

## **Type PR Online Assurance Program**

**The Challenge:** Today, refiners utilize the ebullated bed hydrocracking process to convert heavy residues and petroleum bottoms into saleable distillate products, thus maximizing plant throughput and equipment performance. Recently, a world class refinery experienced three upsets of their ebullated bed process within a period of five years. Because the refinery was operating with an unspared pump, as is customary in this service, the upsets resulted in 60 days of unplanned downtime, with significant production losses.

**The Solution:** The Flowserve Type PR Online Assurance program has been implemented at refineries in order to help diagnose these recurring problems within the ebullated bed hydrocracking unit. Utilizing the Flowserve Technology Advantage™ platform, the Type PR Online Assurance program combines equipment performance data acquisition with expertise and advanced diagnostics. This makes it possible for plant operators to not only detect system problems, but to take corrective actions to optimize the ebullated bed process. At the heart of this system is IPS APEX™, an intelligent monitoring, diagnostic and control device developed by Flowserve engineers.

After the installation was complete, the PR Online Assurance program quickly identified the problems and allowed plant personnel to take the necessary actions to improve overall unit performance.

The Type PR “Ebullator” reactor recycle pumping system operates in extremely demanding conditions. High-temperature, high-pressure feed is mixed with hydrogen and reacted within a catalyst bed that is “ebullated” by the Type PR system. This system includes the ebullating pump, variable frequency drive and oil injection pumps.

In the typical ebullated bed conversion process, refiners can potentially be faced with a wide variety of problems. Some of the more common problems encountered are:

- Carryover events: Solids in the catalyst bed enter the suction of the Type PR downcomer and impeller, causing an obstruction in the flow.
- Catalyst bed compression: Catalyst bed becomes filled with solids, causing a dead-head condition within the reactor vessel.
- Impeller jam: Large solids in the system lodge in the impeller inlet, causing it to stall.
- Improper lubrication: Oil condition deteriorates, or incorrect oil grade is used.
- Reverse rotation: Motor incorrectly wired at commissioning

- Gas holdups: Catalyst bed partially fills with trapped gasses, reducing flow through the unit.

Left undetected, these problems can result in decreased efficiencies, damaged equipment and the loss of millions of dollars in costly downtime.



*Type PR Reactor Recycle Pump Installation*

**Recommendations:**

As a solution to these harmful conditions, Flowserve has developed the PR Online Assurance Program, offering 24/7 monitoring of the reactor recycle pump. Together with IPS APEX data acquisition and diagnostics, this system:

- Acquires data from the pump and other components via its onboard, sensor-based monitoring and control system
- Analyzes data, diagnosing any problems using advanced algorithms developed by Flowserve engineers specifically for the PR ebullator pump
- Warns plant personnel of current or developing problems within the ebullated bed system or any of its components

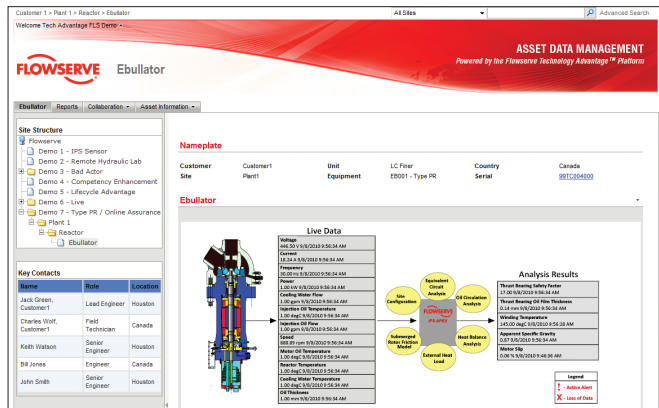
Data is then transmitted to the Technology Advantage Web portal. This user-friendly tool allows plant personnel to monitor the ebullated bed unit operations via a secure system accessible from anywhere in the world.

**Results:**

After the last pump repairs were made and the Type PR Online Assurance system installed, the refinery was able to:

- Optimize system efficiency
- Maximize productivity
- Reduce or eliminate downtime
- Minimize maintenance costs
- Execute timely implementation of upgrades
- Perform all of the above for minimum investment

Through the application of advanced technologies and with the cooperation of product and industry experts, users of the Type PR Online Assurance program can proactively manage every facet of the life cycle cost of ebullated bed process equipment. In doing so, customers can look beyond traditional equipment and aftermarket purchase agreements for alternative, value-based business relationships.



*Technology Advantage Web Portal*

**Bulletin FSG-SS-011a (E)** Printed in USA. February 2012.  
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**To find your local Flowserve representative:**

For more information about Flowserve Corporation, visit [www.flowserve.com](http://www.flowserve.com) or call +1 937 890 5839.

**USA and Canada**

Flowserve Corporation  
5215 North O'Connor Blvd.  
Suite 2300  
Irving, Texas 75039-5421 USA  
Telephone: +1 937 890 5839

**Europe, Middle East, Africa**

Flowserve Corporation  
Parallelweg 13  
4878 AH Etten-Leur  
The Netherlands  
Telephone: +31 76 502 8100

**Latin America**

Flowserve Corporation  
Martín Rodríguez 4460  
B1644CGN-Victoria-San Fernando  
Buenos Aires, Argentina  
Telephone: +54 11 4006 8700  
Telefax: +54 11 4714 1610

**Asia Pacific**

Flowserve Pte. Ltd.  
10 Tuas Loop  
Singapore 637345  
Telephone: +65 6771 0600  
Telefax: +65 6862 2329