UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE of ENGINEERING
Industrial Solutions Laboratory

Company Information

Company Name	*Electric Power Research Institute (EPRI)*	**Date Submitted**	*05/03/2021*
Project Title	Steam Turbine Solid Particle Erosion Damage Vulnerability Detection Method **(EPRI_ERODE)**	**Planned Starting Semester**	*Fall 2021*

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	**Number**	**Discipline**	**Number**
Mechanical	4	Electrical	
Computer		Systems	1
Other ( )			

Company and 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.

EPRI has collaborated with the electricity sector and its stakeholders since 1972 and our membership has grown to represent approximately 90% of the electric utility revenue generated in the United States and extends to participation in more than 38 countries. The worldwide membership that supports our work comprises more than 1,000 organizations. While most members are electric utilities, others are businesses, government agencies, regulators and public or private entities engaged in some aspect of the generation, delivery, or use of electricity. Through their advisory roles in EPRI, its research sectors and programs, EPRI members help inform the development of EPRI's annual research portfolio, identify critical and emerging electricity industry issues, and support the application and technology transfer of EPRI's research and development. This project will investigate improved methods for determining Solid Particle Erosion in Steam generators.

Project Requirements:

Rotating equipment of power plants are critical systems with many failure mechanisms that cannot

be evaluated during operation. To ensure safe and reliable operation, these systems require routine maintenance and inspection to identify and assess degradation. Frequency of these inspections depend on the equipment design and operation stressors applied to the system.

Solid Particle Erosion (SPE) is a damage mechanism on steam turbines in fossil power plants that impacts turbine safety and reliability. The source of SPE in steam turbines is from exfoliation in boilers and heat recovery steam generators (HRSG). Solid particles travel through the admission and reheat steam pipe work and erode Steam Turbine valves and high temperature blading where steam velocity vectors are amplified during routine and off-design operating conditions.

Steam turbine valves and steam paths vary by design. Therefore, quantifying the damage to the direct components is very difficult without performing routine overhaul inspections. However, if there were a way to correlate the damage based on influence of the admission and reheat steam, the risk could be managed without requiring frequent and costly maintenance activities.

Expected Deliverables/Results:

The UNCC design team would define and execute a project to develop a monitoring solution.The steps envisioned may include:

1. Understanding the degradation mechanism and failure locations.
2. Analytical determination of erosion behavior (particle hardness, particle size, steam velocities, target material erosion properties, etc.)
3. Concept and testing of an existing, or sacrificial erosion monitoring feature.
4. Development of a non-invasive inspection method to track and trend erosion impact. The inspection technique for monitoring should not include valve or turbine disassembly.
5. Theoretical correlation to specific steam turbine design feature locations. This is expected to be an analysis of selected geometry to determine a correction factor to quantify risk associated with critical failure locations.

Disposition of Deliverables at the End of the Project:

The prototype system and a technical write-up of the system would be demonstrated at the Expo and transitioned to EPRI after the conclusion of the Expo.

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

- Solid modeling
- 2-D Computational Fluid Dynamics (CFD) with particle simulation
- Destructive Testing for Erosion Properties
- Materials (low alloy and martensitic stainless steels)
- Non-Destructive Volumetric Inspection Testing Methods

- Failure Modes and Effects Analysis (FMEA)
- SEGR 4142 for SE student