California State Lands Commission Prevention First Symposium

"Environmental Challenges Associated with Offshore Well Abandonment"

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Environmental Challenges Associated with Offshore Well Abandonment

1. What are the Objectives of a Successful Abandonment?
2. What Materials & Techniques are Used?
3. What do the Regulations Require?
4. What Special Challenges Exist Offshore?
5. What makes Subsea Well Abandonment Unique?
6. What is Rigless P&A?
7. What is Sustained Casing Pressure?
8. Why do Some Wells Require Reabandonment?
9. What New Technologies are Available?
10. What Best Practices Ensure a Successful Offshore P&A?

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What are the Objectives of a Successful Well Abandonment?

- Prevent Migration of Fluids within the Wellbore
  - Isolate Hydrocarbon Zones
  - Protect Fresh Water Aquifers
- Prevent Release of Formation Fluids to the Environment
- Restore Surface Uses
  - Remove Wellhead / Xmas Tree
  - Cut Casings Below Ground Level / Sea Floor
- Meet Regulatory Requirements
- Minimize Environmental Impacts during Operations
  - Maintain Well Control
  - Avoid Spills
  - Minimize Environmental Effects (Air Emissions, Biological Impacts)

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What are the Objectives of a Successful Well Abandonment?

Insert Well Diagram

1. Seal Fluid Pathways Created to Produce Oil & Gas
   - Perforations
   - Slotted Liners
2. Remedy Deficiencies / Failures in Well Construction
   - Cement Channels
   - Lack of Cement
   - Casing Leaks

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What Materials & Techniques are Used?

Materials Used to Seal Fluid Pathways

- Common
  - Cement: Used since 1920s±
  - Mechanical Seals: e.g., Bridge Plug – cast iron, steel, elastomers
- Other
  - Bentonite Pellets
  - Epoxies, Resins, Polymers
- Historical
  - Wooden Plugs

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What Materials & Techniques are Used?

Abandonment Techniques

- Cement Placement Techniques
  - Balanced Plug
  - Squeezing – Pumping cement under pressure

- Severing Techniques
  - Explosives
  - Mechanical Cutter
  - Abrasive Jetting
  - Bandsaw
  - Diamond Wire
  - Torch Cutting

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What do the Regulations Require?

- DOGGR: Onshore, Offshore State Waters
- CSLC: Offshore State Waters
- MMS: Offshore Federal Waters
- Other Federal, State & Local Agencies may be involved depending on project scope.

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What Special Challenges Exist Offshore?

- Equipment Availability
  - Lack of mobile rigs on west coast
- Operating Challenges
  - Weather
  - Seas
  - Logistics
  - Corrosion
- More Elaborate Well Completions
  - Multiple Tubing strings
  - Chemical Injection Lines/ Sensor Cables
- Stricter Environmental Requirements
- Subsea Wells

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What Makes Subsea Wells Unique?

- Wellhead Equipment is Located on Sea Floor
  - Rather than above sea level (e.g., on platform or island)
  -
- Wellhead/Tree Design
  - Obsolete / One-Off Designs
  - Well Control Equip./Procedures
  - Complicated Flowpaths
  - Custom Tool Fabrication
- Special Resources Required
  - Divers
  - Mobile Drilling Rig or Rigless

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What is Rigless P&A?

- Abandonment operations conducted without a conventional drilling or workover rig, using
  - Coiled Tubing, Wireline, Pumps, Crane, and/or Workboat/Barge

Benefits	Limitations
+ Avoid rig mobilization	- Inability to fish stuck tubing/ tools
+ Generally lower cost	- Casing recovery difficult
+ Avoid tubular disposal	- Difficult w/ some completions
+ Often lower well control risk	

- Hydraulic Workover Units (snubbing units) offer similar benefits & can overcome certain rigless limitations

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What is Sustained Casing Pressure?

aka: Annular Gas Pressure, Casing Vent Flow

- Sustained pressure on the annuli of production or surface casing.

- Cause: Presence of a flow path to the surface from higher pressure subsurface zones
  - Uncemented annulus
  - Channel through a cemented annulus
    - ✓ Can develop during well construction
    - ✓ Can develop over time

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What is Sustained Casing Pressure?

Solutions

- Diagnosis Source
  - Research
  - Fluid analysis
  - Logging

- Remediation
  - Cement squeezing
    - From surface, or
    - Thru perforations
  - Cement plug
    - After casing removal
  - Cement Circulation
    - Through cut or perfs

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Why Do Some Wells Require Reabandonment?

1. Leak Develops
   - Original Abandonment Fails or Was Never Performed
   - Changing subsurface conditions
     - E.g., Repressurization, earth movement
   - Temporary P&A (e.g., wellhead not removed), Uncemented Annulus
   - Inadequate well construction
   - Historical P&A Practices – e.g., wooden plugs

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Why Do Some Wells Require Reabandonment?

2. Original P&A Doesn't Meet Current Requirements
   - Rebandonment is called for when land development or construction will prevent future access to the well.
3. The Well becomes Exposed
   - Subsidence
   - Storm / Tidal Action
   - Development / Grading / Dredging

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What New Technologies are Available?

- Cement Plug Placement Tools
- Specialty Cements
- Low Melting-Point Metal Alloys
- Rigless Integrated Tools (Annular perforation and circulation)

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What Best Practices Ensure a Successful P&A?

Planning

- Thorough Understanding of Subsurface Conditions
  - Original Well Construction
  - Current Wellbore, Reservoir & Geologic Conditions
  - Field Practices – lift methods, historical problems
- Evaluation of Surface Conditions
  - Wellhead /Tree Condition
  - Equipment / Material Logistics
  - Marine Conditions
  - Impact Mitigation
- Detailed Abandonment Plan
  - Abandonment Design
  - Cement Design
  - Contingency Planning
  - Well Control Planning
  - Health, Environment & Safety Planning

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What Best Practices Ensure a Successful P&A?

Execution

- Ability to Respond to Changes
- Lab Testing of Cement Slurries
- Wellbore Cleaning
- Effective Cement Placement
- Minimize Cement Contamination

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We Plan. We Execute.

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