



# FLUID CATALYTIC CRACKING VALVE TECHNOLOGY

Robert Holian  
Director - Site Leader

TAPCOENPRO

# Global Customer Experience





# Channelview Texas Facility



We specialize in a wide variety of capabilities including valve and actuator design and manufacturing, ASME code welding, large and small CNC machining and production work, surface grinding, stress relieving, weld overlay, refractory installation and valve repair.



# Barnsley UK Facility



Onsite and in-shop repairs include welding, refractory installation and in-line machining. Our technicians are highly skilled and trained in all crafts needed to provide a high quality and “zero accident” turnaround.





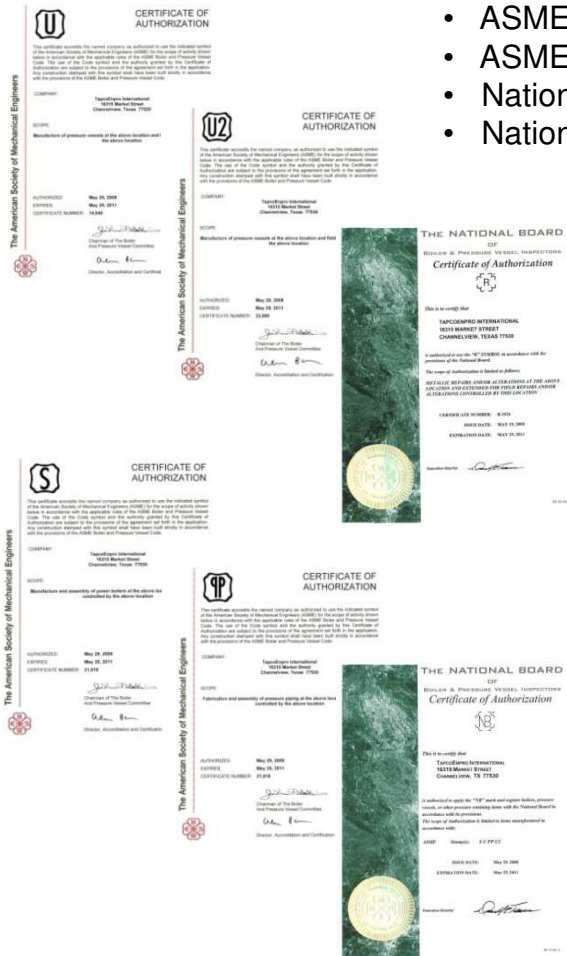
# Global Service Centers and Support Teams



Our team consists of Qualified Engineers, Mechanics And Technicians available from locations currently in the United States, Canada, England, India, Australia and Japan.

# Qualifications and Certifications

TapcoEnpro is ISO 9001:2008 certified and as a minimum we maintain the following stamps, certifications and capabilities:



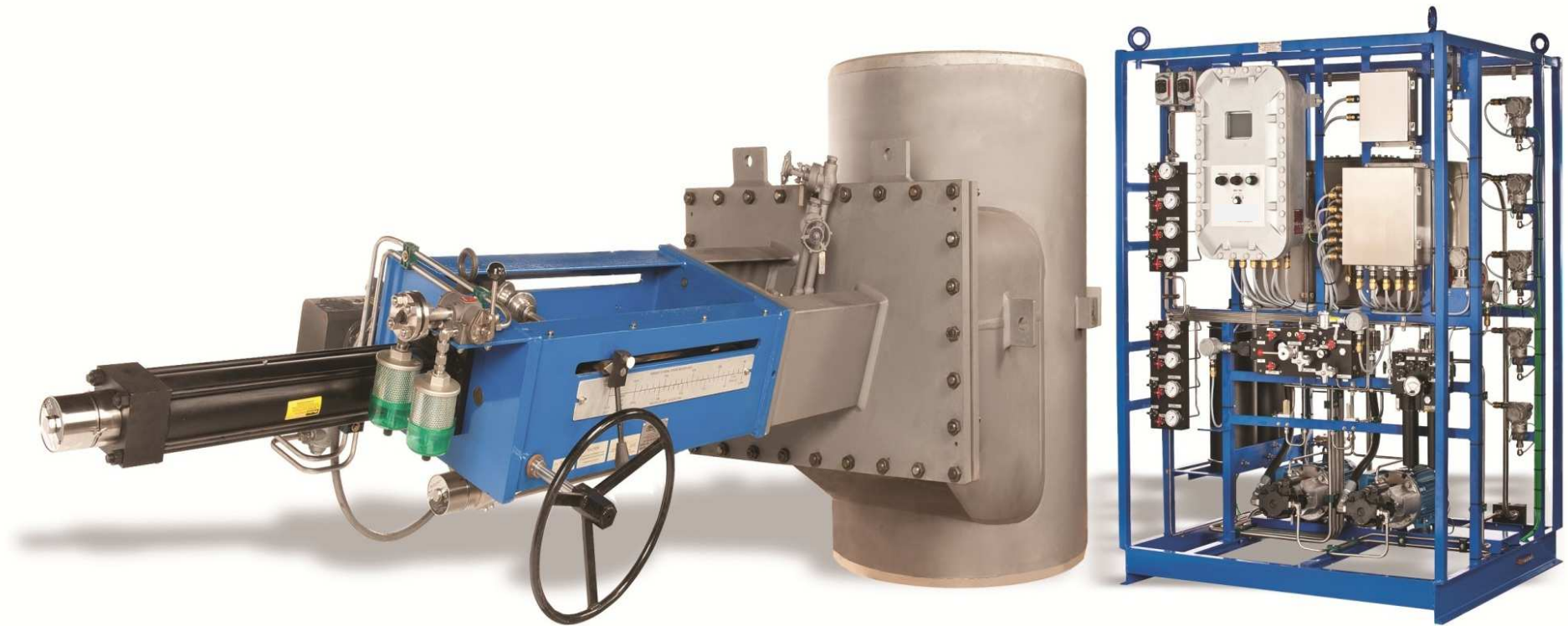
- ASME U Stamp, Division 1
- ASME U Stamp, Division 2
- National Board R Stamp
- National Board Registered
- ASME PP Stamp, Pressure Piping
- ASME S Stamp, Steam Boiler



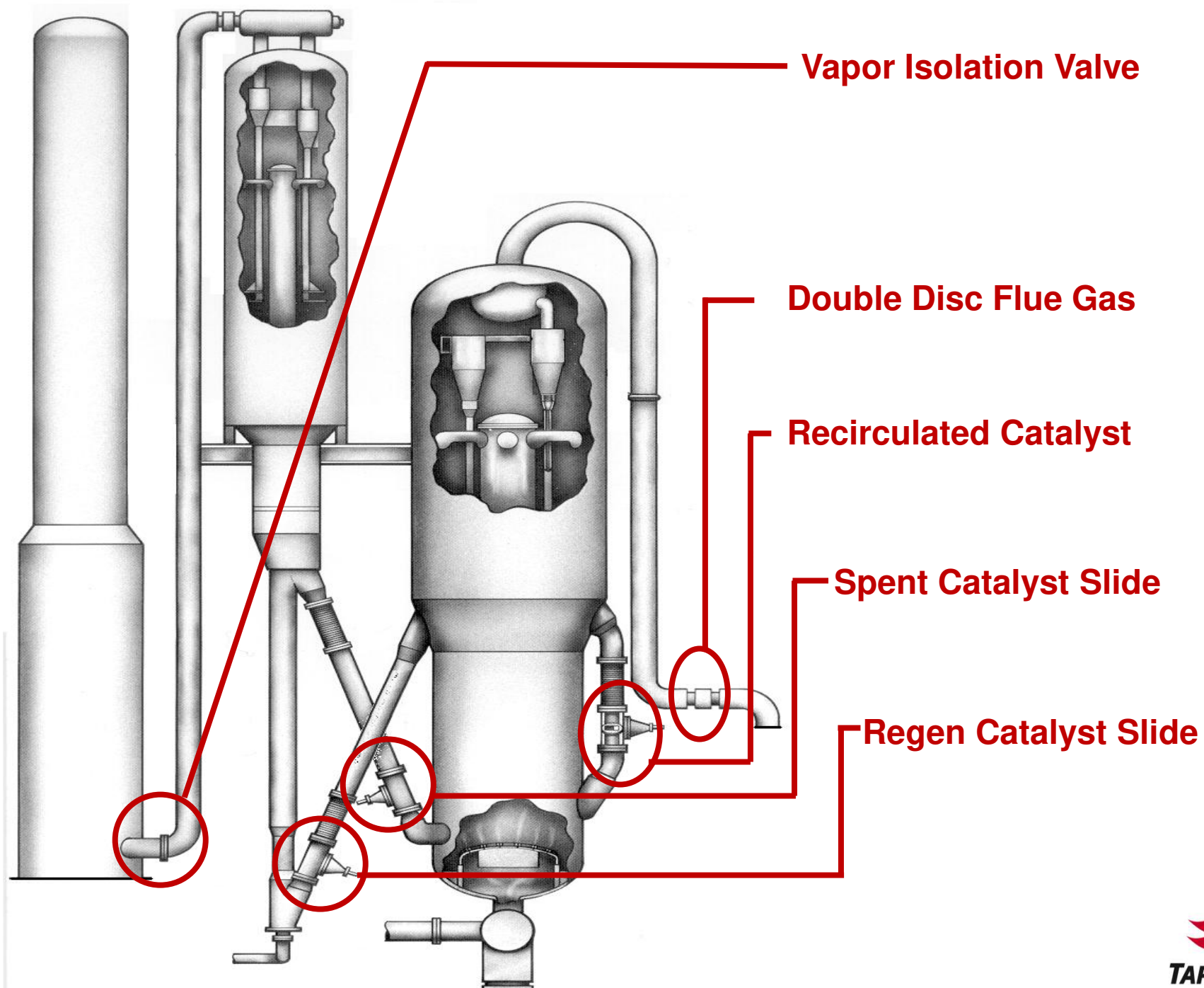
The following international requirements can be applied in addition to our standards, depending on the country where the valve will be installed.



# Slide Valves and Control Systems for Catalyst Cracking & Flexi-coker Technology



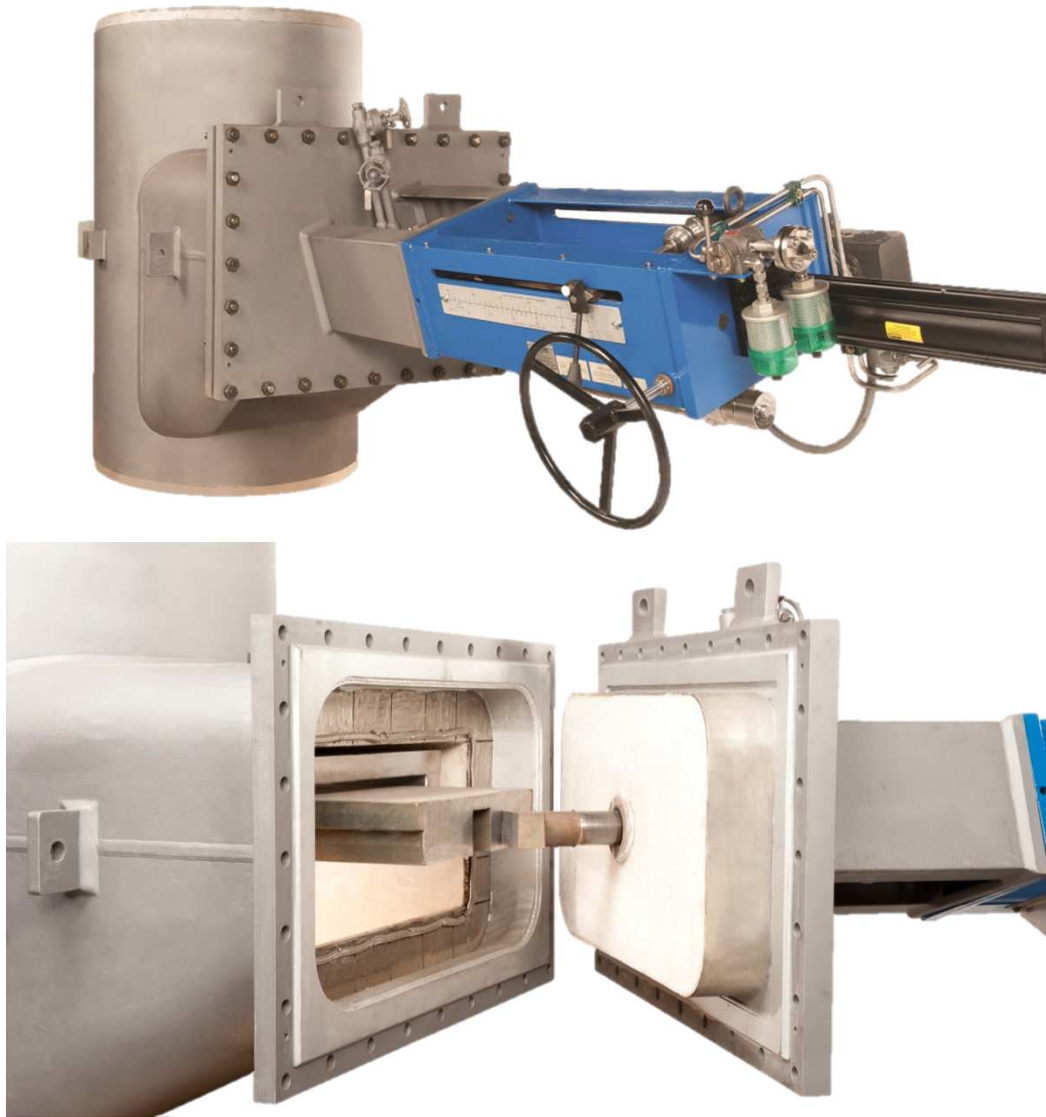
Reliability by Design and Exceptional Quality  
Ensures Customer Satisfaction from the Start.





# Catalytic Cracking Technology

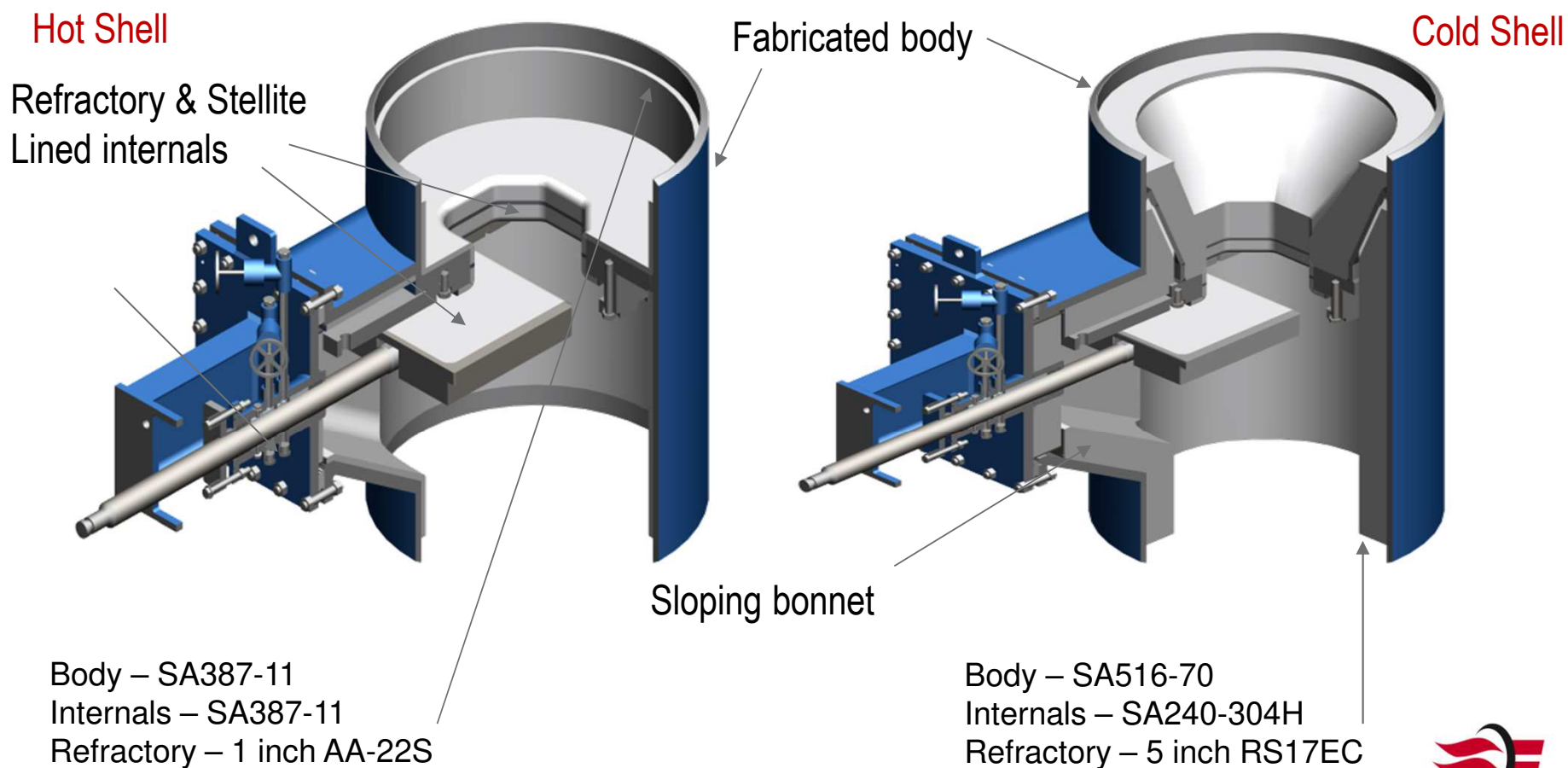
## FCC Single Disc Slide Valves



## Slide Valves

Slide valves are control valves and are identified by their location and function in the Fluid Catalytic Cracking Unit. Valves typically found on the FCCU include the **regenerated catalyst** slide valve, **spent catalyst** slide valve, **cooled catalyst** slide valve and the **recirculation catalyst** slide valve

The primary valves are the regen and spent slide valves. The regen regulates the flow of regenerated catalyst to the riser, maintains the pressure head in the standpipe and protects the regenerator from a flow reversal. The spent controls the stripper catalyst level, regulates flow of spent catalyst to the regenerator and protects the reactor and main fractionator from a flow reversal.

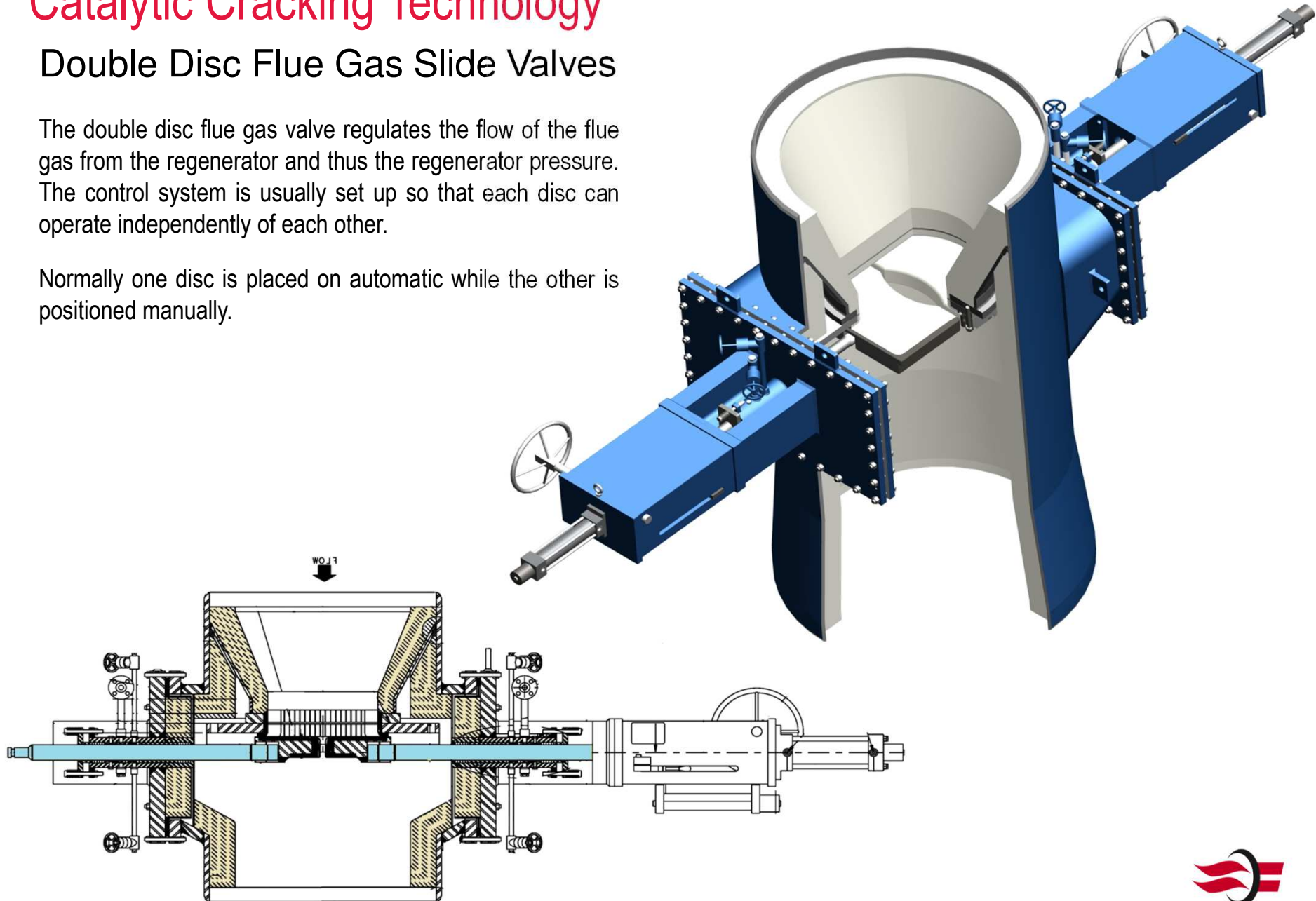


# Catalytic Cracking Technology

## Double Disc Flue Gas Slide Valves

The double disc flue gas valve regulates the flow of the flue gas from the regenerator and thus the regenerator pressure. The control system is usually set up so that each disc can operate independently of each other.

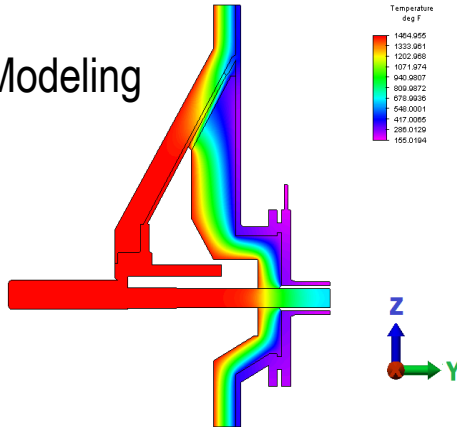
Normally one disc is placed on automatic while the other is positioned manually.



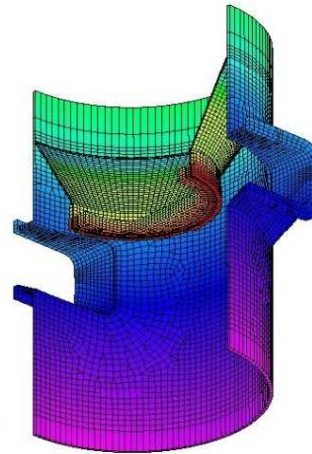


# Catalytic Cracking Technology

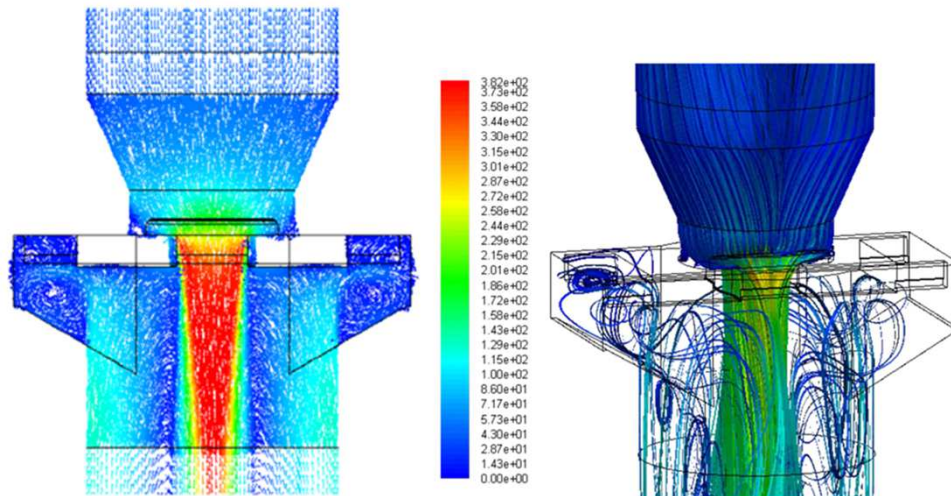
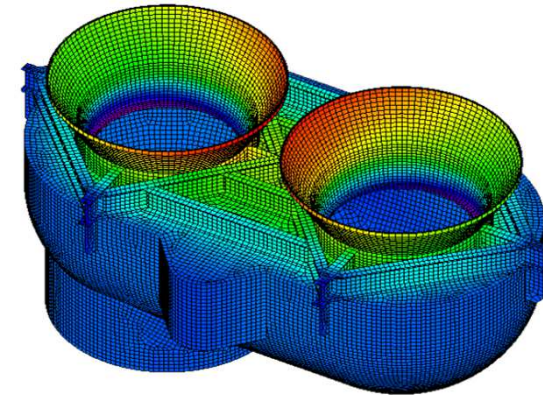
Thermal Modeling



Stress Modeling



Finite Element Analysis

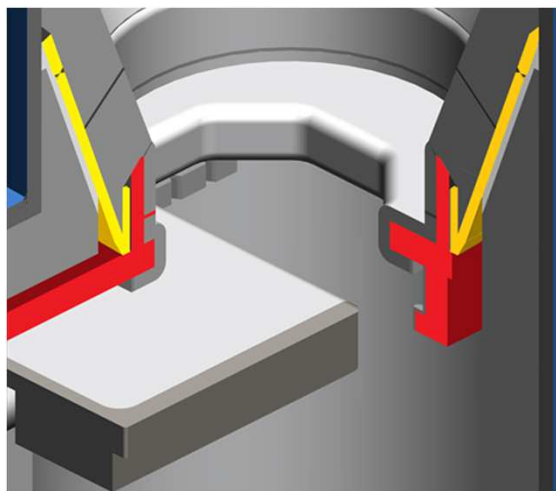


Computational Fluid Dynamics

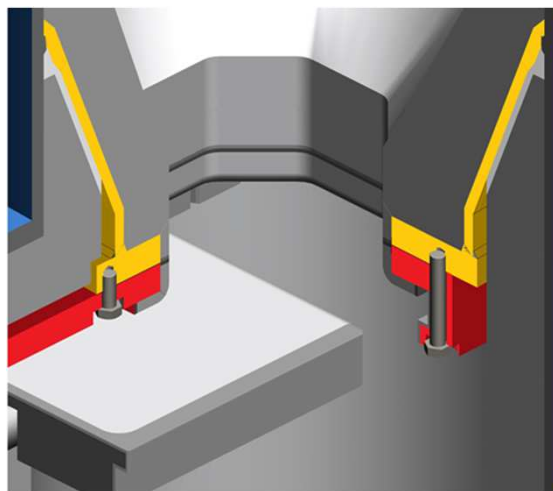
## Design Philosophy

The engineering design process at TapcoEnpro is a multi-step process which includes research, conceptualization, feasibility assessment, establishing design requirements, preliminary design, detailed design, production planning and finally production.

# Catalytic Cracking Technology – internals design



Cold Shell Bolt-less Slide Valve



Cold Shell Bolted Slide Valve

## Bolt-less Slide Valve

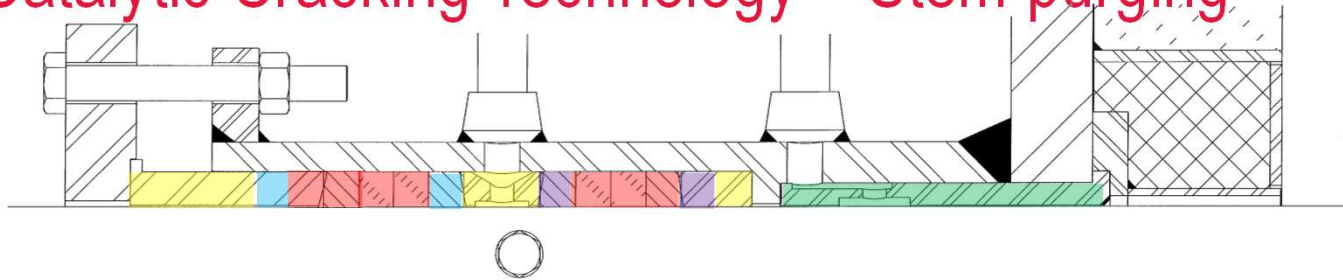
TapcoEnpro's engineering team is constantly re-inventing FCCU flow control and was the first company to develop slide valves that resist failure even under the most extreme operating conditions.

The innovative design is engineered to eliminate the loading on the internal bolting that leads to deterioration and eventual failure of the valve. Since its original patent in 1976, the Bolt-less slide valve has outperformed all others.

### Advantages over conventional slide valve designs using bolted internals:

- Boltless orifice / guide assembly is more robust and eliminates guide and orifice plate bolting.
- Forces created by the operating differential and support of the internals produce lower stress in the unitized connection
- Loads are transferred to the internal support cone and produce a lower stress across the assembly
- Internal design cold set tolerances are preset and not be disturbed by handling or field installation.
- Positive seal between seating plate and orifice plate protects against by-pass or flow erosion.
- Seal between guides and seating plate eliminated.
- Replacement of internals during a turnaround with Boltless design accomplished in less time.
- Eliminate broken bolting during disassembly due to exposure to high operating temperatures.
- Field welding and machining of gasket surfaces and tapped bolt holes is eliminated.

# Catalytic Cracking Technology – Stem purging



Purged Stuffing Box

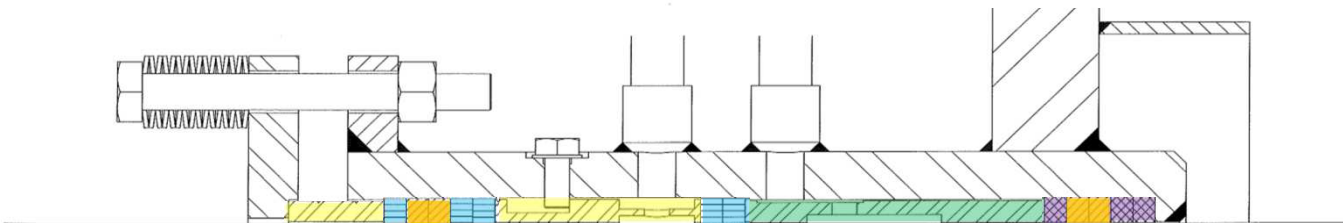
John Crane 1625G

John Crane 235

304 Stainless

Chesterton 1601

Nitronic 60



Static Purge Stuffing Box

John Crane 1625G

John Crane 237

304 Stainless

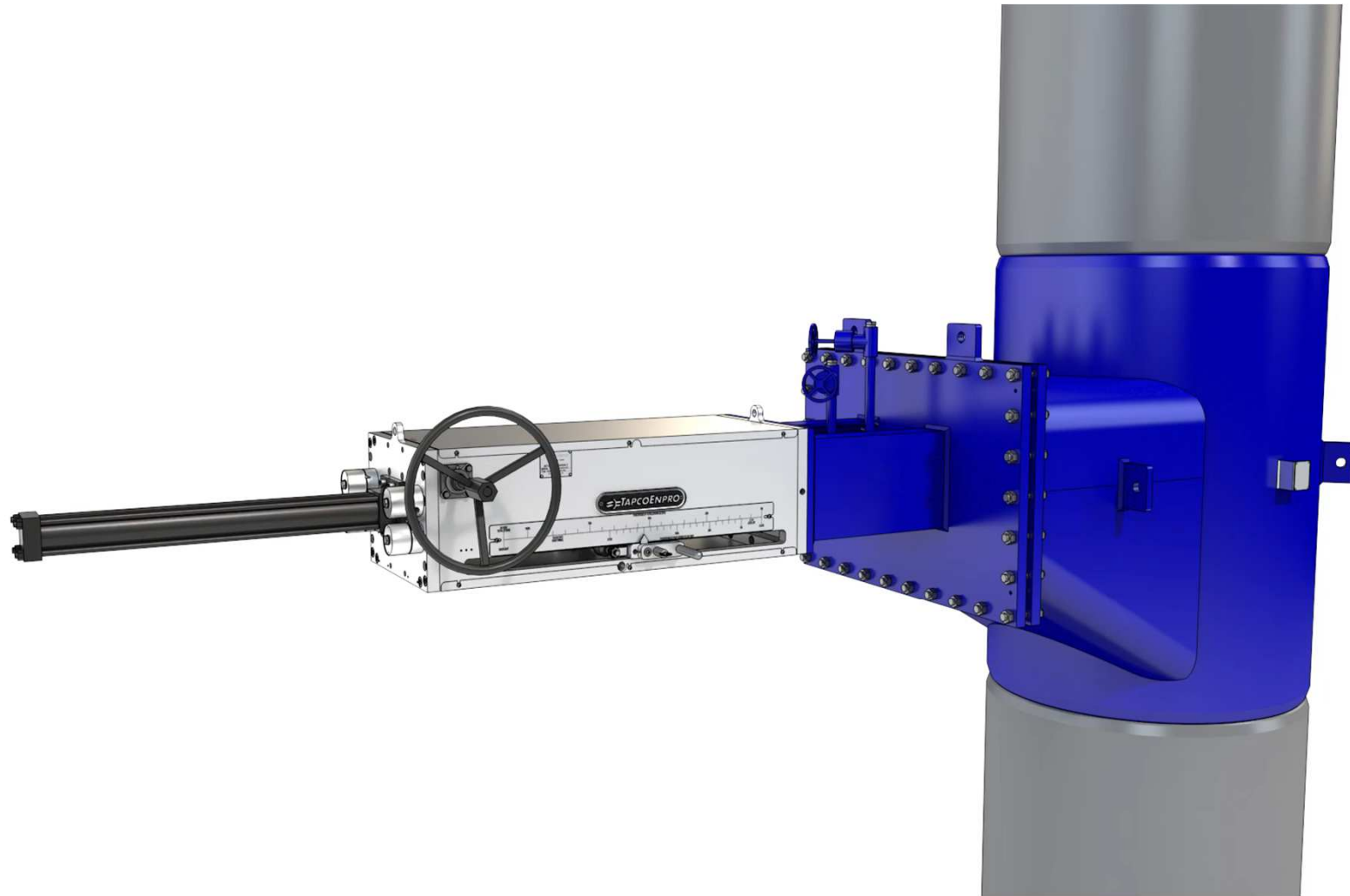
Chesterton 1601

Nitronic 60



# Fluid Catalytic Cracking Technology

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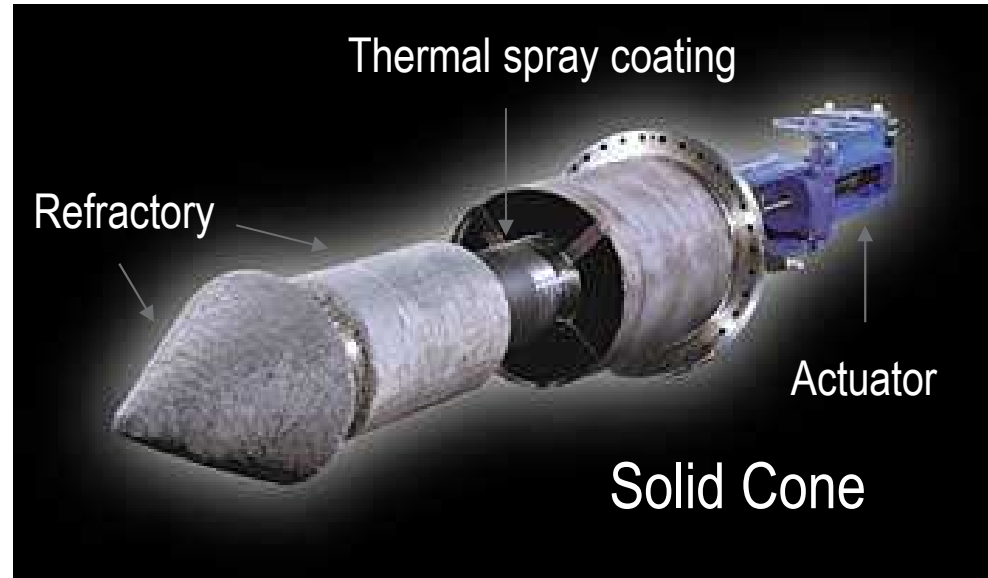


**Cold Shell Bolted and Bolt-less Slide Valve Comparison**



# Catalytic Cracking Technology – plug valves

Stone & Webster  
Axens  
Kellogg Brown & Root  
  
FCC Plug Valves



Hollow Cone

# Catalytic Cracking Technology

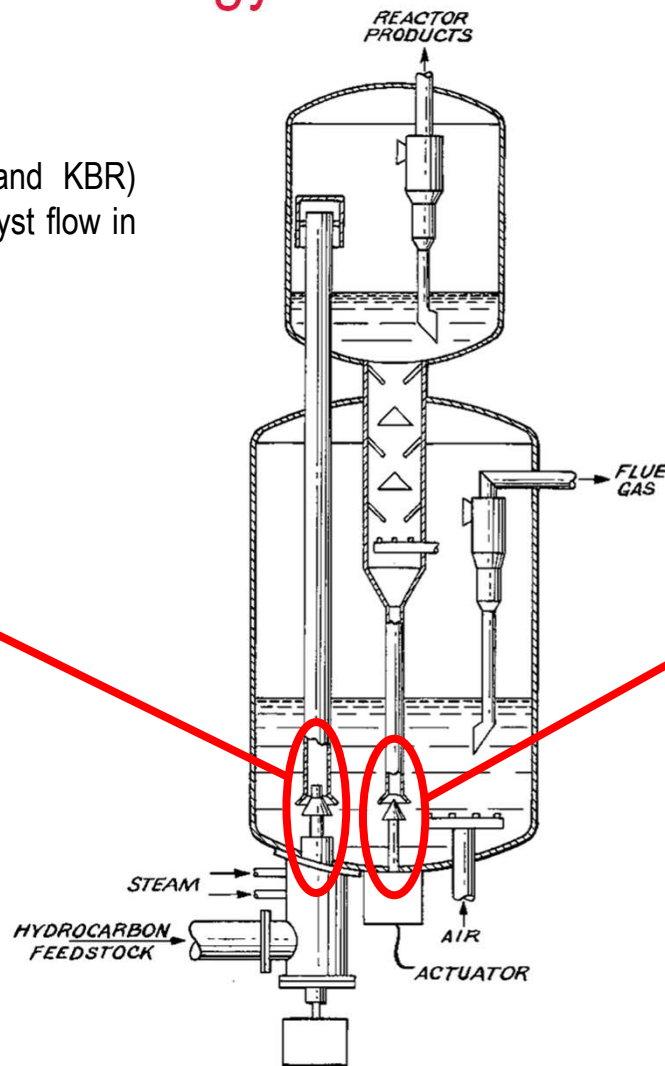
## Catalyst Plug Valves

Several licensors (Axens, Technip and KBR) utilize plug valves to control the catalyst flow in their units in lieu of slide valves.

Patented Internal  
Check valve.  
Protects Guide tube  
Against blockage



Hollow Tube  
Plug Valve



Solid Cone Plug Valve

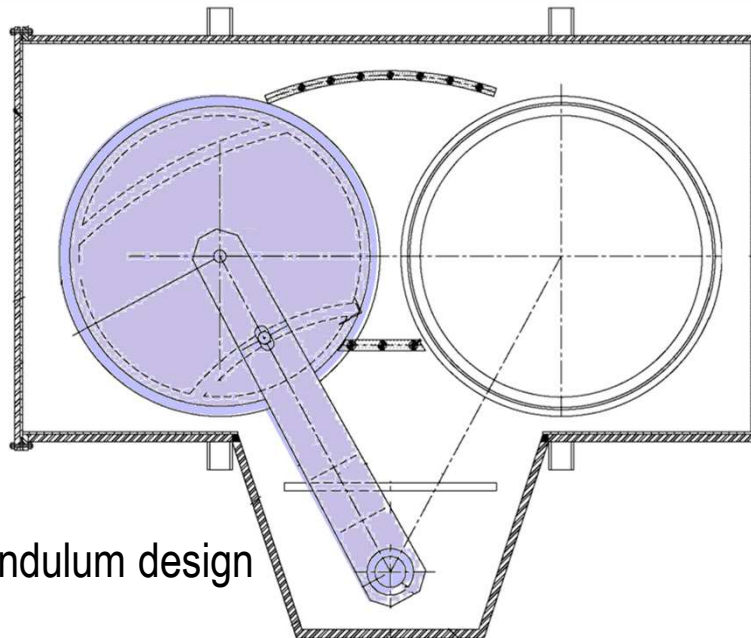


# Catalytic Cracking Technology

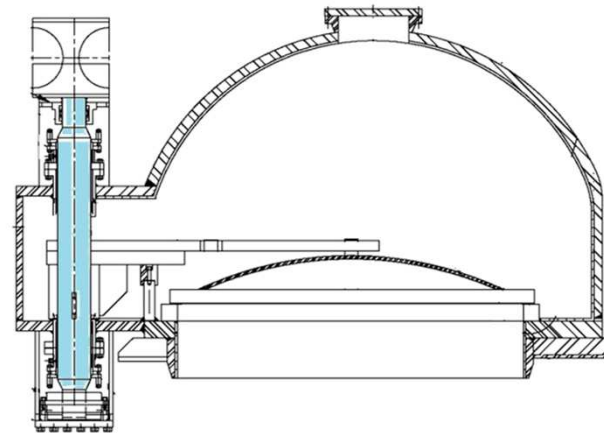
## Flue Gas Diverter Valves

In normal operations, after the double disc valve, flue gas stream is sent through the CO Boiler (the CO boiler generates steam from the existing flue gas temperature level) to the electrostatic precipitator (the electrostatic precipitator is responsible for filtering out catalyst fines before moving through the stack and into the atmosphere).

Other operations include third stage separators and power recovery systems (expanders) and would require a diverter valve to divert flow during normal operation and turnarounds.

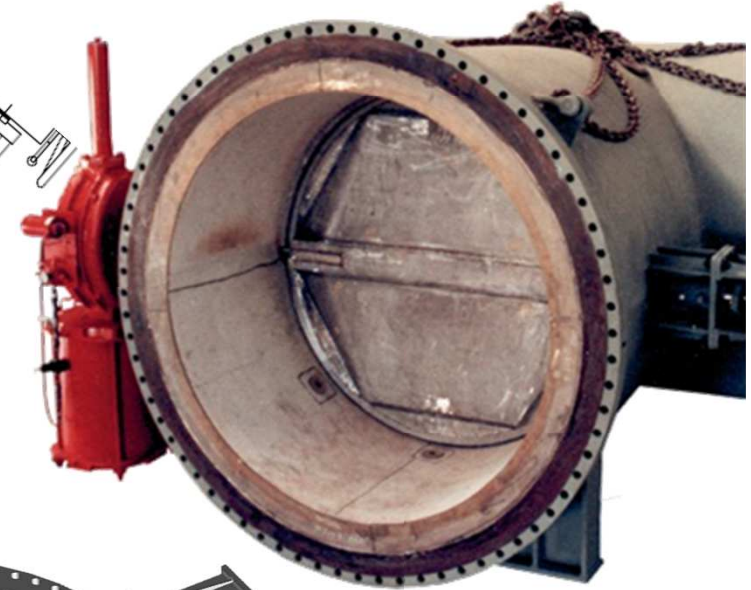
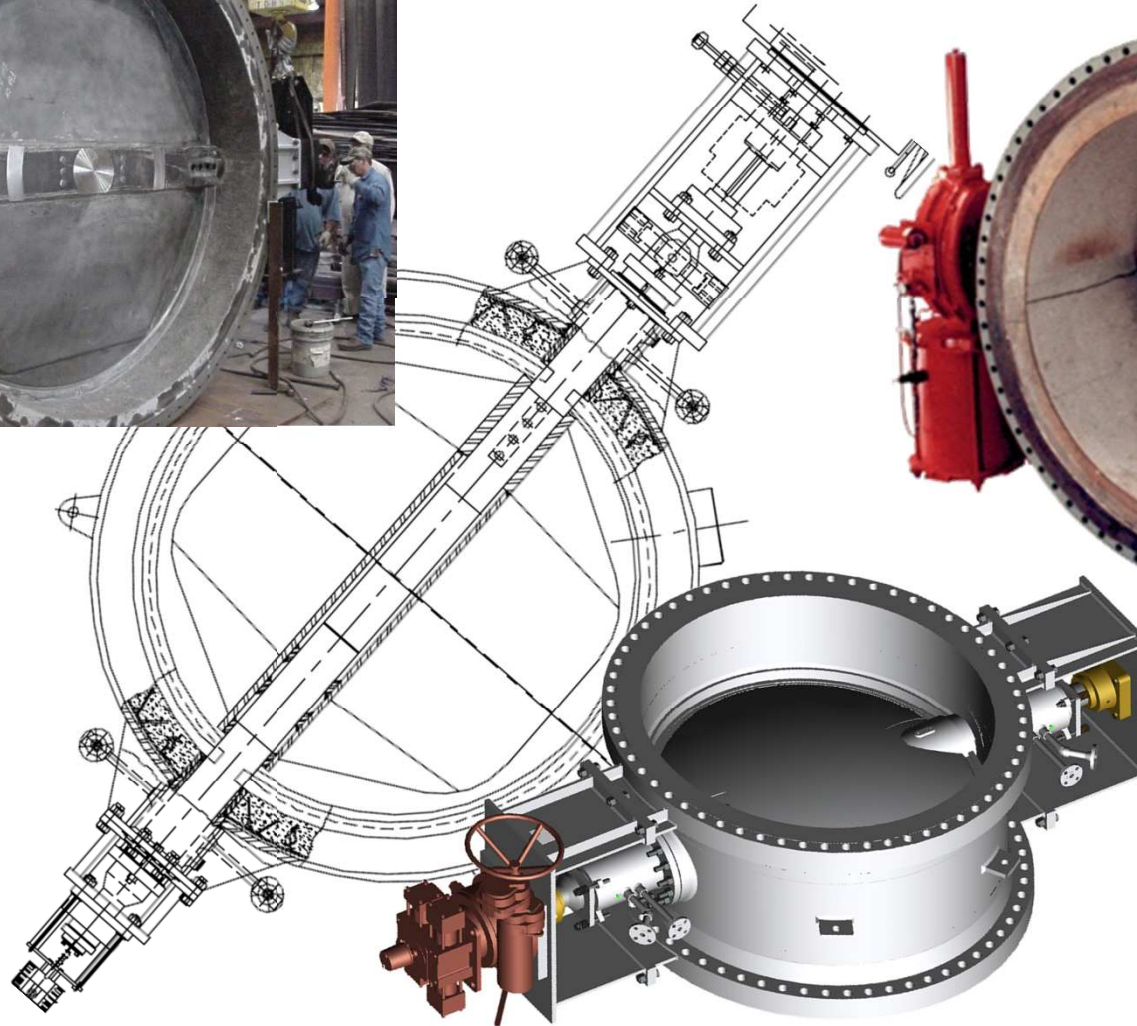


Pendulum design



# Catalytic Cracking Technology

## Expander and Flue Gas Butterfly Valves



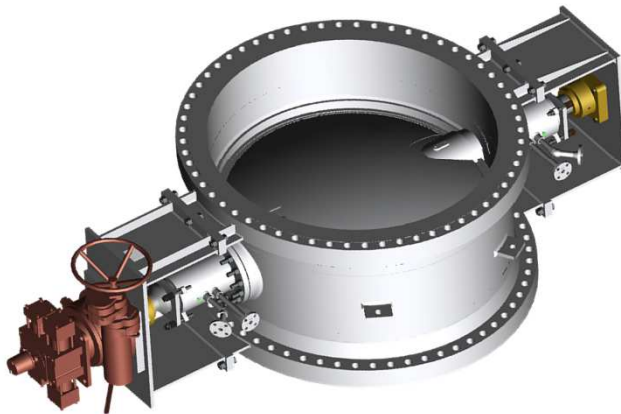


# Butterfly Valves

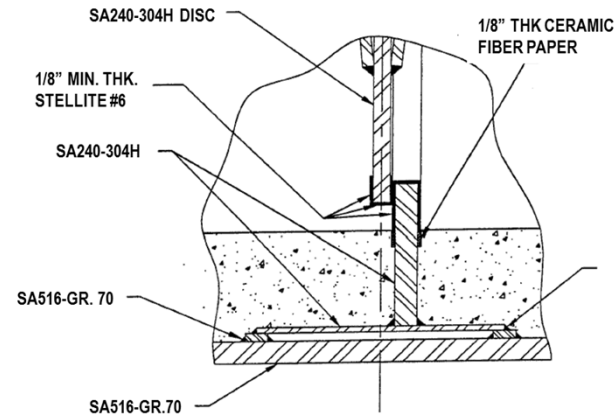
Butterfly Valves provide Flue Gas control by means of throttling or shut off and in either Cold and Hot Shell designs.

Applications include:

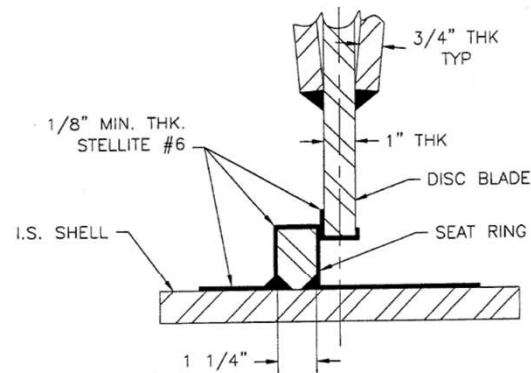
- Expander Inlet Service
- Expander By-Pass Service
- CO Boiler Isolation
- Waste Heat Boiler Isolation
- Flue Gas Diversion
- Flue Gas Isolation



## COLD SHELL SEAT DESIGN



## HOT SHELL SEAT DESIGN





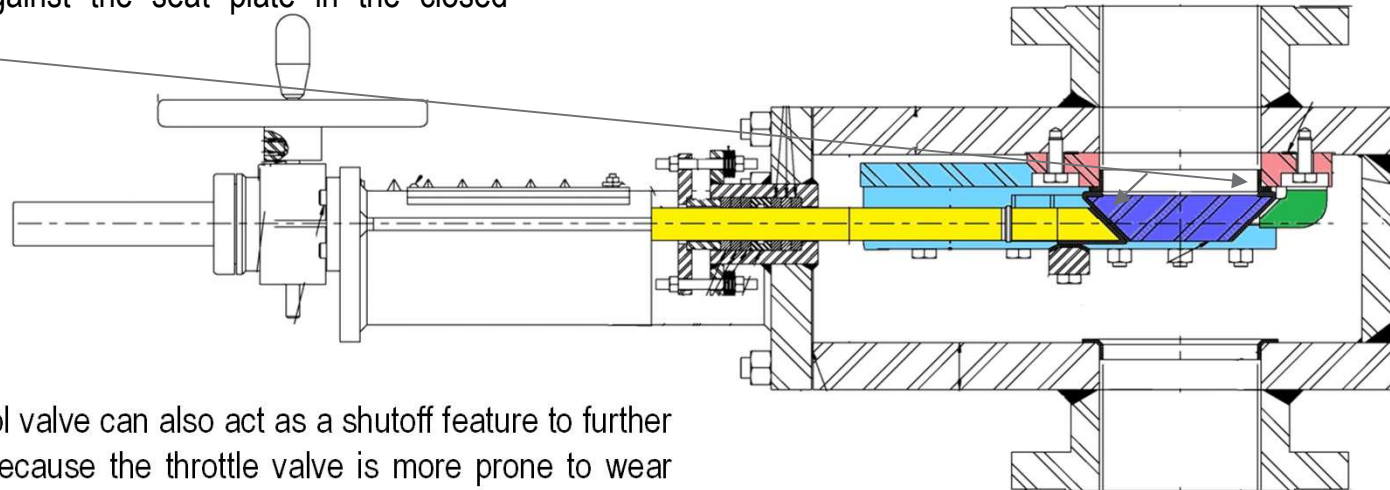
# Catalyst Withdrawal Valves

Conventional valves have had limited resistance to erosion conditions that occur when catalyst goes from ambient temperatures to 1300 degrees. To deal with the problem, refineries have been stacking and replacing valves frequently, even before scheduled turnarounds, in a make-shift effort to withstand the distortion and erosion caused by extreme variations in catalyst temperature and thermal shock.

The control valve, mounted in-line down- stream, throttles the catalyst until the desired amount has been withdrawn. The stem knuckle and the nose of the disc are tapered to lift and torque seat the disc against the seat plate in the closed position.



- Disc
- Guides
- Orifice Plate
- Disc Wedge
- Stem



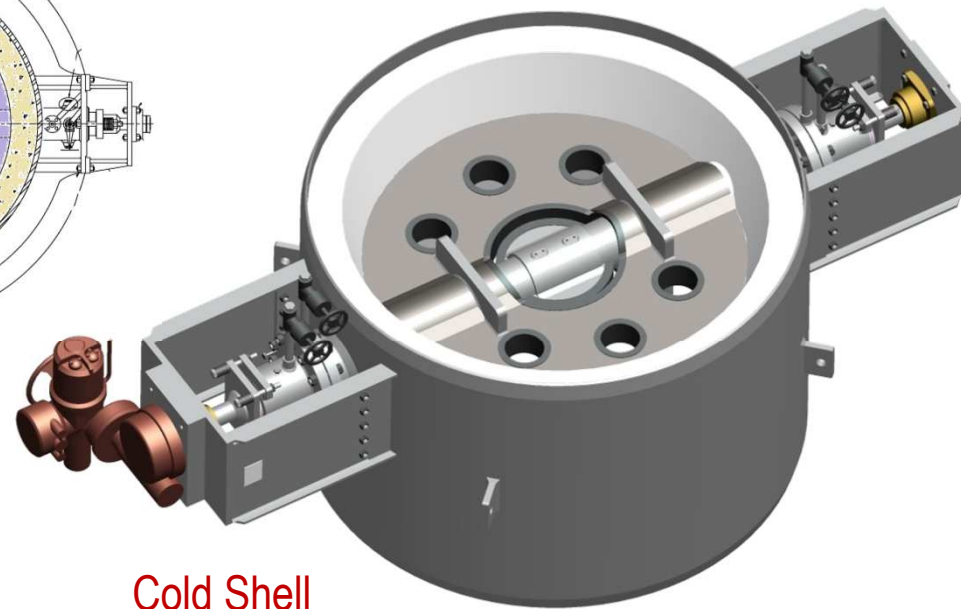
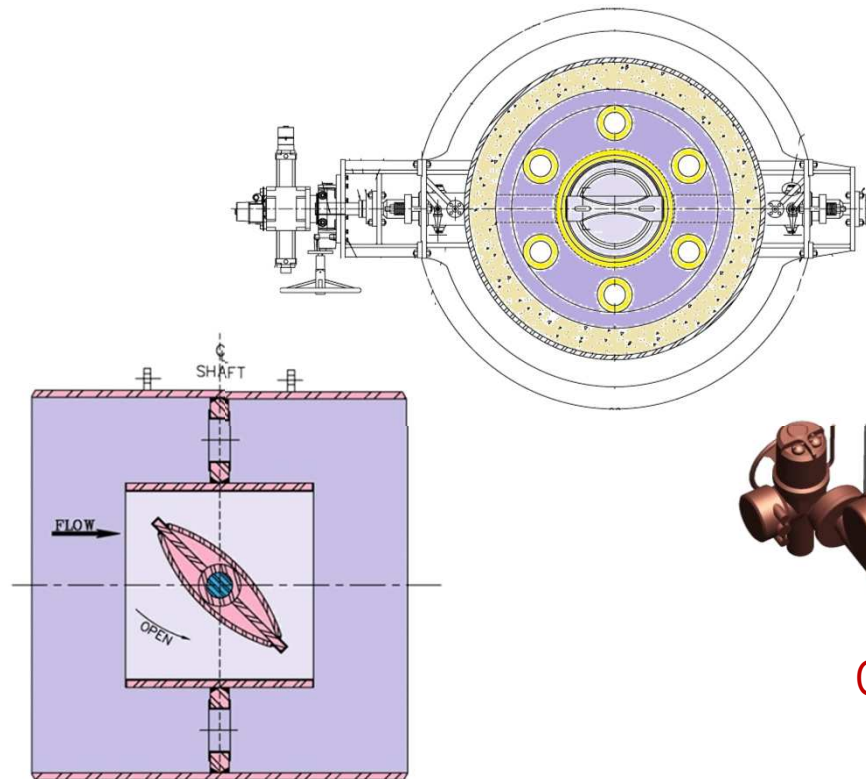
In this position, the control valve can also act as a shutoff feature to further enhance flow control. Because the throttle valve is more prone to wear than any other valve in the catalyst withdrawal system, TapcoEnpro has designed the valve with replaceable internal parts. The replaceable internal parts extend the life of the control valve body through several turnarounds and allows reconditioning of valve internals during the turnaround.

# Variable Orifice Valves

The need to achieve pressure control is available by the use of variable orifice valves in lieu of conventional orifice chambers. The disadvantage of fixed orifices is that pressure control and/or sound attenuation is achieved only at a constant flow rate. However, since refineries operating conditions are seldom uniform and therefore experience variable internal flow rates and pressure fluctuations, a variable orifice design is highly advantageous to accomplish optimum results.



Hot Shell

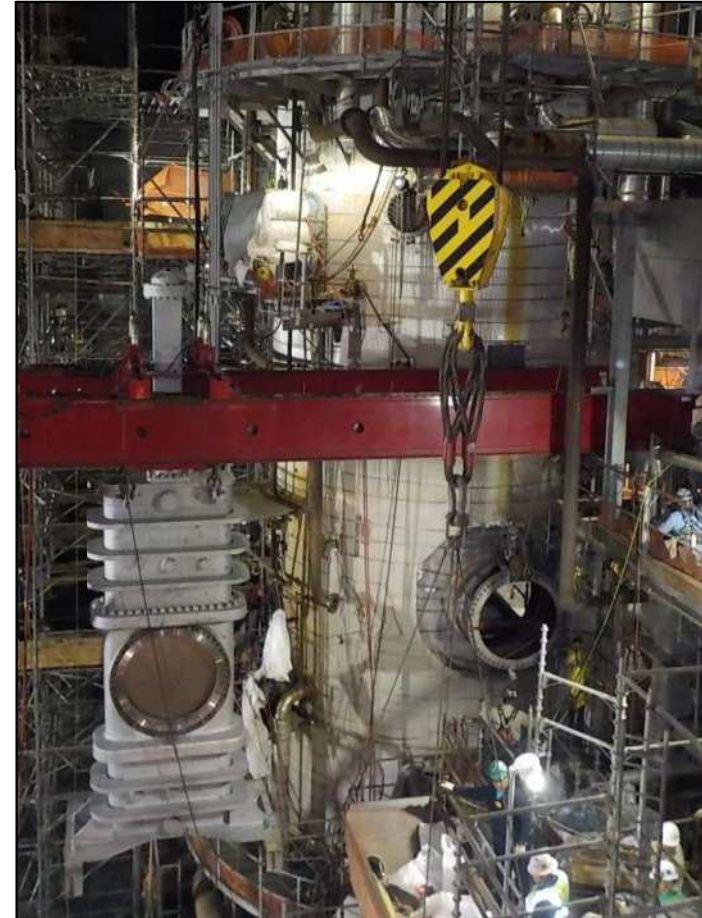
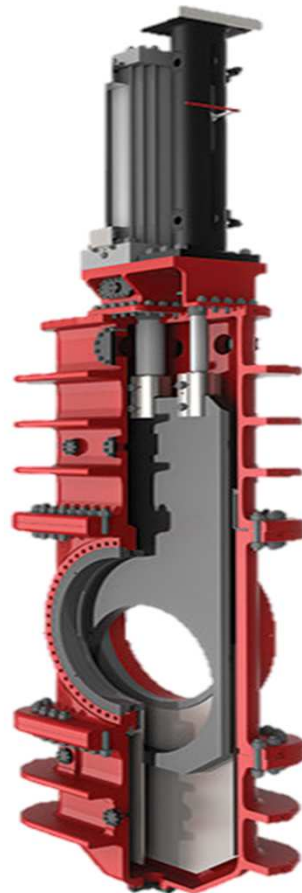


Cold Shell



# FCCU Reactor Isolation Valves

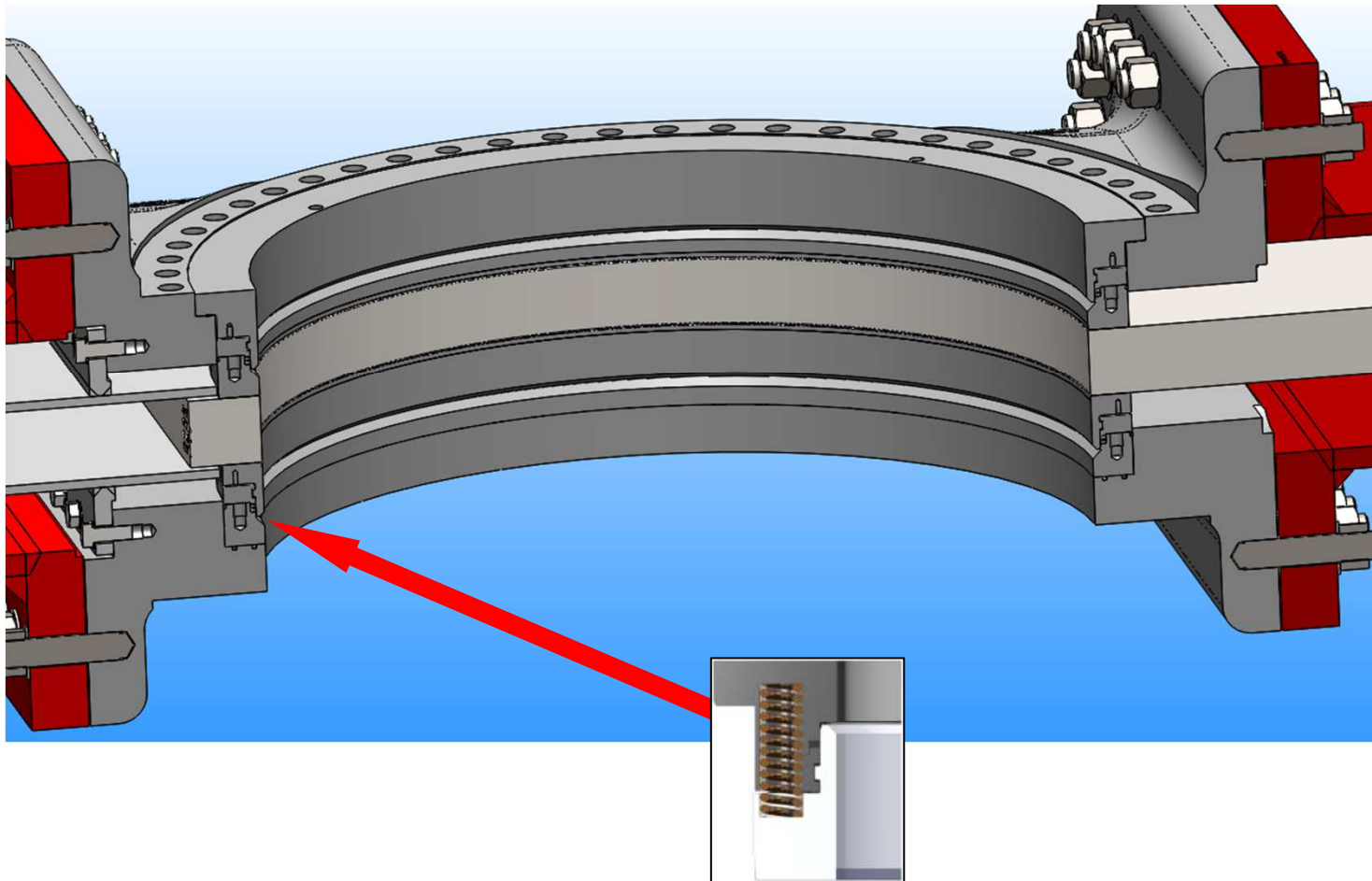
Chevron Pascagoula Installation – March 2016





# FCCU Reactor Isolation Valves

- Proven dual-live-loaded bi-directional flow seating technology
- Provides a safer operator environment for isolation of a hazardous environment
- Allows for shorter restart timelines and faster more efficient shutdowns
- Capable of sitting idle for 3 to 6 years and then operate smoothly



# Turnaround Services

Worldwide Assistance Within Hours



Field Installation and Repair



# Turnaround Services

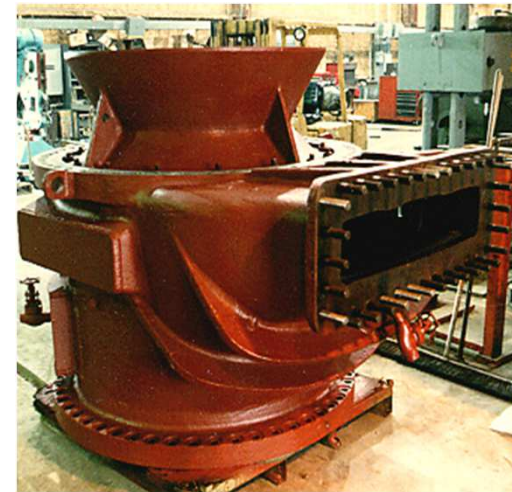
Before



After



Shop Repair and Modification



Complete valve overhaul



# Turnaround Services

## After the Turnaround...

There's no better or more efficient way to handle valve maintenance, troubleshooting or possible repair than having your own people do the job on the spot, within your own facility. And there is no better way to train them for this vital function than having them attend a TapcoEnpro maintenance seminar held at your plant immediately following the turnaround while all events are still current.



**Operators**



**Instrument Techs**



**Mechanics**



Thank You

Questions?

