INDUSTRIAL SOLUTIONS LABORATORY

Company Information

Company Name	*Electrical Power Research Institute*	Date Submitted	*11/08/2024*
Project Title	*Software Tools Supporting Analysis and Comprehension of Operation Experience Data (EPRI_ANALYSIS)*	Planned Starting Semester	*Spring 2025*

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		Electrical	
Computer		Systems	5

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 the public interest, 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 35 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.

Project overview:
EPRI has a collection of 2300 curated and categorized events that has processed using excel. This project will look at developing:

1. a software tool to support intake, curation, categorization and configuration control (i4C tool) of the review process of operational data for nuclear power plants
2. A software tool that provides visualizations and summaries of the categorized data (NICK).

Operational data on this context should be understood as any record that describes an event that can be either a normal or abnormal occurrence (such as maintenance workorders, operator logs or equipment or human failures). The events will be mostly descriptions in natural language with some predefined fields (such as plant, system, type of activities, date, etc.)

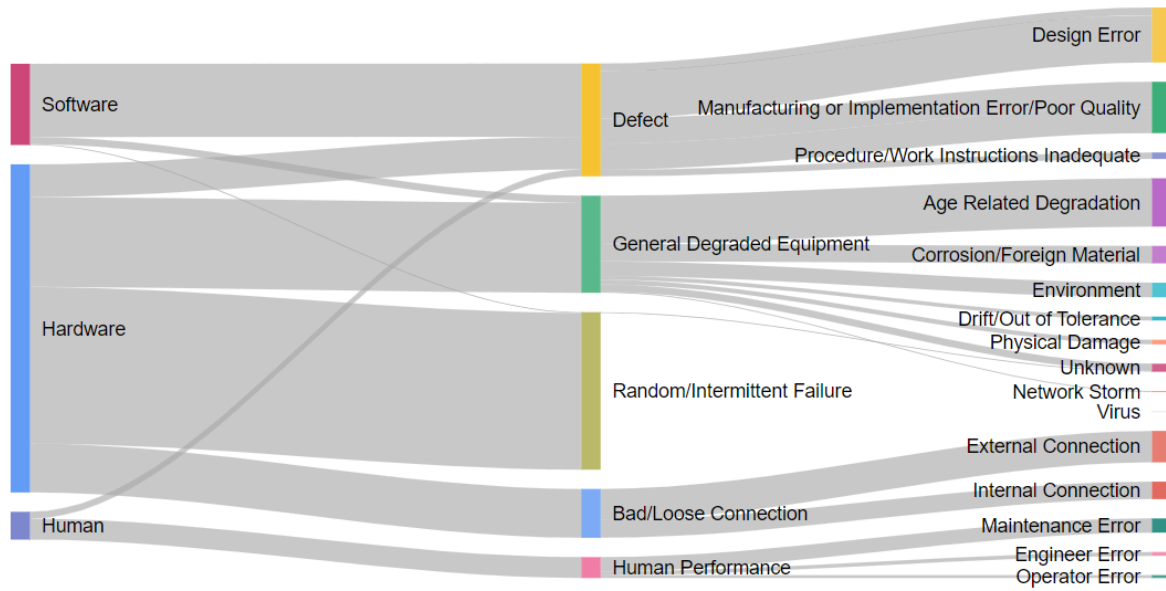**Project Requirements:**

For the data i4C software tool:
- Simultaneous access to people working remotely and at least two modes of use, edit and visualization. (Use of Google Sheets)
- Operational data is imported from records that can be PDF documents (possibly), spreadsheets or databases.
- The data model is defined but expected to be modified as records are added, and methodology is refined, so tool should be configurable.
- Use and expansion of capabilities of Excel and its associated data modeling capabilities is encouraged.

For the NICK I&C Knowledge visualization software tool:
- Utilizes the data from the i4C tool.
- Uses google graphs (or similar) and python scripts to design new meaningful representations of the data. See examples below of desired graph and existing ones (that at a minimum should be replicated).

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Software

Hardware

Human

Defect

General Degraded Equipment

Random/Intermittent Failure

Bad/Loose Connection

Human Performance

Design Error

Manufacturing or Implementation Error/Poor Quality

Procedure/Work Instructions Inadequate

Age Related Degradation

Corrosion/Foreign Material

Environment

Drift/Out of Tolerance

Physical Damage

Unknown

Network Storm

Virus

External Connection

Internal Connection

Maintenance Error

Engineer Error

Operator Error

4.1.2 Primary and Secondary Causal Factor Analysis

The system element analysis is further decomposed into primary causal factors. Figure 4-2 shows the primary causal factors for all systems and equipment events reviewed.
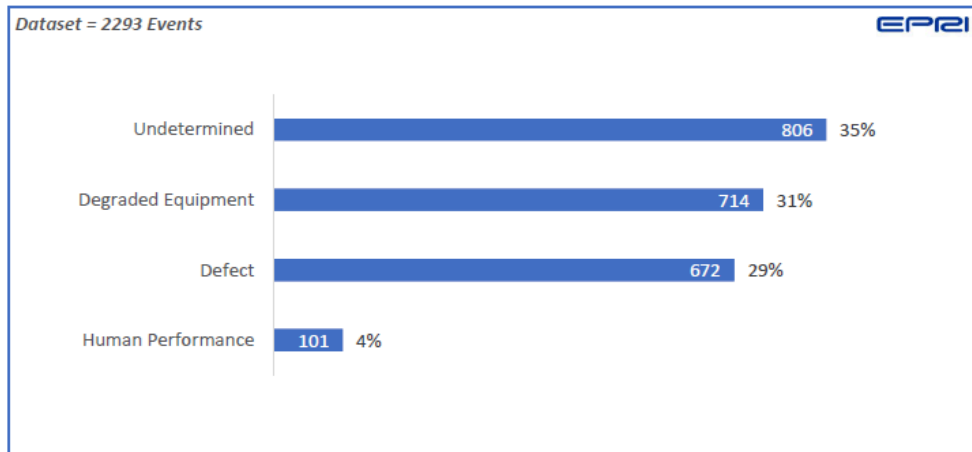

Figure 4-2. Primary Causal Factors—All Systems and Equipment

Table 4-1 provides a view of the prevalent causes for each initiator.

Table 4-1. Cross-Map Analysis of Initiators and Primary Causes

Primary Causes	System Elements/Initiators				
	Hardware	Software	Human	Unknown	Total
Undetermined	33%	0%	0%	2%	35%
Degraded Equipment	31%	0%	0%	0%	31%
Defect	10%	18%	2%	0%	29%
Human Performance	0%	0%	4%	0%	4%
Total	74%	18%	6%	2%	100%

Expected Deliverables/Results:

- Design specification of the i4C analysis tool
- Prototype of the i4C analysis tool
- Design specification of the NICK visualization tool
- Prototype of the NICK visualization tool

Disposition of Deliverables at the End of the Project:

Students are graded based on their display and presentation of their team's work product. It is mandatory that they exhibit at the Expo, so if the work product was tested at the supporter's

location, it must be returned to campus for the Expo. After the expo, the team and supporter should arrange the handover of the work product to the industry supporter. This handover must be concluded within 7 days of the Expo.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):
- Data analysis and software development skills
- Students with control systems knowledge can also contribute in the events analysis