CQI NucSIG: The Evolution of Risk Assessment in Management Systems

NUCLEAR SIG
Chartered Quality Institute

SCANDPOWER
Risk Management

Office for Nuclear Regulation
An agency of HSE

Research Sites Restoration Ltd

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CQI NucSIG: The Evolution of Risk Assessment in Management Systems

Welcome!

Kevin Smith
UK Sales and Marketing Manager
LRQA Ltd

3 July 2013

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Venue and Safety

- Fire alarms and tests
- Location of emergency exits and assembly point
- Toilets
- Mobile phones and handheld devices.

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Agenda

09:30 am	*Registration, Refreshments and Networking*	
10:00 am	**Welcome & Introduction**	Kevin Smith UK Sales & Marketing Manager LRQA
10:15 am	**Deepwater Horizon & Fukushima NPP: Lessons learned from Safety Critical Events** • Two recent beyond design basis accidents • Major safety critical events • Where generic lessons could have been learned • Some thoughts on lessons learned	Frank Cronin **Nuclear Risk Consulting Manager** **LR Scandpower**
11:30 am	**A regulators perspective on learning form the Fukushima event**	Geoff Grint **Head of Regulatory and Technical Standards** **Office for Nuclear Regulation**
12.30	*Lunch*	
13:15 pm	**The challenges of aligning risk assessments in a Management System** • The various types of risk assessment used in the RSRL Management System • Interfaces between different types of risk assessment • Key integration points in the management system • Introducing new risk assessment methods due to adopting additional management system standards (ISO 27001 and PAS 55) • Key lessons learned	Richard Hibbert **Head of Quality and Management Systems** **RSRL**
14:15 pm	Open Forum Discussion: What learning is there for the Quality Professional from Risk Management professionals and the events at Fukushima, what should we do differently	Mike Underwood/Richard Hibbert
15:15 pm	Close	Mike Underwood **Chair** **CQI NucSIG**

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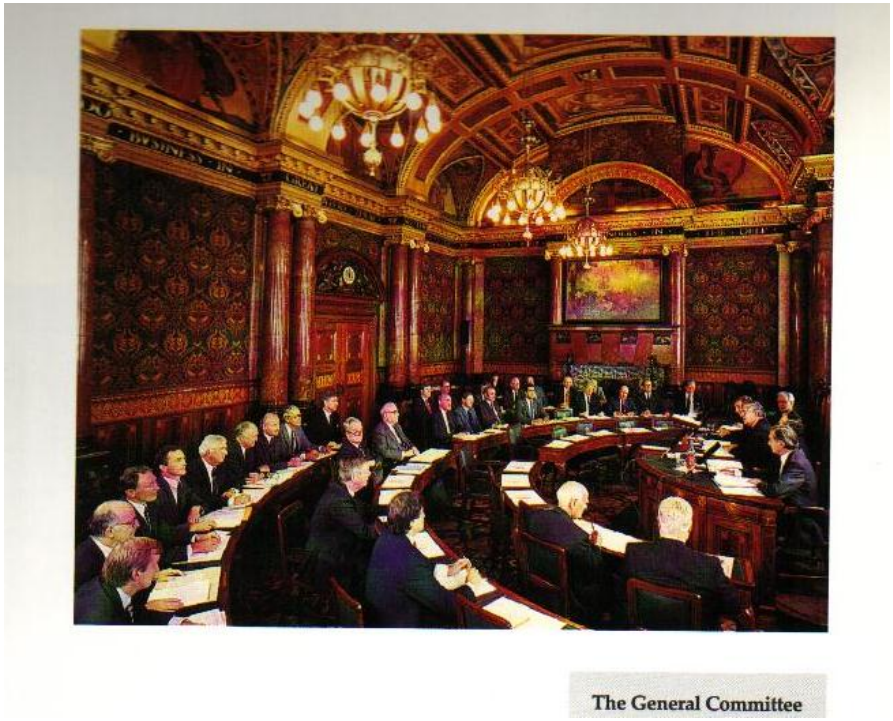

The General Committee

- Formed in 1760, a non-profit distributing society using its operational surplus to enhance knowledge and promote safety of property and people.

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- The organisation employs over 6,200 people in its 250 offices in over 100 countries across the world, managed from its City of London headquarters.
- Lloyd's Register has remained at the leading edge of engineering excellence.

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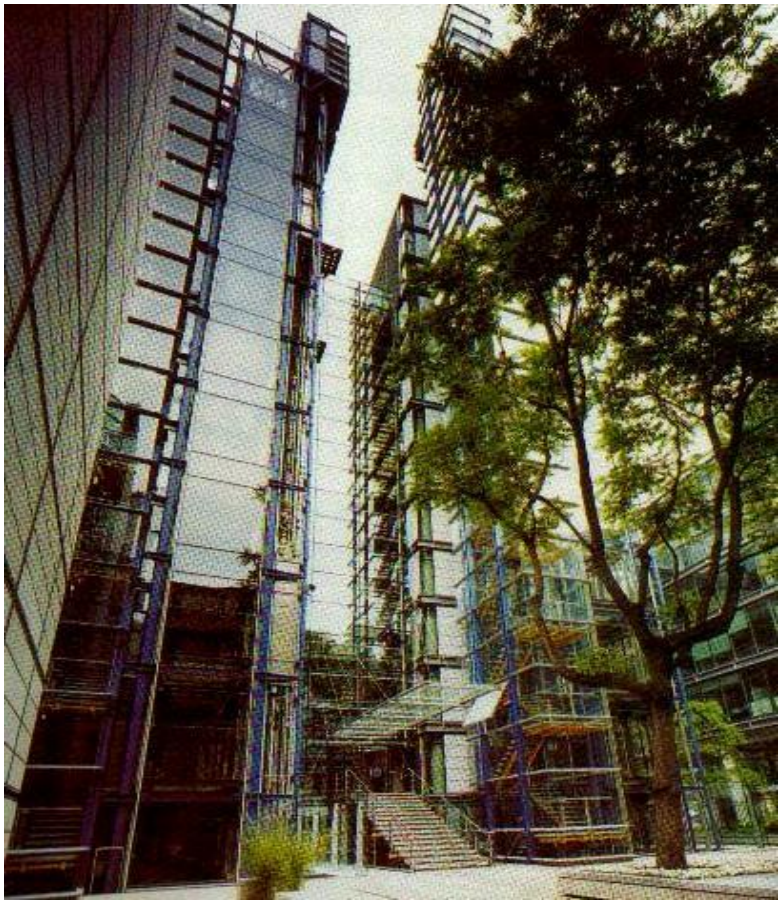

Four Global Businesses

- Management Systems
- Marine
- Energy
- Transportation.

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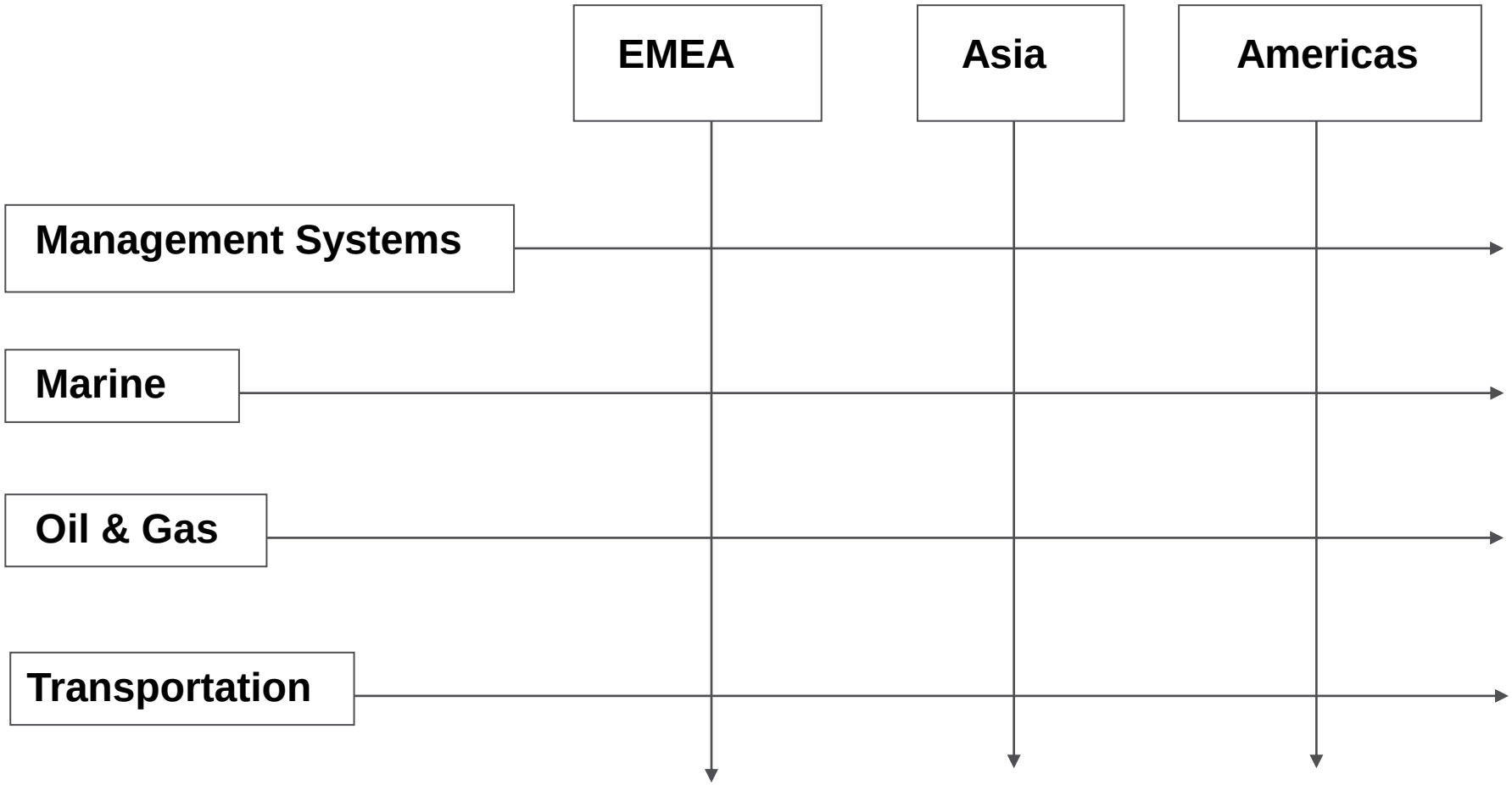
Group Operational Structure



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The future of Management System Standards

- ISO Directive: Annex SL, Appendix 3
- PAS 99: 2012
- ISO 9001
- ISO 14001
- OHSAS 18001

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ISO Directive No. 1: Annex SL, Appendix 3

- Defines the basic procedures to be followed for the development of International Standards
- Structure of all ISO MSS is being harmonized as defined in Appendix 3 of Annex SL of the ISO/IEC Directives, Part 1

1) Scope
2) Normative references
3) Terms and definitions
4) Context of the organisation
5) Leadership
6) Planning
7) Support
8) Operation
9) Performance Evaluation
10) Improvement.

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PAS 99: 2012

- Publicly Available Specification of common management system requirements which can be used by organisations as a framework for developing an integrated management system
- Organisations with more than one management system can use PAS 99 as an aid to achieving a single holistic management system
- The framework links to the new structure for requirements of MS Standards

a) Context of the organisation
b) Leadership
c) Planning
d) Support
e) Operation
f) Performance evaluation
g) Improvement.

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PAS 99: 2012

- New version of PAS 99 has been generated using the Annex SL structure
- The guidance contained within PAS 99 is valuable
- There is additional guidance in Annex B
- Annex C gives a correlation with other management systems
- PAS 99 is not assessable in isolation . . . if assessed, it must always be alongside at least two other management system standards
- LRQA will not be offering a certification service against PAS 99

  However . . .

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Management System - Core Elements Correlation

Common Management System Elements	ISO 9001	ISO 14001 & OHSAS 18001	Annex SL
Policy	5.3	4.2	5.2
Objectives	5.4.1	4.3.3	6.2
Responsibilities	5.5	4.4.1	5.3
Competence	6.2.2	4.4.2	7.2
Management Review	5.6	4.6	9.3
Internal Audit	8.2.2	4.5.5	9.2
Documentation requirements	4.2.1	4.4.4	7.2
Control of Documents etc	4.2.3; 4.2.4	4.4.5; 4.5.4	7.5.3
Legal & other requirements	7.2.1	4.3.2	6.1
Design	7.3	4.4.6	6.2; 8.1
Planning	5.4; 7.1	4.3; 4.4.6	8.1; 6.1; 6.2
Controls	7.5	4.4.6	8.1
Checking	8	4.6	9.1
Monitoring & Measurement	8.2.3	4.5.1	9.1
Non conformity/Corrective and Preventive action	8.3; 8.5.2; 8.5.3	4.5.3	10.1 6.1.

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ISO 9001: 2015

Scheduled publication September 2015

Unlike the 2008 version, ISO/TC 176 has major changes planned, with a draft design specification including recommendations to:

- Provide a stable core set of requirements for the next 10 years or more
- Keep current focus on effective process management to create desired outcomes
- Review, with a view to revising, the eight Quality Management Principles
- Take account of changes in quality management systems practices and technology since the last major revision in 2000

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ISO 9001: 2015 . . . *(continued)*

- Apply Annex SL of the ISO Directives to enhance compatibility and alignment with other ISO management system standards
- Facilitate effective organisational implementation and effective conformity assessment by first, second and third parties
- Use simplified language and writing styles to aid understanding and consistent interpretations of its requirements.

ISO 9001: 2015 Proposals

- Integration of ‘risk-based thinking’
- Better alignment with business management processes
- ‘Output matters’ (product conformity and process effectiveness)
- Knowledge management
- Life cycle management (LCM)
- Improvement and innovation
- ‘Time / Speed / Agility’
- Technology and changes in IT
- Incorporation of ‘Quality Tools’ like 6ó, QFD, benchmarking etc.

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ISO 14001: 2015?

- At Committee Draft (CD) stage, with LRQA active in ISO committee activities. Revision expected to be released late 2014, early 2015
- Includes two significant actions:
  1. High level structure for management systems
     Alignment with the ISO Directives Annex SL
  2. The 'Future Challenges for EMS Study Group' evaluated potential implications of evolving stakeholder expectations and new developments in environmental management systems.
     Eleven themes analysed along with obstacles and opportunities to increase the uptake of ISO 14001 in small organisations to help them control environmental impacts in the supply chain, engage stakeholders, and communicate their environmental commitment externally
- In addition to these, the mandate requires that basic principles and existing requirements of ISO 14001:2004 be retained and improved.

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OHSAS 18001: 2017?

- Expected around 2016-17 and may well appear converted into an ISO and so have been written by an international committee
- The ISO ballot has been completed but the result is not yet known
- As with the other ISO standards up for revision, any High Level Structure changes to this standard will be done in line with ISO Annex SL.
- Eight Principles
  - Market Relevance
  - Compatibility
  - Topic Coverage
  - Flexibility
  - Free Trade
  - Applicability of Conformity
  - Exclusions
  - Ease of Use

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Other Standards

Standards relevant to the Nuclear sector:

- IAEA GS-R-3
- NQA1
- ISO 22301
- ISO 27001
- PAS 55
- CSR / ISO 26000

Additional information can be found at: www.lrqa.co.uk and www.lr.org

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Who sees the bigger picture?

LRQA's **Business Assurance** helps you manage your **systems** and **risks** to **improve** and **protect** the **current** and **future performance** of your organisation

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Deepwater Horizon & Fukishima NPP: Lessons learned from Safety Critical Events

Frank Cronin
Nuclear Risk Consulting Manager
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Deepwater Horizon & Fukishima NPP Lessons Not learned from Safety Critical Events:

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Contents

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Introduction	Lloyd's Register, Lessons Learned
Part I	Beyond design basis events Deepwater Horizon Fukishima NPP
Part II	Major Safety Critical Events Prof Perrow – on accidents Davis Besse, PAKS NPP, Texas City , Buncefield Generic Lessons - HSE study
Part III	Formal processes and regulation IAEA, HSE - Deepwater and Fukishima
Part IV	Lessons Learned - some thoughts on 'Learning' Facilitators and Barriers to Lessons learned Teaching and Learning Styles 'Making it personal'

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- Founded 250 years ago in Edward Lloyd's coffee house, the earliest surviving Register (1764) details 4118 vessels – with over 2000 vessels built overseas
- Focus on Safety – marine, power and wider industry application
- Lloyd's Register Group, HQ London, with offices in 250 cities around the world. Divisions include Marine, Oil and Gas, Transportation, Energy, LRQA
- 20011/12 Turnover +£800m - Group Employees +7700
- Provide independent, Authorative and Global –
  - Risk based Consultancy and
  - inspection, verification and assessment services
- Lloyd's Register Educational Trust; a registered charity

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Lessons Learned

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Deepwater Horizon and Fukushima
Why this presentation was developed - in Feb 2011

Lessons learned from Safety Critical events - how effective?

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Part I
Beyond design basis events

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Deepwater Horizon
20 April 2010

Fukushima Dai-ichi 1-4
11 March 2011

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Deepwater Horizon: The Background

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- BP is the operator and principal developer of the Macondo Prospect with a 65% share, while 25% is owned by Anadarko Petroleum Corporation, and 10% by MOEX Offshore 2007, a unit of Mitsui
- The Deepwater Horizon was a 9-year-old semi-submersible mobile offshore drilling unit, that could operate in waters up to 8,000 feet (2,400 m) deep and drill down to 30,000 feet (9,100 m)
- It was owned by Transocean, operated under the Marshallese flag of convenience, and was under lease to BP from March 2008 to September 2013.
- At the time of the explosion, it was drilling an exploratory well at a water depth of approximately 5,000 feet (1,500 m) in the Macondo Prospect
- Production casing was being installed and cemented by Halliburton Production Energy Services. Once the cementing was complete, the well would have been tested for integrity and a cement plug set, after which no further activities would take place until the well was later activated as a subsea producer.
- Halliburton modelling systems were used several days running to design the cement slurry mix and ascertain what other supports were needed in the well bore.

Deepwater Horizon: The Review

SCANDPOWER Risk Management

- 2008/2009: Transocean suffered a number fatal of accidents during their international drilling campaigns
- Transocean conducted in-depth investigations into these events to determine what happened, but did not fully understand the underlying root causes
- The LR Consulting Team was supplemented by personnel from Human Engineering and Moduspec to fully assess Transocean's Company and Safety Management Systems, for content, clarity, tone, accessibility and suitability
- Also to assess the Safety Culture of the organisation and the Safety Climate onboard the rigs visited, as well as within the Divisions
- LR visited 21 Transocean rigs in 5 Divisions (divisional and sector offices)
- The North American Review involved visiting 4 rigs in the GoM, including the Deepwater Horizon 9th - 26th March 2010

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Deepwater Horizon: On the platform

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- The Lloyd's Register team arrived onto the rig and were given a full day safety / platform Induction, plus the Platform Safety Engineer insisted they do a specific Deepwater Horizon orientation . . . additional to their Induction
- The rig was manned by a full complement of highly qualified and experienced oil platform staff - including key Partner staff from BP and Halliburton
- Interviews conducted across the platform on all levels of staff using a number of Lloyd's Register assessment and other analysis tools -they raised a number of concerns - found across the Transocean operation
- LR still cannot divulge specifics under 'legal privilege' due to ongoing court claims

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Deepwater Horizon: The Causes

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"But who cares, it's done, end of story, (we) will probably be fine & we will get a good cement job . . ."

BP Engineer Brett Cocales (e-mail to Brian Moore -April 16th)

- Most, if not all, of the failures at Macondo can be traced back to underlying failures of management and communication. Better management of decision making processes within BP and other companies, better communication within and between BP and its contractors, and effective training of key engineering and rig personnel would have prevented the Macondo incident

- BP's management process did not adequately identify or address risks created by late changes to well design and procedures. BP did not have adequate controls in place to ensure that key decisions in the months leading up to the blow-out were safe or sound from an engineering perspective

- Halliburton and BP's management processes did not ensure that cement was adequately tested.

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Deepwater Horizon: The Causes

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- Decision-making processes at Macondo did not adequately ensure that personnel fully considered the risks created by time - and money-saving decisions. Nothing inherently wrong with choosing a less-costly or less-time-consuming alternative as long as it is proven to be equally safe and part of a process

- Regulatory oversight: Many critical aspects of drilling operations were left to industry to decide without agency review (eg., there was no requirement, let alone protocol, for a negative-pressure test, the misreading of which was a major contributor to the Macondo blow-out. Nor were there detailed requirements related to the testing of the cement essential for well stability.

(National Commission on the BP Deepwater Horizon Oil Spill & Offshore Drilling)

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Fukushima Dai-ichi

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Unit I - GE Mark I BWR (439 MW), Operating since 1971
Unit II-IV - GE Mark I BWR (760 MW), Operating since 1974

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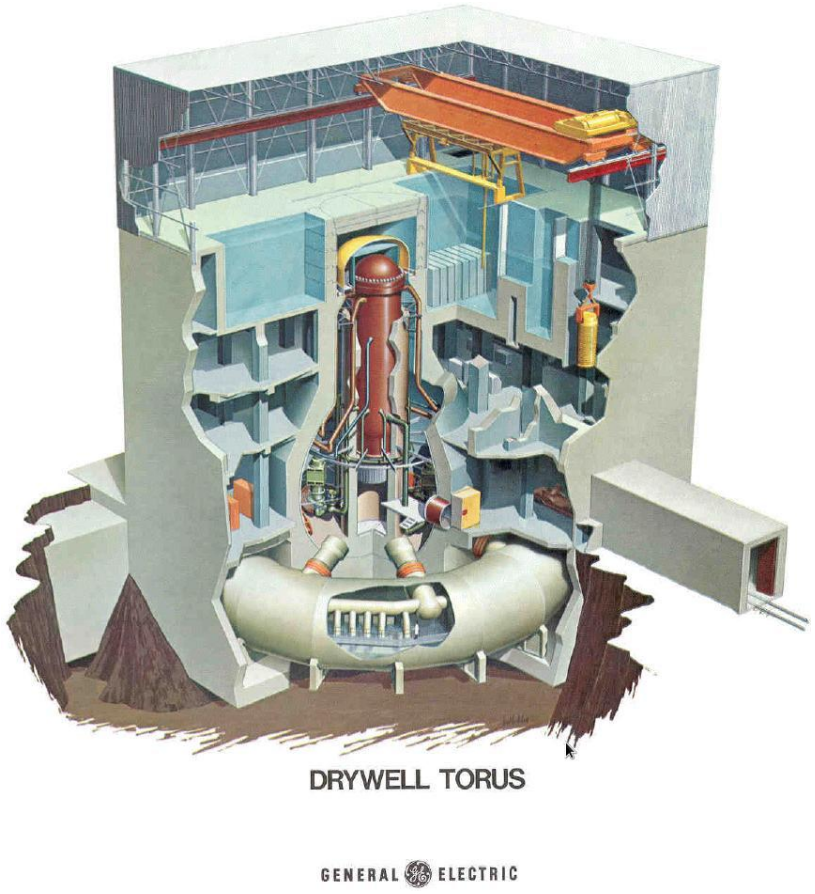
Fukushima Dai-ichi 1-4
The Background MARK- I containment



This cutaway diagram shows the central reactor vessel, thick concrete containment and lower torus structure in a typical boiling water reactor of the same era as Fukushima Daiichi 2

All six reactors designed by General Electric

- Units 1, 2 and 6 supplied by General Electric
- Units 3 & 5 by Toshiba
- Unit 4 by Hitachi

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Fukushima Dai-ichi
The Background 11 March 2011

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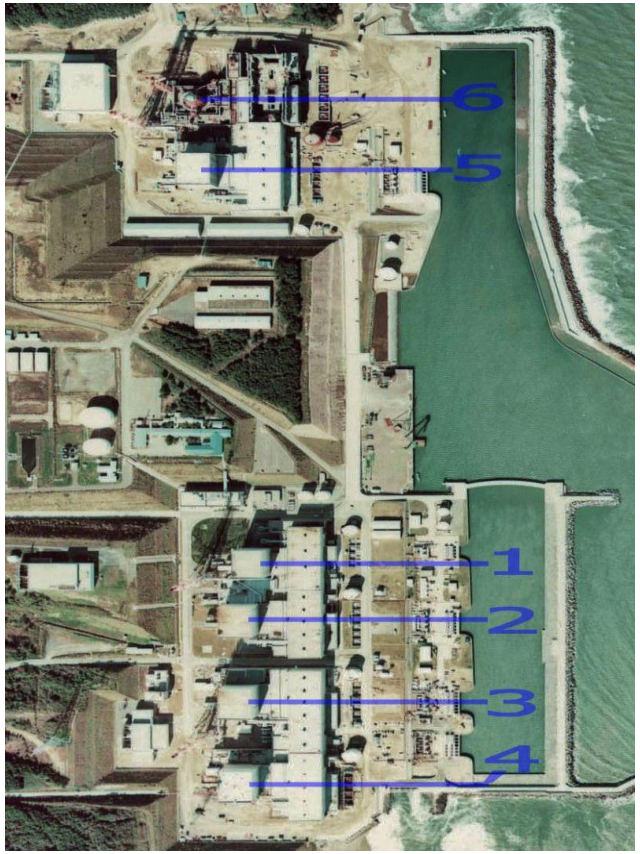
- Units 1,2 & 3 at power
- Unit 4 de-fuelled
- Units 5, 6 cold shutdown (planned maintenance)
- The East coast of Japan struck by an earthquake magnitude now estimated as 9.0 on the Richter scale
- At 15.27 (41 min after the earthquake) TEPCO report the site struck by three tsunami waves – the height of the third wave -15 m above sea level – the plant tsunami wall was designed to accommodate a 5.7m high wave.



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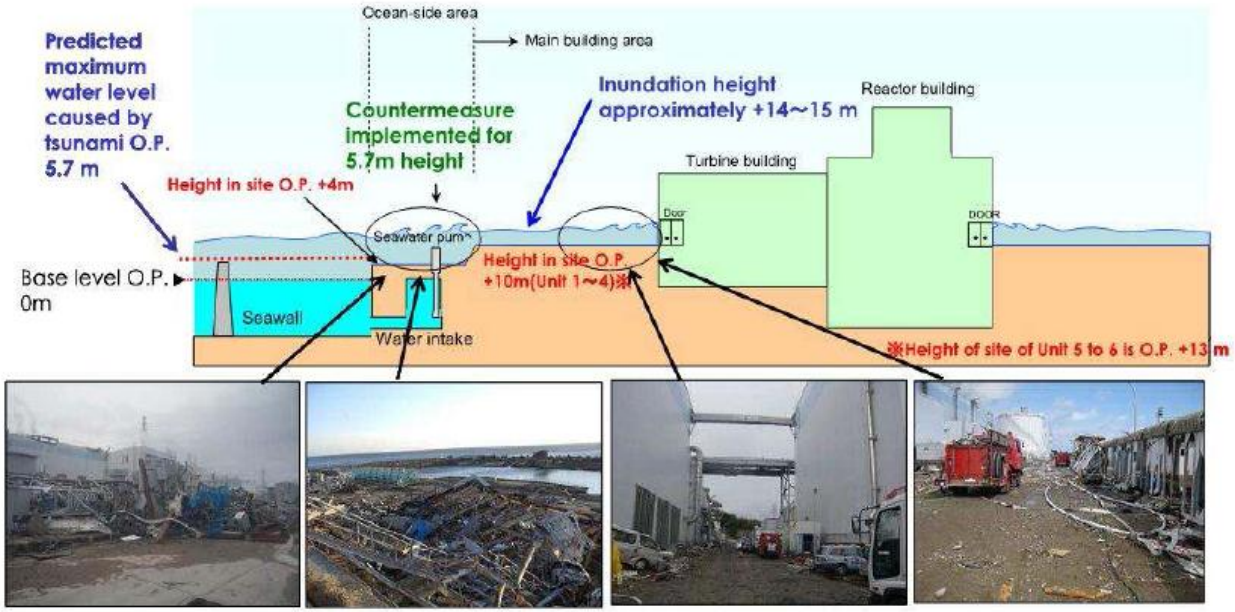
Fukushima Dai-ichi
What the Tsunami did



We have conducted the investigation on Tsunami arrived at Fukushima Daiichi Nuclear Power Station generated by the Tohoku-Chihou-Taiheiyo-Oki Earthquake on March 11th, 2011. Result on the investigation on height and area inundation and run-up height are as follows. We did not consider the effect of diastrophism and facilities, approximately O.P. +14 to 15m (inundation depth: approximately 4 to 5m) in most of the ocean-side of main building area. (2) Inundation area: Most of the ocean-side area (height of site: O.P. + 14.5m." – Appendix A [in the TEPCO report]

Fukushima Dai-ichi 1-4
Immediate impact

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Result of water inundation - Loss of cooling containment and control

- Site submerged to a depth of between 10-15 metres in sea water
- Complete loss of Grid supplies
- Electrical infrastructure for emergency supplies rendered non operable
- Backup diesel generators, 12 of the 13 were destroyed
- Battery system exhausted
- Temperatures in both reactors and used fuel cooling pools rose (rapidly)
- Reactor fuel, compromised, then failed
- Venting to release reactor pressure commenced

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Fukushima Dai-ichi 1-4
The Result

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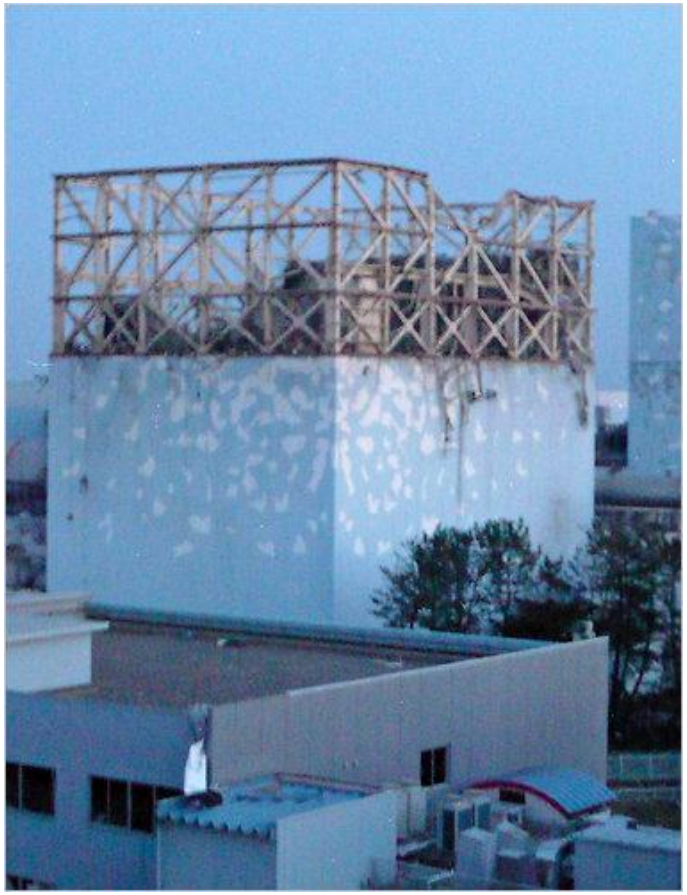
- **Unit 1:** Explosion, roof blown off (12 March)
- **Unit 3:** Explosion, most of concrete building destroyed (14 March), Possible plutonium leak
- **Unit 2:** Explosion (15 March), Contaminated water in underground trench, leak from suppression chamber
- **Unit 4:** Fire (15 March), Water level in spent fuel pools partly restored through innovative action
- Source of contaminated water, partly underground, leaked into the sea and surrounding environment (6 April)
- Surrounding infrastructure damaged to the point that site Emergency services at first unable to gain access
- The event duration continued beyond anything planned or prepared for by the nuclear industry.



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Fukushima Dai-ichi 1-4
The Result . . . *(continued)*

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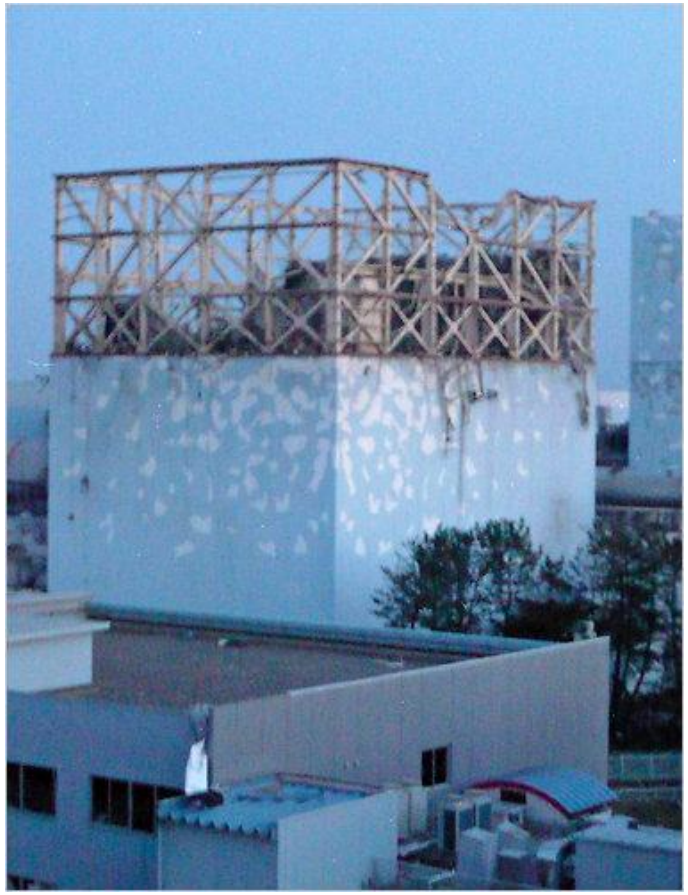
Institutional Response:
NUREG
"Stress test initiatives"
WENRA stress test specifications
NRC "Near-Term Task Force Report," July 12, 2011
IAEA Ministerial Conference on Nuclear Safety, 20-24 June, 2011
OECD/NEA Forum on the Fukushima Accident
NRC Bulletin 2011-01, "Mitigating Strategies," May 11, 2011
NEI, INPO & EPRI, "U.S. Industry Leadership in Response to Events at the Fukushima Daiichi NPP"

Government Responses:
German, Italian, Spanish
Japan
UAE , Turkey
Russia, Korea, China



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Fukushima Dai-ichi 1-4 Today

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A cover has been built over unit 1 to protect it from the weather and ensure no further airborne releases.

Work is going on in the reactor building in preparation for designing equipment to enable engineers to determine the status of the torus for the suppression chamber structure which is thought to be damaged.

Debris is being removed from the top of the building And from the used fuel storage pool. A covering structure has been planned.

The most heavily damaged building, the structure of its fuel storage pool has already been reinforced and debris has been cleared from the service floor. Now a more substantial over-structure is being built which will enable unloading of fuel from its storage pool, commencing in December 2013.

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Part II
Major Safety Critical Events

"Any sufficiently complex, tightly coupled system will fail sooner or later"

(Charles Perrow, emeritus professor at Yale)

Part II
Major Safety Critical Events

"Complexity makes it likely that some essential feature will be overlooked. Being tightly coupled means that the failure of one part will drag down the rest."

In my work on accidents, I have argued that some complex organisations such as chemical plants, nuclear power plants, nuclear weapons systems, and, to a more limited extent, air transport networks have so many non linear system properties that eventually the unanticipated interaction of multiple failures may create an accident that no designer could have anticipated and no operator can understand.

In other words, according to Perrow, accidents are '*normal*.'

Ref - Perrow C (2011) Fukishima and the inevitability of accidents – *Bulletin of Atomic Scientists 2011 67:44*

Major Safety Critical Events

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Learning from experience . . . Davis Besse, PAKS NPP Buncefield . . . Generic lessons

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Major Safety Critical Events
Davis Besse

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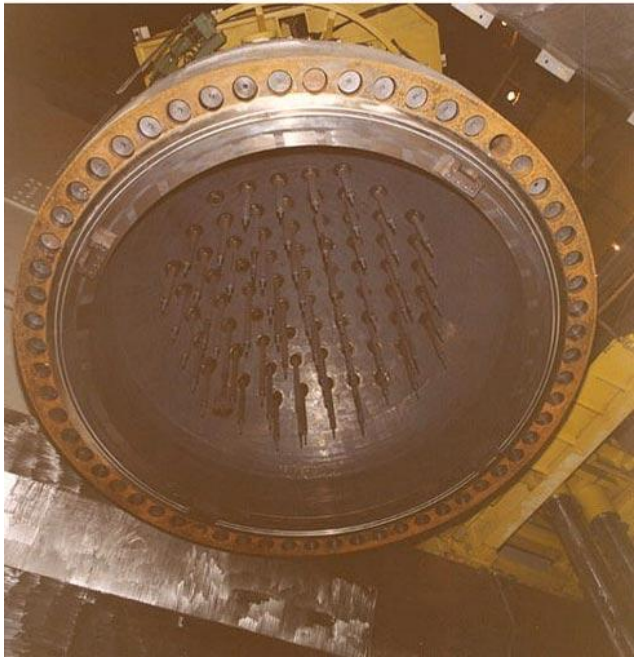
Davis Besse - an INPO Level 1 plant

- March 2002 discovery of a cavity in the DBNPS RPV head
- Found when nozzle cracking, due to primary water stress corrosion inspections repairs, were being carried out
- The cavity was approximately 20-30 square inches extending completely through the 6.3 inch vessel pressure head to a thin stainless steel cladding - not designed to withstand the primary system pressure
- Lack of management attention and questioning attitude.

Davis Besse Under the Reactor Vessel Head



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Major Safety Critical Events
Davis Besse . . . *(continued)*

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- Poor learning from internal and external experience.
- Failure to address/recognise repetitive recurring problems
- Poor internal self-assessment of safety performance
- Weaknesses in response to employee concerns
- Lack of compliance with procedures
- Strained resources & acceptance of degraded plant
- Addressed symptoms (not root causes). Lack of rigour (complacency / mindset)
- Some evidence of production pressures.

(NRC report)

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Major Safety Critical Events PAKS NPP

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April 10, 2003 — INES Level 3 - PAKS, Hungary - Fuel damaged

- Partially spent fuel rods undergoing cleaning in a tank of heavy water ruptured and spilled fuel pellets at PAKS Nuclear Power Plant
- It is suspected that inadequate cooling of the rods during the cleaning process combined with a sudden influx of cold water thermally shocked fuel rods causing them to split
- Boric acid was added to the tank to prevent the loose fuel pellets from achieving criticality
- Ammonia and hydrazine were also added to absorb iodine-131
- Operations had been 'turned over' to the contractor.

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Major Safety Critical Events
PAKS NPP . . . *(continued)*

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- Neither HAEA nor PAKS NPP used conservative decision making in the rigour of safety assessment given to an unproven fuel cleaning system
- The aggressive schedule to develop and use the vessel, influenced the rigour of safety assessment and design review
- Communication between organisational units was not encouraged except at senior levels
- Inadequacies in training and in procedures
- The HAEA underestimated the safety significance of the design - this resulted in less review and assessment than required

(*IAEA Mission)*

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Major Safety Critical Events Buncefield

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- **Buncefield** was the fifth largest of 108 oil storage sites across the UK
- It opened in 1968 and mainly supplied London, the South-East and Heathrow airport

- Sunday 11 December 2005, a series of explosions (fuel leakage and ignition) followed by a large fire destroyed large parts of the depot and caused widespread damage to homes and businesses surrounding the site – £1 billion in damages
- Explosion measured 2.4 on Richter scale (largest explosion in peacetime Europe)
- 43 people injured, no deaths
- Previous 'near miss' of 2003 when ATG stuck did not get thorough response ATG stuck at least 14 times in previous 3 months – trend not picked up as systemic fault

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Major Safety Critical Events Buncefield . . . *(continued)*

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- System for monitoring safety critical tasks was seriously defective e.g. no monitoring/audit of performance
- Single overview screen so only one tank gauge visible at any time
- Control room actually had no control over pipeline deliveries
- Supervisors not able to maintain situational awareness as out of control room on other work
- Senior staff workload (ops manager and terminal ops) far too high with duties at other sites
- Investigation Board recommended more focus on attributes of 'high reliability organisations'
- Board Judge - companies had shown 'a slackness, inefficiency and a more-or-less complacent attitude to safety'

(*Buncefield Major Incident Investigation Board)*

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Major Safety Critical Events
Generic Lessons Learned

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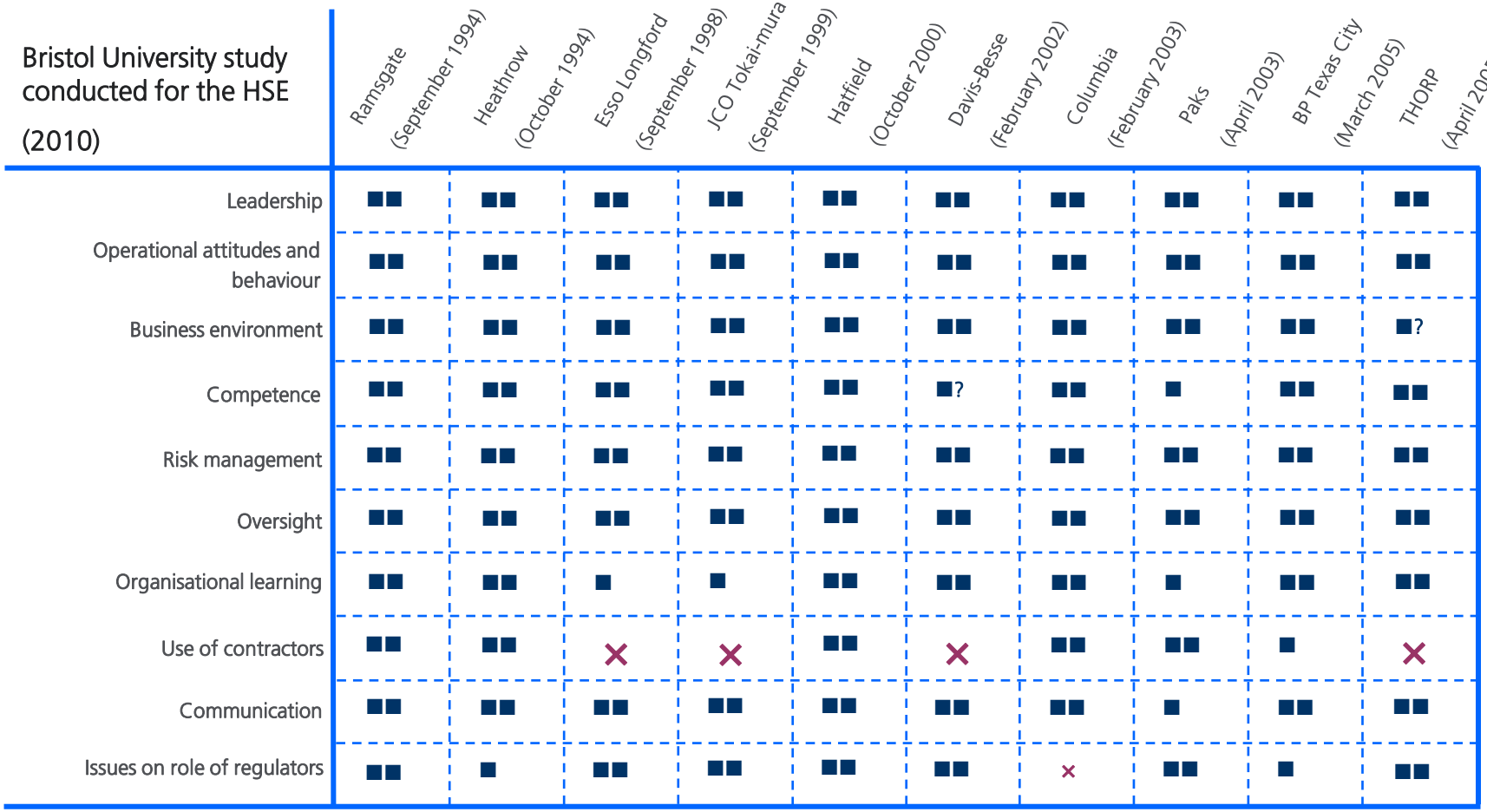

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Part III
Formal processes and regulation

"Wise men learn from other men's mistakes, fools by their own".

(Chinese proverb)

UK Nuclear Regulatory - SAPS Leadership and Management for safety

SCANDPOWER Risk Management

Based on four Leadership and Managing for Safety SAPS (Safety Assessment Principles)

Leadership (MS1)

Directors, managers and leaders at all levels should focus the organisation on achieving and sustaining high standards of safety and on delivering the characteristics of a high reliability organisation

Capable Organisation (MS2)

The organisation should have the capability to secure and maintain the safety of its undertakings

Decision Making (MS3)

Decisions at all levels that affect safety should be rational, objective, transparent and prudent

Learning from Experience (MS4)

Lessons should be learned from internal and external sources to continually improve leadership, organisational capability, safety decision making and safety performance

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IAEA
INSAG 23 Lessons Learned

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It is widely observed in all fields of human activity that serious accidents are nearly always preceded by less serious precursor events. If lessons can be learned from the precursors and these lessons put into practice, the probability of a serious accident occurring can be significantly reduced

"IAEA - INSAG 23
IMPROVING THE INTERNATIONAL SYSTEM FOR OPERATING EXPERIENCE FEEDBACK"

Nuclear Associations with 'Lessons Learned' as a key element

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Formal processes and regulation

Nuclear Guidance and Regulation

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So do we learn from others lessons?

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Lessons not Learned - for Deepwater Horizon

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Lessons not Learned - for Deepwater Horizon Ixtoc 1 - 1979

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- Spewed oil into Mexico's Bay of Campeche for 290 days, dumping around 3.3 million barrels of oil into Gulf waters. Gas from below fed continuous fire on ocean's surface.

- Many circumstances were similar to Deepwater Horizon:
  - Oil emerging from broken pipe on the sea floor mixing with water and gas under high pressure to make oily emulsions
  - Both blowouts followed explosion and sinking of their drilling rigs
  - In both cases the blow-out preventer failed

- PEMEX (Mexican Gov't Org'n/ rig owners) responded by trying to stop the gush with a plug of metal balls and with a giant "sombrero" placed over the well to capture oil (like the "junk shot" and containment dome attempted by BP). None of those methods worked

- PEMEX avoided most compensation claims by asserting sovereign immunity as a state-run company. Finally capped on 23 March 1980, nearly 10 months later - by Red Adair

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Lessons not Learned – for Deepwater Horizon Transocean - North Sea 2009

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The Macondo was a difficult well. Deep water, high pressure, high temperature, complex frontier technology. The Deepwater Horizon was a new generation, high-tech drilling rig, with a crew which ranged from highly experienced and knowledgeable rig hands and drillers, to wide-eyed, inexperienced new starts

The crew had obvious and highly concerning well control problems, which had been evident long before the VIP's arrived, but the crew was so involved in the tasks at hand they were unable to step back and look at the big risk picture

However . . .

Following a blow-out and near disaster on a Transocean oil rig in the North Sea in 2009, Transocean established an Investigation Group who had issued a 10 page Advisory Note plus presentation to every rig they operated with the key message

'Don't be complacent, remain focussed on well control.'

Transocean failed to adequately communicate lessons from this earlier near-miss to staff

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Lessons not Learned – for Deepwater Horizon By their Executive

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- On the day of the Macondo well blow-out, 4 Transocean VIP visitors, all experienced Drilling Engineers and Rig Managers, arrived onboard Deepwater Horizon conduct a 'Managagement Visibility Tour.'

- They were there to recognise that the Deepwater Horizon had gone 7 years without an LTI.
  They were there to say 'thank you' to the crew

- The VIP's came onboard with a positive intent, they wanted to praise and recognise the rig crew. They didn't want to find fault *(attitude)*

- They had some key occupational safety topics in mind that they wanted to focus on *(comfort zone)*

- They didn't want to interfere in the drill crews' activities, they knew that because of their 'seniority' anything they challenged or questioned could be seen as being critical or disrespectful of the rig leaders *(culture).*

They saw the event unfold but did not intervene

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Lessons not Learned – for Fukishima NPP

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Lessons not Learned – for Fukishima NPP Vogtle NPP – loss of offsite power

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- On March 20, 1990 at 9:20 a.m. a truck carrying fuel and lubricants in the plant's low voltage switchyard backed into a support column for the feeder line supplying power to the Unit 1-A reserve auxiliary transformer

- Even though Unit 1 was not operating at full-power, residual heat from the natural decay of the radioactive fuel needed to be removed to prevent a rise in core temperature. At 9:40 a.m. the plant operators declared a site area emergency (SAE) - where power is lost for more than 15 minutes
- At 9:56 a.m., plant operators performed a manual start of the A-train emergency diesel generator (EDG), which bypassed most of the EDG's protective trips that had prevented it from coming on-line. RHR-A was then started using power from EDG-A. With core cooling restored the SAE was downgraded – however the temperature of the Unit 1 core coolant increased from 90 °F to 136 °F during the 36 minutes required to re-energize the A-side bus bars.

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Lessons not Learned – for Fukishima NPP Cooper NPP – flooding

SCANDPOWER Risk Management

NRC Report IN-94-27

- The Cooper nuclear power plant is built on a flood plain in Nebraska
- 1000-year flood and the 10,000-year flood are predicted to be 274.3 and 274.9 metres [900 and 902 feet]
- Federal Levee 550 located upstream of the station collapsed 26 July 1993
- During this event, the Missouri River peaked at 274.6 metres [900.8 feet]

- In a lower hallway in the turbine building standing water was found leaking in and around safety-related cable trays

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Lessons not Learned – for Fukishima NPP Cooper NPP – flooding . . . *(continued)*

SCANDPOWER Risk Management

- The turbine-driven feedwater pump rooms had water dripping on control boxes, and the floor drain system had backed up so that standing water from within areas known to be radiologically contaminated water had migrated out into designated clean areas

- Water levels rising inside the reactor building impinged on electrical cables and equipment - notably the Reactor Core Isolation Cooling (RCIC) pump room causing an earth fault

- The RCIC system is critical to plant safety in the event of loss of offsite power.

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Lessons not Learned - for Fukishima NPP Historical Tsunami Stones

SCANDPOWER Risk Management

This stone in Aneyoshi, a village halfway between Sendai and Aomori in Iwate Prefecture on coastal Route 45.

In the recent tsunami, inundation at Aneyoshi was more than 1.8km inland and stopped about 100m short of the stone.

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Part IV - Lessons Learned, some thoughts on 'Learning'

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"That men do not learn very much from the lessons of history is the most important of all the lessons of history "

(Aldous Huxley)

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What do we focus on in ‘Lessons Learned’?

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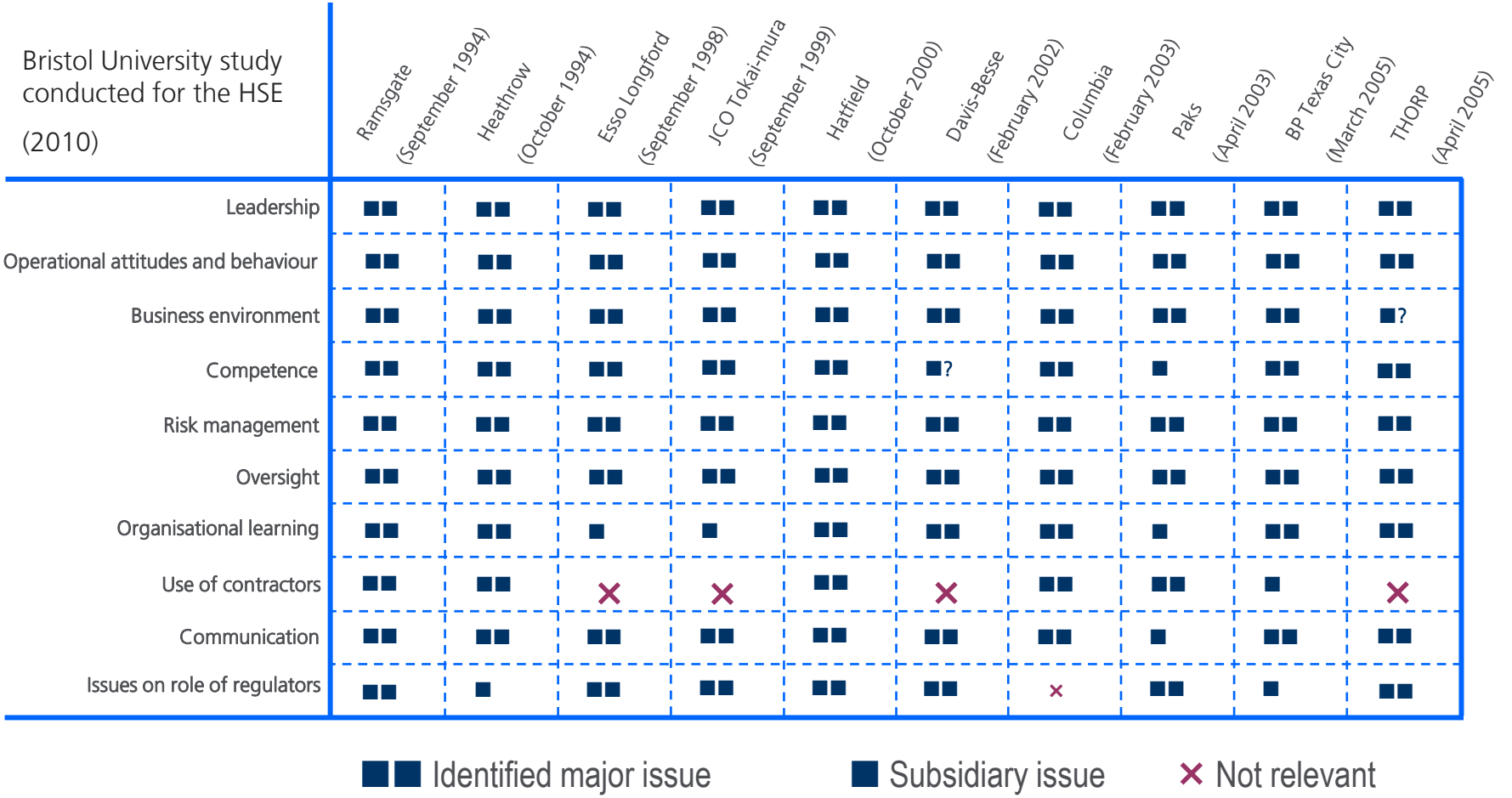
What do we focus on in 'Lessons Learned'?

SCANDPOWER Risk Management

Major Safety Critical Events



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What do we focus on in 'Lessons Learned'?

SCANDPOWER Risk Management

Rarely good news…bad news 'makes news'

Incidents and events significant to safety

- Risk reduction measures
- Enhancement of operational safety
- Improvements in Design
- Improvement to practises in the management, operation, maintenance, planning scheduling, training . . .

Rarely business improvement opportunities

Ref - US National Climatic Data Center 1991 - Perfect Storm - 100.7 feet

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What facilitates effective 'Lessons Learned' (1)

SCANDPOWER Risk Management

- Good processes
- Support of organisation
- Use of technology
- Interaction of others
- Relevance to the job
- Personal desire to learn
- Flexibility of schedule
- PRIMAL (2)

Ref 1 - Doyle W, Reid JG, Young JD – Barriers to and facilitators of learning in small and large knowledge based firms – *Small Business Institute Research Review Volume 35 2008*
Ref 2 - LRQA PRIMAL model for auditing Managers

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What prevents effective 'Lessons Learned' (1)(2)

SCANDPOWER Risk Management

Infrastructure

- Lack of leadership involvement in and commitment to the learning process
- Insufficient time
- The quantity of lessons available (too few or too many)
- Difficult location and accessibility (of lessons)
- Untimely lesson capture and application

Culture and Behaviour

- Cultural fit
- Too superior to learn
- Individual learning contexts

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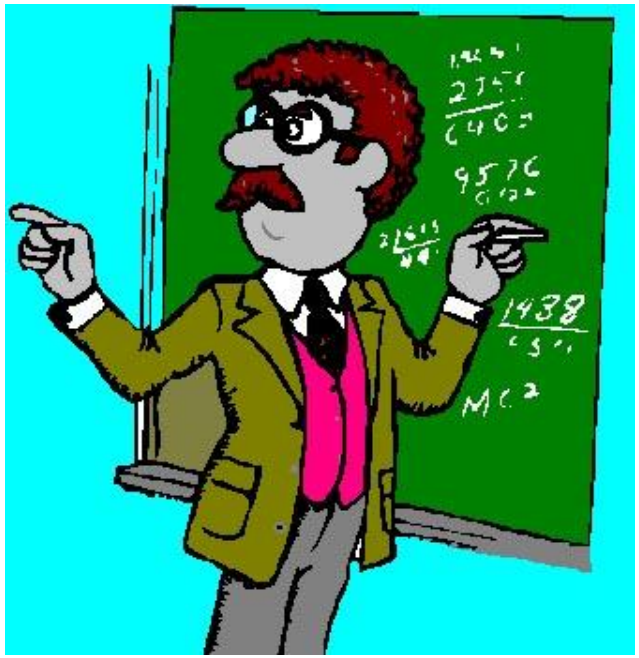
Individual learning contexts

- **Teaching styles**



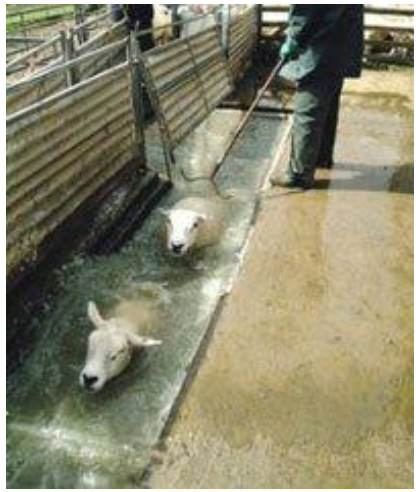
- **Learning styles**

"No, Johnny -
first you punch the airholes, and
then you put in the hamster!"

Teaching styles – how we promote 'lessons learned'

SCANDPOWER Risk Management

- Directed reading
- Presentations
- Stand downs
- Town hall meetings
- Workshops / Seminars
- Toolbox talks
- On the job
- Reports
- Case studies
- Worked examples
- Enhanced training
- Updates to specifications, designs, standards, etc.
- E-learning
  - Webex, etc.
- Simulations



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Learning Styles – how we 'learn'?

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Felder and Silverman's Index of Learning Styles

Sensory	⟷	Intuitive
Visual	⟷	Verbal
Active	⟷	Reflective
Sequential	⟷	Global

"Making it personal"

Ref 1– Felder PM, Silverman LK (1988) – Index of Learning styles – *Learning and teaching styles in Engineering education*

Or School Girls Using Lipstick

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Learning Styles - Felder and Silverman's Index of Learning Styles

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SENSORY		INTUITIVE
Sensory learners prefer concrete, practical, and procedural information. They look for the facts.	⟷	Intuitive learners prefer conceptual, innovative, and theoretical information. They look for the meaning.
VISUAL		VERBAL
Visual learners prefer graphs, pictures, and diagrams. They look for visual representations of information.	⟷	Verbal learners prefer to hear or read information. They look for explanations with words.
ACTIVE		REFLECTIVE
Active learners prefer to manipulate objects, do physical experiments, and learn by trying. They enjoy working in groups to figure out problems.	⟷	Reflective learners prefer to think things through, to evaluate options, and learn by analysis. They enjoy figuring out a problem on their own.
SEQUENTIAL		GLOBAL
Sequential learners prefer to have information presented linearly and in an orderly manner. They put together the details in order to understand the big picture emerges.	⟷	Global learners prefer a holistic and systematic approach. They see the big picture first and then fill in the details.

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Where can we learn about ‘making it personal’?

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Look at the world of advertising!

www.youtube.com/watch?v=MYSmij0407A&feature=player_embedded

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Where can we learn about ‘making it personal’

SCANDPOWER Risk Management

Costa gave fans the chance to appear in its advert

For its final advert slot on Friday 26 October, Costa made its customers the stars. An app launched allowed Costa fans to record and upload themselves singing along to the Kiss song, with winning performances featuring in the final ad.

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Summary
Making it personal

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- **Ensuring that lessons lead to action,** and that these actions are followed through to application in the future It is probably the lack of follow through that causes the greatest frustration (1)

- **Clear involvement by senior management**, with clear expectations that the lessons learned system will be applied. Without senior management attention, time for lesson-learning is not prioritised, or lesson learning is treated as a tick-box activity

- **Styles, content ,formalising, defining, embedding and consistently** applying the system (and there are sub-issues here, for example accountabilities, and avoiding the "tick box" mentality)

- **A supportive culture** (and this will be driven largely through the behaviours of leadership, and by the importance they place on lesson learning).

Experience: *that most brutal of teachers, but you learn, my God, do you learn*
(C .S. Lewis)

Ref (1) - Knoco (2009) Survey - *The Status of Lessons Learning in Organisations*

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- IAEA/NEA International Reporting System (IRS) - Operational experience – Services Series 19 March 2010
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- D A Lucas, F Cronin – Deepwater Horizon – Lessons Learned from Safety Critical - Events Feb 2011
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For more information, contact us:

SCANDPOWER
Risk Management

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CQI NucSIG: The Evolution of Risk Assessment in Management Systems

A regulator's perspective on learning from the Fukushima event

Geoff Grint

Head of Regulatory and Technical Standards

Office of Nuclear Regulation

Office for Nuclear Regulation

An agency of HSE

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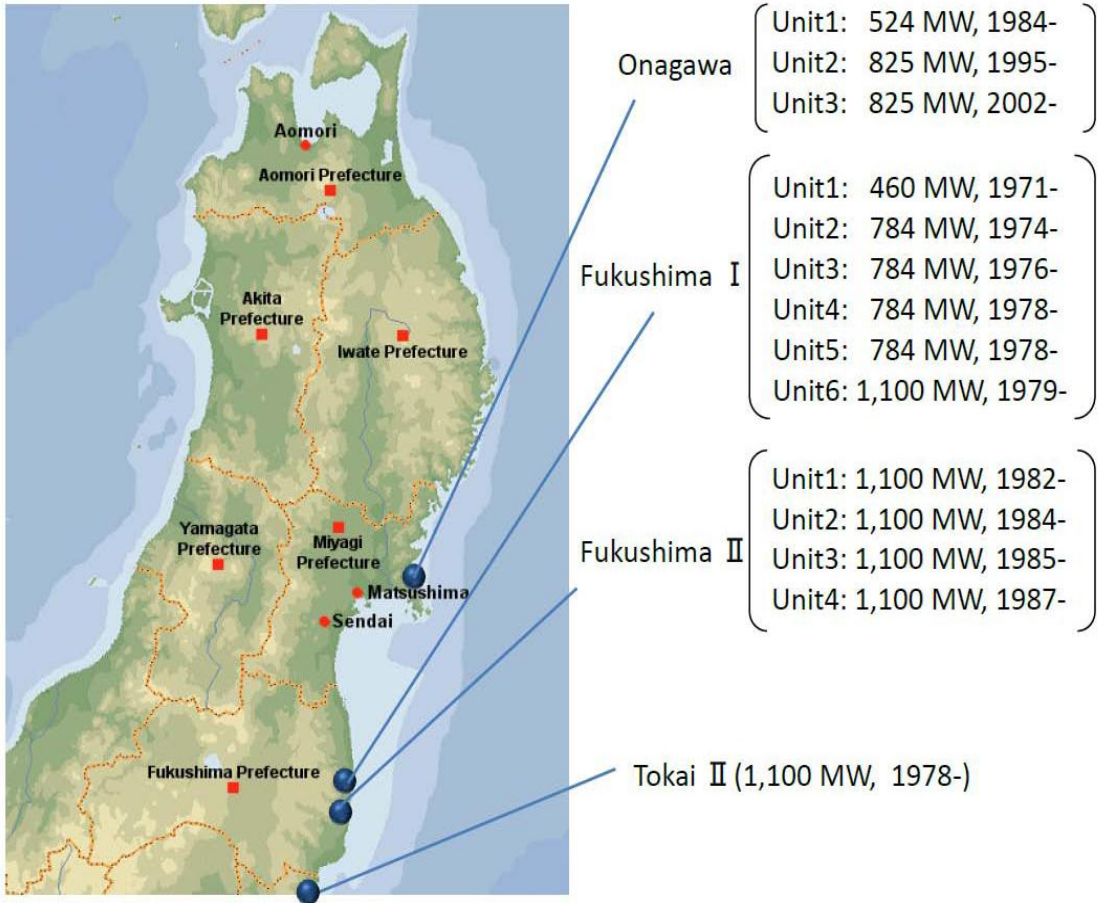
Presentation overview

- Fukushima Event
- ONR action
- Interim Report
- Final Report
- Implementation Report
- Ongoing work.

11 March 2011

- Magnitude 9 earthquake
- Subsequent tsunami
- 14-15m Fukushima 1



The Fukushima event

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The Fukushima event

Tsunami inundates the site

The Fukushima event

Tsunami inundates the site

Fukushima Dai-ichi

- Regulatory Design Basis tsunami of 3.1m, TEPCO 5.7m

Fukushima Dai-ichi

- Loss of all external power
- Only 1 of 13 EDGs available
- Unprecedented devastation
- Impaired infrastructure
- Long term developing scenario

Fukushima Dai-ichi

- Loss of cooling – loss of containment

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UK Response

- Setting up RCIS
- Advice to SAGE and COBR
- Links with International Stakeholders
- Prompt assurance of UK fleet

'Ensure Protection of People and Society'
17000 UK Nationals in Japan

Secretary of State Request

- Identify any lesson to be learnt by the UK nuclear industry
- Co-operate and co-ordinate with international colleagues, to include 'stress test' requirements
- Interim report by the middle of May 2011
- Final report within 6 months

Interim Report

- Provided on 15 May 2011
- Focus on Civil NPP
- Background to radiation, technology and regulation
- Timeline of events
- Comparison of Japan situation and UK
- 11 Conclusions and 26 Recommendations

Final Report additional information

- Responses received on all Interim Report recommendations
- IAEA Fact Finding mission
- Engagement to define Stress Test
- Ongoing receipt of submissions
- Reports by Japanese and US NRC

Final Report

- Provided on 30 September 2011
- Inclusion of all UK Nuclear Facilities
- Built on Interim Report
- 6 additional conclusions and 12 additional recommendations
- See www.hse.gov.uk/nuclear/fukushima/index.htm

Ongoing ONR activities

- Provision of stress test National Report
- Participation in European peer review of stress test
- Subsequent ONR report for emerging information in 12 months time
- IAEA action plan

Report Conclusions

- All findings of the Interim Report remain valid
- UK approach to design basis is sound
- Remediation of Legacy Ponds and Silos should continue
- Periodic Safety Reviews robustly identify necessary improvements to facilities in the UK
- Level 2 PSA is important for sites with the potential for significant off-site consequences

Report Conclusions

- No reason to curtail nuclear operations in UK
- UK nuclear industry has reacted appropriately
- The creation of ONR should enhance confidence in the UK regulatory regime
- No gaps have been revealed in the SAPs
- No weaknesses been revealed in UK nuclear licensing regime

Report Conclusions

- Flooding risks are unlikely to prevent construction of new NPP
- No need to change present siting strategy
- No reason to depart from multi-plant site concept

Report Conclusions

- UK AGRs give longer timescales for remedial action
- No evidence that the presence of MOX contributed to health impact
- There is likely to be scope for lessons regarding human behaviour

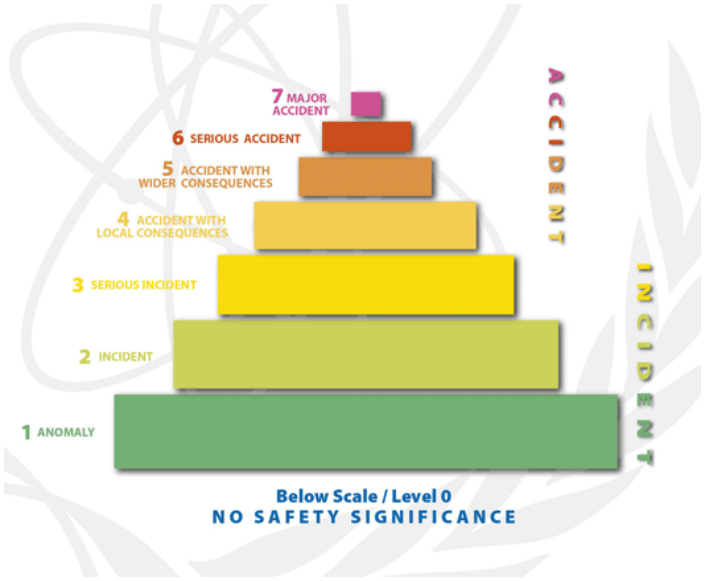
Report Recommendations

- General
- Relevant to the Regulator
- Relevant to the Nuclear Industry
- Way Forward

General Recommendations

International

- Improve dissemination of information
- UK should support review and implementation of international safety standards



General Recommendations

- Identify lessons for contingency planning
- Review UK nuclear emergency arrangements
- Review source term estimation techniques
- Review dose prediction and measurement arrangements

General Recommendations

- Examine planning control adequacy for developments near nuclear installations
- Enhance Openness and Transparency, including by legislative means during ONR creation

Recommendations for the Regulator

- Review SAPS
- Consider exercising long term accidents
- Review ONR's response to severe accidents
- Expand oversight of research

Recommendations for Industry

- Review dependency - enhance self sufficiency
- Compare difference of consequences at Fukushima Dai-ichi and Dai-ni
- Review flooding studies
- Ensure adequate safety cases for new sites of multi reactors

Recommendations for Industry

- Ensure adequacy of spent fuel management strategies
- Review plant layout
- Ensure adequacy of the design of new spent fuel ponds
- Consider detailed information regarding performance of concrete and other structures

Recommendations for Industry

- All recommendations should be considered in the light of all extreme hazards
- Ensure all systems, structures and components needed for accident response are protected against hazards
- Ensure all systems, structures and components needed for accident response are capable of operating in severe accident conditions

Recommendations for Industry

- Establish the robustness of the UK grid
- Review the need for long term diverse supplies
- Review contingency plans for pond water make up
- Review venting routes
- Review provision of control
- Review communications

Recommendations for Industry

- Review and extend accident analysis sequences
- Review training for severe accidents

Recommendations for Industry

- Promote high levels of safety culture
- Complete Periodic Safety Reviews
- Provide level 2 PSA for nuclear installations with potential for off-site consequences

Recommendations way forward

Office for Nuclear Regulation
An agency of HSE

- Respond to the Interim Report recommendations within one month (completed)
- Further respond to all recommendations by June 2012

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EC Stress Test

- European Council 24/25 March – safety of all EU nuclear plants should be reviewed
- WENRA developed, and ENSREG agreed, specification
- Review design
- Check consequences of power/cooling loss
- Consider severe accident management issues

EC Stress Test

- Duty holder report - Oct 11
- National regulators report - Dec 11
- International task force peer review Apr 12
- UK Action plan – 2012
- Review April 2013
- UK also undertook non-NPP stress test

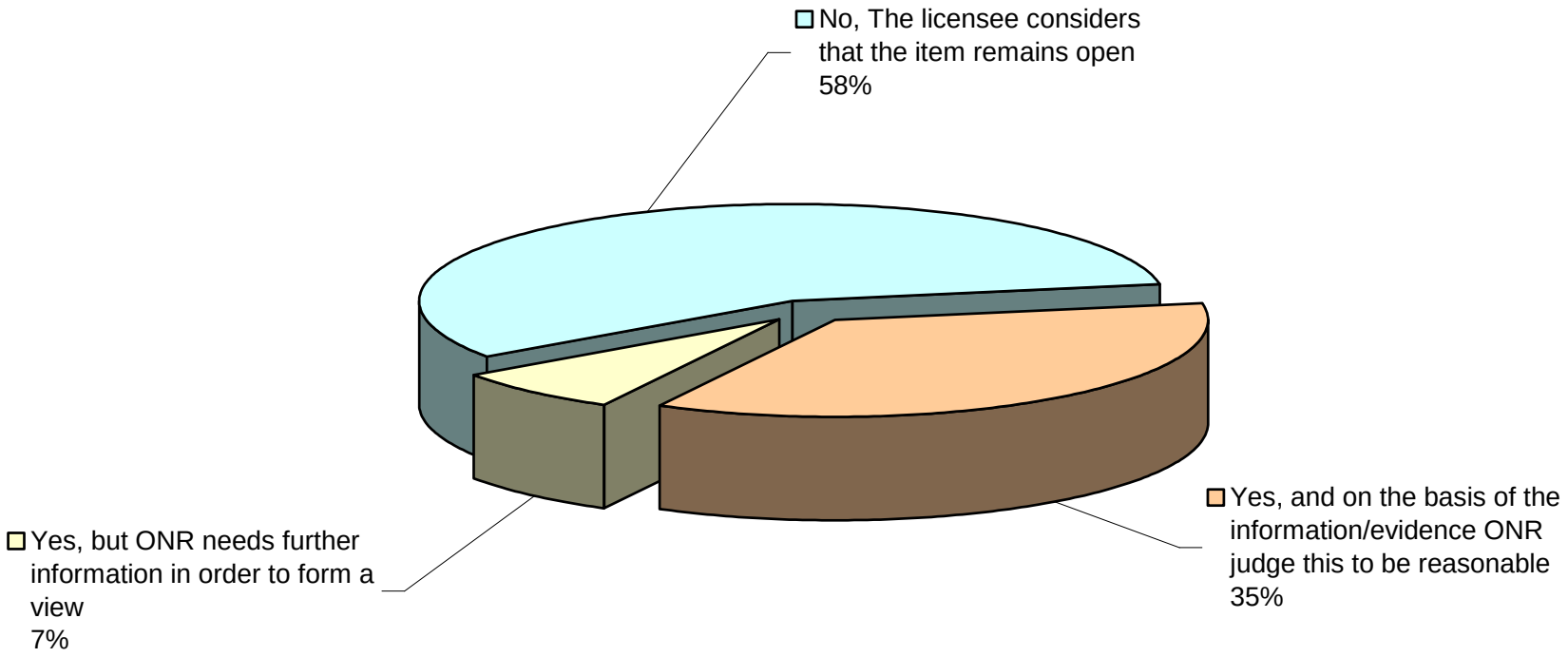
Progress in implementing the lessons learned

- All parties on who actions were placed in the CI report and the Stress Test reports provided an update on progress by June 2012
- ONR produced a report collating all of this information in October 2012

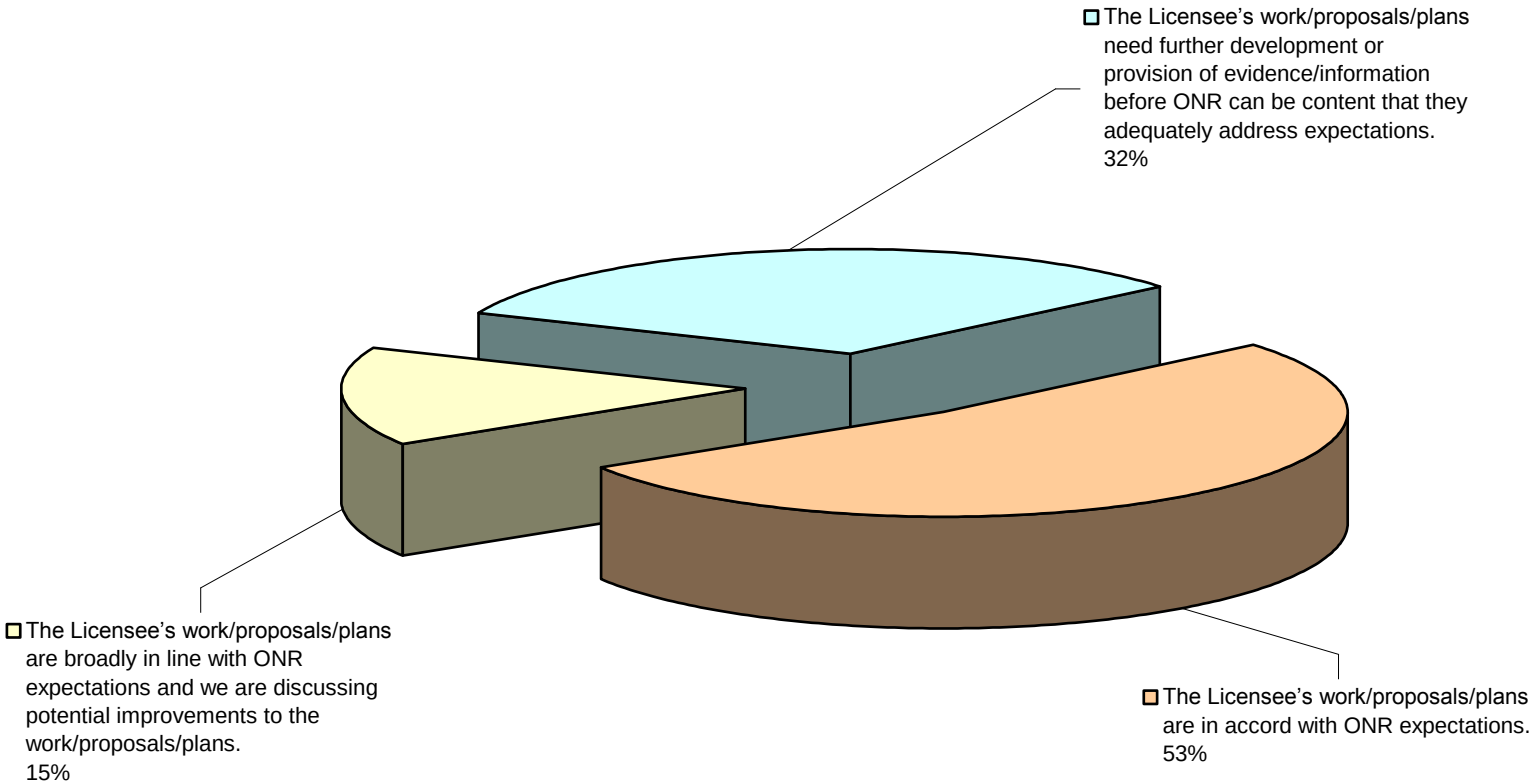
Progress on general recommendations

- ONR reviewing SAPs
- Enhancement to emergency response arrangements
- Cooperation on global nuclear safety standards
- Strategic review of research

Overall Totals - *"Is the recommendation, finding or consideration considered closed by the Licensee?"*



Overall Totals - *"Is there a reasonable match with ONR technical expectations?"*



Examples of progress

- Back up emergency equipment
- PARs for Sizewell B
- Damage repair equipment
- Communications equipment
- Enhanced fuel and water stocks
- Improved electrical supplies
- Development of enhanced SAMGs and associated training
- New emergency response facilities

Next steps

- Further updates on progress on all recommendations and findings will be included in the ONR Chief Inspector's annual report.
- 2014 target for completion the most significant work arising form the lessons.

CQI NucSIG: The Evolution of Risk Assessment in Management Systems

The Challenges of Aligning Risk Assessments in a Management System

Richard Hibbert
Head of Quality and Management Systems
RSRL

Research Sites Restoration Ltd

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Purpose of Presentation

- Share RSRL experience and challenges in relation to:
  - The various types of risk assessment used in the RSRL Management System
  - Interfaces between different types of risk assessment
  - Key integration points in the management system
  - Introducing new risk assessment methods due to adopting additional management system standards (ISO 27001 and PAS 55)
  - Key lessons learned

Prompt for presentation – Audit Finding

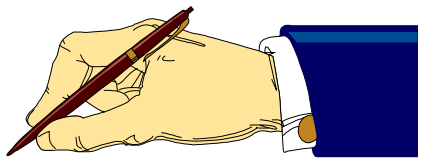
Finding

“During the audit, it was established that there is not a ‘golden thread’ running through the various approaches to risk management at the various levels within the company.”

Response

“A review of RSRL risk management arrangements will be undertaken. Any recommendations from the review will be drawn to the attention of the Executive and relevant Process Owners.”

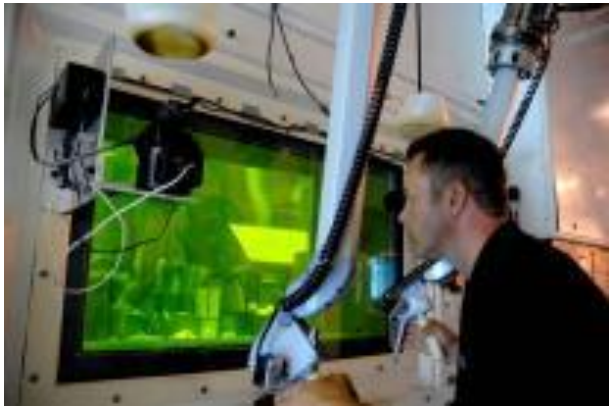
Review is being carried out as part of RSRL independent assessment programme this FY



Research Sites Restoration Ltd

About RSRL

- Research Sites Restoration Limited (RSRL) is the site licence company responsible for the closure programme at Harwell and Winfrith.
- Operates under contract to the NDA
- Employs around 440 people



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RSRL Management System

- Process based system
- Integrated - covers all RSRL activities
- Externally certificated to ISO 9001, ISO 14001 and BS OHSAS 18001
- Uses the principles in PAS 55 in relation to asset management and ISO 27001 in relation to information security

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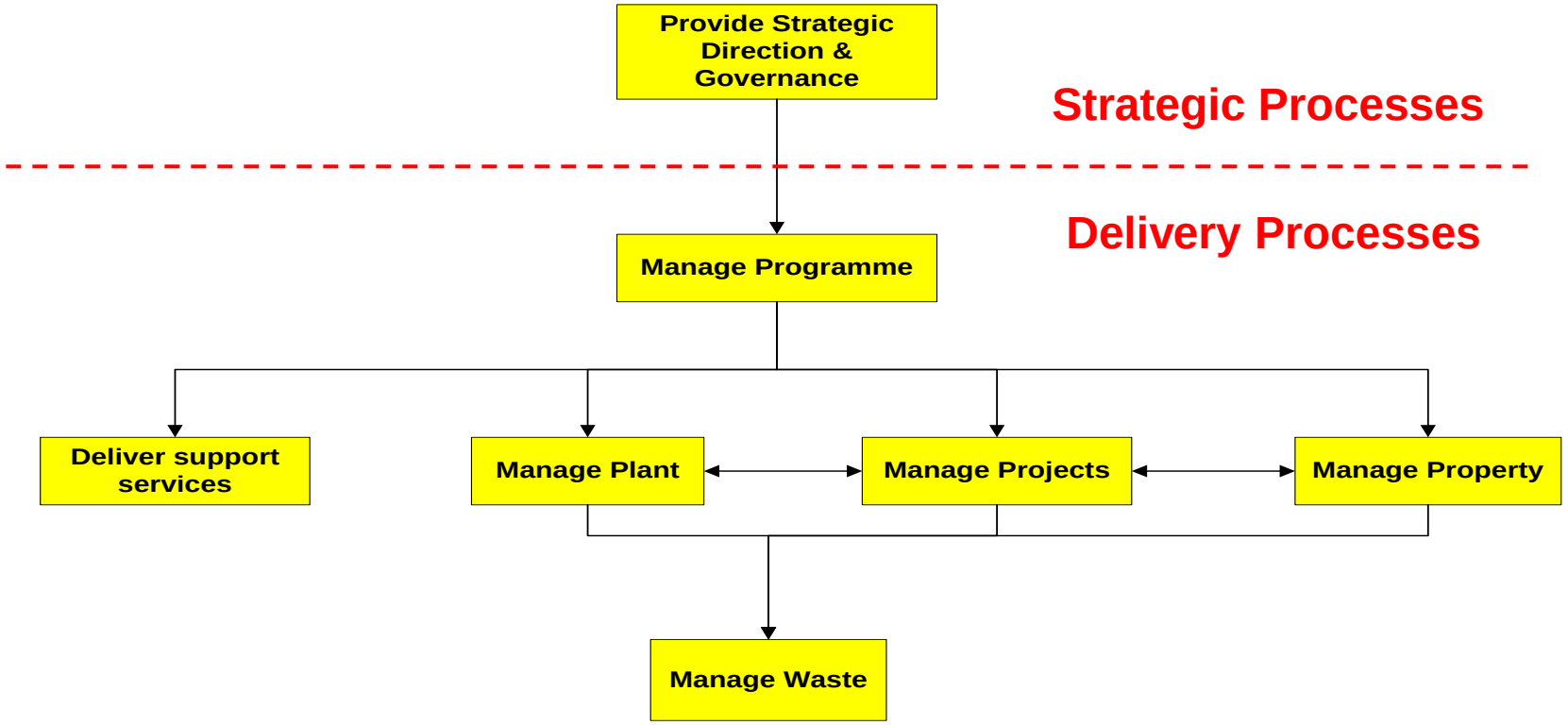
RSRL Main Process Structure



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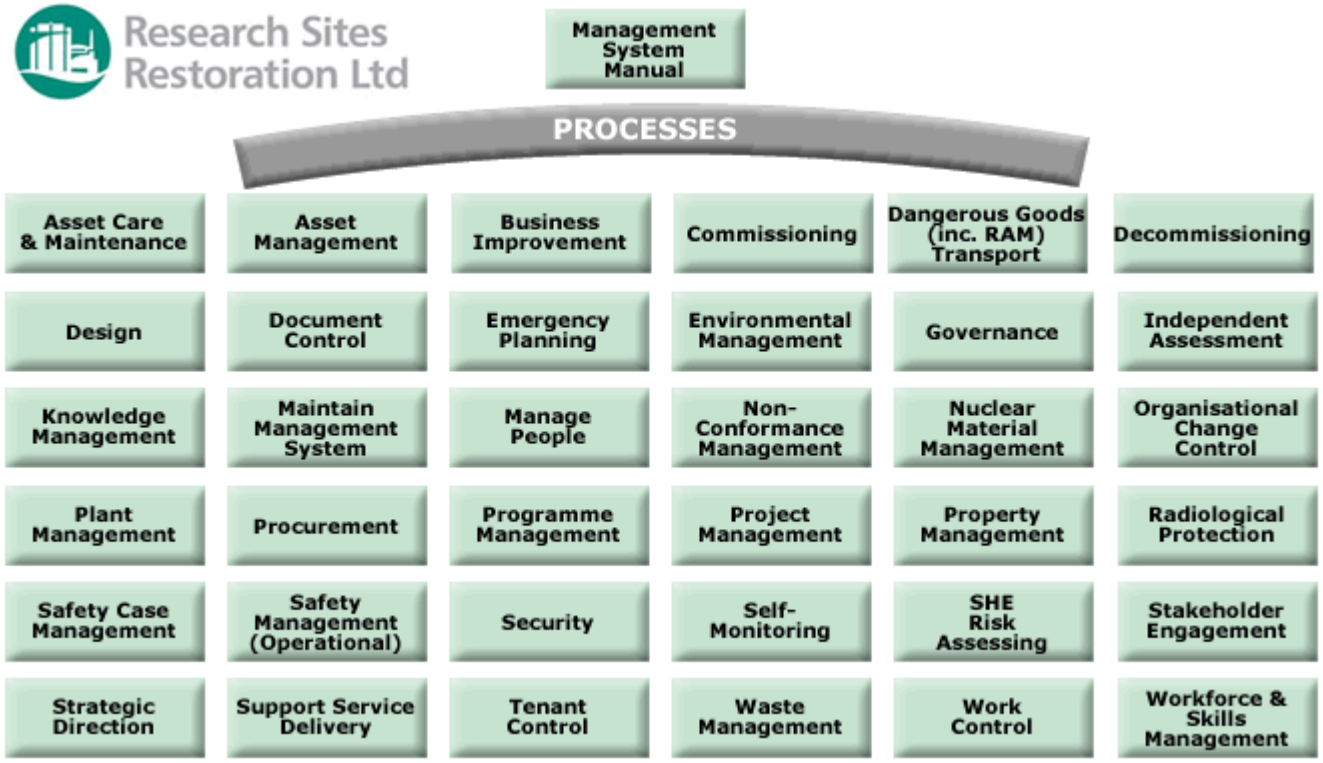
Management System Homepage



Key RSRL Considerations in relation to Risk

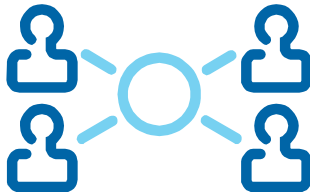
- Nuclear safety
- Conventional safety
- Environment
- Security
- Programme delivery
- Meeting obligations
- Stakeholders

Formal Risk Assessment Methods Used

- Programme risks
- Project risks
- Safety Cases for nuclear facilities
- Environmental aspects evaluation
- Security and information security
- Contract risks
- SHE risk assessments for buildings and tasks
- Organisational and MS change assessments
- Business continuity impact assessment (in progress)

Risk Management Organisation

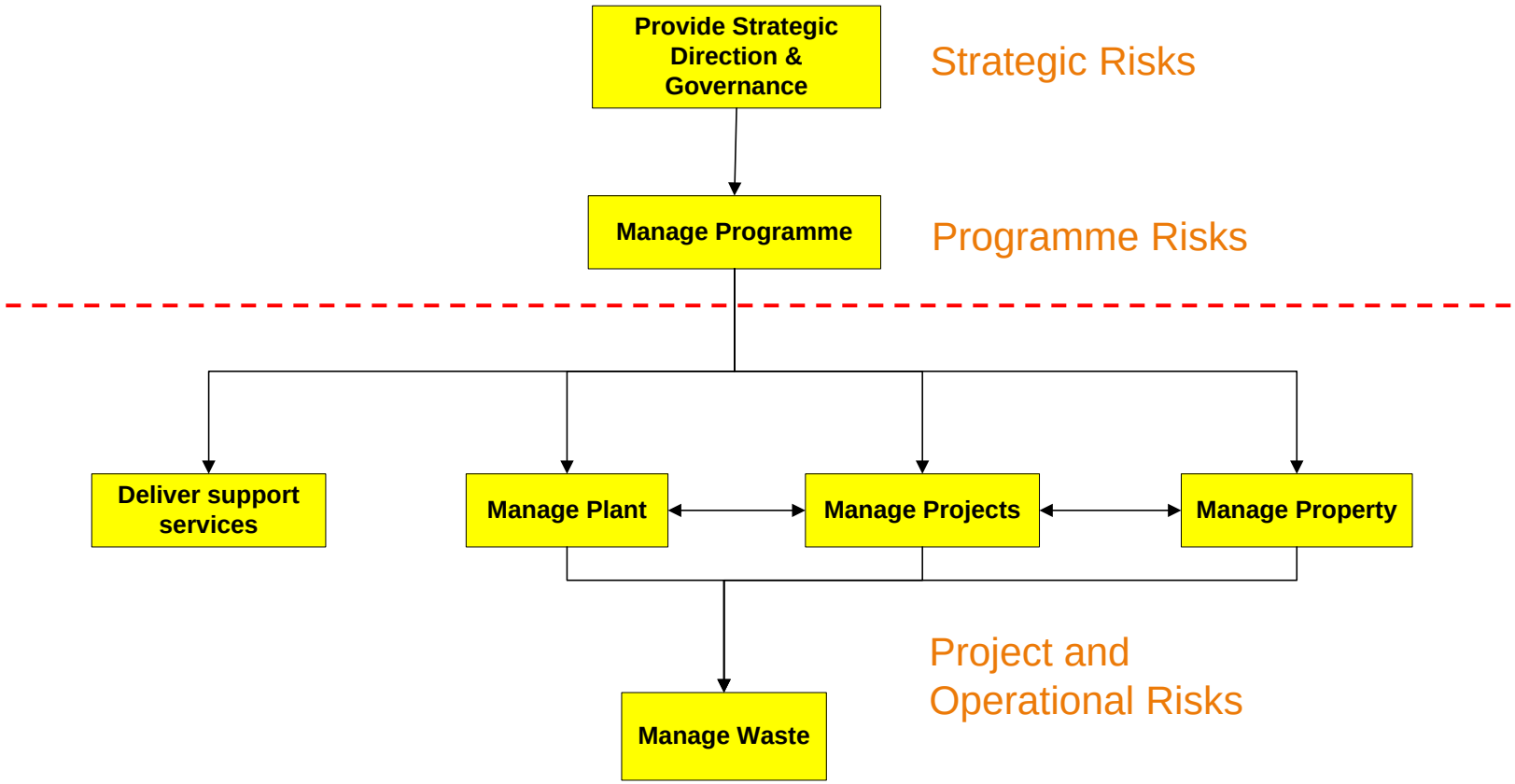
- Risk ownership is at various levels
  - Top management own business and programme risks
  - Project mangers own project risks
  - Operational mangers responsible for facility and task risks
  - Contract risks shared between RSRL and suppliers
- Business, programme and project risk assessment is coordinated by RSRL Programme Office
- Specialist risk assessments are carried out by specially trained personnel



Risk Assessment Coordination

- Various risk assessment methods are embedded in a number of different processes
- Coordination is mainly at the following levels:
  - Programme including asset and workforce related risks
  - Major facility
  - Project

Main Process Structure & Risks



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Frequency of Risk Assessment Reviews

- RSRL Executive reviews risks on a monthly basis from a programme perspective
- Significant project and contract risks are also reviewed regularly
- Other risk assessments are reviewed at defined intervals or following changes or when reason to question adequacy

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Development of Risk Assessment in RSRL

- A number of risk assessment methods were inherited from UKAEA on formation of RSRL
  - These methods have been reviewed and in some cases modified
- Enhancements have been made as a result of adopting good practice in relation to asset management (PAS 55) and Information Security (ISO 27001)
  - Considered from a process perspective
  - Physical asset risks considered as part of programme planning
  - New information security risk assessment method introduced
  - Executive accepts residual information security risks

Lessons Learned

- MS standards are useful as a basis
  - Approach needs to be tailored to organisational context
- Process approach is important
- Taking different perspectives is helpful to ensure comprehensive risk coverage
  - Now much better RSRL understanding of asset and information security risks
- Coordination of different methods presents a challenge

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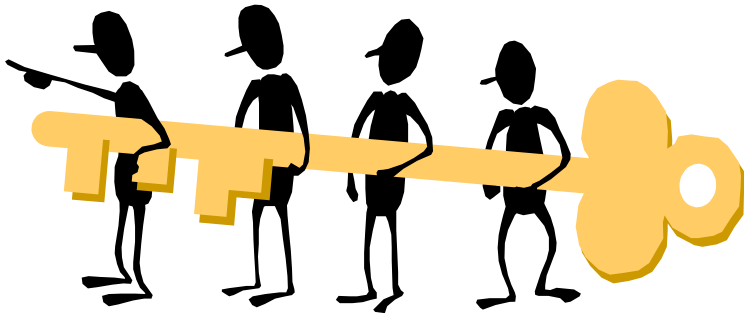
Future RSRL Developments

- A review will be carried out in response to an audit finding to check alignment of risk assessment methods
- A business continuity impact analysis will be completed
- A set of knowledge loss risk assessments will be carried out and used as an input to workforce and skills planning



CQI NucSIG: The Evolution of Risk Assessment in Management Systems

Open Forum Discussion

Mike Underwood
Chair
CQI Nuclear Specialist Interest Group

NUCLEAR SIG
Chartered Quality Institute

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Business Assurance

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Risk Management Discussion
ISO 9001 Committee Draft

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Annex SL

- No mention of "Preventive Action" in Annex SL as "the key purpose of a management system is to act as a preventive tool"
- TC 176 on re-writing ISO 9001: "Requirement for risk based thinking and a risk based approach to preventive action throughout the development and implementation of the quality management system".

ISO/CD 9001 Clause 6.1

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Planning

Actions to address risks and opportunities

When planning for the quality management system, the organization shall consider the issues referred to in 4.1 (Organisation and its context) and the requirements referred to in 4.2 (Understanding needs and expectations of interested parties) and determine the risks and opportunities that need to be addressed to:

a) assure the quality management system can achieve its intended outcome(s),
b) assure that the organization can consistently achieve conformity of goods and services and customer satisfaction,
c) prevent, or reduce, undesired effects, and
d) achieve ~~continual~~ improvement

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ISO/CD 9001 Clause 6.1 . . . *(continued)*

The organization shall plan:

a) actions to address these risks and opportunities, and
b) how to
    1) integrate and implement the actions into its quality management system processes (see 4.4), and
    2) evaluate the effectiveness of these actions

Any actions taken to address risks and opportunities shall be proportionate to the potential effects on conformity of goods and services and customer satisfaction.

Note: *Options to address risks can include for example risk avoidance, risk mitigation or risk acceptance*

So how should we deal with this change?

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What have we learned from Fukishima in the context of risk management - capture on flipchart

Discuss and score:

1. Is the future ISO 9001 risk requirement a fundamental change requiring a complete re-think of our management systems?
2. Do we do it anyway? Is it just another procedure or matrix showing how we already manage risk?
3. Should we try to "integrate" the ways we consider risk: financial; industrial safety; project; environmental; nuclear safety, etc?
4. Is a "risk based" management system an executive euphemism for a smaller management system?
5. Can this change help us make our management systems more effective - targeted at risk elimination or mitigation?
6. What about Opportunities - the prize if you take the risk? Is it just the other side of the coin?

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Any questions?

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Thank you very much for your time today

For more information, please visit www.lrqa.co.uk

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