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High Integrity Pressure Protection System (*HIPPS)*

What's HIPPS?

-- HIPPS --
High Integrity Pressure Protection System

- Response to increasing environmental awareness.
- Protection against Process over-pressurization.
- Approved Alternative to traditional relief systems – Reduce Flare
- Reduce OPEX (Relief Valves cost and testing)

Excess uncontrolled pressure in the Process Industry can result in severe threats to human life and the environment when flammable, explosive, hazardous, or toxic chemicals are released to the atmosphere.

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 parameters. It is a system of protection against high pressure & flow situations that leads dangerous processes to a predictable & safe state in a very short time.

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Where can HIPPS be used?

International standards - API 521, Code Case 2211 of the ASME Section VIII, Division 1 and 2, ANSI/ISA 84.01-2004, IEC 61511 - are now in place to allow for the application of high reliability safety instrumented systems to replace traditional mechanical relief devices and to remove the need for flaring.

The evolution of High Integrity Pressure Protection System (HIPPS) has therefore radically reduced the need for traditional mechanical relief devices and the level of flaring in oil and gas applications.

- Long-distance connection of a highpressure 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

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HIPPS Technical Specifications

REDUNDANCY:

- 2oo3 Pressure Transmitters
- Isolators to DCS (trip & deviation alarms)
- 2oo3 Relays
- 1oo2 Block 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 Year MTTF spurious trips

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SIMPLE OR DOUBLE VALVE, MOUNTED ON SKID OR INDEPENDENT, PNEUMATIC, HYDRAULIC OR LINE GAS.

- 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

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A HIPPS system protects site personnel, the general public and the environment, in addition to valuable production assets.

Operating conditions:

Pressure ranges: up to 20,000 psi
Temperature: -50 - 1400 ° F
Sizes: 2 to 36 inches

Applicability:

Torch systems
Replacement of relief systems
Wellhead Flowline Protection
Pipe and compressor stations
Gas Plant / Gas Storage
Offshore Platforms
Onshore Operations
Floating Storage Ships and discharge of fuels
Emergency Shut Down systems
Overpressure Protection Systems

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HIPPS Justification and Benefits

Justification

Improvement over Mechanical relief devices based on:

- Environmental considerations.
- Increased Safety, identifying and mitigating the overpressure risk.
- Project costs reduction (safety relief valves, flares, downstream process line ratings).
- Reduction or elimination of the flare (little or no hydrocarbon in the flame).
- Removal of safety valves (API 521, ASME Code Case 2211, ANSI / ISA 84.01-2004, IEC 61511)
- Easier to operate, practical system.
- Offshore Platform weight savings: No need for flare or safety relief valves, pipe rating reduction.
- Increased flexibility, increase operating pressure, performance and production.
- Increased diagnostics and reduced downtime (fault location, reset and continuous production).
- False trips reduction.

Benefits

- Gas burning reduction.
- Less Capital Expenditure.
- Less Operational Expenses.
- Less False Trips.
- Free valuable real estate for Offshore installations.

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Standards

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
- Case Code 2211 of ASME Sección VIII, Division 1 and 2
- ANSI / ISA 84.01-2004
- IEC 61511

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HIPPS Guidelines

- 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

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.

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Risk Matrix Example

The SIS standards cover a variety of techniques for determining SIL requirements; Risk Matrix, Risk Graph and LOPA (layers of protection analysis) are techniques that are considered to determine the level of risk for protection by the SIS system.

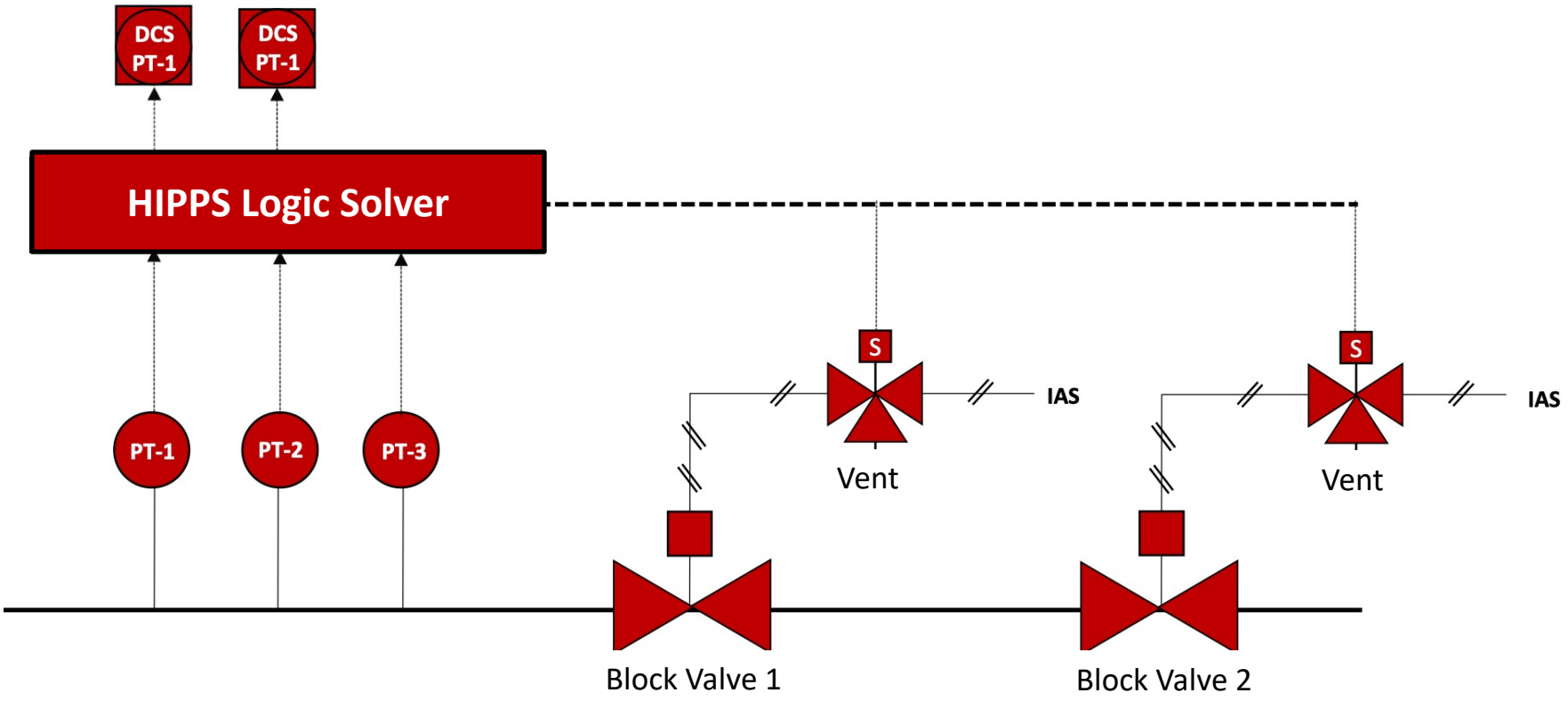
SIL Assignment Matrix to Determine the SIL level to be assigned.

SEVERITY	L	M	H	(2) Occasional	(3) Probable	(4) Frequent
Higher -4	2	2	2	3	NA	NA
Meaningful -3	1	1	2	2	3	NA
Moderate -2	NR	1	1	2	2	3
Less than -1	NR	NR	NR	1	1	2
	(1) Remote					

FRECUENCY

NS = Not suitable; Additional safeties are required.
NR = Not required; SIF most likely not necessary.

HIPPS Architecture



Skid HIPPS

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Skid HIPPS

Logic Solver

Why TRAC?

- Experience.
- Responsibility of a single source.
- Compliance with the IEC 61508.
- 34 Systems (68 Valves) currently in operation.
- Zero Failures.
- Continuation of R+D.
- Complete documentation package.
- Fully functional supplied slip system (Plug & Play).
- Piggable design.
- Integration of systems with other suppliers (Measurement, wellheads)
- Commisioning and Start-Up Services.
- Worldwide Support / Field Service.

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Conclusions

- 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.
- HIPPS Solutions provide direct savings in Capital (CAPEX) and Operational (OPEX) Costs and reduced Space requirements for new and existing Projects.

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HIPPS Experience

- 2004 – BG – Trinidad
- 2004 – BG / Reliance IND – India
- 2005 – BG – India
- 2005 – 2006 – Chevron – Bangladesh
- 2006 – BG – India (Skid HIPPS)
- 2006 – 2007 – BG – Trinidad
- 2007 – 2008 – BG – Trinidad
- 2008 – Cairn Energy India – India
- 2008 – BG – Trinidad, Platform Hibiscus
- 2009 – BG – Trinidad Dolphin Deep – Trinidad
- 2010 – 2011 – BG – Bolivia, Platform PMO-6

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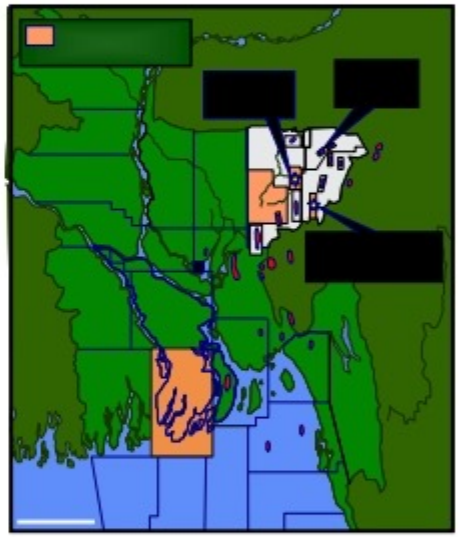
Case Study Bibiyana

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.



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HIPPS Goals Bibiyana

A HIPPS was selected for the overpressure protection on the pipeline from the North cluster to the South Cluster.

Goals

- Security pressure protection and high reliability.
- Remote clusters flame minimization (environment considerations).
- Tubing pressure reduction from wellheads API 5000# clasisification.
- Burners installation cost reduction.

Application

- HIPPS SIL 3 system located in each flowline for a (7) systems total.
- 4 km ofpipeline rated ANSI 600#

Achievements

- Downstream pipeline length reduction.
- No burner systems.
- No wellhead relief valve.
- CAPX savings, more than 2 Million USD.

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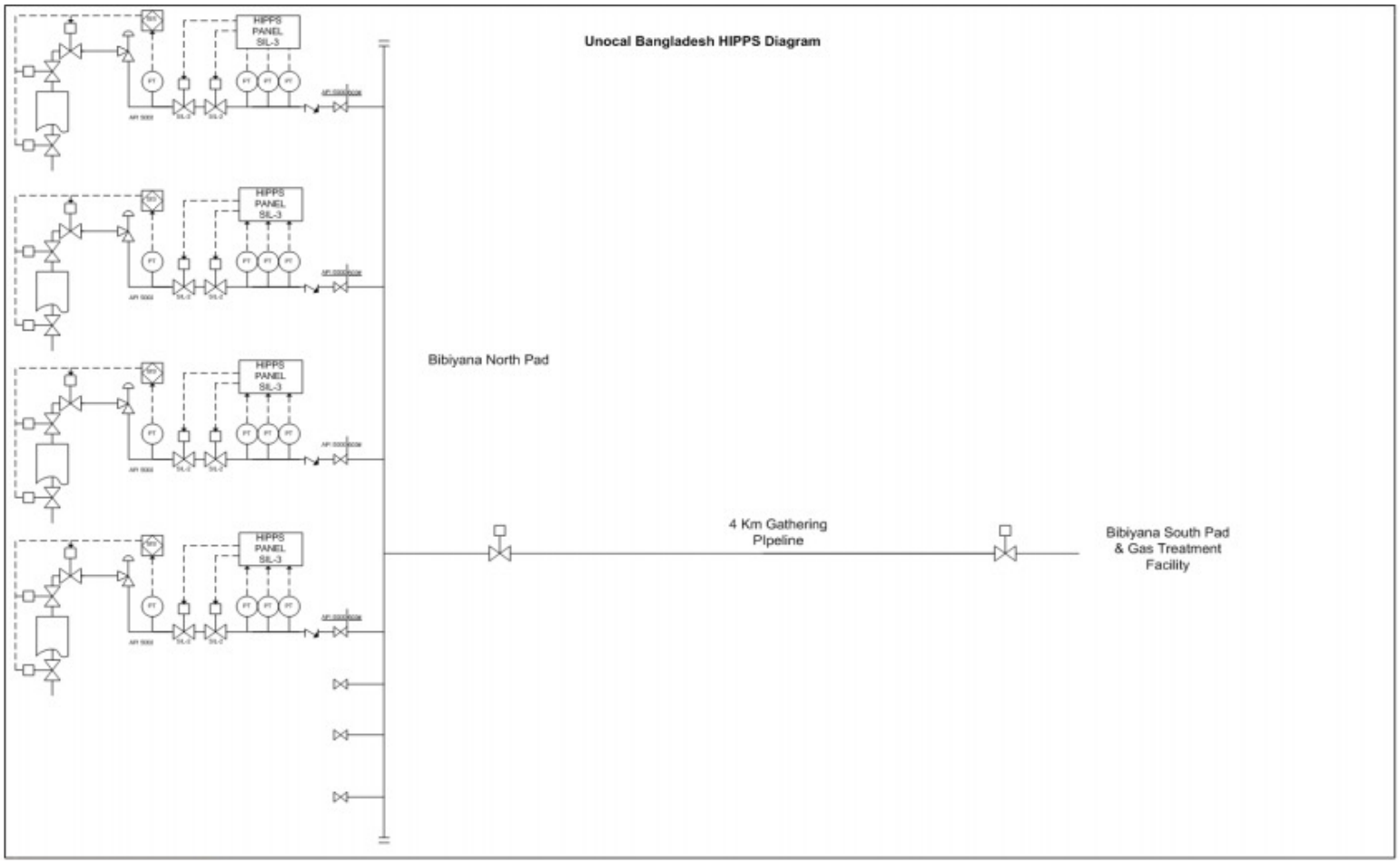
Bibiyana HIPPS Layout



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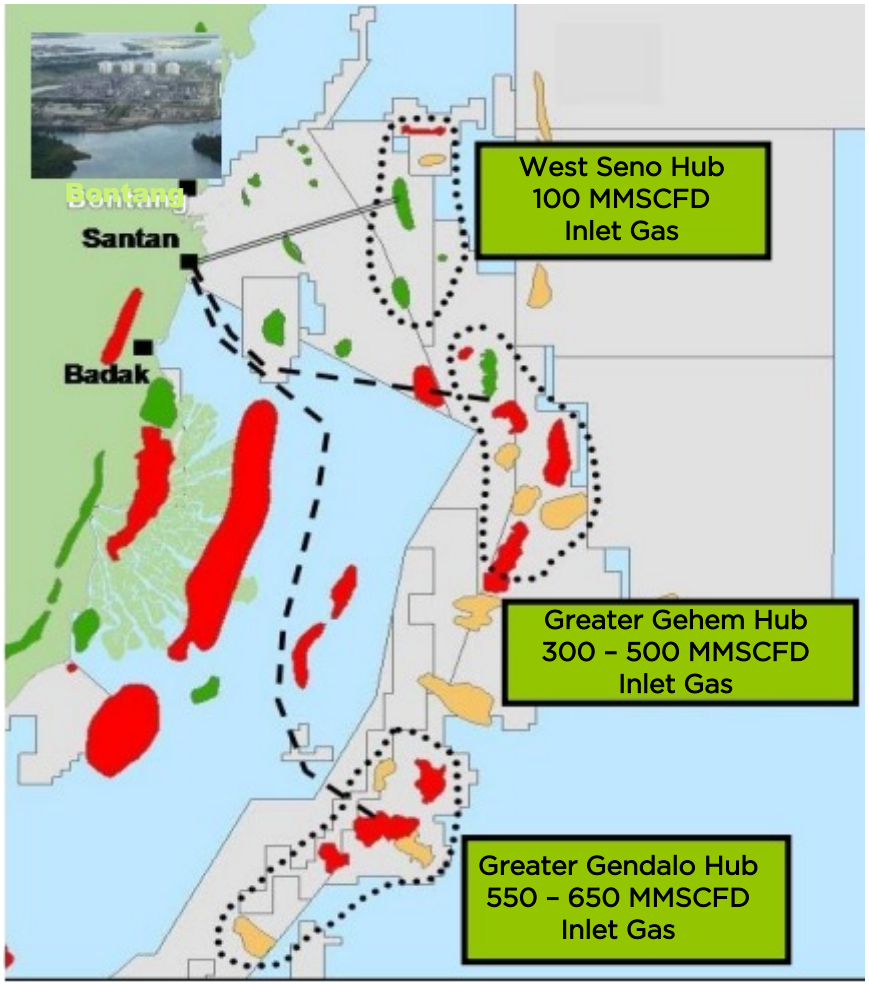
Case Study
Botang LNG



Waterdeep Gas Cube

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.

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Limitations and Considerations Botang LNG

Pressure limitations existing in the pipeline:

1. HP pipelines from Gendalo and GehemRanggas 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.

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