Managing Well Casing
From Well Design Through Production
2015
Managing Well Casing

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Managing Well Casing

Introduction

“In many industries, continual communication and coordination are becoming mandatory as the time allocated for project development shrinks dramatically, the members of the development team become geographically displaced, and the projects increasingly involve external partners and resources.”

-Jeffrey Elton and Justin Roe in Harvard Business Review

Being involved in the life of a well today, whether as an engineer or business person, requires some understanding of the big picture.

This short book is written as an introduction to overall casing management for people who are starting out in oil and gas. Increasingly, workflows are being integrated over domain and over time to enable engineering and cost efficiencies that can set operators apart from their cohorts. Communication and coordination across traditional silos has never been more important.

Transferring information between the phases of a well casing’s life—from design through production and into abandonment—can lead to better decision making on the current project and on subsequent ones, in addition to long-term sustained production.

Landmark is an expert in E&P information management and builds its software applications on DecisionSpace®, the industry’s first and only enterprise platform. Landmark does this in order to support the value companies can gain by integrating workflows like those related to casing management.
Chapter 1

Know the Well Trajectory

Understand the path, shape, and conditions of the wellbore where the casing strings will hang.
It is impossible to know how to design a casing string without knowing the shape of the hole it will be hanging in. The more complex the wellbore, the greater the need for sophisticated modeling software that relays information about the wellbore’s path and conditions to the tubular string designers.

COMPASS™ software is the industry’s premiere application for directional well path planning, survey data management, and anti-collision analysis. It provides operators with an optimal well trajectory given a well surface position and target location.

Additional Resources:

• TRAINING: COMPASS™
Chapter 2

Design the Basics

Preliminary design work takes subsurface conditions into account in defining general casing parameters.
In the preliminary casing design, once operators know certain characteristics about the subsurface, like formation pore pressure and fracture pressure, the following decisions must be made:

- Number of strings
- Size of strings
- Cement depth
- Mud weight
- Pressure margins

The earlier these preliminary design decisions are made in a project, the more uncertainty is eliminated from the budget.

CasingSeat™ software graphically shows casing setting depth and viable casing and wellbore schematics given known characteristics and using top-down or bottom-up calculations. Unlike more rudimentary tools used for this stage of design, CasingSeat™ simulates kick volumes and performs various sensitivity analyses. Subsequent design and cost calculations can be more exact.

Additional Resources:

- TRAINING: CasingSeat™ - Preliminary Casing Design
The preliminary design must be taken through rigorous stress analysis and then final casing grades and weights can be selected.
Once the preliminary casing design is complete, more complex analysis must be performed on the strings to see whether they will hold up properly given the complex stresses put on them downhole. This makes for an iterative design process; results of analyses frequently require changes to the design.

Through analysis, the actual grade and weight of the casing can be determined. A company typically has a casing design policy that lays out if-then design instructions around different load scenarios. The design policy is based on American Petroleum Institute formulas and guidelines and the company’s tolerance for risk.

Analysis shows which loads—burst, collapse, axial—will be exerted on the casing string, where, and with what magnitude. With this, engineers can optimize the casing design for the company’s safety factors and budget.

StressCheck™ software performs this analysis, allowing for fast and accurate evaluation of casing wear limits and automatically creating minimum cost designs.

Additional Resources:

- TRAINING: StressCheck™ - Basic Tubular Design and Analysis
• TRAINING: Well Design and Analysis Using COMPASS™, StressCheck™, and WELLPLAN™

• USE CASE: Estimating Drillpipe Body Wear to Improve Drilling Performance in Challenging Shale Plays, SPE 171005
Advanced stress analysis is needed when operating conditions are particularly challenging. Then, once operations begin, actual stresses must be monitored.
Conditions arise during casing installation that sometimes haven’t been foreseen. During the drilling of the actual wellbore, more exact information is learned about the subsurface than was known before. For example, in complex projects, like those in deep water and ultra deep water, there can be extreme low pressure/low temperature or extreme high pressure/high temperature pockets that exert unexpected loads, potentially causing expensive and dangerous problems during completions and production.

For these situations, it is necessary to use WELLCAT™ software to simulate transient wellbore temperature and flow conditions for advanced casing design. This must be done to account for the elastic interaction of annular fluid, casing, cement columns, and the formation itself that happens during installation and over the producing life of the well.

As another example, when drilling laterals or drilling near salt or tectonically active regions, wellbore stability and casing wear must be considered in the design. Drillworks® software analyzes and models geopressure, stress, and stability in a graphical interface.
Once operations begin, engineers monitor the actual versus planned stresses, like torque, drag, and hydraulic loads, on the various components of the well.

As with other aspects of well engineering, an excellent casing design minimizes non-productive time and helps prevent wellbore collapse, lost circulation, stuck pipe, and reservoir damage.

**DecisionSpace® Well Engineering** software is used for both planning and monitoring operations. It is a 3D environment that models all aspects—rig and equipment characteristics, the well trajectory, the wellbore, and the drilling program. It is used to analyze torque and drag forces when tripping the casing in, to determine the centralizer placement, and to model transient pressures while reciprocating the string.
Additional Resources:

- TRAINING: WELLCAT™ - Temperature-Dependent Tubular Design

- TRAINING: DecisionSpace® Well Engineering - Model and Optimize Downhole Drilling Operations

- USE CASE: Multi-Zone Completion Design for Long Horizontal ERD Wells in Al Shaheen Field, IPTC 17611

- USE CASE: Annular Pressure Build-Up Analysis and Methodology with Examples from Multifrac Horizontal Wells and HPHT Reservoirs, SPE/IADC 163557


- USE CASE: Extended-Reach Laterals in the Denver-Julesburg Basin, Landmark
Chapter 5

Manage During Production

The condition of a well’s casing must be managed over the well’s producing life, not just during installation.
After casing is installed successfully, it must withstand years, sometimes decades, of production. More and more operators are proactively and systematically managing casing wear and well integrity for the life of the well because they can’t afford unexpected failures and costly workovers. Operators are considering the lifetime usability of their wells.

DecisionSpace® Casing Wear software helps an operator get the most value out of a well with the least risk. For example, by modeling casing wear operators can identify weak spots in the casing that are susceptible to rupture. This helps show where opportunities exist, and don’t exist, for new laterals once it’s time for secondary recovery.

DecisionSpace® Well Integrity Management software helps a company avoid disaster and operate at peak efficiency. It is an operator’s singular point of interaction with its well integrity management system. It collects, aggregates, and analyzes well data, so users can view reports on how actual performance compares to optimal.
Additional Resources:

- **ARTICLE:** New Drill Pipe Reduces Body Wear During Shale Drilling, World Oil, March 2015

- **USE CASE:** Modeling Method to Estimate the Casing Wear Caused by Vibrational Impacts of the Drillstring, SPE/IADC 167999

- **USE CASE:** Casing Wear Factors: How do They Improve Well Integrity Analyses?, SPE/IADC 173053

- **USE CASE:** Well Integrity Management System (WIMS): Coupled Engineering Analysis, SPE 164230
“The greatest economic value will come from finding ways to connect relevant yet diverse people, both within the firm and outside it, to create new knowledge.”

- John Hagel in *Defining the Big Shift*

It is a good time for holistic thinkers to be building a career in oil and gas. Operators can no longer afford for employees to keep their heads down, focused on only one or two distinct tasks. Employees, and the technologies they use, must facilitate the flow of information throughout a business, so that operations can become significantly smarter. Young engineers must quickly learn to be business managers—to not only build a reliable well, but build it in a cost-effective way. Similarly, young business people must understand how resource constraints affect reserves and production optimization.

Landmark defined the upstream software industry over thirty years ago and is now transforming it for the new generation of oil and gas professionals. Landmark is committed to being a partner for life.