RELIEF PHILOSOPHY

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COMPANY: Pars Oil and Gas Company

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1. INTRODUCTION

1.1 GENERAL PROJECT DESCRIPTION

GHORB is developing of the SOUTH PARS Phases 15 & 16 Project for Pars Oil & Gas Company (POGC) in IRAN. This project includes onshore facilities for the processing of reservoir fluid. Phases 15 & 16 onshore Complex will be located on the Iranian coast of Persian Gulf in ASSALUYEH (approximately 270 km South East of Bandar Bushehr). The Total capacity of Phases 15 & 16 onshore facilities is 2000 MMSCFD of reservoir fluid.

Phase 15 & 16 onshore Complex will include all processing units, utilities, offsets and infrastructure necessary to produce sales gas, gaseous ethane cut of petrochemical feedstock quality, commercial grade propane and butane for export and stabilized condensate. The complex is fed by the reservoir fluid delivered to the onshore plant (Tie-in) via two multiphase lines:

The total capacity of the new Phases 15 & 16 onshore facilities is 2000 MMSCFD of reservoir fluid. They will include all processing units, utilities, offsites and infrastructure necessary to produce sales gas, gaseous ethane cut of petrochemical feedstock quality, commercial grade propane and butane for export and stabilised condensate. The complex is fed by the reservoir fluid delivered to the onshore plant via two multiphase sea lines:

- Receiving facilities for HP separation of raw gas and condensate/water mixture.
- Condensate stabilization producing stabilized condensate for storage and export and light ends recycled in the HP gas system. One condensate flashing unit, normally not operated, is provided as a back-up of the stabilization facilities
- Gas treatment facilities producing sales gas, gaseous ethane and NGL's and consisting of:
  - H2S removal from gas / CO2 partial removal from gas
  - Dehydration unit, using molecular sieves technology
  - Mercury guard
  - Ethane extraction unit producing sales gas, gaseous ethane and NGL's
- NGL fractionation facilities to produce gaseous ethane and sour liquid butane and propane
- Gaseous ethane cut treatment for CO2 removal and drying for further export

- Propane and butane treatment for mercaptan removal and drying for further storage and export
- Export gas compression to export pipeline pressure
- MEG regeneration and injection unit
- Sulphur recovery producing liquid sulphur for further solidification and export
- Utilities, offsites required for operation.

1.2 OBJECTIVES OF THE DOCUMENT

This document details the relief philosophy for the onshore gas processing facilities of the South Pars Gas Field Development, Phases 15 & 16.

Summarised within are the concepts behind the methods employed for protecting the facilities against over-pressurisation. It is not intended that this document describe in detail the design basis for the flare and blowdown systems provided but rather the philosophy to be adopted when designing overpressure protection for equipment/ systems through the Plant.

For details of the design of the flare and blowdown systems, reference should be made to the Flare System Design Basis. For details of the emergency shutdown and depressurising philosophy, reference should be made to the Gas Plant Emergency Shutdown & Depressurising Philosophy.

Reference is also made herein to internationally acknowledged Codes and Standards and to API Recommended Practices.

1.3 REFERENCES

1.3.1 PROJECT SPECIFICATIONS

DB-1516-140-P312-0101	Flare System Design Basis
DB-1516-999-P312-0209	Preliminary Description on Safety Systems
DB-1516-100-P312-001	Process Design Basis for HIPPS Implementation
DB-1516-999-1545-001	Safety Relief Valve Genral Requirement

1.3.2 INTERNATIONAL CODES AND STANDARDS

API RP 520 Part I "Sizing, Selection and Installation of Pressure-Relieving Devices in Refineries, Part I – Sizing and Selection", Seventh edition, January 2000.

API RP 521 "Guide for Pressure-Relieving and Depressurising Systems", Fourth edition, March 1997.

API ST 2000 " Venting Atmospheric and Low Pressure Storage Tanks", Fifth edition, 1998.

ASME Sec. I & VIII ASME Boiler and Pressure Vessel Codes, Eddition 2004.

2. OVERPRESSURE PROTECTION

2.1 OVERPRESSURE CRITERIA

- The simultaneous occurrence of two or more conditions that could result in overpressure shall not be considered if the causes are unrelated, that is if no process, mechanical or electrical linkage exists between them.
- Operator error is considered a potentila source of overpressure. An example would be the inadevertent opening or closing of a valve.
- Overpressure protection shall be used in conjuction with sound enginnering judgment and full consideration of applicable rules and regulations.

- Fail-safe devices, automatic start up equipment and other conventional control instrumentation should not replace pressure-relieving devices as protection for individual process equipment.

2.2 CAUSES OF OVERPRESSURE

Overpressure protection shall be provided throughout the Plant in order to prevent mechanical failure of vessels and pipework on failure of the normal control and operating systems.

All possible causes of system overpressure are to be assessed, as detailed in API RP 520 Part I, API RP 521 and API Std. 2000.

2.3 TYPES OF OVERPRESSURE PROTECTION

Overpressure protection shall be provided by one of the following:

- full pressure rated mechanical design
- pressure relief system
- high integrity protection system (HIPPS)

2.3.1 FULL PRESSURE RATED MECHANICAL DESIGN

If the mechanical design pressure and associated design temperature of the system is greater than the maximum possible system pressure and coincident temperature under all upset conditions. In this instance, no further overpressure protection is required.

At the onshore facilities, this method of overpressure protection shall be employed at all lines and equipment up to the pressure let down station. The maximum gas onshore arrival pressure is 109 barg. *The slug catcher and all lines from slug catcher to ESDV-0039 are designed for 139 barg. Gas heater is designed for 82 barg.*

Relief valves shall, however, still be installed on the slugcatcher and connected to the HP flare system in order to protect against overpressure due to fire.

2.3.2 PRESSURE RELIEF SYSTEMS

In this case, the mechanical design pressure of the process system is set at some margin above the maximum operating pressure. However, under certain upset conditions this design pressure could be exceeded. Pressure relieving devices are therefore used to relieve the accumulating pressure in the system.

The discharges from these relieving devices should be routed to a safe location or, more often, to a common disposal system usually terminating at a flare tip.

Such pressure relief systems will be the principal method of overpressure protection used throughout the onshore facilities.

Section 2.4, below, discusses in more detail the types of relieving devices to be used and their installation.

2.3.3 HIGH INTEGRITY PROTECTION SYSTEMS (HIPPS)

In order to reduce the discharges to the flare, a High Integrity Protection System may be employed. These systems are highly instrumentation intensive, using multiple detectors to observe the rise in system pressure and shutdown valves with signal voting systems.

Such systems should be employed where the design of a pressure relief system would prove to be too large or the loss of inventory would not be acceptable.

Section 2.5, below, details further the installation of HIPPS at the onshore facilities.

2.4 PRESSURE RELIEF SYSTEMS

2.4.1 USE OF PRESSURE RELIEVING DEVICES

The requirement for the installation of pressure relieving devices shall be in accordance with the ASME Boiler and Pressure Vessel Code, as follows:

- Section I : Power Boilers
- Section VIII-Div 1 : Pressure Vessels

Generally, all unfired pressure vessel, including filters and shell and tube heat exchangers, fall under the jurisdiction of Section VIII, while Section I covers fired and electric boilers and organic fluid vapour generators (e.g. Dowtherm vapour generators).

In the case of unfired pressure vessels classified as unfired steam boilers (e.g. waste heat boilers), the vessels can be designed according to Section I or VIII, depending on process conditions and local safety regulations, but their safety devices will follow Section I.

Other types of equipment requiring protection include compressors, pumps, piping and air coolers. Such equipment does not come under the jurisdiction of the above codes. However, safety relief device specification and sizing shall be based on the same rules detailed within the codes.
Reference should also be made to API RP 520 Part I.

The operating and emergency venting requirements of atmospheric and low pressure storage tanks shall be in accordance with API ST 2000.

2.4.2 TYPES OF PRESSURE RELIEF DEVICE

The following types of pressure relieving devices, listed in order of preference, may be used throughout the onshore facilities:

- balanced bellows type relief valves
- conventional spring-loaded type relief valves

- pilot operated relief valves
- buckling pin devices/ rupture discs
- weight loaded devices for venting of storage tanks

The safety relief valves shall meet the requirements of API STD 526.
They shall generally be, except for tank venting or thermal relief, of the direct acting, angle pattern, spring-loaded, full nozzle entry, adjustable blow-down, high-capacity type.
Conventional relief valves shall be used where there is no back pressure or where the back pressure is constant.

Balanced bellows relief valves shall be considered when:

- the back pressure may exceed 10% of the set pressure or is not constant
- the fluid is corrosive or toxic (particularly, bellows will be used on safety relief valves discharging to sour gas flare)
- when two phase flow is expected

For conventional valves, the spring shall be set at the differential pressure between set pressure and constant back pressure.

For balanced valves, the spring shall be set at the set pressure.

Pilot operated pressure safety valves shall be considered when:

- high accuracy of set pressure is required
- quick opening and closing is required

Pilot operated valves shall be used on services such as very high capacities, clean gas in pulsating service.

Pilot operated, balanced bellows or assisted valves may be considered when trying to optimize flare header size and piping.

Buckling pin devices or rupture discs may be installed on intermittent, non-vital services where a much simpler method of overpressure protection could be accepted. It must be noted, that on relieving, such a device will not automatically reset and operator intervention would be required.

Weight loaded safety valves shall be used only for low-pressure safety valves (API 2000).

2.4.3 RELIEF DEVICE SET POINTS

Set points and other characteristics of the pressure relief devices shall be as per API RP 520 Part I for all process equipment, utilities and pressure vessels.

API ST 2000 shall be consulted for the emergency venting requirements of liquid petroleum product tanks.

2.4.4 INSTALLATION OF RELIEF DEVICES

The aforementioned codes specify the relieving capacity required but do not specify the number of relief devices to be installed. This should be confirmed by the process design engineer, based on device type and orifice sizes available. Sufficient devices shall be installed so as to provide the required capacity. Where several valves are required, the set pressures shall be staggered to avoid chattering during relief.

Sparing of relief devices shall be provided, as permitted by the relevant ASME Code, for those vessels protected from overpressure due to reasons other than fire alone. Where spare pressure relief devices are installed, car seal procedures shall be adopted for both upstream and downstream isolation valves. These isolation valves shall be full-bore. The full bore requirement should be noted on the P&ID. Interlock devices with keys shall not be used.

2.4.5 RELIEF SYSTEM PIPING

Inlet lines to pressure relieving devices shall be sized so as to limit the total pressure drop due to non-recoverable losses to 3% of the device set pressure, based on the rated flow of the relieving device.

Discharge lines from pressure relieving devices shall be sized based on built-up backpressure and velocity considerations. For conventional spring-loaded relief valves relieving to atmosphere or safe location, the discharge line shall be sized so as to limit the total pressure drop due to non-recoverable losses to 10% of the device set pressure. For balanced bellows type relief valves relieving to a closed collection system or flare header, a detailed hydraulic analysis of the discharge system shall be performed in order to limit non-recoverable losses to 30 – 50% of the valve set pressure.

Tail-pipes from the relieving device and lines to a common header system shall be sized based on the rated capacity of the relieving device. The common discharge header system shall be sized based on the actual flow calculated due to the controlling upset condition.

All tail pipes and headers discharge to a flare system must free drain to the related flare K.O. drum.

The discharge lines and associated fittings from individual pressure relief devices shall not be smaller than the pressure relief device outlet size.

The materials of construction of the tail pipes must take into account the fluid corrosive properties (if any), the possibility of auto-refrigeration, Joule-Thomson affect, and possibility of sour condition down stream of the relief valve(s). The relief piping shall be selected from material suitable for the lowest expected temperature.

Silencers or any possible form of restriction shall not be installed at the discharge of pressure relief valves without specific authority from the Client.

2.4.6 SPLIT OF RESPONSIBILITY

For those relief devices discharging to “safe location” or to atmosphere (i.e. non-hydrocarbon services), the inlet lines, the devices themselves and the discharge lines shall be sized by the process design engineer responsible for the equipment being protected.

For those relief devices discharging into a closed system (e.g. a flare system), the inlet line to the pressure relief device and the pressure relief device itself shall be sized by the process design engineer responsible for the equipment being protected. The discharge lines and all relief system piping shall be sized by the process design engineer responsible for the flare or closed relief system.

2.5 HIGH INTEGRITY PROTECTION SYSTEMS (HIPPS)

2.5.1 GENERAL

High Integrity Protection Systems (HIPPS) are entirely independent from the Process Control and Emergency Shutdown System. HIPPS shall be selected, as an alternate of conventional system against overpressure, when full pressure rated designs and relief systems prove impractical because of:

- environmental considerations (to avoid relief to atmosphere if possible)
- layout constraints (size of relief headers and associated downstream systems : vents, flares , etc ...)

A HIPPS may be installed in conjunction with a safety relief system, to reduce the size and complexity of the relief system. A SIL (Safety Integrity Level) analysis must be performed on all HIPPS installed. In addition a HIPPS study report must be produced.
For further details of the design of HIPPS, reference should be made to the Preliminary Process Description for Safety Systems.

2.5.2 INSTALLATION OF HIPPS

The design capacity of each of the HP flare systems (one per phase) shall be limited to the design throughput of one phase. (The depressurizing of the gas part of Slug Catcher may be performed through the two HP flare systems simultaneously in order to reduce the time to depressurize.)

A HIPPS shall be installed immediately downstream of the pressure let down station in order to eliminate the potentially high HP flare loads that could occur at the HP Separators due to the change in design pressure at the let down station. Should the let down valve open suddenly following the “packing” of the sea-line and onshore system up to the let down station, the ensuing relief at the HP Separators would far exceed the capacity of the HP flare system.

3. FLARE SYSTEMS

All relief devices capable of relieving hydrocarbons under any failure mode shall relieve to a closed flare system. Hydrocarbons shall not be relieved to the atmosphere directly from relief devices wherever possible. In certain instances where the routing of hydrocarbon vents to a closed relief system is not possible (for example, the low pressure seals on large compressors), discharges may be routed to atmosphere at safe location.

There shall be one high pressure flare system, with separate wet and cold headers and K.O.drums, one medium pressure flare system, with separate wet and cold headers, and one low pressure flare system, with separate wet and cold headers, dedicated to each phase of the Gas Plant. In addition to these there shall also be one Propane/Butane Storage Flare System and a common low low pressure flare system serving the MEG tanks and Offspec Condensate Gas Boot.

Details of these flare systems, including the design capacities, may be found in the Flare Design Basis, DB-1516-140-P312-0101.