Risk Assessment
Safety Plan

Project information:

Name of Project	Date of Submission
High Speed Motor Test Stand (Team 05)	03/02/2018

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Faculty mentor	Phone Number	e-mail
Dr. McConomy	(850)410-6624	smcconomy@eng.famu.fsu.edu
Dr. Shih	(850)410-6321	shih@eng.fsu.edu
Dr. Hollis	(850)410-6319	hollis@eng.fsu.edu

I. Project description:

Danfoss is tasking Team 05 with designing a system that can measure motor efficiency at standard operating speeds for motors inside various Danfoss Turbocor compressors. Team 05 will determine the best way to measure output power for efficiency calculations and the best way to couple the motor shafts for operation at high speeds. It is important to note that this is a continuation of a senior design project from the past two years. It is this year's team's goal to improve upon the previous teams' design. The contributions of the previous teams include a testing frame, two different types of couplers for the motor shaft, and a laser alignment tool, which Team 05 will attempt to utilize in their design. Team 05 will spec out a torque transducer for possible future senior design teams to purchase, design a mock torque transducer for proof of concept, and design a safety shield to maintain safe operating conditions while testing the system.

II. Describe the steps for your project:

The shaft, shaft extender and coupler connector are balanced at Danfoss. These parts will then be put back in the compressors. The mock torque transducer is then fixed to the test stand. The couplers are mounted onto the coupler connector and the motors are positioned on the test stand and coupled to the torque transducer. Using the laser alignment tool, the shafts will be properly aligned with the use of shims and the axial alignment screws on the test stand. Then safety shield is dropped into place and the power connectors will then be attached. The software is connected to the compressors and calibrated. The speed of the compressor is then ramped up to 10,000 RPM.

III. Given that many accidents result from an unexpected reaction or event, go back through the steps of the project and imagine what could go wrong to make what seems to be a safe and well-regulated process turn into one that could result in an accident. (See examples)

-Possibly getting a finger or hand pinched when assembling
-Part of rotating assembly breaking off during operation and becoming a projectile
-Dropping a small object which can fit through the safety shield onto the assembly during operation
-Getting hair, jewelry, or clothing caught in the rotating parts
-Failure to properly align motor shafts can cause vibrations and structural damage
-Exposed heated parts of the compressor can cause burns

IV. Perform online research to identify any accidents that have occurred using your materials, equipment or process. State how you could avoid having this hazardous situation arise in your project.

There are many documented cases of accidents that have occurred while working with machines that have exposed rotating parts. In many cases, machine guards were removed or bypassed because they were inconvenient for the operator. We could avoid this in our project by making sure the safety shield does not make the operators job more difficult.

V. For each identified hazard or "what if" situation noted above, describe one or more measures that will be taken to mitigate the hazard. (See examples of engineering controls, administrative controls, special work practices and PPE).

We will inspect each part of the rotating assembly to look for signs of stress and make sure that no parts are close to failure and ensure the couplings are properly secured to the mock torque transducer and the coupler connector. We will enforce standard machine shop attire ensuring that no loose clothing, hair, or jewelry will be caught in the machine. We will keep track of the location of all the tools used in the process so that when we run tests we will make sure nothing gets left or dropped in the rotating assembly. During the alignment process we will ensure that a supervisor is present to ensure that the shafts are properly aligned After the tests have been completed we will set a standard cool down time of 10 minutes to let the compressor reach a safe working temperature.

VI. Rewrite the project steps to include all safety measures taken for each step or combination of steps. Be specific (don't just state "be careful").

The shaft, shaft extender and coupler connector are balanced at Danfoss. The parts will be inspected for stress indicators and then will be put back in the compressors. The mock torque transducer is then fixed to the test stand. The couplers are mounted onto the coupler connector and the motors are positioned on the test stand and coupled to the torque transducer. The couplers and the shaft bolt are inspected for their proper torque rating. Using the laser alignment tool and with a supervisor present, the shafts will be properly aligned with the use of shims and the axial alignment screws on the test stand. The motor bolts are also checked for proper torque ratings. Then safety shield is dropped into place and the power connectors will then be attached. The software is connected to the compressors and calibrated. A safe area is designated and cleared, and the users operating the system will check for any loose clothing or accessories that may interfere with the test. The speed of the compressor is then ramped up to 10,000 RPM. Once the test is completed a cool down period is assigned for users to avoid accidental injuries from the hot compressor.

VII. Thinking about the accidents that have occurred or that you have identified as a risk, describe emergency response procedures to use.

The motor power would be immediately cut off via a lever and the incident will be evaluated on site. Emergency medical staff would be contacted if necessary. The incident would then be reported to the relevant supervisors and a cause analysis program will be initiated.

VIII. List emergency response contact information:

- Call 911 for injuries, fires or other emergency situations
- Call your department representative to report a facility concern

Name	Phone Number	Faculty or other COE emergency contact	Phone Number
William Sun	(850) 504-4800	Shane McConomy	(850) 410-6624

IX. Safety review signatures

- Faculty Review update (required for project changes and as specified by faculty mentor)
- Updated safety reviews should occur for the following reasons:
  1. Faculty requires second review by this date:
  2. Faculty requires discussion and possibly a new safety review BEFORE proceeding with step(s)
  3. An accident or unexpected event has occurred (these must be reported to the faculty, who will decide if a new safety review should be performed.
  4. Changes have been made to the project.

Team Member	Date	Faculty mentor	Date
	3/1/18		1-3-18
	3/1/18		
	3/1/18		
David Sullivan	3/1/18		

Report all accidents and near misses to faculty mentor.