ambient temperature: 33.03 °C
- Heat transfer coefficient : 5 W/m2°C
- For restriction orifice, atmospheric conditions shall be considered downstream the orifice.

Depressurization after prolonged shutdown

In the cold depressurization procedure, the target is to check the final temperature after the system has reached the final network pressure (around 0 barg), in order to assure the material resistance at the lowest temperature reached in the system. Besides, this calculation allows calculating the time necessary to reach this pressure: in fact, the restriction orifice will be sized for the depressurization in case of pool fire, which usually gives the highest peak flow.

The same initial pressure for the fire case is assumed as starting point for the depressurization, while the initial temperature is the operating temperature or 21°C, whichever the lowest. Total volume of the circuit to be depressurized (same as calculated for depressurization for fire). Total volume of the circuit to be depressurised (same as calculated for depressurisation for fire). Heat exchanges by natural convection with the ambient shall be based on:

- Ambient temperature: 18.75°C
- heat transfer coefficient : 5 W/m2°C

In case of conflict between this calculated minimum temperature and the material resistance low limit temperature, API RP 579 and ASME BPVC Section VIII Division 1 can be followed using critical exposure temperature (CET). In particular, the maximum operating pressure, instead of the design pressure, will be selected as starting point and the calculation procedure will also consider the effect of metal weight on heat capacity.

Spurious blowdown

Spurious blowdown will be applied for all systems and defined as follows:

a) Initial conditions :

Pressure = Network design pressure or PSHH.

Temperature = Minimum operating (it is assumed that heat exchanges are stopped)

Liquid Level = NLL for vessel with auto level control, LSH for vessel with ON/OFF control Liquid Level corresponding to piping hold up for piping, LSL for relief K.O. drum or flare vessel

b) Final Conditions:

The calculation shall be carried up to ATM pressure to find the minimum achieved temperature.

c) Depressurization time

No time is taken into account here because the blowdown rate depends on the orifice sized on fire case blowdown basis.

d) Heat input

None in this case. However, insulation, if any, will be considered.

Heat exchanges by natural convection with the ambient shall be based on:

- Ambient temperature : 17°C
- Heat transfer coefficient : 5 W/m2°C

7.5 FIRE ZONE DEPRESSURIZATION

Inside one fire zone, the system exposed to fire will be defined within a cylindrical volume (dimensions: about 18 m diameter x 8 m height). This zone will be determined as the area generating the largest blowdown flow (in general this area presents the largest liquid inventory). Therefore, the flow rate generated by the blowdown of one fire zone will be calculated by adding flow rate through BDV's and included in the cylindrical volume exposed to fire with the flow rate calculated on the basis of a spurious blowdown for other BDV's. Phased EDP system within one fire zone, using sectionalizing of process systems within the fire zone using sectionalization valves to mitigate Depressuring rate, will be foreseen if instantaneous flow rate generated by the depressurization is higher than the design flow rate of the flare.

7.6 SIMULATION SOFTWARE FOR EDP CALCULATION

Depressurizing Utility in Aspen HYSYS is used as default software tool to perform corresponding calculation procedure in previous section.

8.0 IMPACT OF EDP ON MATERIAL SELECTION

The piping material will be selected taking into account the temperatures occurring during depressurisation. Piping repressurization shall be considered to be performed with the minimum depressurisation temperature. As a base case, the above consideration shall be applied also for vessels: the minimum temperature due to blowdown conditions shall be associated with design pressure. bed below.