



CCR REFORMER OPERATIONAL REVIEW

GENERAL

The purpose of a CCR Reformer Operational Review is to provide the customer with an independent external assessment of their CCR Reformer unit performance. The Review takes a one week site visit by a CCR Reforming expert. The focus will be on all aspects which have the potential to reduce the Operational Availability of the unit, and on the identification of opportunities for performance improvement. Such review will typically consist of the following five elements:

1. HEALTH CHECK OF UNIT OPERATIONS

During a health check the main operating conditions will be reviewed, such as:

- Feedstock quality and level of contaminants
- Pressure drop and delta T profile over the reactor circuit;
- Reactor inlet temperature profile and balancing of the fired heaters;
- Fouling of the recycle gas compressor and stabiliser;
- Abatement of Metal Catalyst Coking and Metal Dusting;
- Functioning of the reactor feed/effluent exchanger;
- Regenerator coke load;
- Regenerator burn zone temperature profile and oxygen utilisation;
- Functioning and robustness of the catalyst transfer system, and identify potential for plugged catalyst transfer pipes;
- Size distribution of the circulating catalyst and catalyst fines make;
- Review of the catalyst coke profile over the reactors as observed during the last catalyst unloading;
- Pressure drop and delta T profile over the reactor circuit;

- Energy consumption;
- Occurrence of upsets.

2. REVIEW OF UNIT OPERATIONAL AVAILABILITY

The unit Operational Availability is very important. For a CCR Reformer, the typical and realistically achievable target Operational Availability is minimum 99% in between planned maintenance shutdowns, carried out once per 6 years for maximum 25 days. During the operational review, all shutdowns during the last 6 years will be studied, the reasons for unplanned downtime will be reviewed and whether corrective measures have been implemented in a sustainable manner. The status of the critical reactor internals (scallop, centre pipes, internal catalyst transfer pipes) will be reviewed in detail.



3. ASSESSMENT OF CATALYST PERFORMANCE

The catalyst performance determines the product yields, reactor inlet temperatures, coke make and achievable product RON. Assessment of the catalyst performance will be carried out using software which has proven its adequacy for several generations of UOP, Axens and Criterion Reforming catalysts. The catalyst physical properties will be reviewed on the basis of the supplier analysis, including chloride retention, platinum dispersion, contamination, size distribution and presence of alpha alumina.

4. UNIT OPTIMIZATION

Possible options for unit optimisation will be reviewed:

- Feedstock quality improvement (presence of C5's, benzene precursors, contaminants);
- Possible constraints and opportunities to relax them in a cost effective manner;
- Utilizing potential spare regenerator coke burning capacity;
- Prolong the operating cycle between turnarounds;
- Options to reduce the energy consumption.

5. REVIEW MAIN OPERATING PROCEDURES

Good operating procedures are essential to avoid upset conditions which have the potential to cause damage to the reactor and regenerator internals, feed/effluent exchanger and the catalyst itself. The focus will be on:

- Operating to cope with emergency situations such as a sudden loss of recycle gas flow, feed or fired heaters, and the restart procedures following such upsets;
- Regenerator black burn operation;
- Regenerator switches between black burn to white burn operation;
- Catalyst handling during the next turnaround.

ASSESSMENT OF REFORMER UNIT POTENTIAL

As an optional extension of the typical program, the unit potential can be assessed. For a given feedstock quality, the maximum feedrate and corresponding Platformate RON can be assessed.

BENEFITS FOR THE CUSTOMER FROM THIS REVIEW

The actual operation of the CCR Reformer unit will be reviewed by an independent technology and operating expert against the most recent industry best practices, such that the operation can be considered as "up to date". It is very likely that improvements will be identified with a value greatly surpassing the costs of the review.

WHY SELECT EPS?

Reviews offered by catalyst vendors cover catalyst performance only. This EPS review has a strong focus on achieving a high Operational Availability, and is carried out using a proven methodology by a true CCR Reforming expert.

During the ERTC (European Refining Technology Conference) of November 2016, EPS made a presentation on the topic "Improve Operational Availability of CCR Reformers".

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