

The role of Standards in an Objective/Risk based Regulatory Regime: An Australian Perspective

Cyprus Standards Roadshow 15th October 2024

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– Department for Energy and Mining South Australia (DEM)



Background: Land Down Under



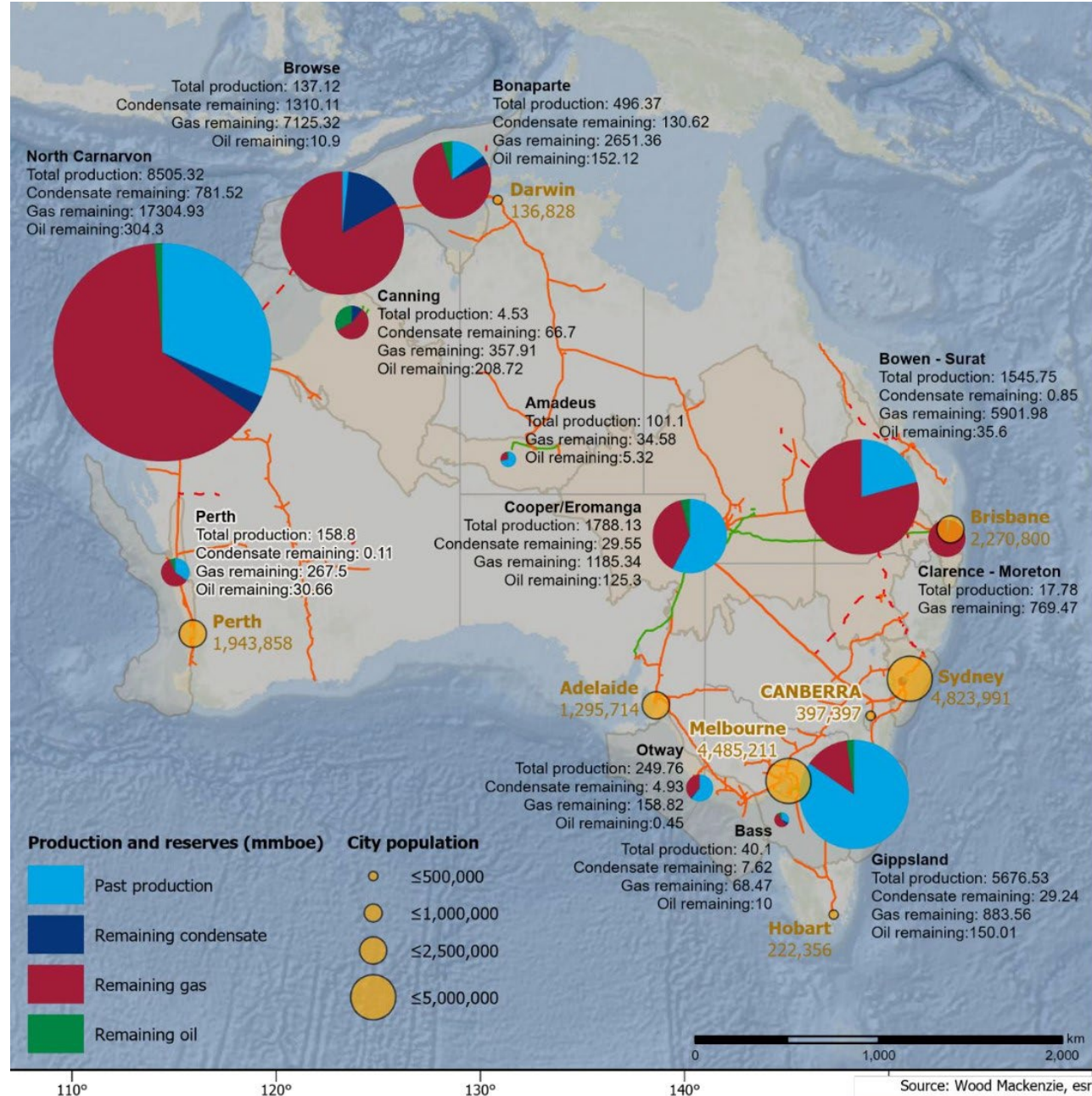
Background: Land Down Under




Government
of South Australia
Department for
Energy and Mining

Background: Australian Oil and Gas Resources

OFFICIAL



Government of South Australia
Department for Energy and Mining

Background: Australian Oil and Gas Regulation

Commonwealth:

Offshore Petroleum and Greenhouse Gas Storage Act 2006

Western Australia:

- Work Health and Safety Act 2020
- Work Health and Safety (Petroleum and Geothermal Energy Operations) Regulations 2022

South Australia:

- Energy Resources Act 2000
- Petroleum (SL) Act 1982

Northern Territory:

- Petroleum Act 1984
- Energy Pipelines Act 1981
- Petroleum (SL) Act 1981

Queensland:

- Petroleum and Gas Act 2004
- Petroleum Act 1923

New South Wales:

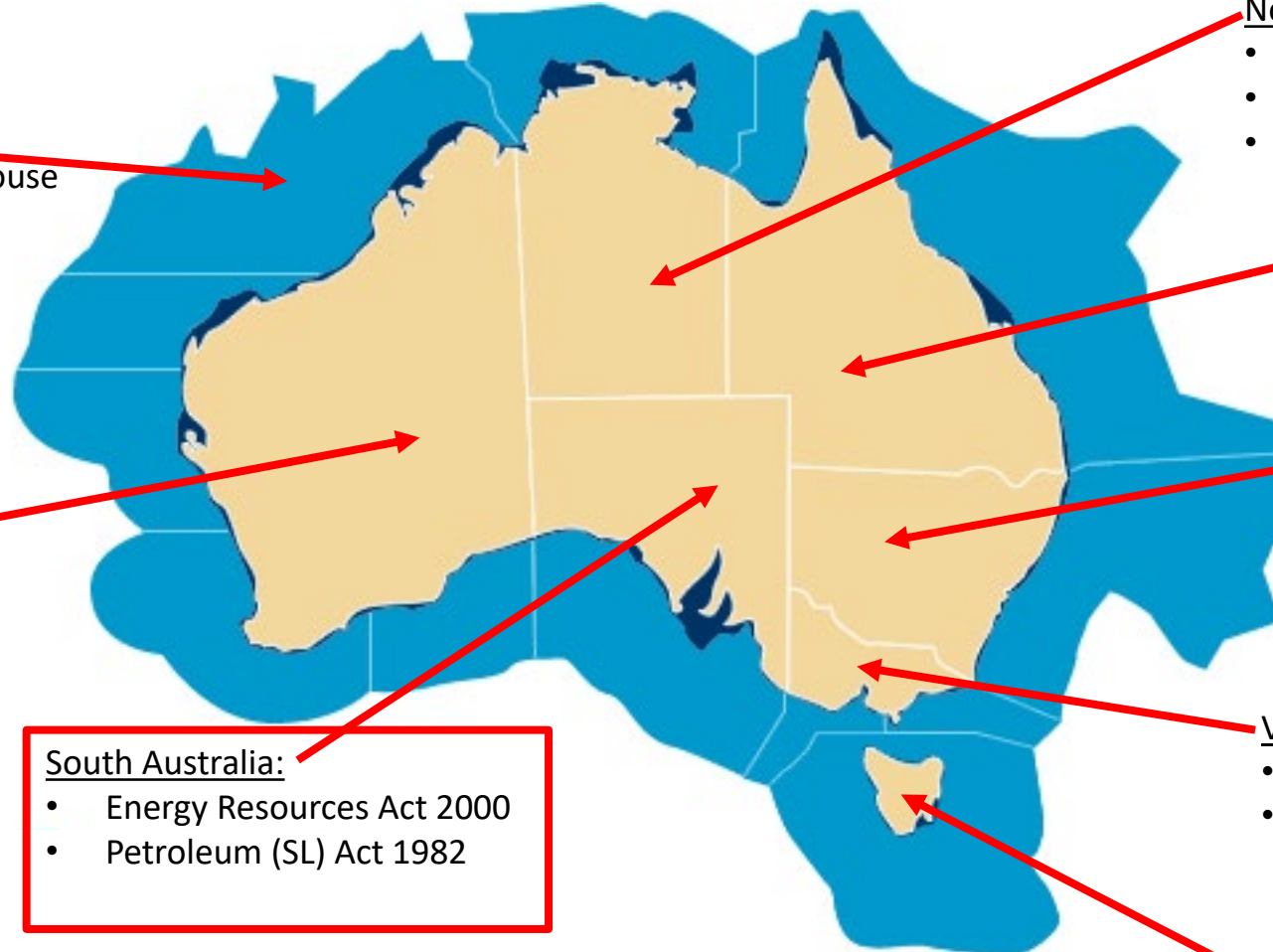
- Petroleum Onshore Act 1991
- WHS (Mines and Petroleum) Act 2013
- Pipelines Act 1967

Victoria:

- Petroleum Act 1998
- Offshore Petroleum and Greenhouse Gas Storage Act 2010

Tasmania:

- Mineral Resources Development Act 1995



Background: South Australian Legislation

- *Energy Resources Act 2000*:
 - Oil and gas exploration and production and processing activities;
 - Geothermal exploration and exploitation activities;
 - Carbon Capture and Storage;
 - Natural CO₂ exploration and exploitation;
 - Underground coal gasification (UCG);
 - Natural hydrogen (gold) exploration and production;
 - Underground regulated substance storage (e.g. natural gas/H₂/CO₂);
 - High pressure transmission pipelines (oil and gas/H₂/CO₂)



Background: South Australian Legislation

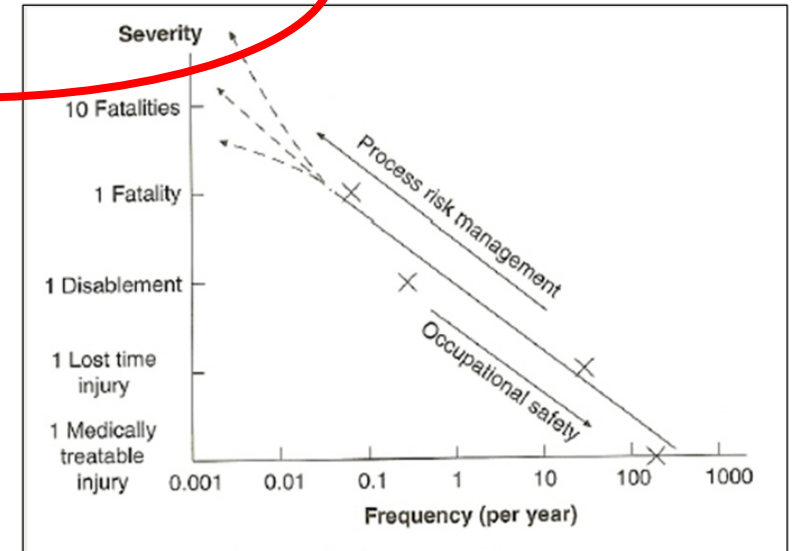
- *Hydrogen and Renewable Energy Act 2023:*
 - Licensing and regulation of renewable energy projects (e.g. wind/solar/wave energy);
 - Associated infrastructure for renewable energy (e.g. power transmission lines, energy storage etc.);
 - Hydrogen generation (includes all hydrogen types, brown/blue/green/pink....etc.);
 - Hydrogen processing facilities (e.g. electrolyzers/methane reformers, surface storage);
 - Hydrogen power plants;
 - Hydrogen export terminals (e.g. wharves)



Regulatory Philosophy

- Objective and Risk-based
- Duty of care/Safety Case Philosophy
 - Process Safety Management Focus
 - Focus on high consequence events
 - Licensees are responsible for demonstrating case for safety and Environment Protection
 - Compliance with good industry practice
 - Good industry practice equates to good standards

Bhopal, 1984; Chernobyl, 1986;
Piper Alpha, 1988; Texas City Refinery, 2005

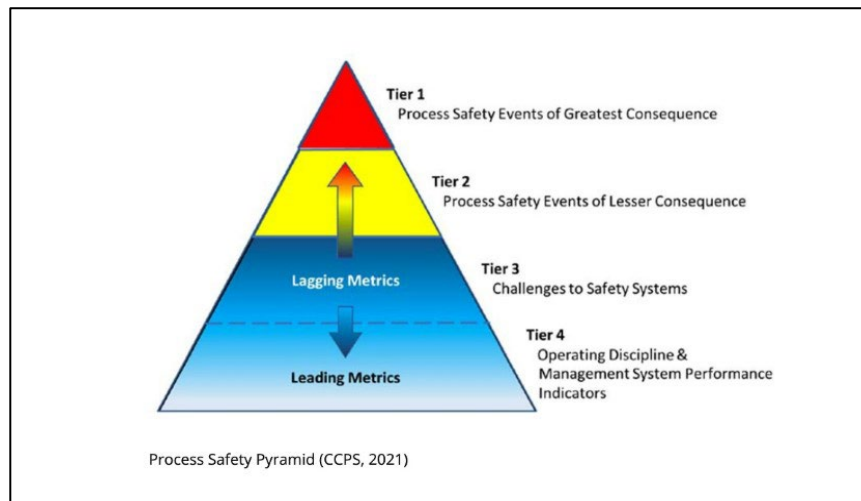


Security of Gas Supply

Environment

Small Gas Release

Small leak



Focussing on compliance to industry standards – forms good basis for leading indicator metrics

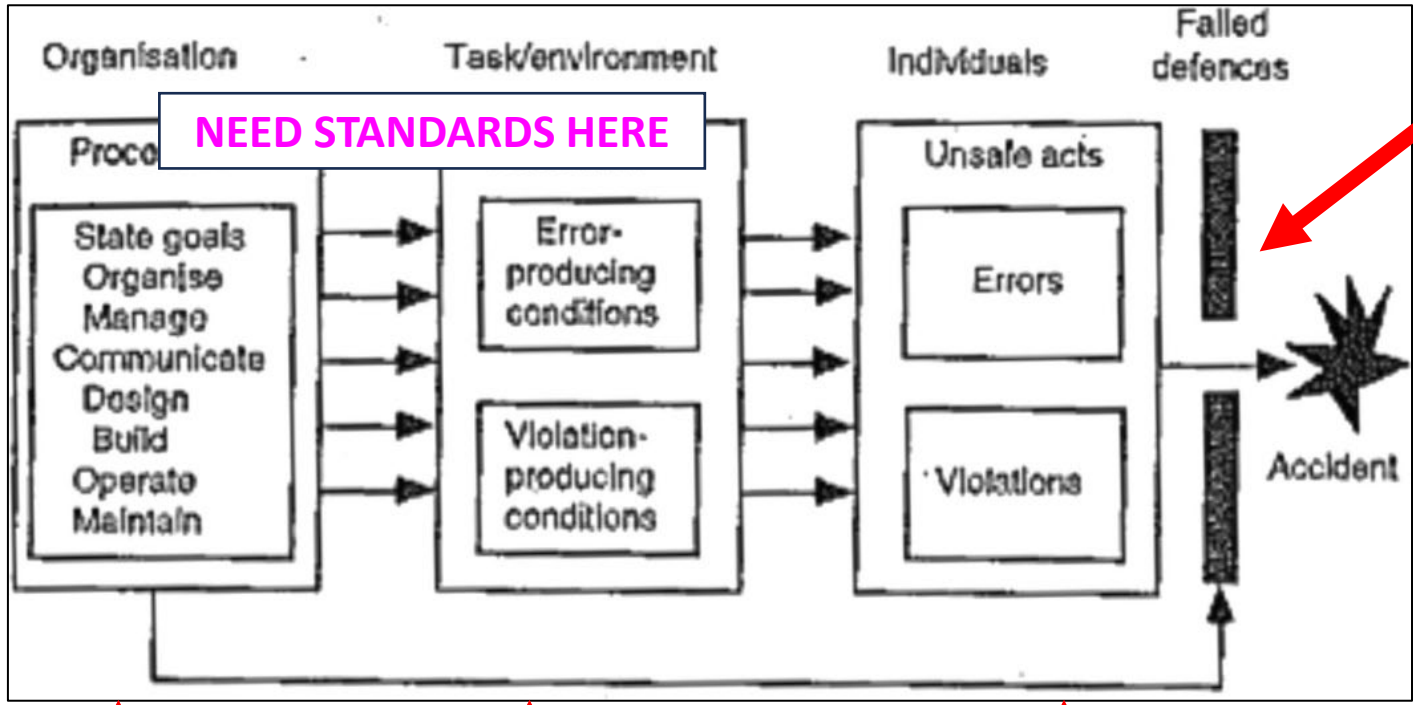


Process Safety Management Philosophy: James Reason Swiss Cheese Model (1993)



“WHY” things Happen

“HOW” things Happen



Example of such defences: SRV's, trip switches, safety XV valves, pipe or vessel containment, BCPS/SIIS, bunds etc.

“WHAT” Happens

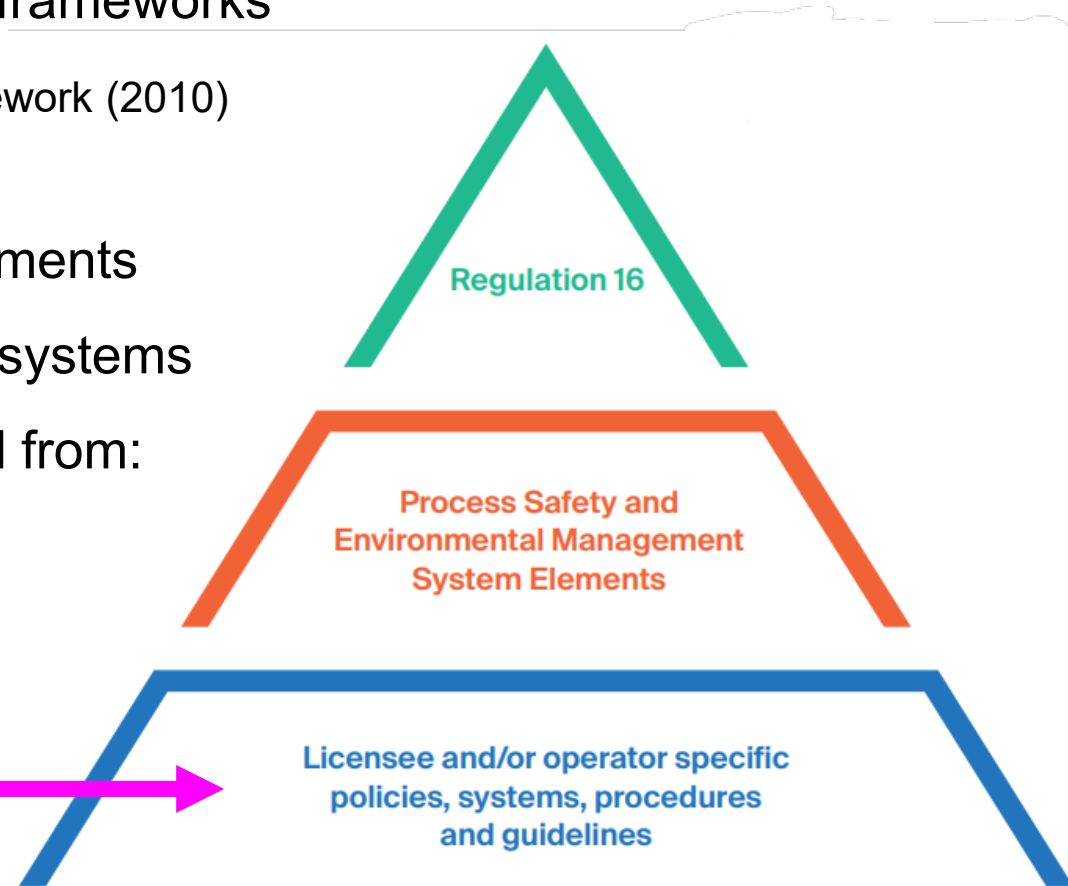
Example of such organisational and systemic conditions include: poor training; poorly written or deficient procedures; poor design; poor construction or commissioning practices; lack of appropriate competencies and training; communication failures; fatigued workers; lack of supervision; inadequate monitoring and maintenance; poor hazard awareness; timeline pressures etc.

Examples of such unsafe acts include failures to: - follow correct procedures; carry out test of SCE; maintain equipment; respond to alarms; check process is not deviating outside safe operating envelope; conform to PTW, undertake MOC.

SEMS Maturity Assessment Framework

- Developed against industry recognised process safety frameworks
 - Energy Institute High Level Process Safety Management Framework (2010)
 - “A recognised industry standard here would be useful”
- 15 PSM Elements, mapped against Regulatory requirements
- Licensees use it as a maturity self-assessment of their systems
- Regulator use it to assess systems using data acquired from:
 - Incident investigations
 - Regulatory inspections/audits
 - Licensee compliance reports (FFP, annual, incident reports etc)
 - Observed licensee behaviours formal and informal

Standards apply here



System Maturity Assessment Elements

- 1) Leadership and awareness
- 2) Identification and compliance with legislation and industry standards
- 3) Management of change and project management
- 4) Hazard identification and risk assessment
- 5) Asset and integrity management
- 6) Critical equipment management
- 7) Planning, manuals and procedures
- 8) Document and records management
- 9) Work control and task risk management
- 10) Competency management
- 11) Communication with stakeholders
- 12) Contractor and vendor management
- 13) Monitoring, assurance, audit and review
- 14) Incident reporting and investigation
- 15) Emergency arrangements.

Table 1 PSEMS element maturity scoring matrix

Score/Level	Description	Maturity
1	Less than expected performance, urgent attention required.	Requirements of the Act (Regulation 16) are met on paper, but oversight is required by the regulator to ensure implementation.
2	Improvement is required in this area.	Element is implemented but generally at minimum levels, but improvement is required to meet the anticipated performance for a low-level official surveillance activity.
3	Ongoing improvement evident.	Element is mostly implemented; plans are in place to improve performance.
4	Expected outcome and satisfactory.	The element is implemented and fit-for-purpose. There is a commitment to continuous improvement.
5	Better than expected performance.	Performance is beyond fit-for-purpose.

System Maturity Assessment Elements

- 1) Leadership and awareness
- 2) Identification and compliance with legislation and **industry standards**
- 3) **Management of change and project management**
- 4) **Hazard identification and risk assessment**
- 5) **Asset and integrity management**
- 6) **Critical equipment management**
- 7) Planning, manuals and procedures
- 8) **Document and records management**
- 9) **Work control and task risk management**
- 10) **Competency management**
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These elements rely on good industry standards e.g:

- ISO 29001/29010 – quality and operating management systems incl. MOC
- ISO 31000 – risk management and assessment
- ISO 17969 Competency for personnel
- ISO 16530 Well integrity life cycle governance
- API RP 59 – well control operations
- AS2885/ISO13623 – pipeline construction and operation standards
- IEC 61511 – functional safety system
- ISO 16528/AS 3788 – pressure vessel testing and inspection
- ISO 10418 – process safety systems
- ISO 15544 – Emergency response plans
- ISO 21457 – Materials selection
- ISO 19277 – qualification testing for coating under insulation
- ISO 27913 – Carbon Dioxide Pipeline systems
- ISO 13623 – Petroleum and Natural Gas Industries Pipeline transportation systems



ISO Standards for use in the oil & gas industry

<p>ISO 3250 Calculation and reporting production efficiency in the operating phase</p> <p>ISO 3421 Offshore drilling conductor (New)</p> <p>ISO 5124 LNG railcar applications (New)</p> <p>ISO 6398-1 Submersible linear motors (New)</p> <p>ISO 10418 Process safety systems</p> <p>ISO 10419 Replaced by API Spec 6W2</p> <p>ISO 10423 Wellhead & christmas tree equipment (Rev)*</p> <p>ISO 12489 Reliability modelling/safety systems</p> <p>ISO 13354 Shallow gas diverter equipment</p> <p>ISO 13533 Drill-through equipment (BOPs)</p> <p>ISO 13534 Hoisting equipment – care/maintenance</p> <p>ISO 13535 Hoisting equipment – specification</p> <p>ISO 13625 Drilling and well-servicing structures</p> <p>ISO 13702 Control and mitigation of fires and explosions</p> <p>ISO 13703 Offshore piping systems (Rev)</p> <p>ISO 14224 Reliability and maintenance data</p> <p>ISO 14692-1 GRP piping vocabulary, symbols, applications and materials</p> <p>ISO 14692-2 GRP piping qualification and manufacture</p> <p>ISO 14692-3 GRP piping system design</p> <p>ISO 14692-4 GRP piping fabrication, installation and operation</p> <p>ISO 14693 Drilling equipment</p>	<p>ISO 15138 Heating, ventilation and air-conditioning (Rev)</p> <p>ISO 15156 Cracking resistant materials for use in H2S environments</p> <p>ISO 15544 Emergency response</p> <p>ISO 15663 Life cycle costing (Rev)</p> <p>ISO 16901 Risk assessment in the design of onshore LNG installations (Rev)</p> <p>ISO 16903 Characteristics of LNG influencing design and material selection</p> <p>ISO 16904 LNG Marine Transfer Arms</p> <p>ISO 17177 Unconventional LNG transfer systems</p> <p>ISO 17292 LNG Metal ball valves</p> <p>ISO 17776 Major Accident hazard management during design</p> <p>ISO 17781 Duplex stainless steel materials testing (New)</p> <p>ISO 17782 Qualification of manufacturers of special materials</p> <p>ISO 17945 Materials resistant to sulfide stress-cracking</p> <p>ISO 17969 Guidelines on competency for personnel</p> <p>ISO 18083 Systems and installations for supply of LNG as fuel to ships (Rev)</p> <p>ISO 19008 Standard Cost Coding System</p> <p>ISO 19277 Qualification testing for coating under insulation (Rev)</p> <p>ISO 20521 Powered elevators</p> <p>ISO 20815 Production assurance and reliability management</p> <p>ISO 21457 Materials selection</p> <p>ISO 23936-1 Thermoplastics (Rev)</p> <p>ISO 23936-2 Elastomers</p> <p>ISO 27469 Method of test for offshore fire dampers</p> <p>ISO 29001 Sector-specific quality management systems</p>	<p>ISO 10855-1 Offshore containers design, manufacture and marking (New)</p> <p>ISO 10855-2 Offshore containers lifting sets (New)</p> <p>ISO 10855-3 Offshore containers periodic inspection (New)</p> <p>ISO 10864 Modular drilling rigs (New)</p> <p>ISO 10797-1 Elastomeric coating of frisers – polychloroprene or EPDM Maintenance and field repair (New)</p> <p>ISO 10797-2 General requirements for offshore structures</p> <p>ISO 10900-1 Methocean design and operating considerations</p> <p>ISO 10900-2 Service design procedures and criteria (Rev)</p> <p>ISO 10900-3 Topside structure (Rev)</p> <p>ISO 10900-4 Geotechnical and foundation design (Rev)</p> <p>ISO 10900-5 Weight control (Rev)</p> <p>ISO 10900-6 Marine operations</p> <p>ISO 10900-8 Mainesoil investigations (Rev)</p> <p>ISO 10900-9 Structural Integrity Management</p> <p>ISO 10900-10 Marine geophysical investigations (New)</p> <p>ISO 10902 Fixed steel offshore structures</p> <p>ISO 10903 Fixed concrete offshore structures</p> <p>ISO 10904 Monoliths, semi-submersibles and spars</p> <p>ISO 10905-1 Site-specific assessment of jack-ups (Rev)</p> <p>ISO 10905-2 Jack-ups commentary</p> <p>ISO 10905-3 Site-specific assessment of mobile offshore units (Rev)</p> <p>ISO 10906 Arctic offshore structure</p> <p>ISO 35100 Arctic Working environment</p> <p>ISO 35102 Arctic Operations/Escapes, evacuation and rescue</p> <p>ISO 35103 Arctic Environmental monitoring</p> <p>ISO 35104 Arctic operations – ice management (New)</p> <p>ISO 35105 Arctic material (New)</p> <p>ISO 35106 Arctic meteorology, ice and seabed data</p>	<p>ISO 3977-5 Gas turbines – procurement</p> <p>ISO 6308 Compressors – dry gas sealing systems (New)</p> <p>ISO 10428 Sucker rods</p> <p>ISO 10431 Pumping units</p> <p>ISO 10434 Bolted bonnet steel gate valves</p> <p>ISO 10436 Replaced by API Std 611</p> <p>ISO 10437 Special purpose steam turbines</p> <p>ISO 10438 Lubrication, shaft-sealing and control-oil systems, Parts 1-4</p> <p>ISO 10439 Centrifugal compressors</p> <p>ISO 10440-1 Rotary type positive displacement process compressors</p> <p>ISO 10440-2 Rotary PD packaged air compressors</p> <p>ISO 10441 Flexible couplings – special</p> <p>ISO 10442 Integrally geared air compressors</p> <p>ISO 10443 Spiral plate heat exchangers</p> <p>ISO 10444 Multiple heat exchangers</p> <p>ISO 10445 Reciprocating gas compressors</p> <p>ISO 13681 High speed enclosed gear units</p> <p>ISO 13691 Calculation of shaft tube thickness (Rev)</p> <p>ISO 13704 Fired heaters for general service</p> <p>ISO 13705 Air-cooled heat exchangers</p> <p>ISO 13706 Reciprocating compressors</p> <p>ISO 13707 Centrifugal pumps</p> <p>ISO 13710 Reciprocating positive displacement pumps</p> <p>ISO 14691 Flexible couplings – general</p> <p>ISO 15547 Heat exchangers, Parts 1-2</p> <p>ISO 15648 Piping</p>	<p>ISO 15761 Steel valves DN 100 and smaller</p> <p>ISO 16012 Shell & tube heat exchangers</p> <p>ISO 16901 Risk assessment of onshore H2 storage tanks (Rev)</p> <p>ISO 16961 Internal coating and lining of steel storage tanks (Rev)</p> <p>ISO 17177 Unconventional LNG transfer systems</p> <p>ISO 17292 Metal ball valves</p> <p>ISO 17348 Materials Selection in CO2E environment for casing, tubing and downhole equipments</p> <p>ISO 17349 Steel tanks containing high levels of CO2</p> <p>ISO 18024 Guidelines for design of LNG storage tanks</p> <p>ISO 18796-1 Internal coating and lining of process vessels</p> <p>ISO 20080-1 Resistance to cryogenic spillage of insulation materials – Liquid phase</p> <p>ISO 20080-2 Resistance to cryogenic spillage of insulation materials – Vapor phase</p> <p>ISO 20080-3 Resistance to cryogenic spillage of insulation materials</p> <p>ISO 20252-1 General requirements for floating LNG installations</p> <p>ISO 20252-2 Specific requirements for FSU (New)</p> <p>ISO 21049 Centrifugal and rotary pumps shaft sealing</p> <p>ISO 22521 Pressure relieving and depressuring systems</p> <p>ISO 24017 Composite repairs for pipework</p> <p>ISO 25457 Flange details</p> <p>ISO 27500 Compact flanged connections</p> <p>ISO 28300 Lifting of storage tanks (Rev)</p> <p>ISO 28360 LNG – Ships to shore interface</p>		
<p>ISO 13628-1 Subsea production systems</p> <p>ISO 13628-2 Subsea flexible pipe systems</p> <p>ISO 13628-3 Subsea TLP, pumpdown systems</p> <p>ISO 13628-4 Subsea wellhead and tree equipment</p> <p>ISO 13628-5 Subsea control umbilicals</p> <p>ISO 13628-6 Subsea production controls</p> <p>ISO 13628-7 Completion/workover riser system</p> <p>ISO 13628-8 RCT and interfaces</p>	<p>ISO 13624 Marine drilling riser systems, Parts 1-2</p> <p>ISO 13625 Marine drilling couplings</p> <p>ISO 19901-7 Stationkeeping systems</p>	<p>ISO 13628-9 RCT intervention systems</p> <p>ISO 13628-10 Bonded flexible pipe</p> <p>ISO 13628-11 Flexible pipe systems for subsea and marine applications</p> <p>ISO 13628-15 Subsea structures and manifolds</p>	<p>ISO 13900 Drilling fluids</p> <p>ISO 13901 Drilling fluids – processing systems evaluation</p> <p>ISO 13901-1 Measurement of viscosity properties of completion fluids</p> <p>ISO 13901-2 Measurement of properties of preproppants</p> <p>ISO 13901-3 Testing of heavy fines (Rev)*</p> <p>ISO 13901-4 Measurement of stimulation & gravel pack fluid leakoff</p> <p>ISO 13901-5 Measurement of long term conductivity of preproppants</p> <p>ISO 13901-6 Measuring leak-off of completion fluids under dynamic conditions</p> <p>ISO 13678 Thread compounds</p> <p>ISO 13679 Casing and tubing connections testing</p> <p>ISO 13680 CRA seamless tubes for casing & tubing</p> <p>ISO 14310 Packers and bridge plugs</p> <p>ISO 14998 Accessory completion equipment</p> <p>ISO 15136 Progressing cavity pump systems, Parts 1-2</p> <p>ISO 15463 Field inspection of new casing, tubing, and plain end drill pipe</p> <p>ISO 15464 Gauging and inspection of threads</p> <p>ISO 15551-1 Electric submersible pump systems for artificial lift (Rev)</p> <p>ISO 15546 Aluminium alloy drill pipe</p>	<p>ISO 16090 Lock mandrels and landing nipples</p> <p>ISO 16530-1 Well integrity manual</p> <p>ISO 17078-1 Side-pocket mandrels</p> <p>ISO 17078-2 Flow control devices for side-pocket mandrels</p> <p>ISO 17078-3 Latches & seals for side-pocket mandrels & flow control devices</p> <p>ISO 17078-4 Side-pocket mandrels and related equipment</p> <p>ISO 17824 Sand control screens</p> <p>ISO 20312 Design of aluminium drill string</p> <p>ISO 27627 Aluminium alloy drill pipe thread gauging</p> <p>ISO 28781 Subsurface tubing mounted formation barriers</p> <p>ISO 3183 Steel pipe for pipeline transportation systems</p> <p>ISO 12499 Actuation, mechanical integrity and sizing for pipeline valves</p> <p>ISO 12736 Wet thermal insulation coatings (Rev)</p> <p>ISO 12747 Pipeline life extension (Rev)</p> <p>ISO 13623 Pipeline transportation systems (I and II)</p> <p>ISO 13947 Welding of pipelines</p> <p>ISO 14313 Pipeline valves</p> <p>ISO 14723 Subsea pipeline valves</p>	<p>ISO 15389-1 Cathodic protection of on-land pipelines</p> <p>ISO 15389-2 Cathodic protection for offshore pipelines (Rev)</p> <p>ISO 15590-1 Pipeline induction bends</p> <p>ISO 15590-2 Pipeline fittings (Rev)</p> <p>ISO 15590-3 Pipeline flanges (Rev)*</p> <p>ISO 15590-4 Pipeline factory cold bend</p> <p>ISO 16440 Steel cased pipelines</p> <p>ISO 16708 Pipeline reliability-based limit state design</p> <p>ISO 19345-1 Full life cycle integrity management for onshore pipeline</p> <p>ISO 19345-2 Full life cycle integrity management for offshore pipeline</p> <p>ISO 20674 Geological hazards risk management of pipelines</p> <p>ISO 21329 Test procedures for pipeline mechanical connectors (Rev)</p> <p>ISO 21809-1 Polyethylene coatings (3-layer PE and 3-layer PP)</p>	<p>ISO 21809-2 Fusion-bonded epoxy coatings (Rev) ISO 21809-3 Pipeline field joint coatings (Rev)</p> <p>ISO 21809-4 Polyethylene coatings (2-layer PE)</p> <p>ISO 21809-5 Pipeline external concrete coatings (Rev)</p> <p>ISO 21809-11 Pipeline coating repairs</p> <p>ISO 21857 Corrosion prevention of pipeline systems by stray currents (New)</p> <p>ISO 22504 Pig trap (Rev)</p> <p>ISO 22974 Pipeline integrity (New)</p> <p>ISO 24139-1 Clad bends (New)</p> <p>ISO 24139-2 Clad fittings (New)</p> <p>ISO 24277 Internal coatings for corrosion protection (New)</p> <p>ISO 24300 Pipe support (New)</p> <p>ISO 24302 Monorail beam and padeye (New)</p> <p>ISO 24565 Ceramic lined tubing (New)*</p>



Standards in purple* issued in 2021
Standards in blue are a priority for 2022 issue
* already published in 2022 (reference date 2022-04-26).

These ISO standards, TR and TS (abbreviated titles) are only a core collection of several hundreds of standards available for the oil & gas industry from AENIT, ANSL, API, AS, BSI, CSA, NORSOK, NF, GOST, SAC, etc. Some ISO/TC67 standards have been withdrawn and the relevant API standard is referenced above

PSM System Self-Assessment Latest Results



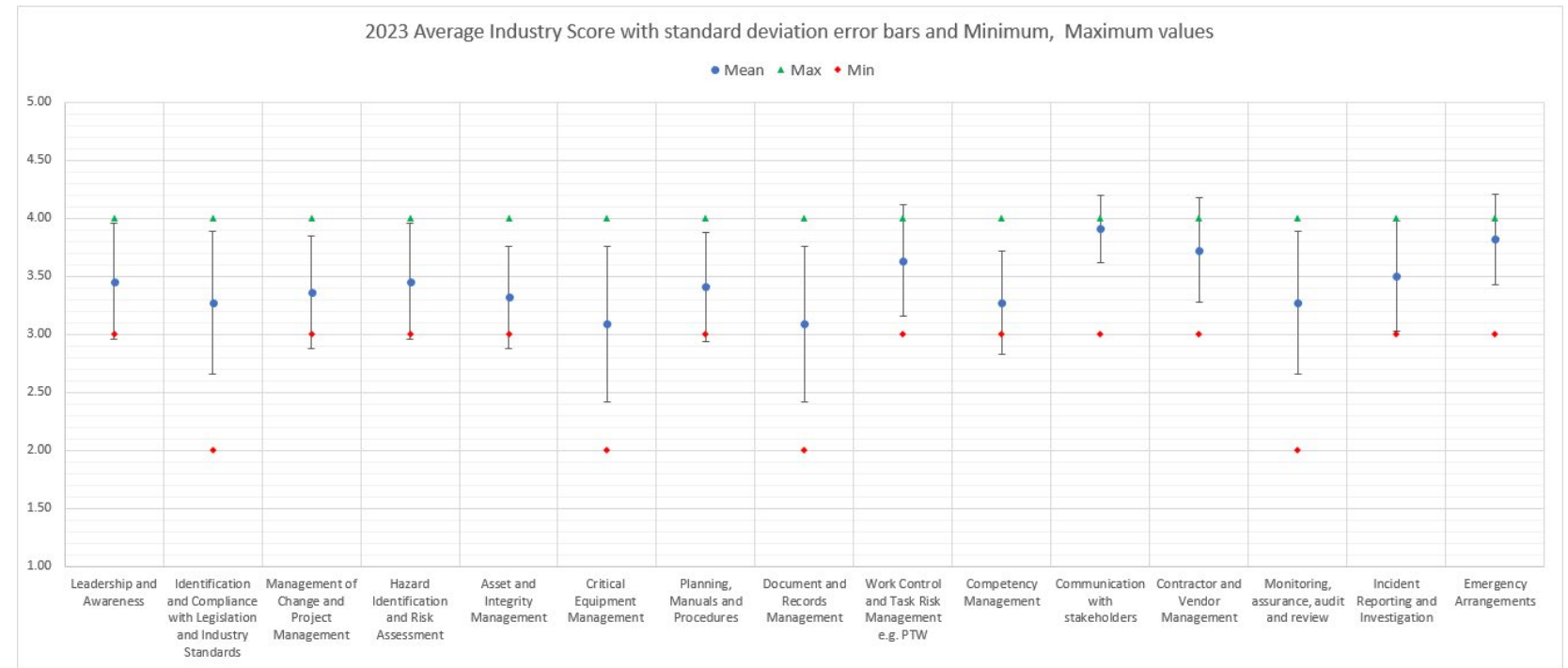
Identified areas for improvement:

- (5) Asset integrity management
- (6) Critical equipment management
- (8) Documents and Records Management
- (13) Monitoring, assurance, audit and review

Results influence regulatory surveillance focus

Regulatory surveillance includes focus on standards:

- Are they the correct ones?
- Are they properly applied?
- Do they reflect good practice?



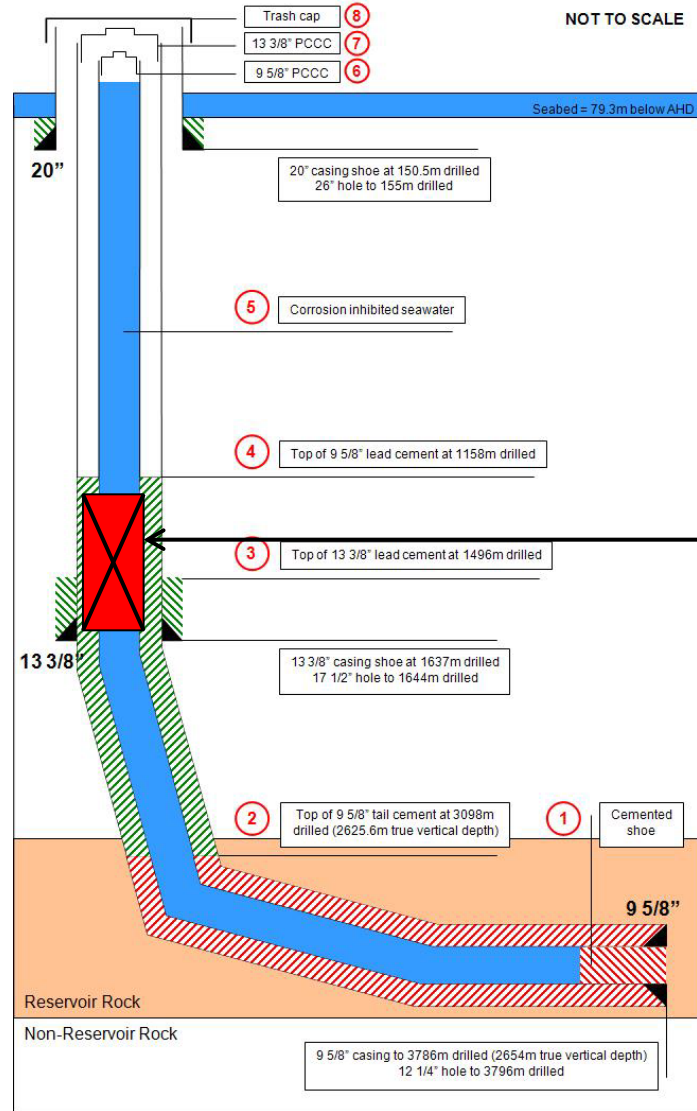
CASE STUDIES: Why standards are important



Well blow out case study:

Well Construction and Suspension Operation

How it should have been done

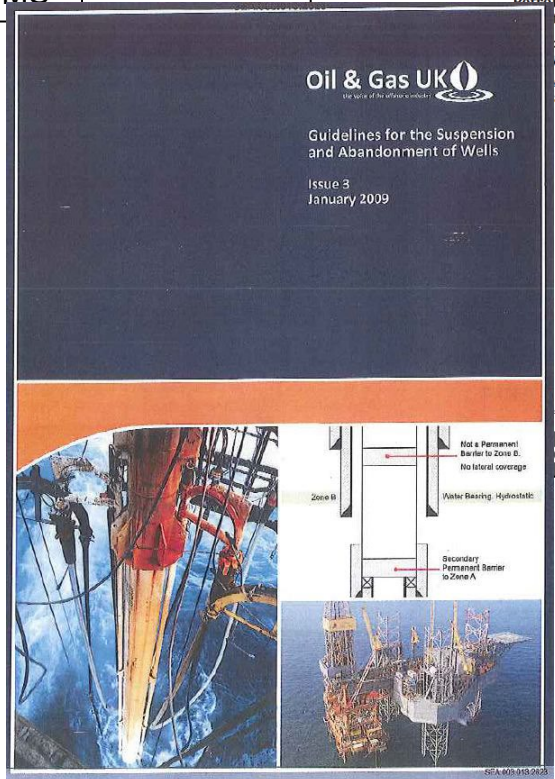
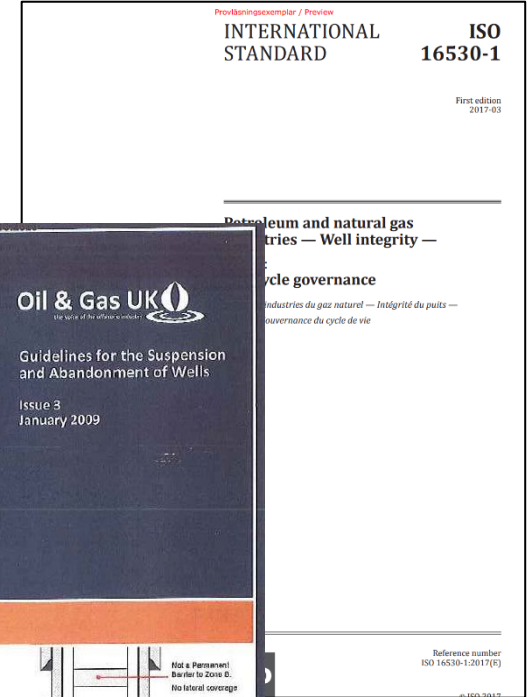


Good Practice entails:

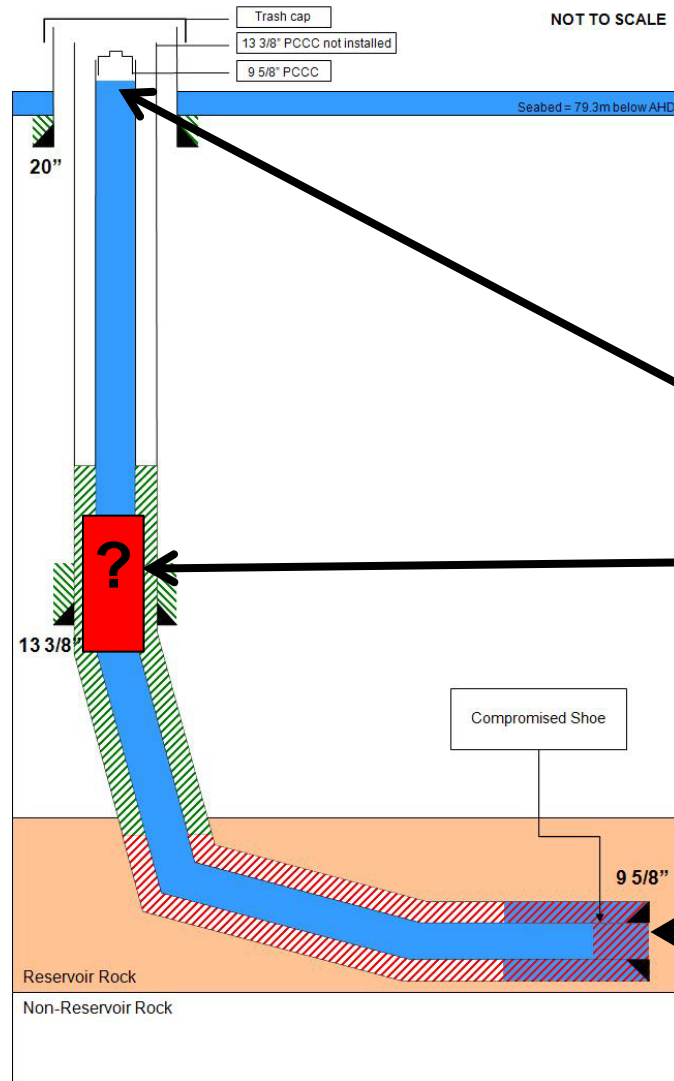
Good Standards to ensure:



Needed MOC to suspend well due to delays in top sides



How it was done and Why?



The answers (or lack of) to the "why" questions pointed to significant deficiencies in systemic and organisational factors – poor execution of industry recognised practices and standards being the key element of offence

Why did the second MOC replace a testable suspension plug with a non-testable PCCC? Standard requires all such barriers have to be testable

Wet Shoe, why wasn't it recognised, given pressure testing is required by industry standard?

Crude Oil Shipping Pump fire:

OFFICIAL



Failure of fuel feed line.
Diesel ignited once it contacted hot exhaust pipe.
Given it had no fail-safe isolation valve installed it kept feeding the fire




Gravity fed fuel tank



AS 1940—2004
(Incorporating Amendment Nos 1 and 2)

Australian Standard®

The storage and handling of flammable and combustible liquids



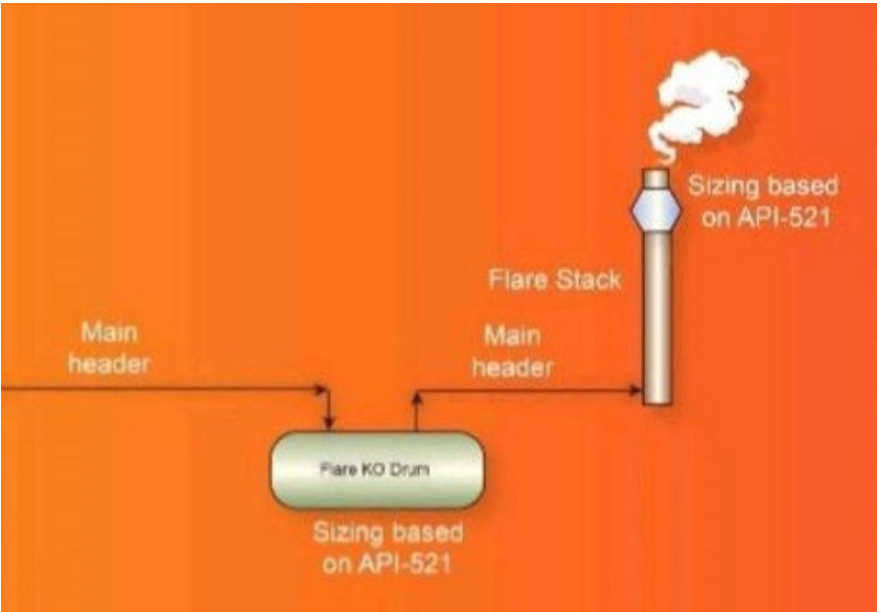
7.2.2 High-level tanks
Any tank which is so situated as to produce a gravity head at the dispenser shall be equipped with a fail-safe solenoid valve or other equally effective device which shuts off the supply at the tank outlet except when the dispenser is in use. Where the tank is either Category 1 or 2 and there is no metering dispenser, a manual shut-off valve shall be provided at the tank.



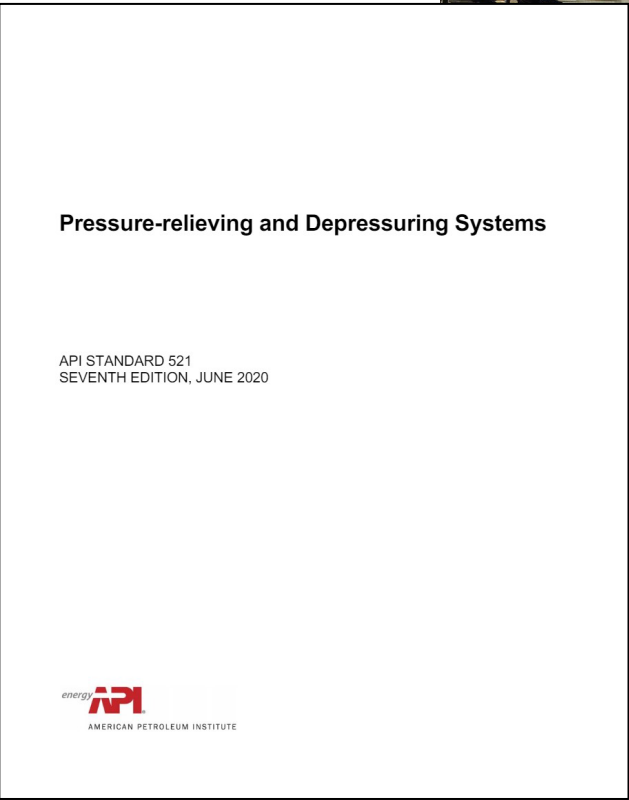
Government of South Australia
Department for Energy and Mining

Flare Drum Overflow

OFFICIAL



Undersized flare KO drum resulted in hydrocarbons expelling into flare stack



Section 5.6: Design details for knock out Drums



Pipeline rupture due to SCC

OFFICIAL

High pH soil +
tap wrapped pipe +
high temperature +
high hoop stress +
CP range between -625 mV to -850 mV

Pipelines succumbing to SCC



= Pipeline susceptibility to Stress Corrosion Cracking

INTERNATIONAL STANDARD

Petroleum and natural gas industries—Pipeline transportation systems

The types of external corrosion damage for consideration shall include the following:

- general metal loss and degradation;
- localized corrosion, e.g. pitting under deposit or crevice attack;
- microbiologically induced corrosion;
- stress-corrosion cracking

9 Corrosion management

9.1 General

Internal and external corrosion of pipeline systems shall be managed to prevent unacceptable failure or loss of operability from corrosion within the specified design life. The corrosion management program should include the following:



SP0204-2008
(formerly RP0204)
Item No. 21104

Standard Practice

Stress Corrosion Cracking (SCC) Direct Assessment Methodology

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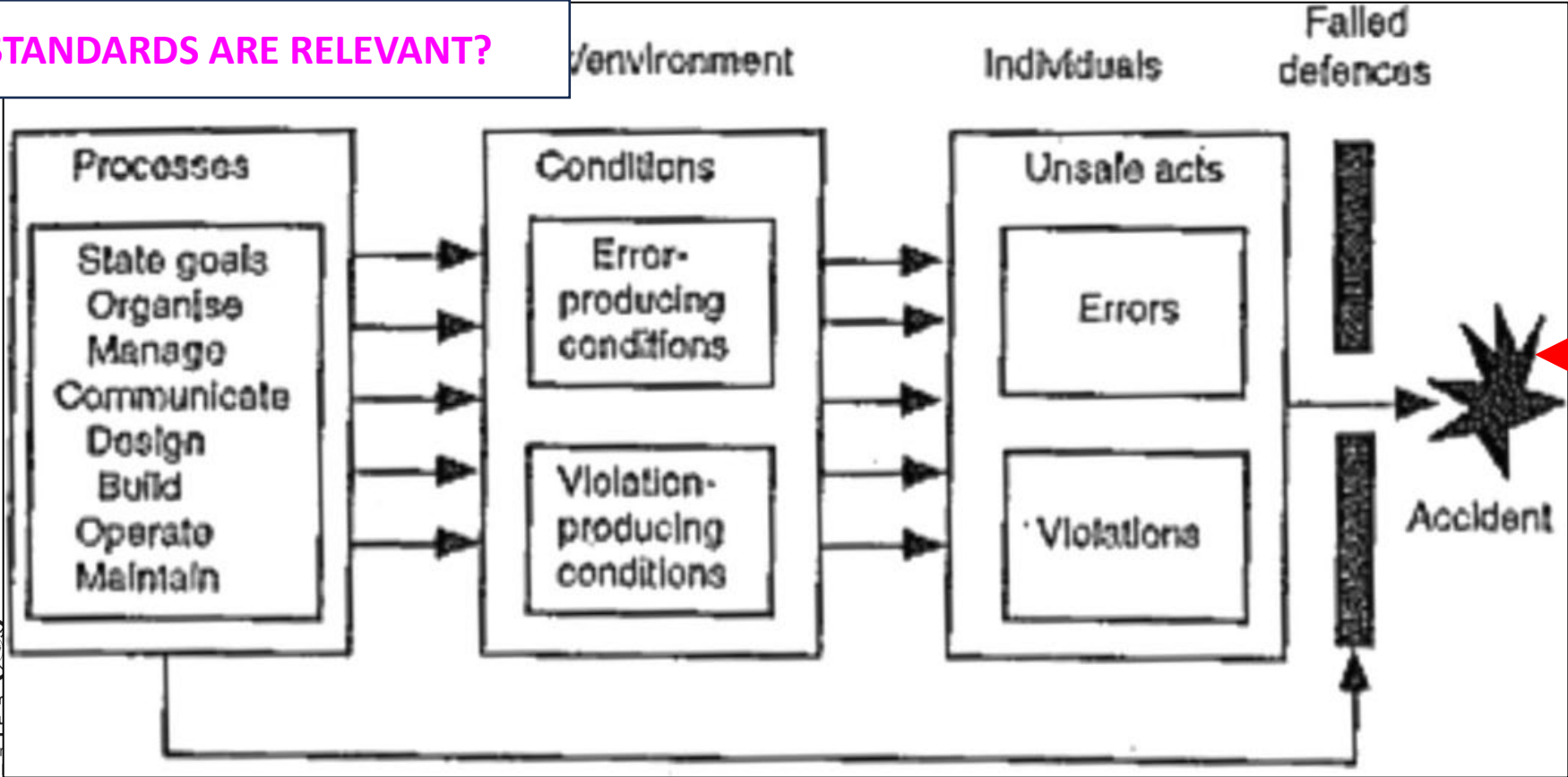
Take away lesson:

When designing or executing an activity, ask yourself the following questions:

“WHY” can it happen?

“HOW” can it happen?

WHAT STANDARDS ARE RELEVANT?



“WHAT” can happen?

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