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## **Question 1: What are your experiences taking reactor effluent samples? What safety issues do you consider when taking samples? What do you consider to be best practices?**

**Edwin Yuh (UOP)**

UOP has traditionally included sampling capability in our licensed units when there are multiple reactor systems. For example, a sample point is typically installed at the pretreat reactor outlet before the cracking reactor in hydrocracking units to measure nitrogen slip. Many UOP licensees collect reactor effluent samples routinely. Quite a few recently licensed units are designed as integrated hydroprocessing units processing different feeds with different catalyst systems. UOP has added sampling capability at each stage in the unit so that we can monitor catalyst performance individually to optimize unit operation. Occasionally we have had problems with sampling systems. Over the years, we have made modifications. Several considerations are important in the design of a reactor effluent sampling system,

- 1)The sample is normally at high pressure and high temperature containing H<sub>2</sub> and H<sub>2</sub>S.
- 2)The sample is taken at the bottom of a horizontal process pipe.
- 3)A two-phase sample needs adequate cooling in a cooling water pot.
- 4)The sample system has an intermediate holding reservoir designed at operating pressure. The holding reservoir has pressure let-down capability to flash the light gaseous components to flare.
- 5)Proper metallurgy and piping class are used for the entire sampling system.
- 6)Reliable valves are important that tolerate frequent use.
- 7)The sample station has adequate temperature and pressure indications.
- 8)The system should have proper relief considerations.
- 9)The system should also have various purging capabilities to deal with viscous fluids.
- 10)Sufficient purging of the reactor effluent sample needs to occur in order to collect a representative sample.
- 11)The purged liquid is sent to appropriate destinations.
- 12)The sample system has appropriate back flow prevention.
- 13)The system should use a closed sample system to avoid environmental release.

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14)The sampling system requires a detailed set of operating procedures.

15)The operators require proper training and safety gear when taking the sample.

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