FAMU/FSU College of Engineering

Department of Mechanical Engineering

**Needs Assessment and Project Scope**

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**Needs Assessment**

Gas compressors are used in the field of oil and gas to be able to compress gasses into trucks or tanks. This makes the transportation or storage of gas much more feasible by increasing the density making it possible to fit more gas into a smaller volume. The purpose of this project is to design a valve to replace the valves being used now days. To achieve this, the valve must be designed around a few parameters. The part must be reliable. It must work consistently between every open and close. The valve must also be worth its cost. The lifetime of the valve is also critical. The valve must be able to keep up with the lifetime of the current accepted valve. If the valve does fall short of this, it must be able to be quickly and easily replaced or have a much larger flow rate to justify its lack of lifetime. The valve must also be able to achieve or surpass the flow rate of the current valves. The larger the flow rate, the more compressed gas produced within the same time period, the happier the customer.

**Project Scope**

**Problem Statement**

Current gas compressor intake and exhaust valves restrict flow, which cause inefficiencies within the system. The currently accepted valve is a plate valve. The problem with these valves is that the gas must flow around the plate rather than taking a more direct efficient path. This causes a restriction of mass flow both coming in and out of the cylinder. A better flowing valve is needed. The main proposed solution is a valve that rotates to allow for flow. A mode of rotating the valve is need. Though a proposed solution, this idea is not to constrain the project.

**Justification/Background**

The project focuses on improving the valve design used in GE gas compressors. These compressors are used all over the world to compress gases for either transportation or storage. They are piston type units that operate on a dual strokecycle that uses the piston to compress gas on each forward and backward stroke. Each side of the piston requires two sets of valves, one for intake and one for exhaust.

Currently, GE compressors utilize a plate type valve for this application. A plate valve is a valve that is activated by a pressure difference that pushes against a specified spring force for the given compressor. The pressure difference at which the valve opens can be changed using different spring rates. As the pressure acts on the sprung plate, the plate is pushed forward, opening the valve and allowing the fluid to pass around the plate. While this design is relatively cost effective and is very reliable, it does not flow very efficiently due to the fact that the fluid must pass around the plate, which is not a very direct flow route.

In order to maximize efficiency of the compressor, it is important that the valve design has as high flow as possible. During each stroke of the piston, the valve creates a minor loss in the flow of fluid into the cylinder. A restrictive valve limits the flow into the cylinder, which forces the compressor to go through more cycles to pump the same amount of gas. A better flowing design can be created using a more direct flow path that would increase the overall efficiency of the pump by limiting the pumping losses of each compressor cycle.

**Objective**

 One objective is to find a means of operating a rotational compressor valve that as been previously designed. It is also possible to design and build a new type of intake and exit valve that out performs the existing plate valve designs. This valve should be able to flow gas into and out of a GE compressor more efficiently while being completely leak-tight. The new valve design must be adaptable to current GE compressors and should be cost effective. The new design must also be at least as reliable as existing designs in order to limit compressor down time during maintenance.

**Methodology**

To begin deciding what aim we will be taking for the project we will first analyze and understand the products that are already available. Once we know what valves are currently being used in the field, we can research the problems these valves currently posses.

It is also important that the gas compressor that the project is focused is well understood. This is critical to designing the valve towards the applications parameters. Some of these parameters are operating pressure, size of the valve necessary to fit the seat, and operating temperatures.

Once the style of valves already available, their weaknesses, and the compressor in which the valve will be fitted for are known, we must decided in which manner we plan to have the valve operating. Each type of operation has its pros and cons. Though some may have a more reliable operation short term, they may not have long life times.

Along with the type of valve operation, we must analyze the amount of flow rate achieved by the decided design. In this market, flow is money. The more flow per valve opening, the better. The valve must also produce efficient flow avoiding adding to much heat to the gas due to friction. With a few types of operations decided on, a decision matrix will be implemented to assure that the design decided on is indeed the best design overall. The proposed rotational valve will be included in the matrix to decide of it is one of the better choices.

After the mode of operation is known and the desired flow rate is achieved, materials for the fabrication must be chosen. The materials for the entire valve must be able to withstand long time exposure to natural gas. Further more, the valve must be airtight. No amount of gas can seep around or through the valve. So a type of seal must be implemented in which can also last the life of valve itself.

With the style of valve, the desired flow rate achieved, and necessary materials are chosen, a pro-type must be produced. To do this, we will use a 3-D modeling program such as ProE to produce a digital model of the valve. With the digital model complete, we can then produce the physical part itself. Most of the parts will be sent to the on campus machine shop to be fabricated. Any part that is too intricate to be fabricated on campus will be sent to GE to be made. Any parts such as springs and bolts will be purchased for a local store of off the Internet.

Having the part produced then allows us to build a working simulation. Along with group 19, whom are producing the digital instruments and software to be able to analyze the system, a physical representation of the gas compressor will be made. Both the sensors and valve will be modeled.

**Expected Results**

The valve should operate at a higher efficiency than the current model and have a higher factor of safety. A rotating action will open the valve as well as close it with a tight seal. This rotation may be actuated by an electric motor or a mechanical system synchronized with the compressor. Our design must be contain the complexities necessary for operation but still be simple enough to ensure durability and ease of installation.

**Constraints**

A G.E high speed reciprocating gas compressor has specific pressures and temperatures that it operates between. Exact dimensions of the space where the valve fits will constrain the size and shape of the design. The valve must be tested thoroughly to ensure that the design concept and material selected can withstand the rigors of operation. The valve must be designed, fabricated, and tested within the allotted time frame of 18 weeks and the budget determined by G.E