

Creeping Changes

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IOSH Managing Change

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Creeping change



- Small problems can escalate to major accidents or major equipment failure
- Creeping changes are:
 - Gradual
 - Unseen
 - Not planned
 - Difficult to monitor

Major incidents

- RAF Nimrod
- Space shuttle Columbia
- Kings Cross fire
- Texas City



Types of creeping change



- Ageing (including degradation and obsolescence)
- Process changes
- Equipment/infrastructure changes
- Management/ownership changes
- Workforce change/loss of skills
- ORAs/MOCs
- Culture changes

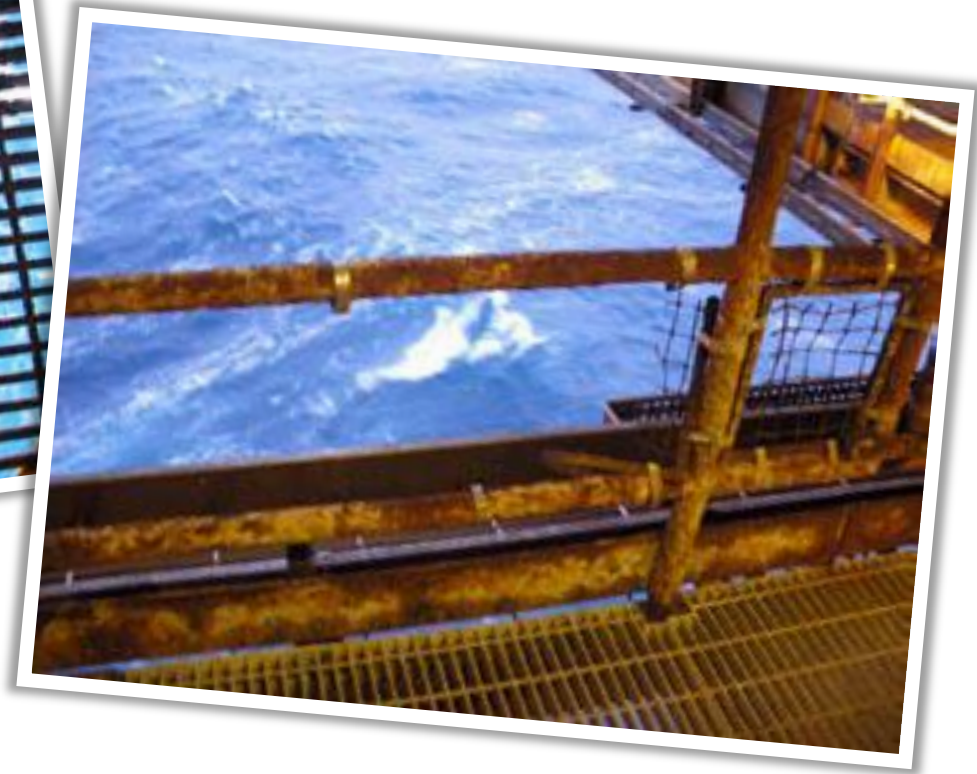
Creeping change offshore



Creeping change offshore (cont.)



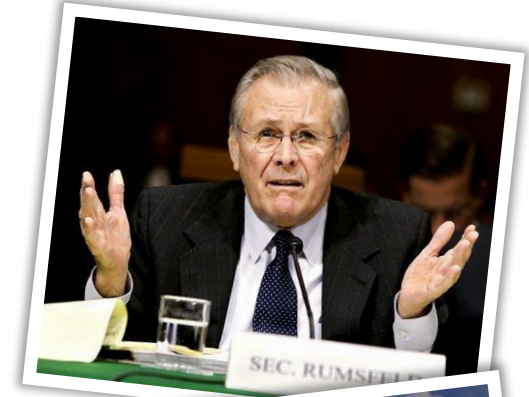
Creeping change offshore (cont.)



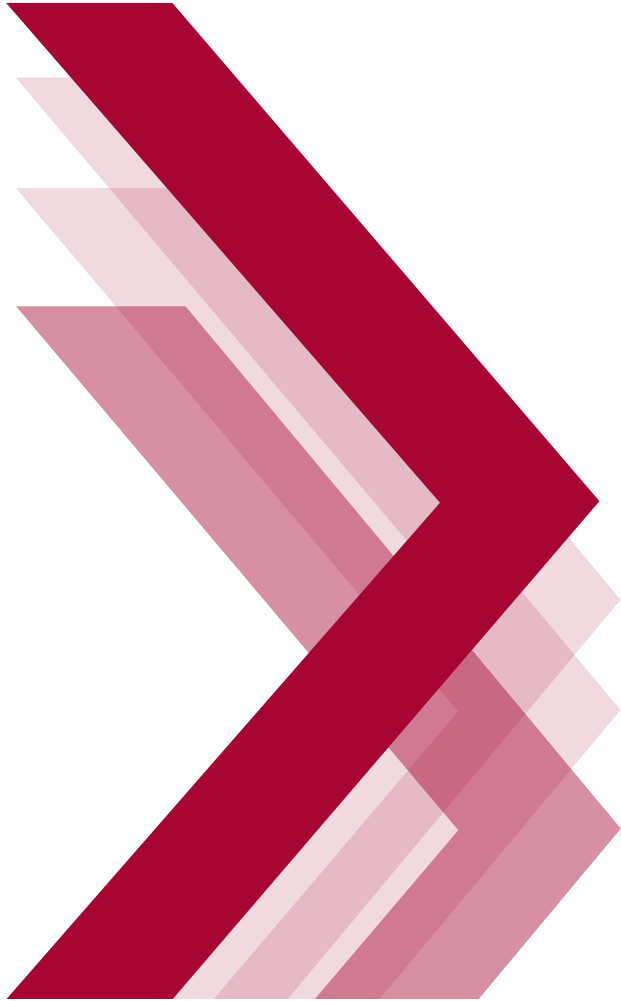
Atypical events

- Types of events following the Donald Rumsfeld classification system:

	Knowledge	Lack of Knowledge
Awareness	Known known	Known unknown
Unawareness	Unknown known	Unknown unknown



Lessons Learned from Toulouse and Buncefield Disasters,
N. Paltrinieri et al, Risk Analysis 32, 1404 (2012)



Organisation and Safety Culture

Organisational culture

- Values, norms and beliefs shared by the people in the organisation
- Driven and influenced by management



Procedural drift



High reliability organisations and mindful culture



What sets them apart includes:

- Management commitment
 - Mindful leadership/leadership style
 - Deference to expertise during emergencies
 - Constant unease/preoccupation with the possibility of failure
- Bad news communicated upwards
- No blame culture
 - Reporting and stopping work on safety grounds

Remember – the next major accident could be incubating itself in your organisation at this moment

Leading by example

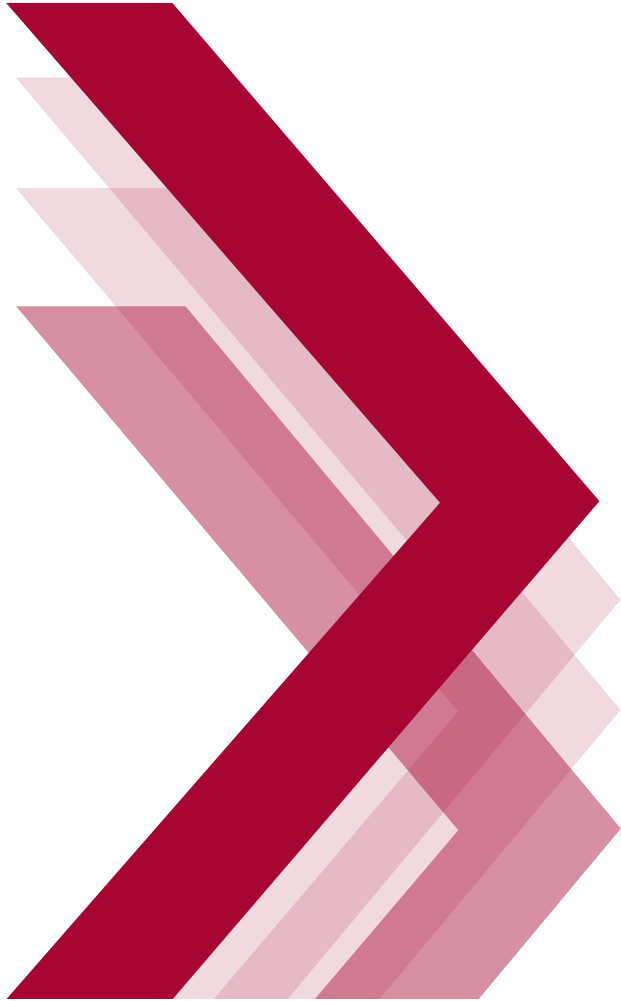


- Being a role model
 - If you don't believe safety is important, then unlikely to convince others
 - Every time you turn a 'blind eye' to unsafe behaviour and conditions, you are sending the workforce a message of acceptance/tolerance
 - Zero tolerance
- Be proactive not reactive

“What gets measured gets done”

Tom Peters (writer “In Search of Excellence”)

“If you aren’t measuring then you can’t know if you are improving.”



Creeping Change HAZID (CCHAZID)

Why?



- Creeping changes identified as a potential issue with ageing assets offshore during HSE's KP4 inspection programme
- One of the recommendations was to use audits to identify and manage creeping changes

Creeping Change HAZID (CCHAZID)



- Similar to a conventional HAZID
 - Use of keywords
 - Team of experts brainstorming issues
- Differences
 - Faster paced
 - Less detailed
 - Focus on creeping change

Application



- To be used as part of regular plant review
 - Part of the suite of safety studies available
 - Complements a traditional HAZID rather than replaces
- Looks at both engineering and human/organisational factors
- Not specific to high hazard industries
 - Could be applied anywhere there is a reliance on ageing equipment

Application (cont.)



- Applied to:
 - A whole site or organisation
 - A defined module of plant
 - One particular piece of equipment
 - A (safety) barrier
 - A safety (or safety and environmentally) critical element (SCE/SECE)

Keywords



- A mixture of keywords and questions was found to be needed to prompt discussions on the different creeping changes
 - Grouped into themes
 - Some themes required further prompts to direct discussions
 - Open questions used
 - Some targeted at the organisation/site, others at equipment or process

Keywords (cont.)



- The keywords/questions were around the themes of:
 - Equipment and infrastructure changes;
 - Process changes;
 - Workforce and organisational changes; and
 - Ageing plant changes.

Keywords	Prompts	Additional questions/information	Applicable to	
			Whole site or organisation	Barrier or equipment
Equipment/infrastructure changes			✓	✓
Structural/civil engineering changes		Gratings, handrails, etc. Piping supports Ground conditions, flooding	✓	
Operational changes			✓	✓
Workforce changes		Loss of skills (including knowledge)? Ageing workforce? Especially leadership and key experts (overlap with organisational factors)	✓	✓
Contractor changes			✓	✓
Working Environment Changes		Lighting, temperature, etc.		✓
Organisational factors	Change in management/ownership?	More/less mindful leadership?	✓	
	What is the culture like? Have there been any changes?	Particularly safety (could be monitored with safety climate tool). Is there a blame culture?	✓	
	How thorough are investigations of incidents and near misses?	Root/underlying causes determined or just what happened?	✓	
	Is there reporting of bad news?	Continuous good news with regard safety is a worrying trend, there is always bad news	✓	
	Communication issues/changes		✓	✓
	Procedural violations/work arounds	Are procedures followed? Are there differences between shifts?	✓	✓
	Issues that make life difficult/increasingly difficult	How easy is it to get things fixed?	✓	✓
	Task changes	Nature of the task, complexity, time restraints		✓
	Changes in supervision/training	E.g. shift handover, role of supervisor		✓

Loss of containment	Leaks Weeps	Hydrocarbons, hydraulic fluid, water, chemicals, air, etc. Has the number been trended? Are they increasing?	✓	✓
Equipment failures		How do they compare to benchmark data? Has the number been trended? Are they increasing?	✓	✓
ORAs and MOCs	Are there any areas/equipment with lots of MOCs and/or ORAs? Was the MOC study done? Have any ORAs not been closed out after a long time? Are cumulative effects considered? Are the drawings up to date?	Has this been trended? Numbers and duration	✓	✓
Process monitoring	Process/reservoir/feedstock changes Flow rate Temperature Pressure Composition Alarms/gauges ignored Alarms/gauges unreliable Spurious trips/Overrides Learnings from Process safety Performance Indicators (PSPIs)?	Including changes to apparently less hazardous conditions - are there any potential knock on effects? What % of alarms/gauges do process operators believe matter or work reliably? How many and which ones are ignored? Fix or remove	✓	✓
Ageing	Obsolescence Dead legs Corrosion Erosion Fatigue Welds/joints Redundant equipment General degradation Previous history	E.g. has one valve been worked upon more than the others?	✓	✓
Accumulation of changes		Is there anywhere where lots of changes interact?	✓	✓
Inspection and Independent Audits	Have intervals changed? Are results acted upon? Are they independent? Uninspected/uninspectable equipment? Trend monitoring?	Fresh pair of eyes? Useful to include somebody not familiar with the installation If trending does not occur, should it?	✓ ✓ ✓ ✓ ✓	✓

Pilot Studies



Gas fired power station

- Simple site with relatively few changes
 - ½ day on a site-wide study
 - ½ day on a specific piece of equipment

Onshore gas terminal

- Complicated site with extensive changes
 - 1 day on a specific module

Offshore gas storage facility

- Moderately complicated site
 - 1 day on the entire site

Personnel Required



- Appropriate technical experts
 - E.g. process safety, mechanical engineering, EC&I
- Operations and maintenance personnel
- Senior/management personnel
- Challenges due to the large CCHAZID team
 - Managing multiple conversations
 - Need team members to speak freely and honestly

Chairing/facilitation



- Study leader(s) need a broad range of experiences (both engineering and human/organisational factors)
 - Facilitation team may require 2 or 3 people
 - Chair and scribe; or chair, technical expert and scribe
- Degree of independence required
 - Fully independent third party
 - From a separate part of the organisation with no involvement in the facility

Recording



- Spreadsheet used to record the discussions
- Displayed on a projector so that the recorded text could be agreed by all

Information recorded

For each of the keywords and prompts, information was recorded in the following categories:

- Keyword/parameter;
- Prompt details;
- Consequences or problems of the identified change(s);
- Safeguards (existing or potential) against these problems;
- Actions or further studies required to mitigate them;
- Person who the action is on;
- Date for the action to be completed by; and
- Action priority (high, medium or low).

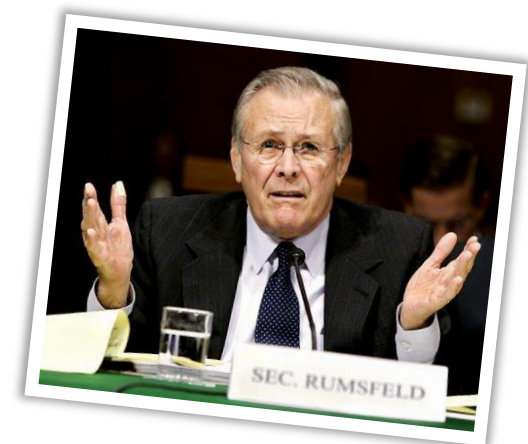
Table D.4: CCHAZID study output from offshore gas storage facility

No.	Keyword	Prompt	Details	Consequences/ problems	(Potential) Safeguards	Action No.	Actions/ further studies	Action on whom	Action due date	Action priority
1	Equipment/ infrastructure changes		Changed operating mode from security supply to operating in a commercial manner. Previously operating a few days p.a.; but now operating 365 days p.a.	Pressure cycling could cause fatigue Corrosion a bigger challenge than fatigue	High risk equipment assessed for fatigue Strategy for operating until 2035	1	Define the strategy to assess equipment for its suitability for use until 2035	[Name]	[Date]	Medium
1b			Increased capacity/ flow and pressure changes Capacity: 135 bcf to 150 bcf Pressure: 3 500 psi max. operating pressure now back down to 3 000 psi	Issues with surge control on injection compressors at low reservoir pressure	Issues known and studies are going to be undertaken					
1c			No longer operate [name] installation	Greater demand on currently operated [name] wells Increased reliability needed						
1d			Increased regulatory scrutiny of oil in water discharged to sea	Additional water polishing equipment leading to additional personal exposure to benzene	Not using polishing unit Oily water put in caisson Project to be started to study this					

Outputs

- Identify weak or overlooked areas
 - Can then be addressed

	Knowledge	Lack of Knowledge
Awareness	Known known	Known unknown
Unawareness	Unknown known	Unknown unknown



Example outputs



- Study stalled because the person doing it had been moved to a new placement;
- No human factors input in a new design;
- The need to develop/improve process for succession planning and apprenticeships, and to identify gaps in roles and responsibilities;

Example outputs



- Increased training needs for new systems and processes;
- Problems in updating P&ID diagrams;
- Specific hardware issues;
- The need to develop rules for trip overrides in the ORA procedure.

Lessons learned



- List of keywords added to throughout the pilot studies
- Works best if applied to a large enough target for many and/or compound changes to have occurred
- If applying to a single piece of equipment or barrier, then the CCHAZID should be divided into two parts
 - Site/organisation as a whole
 - Specific target

Feedback



- Positive feedback from all three sites
 - One site going to use the outputs in the Process Hazards Review
- Issues found at the site that had the HAZOP updated
 - Found problems created as a result of recent changes

Cumulative risk



- Guidance from the offshore industry on how to assess cumulative risk from multiple *'deviations'*
 - Any change to plant, people or processes, outside of normal boundaries, that leads to an increased risk
- Includes deviations to both safety critical and non-safety critical equipment
- Takes into account human factors and other influencing factors



Cumulative Risk Guidelines

Issue 1
October 2016

References

- Creeping Changes, Hazards 25
- Development of a Creeping Change HAZID Methodology, Hazards 27
- What to do About Creeping Change, The Chemical Engineer
- Guidance on applying a creeping change hazard identification (CCHAZID) methodology, Energy Institute