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Session ID: 2-1657
Zero Plant Trip in ADNOC's Delayed Coker Refinery with Double Eccentric Ball Valve

Speakers Names: *Abdulla Al Hammadi (ADNOC , Technology Advisor Manager)*

Viswanathan KN (Emerson Isolation Valves- Regional Manager)

Magdy Helmy (Emerson Isolation Valves- Key Account Manager)

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Inquiries should be directed to:
EmersonExchange@Emerson.com

Agenda

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Magdy Helmy	Key Challenges in Refining and Delayed Coker unit
Magdy Helmy	Legacy Gate Valve Design Limitation
Viswanathan	Emerson Engagement and Solution
Viswanathan	Advance Engineering Valve (AEV) Principle and Design
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Presentation Summary

*How ADNOC Refining achieves **Improved Plant efficiency in Coke Calcination Unit, Delayed Coker(CBDC) with Double Eccentric Cavity Free Ball Valve** (Emerson AEV) as replacement of Legacy Gate Valve.*

ADNOC Refining

ADNOC Refining is a subsidiary of the Abu Dhabi National Oil Company (ADNOC), responsible for refining crude oil and producing various petroleum products.

Capacity: 900,000 barrels per day (bpd).

Products: Fuels , LPG and Petrochemical Feedstocks.

Year of Establishment : 1999

ADNOC Refining Overview

Ruwais Refinery 1

- Crude Distillation Unit. (CDU)
- Clean Fuels Project (CFP)
- Residue Fluid Catalytic Cracking (RFCC)

Ruwais Refinery 2

- Carbon Black Delayed Coker (CBDC)
- Propane Dehydrogenation (PDH) Reaction section
- Propane Dehydrogenation (PDH) Fractionation.

Ruwais Refinery 3

- RRE Condensate
- RRE Gasoline
- RRE Hydroskimer (HSK)
- RRE Hydro Cracker (HCK)
- RRE Green Diesel Plant (GDP)
- RRE Base oil Unit (BOU)

• Carbon Black Delayed Coker (CBDC):

The **Carbon Black Delayed Coker (CBDC) located in RR2** is a specialized refinery unit that **processes heavy residual oil into carbon black feedstock and valuable petroleum coke**. It operates under high temperatures and pressures in a delayed coking process, breaking down heavy hydrocarbons into lighter fractions while producing solid carbon black and coke as byproducts.

Overcoming Valve Failures – ADNOC's Journey to a Reliable Solution

ADNOC Challenges

ADNOC faces Corrosion, Impact in asset integrity, energy loss due to valve passing and maintenance difficulties in high-pressure steam valves

Emerson Engagement

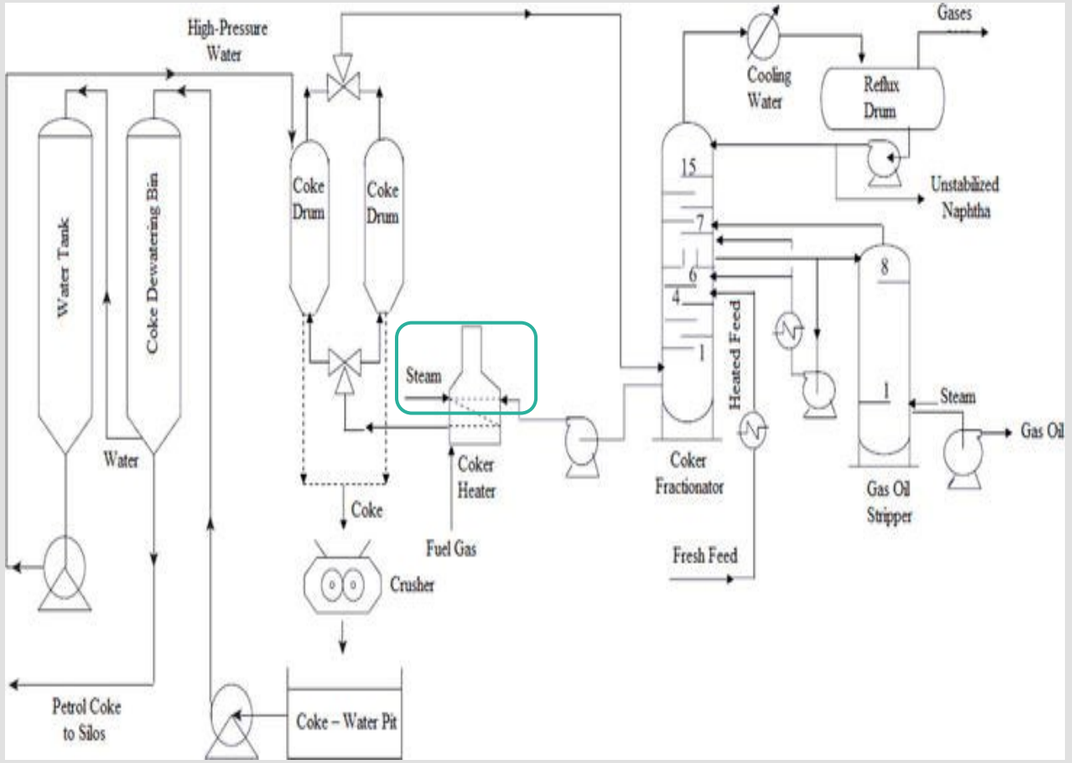
Emerson's strong engagement and technology training add value by supporting STO maintenance, boosting process efficiency, improving reliability, and driving OpEx savings through the adoption of advanced industry technologies.

Outcomes

The AEV valve installation improved safety, efficiency, and reduced maintenance costs, prompting ADNOC Refining to consider upgrading legacy gate valves to AEV.

Challenges with Existing Double Disc Gate Valves

- **Frequent Failures** – Existing double disc gate valves in high-pressure, high-temperature steam applications suffer from **sticking, actuator coupling damage, and heavy vibration** due to design limitations which cause a frequent failure.
  - ➢ Operation Impact: Warrants to use By-pass manual isolation valves. Impacts Operation efficiency.
- **Seat Binding**– **Continuous rubbing at high temperatures** leads to seat binding, compromising shaft and seat integrity, reducing valve performance, and increasing operational and safety risks.
  - ➢ Operation Impact: Passing, Loss of steam energy, corrosion of assets.
- **Maintenance Challenges** – The valves face **difficulties with online maintenance**, recurring costs, and inability to achieve reliable bi-directional shutoff with metal seats.
  - ➢ Operation Impact: Lowers Operation efficiency, OpEx spend, loss of energy.



Typical Delayed Coker and Calcination Unit Block diagram

Typical Double Disc Gate valve failure

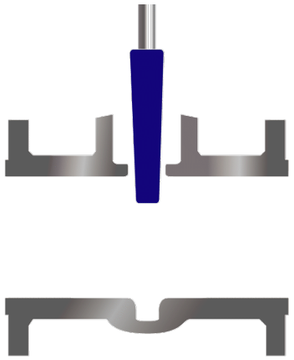
Legacy Gate Valve Design Limitations

- Due to excessive emissions, restrictions on tight shut-off capabilities, and limitations on unidirectional service resulting from cavity relief, progressive ADNOC are moving away from rising stem and gate isolation valves.

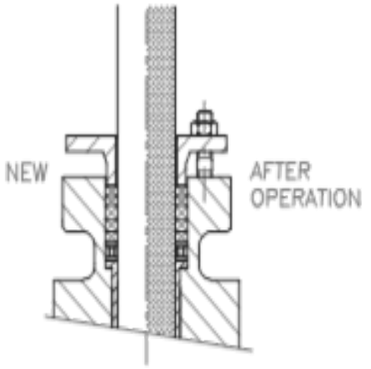
DISADVANTAGES

- Continuous Rubbing while opening & closing.
- Stem tends to extrude packing during every Opening & closing operation.

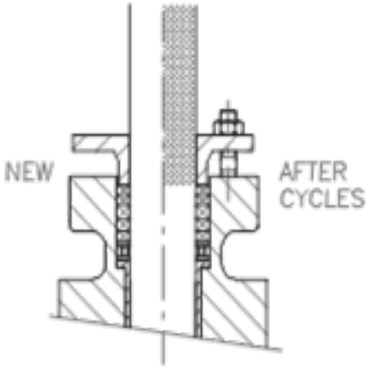
Gate



Linear



Rotary

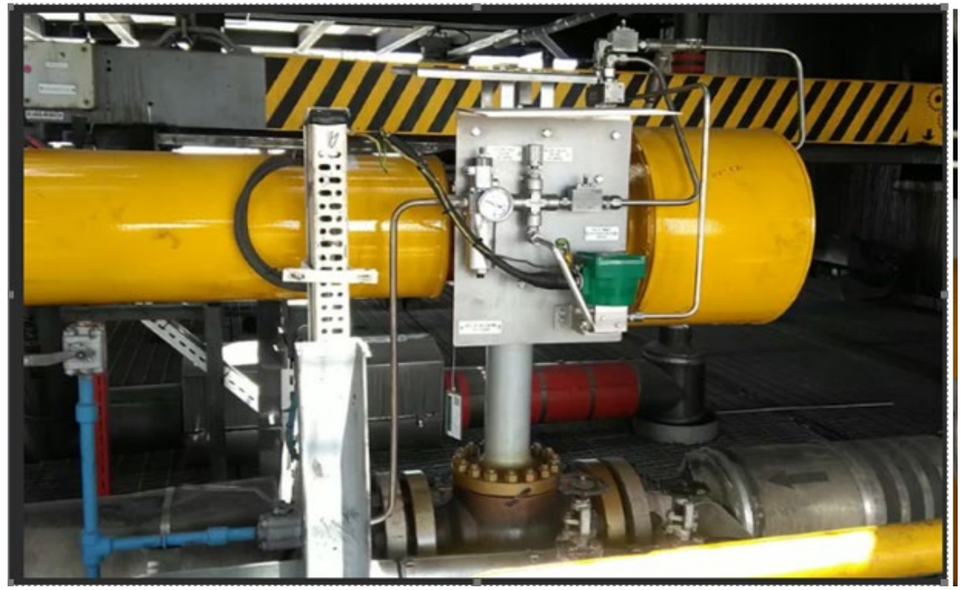


Main function: Isolation

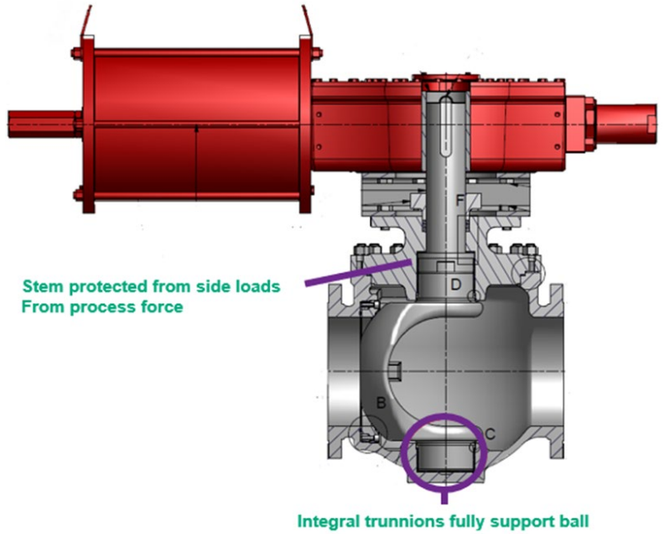
Temperature gradients will affect the wedging angle and increase the risk of jamming

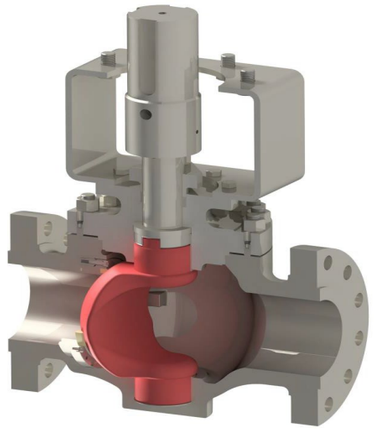
Emerson Implemented AEV 2XC Solution

- **Cavity-Free Design**: Eliminates rubbing, preventing wear and extending valve life.
- **Bi-Directional Zero-Leak**: Meets ISO 5208 Rate ‘A’ standards for superior sealing with Fixed seat
- **Easy Maintenance**: Eliminates particles buildup and simplifies servicing. Top Entry design supports inline maintainance.
- **Metal Seated** : Designed to withstand high-temperature conditions, inherent firesafe and TSO.
- Ultra Low Emission Packing : Advanced Live Loaded packing system meets **ISO 15848 ‘AH’**
- Enhanced Performance: **Torque seated design** C-ball valves improves the reliability and contributes for plant availability.
- Complies to SIL3 and Prototype tests such as Shell DVT.

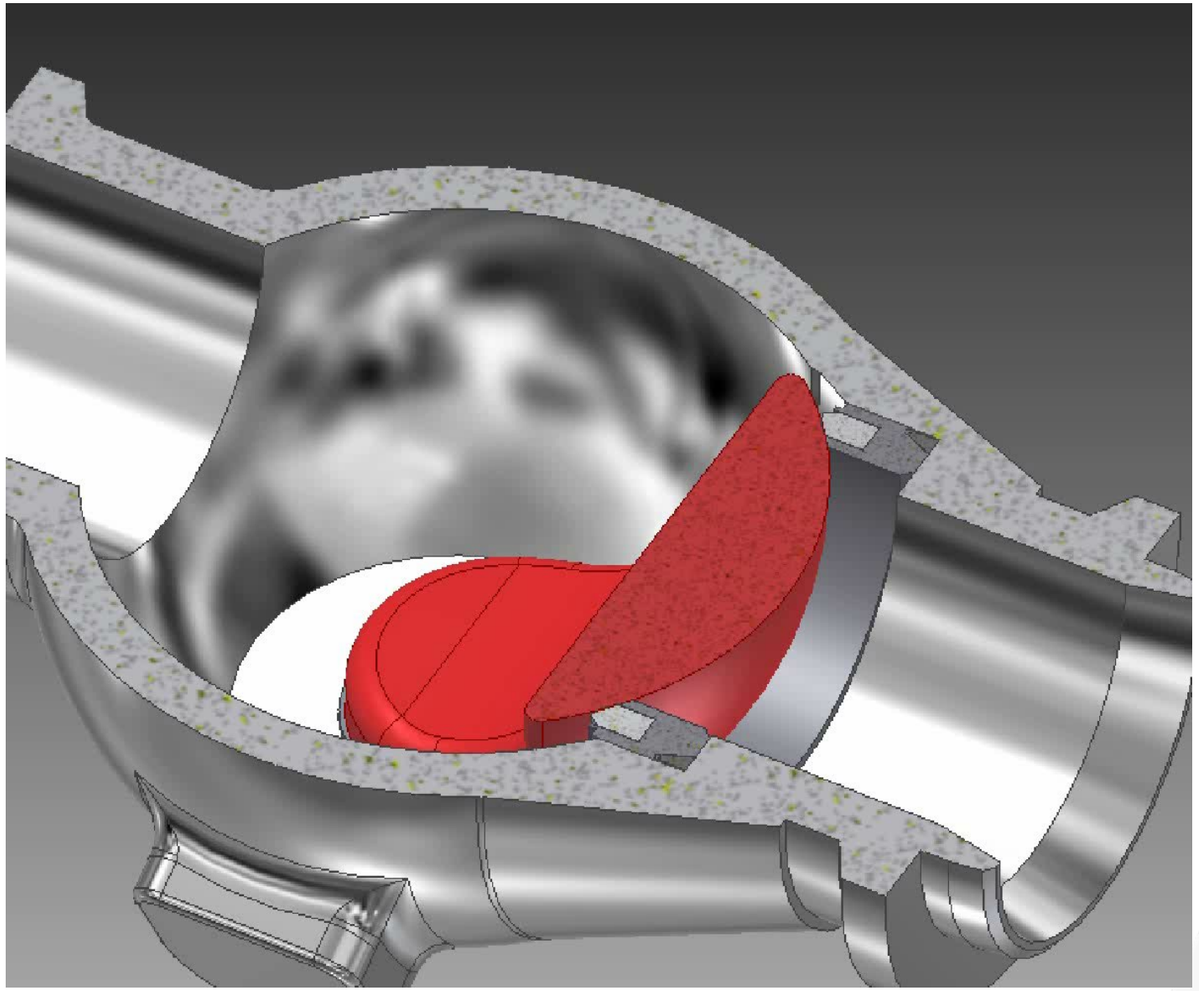


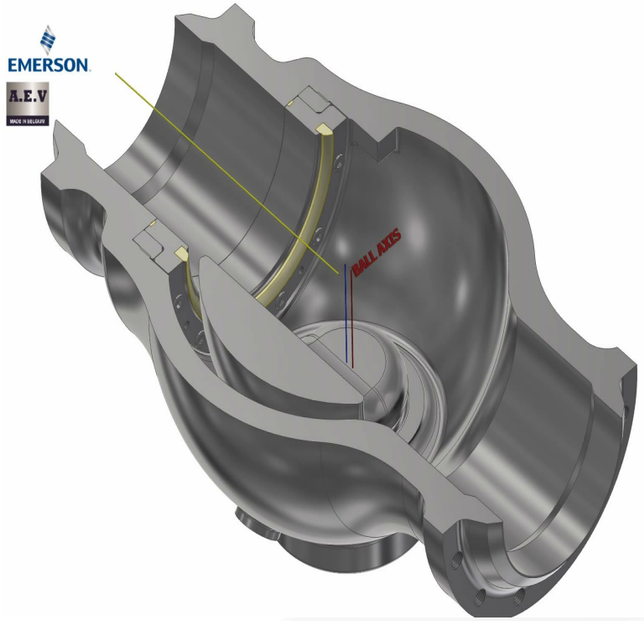
Installed AEV 2XC Ball valve

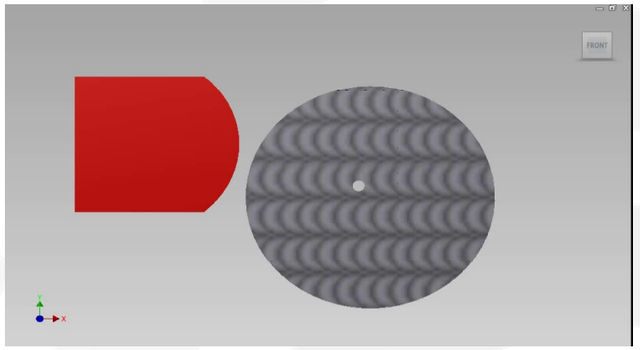




AEV Double Eccentric , Torque Seated , Cavity Free Design







- Cavity Free
- HVOF Ball
- Bi-Direction Zero leakage
- No soft seal
- Robust design
- Convex-Convex Sealing

How Quarter Turn Eccentric Design Leads to Reliability

Gate Valves challenges

- Complex Design – Many parts, difficult maintenance.
- Linear Stroke Operation – Requires more space due to larger actuators.
- Limited compliance on Fugitive emission.
- Higher risk due to rubbing design causes seat leakage.
- Increased CapEx and OpEx due to frequent maintenance and recurrent costs

AEV Torque Seated Cavity Free Ball Valve

- Simple design with few parts and ease of maintenance
- Rotary quarter turn valve- easy to operate and actuate
- Meets Fugitive Emission Class A as per ISO 15848
- Convex to convex sealing – Reduces particle damage and improves wear resistance.
- Less expensive – optimized CapEx and OpEx cost

Ease Of Maintenance

Installed in 2023, the C-Ball valve design has significantly improved safety, reduced steam leakage through gland , and enhanced operational efficiency . As a result, Coke Calcination Unit has experienced zero plant trips, improved heat transfer performance, and achieved substantial maintenance cost savings as compared to the previous installed valves OpEx spend.

Find More Information

https://www.emerson.com/en-ae/automation/brands/aev

Contacts

1-Tareq Al Mansoorii (tmalmansoori@adnoc.ae)- Maintainance Leader-Site

2- KN , Viswanathan (kn.viswanathan@emerson.com)

2- Magdy Helmy (magdy.helmy@emerson.com)

Tareq Almansoori

Team Leader Maintainance-Instrument & Controls/ADNOC Refining

Viswanathan KN

Regional Sales Manager/Emerson

Magdy Helmy

Sales manager/ Emerson

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Thank You

P&ID – Tag UV-031-Automated Isolation Valves