UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE of ENGINEERING

UNC Charlotte – Lee College of Engineering Senior Design Program

Senior Design Project Description

Company Name	*CIRCOR*	**Date Submitted**	*5/21/2019*
Project Title	*Augmented cooling for Twin-Screw pumps* **CIR_PUMP**	**Planned Starting Semester**	Fall 2019

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	4	Electrical	
Computer		Systems	
Other ( )			

Company and Project Overview:

CIRCOR is a market-leading, global provider of integrated flow control solutions, specializing in the manufacture of highly engineered valves, instrumentation, pumps, pipeline products and services, and associated products, for critical and severe service applications in the oil and gas, power generation, industrial, process, maritime, aerospace, and defense industries.

The CIRCOR facility in Monroe NC manufactures Twin-Screw, 3-Screw and Gear pumps for a wide range of Industrial applications including chemical processing, mining, lubrication, hydraulics and oil production.

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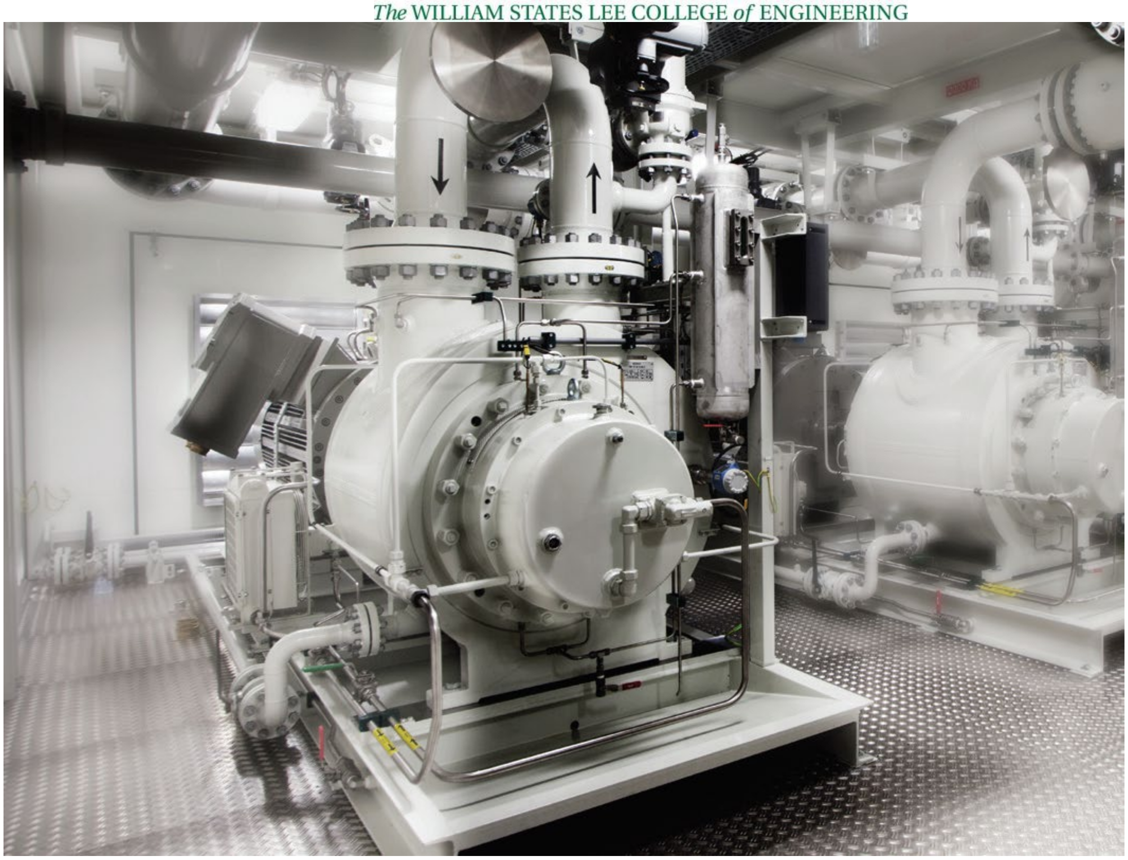

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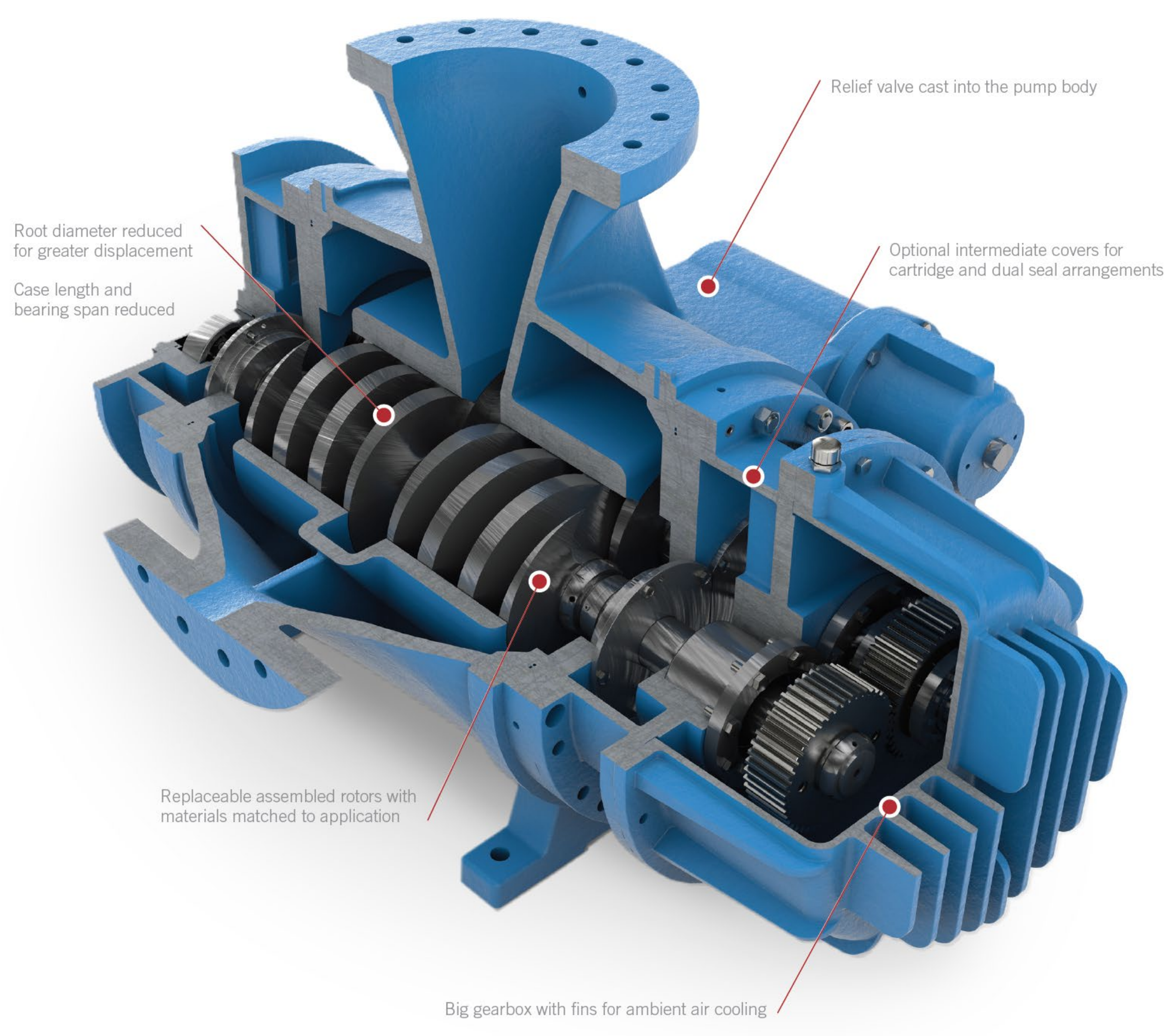
Project Requirements:

CIRCOR manufactures a wide range of Twin-Screw pumps under the Houttuin, Warren and Tushaco brand names. These are used in a range of difficult pumping applications – typically as the “pump of last resort” where other pump types would fail to operate reliably. An example of the pump is shown below.



A critical part of the Twin-Screw pump is the gearbox which transmits power between the two screw rotors and provides timing that allows the screw rotors to operate without contacting each other. The gears and associated bearings within the gear box are oil lubricated and cooling on lower power/speed services is via free air convection from the gearbox housing. Ribs are often added to the gearbox housing to increase the surface area and effectiveness of the convection.

In order to maintain adequate oil viscosity, the gearbox oil temperature limit is normally limited to 180°F (82°C) or less. The amount of heat dissipation capacity is further controlled by the environment the pump will be installed into. For example, in some Middle East locations the ambient air temperature can routinely exceed 120°F (49°C).

When the heat generated by the gears and bearings exceeds the heat dissipation capacity by free air convection, the current solution is to install a circulated oil system whereby an external system of pumps, valves and coolers circulates the oil through the gearbox and a cooler in order to regulate the oil temperature. Depending on the customer requirements these systems can cost anything from $20,000 to $100,000 or more, significantly adding to the cost of the pump.

The goal of this project is to extend the limits where convection cooling of the gear box housing can be utilized. We envisage that use of a shaft driven fan is the most effective way to increase the convection coefficients resulting in much higher cooling, however the project team may consider other methods to augment this. Some aspects to be considered are:

- Minimum effective fan speed
- Fan volume or airspeed optimization
- Gear housing design to optimize cooling
  - Material
  - Size & Surface area
  - Configuration (fins) or other shapes
- Internal liquid volume
  - Is circulation required?
  - Is there benefit to having the gears splash the oil against the upper portions of the gear housing?
- Shroud design for safety and to optimize cooling
- Noise considerations
- Design standardization and sizing tools
- Effect of painting or other coatings

Emphasis should be placed on (in no specific order):

- Maximized heat removal
- Minimized overhung weight
- Minimized sound level increase
- Minimized cost
- Minimized component lead time
- Focus on lack of user interface requirements
- Minimized maintenance and repair requirements

Expected Deliverables/Results:

- A documentation of design optimizations explored and the effect of each on cooling effectiveness vs. other tradeoffs such as complexity/leadtime/cost/size etc.
- CFD/FEA analysis (and/or scale model testing) showing the preferred solution(s) of the design team.
- Engineering drawings and 3D models of the components proposed for the preferred solution(s) of the design team.

- An Excel based tool for the suitable sizing and computation of the fan cooling performance.
- An example costed BOM showing the predicted incremental cost of the preferred solution(s) over baseline.

Disposition of Deliverables at the End of the Project:

Disposition will be per the standard process*Hardware developed is the property of the Industry Supporter. The work product is displayed at the last Expo then immediately handed over to the supporter.*

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

- Knowledge of 3D modelling (SolidEdge preferred)
- Knowledge of CFD/FEA for thermal analysis (ANSYS preferred)
- Understanding of casting, fabrication and machining processes
- Understanding of GD&T as it relates to component dimensioning, tolerancing and drawing
- Microsoft Excel