UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

Senior Design Project Description for SPRING 2016
Project Title: Pneumatic Pump Energy Harvesting System (IR_PROJ)

Supporter: Ingersoll Rand
Supporter Technical Representative: ASSIGNED
Faculty Mentor: _____ ASSIGNED __X__ TBD (check one)
Single Team __X__ Dual Team _____ (check one)
Personnel (EN/ET): __1__ E, __1__ Cp, _____ Cv, __3__ M, _____ SE
(Complete if the number of students required is known)
Expected person-hours: (250 per student)

Description of Project:

Pneumatic Diaphragm Pumps operate by using compressed air to expand a diaphragm and push fluid through the pump. After the pumping stroke is completed, the compressed air must be vented before the suction stroke can begin.

This compressed air contains a high level of energy that is lost while venting, resulting in significant waste and overall low system efficiency. A portion of this energy may be recovered and used to power local electronic devices such as a controller and sensors.

The purpose of this project is to design and prototype a 'muffler' for an ARO diaphragm pump that contains an energy harvesting, conditioning, and storage system.

Initial Project Requirements (e.g. weight, size, etc.):

The output must be suitable to power the ARO Dose Controller and related sensors.

The pump releases the compressed air through a port into the muffler in pulses. The pressure and flow characteristics should be quantified and used as input to the design.

Operating range of the pump is expected to be 50-120PSI air input, running at 1 - 3 cycles per second depending on system pressure.

These operating points can be evaluated to determine the pressure and flow of exhaust air that can be used to drive the energy harvesting system.

The ARO controller requires 24v input, +/- 10%. Typical current draw during operation is 1.0 Amp

The energy harvesting system must store enough energy to maintain the controller in 'standby' mode for at least ½ hour at 100mA current draw when the pump is not running.

The energy harvesting system must always store enough energy to start and maintain the pump operation until the recovered energy can be used to power the system. The exact behavior of sleep

mode for ‘low state of charge’ can be discussed in more detail.

Any resistance to the air being vented through the muffler will reduce the pumping performance. These losses should be kept to the minimum required to generate the power required by the system.

The overall sound level of the pump in operation should not increase; meaning the muffler should have approximately equal performance to the standard muffler used today.

The compressed air is typically not very clean, there is often moisture and oil entrained in the flow. Some care must be taken to protect the energy recovery components from this contamination.

The air being vented is cold due to thermodynamic effects. While this may be a benefit to some system components (generator and power management), it may be detrimental to others (batteries, for example).

Expected Deliverables/Results:

A completely functional and tested prototype shall be provided.

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

None