UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE of ENGINEERING

Senior Design Project Description

Company Name	*Ametek - CSI*	**Date Submitted**	*10/30/20/2020*
Project Title	*Design and Build of a Testing Device for Sulfur Run-Down Lines* **(AMETEK_SULFUR)**	**Planned Starting Semester**	Spring 2021

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

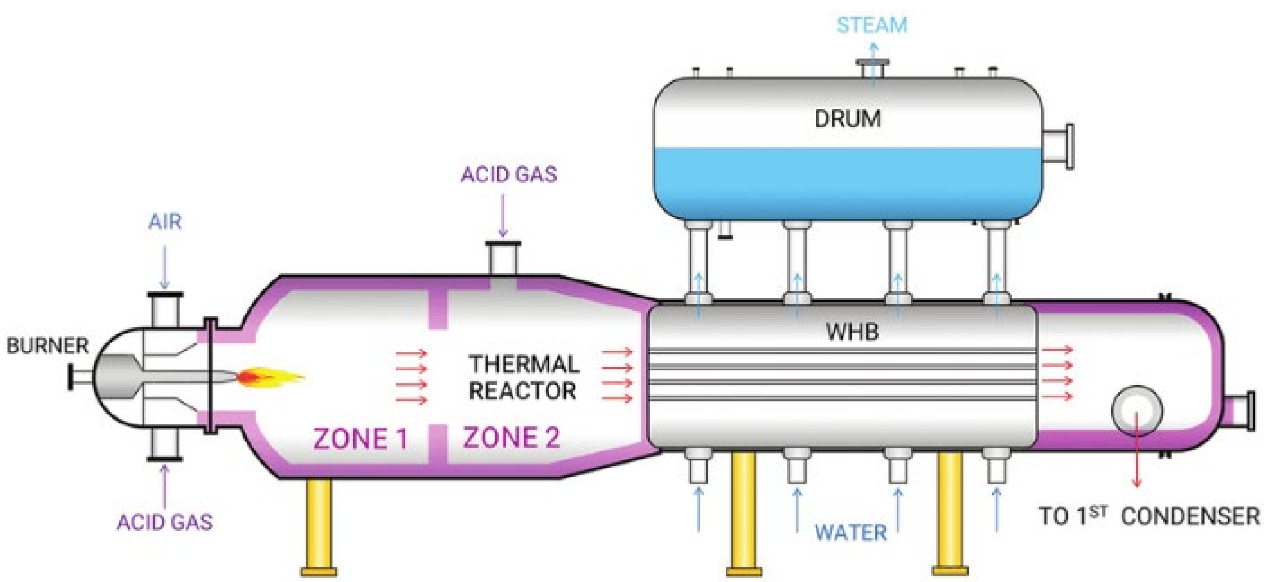
Discipline	**Number**	**Discipline**	**Number**
Mechanical	5	Electrical	
Computer		Systems	
Other ( )			

Company and Project Overview:

AMETEK, Inc. is a leading global manufacturer of electronic instruments and electromechanical devices with annual sales of approximately $4.0 billion. AMETEK has more than 15,000 colleagues at nearly 150 manufacturing locations around the world. Supporting those operations are nearly 100 sales and service locations across the United States and in 30 other countries.

Ametek - CSI is a division of Ametek Corporation and is located in Pineville, NC. CSI provides thermal maintenance systems and specialized process equipment for heating, cooling and control of liquid/vapor processes in the petrochemical, chemical, and refining industries. CSI does this through a combination of proprietary products and engineering methods developed over 40+ years of practice. The flagship products are ControTrace® engineered tracing, ControHeat® jacketing and SxSeal® Sulfur Traps. As a technology-neutral supplier, CSI evaluates all aspects for each project to deliver the most optimized heating or process equipment solution available – maximizing savings for both capital and ongoing operational costs. Some product examples:

In oil and gas refining, it is necessary to remove sulfur from the refining stream to comply with environmental regulations that help to prevent "acid rain". The oil stream is processed in a refining process to strip out sulfur in the form of Hydrogen Sulfide. Hydrogen Sulfide is sent to a unit called the Sulfur Recover Unit or SRU. The H_2S is deconstructed into Sulfur in a liquid form that drains out of a Condenser – see process diagram below:



Pictures of actual Condensers:

From the condenser, the sulfur is piped through a transition device that separates the high pressure section of the condenser from the atmospheric sulfur storage container which can be an in-ground pit or a tank. This transition device is called a “seal”.

CSI provides the refining industry with the widest available choice in sulfur sealing devices through their patented SxSeal® Product line. Choices are provided for below ground (shown on the left below) and two above ground (the two right drawings below) devices.

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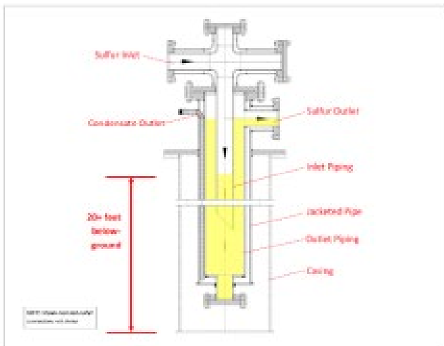

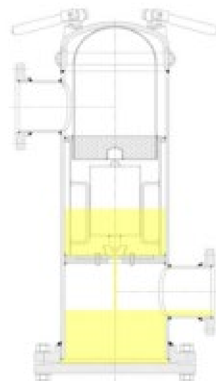

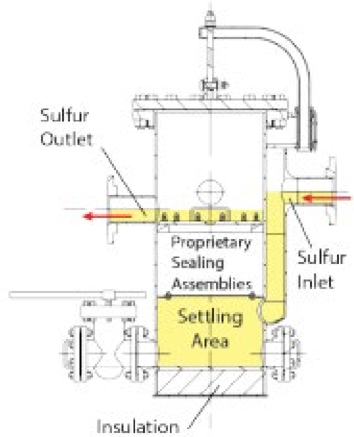

The piping between the condenser and the sealing device is called a run-down line. In most applications, there is not much vertical drop between the condenser outlet and the sealing device. When CSI designs a system, they need to ensure the geometry of the piping system is adequate to accommodate the sulfur flow and process equipment requirements. This project will help improve this design process.

<u>Project Requirements:</u>

CSI has a set of analytical tools that they use for the run-down piping design. It is critical that these calculations are correct as the sulfur flow is a dangerous substance. CSI is interested in refining their analytical methods with a physical validation model of this process. Results of the physical model will be used to anchor and improve the analytical methods.

The project team will design a test apparatus that can simulate sulfur flow through various equipment types and piping geometries. It is envisioned that the testing will be done at ambient temperatures using a test fluid which will mimic liquid sulfur viscosity. The test rig would be a device that has a small scale model condenser with different exit port configurations. The model will be fitted with a variety of scale run-down line geometries (length, slope, diameter, fittings). The model will allow for testing the geometries at different flow rates, pressures and pipe fill levels. The test fluid will be pumped through the apparatus to give a visual indication for flow conditions in the run-down lines. Student team will work with CSI to define all test conditions required to validate the analytical models. Results of the testing will be compared with analytical models for suggested changes to model parameters.

<u>Expected Deliverables/Results:</u>

The project would proceed as follows:

1. Establish a collection of run-down line configurations to be analyzed.
2. Develop a method of predicting the liquid level in the pipe using basic equations (Darcy's formula, frictional loss coefficients, Bernoulli's equation, etc.)
3. Build the collection of run-down line configurations in real life (probably primarily from PVC). Run the tests and compare to the predictions.
4. Revise the formulas (from step 2) based on the results to produce a useful tool for future run-down line sizing.

The primary deliverables would be (1) the complete set of data from steps 2 through 4, and (2) the final formula from step 5.

Disposition of Deliverables at the End of the Project:

Apparatus to be exhibited at the Expo and transitioned to CSI after the conclusion of the Expo.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Interest in fluid dynamics