

Drilling & Production Systems

Surface Wellhead & Tree Technology Update



imagination at work

Core Technologies

- Rapid Make Up Connectors
- Metal to Metal Sealing
- Wellhead Systems Portfolio
- Flow Control Portfolio

The NT-2™ Connector

Rapid make-up

Improved safety

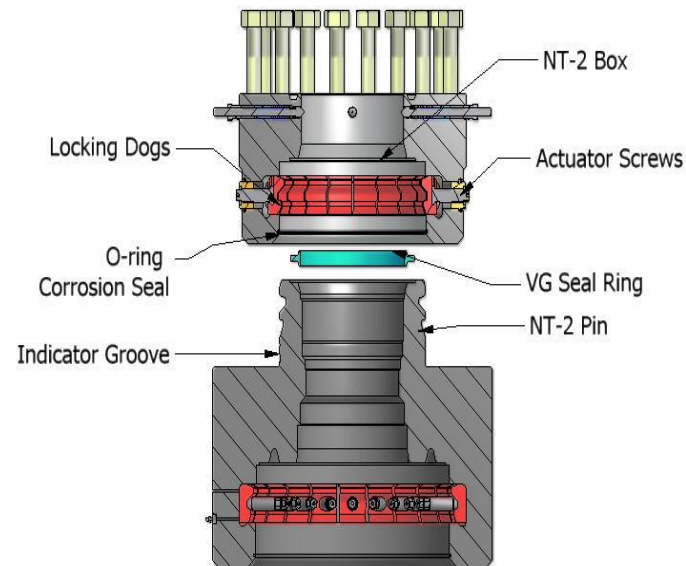
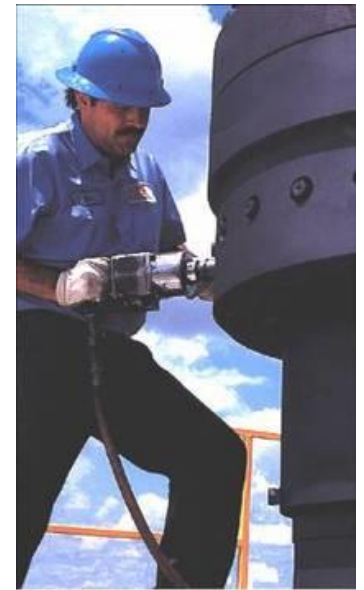
- No flogging spanners
- No loose parts
- No special tools required

Compact to minimize space

Self-aligning

One person make-up

Full pre-load make-up < 5 mins



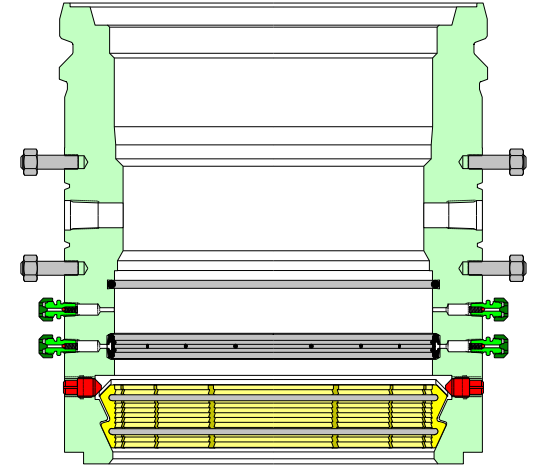
Slip-Loc Connector

Rapid make-up to Conductor Casing

Improved safety

- No flogging spanners
- No loose parts
- No special tools required

Compact to minimize space



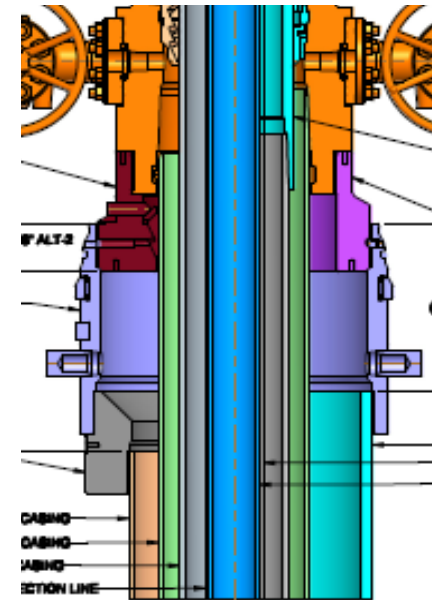
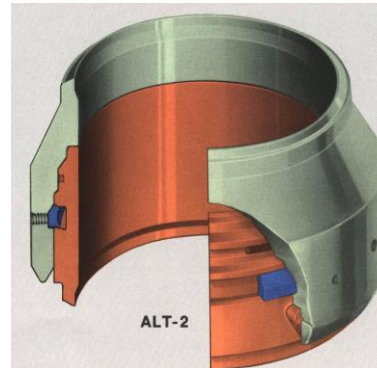
ALT-2 Casing Connector

Rapid make-up diverter / LP riser connector.

Improved safety

- No special tools required

Low pressure seal up to 2000 PSI



Casing Connectors

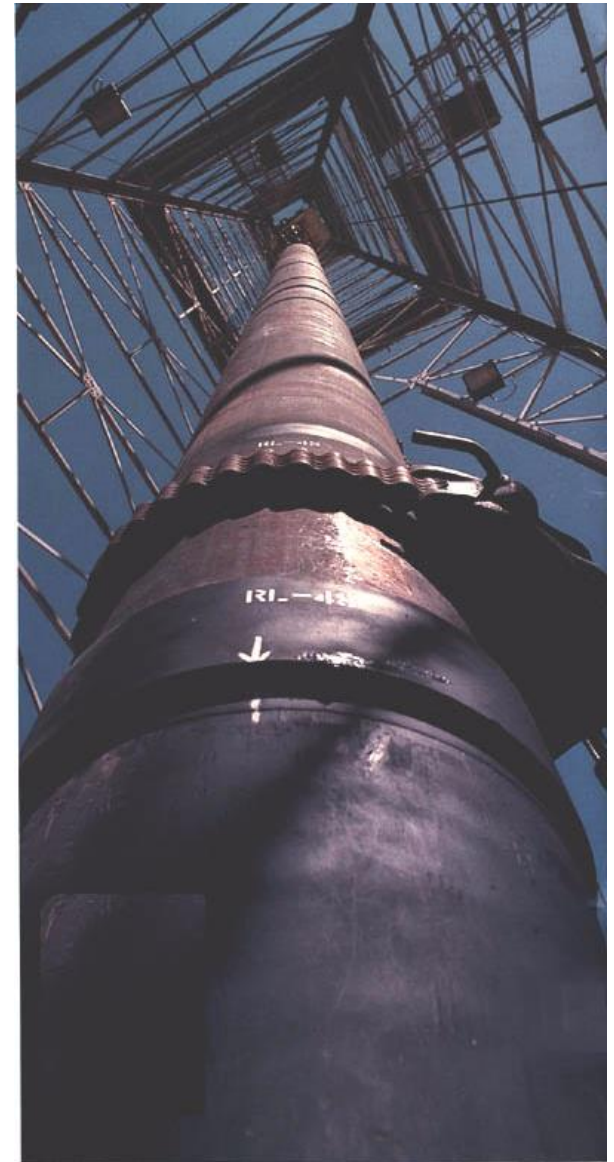
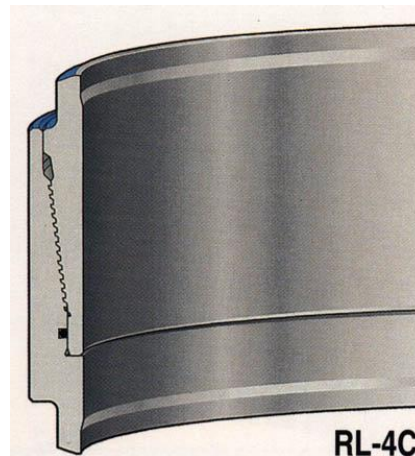
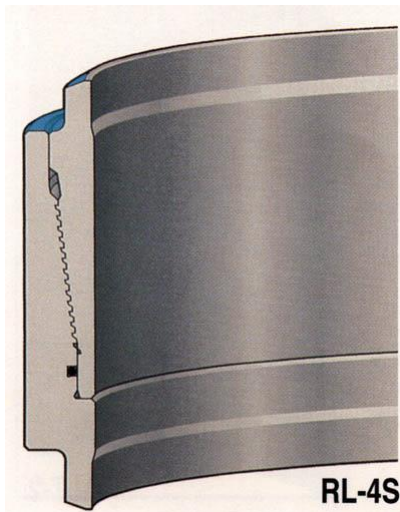
Rapid make-up Casing Connectors

RL-4S Quarter turn make-up

Sizes 18-5/8" through 36"

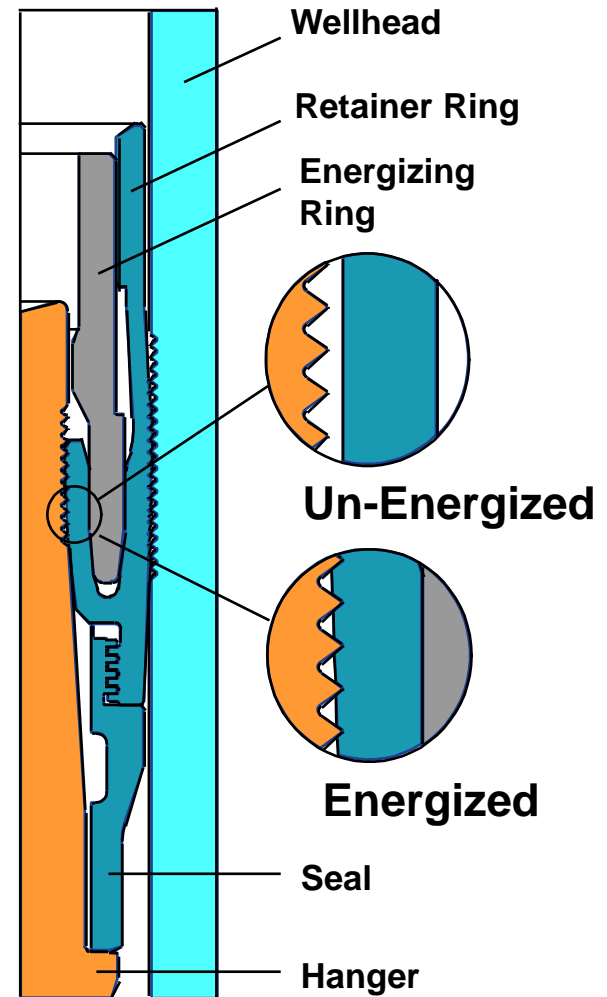
RL-4C (Compact) lighter casing loads

Industry leader last 20+ years



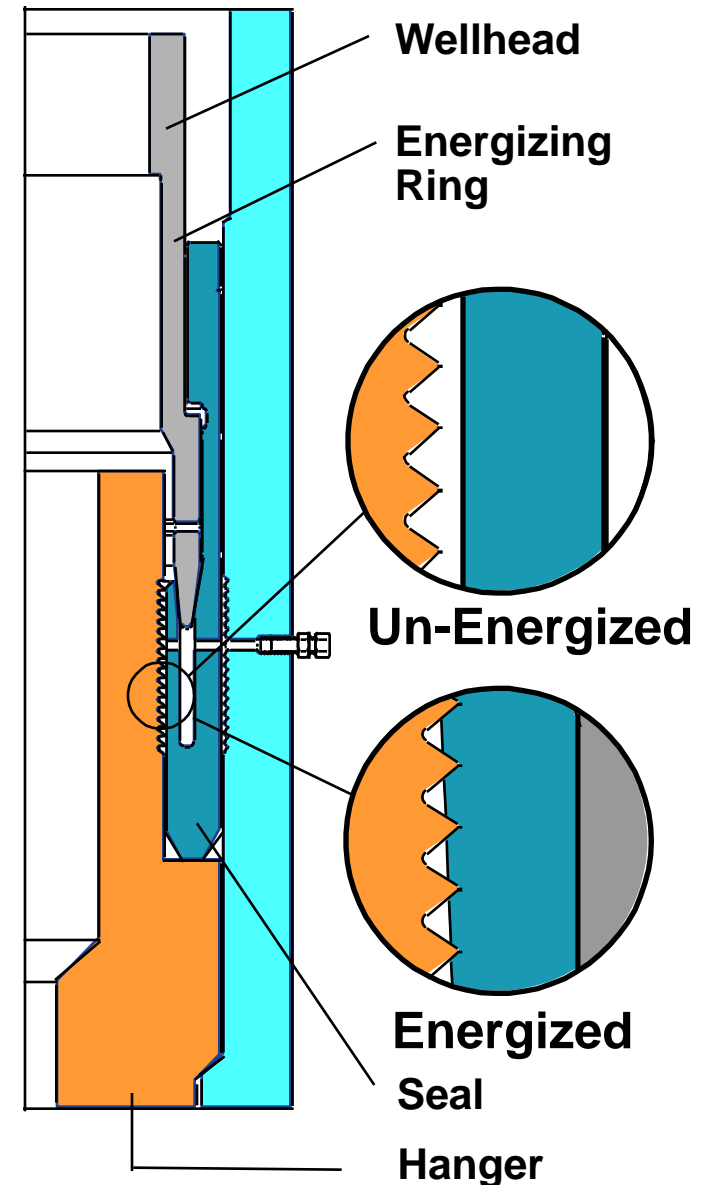
Metal Seals: MS-Seals

- Originally designed for MS-700 Subsea Wellhead system.
- Seal energized to engage a series of wickers on both the hanger neck OD and the wellhead ID.
- Provides multiple metal seals at the wickers and also hanger lockdown pre-load.
- Installed using hydraulic tool to ensure full pre-load.
- Seal fully retrievable after installation.
- Performance Verification Tested up to 15,000 PSI from below and 20,000 PSI from above.



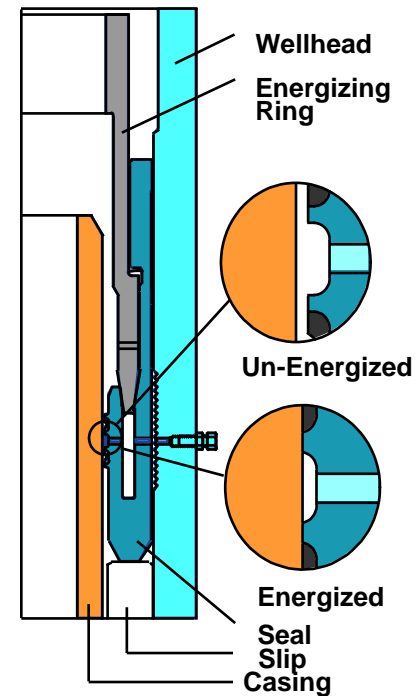
Metal Seals: MS-T

- Developed specifically for Surface Wellhead applications where testing at the wellhead is desired.
- Same design concept to the MS-1 seal
- Penetrations positioned above and below sealing wickers permits external pressure test of seal integrity immediately after installation.
- Provides casing hanger lockdown pre-load to API Group 4 & 5.
- Fully retrievable with zero damage to wellhead or hanger neck seal areas.
- Installation and retrieval (if required) under full BOP control.



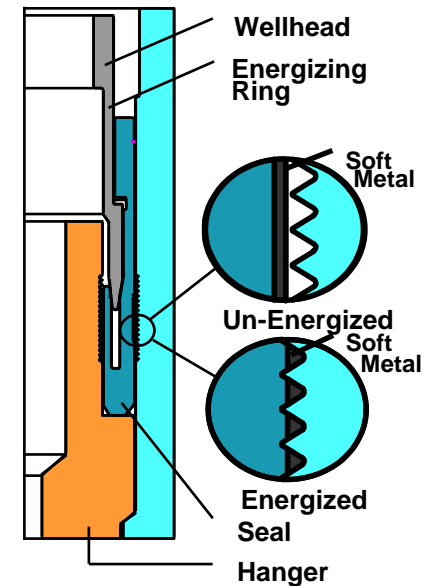
Metal Seals: MS-CBT

- Used in emergency situations for casing is stuck.
- Lands above slip hanger to provide full metal to metal sealing between wellhead and rough casing stub.
- Same design principles to the MS-T seal.
- Permits external pressure test to confirm seal integrity immediately after installation.
- Installation and retrieval (if required) under full BOP control.

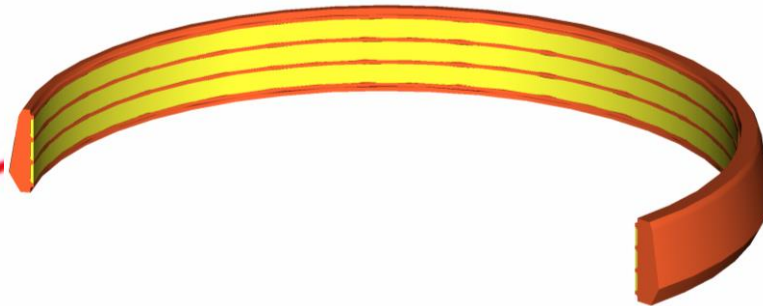
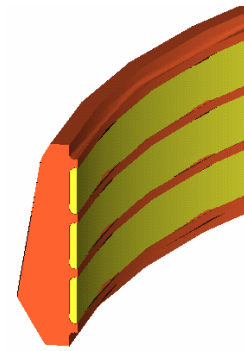
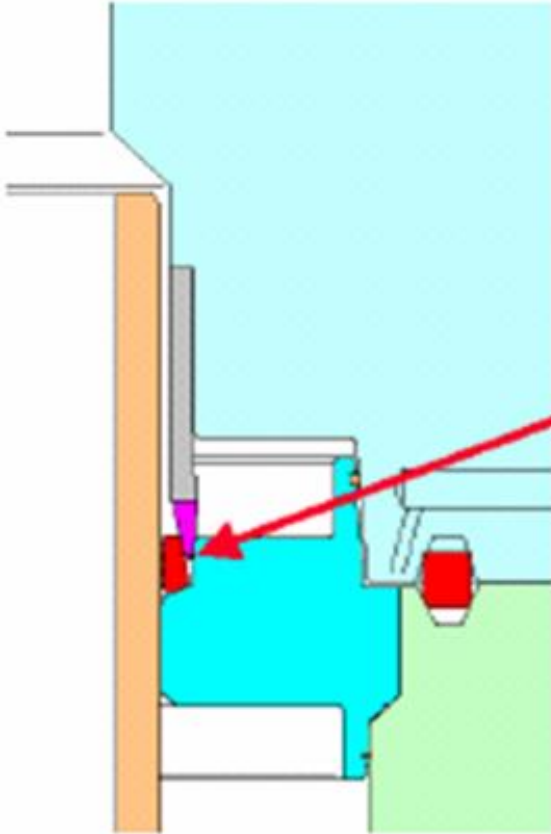


Metal Seals: MS-E

- Used in emergency situations where Wellhead and / or Casing Hanger wicker damage has occurred.
- Same design principles as the MS-CBT seal with Soft Metal inlay on both inner and outer seal legs
- Installation and retrieval (if required) under full BOP control.
- No provision to test at the wellhead.



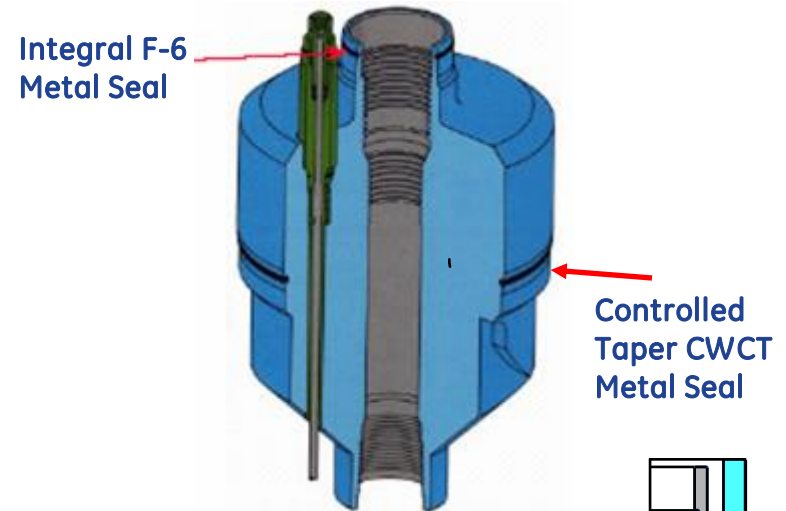
Metal Seals: CB Seal



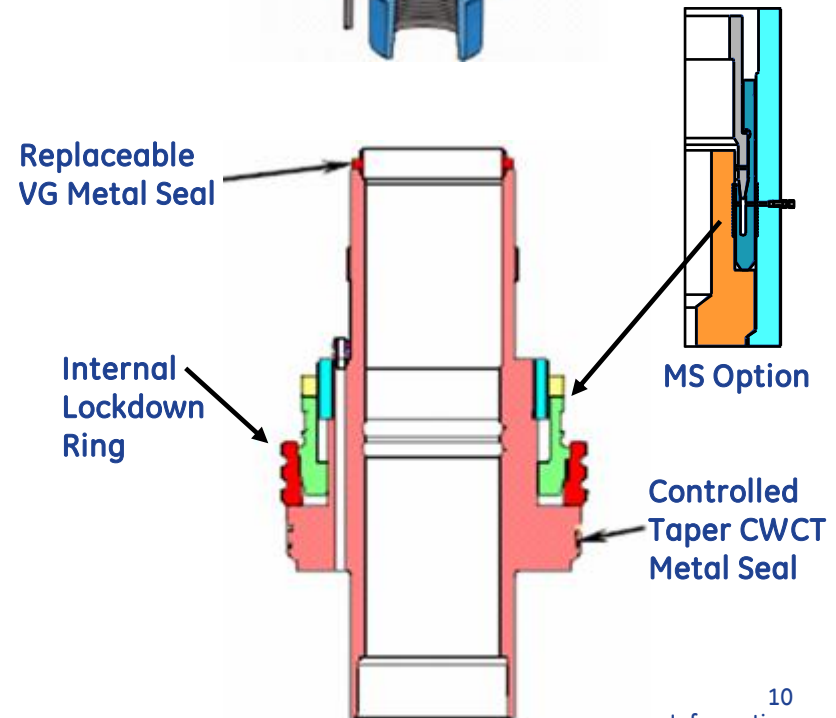
- All metal seal casing annulus isolation seal.
- Designed to seal against rough casing.
- Compression energized by the wellhead compression preload.
- Tested to 20,000 PSI with induced casing movement throughout the test .

Metal Seals: Tubing Hangers

- Solid Mandrel style hanger.
- All metal to metal seals.
- Set Screw energized.
- Modified Centralized Acme Landing Thread
- Integral Back Pressure Valve prep.
- Vertical ports for continuous control lines.

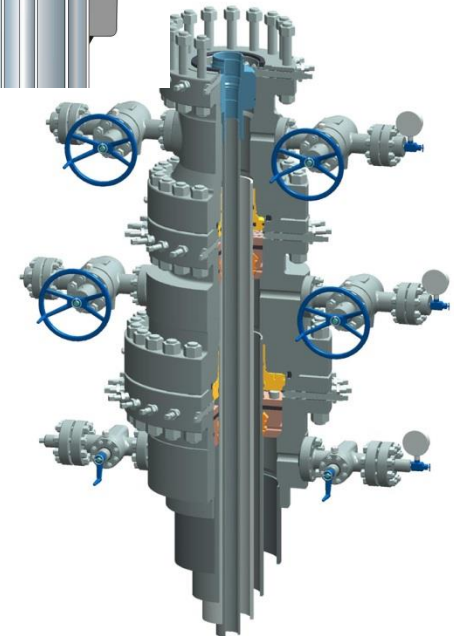
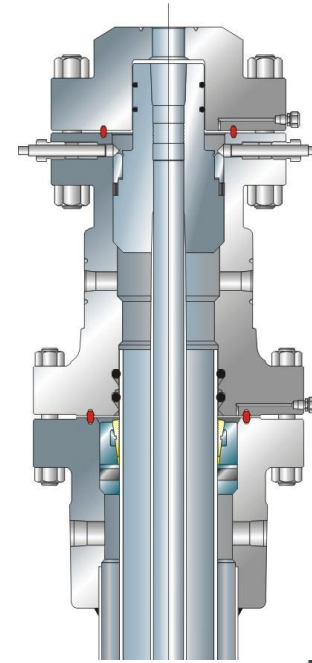


- Solid Mandrel style hanger.
- All metal to metal seals.... Replaceable hanger neck seal.
- Internal locking... No Set Screws
- MCA External Landing Thread
- Integral Back Pressure Valve prep.
- Vertical ports for continuous control lines.



Land, Platform & Jack-up Systems - Products

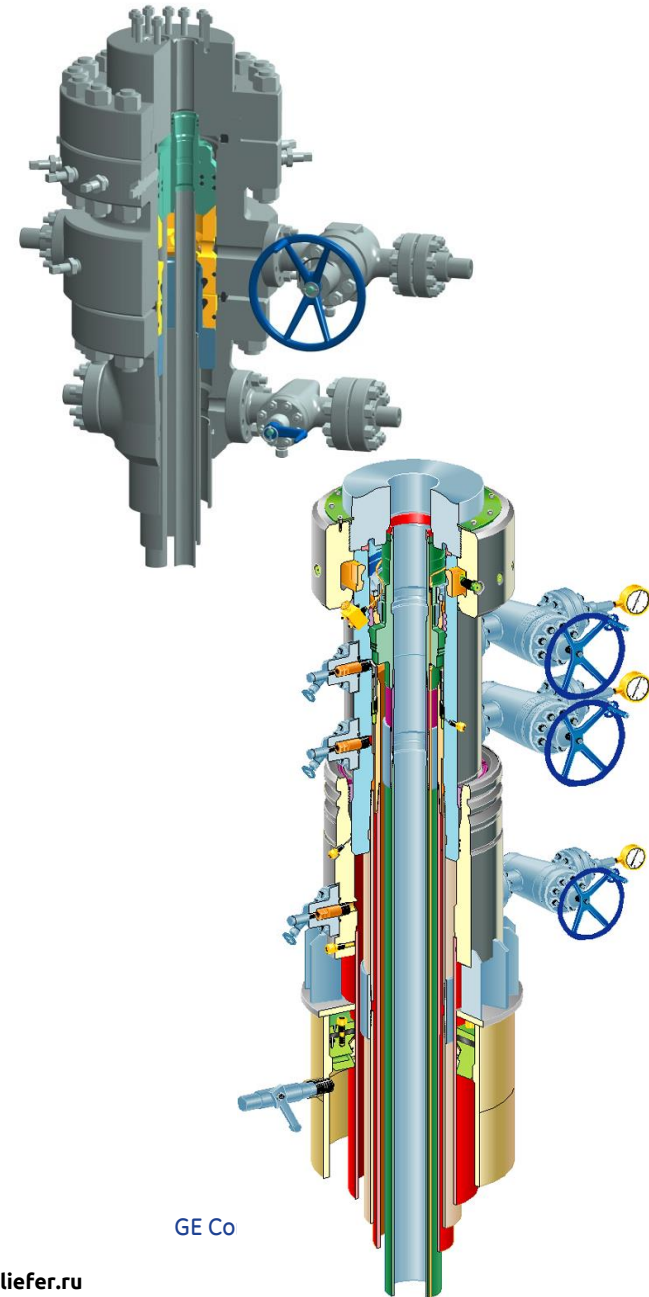
- Conventional Wellhead Systems:
- FC-22 Wellhead line
 - Industry Standard - Low cost solution.
 - Lower pressure ratings up to 10,000 PSI
 - Lighter casing strings.
 - Slip Csg. hangers and elastomer sealing only.
 - Mandrel Tubing Hangers
- CWCT/D-15 Wellhead line.
 - Spans the low tech to high tech gap 3,000 to 20,000 PSI systems.
 - Both elastomer and metal sealing capabilities.
 - Slip or Mandrel casing hangers – Heavier casing strings
 - HP/HT and severe service capable up to 232deg C



Land, Platform & Jack-up Systems - Products

Multi-bowl Systems:

- Elastomer sealing... MB-150
 - Simple 2 stage Compact Wellhead solution... Split Multi-Bowl
 - Lower pressure ratings up to 10,000 PSI
 - Lighter casing strings.
 - Significant rig time savings and safety advantages.
- Metal sealing... MS-NT Multi-bowls.
 - Advanced Technology features.
 - Rapid Make-up connectors.
 - All Metal to Metal sealing systems.
 - HP/HT and severe service capable.
 - Significant rig time savings and safety advantages.
 - Reliability by Design



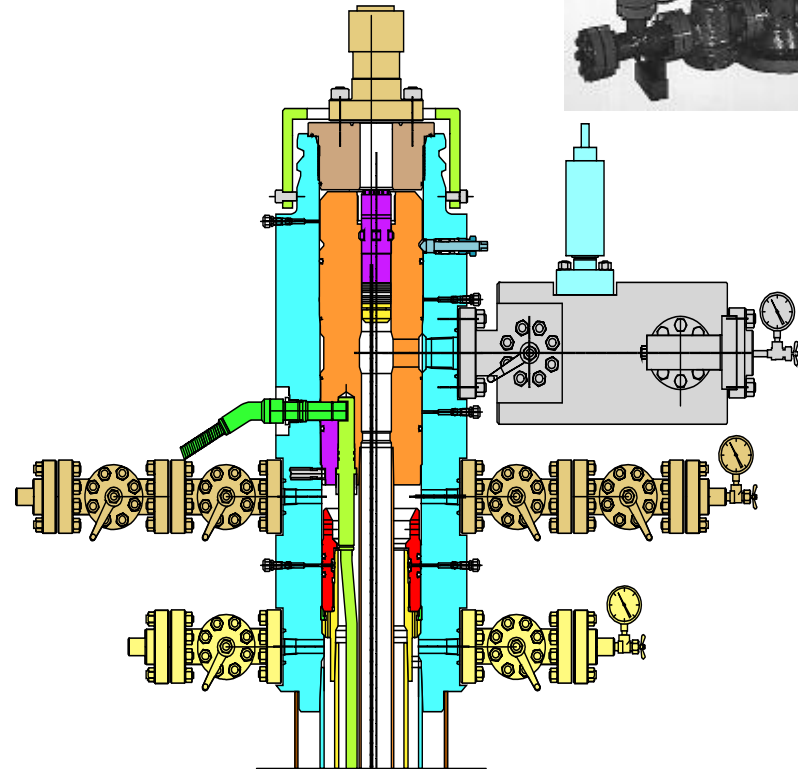
Land, Platform & Jack-up Systems - Products

- Quick Connect Wellhead Systems.
 - Low “Total” cost solution providing:
 - Time savings
 - No hot work
 - Safety
 - Designed for use with latest drilling equipment and applications:
 - Off-line operations.
 - Cement heads.
 - FRAC systems.
 - Pad drilling.

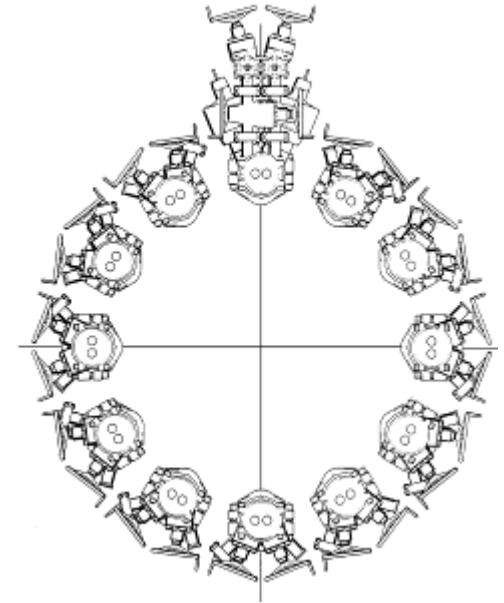


Horizontal Completion Systems

- More than 40 years successful production in industry
- Latest technologies now applied to HT Completions
 - Fast make-up connectors
 - Metal Sealing
 - Block Trees
 - ESP Interface
- Key features - Safety, Speed, Reliability and Ease of Intervention.



Close Proximity (CPW) Systems



- 2 separate wells within a 36" conductor
- 13-3/8" x 9-5/8" casing with 4-1/2" tubing

- 3 separate wells within a 42" conductor
- 13-3/8" x 9-5/8" casing with 5-1/2" tubing

- 12 separate wells in a 120" diameter arrangement.
- 18-5/8" x 13-3/8" x 9-5/8" casing with 5-1/2" tubing and 3" X 3" Duals.

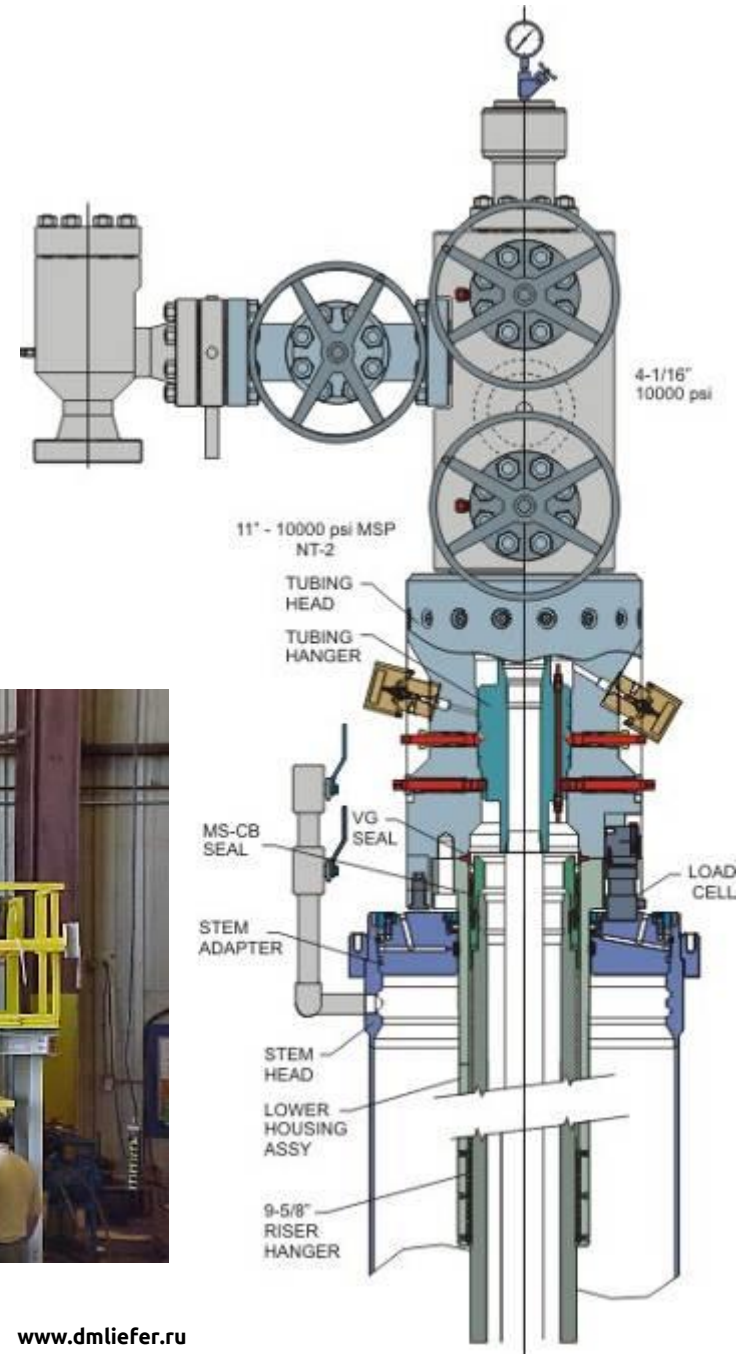
TLP & SPAR Systems

Floating Production systems for TLP's & SPARS

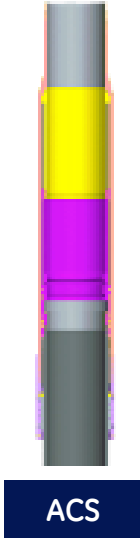
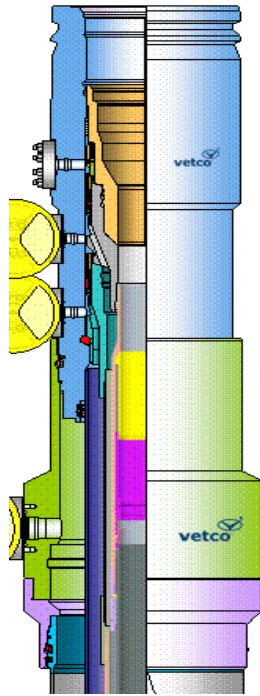
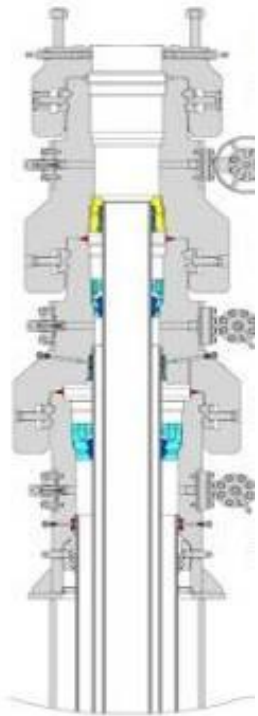
Field proven on Genesis, Marlin, Boomvang, Nansen, Holstein, Mad Dog and Kizomba.

Adjustable Drilling Riser (ADR) technology

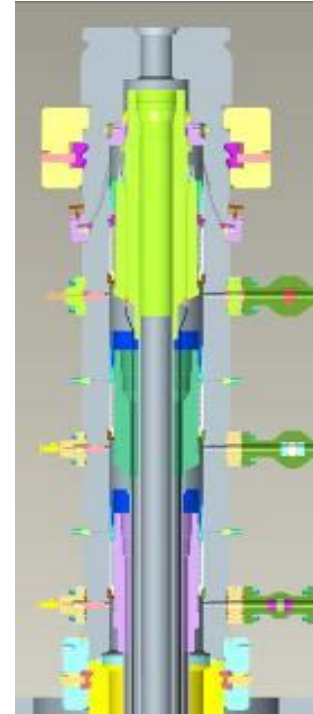
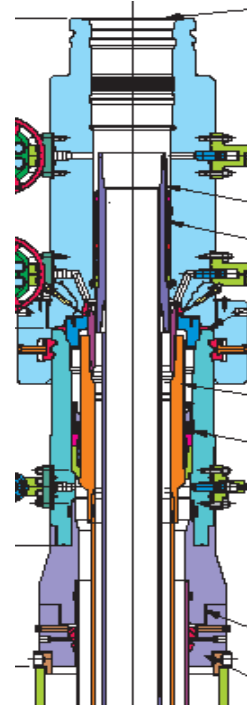
HPHT metal sealing capability



Jack-Up Drilling Systems (JUDS).. Single & 2 Stack



ACS



AMH-2

• Two Stack Spool System

- NT-2 Connectors
- Slip & seal hangers

• Single Stack System – 18-3/4"

- MS Metal to Metal Sealing
- Adjustable Casing Subs



• Single Stack & Two Stack Spool Systems...

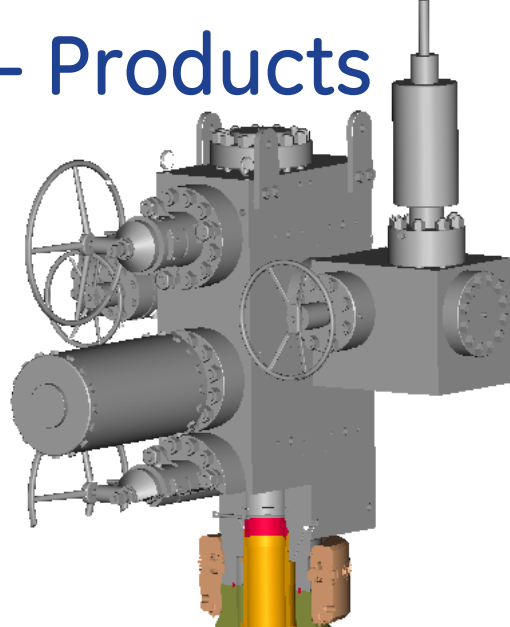
- HPHT 15K @ 350 Rating
- Through BOP control
- NT-2 Connectors
- AMH-2 Hanger Adjustment
- MS Metal to Metal Sealing



Land, Platform & Jack-up Systems - Products

Flow Control Equipment:

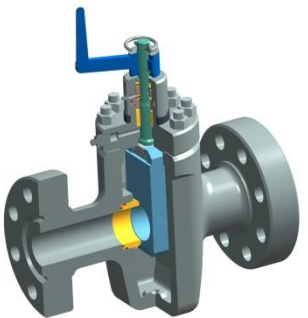
- Valves:
 - VG-M – Split Gate Commodity Valve (5M & 10M)
 - VG-200 – Slab Gate (3M & 5M).
 - VG-300 – Slab Gate (5M to 15M).
 - Large Bore Extreme Service (up to 9"-20M)
 - Various Block Tree configurations.



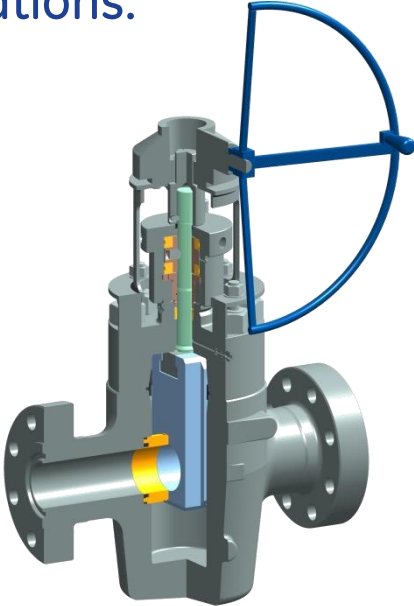
Block Trees



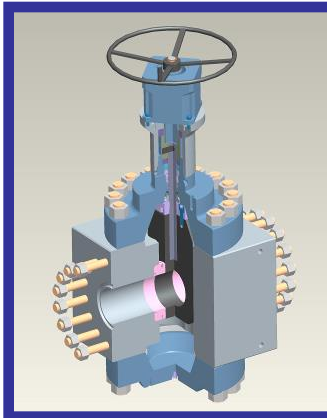
VG-M



VG-200



VG-300



Large Bore
Extreme Service



Hydril Land Products: Chokes

Superior Choke Performance

Hydril offers two high performance choke product lines.

“Sleeve” design Chokes for critical service applications and “plug” design valves for moderate to severe applications.

Standard models in the sleeve design line are the CFB, BFB and BFC. Standard models in the plug design line are the PRB and PRC.



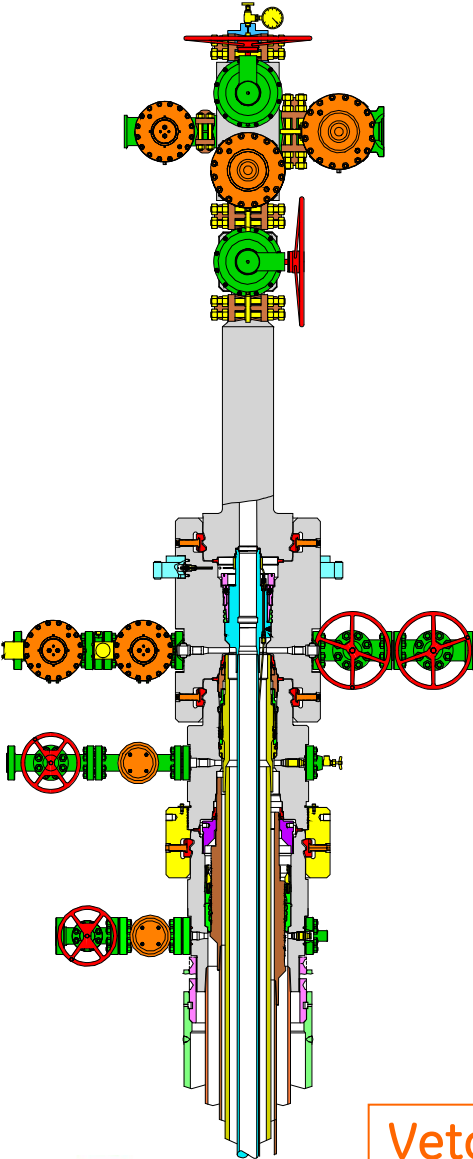
imagination at work

Investing in Technology & Innovation



HP/HT Experience

HP/HT Surface Equipment Experience



20 KSI wellhead & tree - Shell Oil, Mississippi, 1972

30 KSI wellhead & tree - Shell Oil, Mississippi, 1974

10 KSI wellhead & tree 204°C - Mobil Indonesia, 1976

30 KSI wellhead & Tree - Exxon, Mississippi 1980

API 6F "Improved" fire resistant wellhead & tree Elf (Heimdal) Norway, 1981..... 650°C

20 KSI wellhead & clad tree - Shell Oil, GOM, 1984

15 KSI 176°C Integrated Jack-up System - Chevron Destin Dome - 1988

20 KSI wellhead & clad tree 176°C - Chevron Mobile Bay 1988

20 KSI (18 ksi rated at 232°C) integrated mudline, wellhead & test tree - Ranger Oil, Central Graben - 1992

15 KSI wellhead & tree 176°C - Texaco (Erskine), Central Graben - 1998

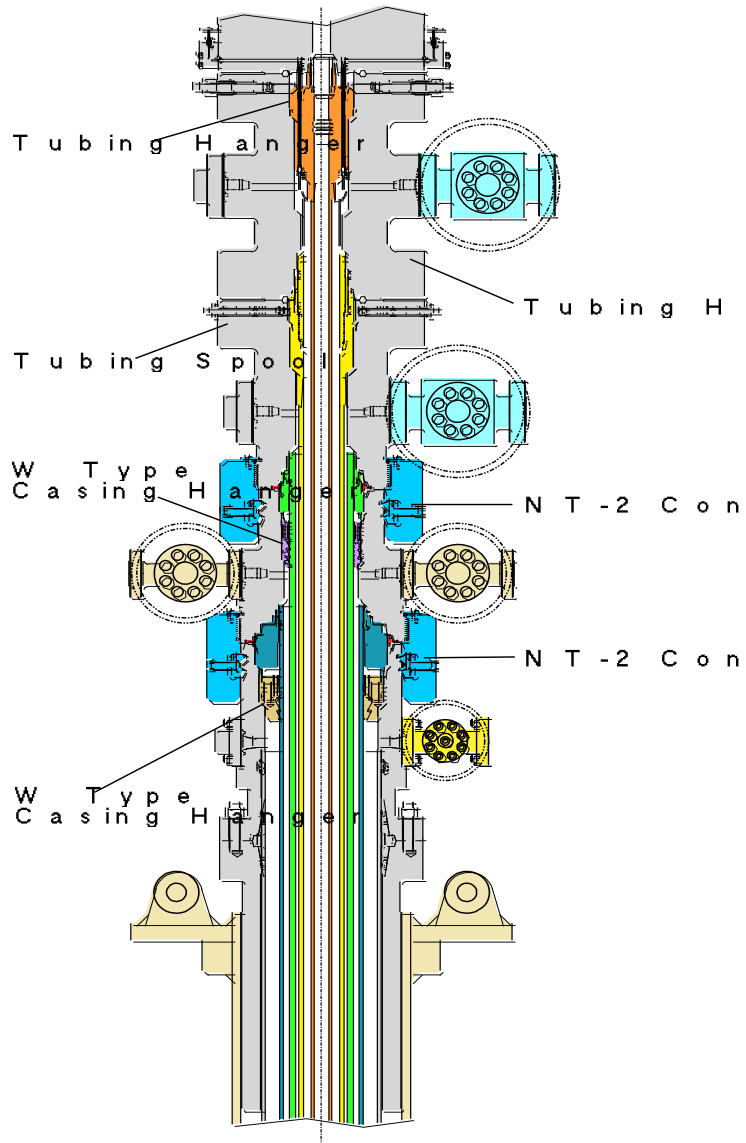
15 KSI wellhead & tree 204°C - Elf Elgin/ Franklin, Central Graben - 1998

20 KSI wellhead & tree 204°C - Elf Triassic Exploration well - North Sea 1999

VG230SE2 - 343°C Steam Injection Valves.... Numerous areas Globally.

Vetco Gray made 10 of the 12 - 30,000 PSI systems worldwide.

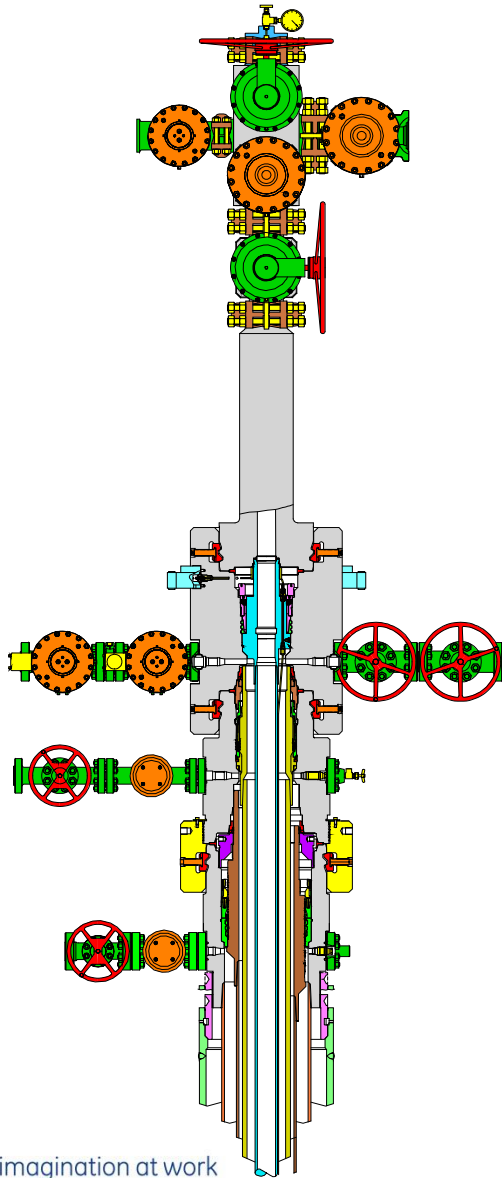
HPHT Systems – Ranger Oil



Technology Features:

- System designed and PR-2 qualified to 20,000 PSI @ 232C.
- Includes HP-HT Mudline System
- Primary Metal to Metal Seals
- Emergency Metal to Metal Seals
- Control line Metal sealing system – 20,000PSI @ 232C
- 3-1/16" – 20,000 PSI Fully Clad Tree
 - 1-1/4" Coil tubing shearing Surface Safety System.

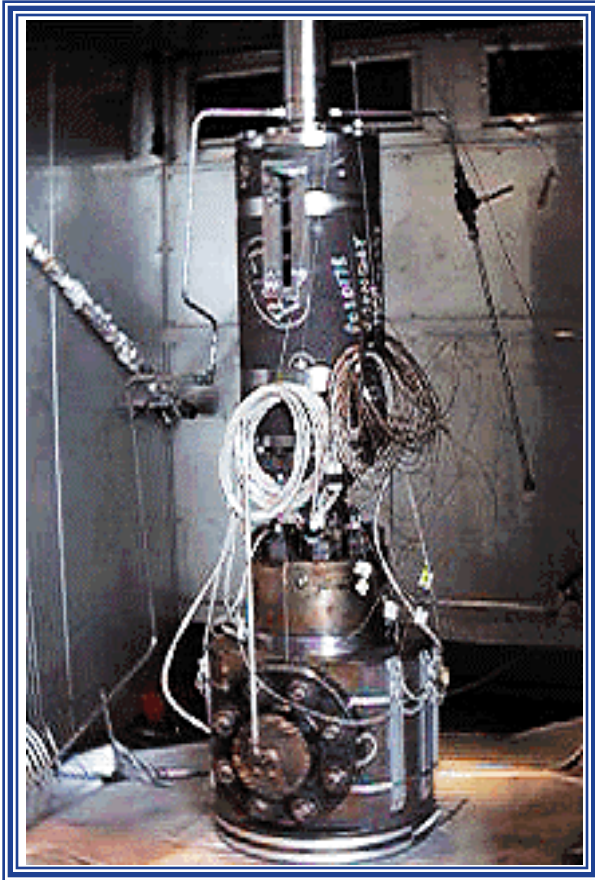
HPHT Systems – Total Elgin/Franklyn



Technology Features:

- System designed and PR-2 qualified to 15,000 PSI @ 204 C.
- Includes HP-HT Mudline System
- Adjustable Mandrel Hangers
- NT-2 Connectors.
- MS-T / CBT Metal casing seals.
- Internal locking tubing hanger.
- 4-1/16" – 15,000 PSI Fully Clad Tree
 - VG-300LM Valves
 - CH Actuators

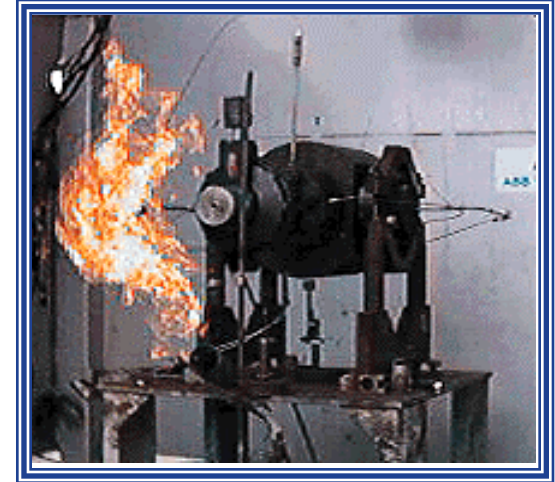
Product Verification Testing Capabilities



Product Verification Testing

Extensive test facilities for HPHT equipment:

- Full dedicated test lab in Houston and Aberdeen.
 - API 6A PR2 performance verification testing
 - API temperature class K thro' X (-60 to 176°C), and up to 343°C.
 - Fire testing to API 6FA, 6FB and 6FC
 - Dynamic gas (blow-down) testing.
 - Supplemented by wider GE laboratory and test facilities
- New test lab facilities under construction in Eastern Europe



New Technology Developments

Valve Technology Developments – Greaseless

Development Challenges:

- Subsea market driving requirements.
- Demanding exceptional reliability
 - No grease during assembly or qualification....
 - 4000 hydraulic blow down cycles, 300 torque cycles, periodic gas testing....
 - Thermal and hyperbaric testing
 - Frozen hydrate test simulation
- Water depth rated to 2500 meters....
- Environmental Impact....
- Cost impact.....
- 20 Year service life.
- Springboard for further valve development

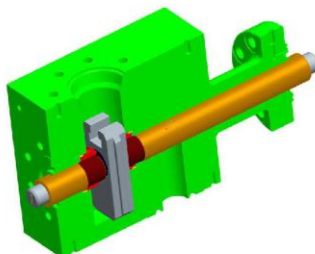


2" 5M Test Valve



4" 5M Test Valve

Hydrate Simulation Tooling

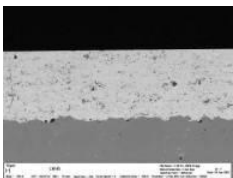


Greaseless Valve... GE Collaboration

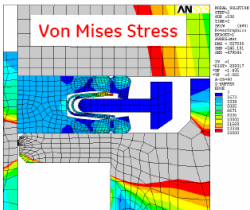
- Most stringent qualification
- 100% Gas sealing ... greaseless
- 4000 cycle with minimum leakage



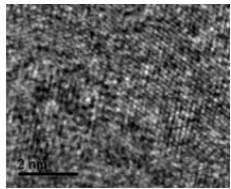
Diamond Lapped Seat Pockets, 2 micron Finish
GE Aviation



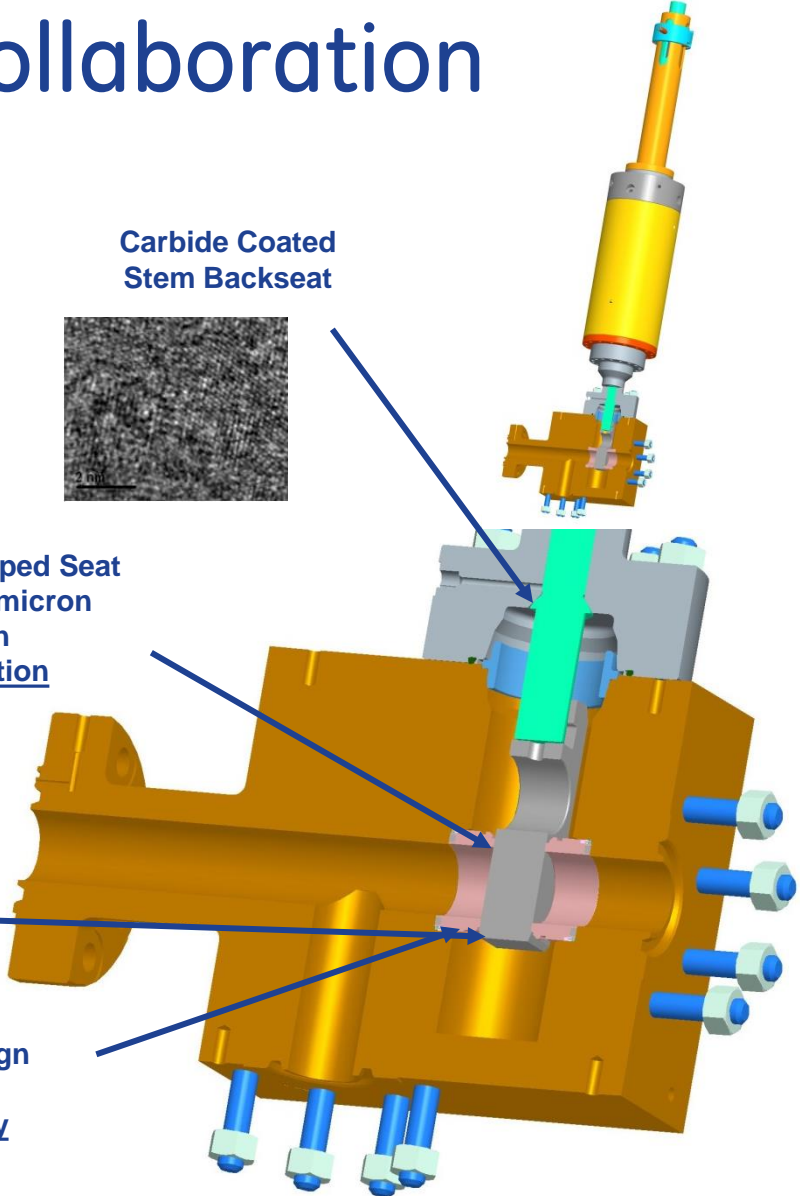
Advanced Coating System
GE Aviation



Low Stress Seat Analysis & Design Optimization, Seal Design
GE Global Research, GE Energy



Carbide Coated Stem Backseat



9 Months ... From 20 cycles to 4000 Cycles with No Leaks

Actuator Developments

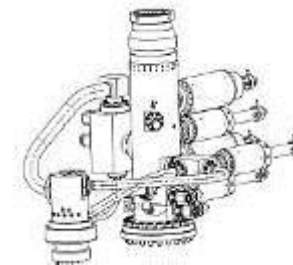
- Existing CH Actuator line....Over 2,000 in service today....
 - Full range of sizes and pressure ratings primarily used in critical service applications
- New “CHA” Actuator development underway:
 - Family of Parts design approach.
 - HPHT / Big Bore & High Gas Flow Rate capable.
 - Includes full range of accessories..
 - API-6A PR-2 Annex F Performance Verification Testing....
- Subsea Version.... CH-OP used on all VG Subsea Trees.



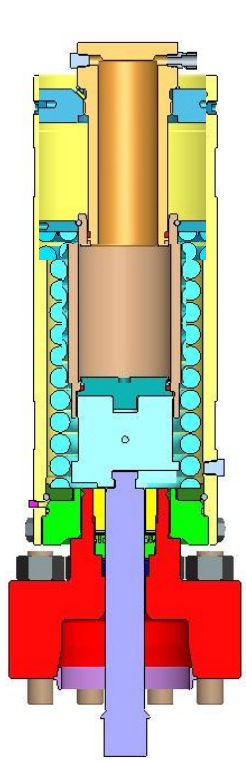
CH 55 on VG 300 valve prepped for PR2 testing in R&D environmental chamber



Subsea CH-OP 55 on VG 300 valve prepped for PR2 testing.

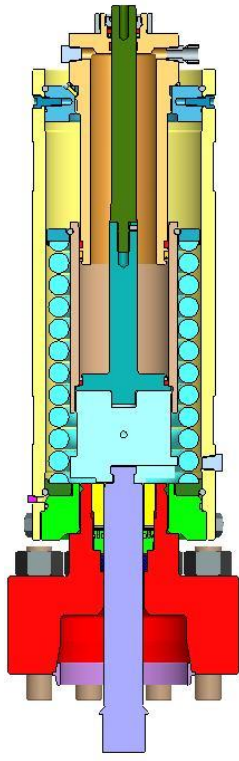


Actuator Developments... CHA-55 Actuator Family



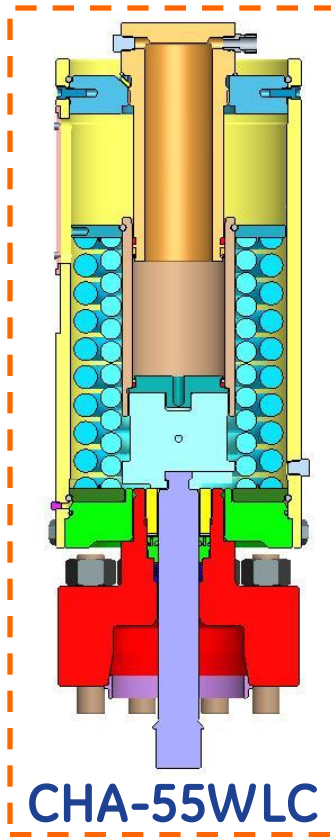
CHA-55C

Standard Classic
CH with Single
Spring...



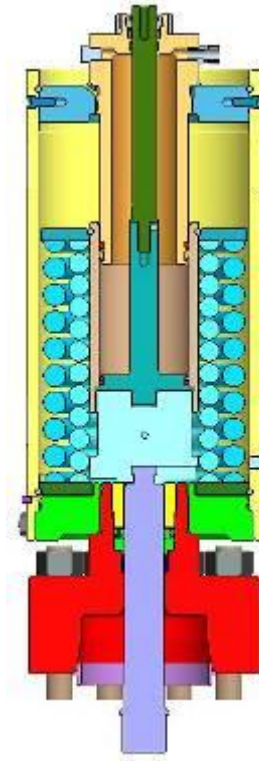
CHA-55

Top-Entry Access
for tools and
accessories



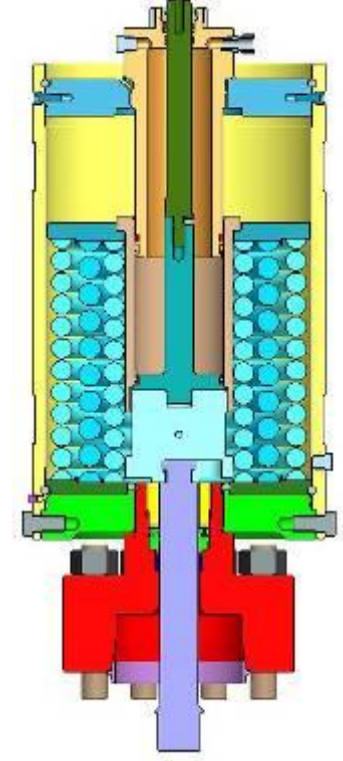
CHA-55WLC

Standard double spring
Classic CH Wireline
Shearing



CHA-55WLS

Wireline Shearing with
Top-Entry Access for tools
and accessories



CHA-55WLH

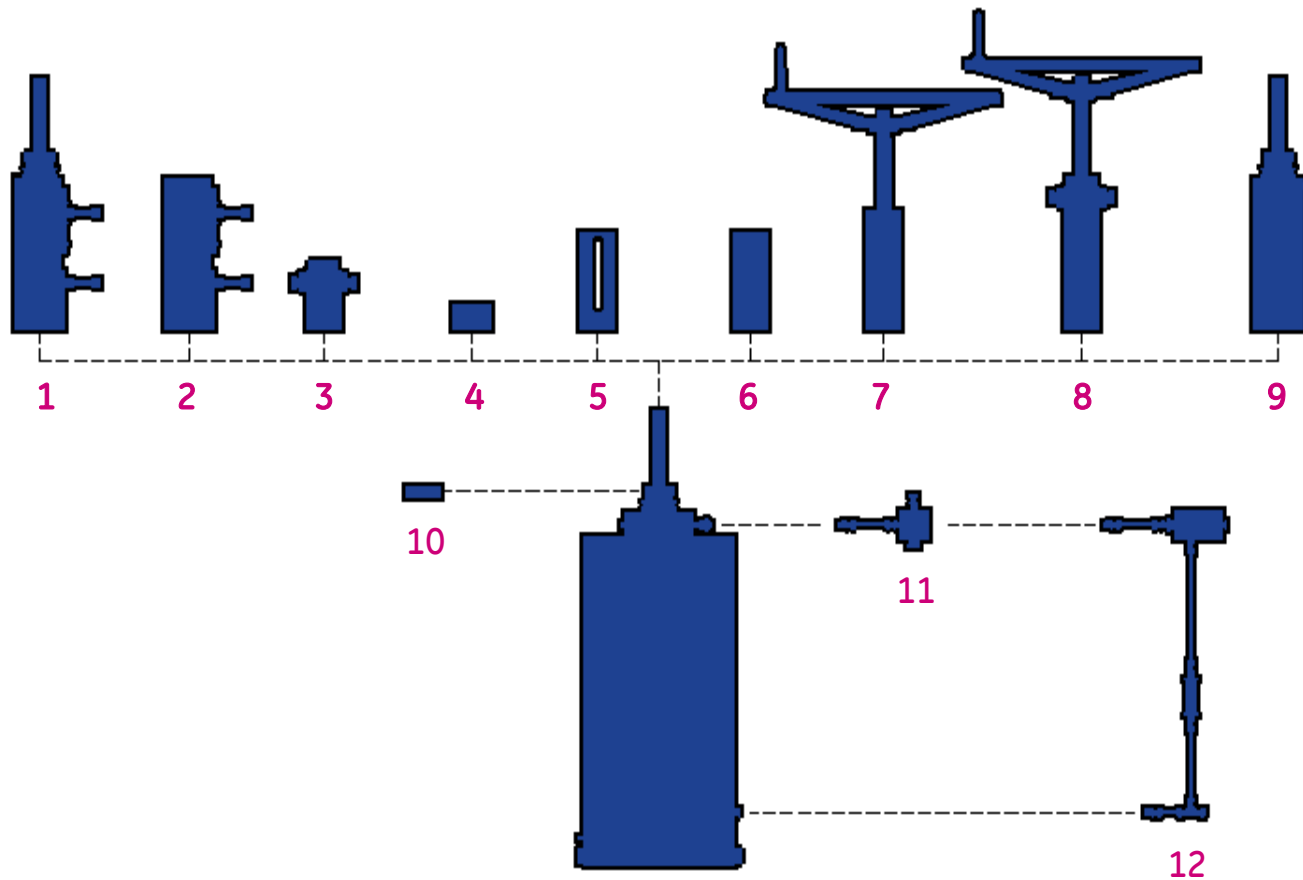
Heavy Duty Wireline
Shearing with Top-
Entry Access for tools
and accessories

Other Sizes in CHA Line

CHA-38
CHA-48
CHA-55
CHA-70
CHA-112



Accessory Tools: Top Accessible



1. Integral Electric Valve Position Indicator
2. Electric Valve Position Indicator
3. Fusible Lock Open Device
4. Lock Open Cap
5. Stem Guard
6. Clear Stem Protector
7. Manual Override
8. Fusible Manual Override
9. Hydraulic Override
10. Thread Protector
11. Quick Exhaust
12. Quick Exhaust System for Coil-Tube Shearing

Actuator Developments - Wireline Shearing

- CHA Standard Wireline Actuators designed to shear 7/32" braided cable and 0.125" slick-line with zero pressure in valve cavity.



9"-6,500psi Valve Wireline Shear Test

- CHA Heavy Duty Wireline Actuators designed to shear up to 7/16" braided cable with zero pressure in valve cavity.

Any questions as to how we can assist in
unearthing new treasures

