**Introduction**

The catalytic reforming (or CCR unit) process can be regarded as the refiner’s main tool to control gasoline octane level. The purpose of this process is to produce gasoline-blending stock. The improvement is achieved by converting paraffin and naphthenes into aromatics and isomers. Simply put, the catalytic reformer takes low octane value feedstock and converts it into relatively stable high octane value gasoline blending components.

**The Process**

In the process, hydrogen gas is produced as byproduct. The excess hydrogen produced by this process is a valuable feedstock to other refinery processes that require additional hydrogen.

The reforming process operates at high temperature levels up to 550°C (1025°F). Over a period of time, the catalyst becomes coated with coke, a natural byproduct of the reforming process, and requires regeneration.

Old reformer units use fixed bed reactors in series. Typically, three to four reactor beds are used in a cascade arrangement. These units are referred to as semi-regenerative catalytic reformers. Removing one
bed at a time from service and physically opening the reactor and removing and replacing the catalyst achieve regeneration of this type of process.

The Lock Hopper System

The modern catalytic reformer uses a stacked three-bed reactor with a continuous catalyst regenerator (CCR), where the catalyst is continuously withdrawn from the reactor, then regenerated, and fed back to the stacked reactor bed.

A series of lock hoppers, typically four complete lock hopper arrangements, are used to move catalyst from the reactor to the regenerator and eventually back into the reactor.

The sequence of lock hopper function is as follows:

1) Catalyst requiring regeneration is gathered in the disengaging zone of the stacked three-bed reactor.

2) Catalyst flow is stopped by a special segmented ball valve located immediately below the disengaging zone and upstream of the two Neles lock hopper block valves. The two valves above the lock hopper are fully open before catalyst is allowed to flow through them.

3) The segmented valve is then opened allowing catalyst to flow into the lock hopper.

4) When the lock hopper is full the segmented valve is closed. After the flow of catalyst is completely stopped, the two Neles valves are closed, isolating the lock hopper.

5) The lock hopper is then inerted with nitrogen. Following this, the two lock hopper block valves located below the lock hopper are opened allowing the inerted catalyst to flow, by gravity, into a lift engager for transport to the next part of the process.
Metso Automation Solution
The Neles X-MBV valve has been specifically designed to meet the requirements of UOP specification 671 and, with a Neles B1J single acting spring return or Neles B1C double acting actuator complete with accessories, provides the ideal lock hopper block valve solution.

Model Number and Description
XA03DWWUUS6SLJBDD
XA Full bore seat supported ball valve
03 Valve size typically 2” to 6”
D ANSI class 300
W ANSI B16.5 raised face flange
UU Full compliance with UOP specification 671
S6 ASTM A351 CF8M 316 stainless steel body construction
SL 316SS/NiBo ball construction
J Solids proof seat construction
B 316SS/CrC coating on seat
D Graphite packing and graphite body seal
D B8M studs and 8M nuts

Valve Design Features
Valve Body – Metso Automation utilizes a full-bore design in lock hopper service. All counter bores and transitions in diameter are removed from the waterway of the valve. This causes the valve to look like a piece of smooth pipe to the flowing media in order to eliminate the possibility of pulverizing expensive catalyst. It also minimizes the possibility of internal valve damage by the highly abrasive catalyst. The valve body is constructed of A351 CF8M for the longest possible life while subjected to the extreme thermal transients associated with this process.

Ball – The ball is constructed of A351 CF8M with a Nickel Boron coating. The base material of the ball was chosen to provide for a coefficient of expansion similar to the valve body. This is required to maintain seat to ball tightness as the valves experience a large number of significant thermal transients. The Nickel Boron coating is applied to raise the surface hardness of the ball to Rockwell HRC 68-70. This is necessary to provide for long component life in this highly abrasive service.

Seat – Metso Automation utilizes 316SS seat with Chromium Carbide (CrC) coating for this application. This material combination was again chosen for compatible coefficients of expansion as well as superior abrasion resistance. The seat energizer, perhaps the most important design feature of the valve, is Metso Automation’s unique “solids-proof” construction. The seat back cavity is completely filled with a graphite stack. The graphite seat back material achieves two important tasks: 1) it serves as seat energizer. The graphite allows for repeatable valve shutoff despite the extremes in temperature. 2) The graphite stack completely fills the seat back cavity. This eliminates the possibility of catalyst fines accumulating behind the seat. This is extremely important as catalyst fines behind the seat can cause the required torque to increase enough to exceed the maximum output capability of the actuator.
The information provided in this bulletin is advisory in nature, and is intended as a guideline only. For specific circumstances and more detailed information, please consult with Metso Automation.