THE WILLIAM STATES LEE COLLEGE OF ENGINEERING

Company Information

Company Name	**Electric Power Research Institute**	**Date Submitted**	*11/1/2021*
Project Title	*Generator Brush/Collector Ring ARC Flash Energy Calculation Method* **(EPRI_ARC)**	**Planned Starting Semester**	*Spring 2022*

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	5
Computer		Systems	

Company and Project Overview:

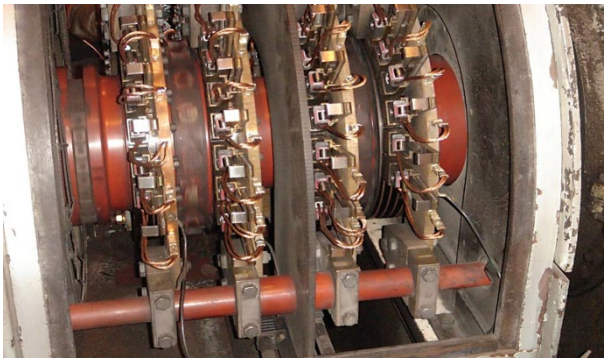
EPRI is a non-profit research entity funded by members of the Electric Industry.

This project is being pursued to research the methods to calculate the ARC Flash Incident Energy available on the Generator Collector Assemblies as this subject has not been defined.

Introduction and Background

Some Generator Exciter Systems use collector rings and brushes like the one shown in Figure 1, to provide energy from the exciter to the rotating field. These brushes wear down and need to be replaced with the unit on-line and OSHA requires ARC Flash Hazards to be quantified such that appropriate PPE can be worn.

Figure 1- Example Brush/Collector Ring Assembly



Existing ARC Flash analytic tools do not currently provide a capability for this unique application. There are multiple variations of Excitation and Field component designs that need to be considered. Some examples are shown in the figures below. The calculations must consider Generator Field and Exciter sources of energy and available protection.

- Larger sources of excitation and field current will provide more potential energy to the fault
- Field Time Constants will extend how long a fault will be fed.
- Field Breaker Trips will reduce Incident Energy from the Exciter.

Figure 2

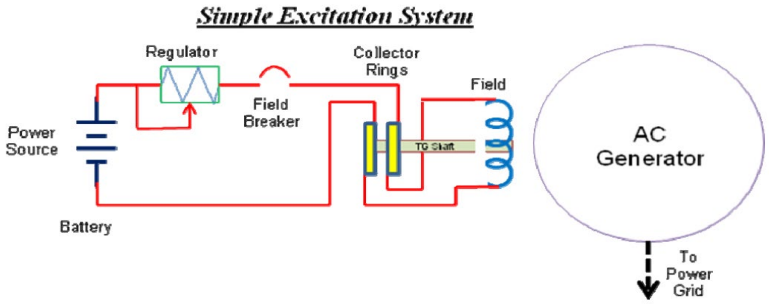


Figure 3

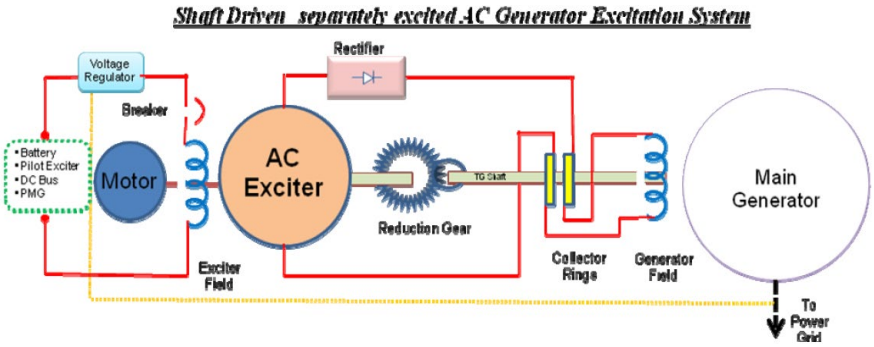
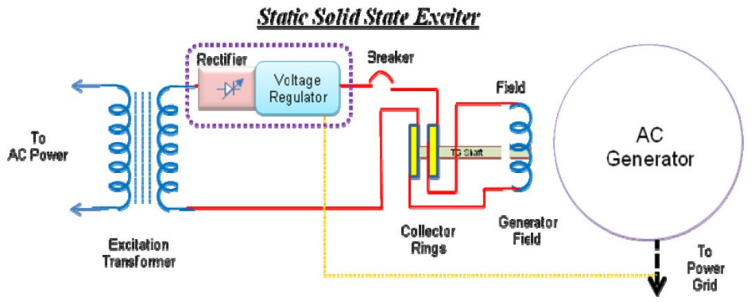


Figure 4



Project Requirements:

Objectives

- Develop a method (or model) to calculate Arc Flash incident energy (Cal/cm^2) on Generator Brush Collector Rings to assure proper *Personal Protection Equipment* (PPE) is used for on-line brush changes. An existing electrical software is suggested to utilize for the modeling and calculation if available.
- Implement a user-friendly tool (e.g. Excel) to allow members to calculate Arc Flash incident energy at their site.

Tasks

1. **Develop and document a basis for the calculate of Brush/Collector ring ARC Flash Incident Energy**

   Determine the Field Excitation system design variations which use collector rings and brushes in the SGT industry and document an ARC Flash Incident Energy calculation basis for each design

   1.11. **Identification of Variations Predominantly Used in Industry**
   Research and document various designs used in Steam Turbine Generation units (STG) by the major Original Equipment Manufacturers (OEMs). Provide results to EPRI contact to determine a subset of designs to be researched further.

   1.12. **Research ARC Flash Calculation Bases for Designs Identified most predominantly used in industry.**
   Identify the factors that will impact the amount of Arc Flash Incident Energy that will be present if the collector rings or excitation circuit were shorted during maintenance. Based on the research, document the basis for calculation methods that are needed to calculate ARC Flash Energy for each design variation

   1.13. **Investigate Ways to Test Theories Developed to Validate Each.**

2. **Implement a user-friendly tool (e.g. Excel) to allow members to calculate energy at their site.**

For each variation identified in 1.1 above;

2.11. Develop a Design Inputs Worksheet of required data needed to calculate the energy available.

2.12. Develop a worksheet to perform the needed calculations and provide an output of the required

Expected Deliverables/Results:

Task/Milestone/Deliverable Description
Begin Project
Develop an IEEE Draft paper to document a basis for the calculate of Brush/Collector ring ARC Flash Energy
Develop Preliminary Presentation of Results
Implement user-friendly tools (e.g. Excel Workbooks) to allow members to calculate energy at their site.
Update the draft IEEE Paper Documenting Results Of The Research Effort To Share Results With Experts And Pursue Industry Consensus
Develop Presentation of Results for the Winter 2022 EPRI TGUG Meeting

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):

- Rotating Electric Machines Knowledge
- Analytical Expertise in calculating ARC flash in accordance with industry standard approaches
- As part of this project the students will have to develop and present a paper for IEEE and EPRI.