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Production Operations – the Need for a Safety Case

Ken Arnold, Senior Technical Advisor

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Outline

- GOM Current Safety and Environmental Regulations
- Prescriptive vs. Goal Setting Regulations
- UK vs. GOM Comparison of Results
- The Case Against a Safety Case Approach in the GOM
- The Next Step in Safety- What We Really Need

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Early 1970 to Late 1980's

Concentration on:

1. Hardware
2. Fire Detection and Mitigation Systems
3. Process Upset Detection and Safety Shutdown Systems

API Specifications and Recommended Practices:

- Subsurface Safety Valves
- Wellhead Surface Safety Valves and Underwater
- Piping Systems
- Electrical Systems
- Fire Prevention and Control
- Process Safety Control and Shutdown

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Process Safety and Control- API RP 14C

- A response to MMS proposal to require FMEA on each facility
- A generic approach based on FMEA and HAZOP analysis of 13 representative facilities
  - Process components function in the same manner regardless of specific design of the facility
  - Analyze each process component for worst case input and output – SAT
  - If fully protected when analyzed standing alone, the analysis will be valid for that component in any configuration
  - If every component protected, the system will be protected
  - When components are assembled into a system some devices can be eliminated- SAC

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Safety Analysis Function Evaluation Chart (SAFE)

- Each component of process is listed on SAFE Chart along with its associated safety devices
- Recommended safety devices are determined from safety analysis checklist in API RP 14C Appendix A
- Each shutdown and safety function is shown in vertical columns
- For each safety device, a shutdown function and/or safety function or SAC reference must be given on SAFE Chart
- Alternate or substitute safety devices can also be listed

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FMEA of a Separator

Event	Primary	Secondary
Overpressure	PSH	PSV
Large Gas Leak	PSL and FSV	Fire Detection, ASH, Minimum Ignition
Large Oil Leak	LSL and FSV	Sump Tank (LSH)
Small Gas Leak	ASH, Minimum Ignition Source	Fire Detection
Small Oil Leak	Sump Tank (LSH)	Manual Observation
Inflow Exceeds Outflow	LSH	PSH and Downstream Vessel
High Temperature	TSH	Leak Detection Devices

High Pressure Sensor (PSH)

- PSH installed
- Input is from a pump or compressor that cannot develop pressure greater than the maximum allowable working pressure of the vessel
- Input source is not wellhead flowline(s), production header or pipeline and each input source is protected by a PSH that protects the vessel
- Gas outlet is connected by adequately sized piping without block or regulating valves to downstream equipment protected by a PSH which also protects the upstream vessel
- Vessel is final scrubber in a flare, relief, or vent system and is designed to withstand maximum built-up back pressure
- Vessel operates at atmospheric pressure and has an adequate vent system

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Benefits of RP 14C

1. Documentation concise and easy to audit
2. Minimizes subjective decisions
3. Consistent results

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1990s- Design Considerations

RP 14J Added Emphasis and Requirements for:

- Layouts
- Mitigation
- Personnel Escape and Evacuation
- Hazards Analysis

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Growing Understanding of Need to Manage Safety

- A facility designed with a safety shutdown system is not necessarily "safe."
- A Hazard Analysis does not necessarily assure safety
- Much more is required if the overall probability of any one chain leading to a hazard is to be acceptable:
  - Maintenance
  - Operating Procedures
  - Testing
  - Drills

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Marine Board – Alternatives for Inspecting Outer Continental Shelf Operations (1990)

- "By comparing accident events data...with the PINC list, the committee was persuaded that most of the items on the list are reliable safety devices and their failure is not relevant to the kinds of accidents that actually occur."

- "The safety of a platform, or any other facility, is not determined just by the quality of its operating manuals and the reliability of it equipment. Major factors are management's safety policy, and the training and attitudes of personnel who manage and operate the facility. MMS should make explicit in its safety management and inspection philosophy that monitoring of safety attitudes of the operators and resulting necessary corrective action are essential"

- "The committee emphasizes its belief that compliance does not equal safety. Thus, although it is certainly desirable to have checklists to guide the inspectors, it is important for MMS to ensure the operators do not sink into a compliance mentality."

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API RP 75 - Safety and Environmental Management Programs (SEMP)

- Goals
  - Application of management principles of planning, organizing, implementing and evaluating to all aspects of safety
  - Principles aid in identifying, evaluating and reducing operational risks
  - Helps prevent uncontrolled and toxic releases
- Originally Made Voluntary
- Now Proposed as Mandatory Part of Regulations

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SEMP Elements Grouped According to Management Principles

Management Principles	Elements
Planning	Employee Participation Process Safety Information (PSI) Process Hazards Analysis (PHA) Pre-Startup Safety Review Emergency Planning and Response
Organizing	Operating Procedures Safety Work Practices Training
Implementing	Contractor Safety Mechanical Integrity Management of Change
Evaluating	Incident Investigation Compliance Audits

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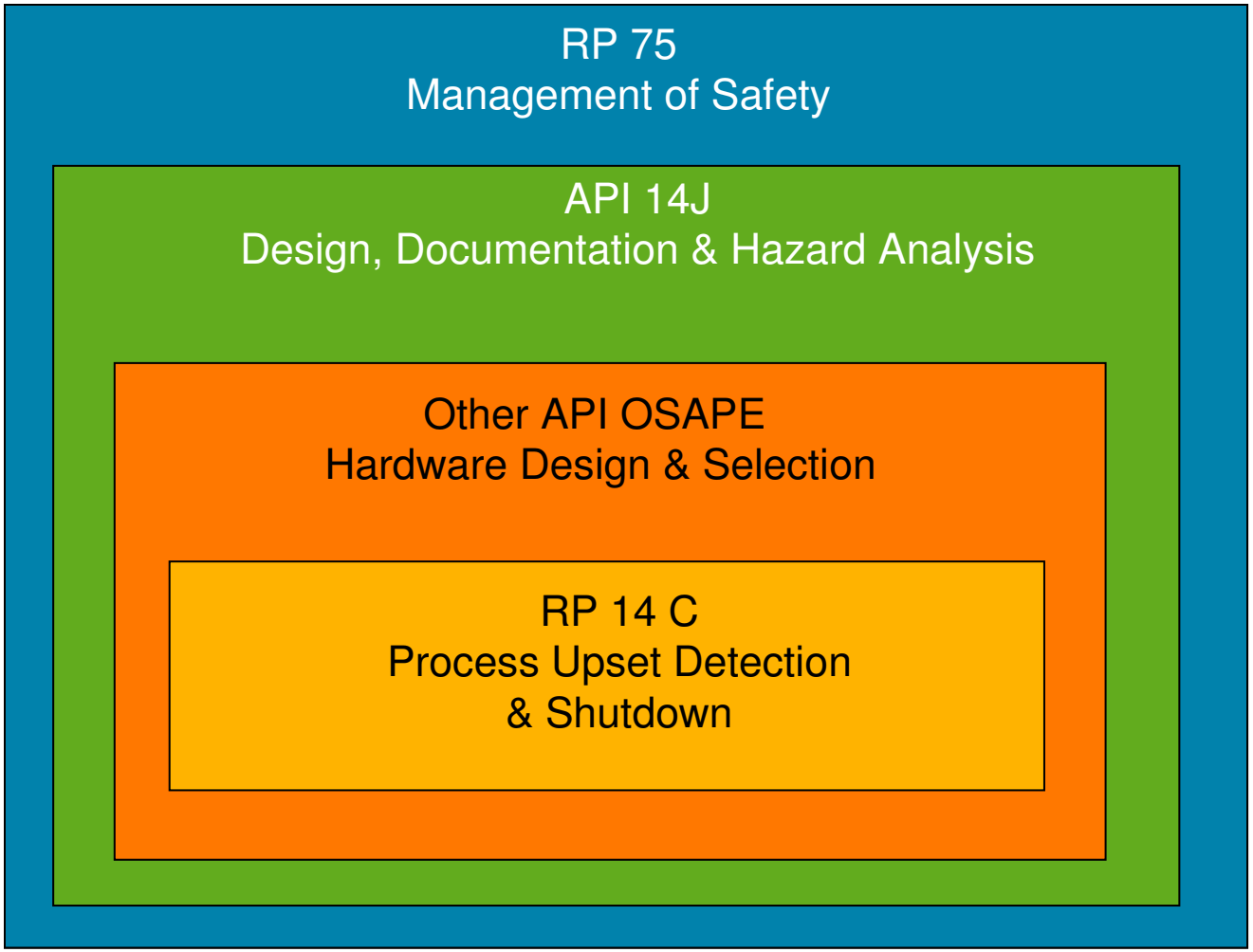

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Prescriptive Regulations

- Based on experience there are certain engineering best practices which can be defined and which should be followed
- Works well for routine installations and operations which have been analyzed many times
- Easy to check for compliance - but:
  - Needs to be supplemented for new situations and technology (need for predictive hazards analysis which is NOT prescriptive)
  - May result in less cost efficient designs
  - Does not do away with the need to manage safety

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Goal Setting Regulations

- Set a goal of level of desired safety (risk) – in UK this is ALARP
- Require operator to prove that the installation design and operating procedures attain this goal by submitting a Safety Case document to demonstrate how the goal is obtained
  - Requires a detailed narrative and quantified risk assessment
- Difficult to check for compliance
- More easily accommodates new technology and situations - but:
  - Must still assure compliance with good engineering practice – in UK this means compliance with the 5 pillars
  - Requires a definition of ALARP
  - A tradition of accept Safety Cases sets a defacto prescriptive regulation

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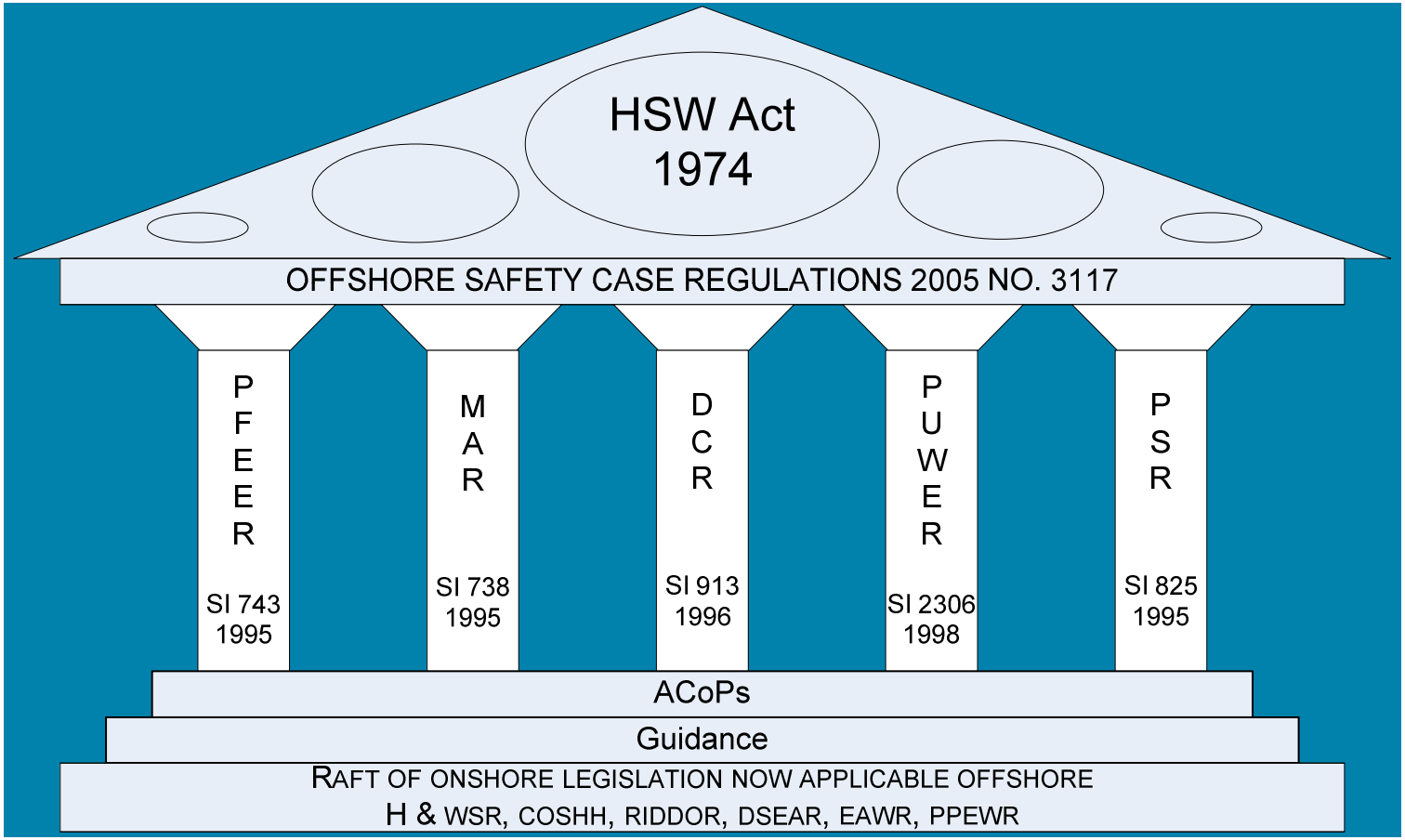
Offshore Regulatory Hierarchy

Offshore Installations – Goal Setting Legislation

Objective: Technical Integrity Assurance and Hazard Management



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PFEER – Offshore Installations (Prevention of Fire & Explosion, & Emergency Response) Regulations 1995 (SI 1995 No.743)

- Fire and explosion analysis
- Definition of emergency response arrangements
- Development of performance standards for safety systems
- Development of a written scheme of examination

MAR – Offshore Installations & Pipeline Works (Management & Administration) 1995 Regulations (SI 1995 No.738)

- Appointment of Offshore Installation Manager (OIM)
- Duty of co-operation with the OIM
- Records of persons onboard installation
- Requirement for Permit to Work (PTW) system
- Health monitoring and surveillance

DCR – Offshore Installations (Design & Construction) Regulations 1996 (SI 1996 No.1913)

- All parts of the installation which are critical to safety are identified - Safety Critical Elements (SCEs)
- All SCEs are confirmed as suitable for their intended purpose and remain in good repair and condition by appropriate audit, examination, and testing by an independent body

PUWER – Provision and Use of Work Equipment Regulations 1998 (SI 1998 No.2306)

- Every employer shall ensure that work equipment is so constructed or adapted as to be suitable for the purpose for which it is used or provided
  - *Designed and constructed properly*
  - *Used for the purpose it was designed for*
- The risk assessment will help to select work equipment and assess its suitability for particular tasks
- Work equipment maintained in an efficient state, in efficient working order, and in good repair
- Work equipment exposed to conditions causing deterioration which is liable to result in dangerous situations is inspected at suitable intervals

PSR - Pipeline Safety Regulations

- Safe design, operation, inspection and decommissioning of onshore and offshore pipelines
- Duty of co-operation with others, especially connected platforms
- Special needs for Major Accident Hazard Pipelines (e.g. ESDV's)
- Major Accident Prevention Document (equivalent of Safety Case for an installation).
- Ensure no damage and danger to persons

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Platform Specific Safety Cases

- A safety case is a narrative which shows that the sum total of design and operating procedures result in a specified level of safety

- Is it really necessary to do this on a platform specific basis?
  - Hard to find situations where the writing of a platform specific Safety Case identified changes in design which were not already specified in prescriptive regulations

  - Hard to find situations where the writing of a platform specific Safety Case identified changes in operating procedures not already specified in SEMP

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Safety Statistics

IADC 2008 US Water Totals

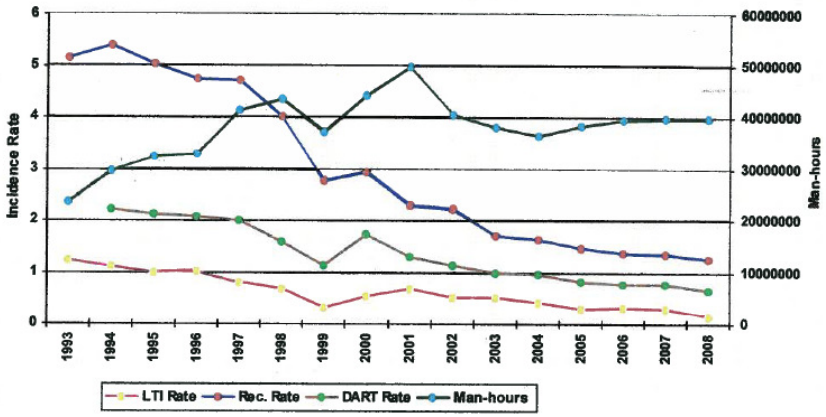
Total Man-hours	**39,665,580**
Total Medical Treatment Incidents	**118**
Total Restricted Work Incidents	**100**
Total Lost Time Incidents	**26**
Total Fatalities	**3**
Total Recordables	**247**
LTI Incidence Rate	**0.15**
LTI Frequency Rate	**0.73**

IADC 2008 European Water Totals

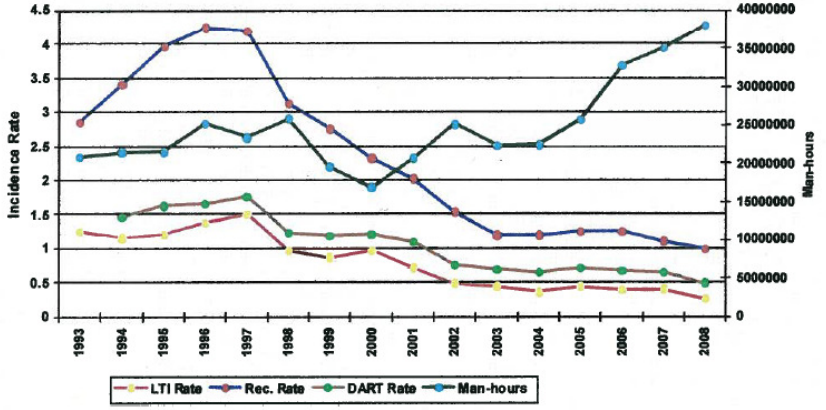
Total Man-hours	**38,049,523**
Total Medical Treatment Incidents	**95**
Total Restricted Work Incidents	**43**
Total Lost Time Incidents	**51**
Total Fatalities	**0**
Total Recordables	**189**
LTI Incidence Rate	**0.27**
LTI Frequency Rate	**1.34**

Lost Time Incidence Rate = LTIs + FTLs X 200,000
Lost Time Frequency Rate = LTIs +FTLs X 1,000,000

US Water Total LTI & Recordable Incidence Rates vs Man-hours (Figure 1)



European Water Total Incidence Rates vs Man-hours (Figure 1)



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Piper Alpha

- Incident occurred in 1988 BEFORE the advent of Safety Cases
- What happened:
  - PSV removed for bench testing as part of its annual safety check when condensate pump taken out of service
  - Permit to work system failed
  - Night crew started pump
  - Release of condensate in compressor module above pump
- In GOM we do not remove PSVs for testing
  - No documented case of a pressure vessel rupturing because the PSV failed to open at set pressure
- Safety Cases since 1988 have NOT recognized the need to evaluate the risks associated with bench testing vs. testing in place.
- It is hard to argue the Safety Cases uncover risks not addressed by GOM mixture of prescriptive rules plus SEMP

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Effort to Implement

- There are over 3000 platforms in the GOM
- Production Operations are similar and are best handled by an operator derived SEMP system
  - This still requires platform specific information and operating procedures
  - But does not require a justification in each case that ALARP has been reached
- Developing Safety Cases for all operating platforms would require many man-hours of scarce expertise
  - Is there a better use for this expertise which will actually increase safety?

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Cause of Accidents

- Accidents are caused by some combination of
  1. Designs which do not follow best practices – prescriptive regulations and hazard analysis (SEMP)
  2. Equipment failure – standards and QC
  3. Incorrect operating procedures – SEMP
  4. Failure to follow operating procedures – training (SEMP)

- Accidents are avoided by
  - People operating in supportive organizations

- We do NOT need another level of analysis and documentation to improve safety

- We DO need to create organizations which encourage their people to take risks FOR safety as opposed to safety risks.

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Encouraging a Culture of Safety

- It starts at the top
- It requires buy-in by middle management
- It requires re-thinking rewards and penalties
- We need to re-focus from measuring for low consequence relatively higher probability events (e.g. lost time accidents) to high consequence vey low probability events
- Risk as measured by probability times consequence is the wrong measure to avoid very very low probability but extremely high consequence events (e.g. Macondo blowout)

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How Do We Encourage Such Organizations?

- ?????
- Let's focus on this problem rather than how to implement Safety Cases.