

Senior Design Project Description

Company Name	EPRI	Date Submitted	May 9, 2017
Project Title	EPRI Quadcopter Design Optimization and Base Station Development (EPRI_QUAD4)	Planned Semester	Fall 2017

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project. 250 hours are expected per person.

Complete the following table if this information is known, otherwise the Senior Design Committee will develop based on the project scope:

Discipline	Number	Discipline	Number
Mechanical	3	Electrical	3
Computer		Systems	
Other ()			

Project Overview:

Amid the Fukushima Daiichi nuclear disaster in 2011, the international community and nuclear power industry are trying to improve methods in which utility companies can respond to beyond design basis events in nuclear power plants. The term “beyond design basis” is used to describe accident sequences that are possible but were not fully considered in the design process because they were judged to be too unlikely [1]. As a result, a practical solution is required for the task of collecting pertinent field data in locations that are potentially uninhabitable following a beyond design basis event, or for use in situations where it could be more cost effective or risk averse to use an unmanned technology to collect data.

In 2015 and 2016, EPRI in collaboration with the University of North Carolina at Charlotte Senior Design Program developed a prototype quadcopter and base station, as a proof of concept, to demonstrate the ability for unmanned technology to monitor environmental conditions within a nuclear power plant containment facility. This project expands upon the 2015 and 2016 research by further developing the requirements for optimization of the quadcopter and development of a base station. The base station should be designed to survive and maintain operability following a beyond design basis event or severe accident. The base station must also be able to charge, store, and communicate with the quadcopter, as well as collect pertinent data from the environment. A proof of concept prototype using a fiber optic connection to separate controller station for data collection and quadcopter operation is desired. In addition, a minimum duration of 30 days of quadcopter operation is desired. Topics that are expected to be investigated in this research include: base station geometry, safety and material selection, battery life, radiation



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susceptibility of instruments, quadcopter automated controls and optimization, radiation detector technology for isotope detection, and communications technology. Existing rover/drone technology could be reviewed and utilized to the extent possible but new technology may also be required to support this research.

[1] US NRC website, <http://www.nrc.gov/reading-rm/basic-ref/glossary/beyond-design-basis-accidents.html>

Initial Project Requirements:

Design Objectives:

1. Create detailed design of base station and optimized quadcopter design
2. Demonstrate integrated quadcopter and base station designs

Expected Deliverables/Results:

Requirement and Goal Overview:

1. Quadcopter Base Station
 - a. **Requirement:** Using the prior research, design a charging and storage location for the quadcopter that can withstand severe accident conditions in a nuclear power plant. The following aspects should be addressed in the design:
 - i. Temperature resistance – TBD
 - ii. Radiation resistance – TBD
 - iii. Humidity resistance – withstand conditions at 100% humidity
 - iv. Pressure resistance – TBD
 - v. Size – Locatable inside nuclear power plant containment facility
 - vi. Durability – Insulated, and blast proof
 - vii. Weight - TBD
 - viii. Battery capacity and Lifetime – 2 years of maintenance free service
 - ix. Sensing capabilities – humidity, pressure, and radiation at a minimum
 - x. Charging capabilities – for one quadcopter in 15 minutes or less
 - xi. Communication capabilities – Optical transmission to operator and data monitoring center; wireless communication from base station to quadcopter
 - b. **Goal:** Manufacture a working prototype of quadcopter and base station for demonstration
2. Quadcopter Optimization
 - a. **Requirement:** Using the prior research, optimize quadcopter
 - i. Design charging system that can restore quadcopter system battery life (including video battery) without opening chassis
 - ii. Design initialization system to power and start quadcopter function without opening chassis or accessing quadcopter
 - iii. Manufacture working prototype



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- b. **Goal:** Optimize Quadcopter
 - i. Incorporate additional sensor technology
- 3. Quadcopter and Base Station Integration
 - a. **Goal:** Develop and manufacture a working prototype (limited functionality) of integrated quadcopter and base station design for demonstration

Note: Design objectives from prior developments shall be maintained unless an authorized deviation is approved by EPRI.

Disposition of Deliverables at the End of the Project:

Deliver to EPRI – Stephen Lopez (unless the project will be continued by future teams)

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

None