Deepwater Horizon Disaster

Sources
- Report to the President: National Commission on the BP Deepwater Horizon Spill
- Deepwater Horizon Study Group Investigation of the Macondo Well Blowout Disaster - Berkeley, 2011
- Many sources in the news

Victims

The mess

Macondo Well Location

4000 active platforms in the US Gulf

5000 feet water depth
DeepWater Horizon Rig
- Owned and operated by Transocean
- Contracted by BP and its partners (Anadarko, Mitsui)
- State of the art vessel
- Dynamically positioned

Macondo Well Design
- Middle Miocene Sandstone (~14 million years old)
- Macondo Well Reservoir Properties
  - Thickness 30.5 m (100 ft)
  - Porosity 0.22
  - Permeability 0.5 Darcy
  - Pressure 82 MPa (12,000 psi)
  - Temperature 130 °C (260 °F)

Fluid properties
- API gravity 35°
- Gas-oil ratio ~ 3000 scf/STB
- Flow rate ~ 56,000 bbl/day

Economic Estimates
- Reserves 50-100 million Barrels
- Cost $96 million
- 51 days to drill

Problems Prior to Accident
- March 7: 13,300 ft, loss of control (kick), stuck bit, side track
- April 4-7: 18,260 ft, loss circulation: Pills + reduced mud weight
- April 9-14: 18,360 ft, TD, severe loss of circulation, well logs run: 53 ft pay zone
- Decision to complete the well

Overpressure in the Macondo Well

Prepare to temporarily abandon the well
- Long string casing
- Nitrogen foam cement job by Halliburton
- Cement test by Halliburton showed 48 hours needed for cement to set at 180 F.
- Later tests suggest cement mix not stable at reservoir conditions
- April 18: Casing installed with only 6 centralizers (instead of 21)
- Had trouble with bottoms-up circulation
**The Blow Out - April 20**

- 12 AM: Finished cementing
- Intended to set a cement plug at 3300 ft: needed to displace mud from the hole
- Positive pressure test 1: close the BOP, increase P in the kill line
- 10 AM: Positive pressure test 2: casing P to 2700 psi for 30 min
- 1:30 PM: start displacing mud from hole
- 5:30 PM: Negative P tests – Some pressure rise was noticed. Disagreement as to the reason.
- 8:30 PM: Tests results interpreted as good, but probably the test was flawed (kill line blocked by mud?)
- No cement bond log was run
- 9:30 PM: The well begins to kick

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**The Blow Out**

- 9:08 Pumps off, but well pressure kept rising
- Mud was being pumped overboard into the Damon Bankston so they could not keep track of fluid volume changes
- 9:40 Mud begins to flow onto the rig floor
- Crew diverts flow to gas separator which fills up
- Crew shuts annular preventer at BOP but gas keeps coming up riser
- 9:47 Gas alarm sounds. Drill string pressure goes from 1200 to 5730 psi: the soda can effect
- 11:22 Coast Guard arrives- 11 dead, 115 evacuated, 17 injured,

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**Aftermath**

- 2 days later, the platform sinks
- Well remains flowing out of control for 87 days
- 5 million barrels spilled
- One of the worst environmental disasters in US history

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**Situation on the sea floor**

(Media from New York Times)
Efforts to stop the leak
• Close BOP with Remotely Operated Vehicle- failed
• Crimp the end of the drill pipe on the seafloor – succeeded
• Capture the oil with a containment box – failed
• Kill the well by pumping mud into the BOP– failed
• Junk shot into BOP- failed
• Cut off riser and fit a cap – succeeded (mostly)
• Kill the well with heavy mud –succeeded (mostly)
• Fill the well from the top with cement - succeeded
• Drill relief wells and pump cement at the bottom - succeeded

Why did it fail?
Owned by Cameron International Co.

Relief Wells
NY Times

Blow Out Preventer
• Shear ram blocked by buckled pipe ?
• Miss wiring and battery failure in the emergency system

Take Home Points
• Small errors add up
• Economic pressures and safety are in a natural conflict
• “Getting the job done” sometimes leads you to a bad outcome
• If something looks wrong, you should stop and take a second look
• Plan what to do in a worst case-scenario