High Integrity Pressure Protection System (HIPPS)
What is a HIPPS?

**HIPPS**, High Integrity Pressure Protection System

What is the solution for increasing environmental awareness?

What is the over-pressurization of a plant?

What's the difference with the traditional relief system?

Too much pressure on the lines can cause explosions, hazards, toxic chemicals that will be released into the atmosphere – threatening lives and endangering the environment.

In many cases, the need for pressure relief, including torch burning, that damages the environment is also eliminated or reduced.

**HIPPS** are installed instead of conventional mechanical relief valves to handle high flow rates and high pressures, reducing the risk of production units exceeding their design pressure.

It is a system of relief of high pressure and flow, which lead dangerous processes to a safe predictable state within a certain safe time.
Where can use HIPPS?

They are used in the oil and gas industry as well as in liquefied natural gas (LNG) facilities and transport and storage systems to ensure the safety of pipelines, ships and process packages. Some examples of the application of HIPPS in the Oil & Gas industry are mentioned below:

- Long-distance connection of a high-pressure marginal reservoir with existing surface facilities.

- High pressure well connected to a low pressure flow line.

- Protection of flexible risers against high pressures (Floating Structures)

Applications:

- Wellhead flowline
- Pipeline and compressor stations
- Flaring systems
- Separation and Processing Facilities
- Gas plants
- Gas storage
- Floating production storage and offloading (FPSO) vessels
- Offshore platforms
- Onshore operations
HIPPS´ Technical Specifications

✔ REDUNDANCY:
  - 2003 Pressure Transmitters
  - Isolators to DCS (tripping and deflection alarms)
  - 2003 Relays
  - 1002 Locking valves with 2oo2D–SOV

✔ TESTS:
  - Transmitters and relays arround 5 years
  - 1 Solenoid for 1 month and partial stroke test
  - 5 year complete test

✔ PERFORMANCE:
  - SIL 3
  - > 200 travel spurious trips
Severe Operating Conditions
- Safety Critical Operations
- Reliability in remote locations

“All these factors are key concerns for the oil and gas equipment used in upstream, intermediate and downstream processes. Control valves are a crucial necessity for absolute closure and reliable pressure and flow control”.

A HIPPS is designed and built in accordance with IEC 61508 and IEC 61511 standards. These international standards refer to Safety functions and instrumented safety systems.
A HIPPS system protects site personnel, the general public and the environment, in addition to valuable production assets.

<table>
<thead>
<tr>
<th>Application:</th>
<th>High Integrity Pressure Protection System (HIPPS)</th>
</tr>
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<tbody>
<tr>
<td>Provides:</td>
<td>Noise Reduction</td>
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<tr>
<td></td>
<td>Control of cavitation</td>
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<tr>
<td></td>
<td>Speed Management</td>
</tr>
<tr>
<td></td>
<td>Range reachability: 500:1</td>
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<tr>
<td>Operating conditions:</td>
<td>Pressure range: greater than 15,000 psi</td>
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<tr>
<td></td>
<td>Temperature: -50 - 1400 ° F</td>
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<td></td>
<td>Sizes: 2 - 36 inches</td>
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<td>In preference to:</td>
<td>Torch systems</td>
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<td></td>
<td>Venting or relief systems</td>
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<td></td>
<td>Wellhead Flowlines</td>
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<td>Pipe and compressor stations</td>
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<td>Gas Plant / Gas Storage</td>
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<td>Offshore Platforms</td>
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<td>Onshore Operations</td>
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<td>Other applications:</td>
<td>Floating Storage Ships and discharge of fuels</td>
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<td>Emergency stop systems</td>
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<td>Overpressure Protection Systems</td>
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JUSTIFICATION

**Mechanical relief devices are available to improve concerning:**

- Environmental considerations
- Safety, identifying and mitigating the overpressure risk
- Economic Justifications, Project costs reduction (The undesirable safety relief valves, burners, downstream piping)
- Reduction or elimination of the flare (little or no hydrocarbon in the flame)
- Remove safety valves (API 521, ASME Code Case 2211, ANSI / ISA 84.01–2004, IEC 61511)
- Need to operate a more practical system, Platform weight saving (no flare, no safety relief valve stem, downstream pipe reduction, compact package), Space saving.
- Increased flexibility, Increase operating pressure, performance and production
- Increased diagnostics and reduced downtime (fault location, reset and continuous production)
- Reduce false trips

BENEFITS

- Less gas burning, means money in the pocket
- Less gas burning, means happy atmosphere
- Liberate valuable real estate
BACKGROUND:

- Until August 1996, ASME required the installation of pressure relief devices.
- In Code Case 2211, ASME recognized that overpressure protection should be provided by the most appropriate engineering option.
- The use of HIPPS can be used but should result in an installation that is equally safe or safer than the conventional design.
- The proposed HIPPS is independent of the possible causes of overpressure; It is as reliable as the pressure relief device it is replacing; And is able to fully mitigate an overpressure event.

**International standards to allow the application of highly reliable instrumented safety systems (SIS) to replace traditional mechanical relief devices are:**

- API 521
- Code Case 2211 of ASME Section VIII, Division 1 and 2
- ANSI / ISA 84.01–2004
- IEC 61511
IEC 61508 defines specific guidelines for developing the SIS for risk reduction.

IEC 61511 defines the applications of the process sector that provides guidance for the implementation of the SIS in the process industries.

These documents govern the development of a HIPPS (like specialized SIS) in applications for the protection of pressure of overpressure.

These international standards govern the HIPPS design and define the level of safety integrity (SIL) required for the HIPPS.

For the application of HIPPS:

The application of these new standards and the later development of the SIS technology have allowed the application to replace the mechanical devices:

- The reduction of risks required, results from the need to have SIS security systems with high availability and reliability.
- These systems are often called High Integrity Pressure Protection Systems (HIPPS).
SIS standards cover a variety of techniques for determining SIL requirements; Risk Matrix, Risk Graph and LOPA (protection analysis layers) are techniques that are considered to determine the level of risk for protection by the SIS system.

### Example of Risk Matrix

<table>
<thead>
<tr>
<th>Higher</th>
<th>2</th>
<th>2</th>
<th>2</th>
<th>3</th>
<th>NS</th>
<th>NS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meaningful</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>NS</td>
</tr>
<tr>
<td>Moderate</td>
<td>NR</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Lesser</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>(1) Remote</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
</tbody>
</table>

**NS** = Not suitable; It's required additional safeties

**NR** = Not required; SIF most likely it doesn’t necessary
HIPPS Design Example

HIPPS Logical Solver (Relay Package)

DCS PT-1

DCS PT-1

PT-1

PT-2

PT-3

IAS Relief

IAS Relief

Locking Valve 1

Locking Valve 2
The IEC 61508 standard refers mainly to the LOGIC SOLUTIONS

Less attention to components

61508 defines the System as a logical solver, the initiators and the final elements.

Reliable valves are required

Controls

Actuators

HPU
Sample Skid HIPPS

Logic Solver
Why CTQ?

✓ EXPERIENCE
✓ Responsibility of a single source
✓ Compliance with the IEC 61508
✓ 34 Systems (68 Valves) currently in operation
✓ ZERO FAILURES
✓ Continuation of R + D
✓ Documentation
✓ The fully functional supplied slip system (Plug & Play)
✓ Piggable design
✓ Integration of systems with other suppliers (Measurement, wellheads)
✓ STARTUP SERVICES and startup
✓ Worldwide Support / Field Service
HIPPS packages and systems installations experience is the following:

- 2004 – **BG** – Trinidad
- 2004 – **BG** / Reliance IND – India
- 2005 – **BG** – India
- 2005 – 2006 – **Chevron** – Bangladesh
- 2006 – **BG** – India (Skid de HIPPS)
- 2006 – 2007 – **BG** – Trinidad
- 2008 – **Cairn Energy India** – India
- 2008 – **BG** – Trinidad, Plataforma Hibiscus
- 2009 – **BG** – Trinidad Dolphin Deep – Trinidad
- 2010 – 2011 – **BG** – Bolivia, Plataforma PMO–6
The Bibiyana gas field was developed by Unocal in the country of Bangladesh using HIPPS as the first protection system.

The Bibiyana gas field is located at the NE corner of Bangladesh, at Block 12. Approximately 150 km from the capital of Dhaka.

**PROJECT DESCRIPTION:**

The project will be designed for a total capacity of over 600 MMSCFPD. The Bibiyana field will be developed from the drilling of wells in two separate clusters. The southern cluster will contain the main gas processing facilities. The north cluster is located 4 km from the main cluster. Both will produce approx. 300 MMSCFD of total production.
An HIPPS was seleccionated for the overpressure protection on the pipeline from the North cluster to the South Cluster

**Goals:**
- Security pressure's protection and high reliability
- Minimize the flame on remote clusters for the environment considerations
- Reduce the tubing pressure from wellheads API 5000# clasisification
- Reduce the derived costs from the burners installations.

**Application:**
- HIPPS SIL 3 system located in each flowline for a (7) systems total.
- 4 km of pipeline rated ANSI 600#

**Achievements:**
- Reduction of the downstream pipeline length
- Not burner systems
- Not to the relief valve in the wellhead
- CAPX savings, more than 2 Million USD
Bibiyana HIPPS Layout

Unocal Bangladesh HIPPS Diagram

Bibiyana North Pad

4 Km Gathering Pipeline

Bibiyana South Pad & Gas Treatment Facility
The Bontang LNG plant is the largest in the world, located in eastern Kalimantan, Indonesia.

New gas production from two large offshore fields has been added to Bontang gas pipelines and facilities for gas treatment.

These facilities, Gendalo and Gehem–Ranggas, are floating deepwater installations with new individual pipelines that will feed the existing onshore pipeline system in the Santan terminal.
Limitations and Considerations BONTANG LNG

Pressure limitations existing in the pipeline:

1. HP pipelines from Gendalo and Gehem-Ranggas will supply gas at a pressure of approximately 1000 psig.
2. The existing piping protection system could not withstand higher pressures due to new production.
3. 910 to 940 psig of the pipeline pressure
4. The intake pressure of the Bontang plant is set at 700 psig
5. A pipeline protection system must be used

Technical Considerations for Pressure Reduction:

1. A full flow relief with a burner would require a very large burner (600 + MMSCFD) for each offshore gas pipeline.
2. Customer determined the most effective protection of existing pipeline will be through a HIPPS system
3. Great reduction of burning to the atmosphere
4. Conservation of natural resources
5. Economic justification through the reduction of lost revenues and the Capex of the construction of burner systems.
Under the new regulations, a special SIS called HIPPS can be applied instead of traditional mechanical relief devices.

A risk assessment is conducted to determine the SIL requirement for the HIPPS system.

A properly applied HIPPS system mitigates the risk of overpressure of the system safely without the need for the burning of natural hydrocarbon resources and the environmental problems that the burning represents.