HPHT Well Design and Casing Engineering: Triaxial Loads, OCTG Selection and Annular Pressure

21 – 25 March 2027
Dammam - Eastern Province five-star



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Introduction:

HPHT well design fails when a casing string rated for burst at ambient conditions loses yield strength at bottom-hole temperature, when trapped annular fluid heats up and collapses an inner string, or when a connection leaks gas under combined load. This Core Concept course takes engineers through HPHT definitions, casing seat selection inside a narrow pressure window, burst, collapse and axial load cases, triaxial and temperature-derated checks, OCTG grade and sour service material choices, premium connections, annular pressure buildup and completion tubular loads. Participants build an HPHT Casing and Tubular Design Dossier.

Course Objectives:

- Classify a well against HPHT pressure and temperature thresholds and list the design consequences for each casing and tubing string
- Select casing setting depths inside a narrow pore and fracture pressure window with kick margin and shoe strength checks
- Calculate burst, collapse and axial loads for drilling, cementing and production cases and apply design factors to size each string
- Verify string ratings with von Mises triaxial envelopes and yield strength derated for bottom-hole and flowing temperature
- Specify OCTG grades, sour service materials and premium connections for high-temperature, hydrogen sulfide and carbon dioxide exposure
- Predict trapped annular pressure buildup and choose mitigation for each sealed annulus before the design is released

Target Audience:

- Engineers who design casing and liner programmes for deep, hot and overpressured wells
- Completion engineers who specify production tubing, packers and tubular connections for high-temperature service
- Well design reviewers who check load cases, design factors and material certificates before approval
- Engineers from tubular mills and service companies who support operators with grade and connection selection
- Rig-based engineers who run and cement heavy-wall strings and monitor well behaviour on HPHT sections

Course Outline:

Day 1: HPHT Well Classification, Hazards and Casing Architecture

- HPHT Pressure and Temperature Thresholds and Ultra-HPHT Tiers
- Offset HPHT Well Failure Review: Collapsed Strings, Leaking Couplings and Annulus Events
- Casing Architecture for Deep Hot Wells: Conductor, Surface, Intermediate, Liner and Tieback
- Narrow Pore and Fracture Pressure Window and Contingency Liner Planning
- Casing Seat Selection with Kick Margin and Shoe Strength Checks

Day 2: Burst, Collapse and Axial Load Cases with Design Factors

- Burst Load Cases: Gas-to-Surface, Displacement to Gas and Tubing Leak Near Surface
- Collapse Load Cases: Full and Partial Evacuation, Cementing and Salt Creep Loading
- Axial Load Profiles: Running, Overpull, Cement Bump and Thermal Piston Force
- Design Factor Method and Minimum Safety Margin Table per String
- Biaxial Collapse Reduction Under Tension and Heavy-Wall Pipe Selection

Day 3: Triaxial Envelopes, Temperature Derating and OCTG Material Selection

- Von Mises Equivalent Stress and Triaxial Design Envelope Plotting
- Yield Strength Derating Curves for Elevated Temperature Service
- Minimum Yield Strength Grade Designation from N-80 to P-110 and High-Collapse Grades
- Sour Service Material Selection: Hydrogen Sulfide Cracking, Hardness Limits and Restricted-Yield Grades
- Corrosion-Resistant Alloy Tubing Selection for Carbon Dioxide and Chloride Environments

Day 4: Premium Connections, Trapped Annular Pressure and HPHT Operations

- Metal-to-Metal Seal and Torque Shoulder Connection Design and Qualification Envelopes
- Annular Pressure Buildup from Trapped Fluid Heating: Volume and Pressure Estimation
- Annular Pressure Mitigation: Rupture Discs, Crushable Foam, Nitrified Spacers and Cement Tops
- HPHT Mud and Cement Overview: Barite Sag, Thermal Stability and Strength Retrogression
- HPHT Kick Detection, Ballooning Versus Influx Diagnosis and Well Testing Tubular Loads

Day 5: Design Build: Casing and Tubular Programme for a Case HPHT Well

- Case Well Basis of Design: Pressure, Temperature and Fluid Composition Profiles
- Casing Seat and Load Case Worksheet for Each String
- Triaxial and Temperature-Derated Check with Grade and Weight Selection
- Connection, Sour Service Material and Annular Pressure Mitigation Schedule
- Design Dossier Presentation and Peer Technical Challenge

Skills You Will Gain:

- HPHT Well Classification
- Casing Seat Optimisation
- Load Case Development
- Triaxial Stress Analysis
- Thermal Yield Derating
- Sour Service Metallurgy
- Premium Connection Specification
- Annular Pressure Buildup Prediction

Why Attend This Course:

- Return with an HPHT Casing and Tubular Design Dossier built for a case well with full load and material records
- Challenge vendor grade and connection proposals using your own triaxial and derated calculations
- Spot the thermal and annular pressure effects that ambient-condition designs miss on hot wells
- Compare HPHT tubular practice with peers from operators, tubular mills and service companies

Conclusion:

Tubular failures on HPHT wells come from loads and temperatures that the design never checked together. The course moves from HPHT classification and casing architecture through burst, collapse and axial load cases, triaxial envelopes and temperature derating, grade and sour service material choice, to premium connections, annular pressure buildup and the fluid, cement and well control effects of heat. The final day applies these methods to a case well and produces an HPHT Casing and Tubular Design Dossier ready for peer review.