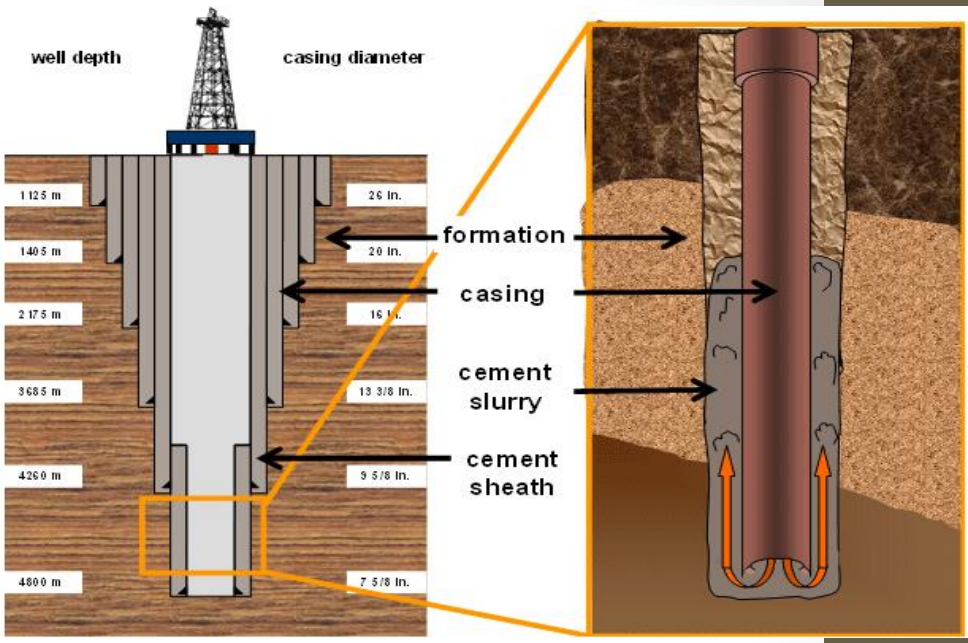
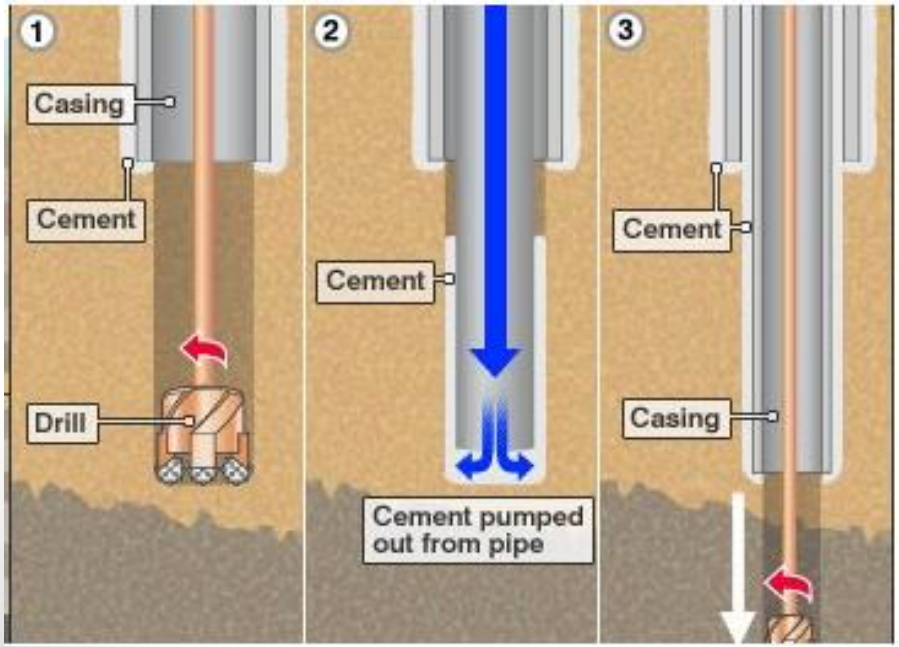
# Land Well Integrity: Development of Industry Cementing Practices

Canadian Oil and Gas Industry

# Cementing basics

- The Process
  - Drill bit drills through formation
  - Casing is run in hole
  - Equipment pump cement slurry down the casing and back up into the annulus



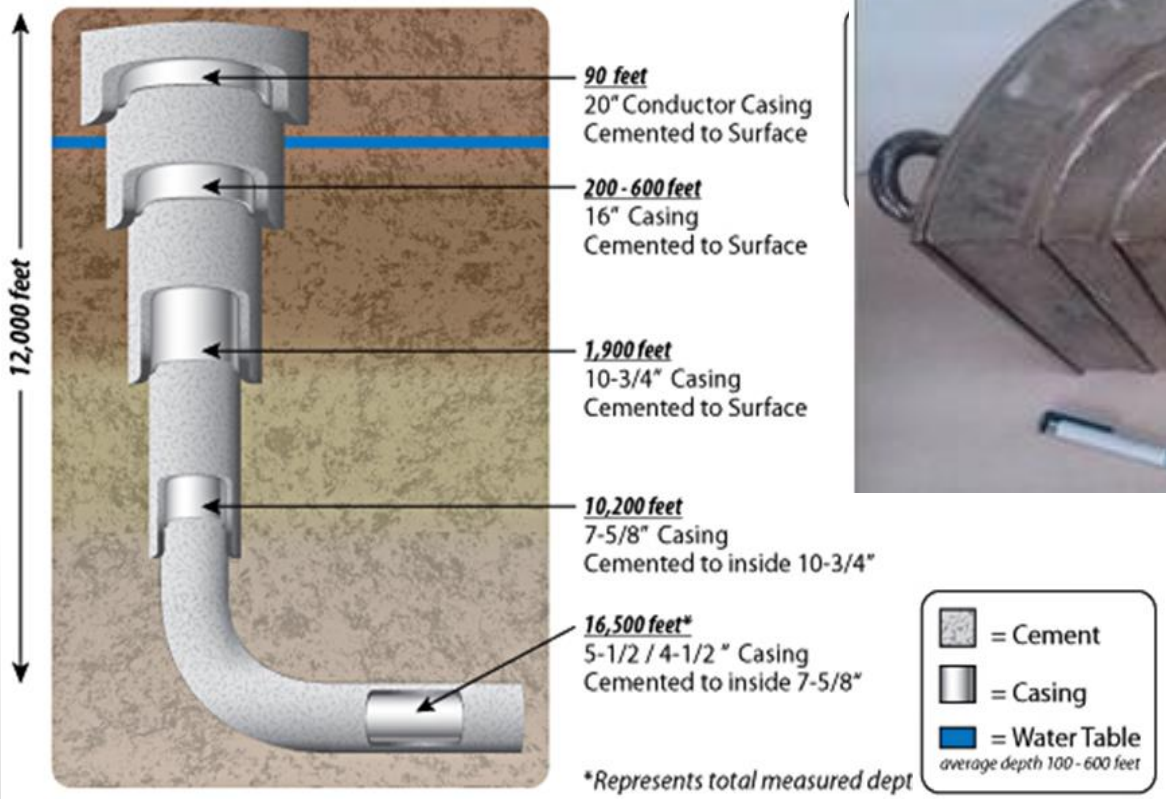




- Slurry hardens and gains compressive strength – turning into a cement sheath
- Process is repeated until well is drilled to total depth (TD).

# Cementing basics

- Ultimate goal
  - Zonal isolation
  - Structural support

and if done correctly…



# Why is it important?

- Many old wells…many more to come
- Financial Cost of not doing it right the first time – pay for it now or pay for it later

- Industry under scrutiny

# What do we have?

- Western Canada Regulatory Agencies
  - Alberta Energy Regulators
  - BC Oil & Gas Commission
  - Saskatchewan Energy & Resources

- Well Drilling Guideline Directive 009: Casing Cementing Minimum Requirements (1990)
  - Cementing requirements for conductor, surface, intermediate, production and liners
  - Minimum cement tops and methods of determination, “adequate centralization,” use of fillers and additives to meet minimum compressive strengths
  - Additional requirements for foam and thermal cementing

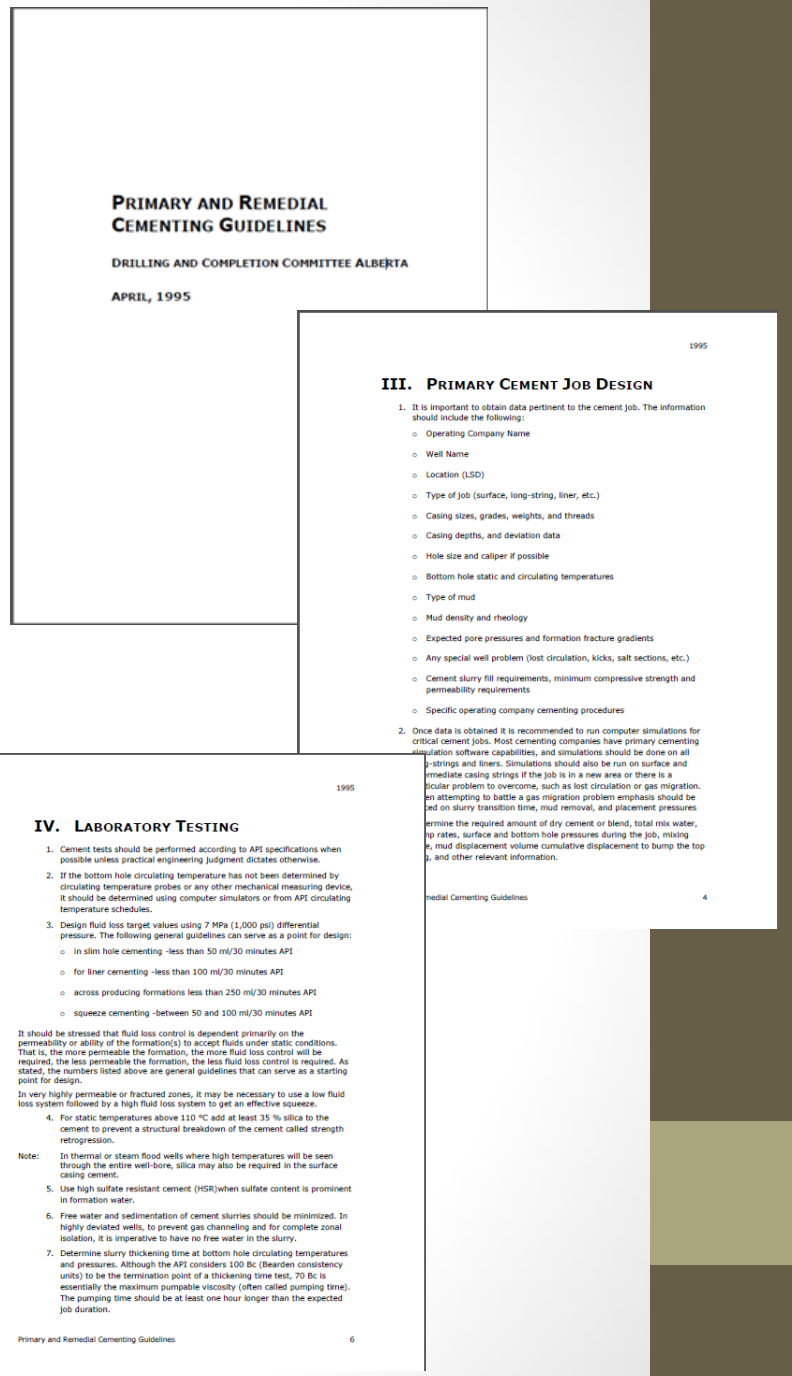
# Filling the Gap

- Difference between “minimum requirements” and proactive operations
- ENFORM
- Drilling and Completions Committee (DACC) is responsible for the development of recommended technical operating practices for the upstream oil and gas industry…Industry Recommended Practices (IRP’s)

Once an IRP is developed and implemented, accountability falls on where it belongs, in the hands of the company and its workers.

# IRP 25

- Old IRP 25: Primary and Remedial Cementing Guidelines, April 1995
  - In response to the problem of uncontrolled gas migration
  - Very high level
- New IRP 25
  - Divide Primary and Remedial
  - Referencing standard
  - Risk based



PRIMARY AND REMEDIAL CEMENTING GUIDELINES

DRILLING AND COMPLETION COMMITTEE ALBERTA

APRIL, 1995

1995

III. PRIMARY CEMENT JOB DESIGN

1. It is important to obtain data pertinent to the cement job. The information should include the following:
   - Operating Company Name
   - Well Name
   - Location (LSD)
   - Type of job (surface, long-string, liner, etc.)
   - Casing sizes, grades, weights, and threads
   - Casing depths, and deviation data
   - Hole size and caliper if possible
   - Bottom hole static and circulating temperatures
   - Type of mud
   - Mud density and rheology
   - Expected pore pressures and formation fracture gradients
   - Any special well problem (lost circulation, kicks, salt sections, etc.)
   - Cement slurry fill requirements, minimum compressive strength and permeability requirements
   - Specific operating company cementing procedures
2. Once data is obtained it is recommended to run computer simulations for critical cement jobs. Most cementing companies have primary cementing ulation software capabilities, and simulations should be done on all -strings and liners. Simulations should also be run on surface and rmediate casing strings if the job is in a new area or there is a icular problem to overcome, such as lost circulation or gas migration. en attempting to battle a gas migration problem emphasis should be ed on slurry transition time, mud removal, and placement pressures

ermine the required amount of dry cement or blend, total mix water, p rates, surface and bottom hole pressures during the job, mixing e, mud displacement volume cumulative displacement to bump the top , and other relevant information.

medial Cementing Guidelines 4

1995

IV. LABORATORY TESTING

1. Cement tests should be performed according to API specifications when possible unless practical engineering judgment dictates otherwise.
2. If the bottom hole circulating temperature has not been determined by circulating temperature probes or any other mechanical measuring device, it should be determined using computer simulators or from API circulating temperature schedules.
3. Design fluid loss target values using 7 MPa (1,000 psi) differential pressure. The following general guidelines can serve as a point for design:
   - in slim hole cementing -less than 50 ml/30 minutes API
   - for liner cementing -less than 100 ml/30 minutes API
   - across producing formations less than 250 ml/30 minutes API
   - squeeze cementing -between 50 and 100 ml/30 minutes API

It should be stressed that fluid loss control is dependent primarily on the permeability or ability of the formation(s) to accept fluids under static conditions. That is, the more permeable the formation, the more fluid loss control will be required, the less permeable the formation, the less fluid loss control is required. As stated, the numbers listed above are general guidelines that can serve as a starting point for design.

In very highly permeable or fractured zones, it may be necessary to use a low fluid loss system followed by a high fluid loss system to get an effective squeeze.

4. For static temperatures above 110 °C add at least 35 % silica to the cement to prevent a structural breakdown of the cement called strength retrogression.

Note: In thermal or steam flood wells where high temperatures will be seen through the entire well-bore, silica may also be required in the surface casing cement.

5. Use high sulfate resistant cement (HSR)when sulfate content is prominent in formation water.
6. Free water and sedimentation of cement slurries should be minimized. In highly deviated wells, to prevent gas channeling and for complete zonal isolation, it is imperative to have no free water in the slurry.
7. Determine slurry thickening time at bottom hole circulating temperatures and pressures. Although the API considers 100 Bc (Bearden consistency units) to be the termination point of a thickening time test, 70 Bc is essentially the maximum pumpable viscosity (often called pumping time). The pumping time should be at least one hour longer than the expected job duration.

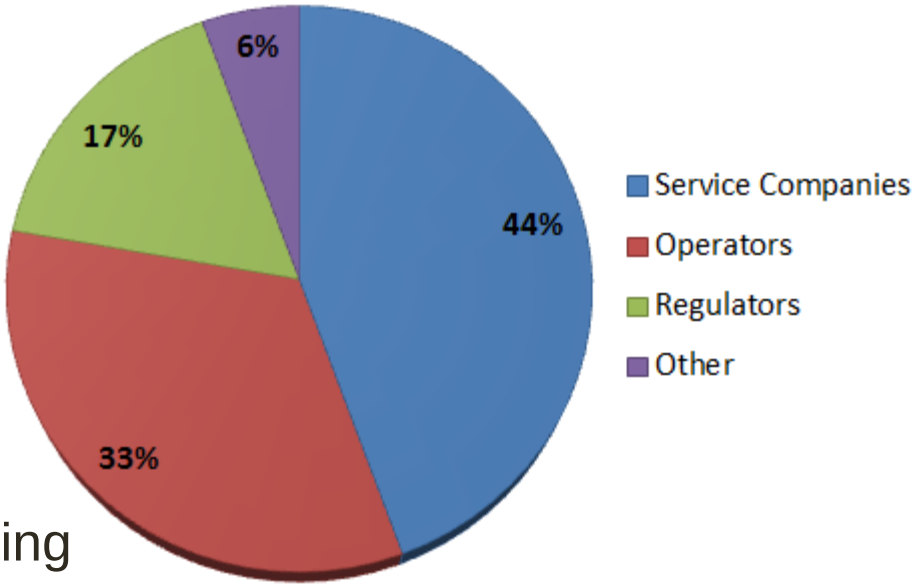
Primary and Remedial Cementing Guidelines 6

# IRP 25 – Comprehensive Approach

- Cement Job Design
- Spacer Design
- Slurry Design
- Lab Testing
- Wellbore Construction & Drilling Operations
- Pre-Job Preparation
- Contingency Plans and Management of Change
- Slurry Placement
- Post Placement
- Job Evaluation
- Continuous Improvement

# IRP Process

- Members
- Used as a reference, guideline for training, a support for internal procedures
- Timeline
- More to come…
  - IRP 25:  Remedial Cementing
  - Iterative process



# Questions


DACC
DRILLING AND COMPLETION COMMITTEE
IRP # : 25
Primary Cementing
An Industry Recommended Practice (IRP)
for the Canadian Oil and Gas Industry
Volume # -2015
EDITION: Insert # here
SANCTION DATE: INSERT DATE HERE
CAODC
CAPP
CANADIAN ASSOCIATION OF PETROLEUM PRODUCERS
EPAC
PSAC
working energy