



## UOP FCC Emergency Interlock System

### Refining

The UOP FCC Emergency Interlock System is a protection system designed to automate the required operator actions during an abnormal event affecting the catalyst sections of a fluidized catalytic cracking (FCC) unit. These abnormal events require immediate and precise operator action. Given the nature of human response to emergencies, it is possible that the operator will either delay action or make an error in judgment. These abnormal events may result in major equipment damage, long down time and/or lost production.

### Background

The FCC process employs a fluidized catalyst system that converts straight-run atmospheric gas oil, vacuum oils and other side products into high octane gasoline, light fuel oils and olefin-rich light gases.

The FCC process offers the refiner a reliable, long-run operation; a wide array of products; a high-quality gasoline with a relatively high octane number; and a method for converting various feed stocks to gasoline.

The combination of high yield, high octane and low cost makes the FCC process a key contributor to a refinery's overall gasoline production strategy.

### Application

The proper implementation of a robust interlock system can assist the refiner with the automated shutdown of the catalyst section of the FCC unit. This automation avoids major equipment damage while placing the FCC unit in a condition suitable for rapid re-start after an abnormal event.

UOP provides a unique interlock system, integrating UOP expertise, the use of fault-tolerant, redundant, programmable electronic systems and process transmitters (supplied by others) to automate the shutdown of the FCC unit.

### Abnormal events

Although the FCC process is a long running, low cost, reliable process to operate, emergency situations may occur requiring the unit to be shutdown. These events are referred to as abnormal events. Some of the more typical abnormal events are:

- Refinery power loss
- Pump failures
- Cooling water failure
- Instrument air failure
- Main air blower failure
- Slide valve failure
- Other equipment failures

### UOP FCC EIS design

To protect the FCC unit from an array of problems, UOP developed the UOP FCC Emergency Interlock System (EIS). The UOP FCC EIS is an independent protection layer for the FCC process, following the requirements of ANSI/ISA S84.01 (Application of Safety Instrumented Systems for the Process Industries). The system also conforms to API Recommended Practice 554 (Process Instrumentation and Control).

Today's safety standards recognize the benefit of fault-tolerant, redundant, programmable electronic systems. The protection layer model, recently recognized by the US and international standards agencies (including OSHA), maximizes the availability and reliability in the interlock system design.

Availability is a measure of a system's success – the system does what it needs to do, when it is asked to do it. The lack of availability means that a system may not trip when asked to trip, that is, failures can be hidden or unknown. Programmable Logic Controllers (PLCs) not designed for safety / critical applications are susceptible to high incidences of covert failures.

Reliability, or percentage of on-stream time, is a measure of safe system effectiveness. A lack of reliability causes unnecessary trips.

### ***Unnecessary trips cause downtime and lost profits!***

To achieve the reliability and availability levels desired, a system must use both fault-tolerant systems and multiple processors with self-diagnostics.

The UOP FCC EIS uses a TÜV-rated, fault-tolerant, triple-redundant, self-diagnostic safety PLC.

A high level of safety availability and reliability is achieved through the use of either two out of three

(2oo3) voting or two out of two with diagnostics (2oo3D) for process variable inputs, and the use of the fault-tolerant PLC.

The UOP FCC EIS monitors the following process variables:

- Air to regenerator flow
- Feed to riser flow
- Reactor temperature
- Slide valve pressure differential
- Spent catalyst stripper level
- Direct-fired air heater outlet temperature
- Other inputs as required

To monitor these process variables, the UOP FCC EIS is designed to integrate with the Basic Process Control System (BPCS), as well as other process and equipment interlock systems. Failures of the BPCS will not interfere with the function of the UOP FCC EIS.

### **UOP FCC EIS functions**

The UOP FCC EIS is designed to perform the following basic functions during an abnormal event:

- Stop catalyst circulation
- Clear the reactor riser
- Remove hydrocarbon feed from the reactor
- Place the regenerator and reactor system into a safe condition to permit a fast, safe re-start.

While the system neither removes the responsibility of the operator from verifying that the system has performed properly, nor prevents the operator from initiating a shutdown manually, if so desired, it does provide the safety integrity level consistent with the previously mentioned industrial standards.

The system is designed to facilitate rapid re-starts. The operator need not bypass process inputs in order to perform proper FCC unit re-starts.

### **Economics**

There is continuous debate in the industry regarding the cost versus use issue. Some refiners consider the idea of spending more than a few thousand dollars on a safety system unacceptable. However, when the cost versus the potential savings is examined, a refiner with an FCC unit cannot afford to be without a UOP FCC EIS. For example, a 40,000 barrel per day FCC unit operating with a \$4 / barrel of feed uplift has a daily margin of \$160,000. Should an abnormal event occur, causing the unit to shutdown, the refiner not only loses production time, but also product. Recovery from an abnormal event can typically require from 8 to 24 hours.

Based on these calculations, the UOP FCC EIS provides the refiner complete payback in approximately one day of shutdown. Further savings may be realized when a refiner considers the potential equipment damage and profitability loss that may occur in the downstream process units.

### **UOP experience**

UOP has installed over 150 programmable electronic systems on various processes throughout the world.

### **Scope of supply**

The typical UOP FCC EIS is supplied as a complete package consisting of:

- Programmable Electronic Protection System – consisting of a logic solver, I/O modules, and communication modules with hardware and software specifically designed for use in process protection applications.
- DCS Communication Interface – for one-way communication between the refiner's distributed control system and the programmable electronic protection system.
- Commissioning Spare Parts – for the commissioning of the control system.
- Project Orientation Meeting – held at the contractor/refiner's site by the actual UOP project engineer to discuss project details and review project parameters.

The UOP FCC EIS is thoroughly tested prior to shipment to site. A process simulator is used to mimic the customer's field inputs and outputs. Component burn-in is provided to detect nascent failures. The system arrives onsite, ready for service.

## Full product support

- Commissioning Service - A staff of field service specialists is available to inspect installation and commission the UOP FCC EIS. Their expertise assures that the control system is on-stream and working as soon as possible.
- Operating Spare Parts and Service - Spare parts are maintained in inventory for prompt delivery. If on-site technical service is needed, our specialists are available for troubleshooting and repair.
- Training - Complete informal operation and maintenance training is provided on-site at time of start-up.

## For more information

For more information, contact your local UOP representative or our Des Plaines sales office:

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