Isolating Potential Flow Zones During Well Construction

API Standard 65 – Part 2

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API Standard 65 - 2

- Document highlights industry recommended cementing and well construction techniques to help ensure cementing jobs include proper planning, design, testing, and execution.
Training sessions on Standard 65-2, zonal isolation and cementing have been presented to

Pennsylvania Regulators

West Virginia Regulators
• API Standard 65 - 2
  • Defined Mechanical Barriers
  • Cement as a Barrier
  • Cementing Practices
  • Post Cement Job Analysis
  • Process Summary
Barrier Definition

A component or practice that contributes to the total system reliability by preventing liquid or gas flow if properly installed.
Defined Physical Barriers

- Hydrostatic barriers
  - Hydrostatic pressure from wellbore fluids
    - Mud, cement, etc.
- Annular mechanical barriers
  - Liner top packers, ECP, swellables
- Wellbore mechanical barriers
  - Retrievable tools, bridge plugs, retainers
- Set Cement as a barrier
Cement as a Barrier

- Cement must have 50 psi compressive strength at temperature and pressure conditions at the uppermost flow zone
  - Some regulations may conflict with requirement

- Consideration of cementing events (e.g. losses, premature returns, deviation from design, low lift pressure, etc.)

- Cement plugs as a barrier
  - Installed and verified properly
Cementing Practices

• Industry accepted design best practices
  – Hole quality - Drilling fluid properties
  – Engineering design
  – Mud removal - Slurry design & testing

• Industry accepted execution best practices
  – QA/QC - Execute as per design
Cementing Practices

• There are competing priorities in well construction

• Not all cementing best practices contained in the Standard are required or even possible for every application

• Sound engineering judgment is required
Post Job Analysis

• Evaluate events prior to, during and immediately after the job to determine the probability that job objectives were met
  – Do recorded pressures match simulator predictions
  – Were there events during the job that suggest likelihood of poor isolation

• Pressure tests (positive and/or negative)

• Logging tools
  – Temperature logs for TOC determination
  – Cement evaluation logs
Process Summary

• A summary of the zonal isolation process is presented in Appendix D

• Designed to provide the user with a comprehensive checklist of the key parameters for successful zonal isolation

• Summary replaces the “scorecard” in the 1st Edition
“Shall” Statements

• Shall statements are summarized in Annex D with only a few found in the main text of the document
Drilling Fluid Parameters
Well Design Parameters
Operational Parameters
Drilling Fluid Removal Parameters
Cement Slurry Parameters
Special Operational Considerations
Critical Well Design Parameters

Wellbore Modeling

• Wellbore fluid hydraulics (ECD) modeling shall be performed in well sections containing a potential flow zone in order to assess pore pressure and fracture gradient limits.

• Centralizer placement, ECD and fluid displacement simulations shall be performed.

• Results of the simulations shall be considered during the cementing design and execution.
Critical Operational Parameters

Cementing Equipment

Float Equipment

• **Shall** be rated for the anticipated differential pressure.

Cement Heads

• Cementing heads **shall** be pressure tested to the maximum working pressure rating of the head, and **shall** have a working pressure in excess of the maximum anticipated surface pressure for the job.
Critical Operational Parameters

Barrier Removal:

- The time from the start of removing the barrier element to securing the exposed annulus shall be minimized.

- If the operator plans to remove a barrier element, such as a diverter or BOP stack, the operator shall determine when it will be safe to do so.
Critical Cement Slurry Parameters

Cement Compressive or Sonic Strength:

• Cement **shall** be considered a physical barrier element only when it has attained a minimum of 50 psi strength as measured at simulated pressure and temperature conditions at the uppermost flow zone.

• Once the time to reach a minimum of 50 psi compressive or sonic strength has been determined, the operator **shall** wait on the cement to set for that amount of time prior to removing or disabling a barrier element.
Critical Drilling Fluid Removal Parameters

Wellbore Barriers:

- Slurry properties shall be consistent with any regulatory requirements. (Primary and plug designs)

- Testing shall comply with accepted industry standard practices.
Special Operational Considerations

Barrier Acceptance:

• If the criteria for verification of a mechanical barrier or cement cannot be met the operator shall establish an appropriate course of action with the regulator or permitting authority.
Special Operational Considerations

Diverter or BOP Obstruction:

• Operators or rig contractors **shall** not run tubing in the annulus between the casing and the diverter, or BOP, after completion of the cementing operation and prior to determining the well has no potential for flow.
Special Operational Considerations

Hydrostatic Overbalance:

• Hydrostatic pressure calculations shall be performed and results considered prior to commencing any operation that will result in a change in hydrostatic pressure in the wellbore.

• Pressure calculations are not limited to fluid change out – can also include use of water ahead of a cementing operation.
Special Operational Considerations

Foamed Cement:

- Operators and cementing service providers **shall**:

  Perform a risk assessment prior to utilizing foamed cement to isolate a potential flow zone,

  Ensure the results of the assessment are incorporated in the cementing plan,

  Communicate to all parties.
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Content Overview
• Annex A – Background and Technology

• Annex B – Well Planning and Drilling Plan Considerations

• Annex C – Drilling the Well

• Annex D – Process Summary: Isolating Potential Flow Zones During Well Cementing

• Bibliography
Questions