

# Relief Systems Design: Simplifying Assumptions Gone Wrong

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- Graduated from St. Edwards University in Austin, Texas with a BS in Chemistry
- Graduated from the University of Texas at Austin with a MS in Chemical Engineering
- Has worked in Process Safety for 3 years
- Experienced in Relief Systems Analysis, Heat and Material Balance Generation, Concern Mitigation, and Flare Analysis
- Current role is as a Technical Lead

# Overview

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- Introduction
- Case 1 - Fluid Catalytic Cracker Unit (FCCU)
- Case 2 - Cat Feed Hydrotreater Reactor Train (CFHT)
- Conclusion

# Introduction

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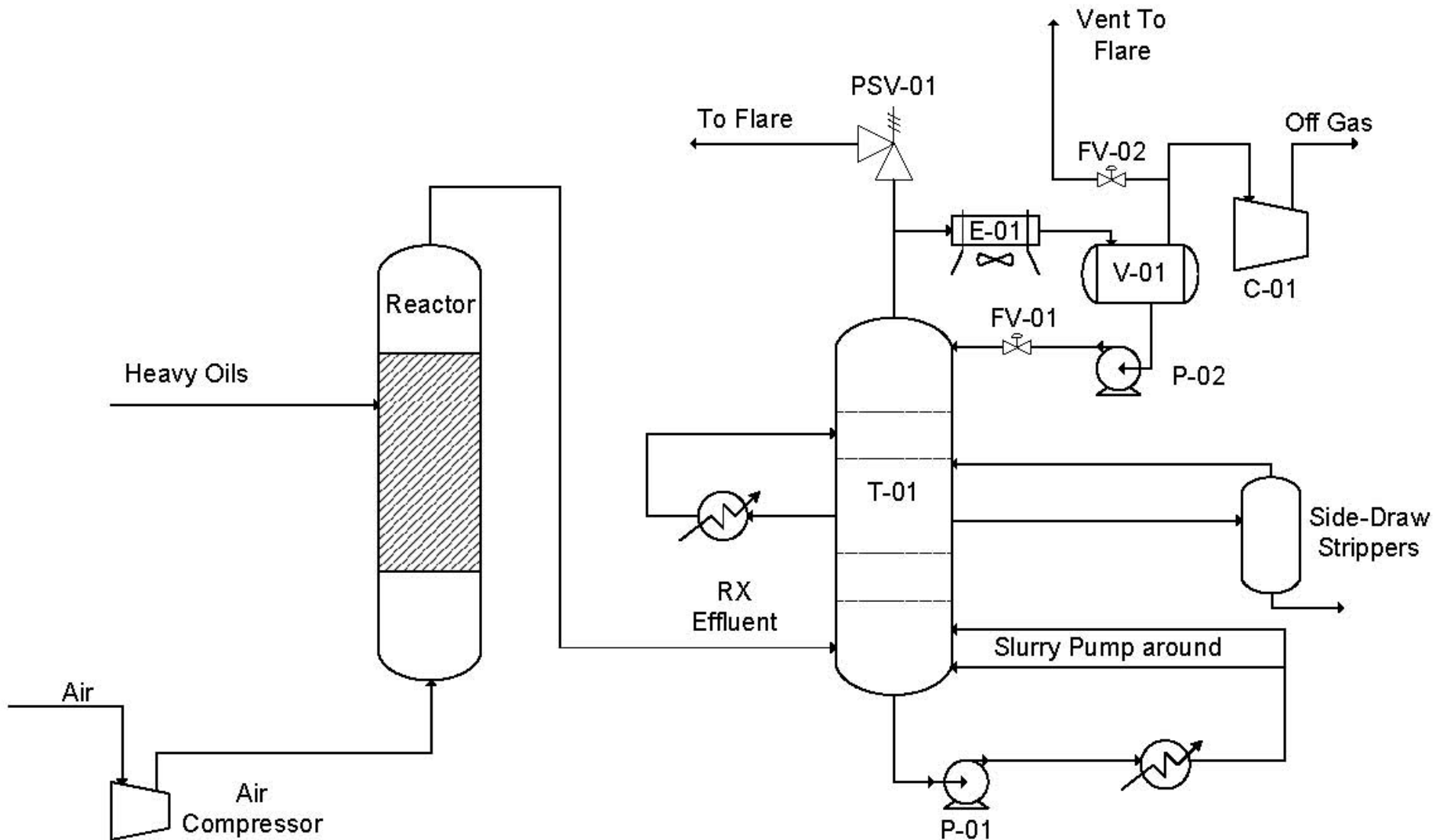
- Simplifying conservative assumptions
- FCCU Slurry Pump around assumptions
  - Assume reactor effluent is relieved
  - Do a detailed analysis by modeling column
- CFHT Reactor Train assumptions
  - Individual relief devices need to be sized for the worst case
  - Global scenarios need to be realistic and make sure flare can handle the load
- What effects these assumptions may have

# Assumptions - Cost Analysis

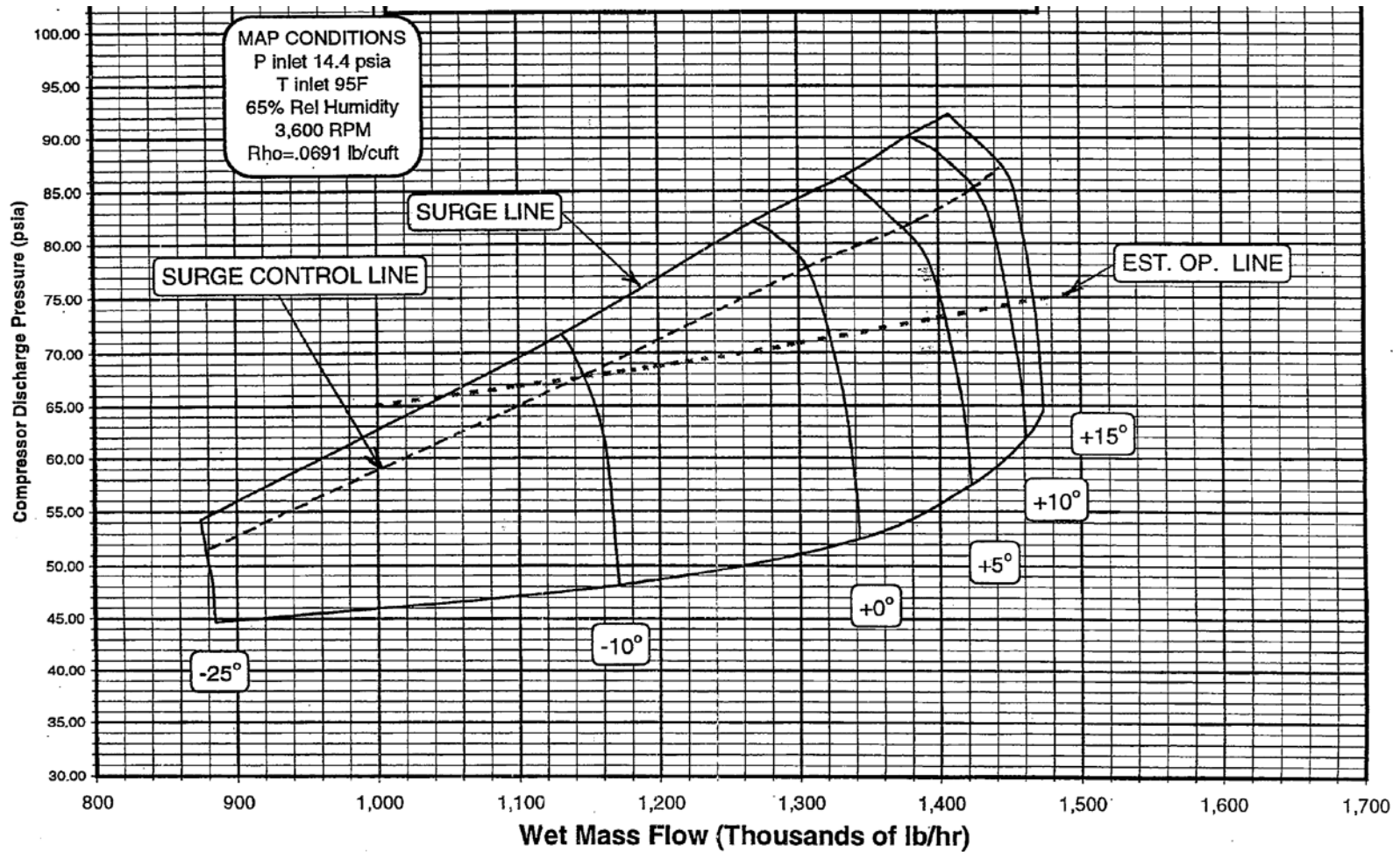
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- Applying simplifying assumptions across the board could allow the work to be done quickly and cheaply
- Multiple relief devices and the flare would need to be mitigated
- The mitigated costs could be significantly diminished by doing a detailed analysis on the 5-10% of the systems that require it

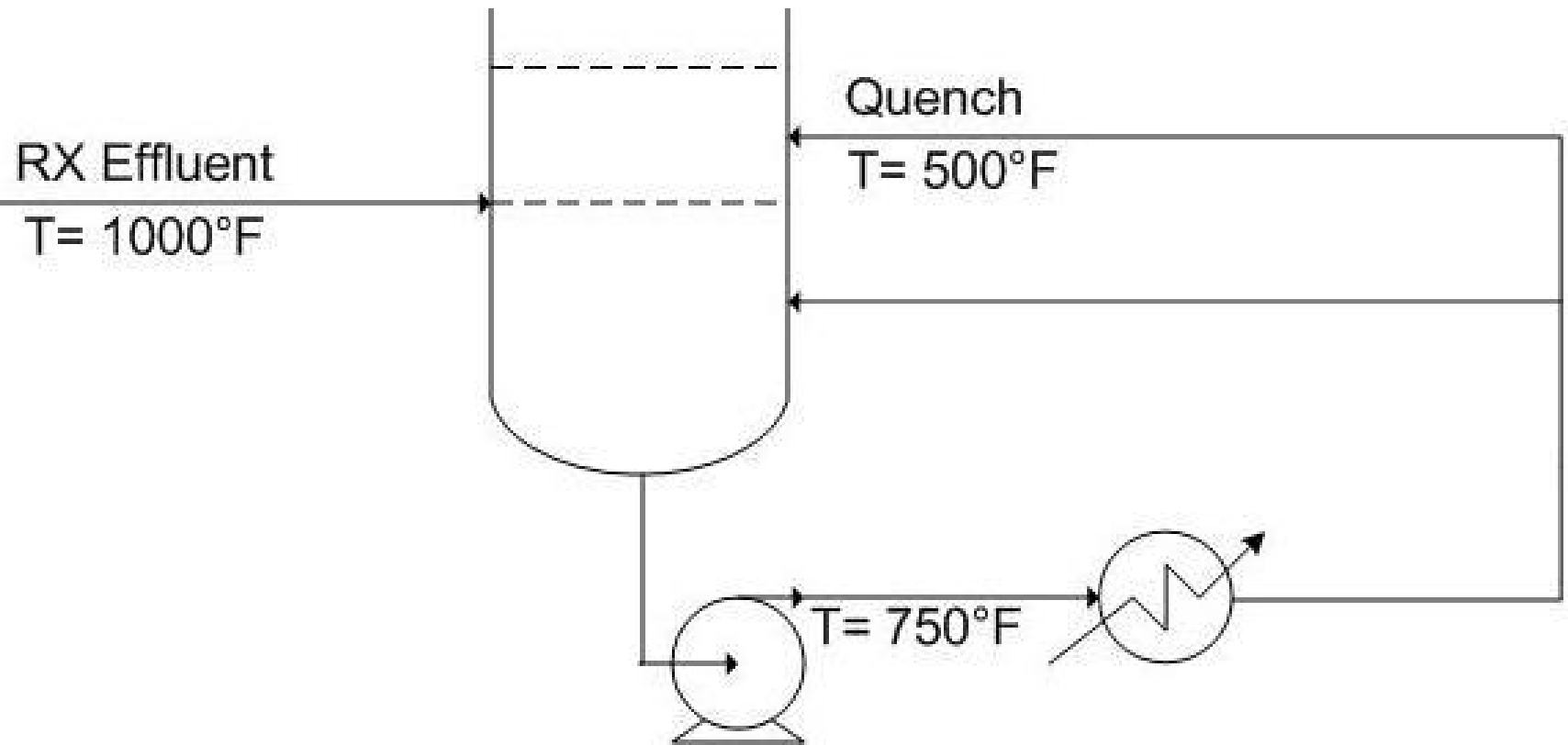
# What Does a FCC do?



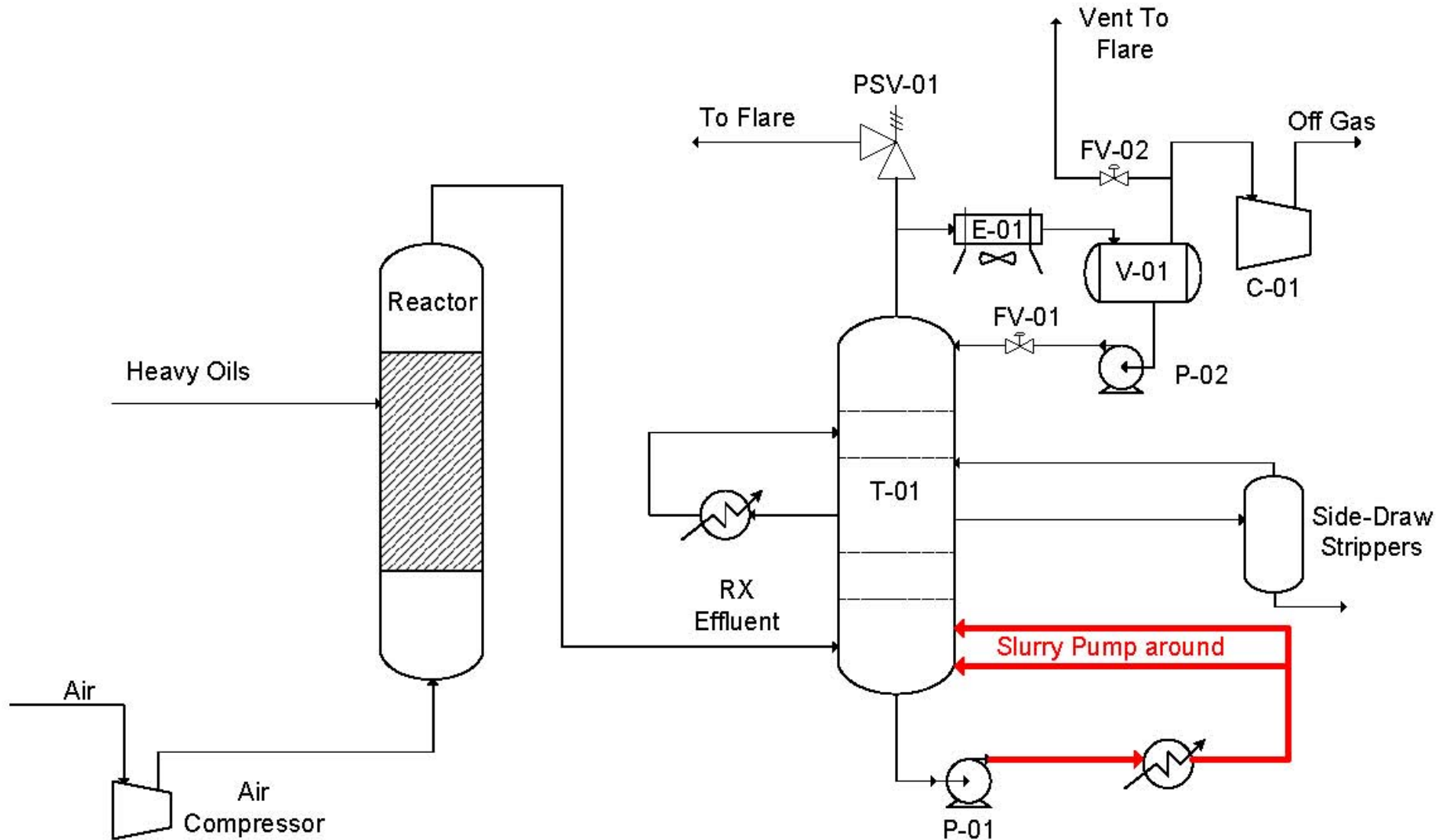
# Compressor Curves



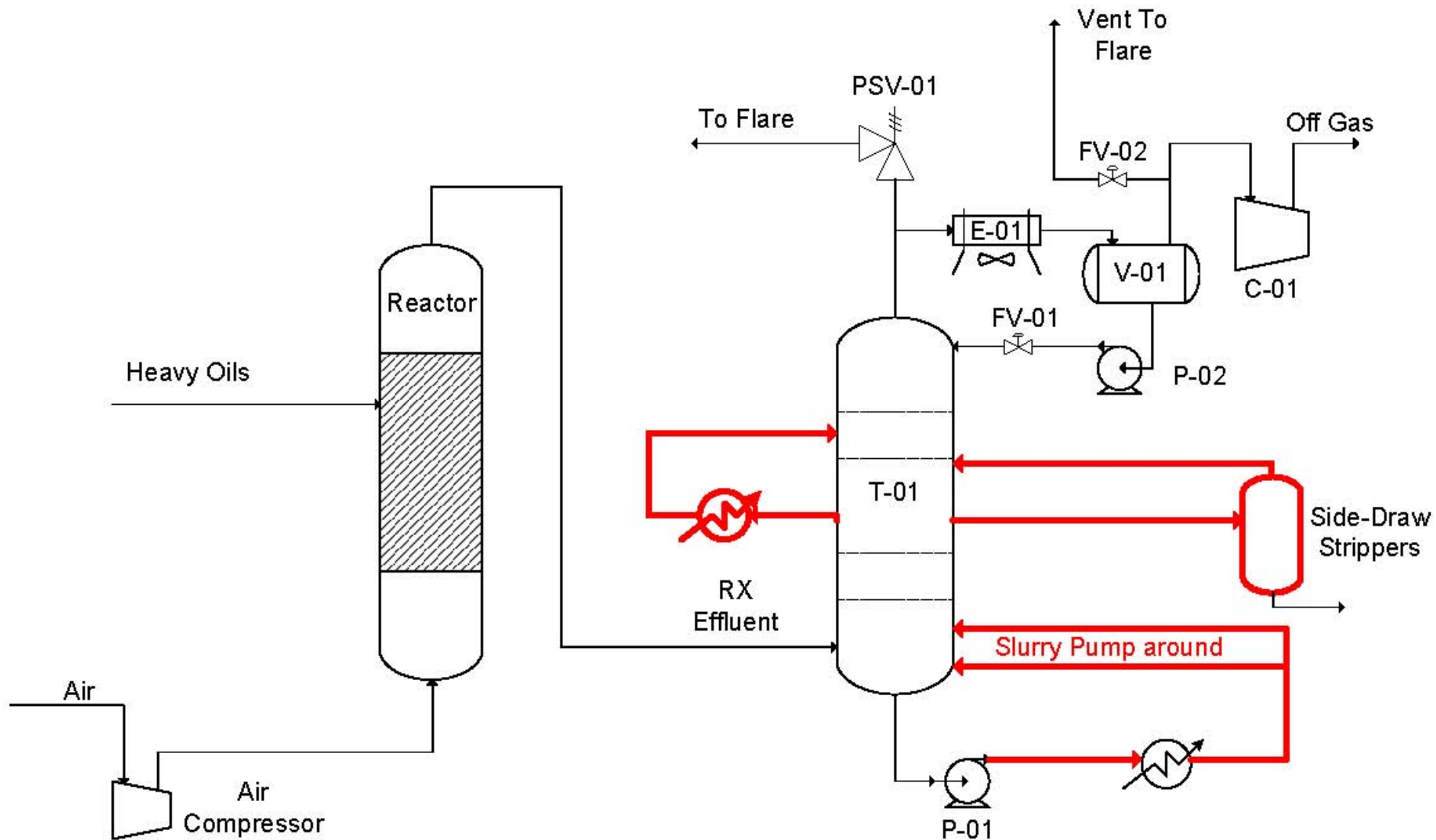
# Slurry Pump around



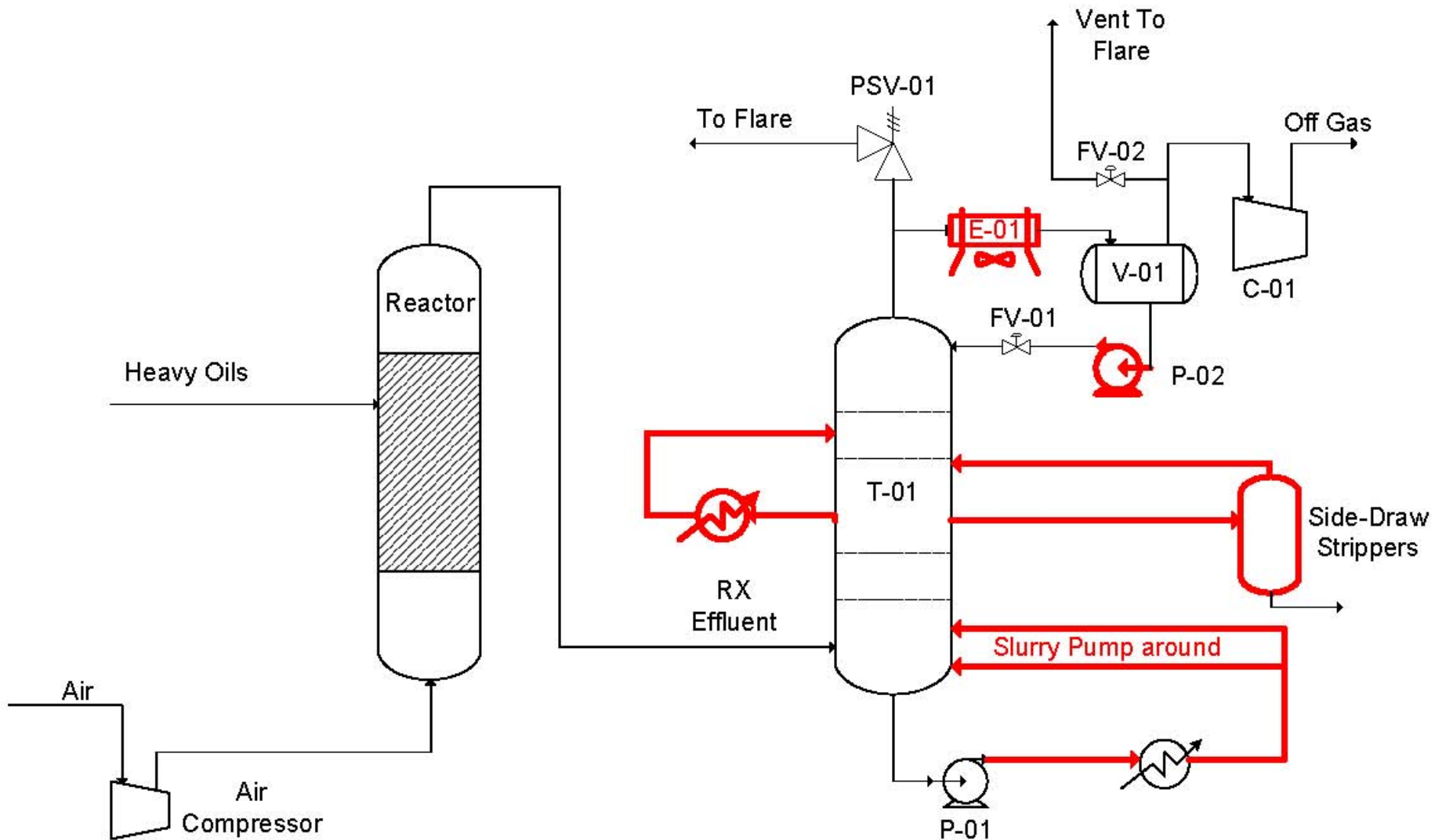
# Partial loss of Slurry Pump around



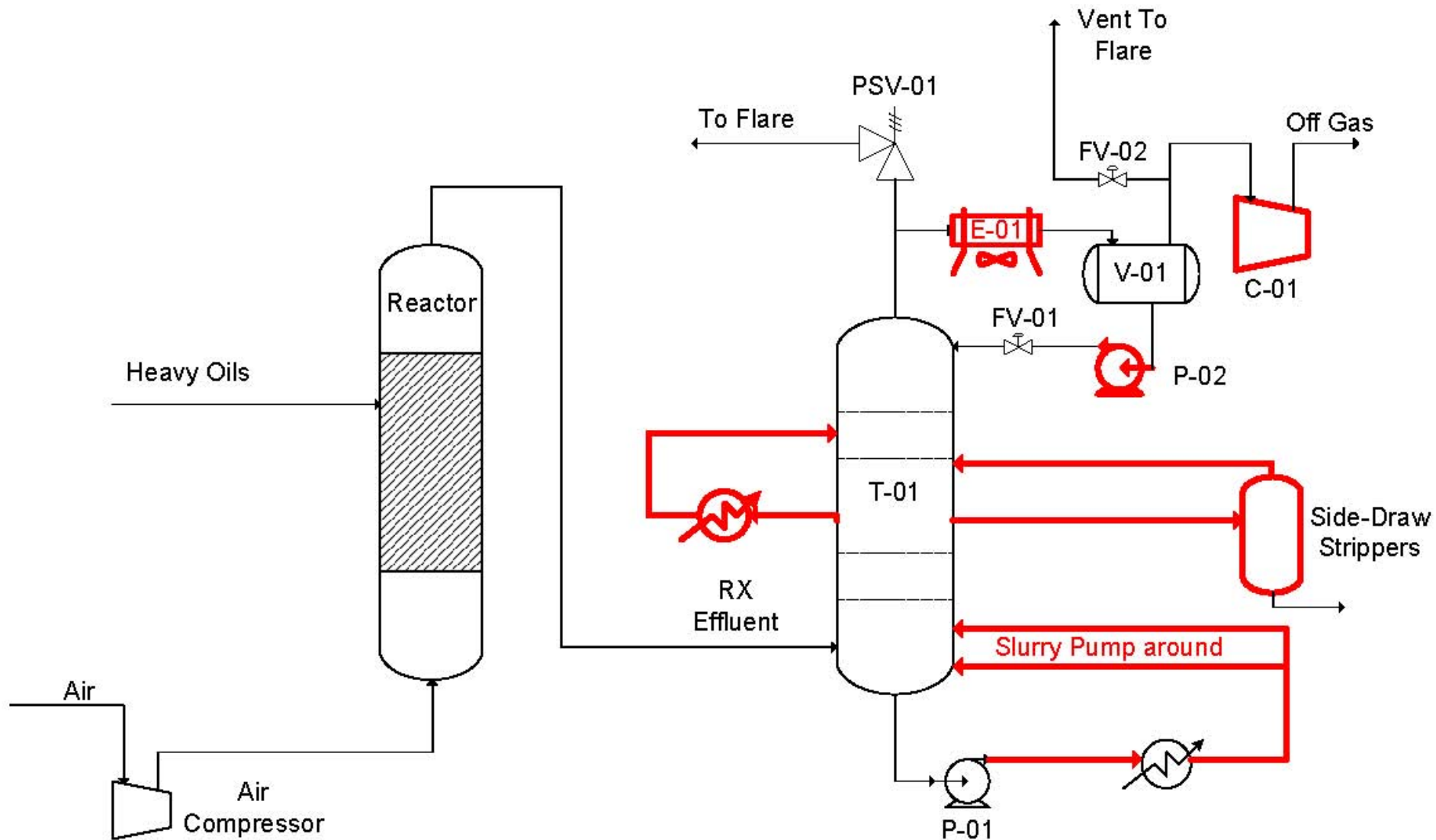
# Are the Pump arounds Lost?



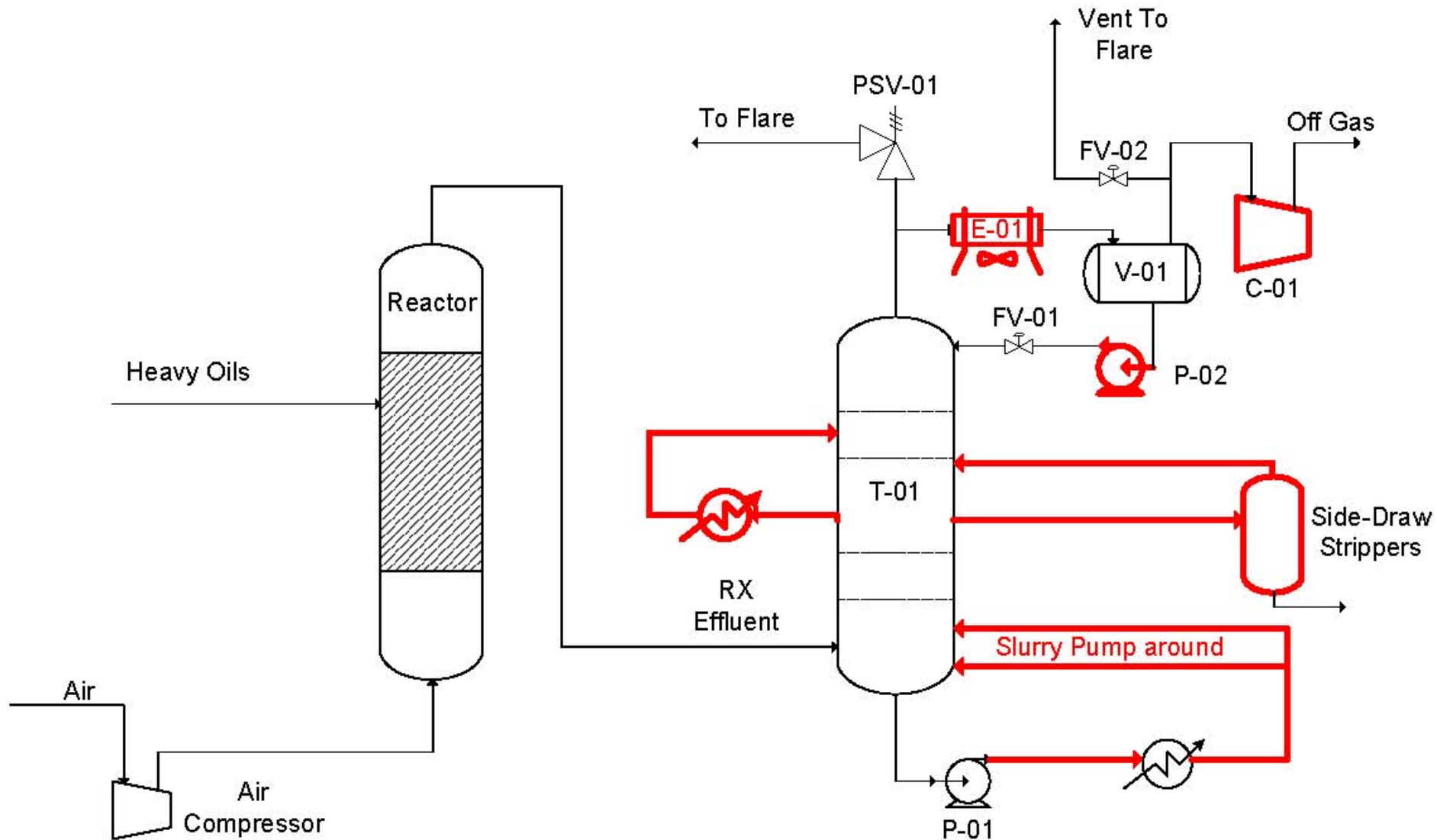
# Are the Overhead Cooling and Reflux Lost?



# Does the Compressor Trip?

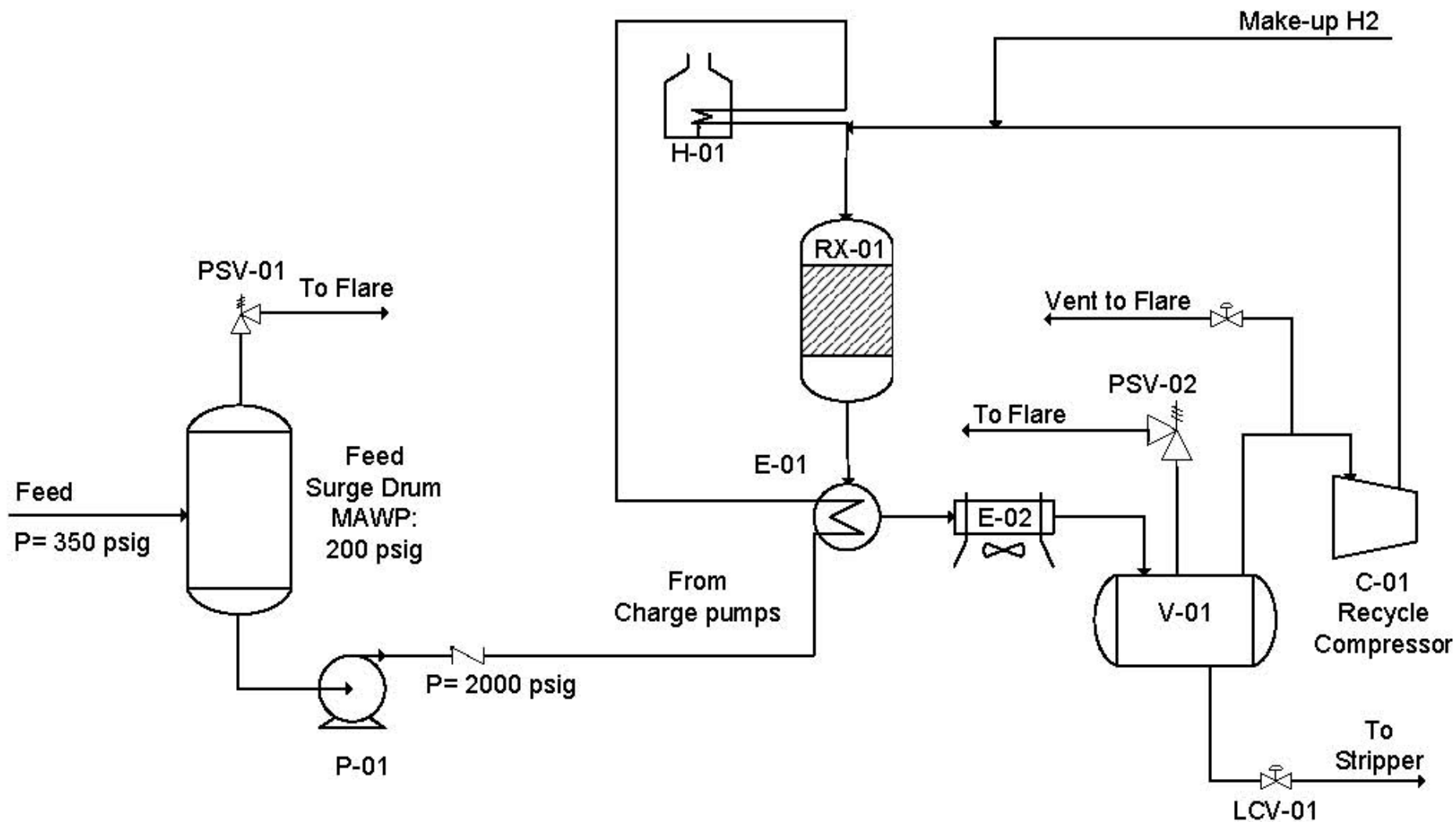


# Total Loss of Slurry Pump around

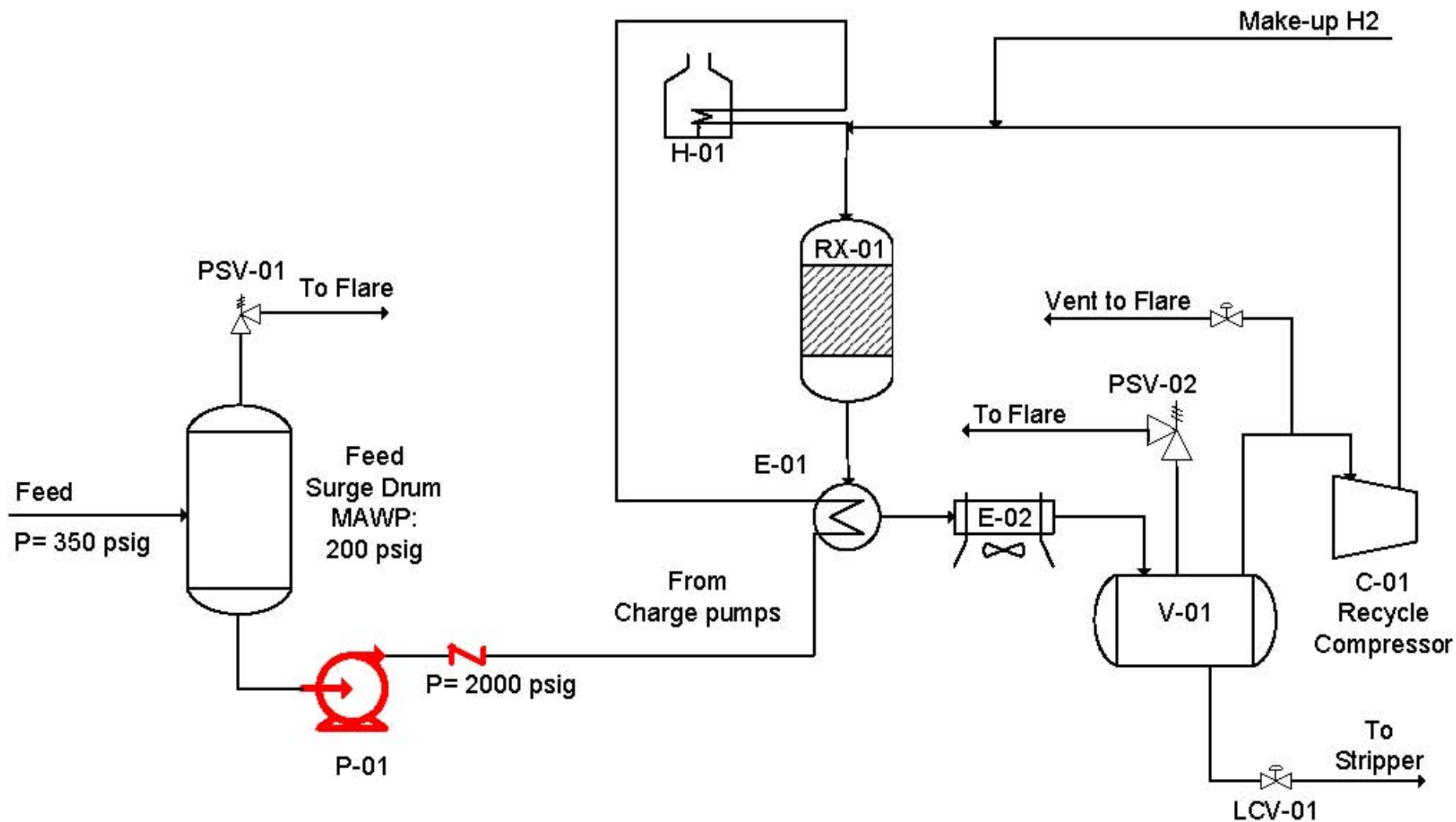


- The conservative assumption of the just relieving the reactor effluent may not be accurate
- The entire system needs to be modeled to understand how the system reacts.
- For the individual scenarios, the reactor effluent may be sufficient given the relief devices provide protection
- For the global analysis, the relief rate needs to be as accurate as possible

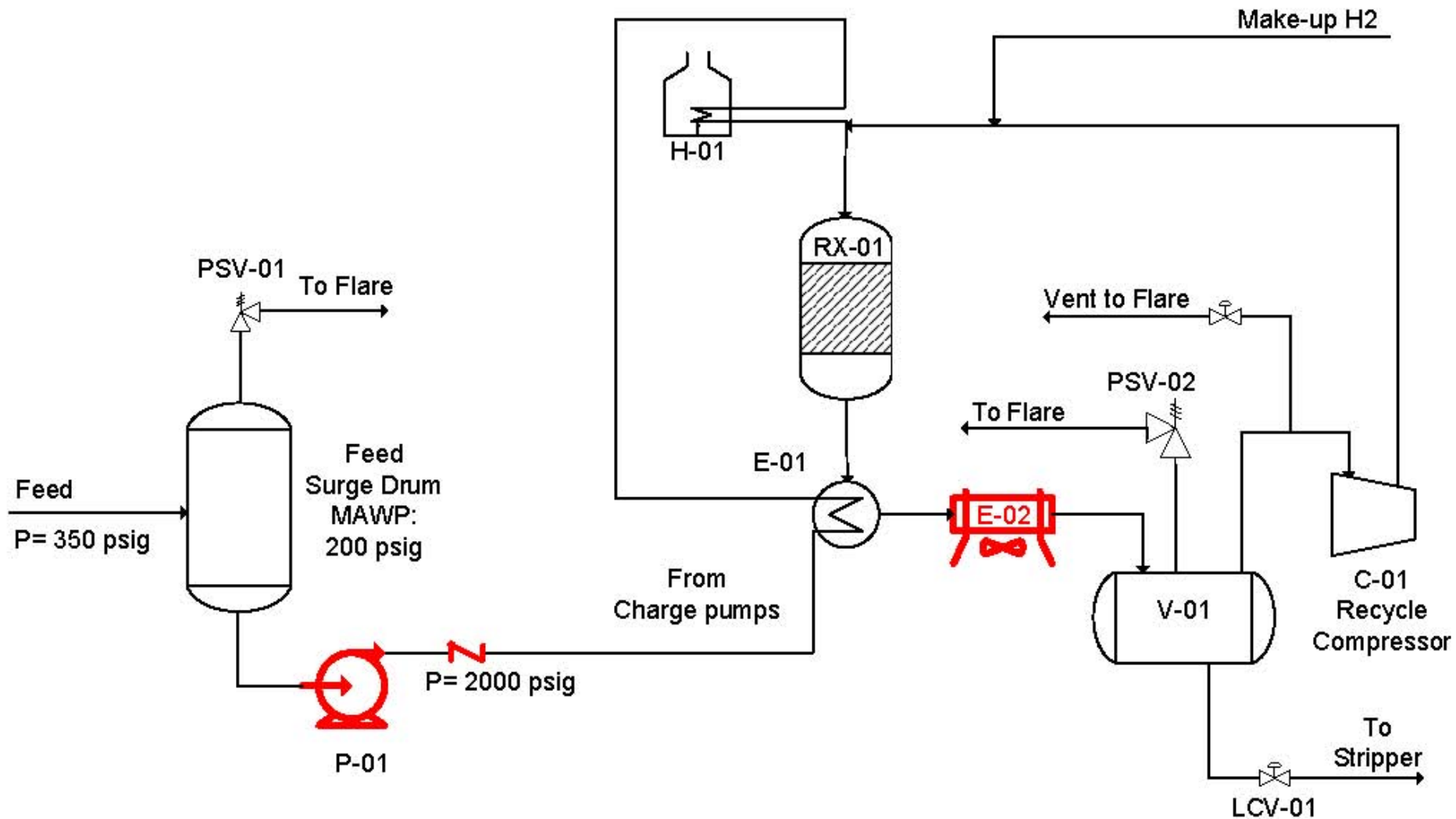
## What Does a CFHT do?



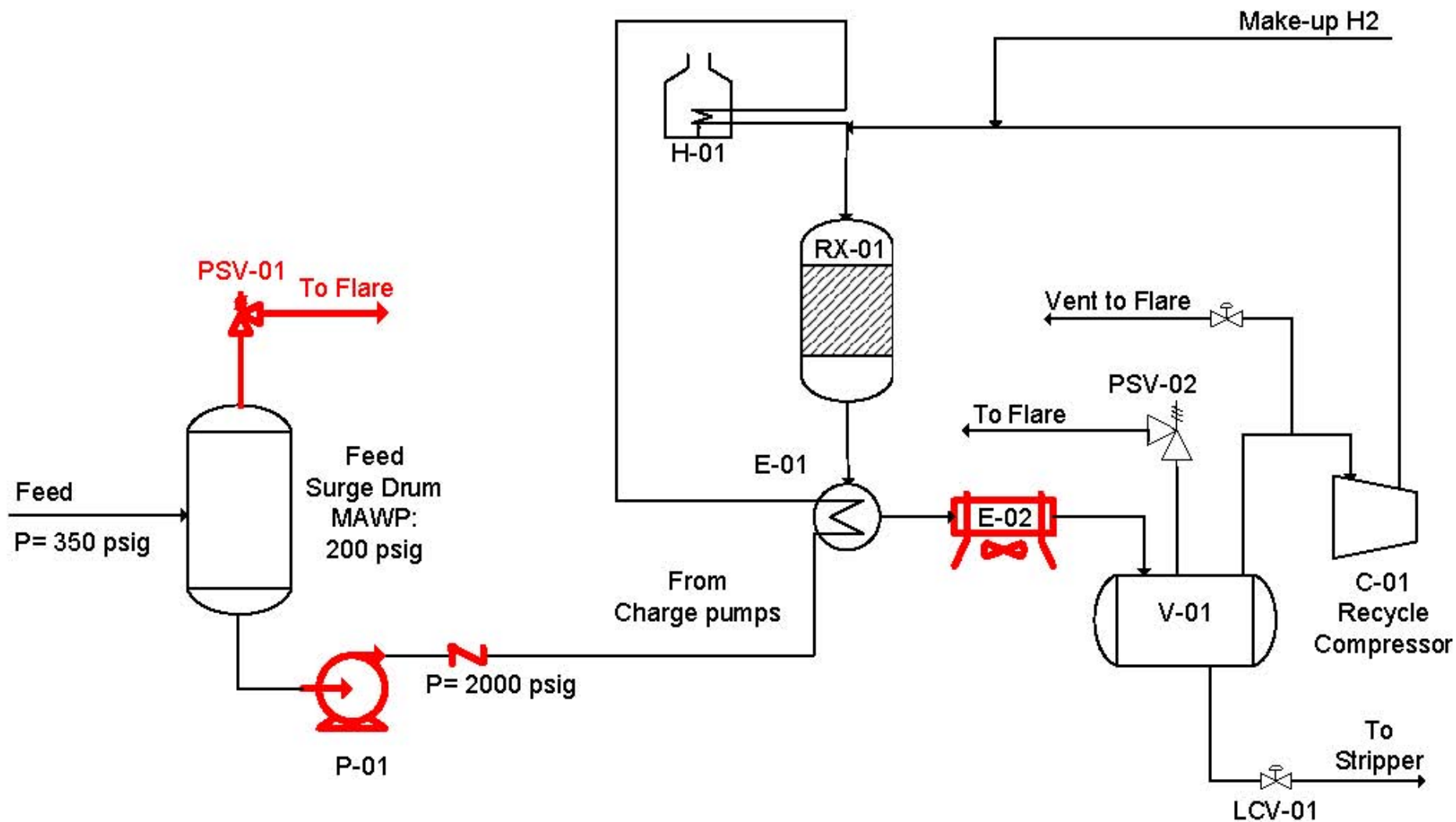
# Individual PSV Analysis



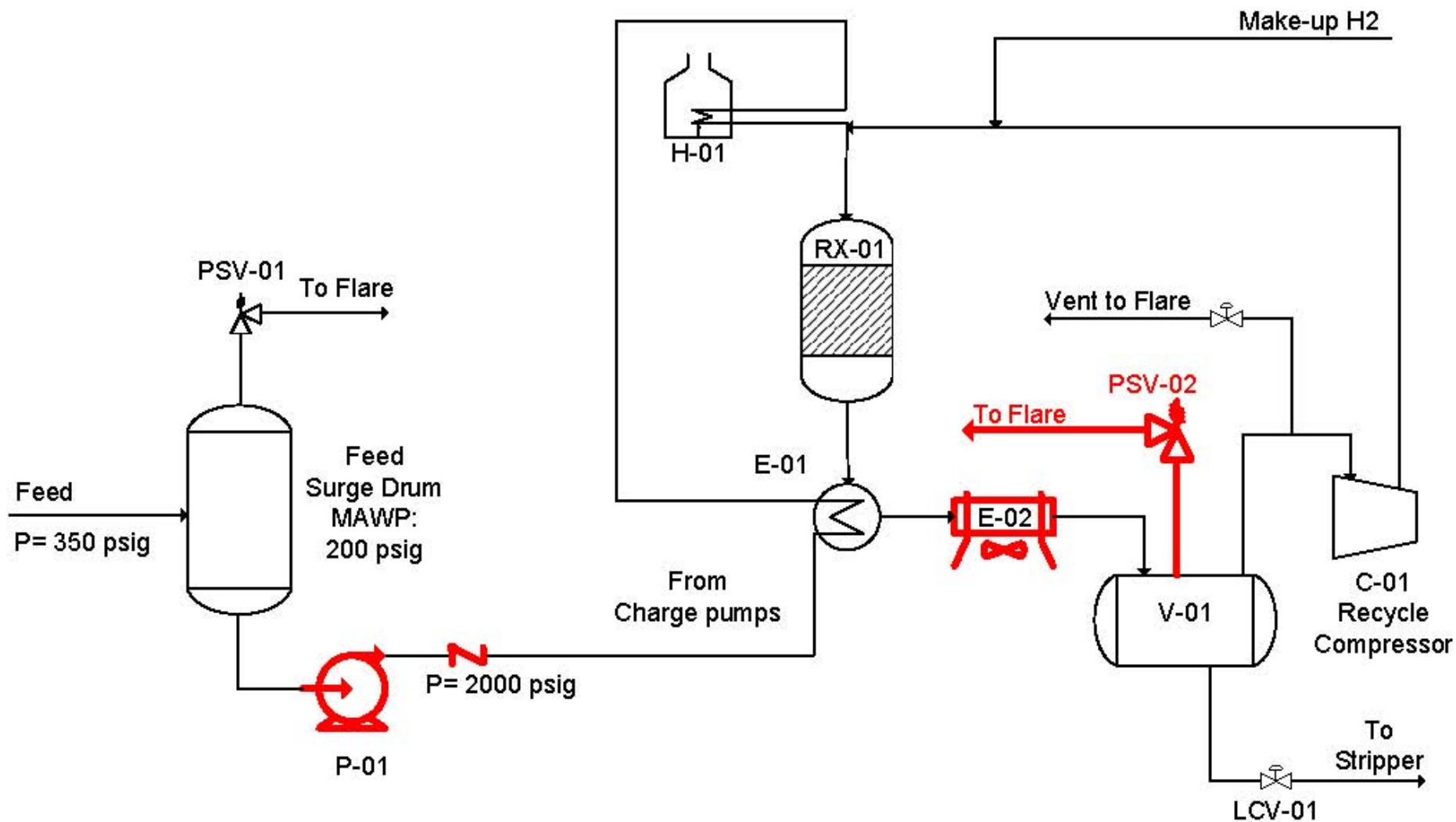
# Global Analysis



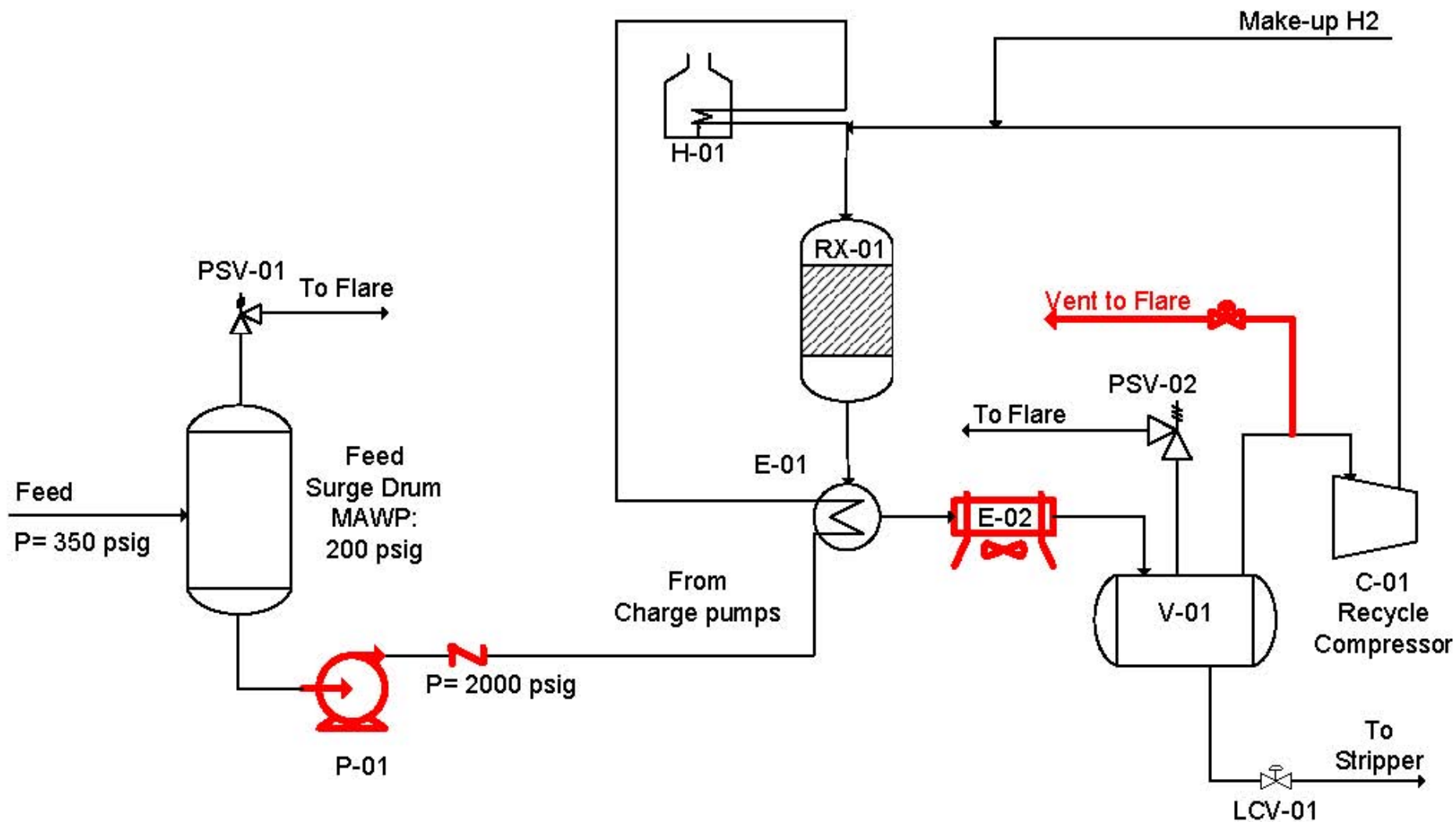
# Does Hydrogen go through PSV-01?



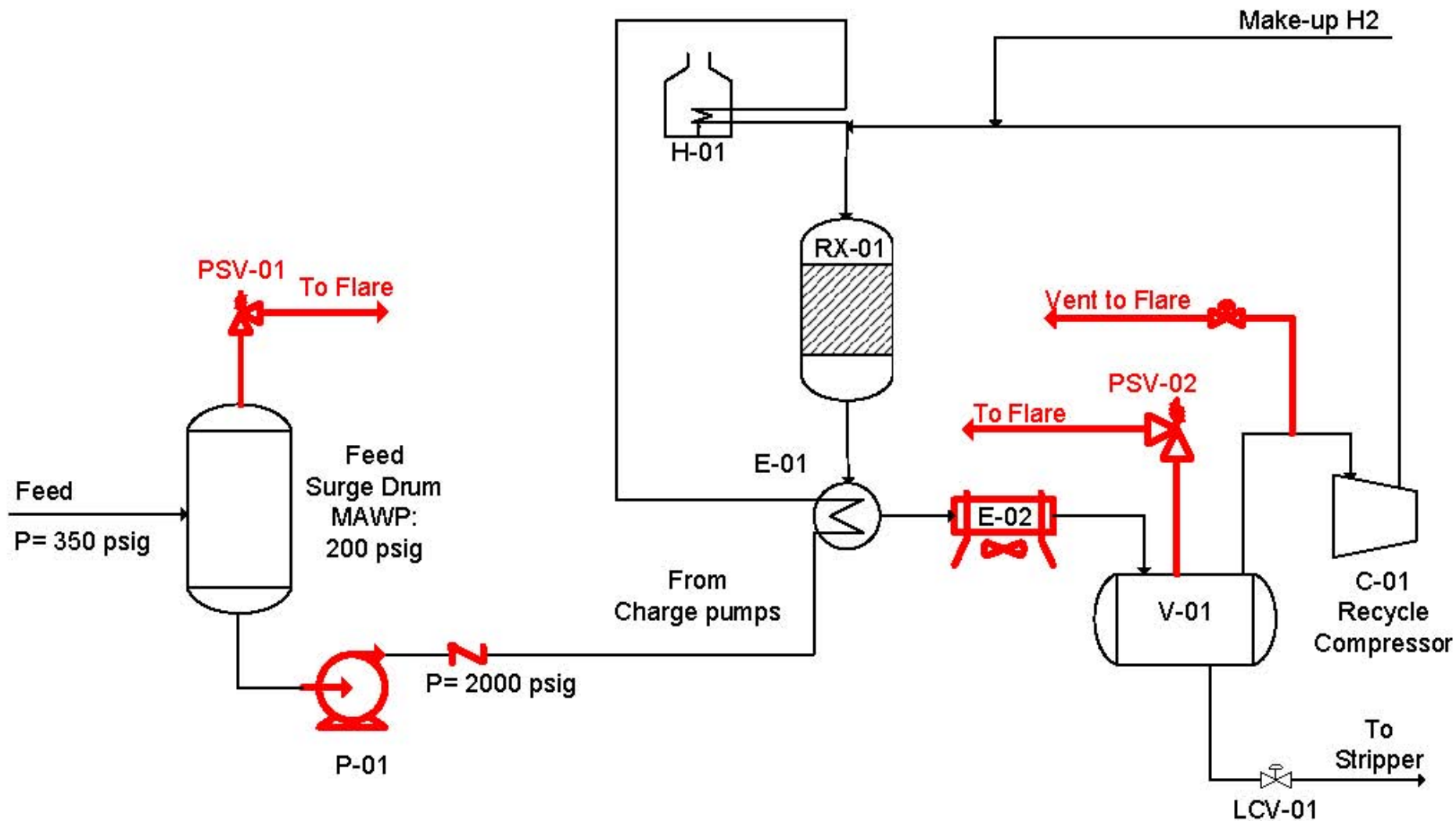
# Does Hydrogen go through PSV-02?



# Does Hydrogen go through Depressuring?



# Where Does the Hydrogen Go?



# Global Analysis

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- Detailed analysis is needed for the global analysis
- Simplifying assumptions could cause the flare to be undersized
- Need to account for the hydrogen in the system only once

Scenario	Conservative Load	Detailed Analysis
Partial Power Failure	4,801,438 lb/hr	4,260,063 lb/hr
	836,708 SCFM	747,874 SCFM

## Conclusion

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- Simplifying assumptions help make the analysis go quicker
- Sometimes they result in undersized relief devices and a detailed analysis needs to be looked at
- Simplifying assumptions are helpful most of the time
- It is the engineer's responsibility to realize when detailed analysis is required
- Detailed analysis can save large sums of money, but the analysis will take longer
- There must be a balance between schedule and detailed analysis

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# Questions?