VALVOLE DI CONTROLLO E INTERCETTAZIONE, SISTEMI DI AZIONAMENTO, DISCHI DI ROTTURA E DISPOSITIVI DI SICUREZZA UTILIZZATI NELL'INDUSTRIA DI PROCESSO

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Setting the Standard for Automation™

Out-of-the-box HIPPS for Oil & Gas Wellheads

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Presenter

- Patrick Flanders is a Consultant, ISA Fellow and inventor named on more than 50 international patents. Patrick has 35 years of oil and gas experience including Saudi Aramco, Shell, Amoco, and Getty Oil Company. He serves as a member of API 14C, ISA S84, and S96.
- Patrick is currently the VP of Business Development with ATV HIPPS.

Outline

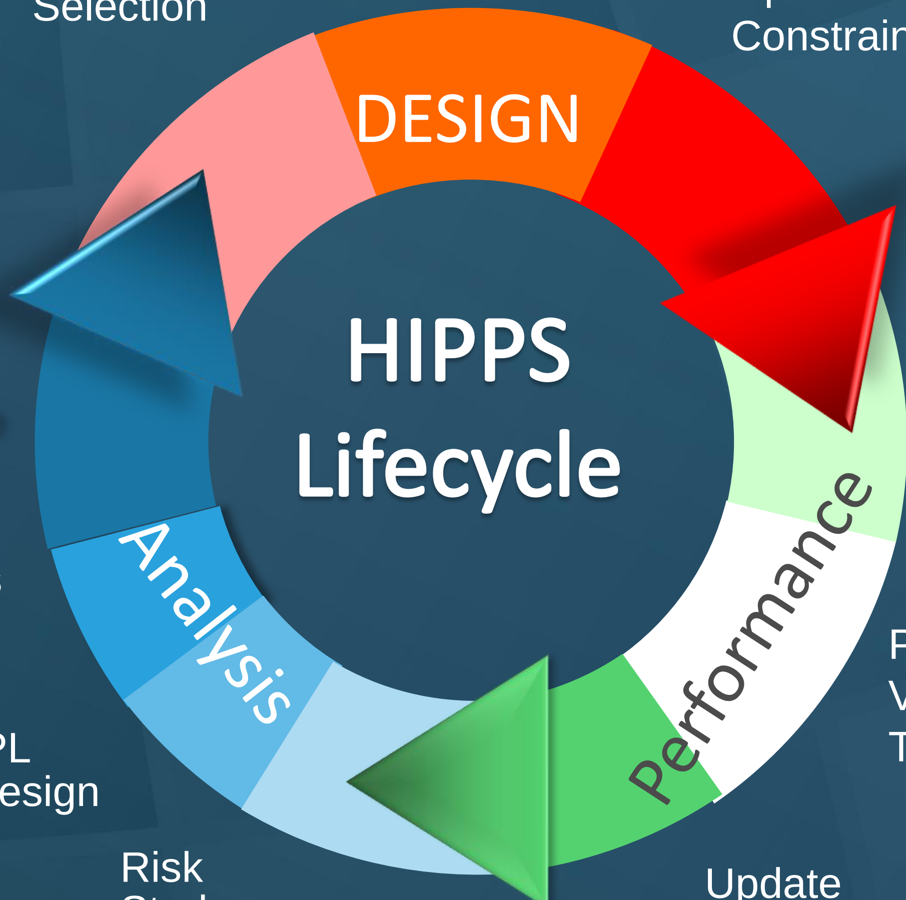
- PSF “life cycle” design approach.
- Out-of-the-box examples of wellhead HIPPS.
- Questions.

Background

- HIPPS is an acronym for High Integrity Pressure Protection Systems.
- International Standards/API/ASME/IEC define risk based and prescriptive design and testing requirements.
- The PSF Life cycle approach includes HIPPS testing and performance verification.

HIPPS is a design alternative that removes the source of overpressure from underrated downstream equipment.

Process Safety Function (PSF) Approach



Deliverables
- Risk Study
- Design
- Simulation
- Functional Test Procedure

ATV HIPPS integration is more than component selection.

Out-of-the-box wellhead HIPPS examples.

Design:

- Risk Reduction Target.
- SIL/PFD.
- Architecture.
- Equipment Selection.
- Test Interval.
- PST Simulation.

Verification:

- Failure rates.
- Architecture.
- Test Procedure.
- Test Interval.
- Installed HRT.
- Installed Risk Reduction.

$$PFD_{avg\ SIF} = PFD_{avg\ Sensors} + PFD_{avg\ LS} + PFD_{avg\ FE} + PFD_{avg\ PS}$$

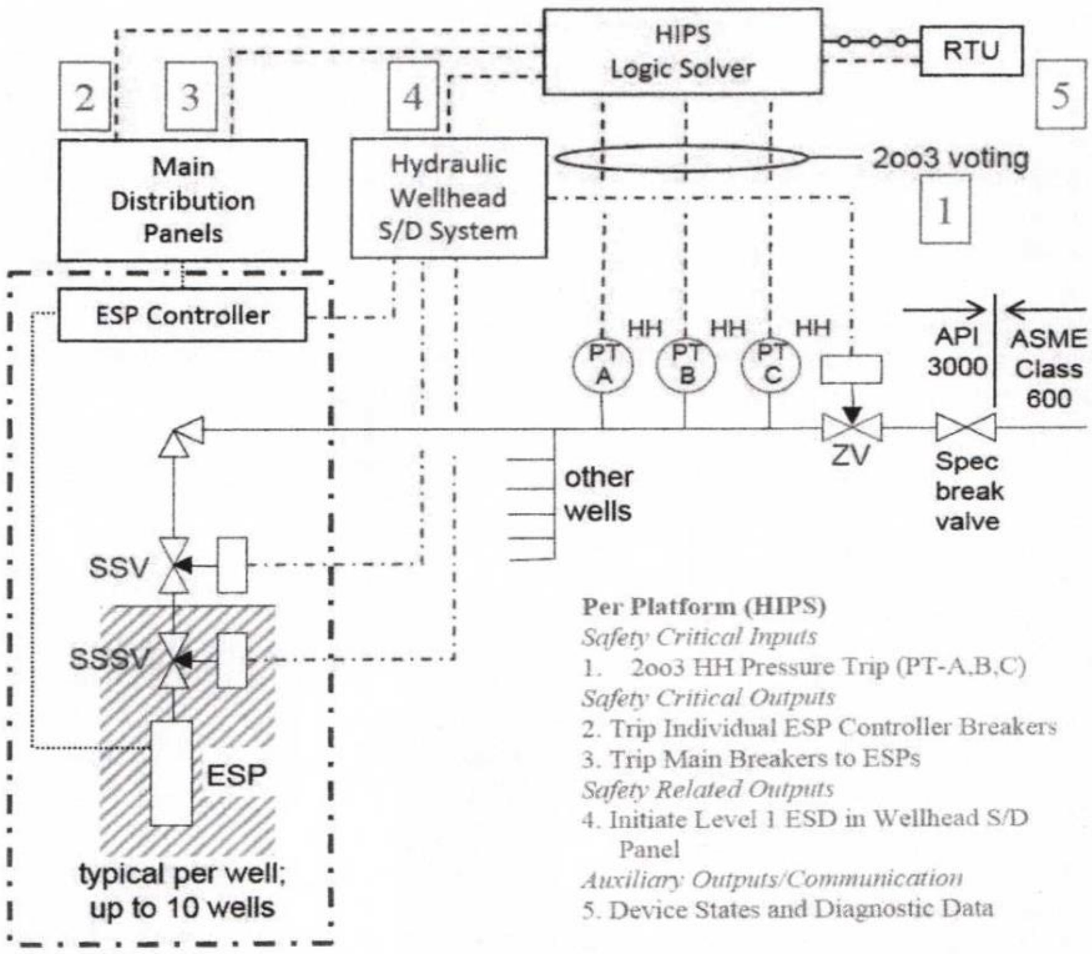
Let's see how architecture, equipment selection, and test interval play a role in real world examples.

Simplified equations for different architectures..

Voting	PFD_{avg}
1oo1	$\left[\lambda^{DU} \times \frac{TI}{2}\right]$
1oo2	$\left[(\lambda^{DU})^2 \times \frac{TI^2}{3}\right] + \left[\lambda^{DU} \times \lambda^{DD} \times MTTR \times TI\right] + \left[\beta \times \lambda^{DU} \times \frac{TI}{2}\right]$
1oo3	$\left[(\lambda^{DU})^3 \times \frac{TI^3}{4}\right] + \left[(\lambda^{DU})^2 \times \lambda^{DD} \times MTTR \times TI^2\right] + \left[\beta \times \left(\lambda^{DU} \times \frac{TI}{2}\right)\right]$
2oo2	$\left[\lambda^{DU} \times TI\right] + \left[\beta \times \lambda^{DU} \times TI\right]$
2oo3	$\left[(\lambda^{DU})^2 \times (TI)^2\right] + \left[3\lambda^{DU} \times \lambda^{DD} \times MTTR \times TI\right] + \left[\beta \times \lambda^{DU} \times \frac{TI}{2}\right]$
2oo4	$\left[(\lambda^{DU})^3 \times (TI)^3\right] + \left[4(\lambda^{DU})^2 \times \lambda^{DD} \times MTTR \times (TI)^2\right] + \left[\beta \times \lambda^{DU} \times \frac{TI}{2}\right]$

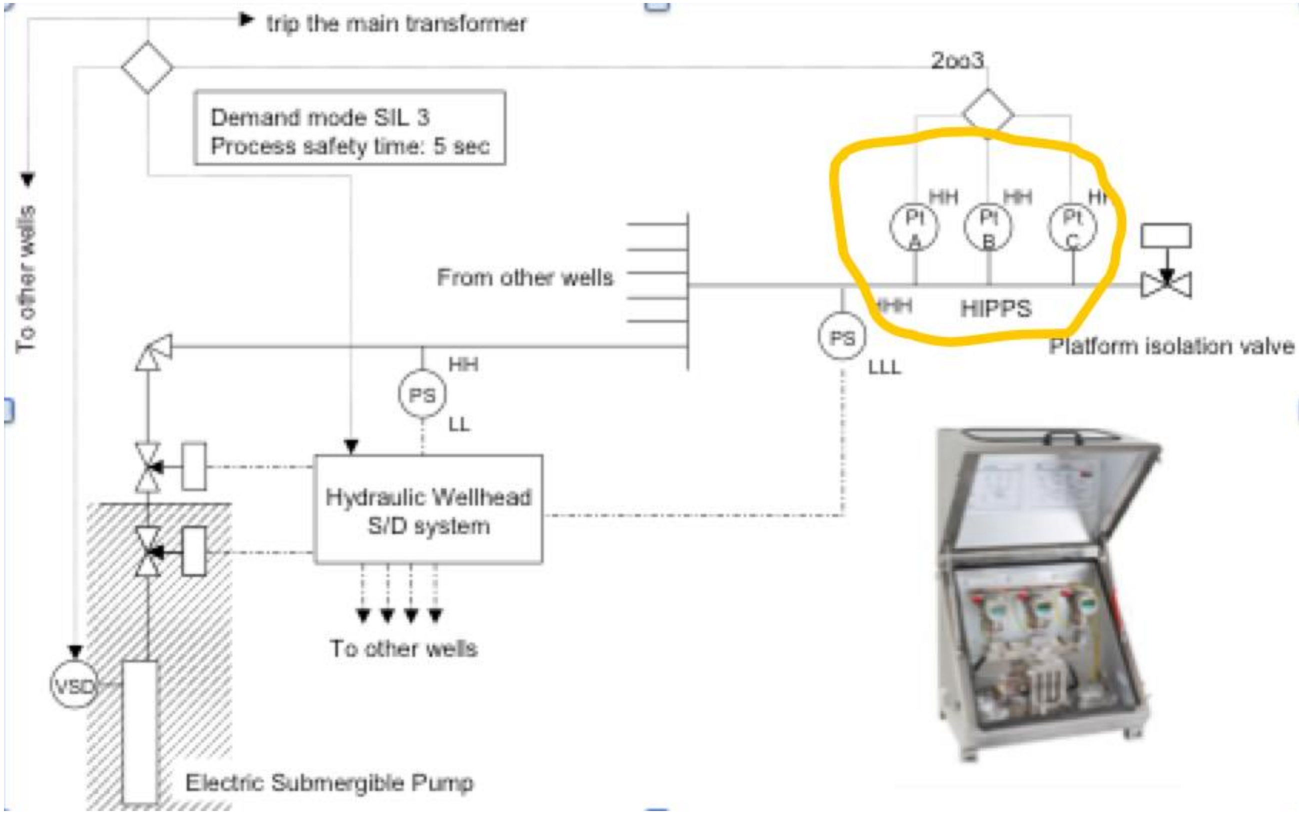
What factors impact the PFD (risk reduction)?

Example 1 – Offshore ESP Production Platform.



What IPL's are present? Where are the sensors? Where are the final elements?

Electric Submersible Pump HIPPS.



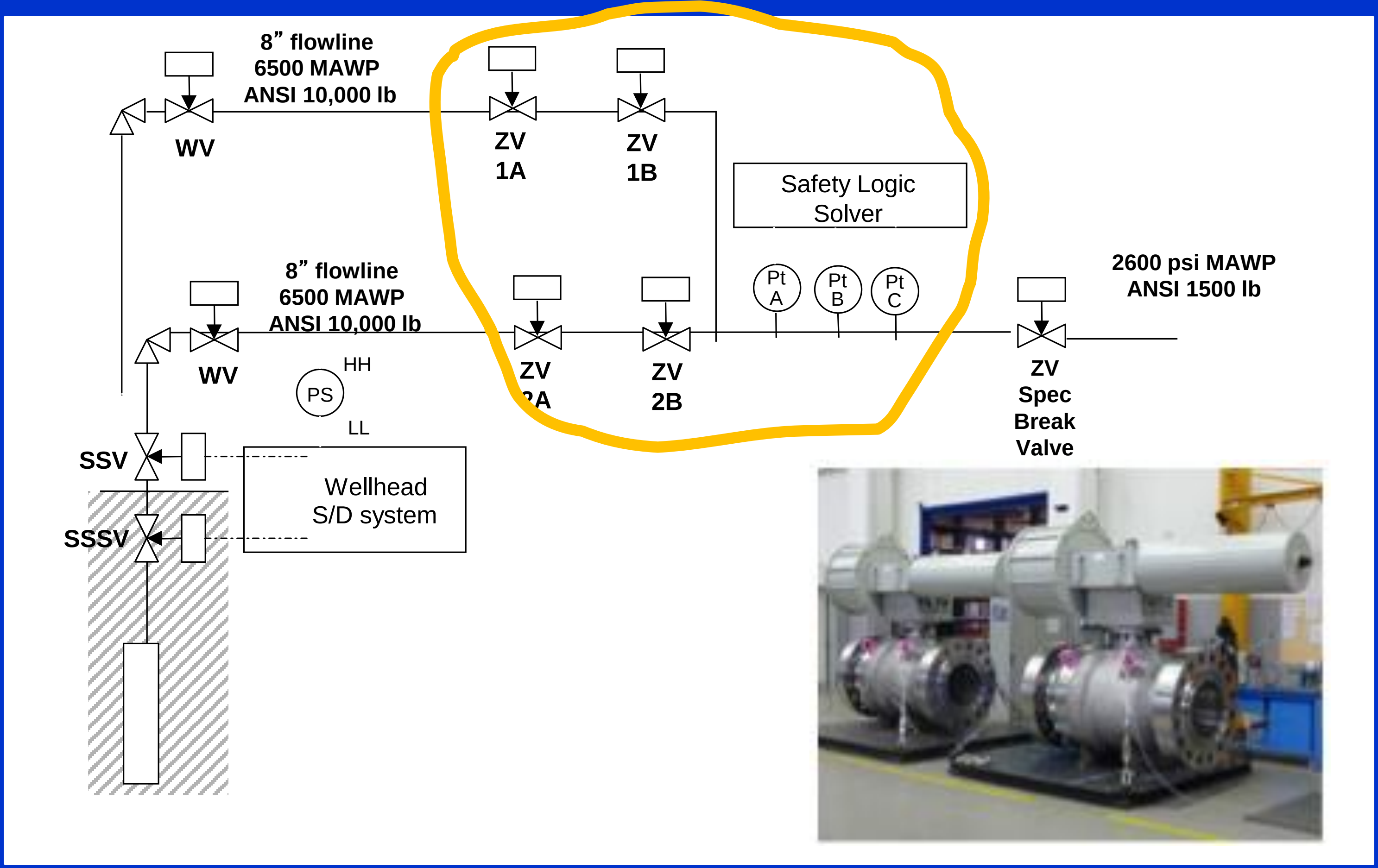
Architecture, device failure rate, and test interval all impact the PFD. How are the sensors voted?

Testing HIPPS Sensors

3	**Dual**	1oo2	25 50 100	1/4 1/2 1
	Triple	2oo3	25 50 100	1/4 1/2 1
	Quad	2oo4	25 50 100	1/2 1 1

2oo3 voting, 100 year failure rate, will reach SIL 3 risk reduction with a 1 year test. But what if the sensors "installed" failure rate is 25 years?

Example 2 - Offshore Gas HIPPS.



Operations requires architecture that allows testing without interrupting production.

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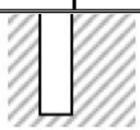
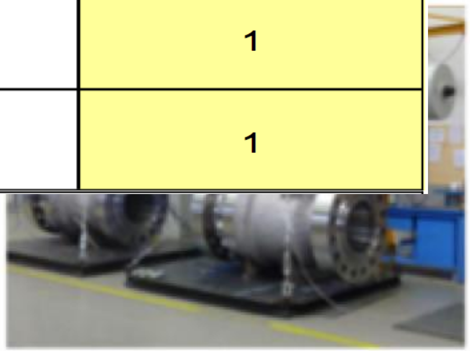
Selection and testing of final elements.

2	Single	1oo1	1/4
	Dual	1oo2	2
		2oo2	Not Recommended
	Triple	1oo3	5
3	Dual	1oo2	1
	Triple	1oo3	1
	Quad	2oo4	1



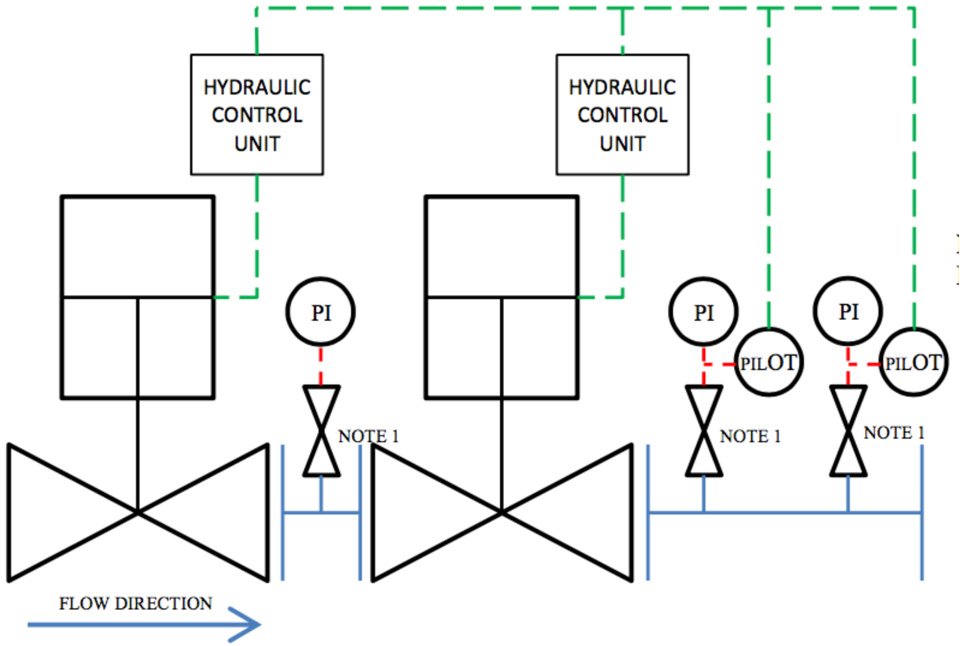


With a ZV failure rate of 25 years, we need to test every 2 years to reach SIL 2. But what if more wells are added that produce to a common header and SIL 3 risk reduction is required at each well?

Example 3 – Onshore oil HIPPS.

What other IPL is present? What architectures were used? Where is the spec break and the choke valve?

Mechanical 1oo2 HIPPS – onshore oil.



Skid mounted, fully self-contained, interchangeable.

Suited for wells with no power.

Functional testing.

What dangerous systematic faults may exist?

PSF HIPPS life cycle design approach.

Different HIPPS, common function … protect the flowline from the wellhead shut-in pressure.

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ATV HIPPS integration offers cost effective and safe solutions.

Thank You.

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