Risk Assessment
Safety Plan

Project information:

High Speed Motor-Generator Test Rig		10-30-15
Name of Project		Date of submission
Team Member	**Phone Number**	**e-mail**
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Faculty mentor	**Phone Number**	**e-mail**
Dr. Patrick Hollis		Phollis@my.fsu.edu

I. Project description:

A test rig system for high speed compressors is needed to test compressor performance. This system will operate up to 40,000RPM and requires high amount of accuracy. Project focus will be on a platform to mount and accurately align the compressor shafts, as well as provide a suitable flexible coupler for the system and a torque transducer. Due to the high speeds, a failure within the system could be catastrophic to the equipment and individuals. There will be a focus upon intuitive system set up design to minimize chances of human error. Components of original design must be extensively analyzed and tested to develop a safe motor-generator test rig.

II. Describe the steps for your project:

Conceptual Design: Resource with Turbocor (sponsor), faculty staff, and faculty advisor to evaluate proposed design concepts. Background research upon motor-generator at the CAPS (Center for Advanced Power Systems) will provide a basis and generic direction for the test rig.

Design Selection and Analysis: From proposed concepts, select a final design that will meet all of the sponsor's specifications. Understand the risks with the design and where extra focus needs to be made for further development. Evaluate power output to predict stresses that will be experienced in the coupling and motor mount hardware. Communicate with faculty and sponsor for regular feedback. CAD drawings will be added to the project and design analysis proves likelihood of success.

Prepare for product production: After a final design is reached, resource for material and component supply. May require outsourcing of components due to time restrictions. There is also likelihood that due to the complexity of components, like the coupler, that outsourcing will be required.

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)

Test Rig Construction Accidents: Due to the heavy weight of the compressors, there are safety risks with the transportation of heavy equipment and possibility that they could be dropped onto an individual. The construction process may require the use of tools such as: impact wrench, grinder, and hydraulic lift. These should be used by trained individuals who understand the proper operational use.

Test Rig Operation Accidents: During the use of the test rig at high speeds, component failure could be catastrophic. The use of a protective shield over the test rig is necessary, parts may work themselves free and become lethal projectiles. If the compressor mounting bolts fail during operation, the compressor may cause bodily injury to nearby individuals. It is recommended that during operation of the test rig, individuals should be at a safe distance with a shielding material between them and the test rig.

Procedure For Accidents: If a harmful accident occurs, the following should be followed: Administer first aid, Seek emergency medical attention, contact the supervisor or trainer, and inform Dr. Gupta and TA's. Additionally, disconnect power supply to tooling and/or test rig.

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.

Although no specific documentation was found that showed past accidents, the errors that could occur in the equipment could lead to bodily harm.

Coupling failures arise from improper coupling selection, errors made during installation, and operating beyond design capabilities[1]. These will cause severe vibrations to occur and will shorten the life of the coupling. Signs up coupling failure will be propagating crack, elongated bolt holes, and discoloration. It is important that precision balancing be preformed upon the coupling due to the high speeds of the system.

These failures can be avoided by increasing the attention to detail during design, installation, and use of the system. During design, members must thoroughly understand the constraints and insure that the coupling selection meets the criteria. In installation, it is important to follow assembly procedures provided by the manufacturer. This may include, tightening hardware to torque specifications.

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).

It is very important to inform all involved individuals of this project the dangers at stake. By doing so, it may instil a higher work effort to avoid hazardous situations. If an individual does not feel safe or capable of being involved in the design, assembly, or operational phase of the system, they should express this to their team. This would insure that those making critical decisions are well prepared and confident in their work. This includes all tasks ranging from tool operation to concept analysis.

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").

During the concept design and analysis, members ought to regularly consult faculty staff to review work and provide their professional input. All mathematics work should be double checked for mistakes. The sponsor company will be included in the analysis and design process for their thorough understanding of the complete system.

In the assembly phase, experienced individuals will handle the tooling. The shaft alignment process is very critical and the user of the alignment tool must be familiar with the operation and well practiced. Those using machining equipment for components must be properly trained and wearing appropriate clothing.

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

1.Administer first aid.

2.Contact emergency medical responder.

3.Contact supervisor/trainer, Dr. Gupta, and TA's.

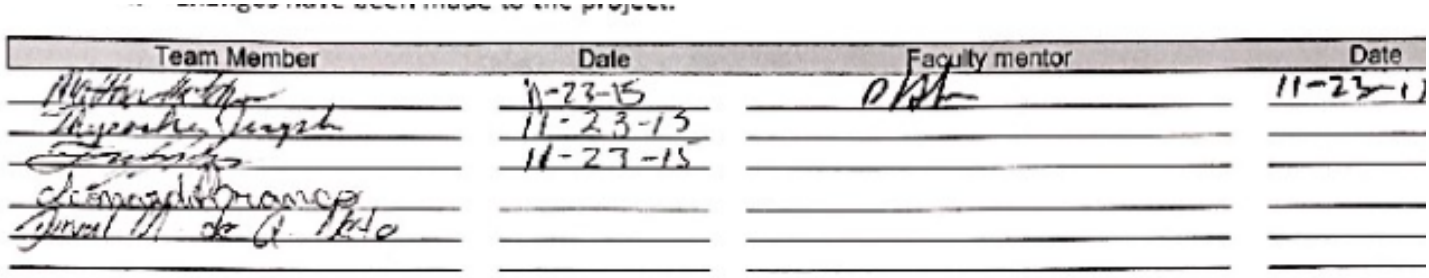
VIII. List emergency response contact information:

- 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
Dr. Nikhil Gupta	(850) 410-6201	(Dr. Gupta email) Ng10@my.fsu	
Dr. Chiang Shih	(850)410-6321	(Dr. Shih email) Shih@eng.fsu.edu	

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
	11-23-15		11-23-15
	11-23-15		
	11-23-15		

Report all accidents and near misses to faculty mentor.

References:

1. **http://www.applied.com/site.cfm/Tracking_the_Causes_of_Coupling_Failure.cfm, accessed on October 26, 2015.**