Robson Forensic

Engineers, Architects, Scientists & Fire Investigators

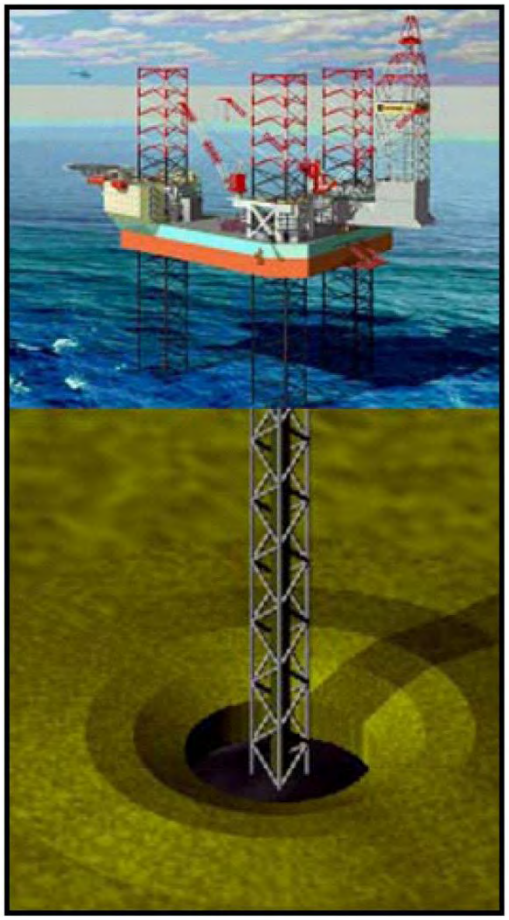
The Forensic Anatomy of the Events on the Deepwater Horizon

Bartley J. Eckhardt, P.E.
& Arthur Faherty

May 20, 2010

Offshore Oil Production:
Early Innovations

- 1947: Kerr-McGee goes offshore beyond piers and begins era of offshore oil and gas.
- Prior “Ocean Energy” came from piers into Southern California and Lake Maracaibo.
- The jack-up rig allowed steady growth in drilling up to 100-150 foot water depths.
- Beyond 100 feet, death through “bends” made any further water depth activity very risky.

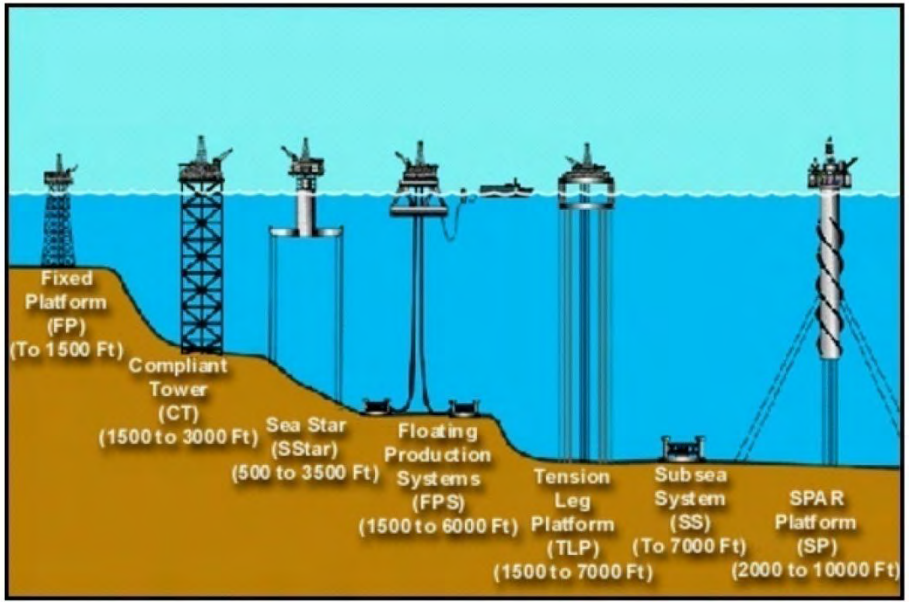


Source: Imperial College of London

Three Decades After the Boom Began…

- Offshore drilling survived
- Contractors financially prosperous
- The offshore fleet totals 518 rigs

	1987	2007
Jackups	378	333
Semis	148	150
Drillships	35	35
Total	**561**	**518**



Source: www.mms.gov

Offshore Drilling Technology Kept Pace with Diving Advances

- Drillships and semis created ability to drill beyond 150 feet water depths.
- 1977: Offshore Company (Transocean today) launched first two deep-water drillships.
- 400-450 foot jack-up rigs extended shallow water reach.
- Subsea well systems led to offshore satellite fields.
- 1993: Real deepwater/ultra deepwater begins.

Robson Forensic
Engineers, Architects, Scientists & Fire Investigators

Largest Marine Oil Spills:
Excludes Acts of War

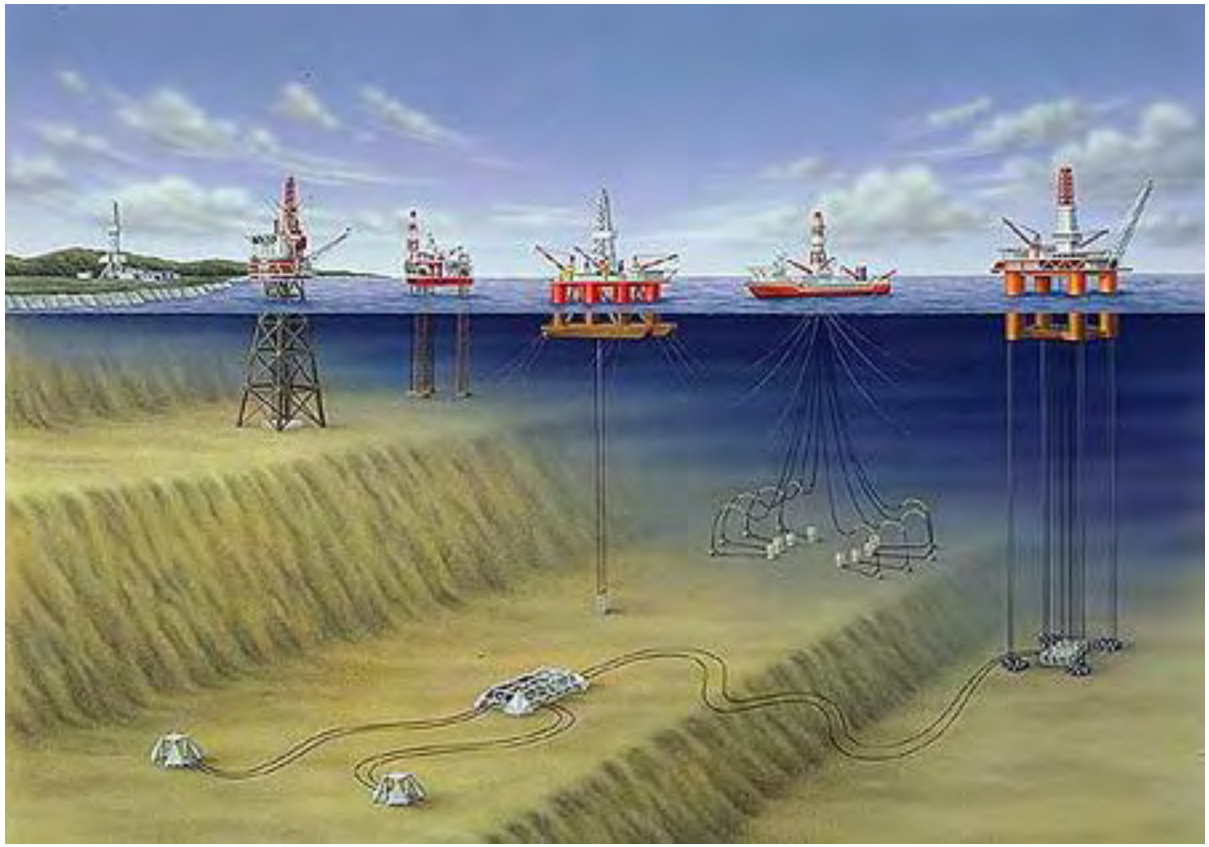
1. Ixtoc-1 well*: 3.25 mbbl (June 1979)
2. Castillo de Bellver: 2.75 mbbl (August 1983)
3. Amoco Cadiz: 2.5 mbbl (March 1978)
4. Odyssey: 1 mbbl (November 1988)
5. Atlantic Empress: 1 mbbl (July 1979)
6. Haven: 1 mbbl (April 1991)
7. Atlantic Empress: 1 mbbl (August 1979)
8. Torrey Canyon: < 1 mbbl (March 1967)
9. Sea Star: <1mbbl (December 1972)

- Exxon Valdez: 265K bbl (March 1989)

* Drill Rig
Source: The Economist, May 8th 2010

Robson Forensic
Engineers, Architects, Scientists & Fire Investigators

Offshore Drilling Platforms



Source: www.mms.gov

Deepwater Horizon

- *Deepwater Horizon* was a fifth-generation, RBS-8D design, ultra-deepwater, dynamically positioned, column-stabilized, semi-submersible drilling rig.

Source: www.ngoilgas.com

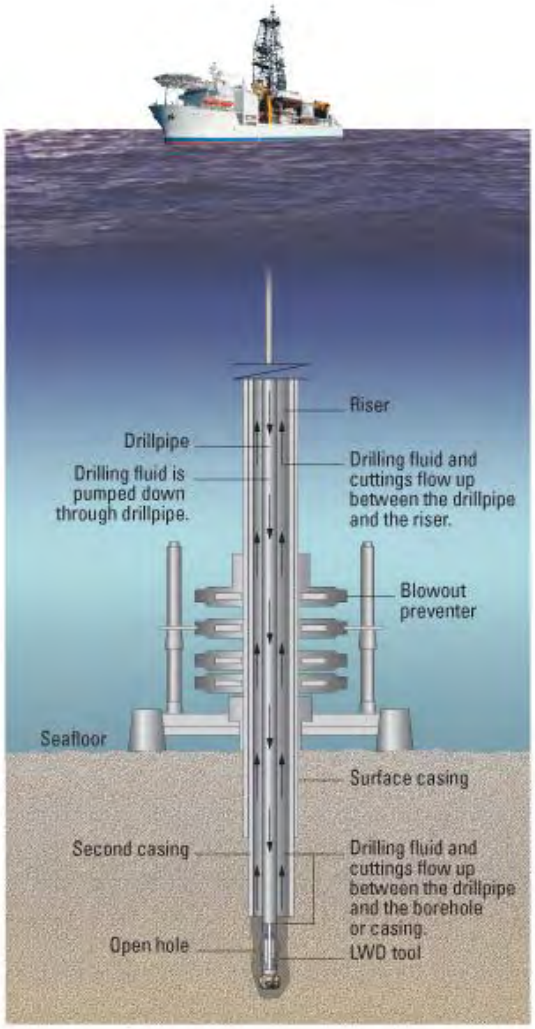
Robson Forensic
Engineers, Architects, Scientists & Fire Investigators

Dynamically Positioned Exploration Semisubmersible

- Leased Vessel “Bareboat” Rate, approximately $500,000 / Day
- Crew, Gear and Support Vessels Rate of approximately $500,000 / Day

Robson Forensic
Engineers, Architects, Scientists & Fire Investigators

Cross-Section of Riser / Drillpipe



Source:
http://www.glossary.oilfield.slb.com

Drilling as a Balancing Act

- Drilling for oil is a balancing act. If the pressure of the working fluids in the well, or the strength of concrete holding the pipeline in place, cannot balance the immense pressure of the oil down below, then things get very bad, very quickly.
  - *Source: The Economist, May 8th 2010*

Robson Forensic
Engineers, Architects, Scientists & Fire Investigators

Drilling as a Balancing Act

- Balance pressure using drilling and barite
  - Vary density
  - Heavier than water
  - Separable from oil

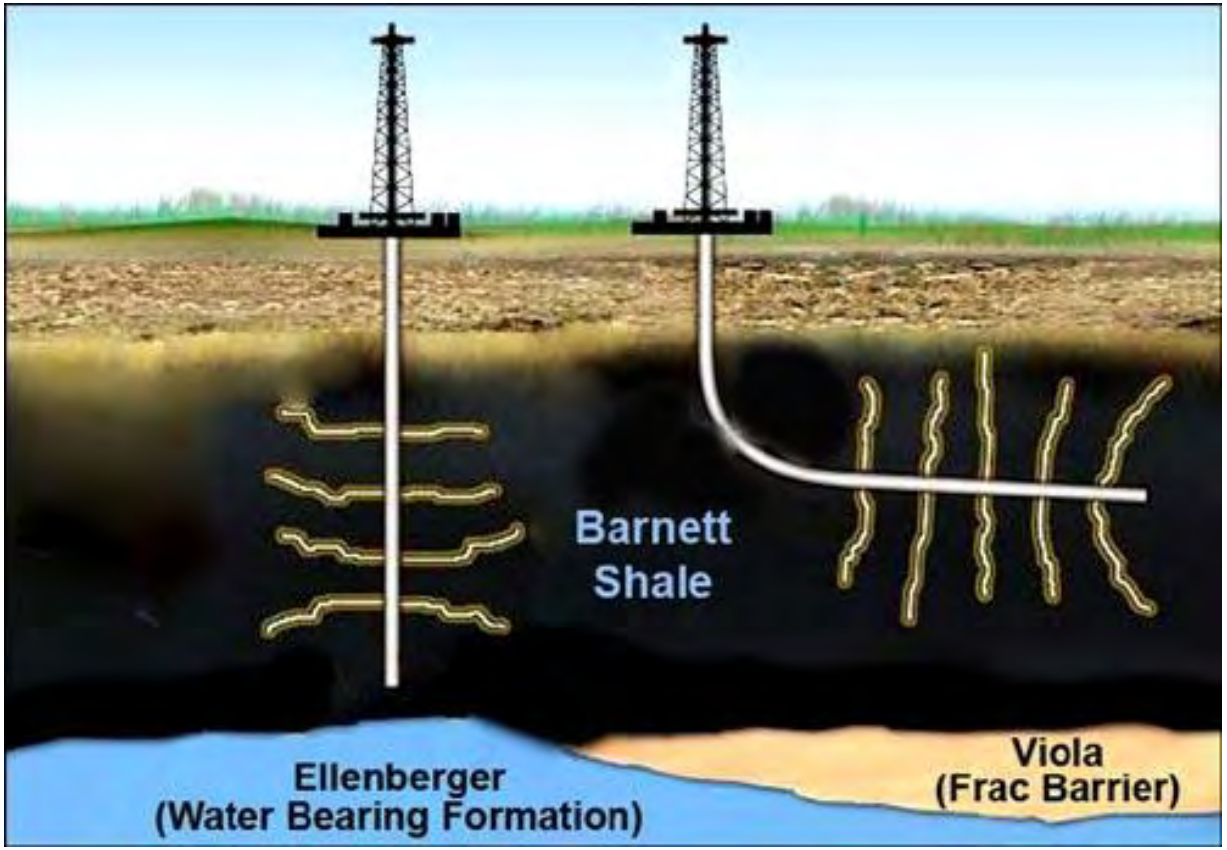
Design and Construction

- Semis – certain types of failures lead to collapse
- Firefighting has special challenges
- Defects in design & workmanship

Spill Response Capabilities

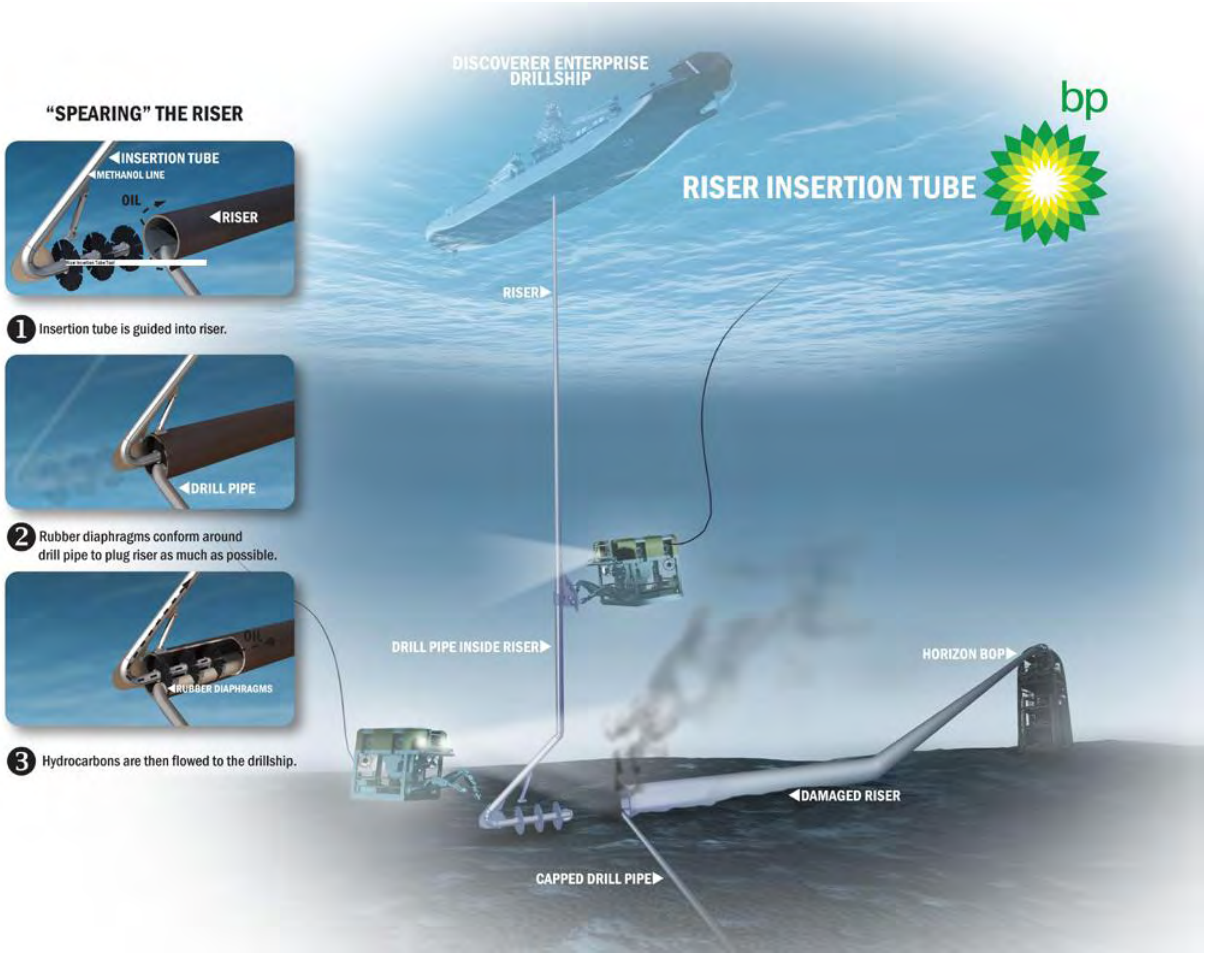
- There are some capabilities, he said (Tony Hayward - Group chief executive, BP), “that we could have available to deploy instantly, rather than creating as we go”
  - Source: The Wall Street Journal 5/18/2010

Directional Drilling



Source: www.horizontaldrilling.org

Riser Insertion Tube



Source: www.bp.com

Drilling Personnel

- Operator
- Company Man
- Drilling Contractor
  - Toolpusher, Assistant TP, Night TP
  - Driller, Assistant Driller
  - Derrickhand
  - Pit Watch
  - Rotary Helpers/Floorhands
  - Rig Mechanic & Electrician
  - Roustabout Foreman, Roustabouts
  - Ballast Control Specialist
  - On Semis Deck Crew per Shipping Regulation

Homegrown Industry

- Translated from drilling ashore
- Non-mariners

Oversight

- Permitting of Drilling
- Vessel Itself
- Vessel Operations - Underway
- Vessel Operations - Drilling

Oversight

- Permitting – Minerals Management Service (MMS)
- Vessel Itself:
  - Classification Society: ABS
  - Registry: Marshall Islands
- Vessel Operations – Underway
  - When Towed or Lifted, parent vessel is subject to registry oversight
  - Licensed marine officers and crew, registry oversight
- Vessel Operations - Drilling
  - Functions like a ship in port
  - General life safety and operation under Offshore Installation Manager (OIM)
  - No published industry standards for offshore drilling

MMS

- The explosion of the Deepwater Horizon has led to accusations that the Minerals Management Service provided lax oversight
  - Source: The New York Times 5/14/2010

Robson Forensic
Engineers, Architects, Scientists & Fire Investigators

MMS

- The federal Minerals Management Service gave permission to BP and dozens of other oil companies to drill in the Gulf of Mexico without first getting required permits from another agency that assesses threats to endangered species.
  - Source: The New York Times 5/14/2010

MMS

- Agency records also show permission for those projects and plans was granted without getting the permits required under federal law.
  - Source: The New York Times 5/14/2010

MMS

- The minerals agency has also given BP and other drilling companies in the gulf blanket exemptions from having to provide environmental impact statements.
  - Source: The New York Times 5/14/2010

Vessel

- In addition to the minerals agency and the Coast Guard, the Deepwater Horizon was overseen by the Marshall Islands, the “flag of convenience” under which it was registered.

  No one from the Marshall Islands ever inspected the rig. The nongovernmental organizations that did were paid by the rig’s operator, in this case Transocean.

  – Source: The New York Times 5/14/2010

MMS

- The Minerals Management Service, the government agency that oversees offshore drilling, in recent years moved away from requiring specific safety measures in offshore drilling and instead set broad performance goals that it was up to the industry to meet.
  - Source: The Wall Street Journal 5/18/2010

MMS

- In joint MMS-Coast Guard hearings into the Deepwater Horizon accident, Michael Saucier, an MMS official, testified that the agency “highly encouraged,” but didn’t require, companies to have back-up systems to trigger blowout preventers in case of an emergency.
  - Source: The Wall Street Journal 5/18/2010

Shoreside Drilling and Petrochemical Operations

- Specific American Petroleum Institute (API) Standards
- Extensive requirements for Hazard Analysis and Response, including redundancy

Robson Forensic

Engineers, Architects, Scientists & Fire Investigators

The Forensic Anatomy of the Events on the Deepwater Horizon

Bartley J. Eckhardt, P.E.
& Arthur Faherty

May 20, 2010