UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

Senior Design Project Description

Company Name	Areva Federal Systems	**Date Submitted**	Nov 22, 2017
Project Title	Next Generation Reactor Containment Building Study (AREVA_NGEN)	**Planned Starting Semester**	Spring 2018

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	6	Electrical	
Computer		Systems	
Other ( )			

Project Overview:

AREVA Federal Services LLC (AFS), a subsidiary of AREVA Nuclear Materials, combines the capabilities, technologies and resources from multiple AREVA companies to serve the United States Department of Energy (DOE) and its subcontractors in all phases of the nuclear fuel cycle. AFS provides key services as an active member in various projects that support DOE's five strategic services: Environmental Management (EM), Nuclear Energy (NE), Office of Science (SC), Office of Energy Efficiency & Renewable Energy (EERE) and National Nuclear Security Administration (NNSA).

AFS develops and explores advanced nuclear science, such as new nuclear energy generation and recycling technologies, to advance proliferation-resistant nuclear fuel technologies that maximize energy from nuclear fuel. One area of current investigation is in the area of next generation reactors. These reactors are being designed to avoid the difficulties with construction costs and schedules that plague current design technology. This project is to analyze and study the mechanical design aspects of Reactor Containment Building technology for a TerraPower reactor design. TerraPower was founded when Bill Gates and a group of like-minded visionaries decided that the private sector needed to take action in developing advanced nuclear answers for pressing global needs.

Project Requirements:

Many current reactor containment structures are of a dome-like structure in order to contain hypothetical accident transient pressures produced from steam and fission off-gas releases. The next generation reactors (e.g., molten salt reactors) do not have the potential of developing extremely high internal pressure accident scenarios. As a potential means to save money during the construction phase, developers of these reactors are considering the financial benefits of moving to box-like containment structure (e.g., reduced building materials costs, labor costs, and time-cost). In this proposal, AREVA suggests a preliminary assessment be made of the benefits associated with moving from a dome-like structure to box-like structure for the reactor containment building (RCB) of TerraPower's traveling wave reactor (TWR) project (sodium cooled reactor).

Expected Deliverables/Results:
This project would specifically address the following activities:

- Become familiar with TerraPower's TWR; specifically identifying hypothetical accident conditions within the RCB for the TWR (e.g., pressure transient and duration of the transient)
- Identify a light water reactor (LWR) similarly sized to the TWR (approximately same electrical power output), which may be operational, shutdown (e.g., La Crosse or Big Rock Point reactors), or proposed
- Identify hypothetical accident conditions within the RCB for this LWR (e.g., pressure transient and duration of the transient)
- Utilizing the design of the (presumably dome-like) LWR RCB either develop a conceptual box-like equivalent RCB for the LWR or develop a comparable dome-like RCB for the TWR, initially assuming the same hypothetical accident conditions used to design the LWR RCB (i.e., design pressure)
    - If the box-like structure was developed for the LWR, then examine the impact to the RCB as a result of changing the LWR to the TWR hypothetical accident conditions
    - If the dome-like structure was developed for the TWR, then examine the impact to the RCB as a result of changing from the LWR to the TWR hypothetical accident conditions, including internal pressurization and external loads such as seismic, wind and tornado effects
    - Examine the best design option for the box type RCB; i.e reinforced concrete, steel or steel plated modular construction
- Identify the differences between the LWR dome-like RCB versus the TWR box-like RCB including:
    - Differences in the bill of materials
    - Advantages of equipment layout in construction and operations
    - Differences in physical construction costs (labor, ancillary equipment, etc.)
    - Impact to construction schedules
    - Potential impacts to reactor operations (e.g., does it limit conditions of operation?)
- Calculate the approximate (order of magnitude) costs associated with building a dome-like structure for a LWR and those associated with building a box-like structure for comparable electrical power output

These activities should be considered scoping in nature and not concise estimates. They are aimed at establishing an (major) advantage next generation of nuclear reactors may have over existing LWRs with respect to initial capital costs, while also supporting cost estimates per kW-hr for these next generation reactors.

Disposition of Deliverables at the End of the Project:

Deliver to Areva at the conclusion of the Expo.

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

- Interest in structural materials background