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**Question 2: Please discuss your experience regarding the need to add an emergency shutdown (ESD) valve between the cold high pressure separator and the product stripper. The typical design for vapor blow through is to size the stripper relief valve for this case.**

**Vern Mallett (UOP)**

UOP considers that an ESD valve between the cold separator and product stripper is not required and not recommended. The design philosophy behind this practice is to prevent liquid from filling the cold high pressure separator and carrying over into the auto depressuring system and filling the relief header. Once the liquid has filled the depressuring line to the relief header, and if the auto depressuring system were actuated, there is a possibility of damaging the depressuring system and relief lines.

However, some UOP customers require such an ESD valve, which UOP will incorporate into the design of the particular unit. When an ESD valve is specified instrumentation is designed for the ESD valve that will allow the valve close on low level as intended, and then to be reset once the level of the cold high pressure separator reaches approximately 10% of scale above the low level trip set point.

UOP's philosophy is that the code requires that the downstream flash drum be provided with a properly sized relief valve to handle the loss of level in the upstream drum. Since we have the relief valve at the downstream vessel sized for the loss of level, a cutoff valve in the hydrocarbon line from the high pressure vessel is not going to provide any more protection. In addition, it introduces an additional failure mode that is undesirable. Often such cutoff valve systems are set up with manual reset. Therefore if a low level (or just a system failure) causes the valve to shut, then it is likely that the separator will overflow because the operator may not have time to go out and reset the solenoid valve (or find out what failed and get the valve open again) before the separator overflows. When that happens, the separator and recycle gas line will fill up with liquid and eventually shutdown the recycle gas compressor. At this point the unit is not safe. If it is desired to depressure the unit it will not be possible because the separator and piping to the depressuring system will be full of liquid and therefore the depressurizing capability is lost. The downstream vessel is already protected according to the code. Therefore UOP does not recommend a cutoff valve at the separator

The downstream stripper should have a relief valve that will be sized for the loss of level case per the requirements of the code. The only issue is the location of the relief valve. In order to avoid tray damage on loss of level, the relief valve could be located at the feed tray.

**Michael Chuba (Sunoco)**

Although this needs to be evaluated on a case by case basis, general practice has been to properly size the relief valve protecting downstream equipment based on the blow through scenario. Doing this eliminates the need for a separate emergency shutdown (ESD) valve between the high pressure separator and the downstream lower pressure rated equipment. If the relief valve is not adequately

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sized, at a minimum a high pressure protection system or HIPPS system would have to be installed. The HIPPS system is a safety instrumented system (SIS) that would have to be designed with a reliability equal to or greater than that of a pressure relief valve. Thus, the safety integrity level (SIL) of this system could be as high as three or greater. Because the control is on level and the potential fouling nature of the material in these vessels, designing a SIL 3 type interlock is very difficult. Therefore, the preferred approach is to ensure that the CV of the letdown control valve and its bypass valve match the RV of the downstream equipment.

To assist in operation and control of the level in the high pressure separators most recently designed or modified separators are equipped with independent transmitters for High and Low level alarms. In addition LOPA analysis typically finds that an additional independent high level interlock switch is required to trip the recycle compressor if a separate KO drum is not present.

### **Alan Leute (El Paso Refinery)**

For typical Hydrotreaters (up to nominal 1000 psi Separator pressure), we design the Stripper overhead relief valve to handle blow through of hydrogen/vapor from total loss of level in the Separator(s).

There may be additional concerns with this for high pressure Hydrotreaters (greater than 1500 psi Separator pressure) and hydrocrackers, but Western Refining does not have any of these units.

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