

## **OPEN-COUPLED CYCLONE SYSTEMS FOR TERMINATION OF REACTOR RISERS**

As an alternate to the Closed-Coupled Cyclone Systems for Reactors licensed by several process licensors, Buell offers without a license fee what we call an Open-Coupled Cyclone System. There are currently eight systems in operation. In an Open-Coupled Cyclone System each riser cyclone outlet is positioned to discharge at the location where the gases will naturally travel directly from a riser cyclone outlet to an upper (second stage) cyclone inlet. There have been many units where the gases from the riser cyclones discharged directly beneath or in front of the upper cyclone inlets. In all of these cases, the gases went past or around the upper cyclone inlets and spent considerable time in the vessel. During this additional residence time, over cracking and increased gas make occurred. On the other hand, there were units in which the riser cyclone outlets were so far from the upper cyclone inlets that the gases dispersed into the vessel, also resulting in over cracking and high gas make.

The following summarizes some of the significant Reactor performance improvements and other benefits that users have experienced with the Open-Coupled Cyclone Systems:

- The amount of coke and dry gas reduction obtained with any riser termination device is a function of Reactor operating conditions, the feed quality, the amount of conversion and the catalyst quality. This having been said, Buell is pleased to report that every refiner who has installed an Open-Coupled Cyclone System has reported a reduction in dry gas production in the range of 30% to 45% plus a reduction in coke production. These reductions occur because of the reduced time the gases spend in the Reactor and the resulting reduction in post riser thermal and catalytic cracking reactions. In units where the riser discharged directly into the vessel, residence times of up to 22 seconds have been measured using nuclear tracer elements. Similar measurements in Open-Coupled Systems have shown the residence time to be about 6 seconds.
- Most riser termination devices offered by others require a steam ring in the top of the Reactor vessel, normally located beneath the plenum, and the continuous injection of steam during operation to inhibit coke deposition on the Reactor head and walls. None of the currently operating Reactors with Buell Open-Coupled Systems have a steam ring in the top of the vessel. There have been no reports of coke build up on the vessel head or walls. In fact, reports from at least five refineries have noted that there was a total absence of coke inside the vessels.
- A major benefit obtained with Open-Coupled Cyclones is observed during each upset when catalyst losses from the riser and riser cyclones are high. In a Closed-Coupled System all of the catalyst lost from a riser cyclone goes to the attached upper cyclone. However, in an Open-Coupled System much of the additional catalyst loading leaves the gas stream in a fountain like discharge between the outlet of the riser cyclone and the inlet to the upper cyclone. Thus, during upset conditions, the loading to the upper cyclones in an Open-Coupled System is much less than the loading to the upper cyclones in a Closed-Coupled System. This not only

***Experienced, Innovative, Responsive***

**Buell**®

**REFINERY CYCLONES**

**FISHER-KLOSTERMAN** 

A CECO Environmental Company

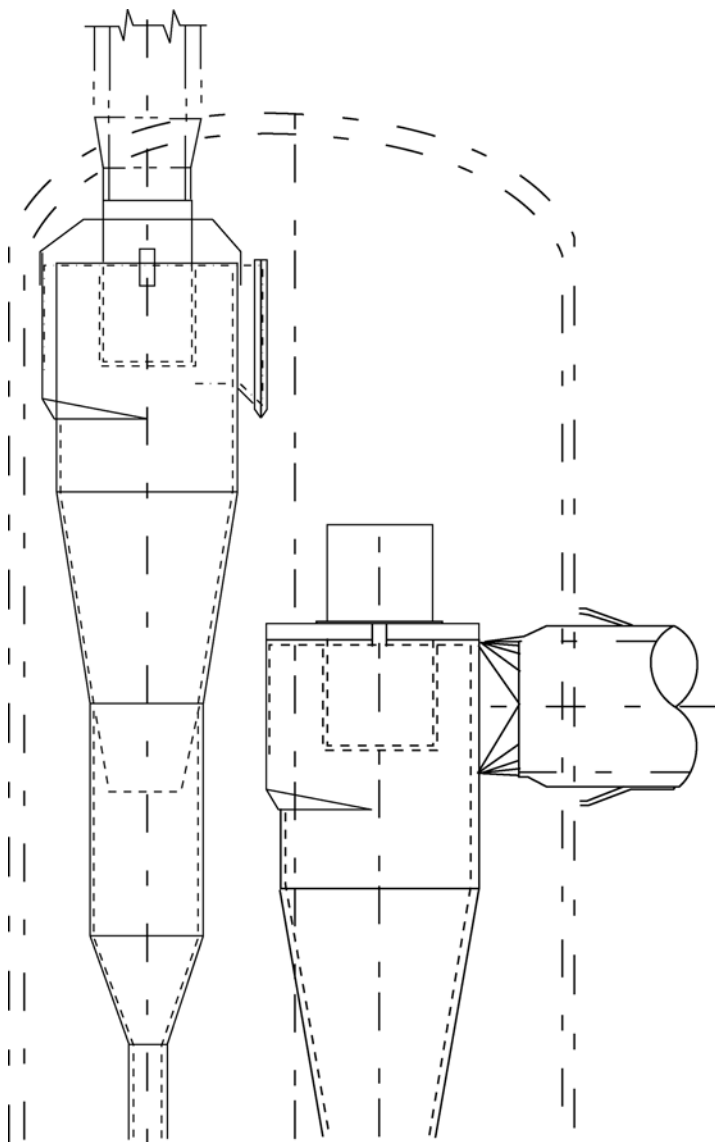
**CECO**

CECO Environmental

## **OPEN-COUPLED CYCLONE SYSTEMS FOR TERMINATION OF REACTOR RISERS**

results in lower losses from the Open-Coupled System, but it also insures that high losses from riser cyclones do not flood the upper cyclone diplegs and cause a major catalyst carryover to the fractionation tower.

- The gap between each riser cyclone outlet and upper cyclone inlet provides an area where pulsations in the gas flow from the riser (which result from catalyst slippage in the riser) are dampened so that there is an essentially smooth flow of gases into the upper cyclone. Since pulsating flow into a cyclone reduces the cyclone efficiency, the losses from an upper cyclone in an Open-Coupled System will be less than the losses from the same cyclone in a Closed-Coupled System.
- Closed-Coupled Riser Termination Systems require a 3 to 6 hour delay during startup to allow Reactor vessel to heat up after the cyclones have reached their startup temperature. Open-Coupled Systems require no such delay because the cyclones and the vessel are heated to the start up temperature at the same time.



# **Buell**<sup>®</sup>

**REFINERY CYCLONES**

**FISHER-KLOSTERMAN** 

A CECO Environmental Company

200 North Seventh Street, Suite 2  
Lebanon, PA 17046

Deliveries to:  
203 N. 5th Street

Phone: 717.274.7154

Fax: 717.274.7342

[buell@fkinc.com](mailto:buell@fkinc.com)

[www.buellrefinery.com](http://www.buellrefinery.com)