What makes a task safety critical?

Human Factors in Control @ ABB

Sondre Øie

26 April 2016

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This presentation

- Definitions
- “The bigger picture”
- @Johan Sverdrup
- Identification & screening
- Task criticality roadmap
- Examples and experiences
- Infiltrate and collaborate
- Ironies of automation
- Sharp end ~~versus~~ AND blunt end
- Summary

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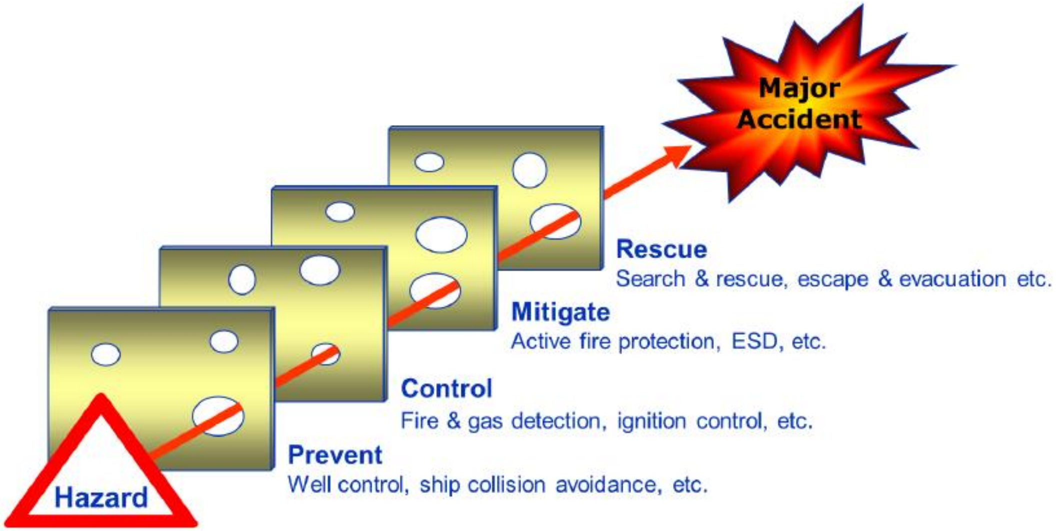
Definitions, definitions, definitions…

- Tasks where human performance contribute positively or negatively to major accident risk, through either:
  - Initiation of events;
  - Detection and prevention;
  - Control and mitigation; or,
  - Emergency response.

Reference: www.rederi.no


Major Accident
Rescue
Search & rescue, escape & evacuation etc.
Mitigate
Active fire protection, ESD, etc.
Control
Fire & gas detection, ignition control, etc.
Prevent
Well control, ship collision avoidance, etc.
Hazard

OK, we know it has something to do with major accidents. Then what?

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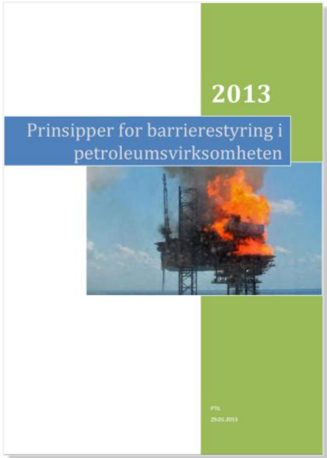
Safety critical tasks and the “bigger picture”

- A **task-based** approach allows systematic identification, analysis and management of human contribution to major accident risk
- Recently, the concept of safety critical tasks has become an integrated part of key approaches to safety management:
  - Barrier management, e.g. PSA and NSA report
  - Quantitative risk analysis (QRA), e.g. Petro-HRA
- Supports risk-informed decision making, e.g. by reducing uncertainties inherent in assumptions previously made about human performance (e.g. in QRAs)
- Still some way to go, but the ball has started rolling



2013

Prinsipper for barrierestyring i petroleumsvirksomheten

PTIL

29.01.2013

Source: www.ptil.no

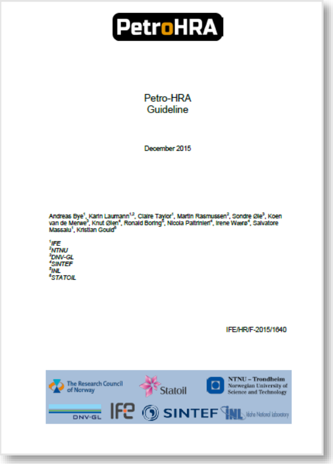
BARRIER MANAGEMENT IN OPERATION FOR THE RIG INDUSTRY

GOOD PRACTICES

March 2014

A DNV GL report commissioned by NSA

Source: www.rederi.no



PetroHRA

Petro-HRA
Guideline

December 2015

Andreas Bye[1], Karin Laumann[1,2], Claire Taylor[1], Martin Rasmussen[2], Sondre Øie[3], Koen van de Merwe[3], Knut Øien[4], Ronald Boring[5], Nicola Paltrinieri[4], Irene Wærø[4], Salvatore Massaiu[1], Kristian Gould[6]

[1] IFE
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[5] INL
[6] STATOIL

IFE/HR/F-2015/1640

Source: To be issued

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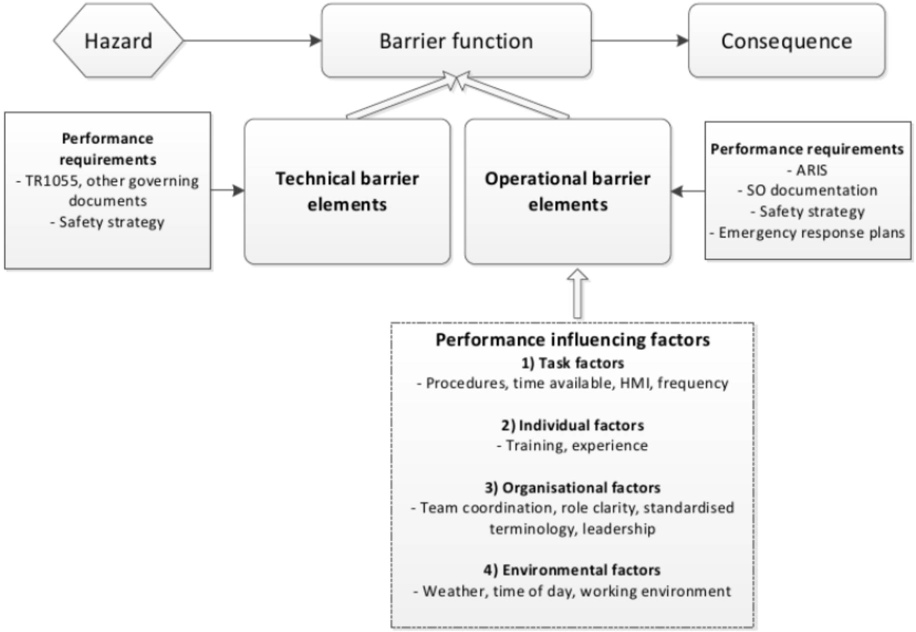
Mapping and assessment of OBEs @ Johan Sverdrup



Hazard

Barrier function

Consequence

Performance requirements
- TR1055, other governing documents
- Safety strategy

Technical barrier elements

Operational barrier elements

Performance requirements
- ARIS
- SO documentation
- Safety strategy
- Emergency response plans

Performance influencing factors

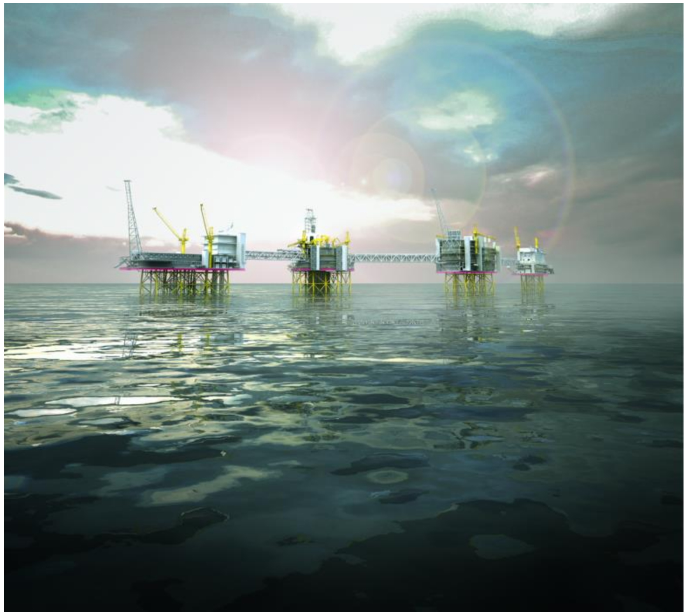
1) Task factors
- Procedures, time available, HMI, frequency

2) Individual factors
- Training, experience

3) Organisational factors
- Team coordination, role clarity, standardised terminology, leadership

4) Environmental factors
- Weather, time of day, working environment

Reference: Definitions and guidelines for non-technical barriers (Statoil, 2015)



The JOHAN SVERDRUP field

AkerSolutions

Main activities:

- Mapping and assessment of OBEs
- HRA in LOPA of human IE’s and IPLs

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Approach

- **Phase 1 – Task identification**: Review or relevant documents (e.g. safety studies) and input from various technical disciplines and operations
- **Phase 2 – Task screening**: Screening of tasks associated with major accident hazards & barriers against a set of pre-defined criteria (high, medium, low)
- **Phase 3 – Task requirement analysis**: Establishing Performance Requirements for inclusion in Safety Strategies & Performance Standards
- **Phase 4 – Task failure analysis**: Human error identification and analysis of the most critical tasks to assess task feasibility and risk reducing measures

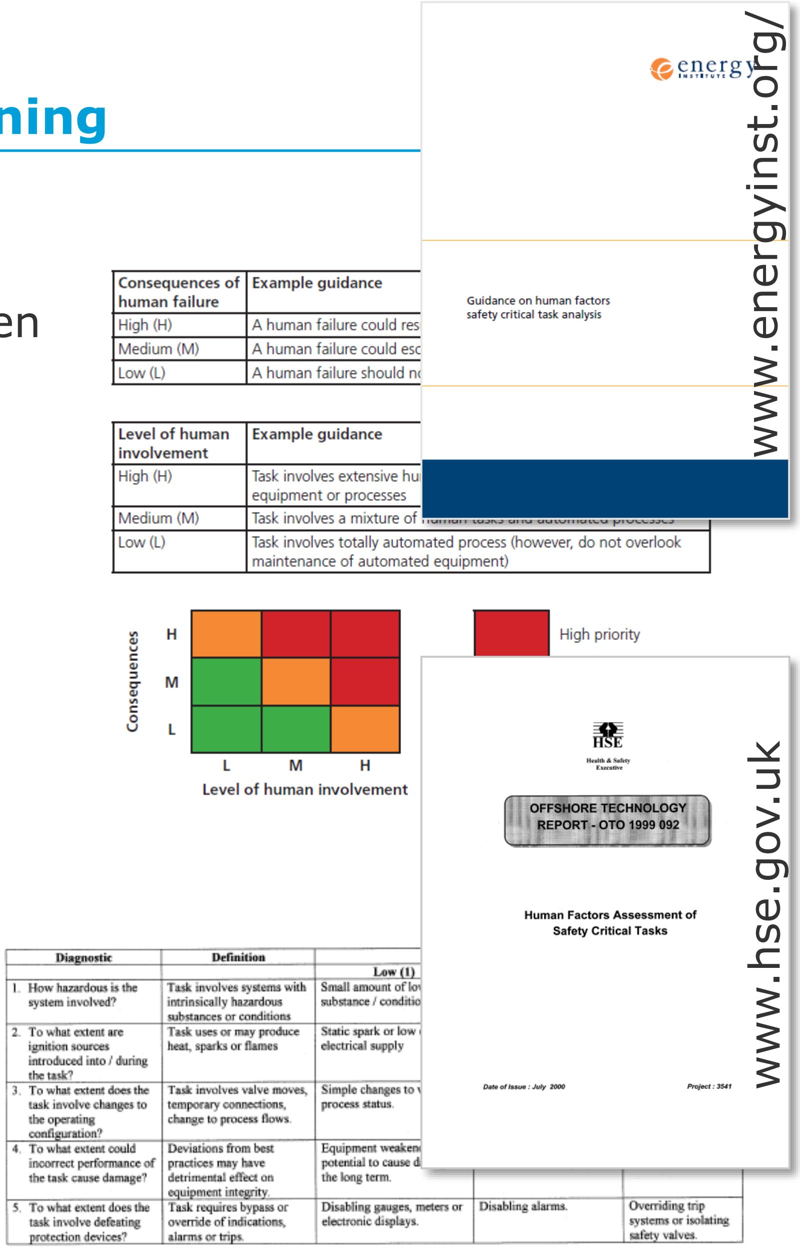
Improvements in design

Operational recommendations

Identify assurance and verification activities

Tools for task identification and screening

- Some are too simple;
  - E.g. does not manage to distinguish between medium and highly critical tasks
- Some are too complex;
  - E.g. require a lot of information about the task to make ranking, thus time consuming
- Top down vs. bottom up dilemma
  - How can we identify which tasks are critical without going too much into detail?



energy institute

Guidance on human factors safety critical task analysis

www.energyinst.org/

Consequences of human failure	Example guidance
High (H)	A human failure could res
Medium (M)	A human failure could esc
Low (L)	A human failure should n

Level of human involvement	Example guidance
High (H)	Task involves extensive hu equipment or processes
Medium (M)	Task involves a mixture of human tasks and automated processes
Low (L)	Task involves totally automated process (however, do not overlook maintenance of automated equipment)

Consequences				
	H	🟧	🟥	🟥
	M	🟩	🟧	🟥
	L	🟩	🟩	🟧
		L	M	H

Level of human involvement

🟥 High priority

HSE
Health & Safety Executive

OFFSHORE TECHNOLOGY REPORT - OTO 1999 092

Human Factors Assessment of Safety Critical Tasks

Date of Issue : July 2000

Project : 3541

www.hse.gov.uk

Diagnostic	Definition			
		Low (1)		
1. How hazardous is the system involved?	Task involves systems with intrinsically hazardous substances or conditions	Small amount of lo substance / conditio		
2. To what extent are ignition sources introduced into / during the task?	Task uses or may produce heat, sparks or flames	Static spark or low electrical supply		
3. To what extent does the task involve changes to the operating configuration?	Task involves valve moves, temporary connections, change to process flows.	Simple changes to v process status.		
4. To what extent could incorrect performance of the task cause damage?	Deviations from best practices may have detrimental effect on equipment integrity.	Equipment weaken potential to cause d the long term.		
5. To what extent does the task involve defeating protection devices?	Task requires bypass or override of indications, alarms or trips.	Disabling gauges, meters or electronic displays.	Disabling alarms.	Overriding trip systems or isolating safety valves.

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Roadmap to task criticality

Fully

- Removes hazard?
- Prevents initiation?

Partly

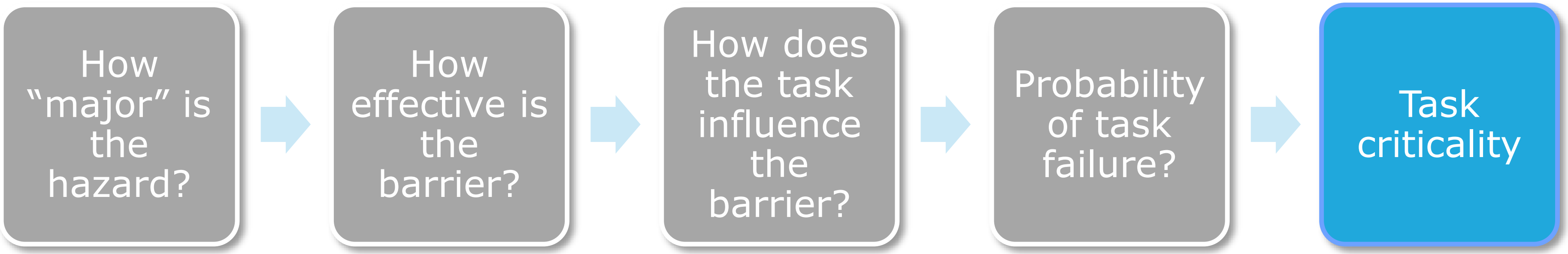
- Mitigates escalation?
- Reduces consequences?

Task frequency

- No. of opportunities to error?
- Task familiarity?

Human reliability

- Human error probability?
- PSF influence/ task feasibility?



How "major" is the hazard?

How effective is the barrier?

How does the task influence the barrier?

Probability of task failure?

Task criticality

Safety

- Number of fatalities?
- Severity of injures?

Environment

- Size and duration of spill?
- Type of spill?

Type of influence

- Latent failure? (Type A)
- Initiates event? (Type B)
- Mitigates event? (Type C)

Dependency

- Level of automation?
- Number of safeguards?

Output

- Level of analysis
- Degree of attention

Examples

Safety critical task	How "major" is the hazard?	How effective is the barrier?	How does the task influence the barrier?	Probability of task failure?	Criticality level
Prevent dropped/ swinging objects during crane operations	Dropped objects onto critical equipment or lifting of personnel (e.g. MOB) is highly critical	100% effective	Crane operations are highly depending on manual operations, however several technical safeguards are in place (e.g. DOP, AOPS).	Routine task, highly familiar. Less routine lifts are carefully planned and regulated by procedures and additional safeguards. Well-established training regime.	Medium
Cancellation of emergency depressurization in case of a gas leak in the flare system	Major gas leaks due to depressurization through a rupture or other leak point is highly critical	60%-90% (higher degree of uncertainty)	Cancellation sequence is automated, but required a push-button activation. Diagnosis is purely cognitive actions, with little assistance from HMI/ control system.	Unfamiliar function and task. Negative influence from several PSF, e.g. available time, stress and task complexity. No current training program targeting task.	High

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Experiences

- Numerical rating systems and scales fails on “face validity”;
  - Too complex construct; qualitative descriptions of criticality levels are preferred

- Works OK; a lot of tasks are screened out based on only one or two criteria, e.g.;
  - The hazard is limited to cause occupational accidents (slips, trips and falls)

- The most difficult part is distinguishing between medium and high criticality
  - If there is uncertainty, more information is collected to help decide

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Infiltrate and collaborate!!

Maybe not all, but many SCTs can be identified and screened through other activities

- **HAZOP/HAZID**
  - Either as safeguards/ barriers, or
  - as “valve left inadvertently open” (pure omissions)
  - These are typical process “deviations”, potentially causing hazardous events
- **LOPA**
  - Follow-up of the HAZOP
  - SIS/SIF (alarm response) or Initiating Events
- **QRA/ EPA, reliability assessments**
  - Not many tasks are modelled, the QRA and EPA is high-level or coarse
  - Some times tasks are part of the event or fault tree model, “Human Failure Events”
- **FMEA/FMECA/FMEDA**
  - “Detection and recovery” column
  - Alarm response, inspection, maintenance etc.

If possible, participate in meetings or ally with meeting chairman/ lead analyst

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Ironies of automation

- Petroleum plants are being increasingly automated, especially SIF/SIS (barriers)
- While these are highly reliable systems, in major accidents many systems are in play
- For major accidents to occur, these systems have to fail
- At some point the operators will be faced with the task of potentially having to recover technical failures

Kilde: www.honchemistry.wikispaces.com

When automation fails, the operator is left to do the dirty work

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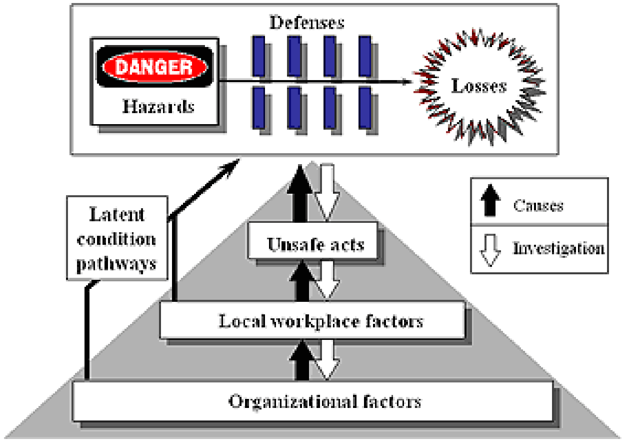
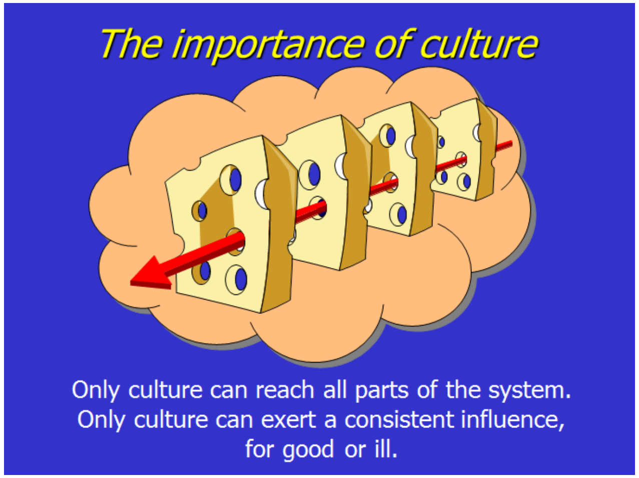
Sharp end ~~versus~~ AND blunt end

- Barrier management and risk analysis can be used to identify, analyse and manage the “bigger holes”

- The smaller, but plentiful and sneaky holes, can be targeted through other initiatives;
  - Safety culture and leadership
  - Scenario-based training/ CRM
  - Management systems, e.g.
    - Maintenance on critical equipment
    - Management of change
    - Operational risk assessments



Ref. J. Reason 1997



Only culture can reach all parts of the system.
Only culture can exert a consistent influence,
for good or ill.

Stolen from J. Reason

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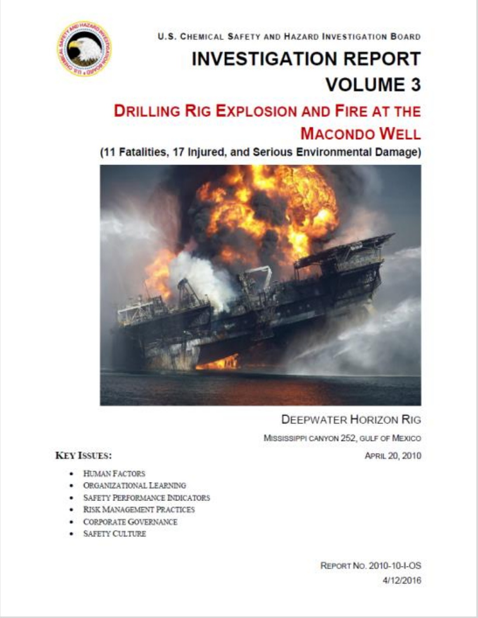
Summary

- Task criticality is a complex measure of safety
  - Requires a certain skill-set and good tools
  - Some sort of "task library" could be of use
  - Guidance on what to look for and where

- Draws on input from several different disciplines
  - Operations
  - Risk & reliability analysis
  - Technical safety
  - Human Factors engineering

Smarter together

- Current applications are barrier and risk management
  - Extend into maintenance and planning?
  - Does not solve all aspects of "human contribution"



U.S. CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD

INVESTIGATION REPORT
VOLUME 3

DRILLING RIG EXPLOSION AND FIRE AT THE MACONDO WELL

(11 Fatalities, 17 Injured, and Serious Environmental Damage)

DEEPWATER HORIZON RIG
MISSISSIPPI CANYON 252, GULF OF MEXICO
APRIL 20, 2010

KEY ISSUES:

- HUMAN FACTORS
- ORGANIZATIONAL LEARNING
- SAFETY PERFORMANCE INDICATORS
- RISK MANAGEMENT PRACTICES
- CORPORATE GOVERNANCE
- SAFETY CULTURE

REPORT NO. 2010-10-I-OS
4/12/2016

www.csb.gov

Questions?

Kilde: www.youtube.com

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Thank you!

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