INDUSTRIAL SOLUTIONS LABORATORY

Company Information

Company Name	Ingersoll Rand Company	**Date Submitted**	*05/12/2022*
Project Title	*Oil Separation System Enhancements to Contact Cooled Rotary Compressors for Remote Monitoring* **(IR_SEPARATE)**	**Planned Starting Semester**	*Fall 2022*

Senior Design Project Description

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	3	Electrical	2
Computer	1	Systems	

Company and Project Overview:

Ingersoll Rand Company (www.irco.com) is a 160 year old diversified industrial equipment manufacturer, with its global headquarters located in Davidson, NC, USA. Driven by an entrepreneurial spirit and ownership mindset, Ingersoll Rand is committed to helping make life better. We provide innovative and mission-critical industrial, energy, and medical products and services across 40+ respected brands designed to excel in even the most complex and harsh conditions where downtime is especially costly. Our employees connect to customers for life by delivering proven expertise, productivity and efficiency improvements.

This project will focus on a sub-system within the Ingersoll Rand contact cooled rotary (CCR) air compressors (https://www.ingersollrand.com/en-us/air-compressor/oil-flooded-air-compressors). CCR air compressors include an oil separation system that uses a separator tank (primary – bulk separation) and a separator element (secondary - removes fine mist) to remove as much compressor oil/coolant from the compressed air as possible. Larger machines have the separator element inside the separator tank while smaller machines will have a separate “spin on” AOS element. The separator tank also acts as a reservoir for the oil and includes a site glass for visual oil level indication.

CCR compressors also include an AOS (Air Oil Separator) Scavenge System that removes oil that accumulates inside an AOS Element. The 1st goal of this project is to develop a way of controlling a solenoid to open/close based on an oil level accumulated and prevent / minimize loss of compressed air

passing through the scavenge system.

Would also like the team to identify a way to monitor the separator tank oil level over time while the machine runs to determine when additional oil should be added. Normal visual inspections occur with machine running loaded and for VSD machines, the Airend speed can also impact oil level. Oil level will change when the machine runs unloaded vs. loaded. Past efforts resulted in many false trips due to the high turbulence nature of the oil level when the machine runs.

Existing Oil changes are determined by run hours or by taking samples for lab testing. We would like the team to identify sensor(s) that can monitor the oil condition in real time so that the needed oil change can be predicted based on the actual operation of the machine.

Project Requirements:

- Identify and develop prototype separator tank oil level sensing system that records data over time for trending and monitoring.
- Identify and develop a prototype oil properties sensing system for remote condition monitoring.
    - TAN
    - Viscosity
    - Water content
    - Others??
- Develop prototype No Air Loss AOS scavenge system:
    - Develop prototype Oil level sensing method that can be integrated into AOS Element.
    - Develop prototype Oil level sensing interface with compressor controller & solenoid valve.
    - Select Solenoid valve for proof of concept.

Scope of Work

- Initial DFMEA for Concept (can provide examples)
- Phase A – Requirements – Finalize detailed project requirements.
- Phase B - Landscaping – Brainstorm different solutions, evaluate and score each.
- Phase C - Selection – Select best ideas, build prototypes & perform bench testing to verify proof of concepts
    - Ingersoll Rand can provide a compressor unit and AOS element samples for reference or test.

Expected Deliverables/Results:

- Project Plan & Schedule
- Bi-Weekly progress report
- Initial DFMEA, Gant Chart of solution ideas with scoring
- Final design concept and alternate concepts
- Working prototype(s)

- Final Design Report – (Description, Diagrams, Calculations, Schematics, Vendor Data Sheets, Drawings)
- Display Poster for Project Team

Disposition of Deliverables at the End of the Project:

Students are graded based on their display and presentation of their team's work product. It is mandatory that they exhibit at the Expo, so if the work product was tested at the supporter's location, it must be returned to campus for the Expo. After the expo, the team and supporter should arrange the handover of all work products to the industry supporter. This handover must be concluded within 7 days of the Expo.

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

- Sensor and control systems using 24Vdc control power, solenoid valves and instrumentation (end devices) interfacing with the compressor controller.
- 3D modeling of prototype concepts.
- General understanding of turbulent flow and fluid dynamics.
- General understanding of lubricants and their chemistry.
- Ability to travel to the IR Davidson NC facility, Mileage will be reimbursed per ISL purchasing policies.