Deepwater Horizon Oil Spill

Nancy E. Kinner
Coastal Response Research Center
University of New Hampshire
Southwest Florida Chapter
UNH Alumni Association
February 25, 2012

Coastal Response Research Center (CRRC)
• NOAA’s Office of Response and Restoration (ORR)/UNH Spill Partnership in 2004
• NOAA = National Oceanic & Atmospheric Administration
• THERE WILL BE ANOTHER MAJOR SPILL IN U.S.
• Many Research Needs Exist Regarding Spill Response, Recovery and Restoration
• Expertise to Call Upon During a Spill
  • Independent voice
  • Honest broker

Why UNH?
• Marine Science & Environmental Engineering Strengths
  • UNH ranked nationally in both areas
  • No Oil = No Oil Politics
  • Senator Gregg
    • NOAA Appropriations
      • Center for Coastal and Ocean Mapping
      • Cooperative Institute on Coastal and Estuarine Environmental Technologies
      • Center for Ocean Observing and Analysis
      • Coastal Response Research Center

CRRC Mission
• Conduct and Oversee Basic and Applied Research and Outreach on Spill Response and Restoration
• Transform Research Results into Practice
• Serve as Hub for Oil Spill R&D
• Educate/Train Students Who will Pursue Careers in Spill Response and Restoration

Oil Wells in U.S. Waters of Gulf of Mexico
Crude Oil Production in U.S.
- Total: 79.8 billion gallons/yr (2009)
- Gulf of Mexico (GOM) produces 23.9 billion gallons/yr (30% of total domestic crude)

Crude Oil Imports into the U.S.
- Total: 10.4 million barrels/day = 159 billion Gallons/Yr (2010)
- Imports Through Louisiana Offshore Oil Port (LOOP) Facility
  - Handles 13% of imported oil = 20.7 billion gallons/yr

Deepwater Horizon Rig
- 33,000 Ton Drilling Rig on Pontoons
  - Built 2001 for $350M
  - Derrick = 20 stories above top deck
  - Held in position using GPS thrusters
  - Crew = 126
  - Owner: Transocean

Mississippi Canyon Block 252 (Macondo Site)
- BP Lease Site (MC252)
  - Cost = $34M
  - Transocean's Marianas rig started drilling in October 2009
  - Damaged in Hurricane Ida
    - November 9, 2009
  - Drill pipe 5,000 ft of water + 4,000 seabed (9,000 ft total)
Macondo Site Drilling History

- ~ 9,000 ft more to drill to gas and oil reservoir (~ 18,000 ft total)
- DWH arrives at Macondo site Jan 31, 2010 and starts putting down pipe
  - Estimated cost = $1M/day fee
  - BP and partners budgeted 51 days and $96.2M for this well

DWH Well Blowout

- Occurred on April 20, 2010
- DWH Rig had drilled into oil/gas reservoir
- 6 weeks behind schedule and $58M over budget

DWH Well Blowout

- Put in Temporary Cement Plug - 3,000ft below Top of Well
- Positive Pressure Test
  - Check casing and seals intact
- Negative Pressure Test
  - No fluids should leak into well

DWH Well Blowout (cont’d)

- Positive Pressure Test - Acceptable Results
- Negative Pressure Test
  - Began 5 pm, April 20
  - Pressure repeatedly increased - fluids leaking in?
  - Decided to try again using “kill line” on blowout preventer (BOP)
    - Results ok no pressure increase
    - Likely kill line was not working properly (clogged)
  - Decision - OK to open BOP and replace heavy drilling mud in drill pipe with seawater

DWH Well Blowout (cont’d)

- 9:15 pm Begin Adding Seawater into Bottom of Well (Annulus)
- ~ 9:40 pm Hissing and High-Frequency Vibration
- Then Mud Shooting Out of Gas Buster on Rig
- Then Explosion
- All Saved Except 11 Killed in Explosion

DWH Well Blowout (cont’d)

- 1:30 am (April 21) DWH Rig Listing; Secondary Explosions & Fire
- 2:50 am (April 21) Rig Spins 180°; GPS Dynamic Positioning Dead
  - DWH moved 1600 ft from well
- 3:15 am DWH Listing Heavily, Fire Continues & Fire Boats Spraying Water on Rig
- 1:27 am April 22 DWH Sank Along with 5,000 ft pipe
Overview of DWH Spill

• 87 Days of Continuous Release of Oil and Gas
• Numerous Attempts to Stop Flow
  • No spill response plan for large blowout
  • July 15 - Well Killed from Top Ending Release
  • Bottom Kill Sept 19, 2010
  • Total Oil Release (est.) = 200 Million Gallons
  • Biggest Accidental Oil Spill in Recorded History!

Priority #1 = Stop Fire, Rescue People

Priority #2 - Stop Source of Leak

• Start Relief Well
• Install “Cap” to Stop Flow
  • High ambient water pressure, cold and dark
    - 2200 psi
  • High exit pressure of oil, hot (212°F)
    - 6500 psi
  • Well Head ~ 7 inches diameter; 1 mile below water’s surface

Relief Wells

Capping Well

Q4030 - RELIEF PRODUCTION - CAPING STATE COUNTERMEASURE
Priority #3 - Identify Natural Resources at Risk

- Crabs, Shrimp, Oysters, Blue Fin Tuna, Charismatic Marine Mammals
- Recreational Beaches
- Commercial Fishing
- Subsistence Fishing

Priority #4 - Minimize Damage to Natural Resources

- Purpose of Response Technology
- Key Is Select Most Appropriate Response Techniques
- Unique to Each Spill

REALITY CHECK!!!!!!!

200 MILLION GALLON SPILL WILL CAUSE DAMAGE
(Exxon Valdez Spill = 11 Million gallons)

RESPONSE MINIMIZES DAMAGE, BUT THERE WILL BE SIGNIFICANT DAMAGE!!!!!

Satellite Image of Oil Slick

Response: Sorbents

Oily Waste Collected
Landfills and Burned
Booms and Skimmers
Capture and Concentrate Oil, Deflect Oil from Critical Area

Response: In Situ Burning

Response Estimate

Deepwater Horizon Oil Budget Through July 14 (Map 96)
Why Use Chemical Dispersants?

- Wind and Waves Often Too High to Allow Mechanical Removal (Booms & Skimmers) or Burning
- Kept Oil Out of Nearshore Waters and Marshes
  - Where organisms were breeding and juveniles
  - Marshes hard to clean if repeatedly fouled with oil

Dispersant Controversy

- Exposure/Toxicity of Dispersants to Marine Life, Humans, Seafood
- Exposure of Marine Organisms Below Surface to Dispersed Oil
- Proprietary Mixture
- Where Did Oil Go?
Nature’s Response

- Function of Environmental Conditions
  - Temperature
  - (H₂O, Air)
  - Wind
  - Oil Type
  - Currents, Tides

Response: Biodegradation

- Every Year, ~ 20 Million Gallons of Oil Enter GOM from Natural Seeps
- Naturally Occurring Bacteria Live in GOM Use Oil as Food Source
- DWH Oil is More Food
- Takes <10 days to Degrade Oil Mass by Half
  - 10 g → 5 g
UNH Innovations During DWH Spill Response

DWH: State-of-the-Art Monitoring Oil
- Detection of Subsurface Oil
- Measuring for leaks and natural seeps
- Holographic detectors from biological oceanography
- UNH Center for Coastal and Ocean Mapping

DWH: State-of-the-Art Managing Spill Response
- Common Operating Picture
  - All responders see same, detailed information
  - Overlay layers of information to help make decisions
    - Where beaches located?
    - Where floating oil?
    - Decide boom placement to protect beaches at risk

DWH: State-of-the-Art Managing Spill Response
- Environmental Response Management Application
  - ERMA® - UNH/NOAA trademark
  - Developed by UNH Research Computing Center
  - Partnership with NOAA
- www.geoplatform.gov Has Hundreds of Layers of Data to Overlay

Phases of Oil Spill
- Emergency Response
  - Immediate to few years after
- Natural Resource Damage Assessment (NRDA)
  - Determine damage to and compensation of natural and human resources by responsible parties (RPs)
    - Not civil suits
- Restoration/Recovery
  - Months to years funded by RPs

www.geoplatform.gov/gulfresponse
Biological Impacts of Spill

What Are the Biological Impacts of this Spill?
- GOM: 100's of spills per year
- Lethal (acute) vs. Sublethal (chronic) effects
- When Has Complete Recovery Occurred (if ever)?
- Is Recovery to Organisms and Community Before Spill?
  - How Clean is Clean Enough?

All Compared to Natural Variation

Key Biota in DWH Spill
- Coral
- Oysters
- Shrimp
- Crabs
- Blue Fin Tuna
- Intertidal/Marsh Vegetation (Marsh as Nursery Grounds)
- Biota That Cannot Swim Away Are Most Impacted

Impact of Deepwater Horizon on Gulf of Mexico
- Short Term, Acute Toxicity (Immediately Lethal) = Lower Than Expected
  - (>4,000 birds DWH 200M gal vs. >100,000 birds in Exxon Valdez 11M gal)
- Long Term, Chronic Toxicity = ????
  - Only Time Will Tell
    - Months to years of data needed

Cuban Oil Drilling
- Started 18 Miles Off Havana
  - Arrived in January
  - Drilling started this month
  - Spanish Company - Repsol
- U.S. Coast Guard Has Contingency Plans for Spill
  - Oil spill response companies Will Be Activated in case of spill

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CRRC Website:
www.crrc.unh.edu
nancy.kinner@unh.edu