

Senior Design Project Description

Company Name	EPRI Technology Innovation	Date Submitted	Nov 8, 2017
Project Title	Seismic Spent Fuel Storage Sloshing Analysis (EPRI_SLOSH)	Planned Starting Semester	Spring 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	6	Electrical	
Computer		Systems	
Other ()			

Project Overview:

The Electric Power Research Institute (EPRI) conducts research, development, and demonstration projects for the benefit of the public in the United States and internationally. As an independent, nonprofit organization for public interest energy and environmental research, we focus on electricity generation, delivery, and use in collaboration with the electricity sector, its stakeholders and others to enhance the quality of life by making electric power safe, reliable, affordable, and environmentally responsible.

One of the operations in a nuclear power facility is storing spent fuel rods. For safety considerations the spent fuel rods are stored underwater in a Spent Fuel Pool (SFP). In the design and operation of the SFP, engineers need to know how much water would be lost during an earthquake. Too much water loss could allow for unwanted radiation release, so this is an important factor in the design and operation.

The purpose of this project is to develop a simplified way of doing the water loss calculations and building a small scale physical model of a SFP. Testing with the model will define what correlation is possible with a model compared to the analysis derivations.

Project Requirements:

It would be useful to have an analysis that could evaluate the amount of water lost from a Spent Fuel Pool (SFP) due to sloshing during an earthquake. Complicated time-history analysis tools are



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available to perform the calculations but a more simplified tool or process derived from more complicated analyses would be helpful. Ideally, the results could be formulated into a simplified spreadsheet tool that could estimate the sloshing losses using basic SFP geometry and the necessary earthquake parameters (e.g. peak acceleration, frequency content, duration, etc.).

The Spent Fuel Pools can be treated like concrete rectangles around 40 ft long, 25 ft wide, and 40 ft deep, open at the top, and filled with water up to about 1 ft of freeboard. The walls and floor are very thick to provide radiation shielding so the pool can be treated like a rigid body. When it shaken by an earthquake, some of the water splashes out. There are fuel racks sitting in the bottom 10 ft but they can be ignored for sloshing purposes.

There are complicated fluid dynamics programs that can do detailed analyses but they can be expensive to use so it isn't done very often. EPRI will attempt to get the results of one of these analysis for comparison purposes. Something that could be done more simply would be nice to have, even if the answers weren't perfect. That is the objective of the project. EPRI will work with the students on assumptions necessary for undergraduate students to develop a model.

We are currently using a simplified, conservative estimate using hand calculations (EPRI will provide the current method). We calculate a sloshing frequency and sloshing height in each horizontal direction, combine the two heights by SRSS, and assume you lose that height of water over the entire surface area of the pool. It may be conservative by factors of 5 to 10. For our recent calculations, we could live with that conservatism but something a little smarter would be the objective.

A scale model will be designed and built to simulate these events and determine if the physical scale model can be useful in correlating to the analytical model.

Expected Deliverables/Results:

- Simplified predictive model for water loss
- Small scale prototype of a SFP and correlation of test data to predictive model

Disposition of Deliverables at the End of the Project:

Sponsor to advise if the prototype is to be transferred to EPRI, discarded or donated to UNC Charlotte for possible uses such as STEM outreach and discarded after it no longer has that purpose.

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

- None