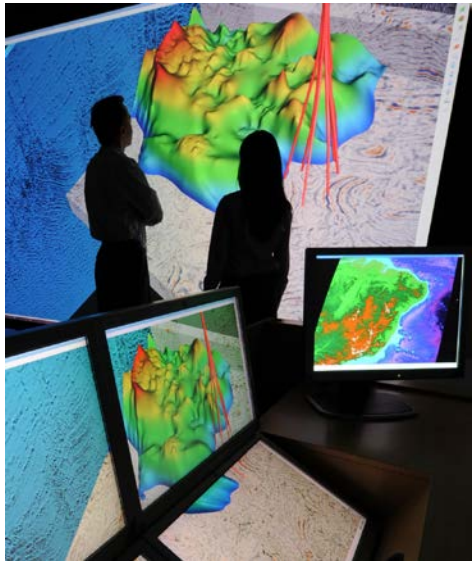
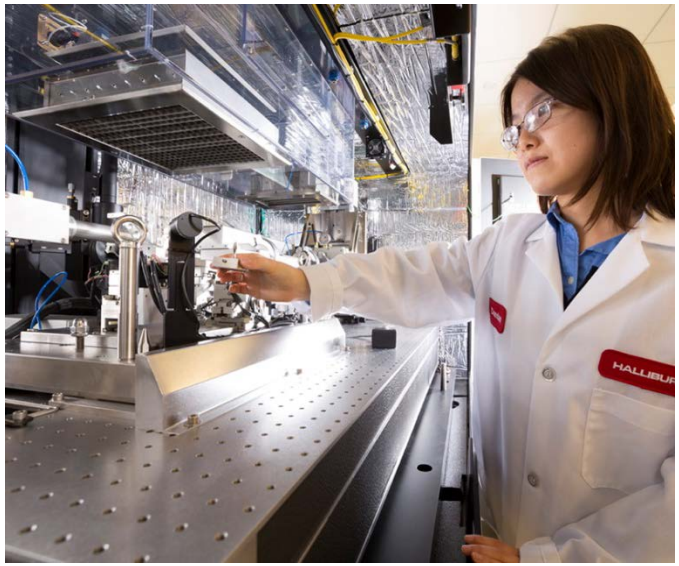
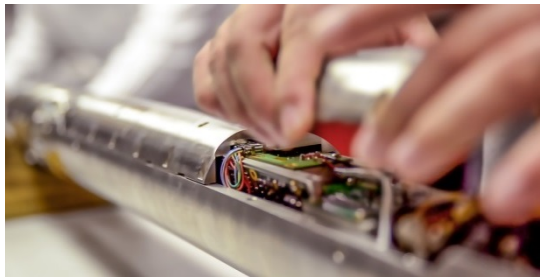






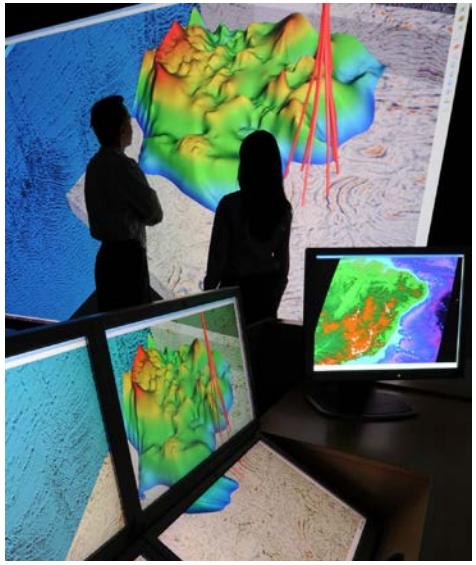
Tubing-Retrievable Safety Valves

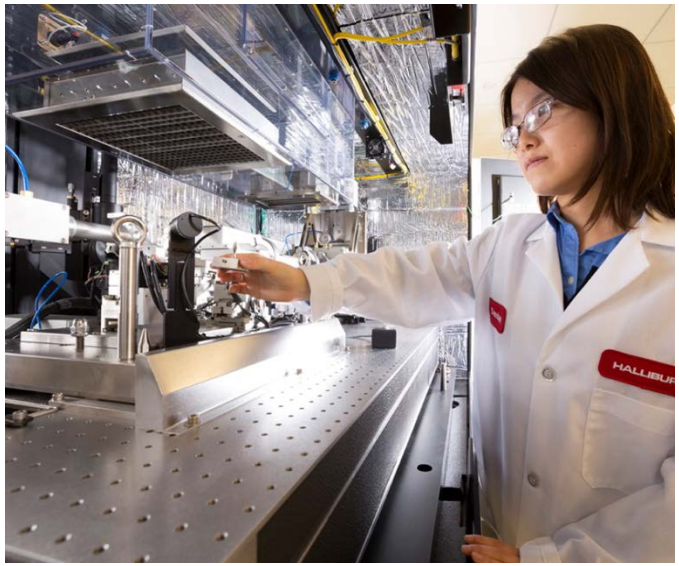
Unsurpassed Reliability for Conventional Shelf, HP/HT and Deepwater Applications

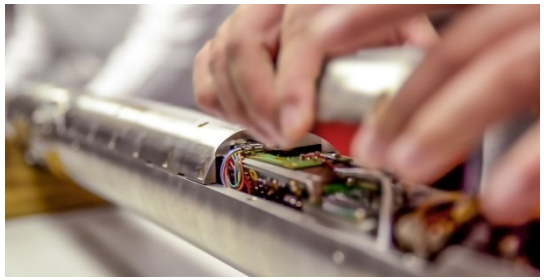
HALLIBURTON

Agenda

- NE™ Tubing-Retrievable Safety Valve
- SP™ Tubing-Retrievable Safety Valve
- DepthStar® Tubing-Retrievable Safety Valve
- High Performance Piston Seals







NE™ Tubing-Retrievable Safety Valves

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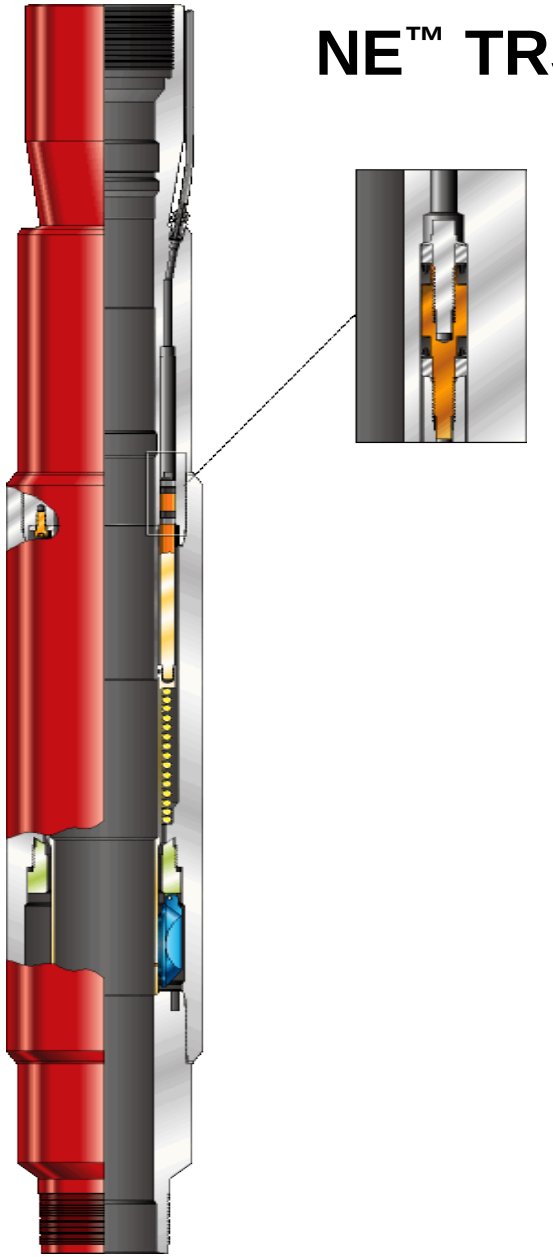
NE™ TRSV - Benefits of Design



- 100% MTM well containment
- No construction seals in the communication system
- Highest hydraulic piston actuator pressure rating in the industry
- Most reliable, field-proven piston actuator in the industry
- MTM body connections
- Enhanced debris isolation

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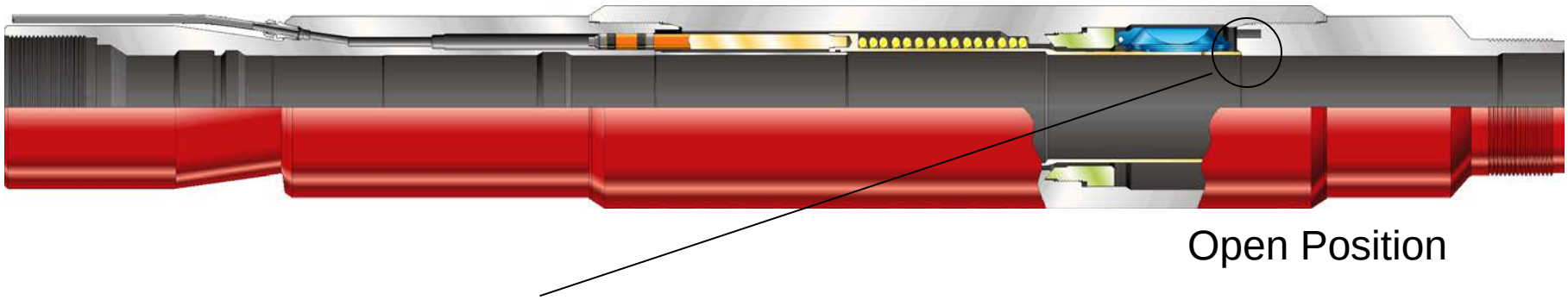
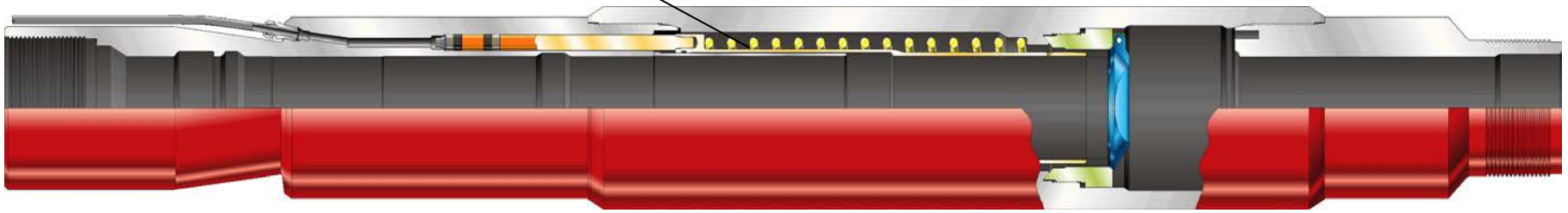
General Production - NE™ TRSV

Enhanced Debris Isolation and Protection



Open Position

- Flapper isolated from wellbore by MTM seating of flow tube
- Inverted flow tube prevents debris from accumulating on its upper end



Closed Position

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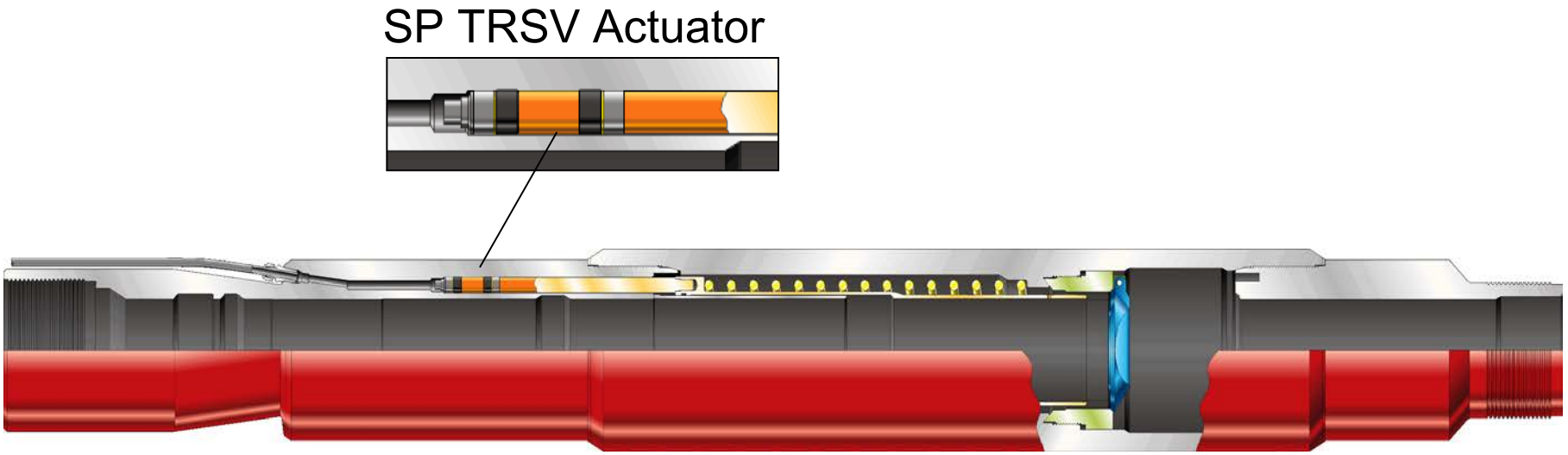
Uses the Field-Proven SP™ TRSV Actuator



- Single rod piston
- Non-elastomer seals
- Solid top sub construction provides for highest
- Hydraulic control chamber rating in the industry

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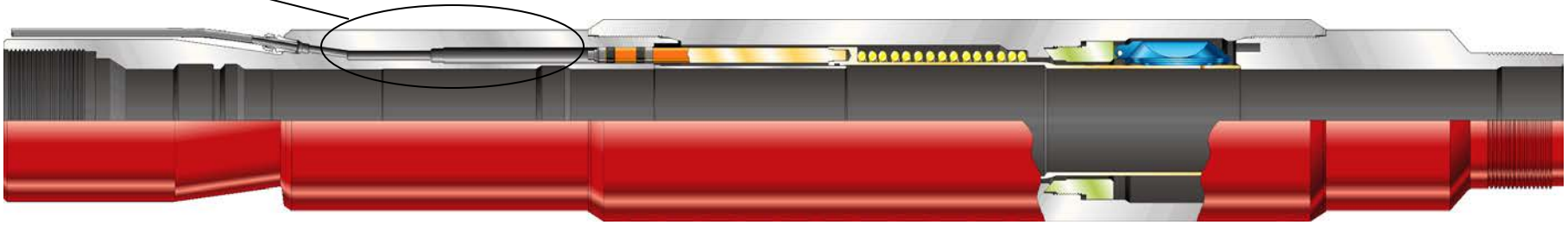
Permanent Lock Open and Communication System

No leak paths in secondary communication system



- Separate lockout and communication capability
- Combined mechanical (slickline) and hydraulic operation
- Secondary wireline-retrievable safety valve capability

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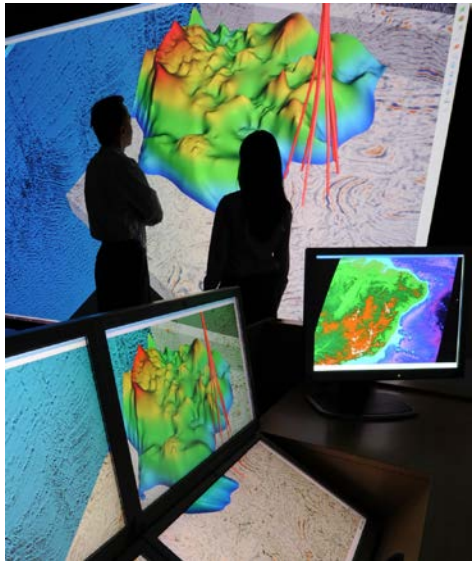

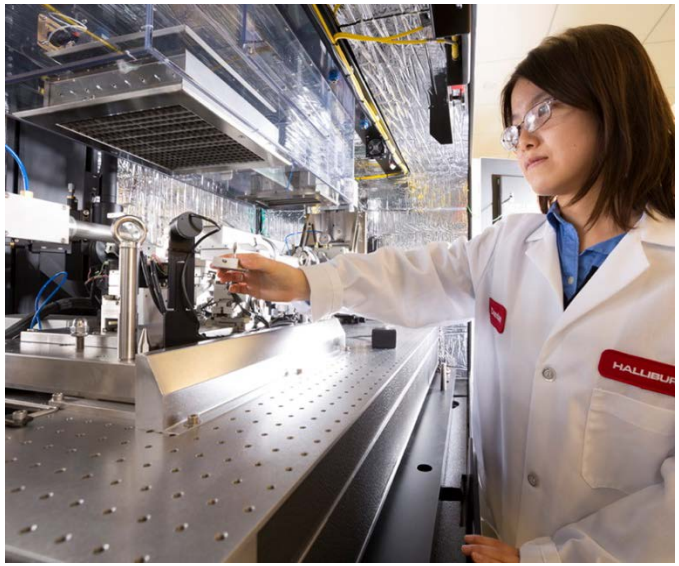

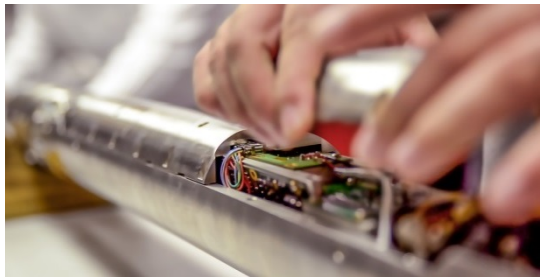

SP™ Tubing-Retrievable Safety Valves

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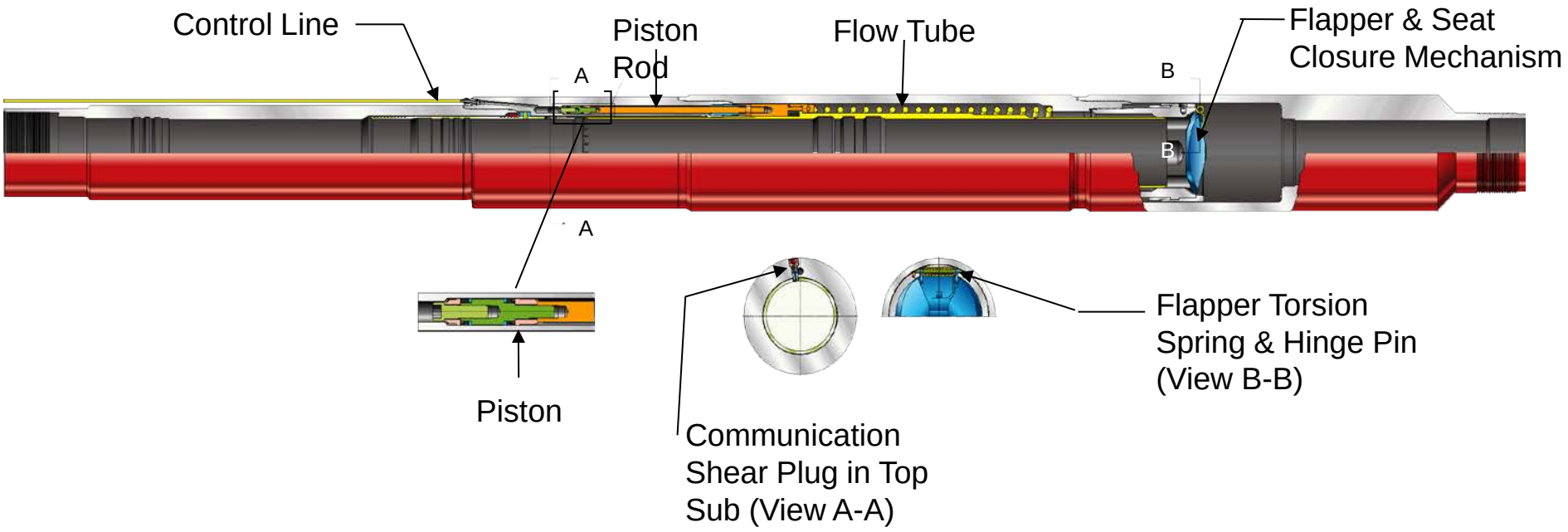
SP™ Tubing-Retrievable Safety Valve



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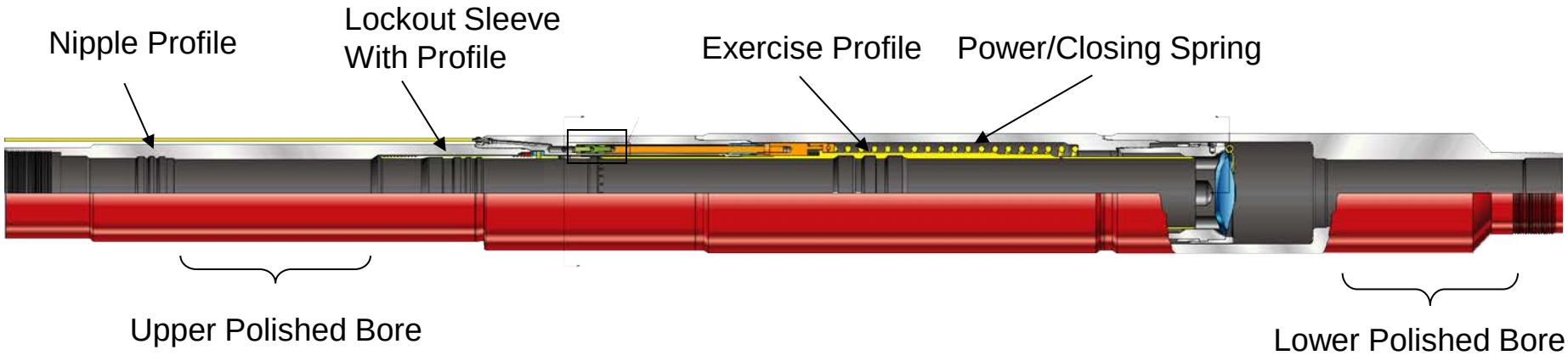
SP™ Tubing-Retrievable Safety Valve



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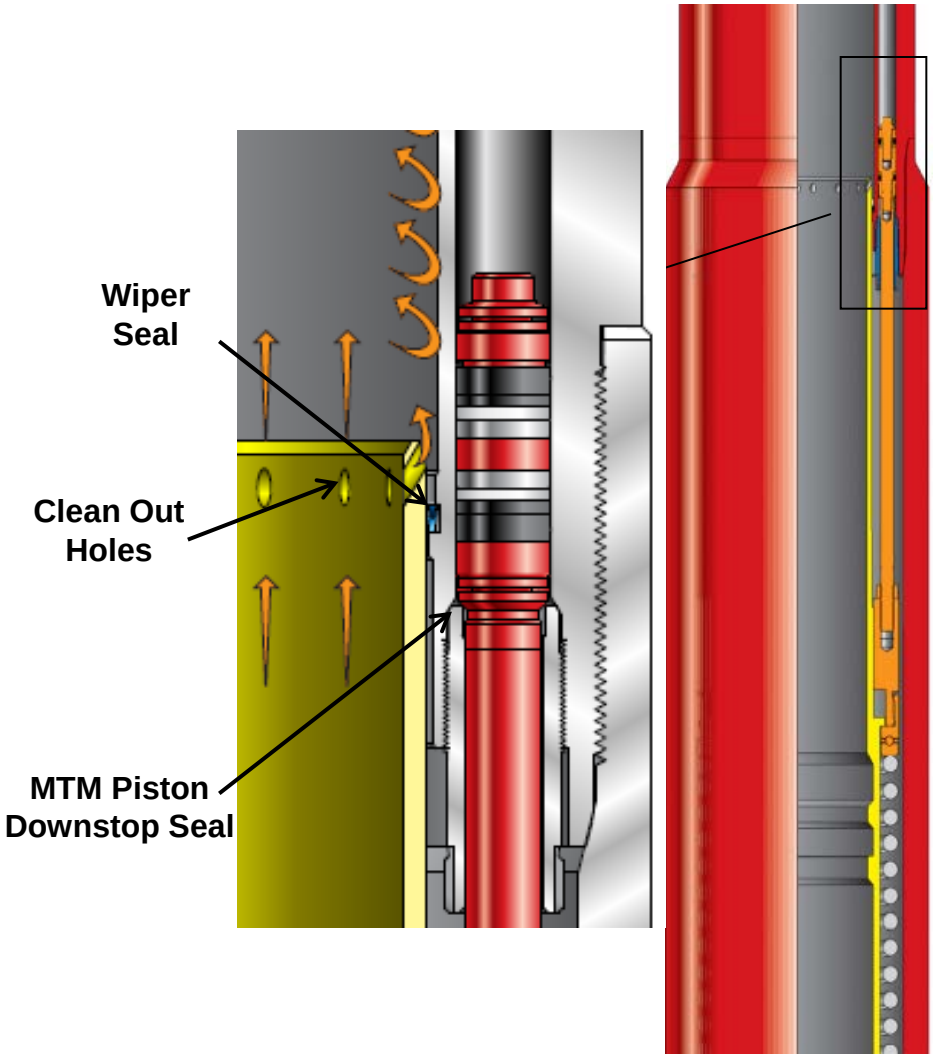
Enhanced Debris Isolation

Isolation of Upper End

- Wiper seal isolates the top
- Flow holes ensure continuous flushing during flowing conditions
- MTM seal on piston isolates the hydraulic system



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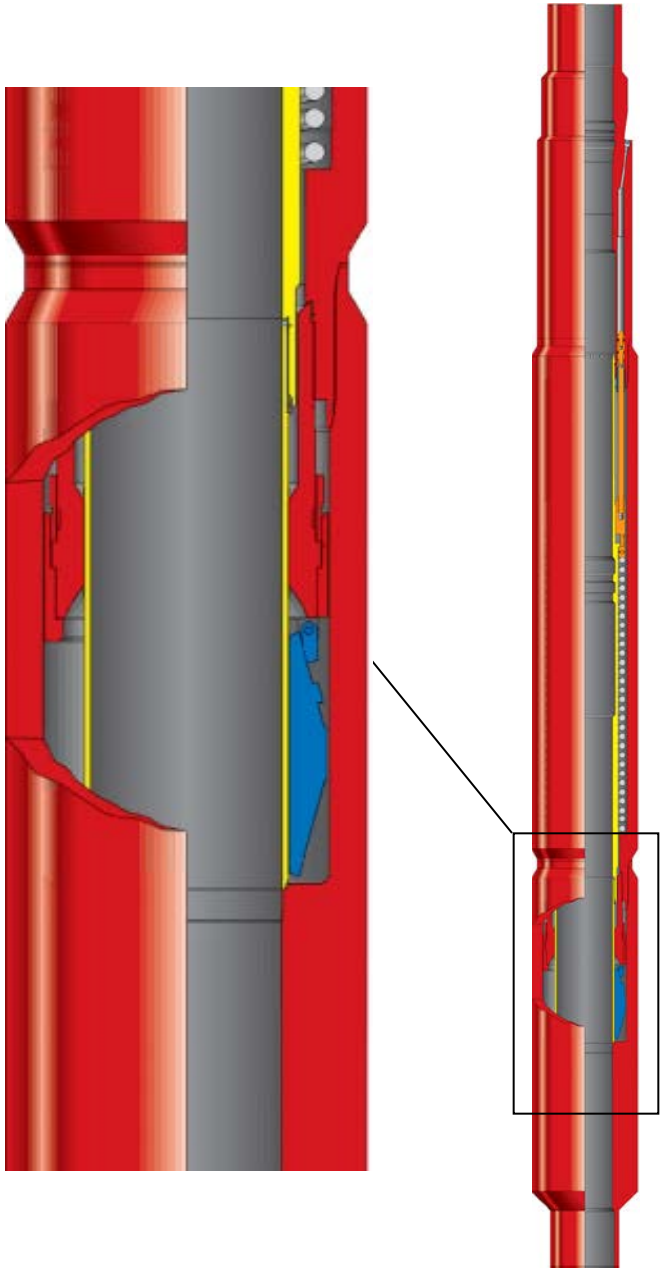
Enhanced Debris Isolation

Isolation of Upper End

- MTM Downstop Seat
- Complete Isolation of the Closure Mechanism
- Eliminates Flow From Entering the Operator of the Valve
- Full Protection During Flowing Conditions



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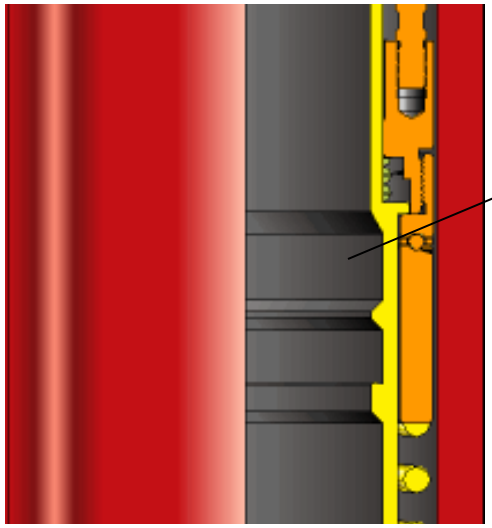
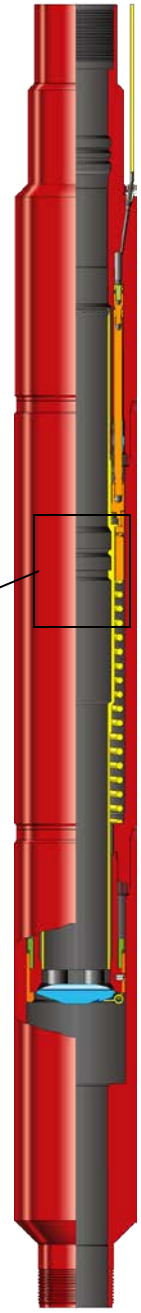
Dedicated Exercise Profile

- Standard feature within all SP™ TRSVs
- Allows flow tube to be manipulated upwards or downwards via slickline
- Helps prevent TRSV permanent lock open





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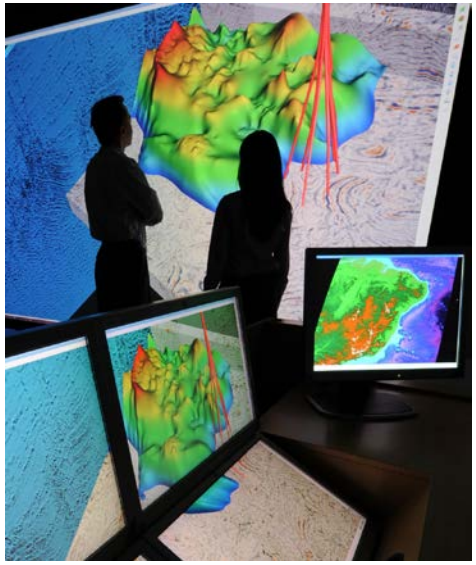

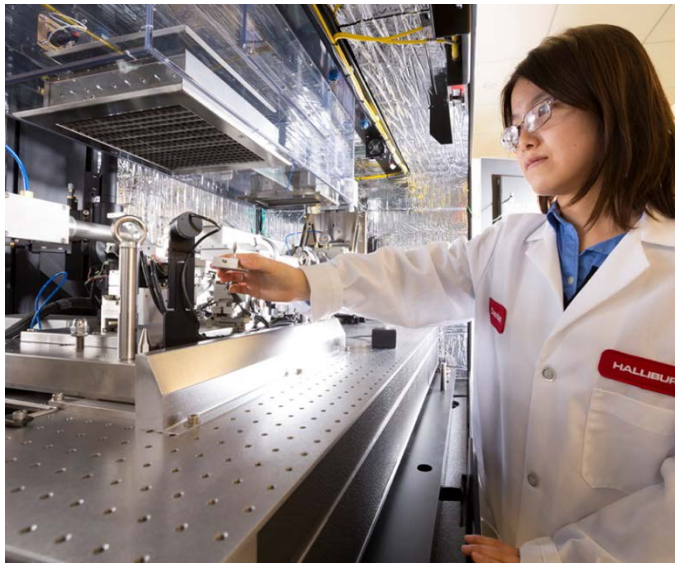

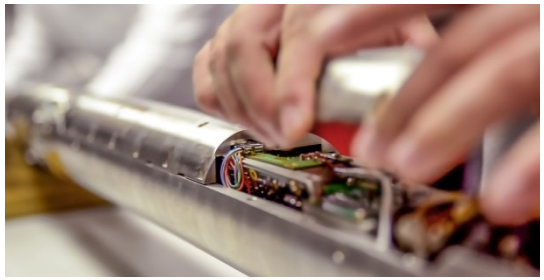

DepthStar® Tubing-Retrievable Safety Valve

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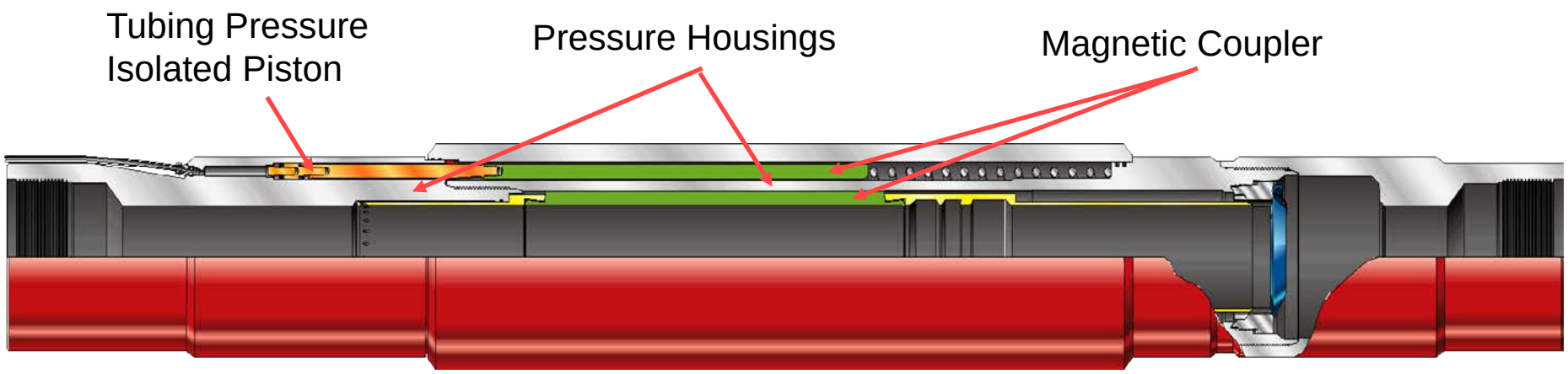
Challenges

- Limited system operating pressure
- Depth limitations
- High-pressure deepwater wells
- Expensive dedicated subsea umbilical for SSSV
- Reliability concerns

DepthStar® TRSV



- Magnetic coupler straddles the housing where the couplers are suspended magnetically
- Primary magnet cylinder outside the main TRSV body hydraulically actuated by the operating piston
- Secondary magnet cylinder moved by the magnetic attraction between the two cylinders
- Piston actuator isolated from the wellbore

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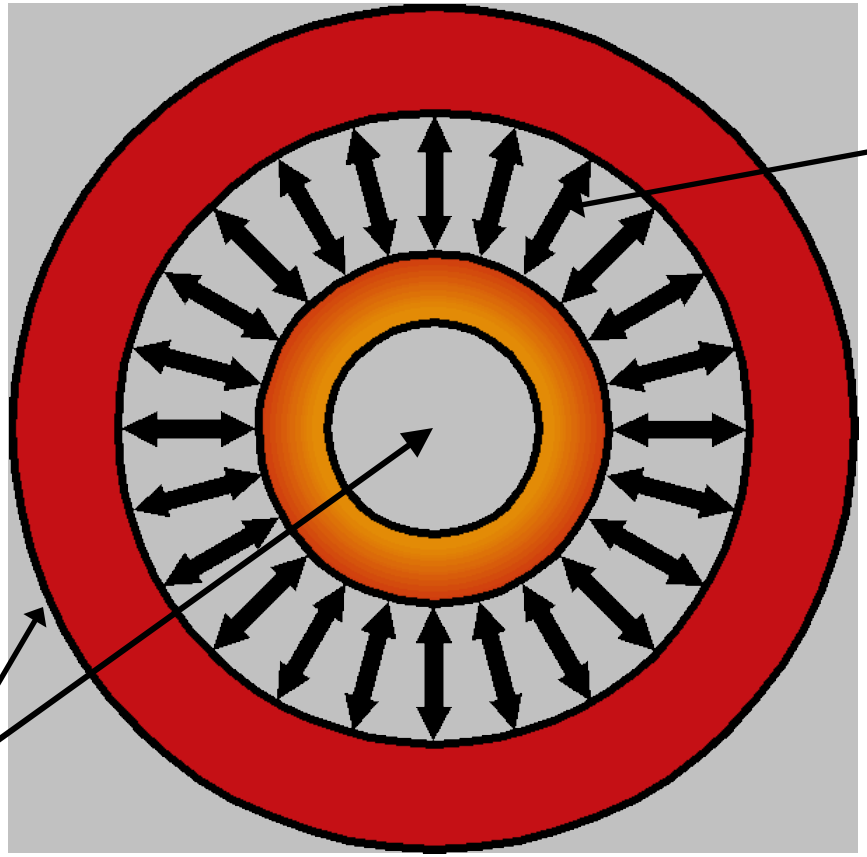
Magnetic Coupler



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Tests Performed to Evaluate Magnetic Coupler

- Electric Coils
- Perforator Detonator
- Collar Locator
- Thermal Multi-decay Logging Tool
- Memory Gauge
- Metal Shavings
- DPU
- Reservoir Monitor Tool Elite
- Firing Head
- Hostile Gamma Neutron Tool
- TEC Line
- Fiber Optics Cable

✓**15 separate tests specifically related to the Magnetic Coupler**

✓**All tools performed normally with no affects from the magnetic coupler**

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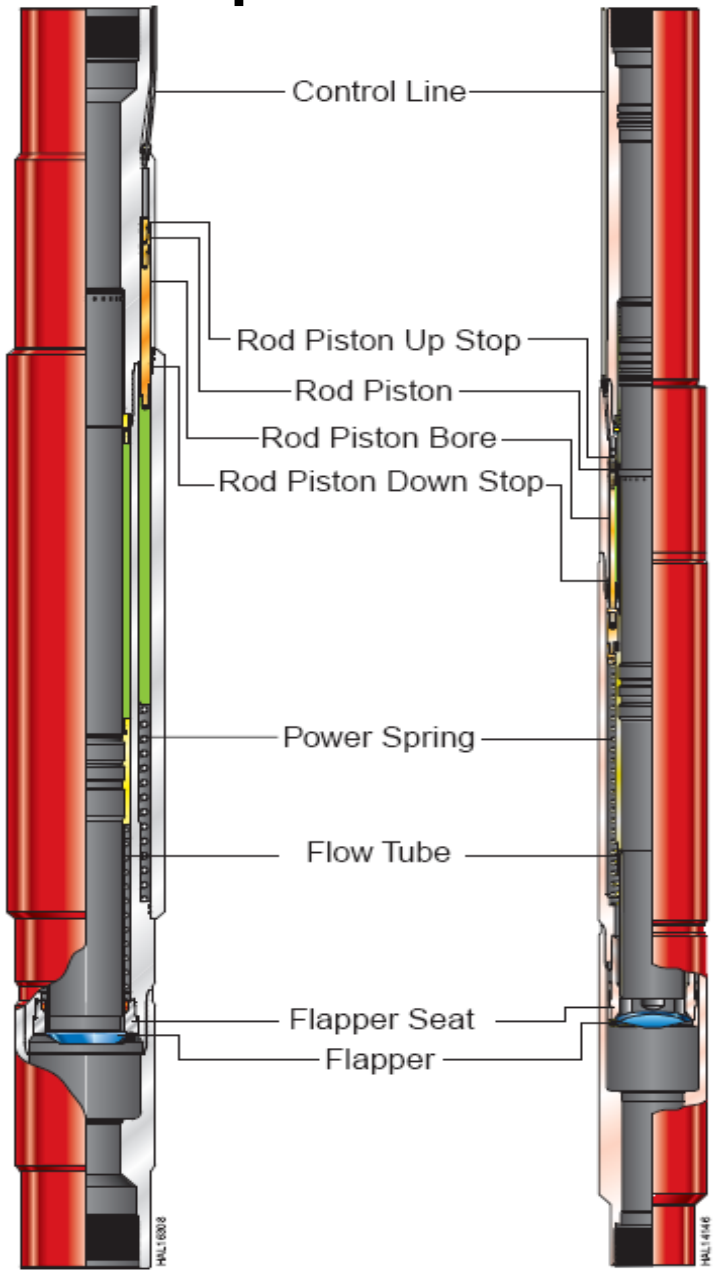
DepthStar® vs. SP™ Component View



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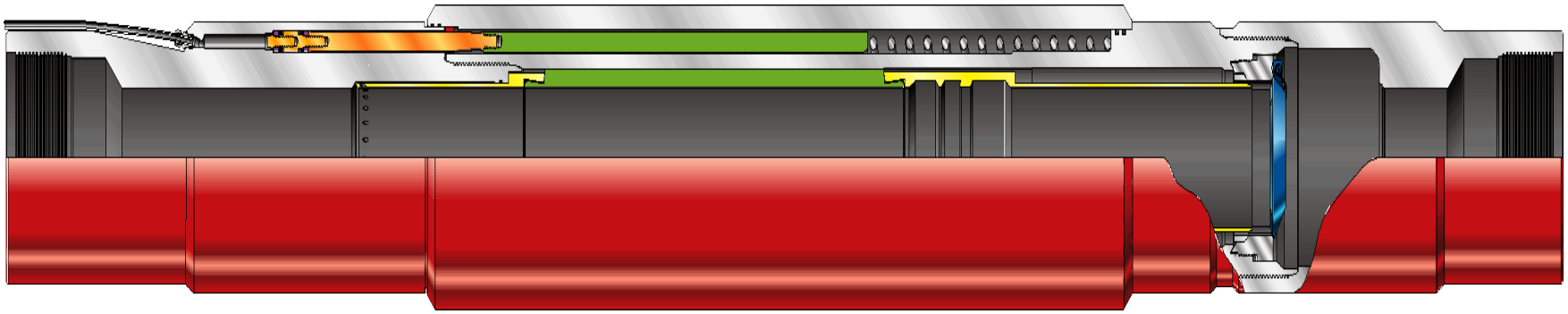
DepthStar® TRSV – A Complete Solution

- **Actuator removed from wellbore**
  - Proven SP™ Actuator
- **Enhanced reliability**
  - No moving seals and 100% MTM within wellbore
- **Low operating pressure**
  - Operates independent of depth and wellbore pressure



Winner of the Woelfel Best Mechanical Engineering Achievement, OTC Spotlight on New Technology, World Oil Best Completion Technology and Energy Institute Technology Awards

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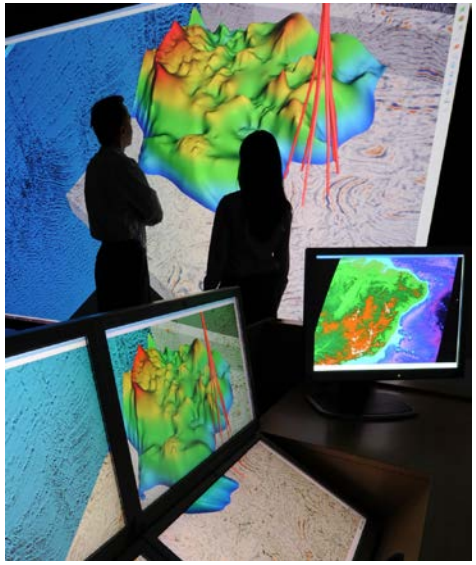

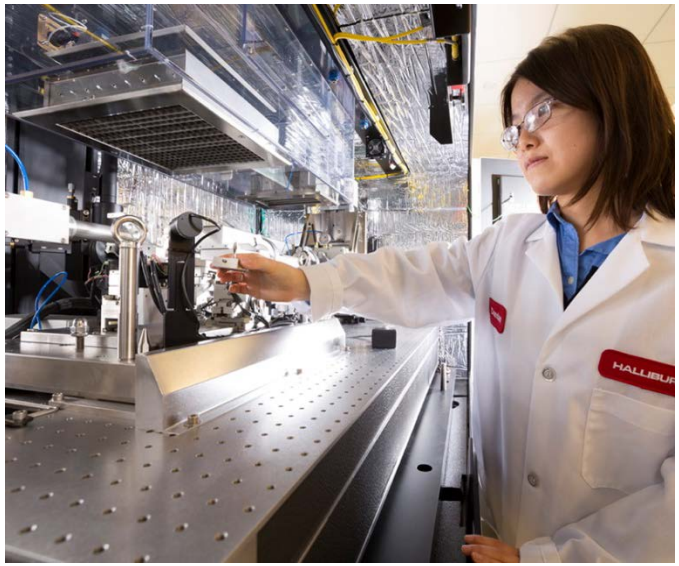

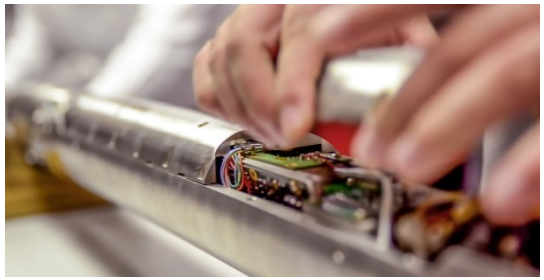

High-Performance Piston Seals

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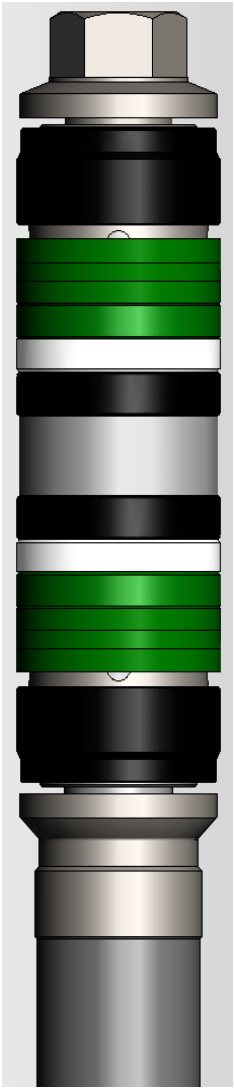
High-Performance Piston Seal

- Multi-ring non-elastomer piston seal stack qualification program
  - 50 psi to 25,000 psi gas
  - -4°C (25°F) to 232°C (450°F) temperature
  - Zero bubble performance – static and dynamic seals, and MTM seal independently verified gas tight for every valve manufactured



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Piston Seal Qualification Test Summary

Cold Temperature Test				
Test No.	Temperature	Nitrogen Pressure	No. of Cycles	Results
1	25°F (-4°C)	50 psi	90	Zero bubbles / no hyd fluid leaks
2	25°F (-4°C)	5000 psi	90	Zero bubbles / no hyd fluid leaks
3	25°F (-4°C)	25,000 psi	90	Zero bubbles / no hyd fluid leaks

Piston Seal Qualification Test Summary

Hot Temperature Test				
Test No.	Temperature	Nitrogen Pressure	No. of Cycles	Results
1	450°F (232°C)	50 psi	90	Zero bubbles / no hyd fluid leaks
2	450°F (232°C)	5000 psi	90	Zero bubbles / no hyd fluid leaks
3	450°F (232°C)	25,000 psi	90	Zero bubbles / no hyd fluid leaks

- 500+ cycles = > 40 years service
- 30 day long term pressure differential test

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Thank You

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