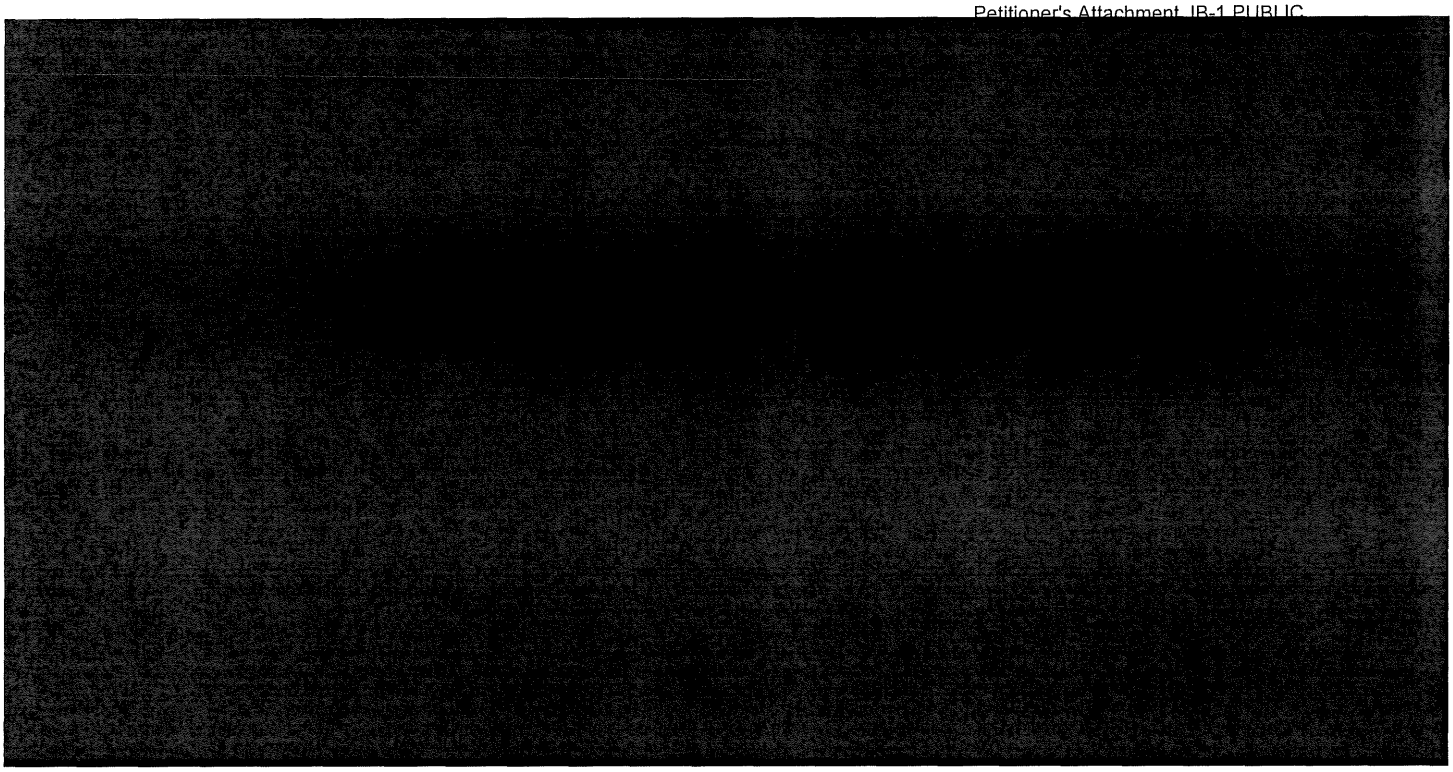


Figure 14, Toshiba wiring schematic of 41E trip circuit

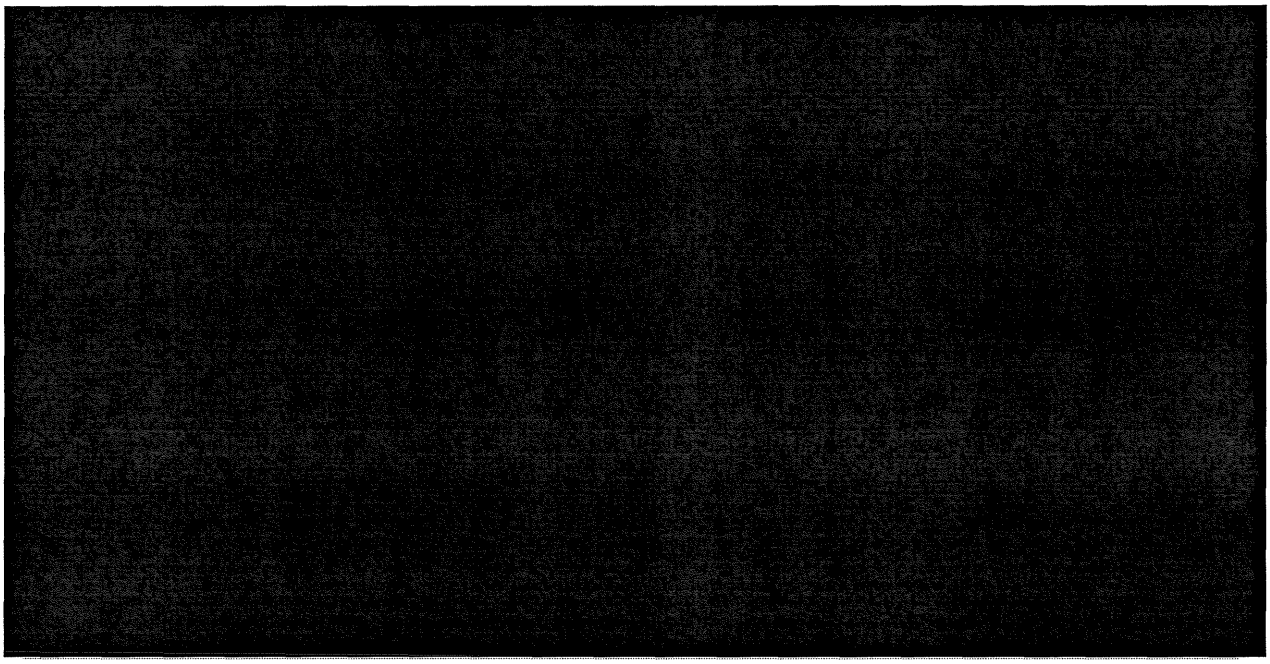


Figure 15, Toshiba wiring schematic of hardwired 41E Trip Demand inputs

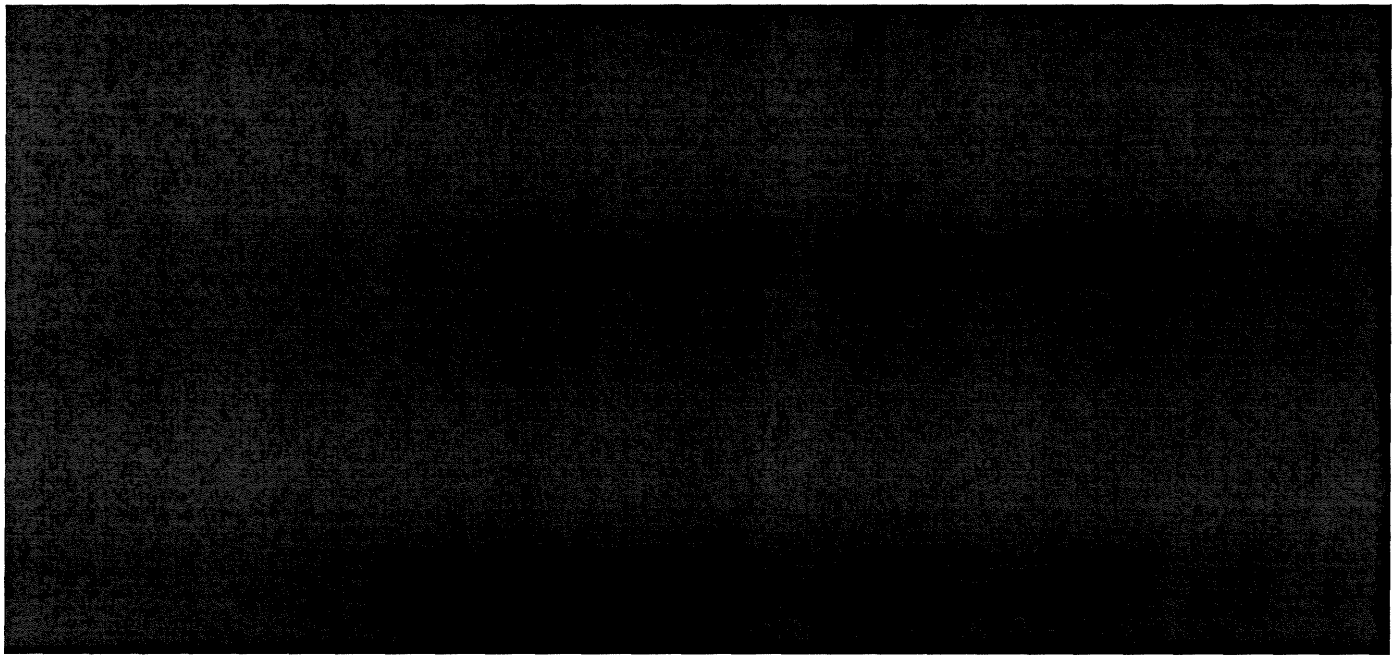


Figure 16, Toshiba wiring schematic of 41EX1 and 52GX1 Relay coils

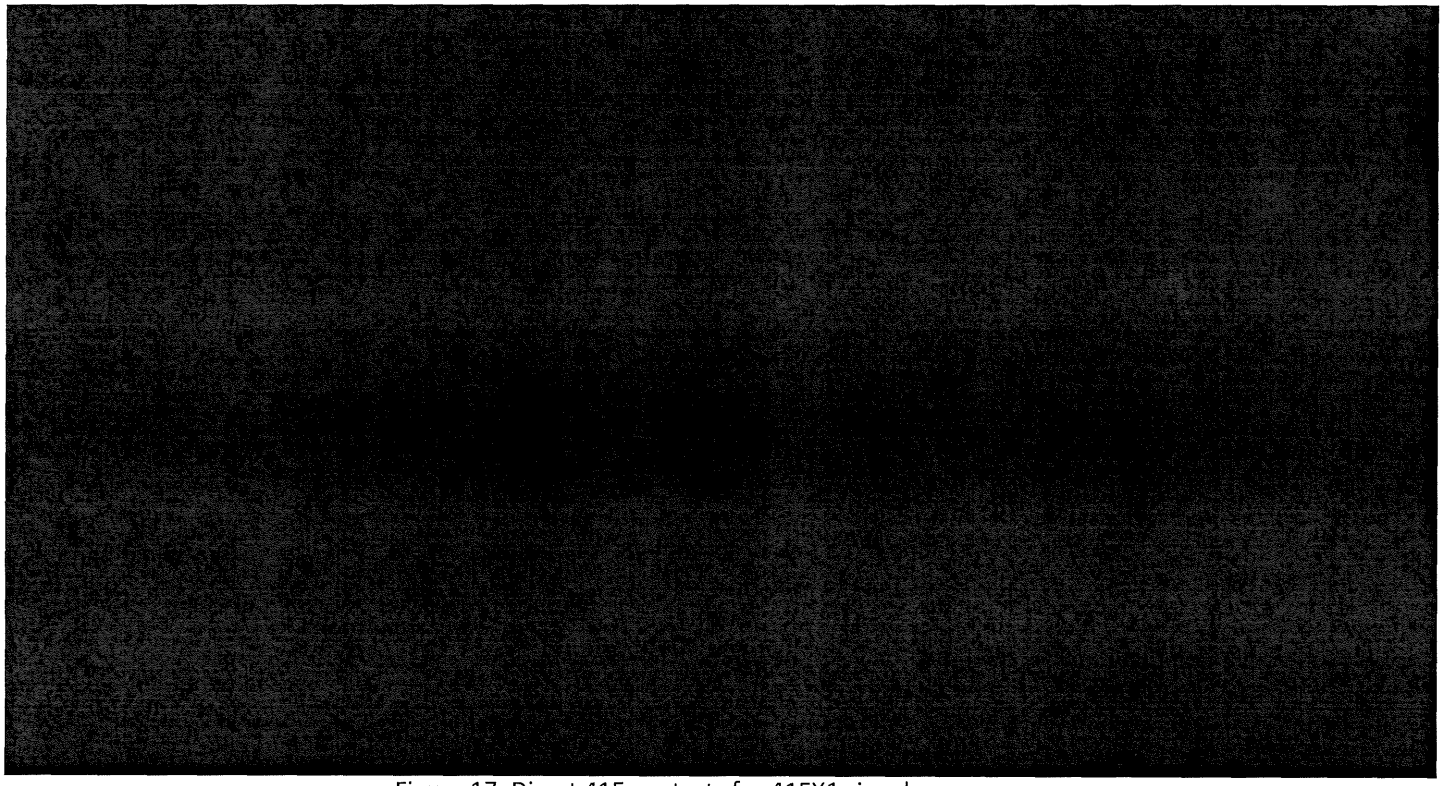


Figure 17, Direct 41E contacts for 41EX1 signal source

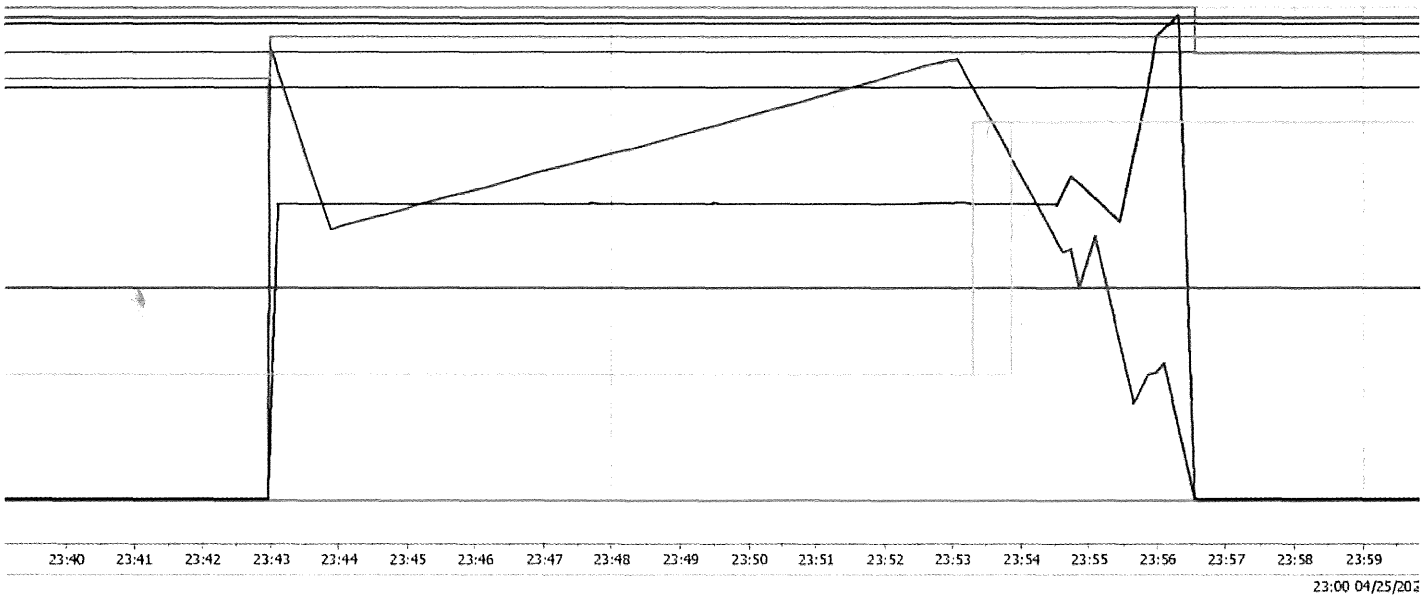


Figure 18, Trend data of Generator Field damage event

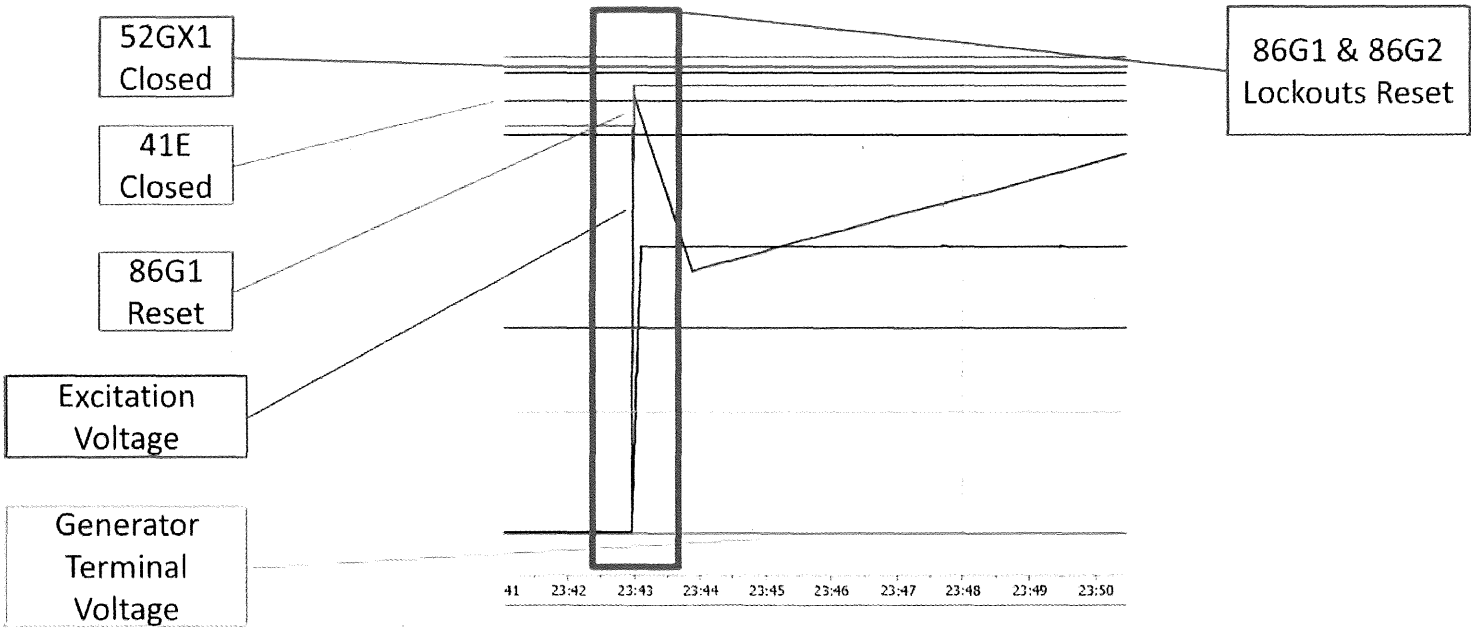


Figure 19, Trend data when 86G1 and 86G2 Lockout Relays were reset.

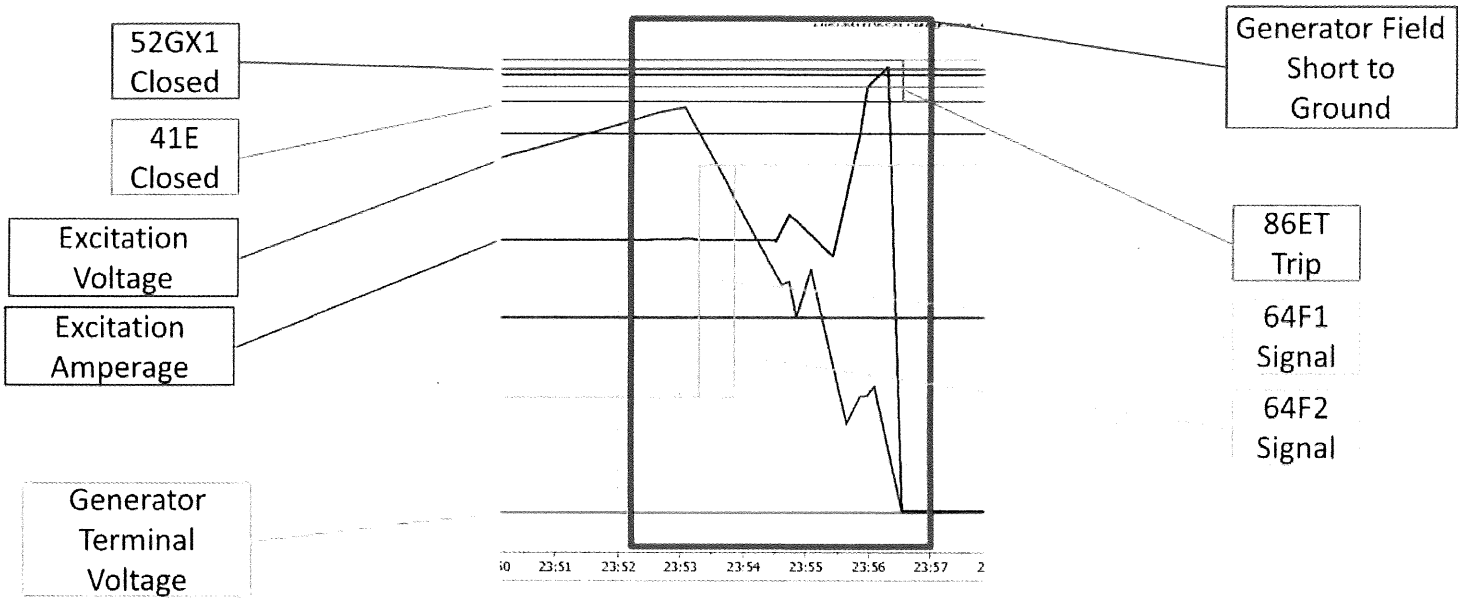
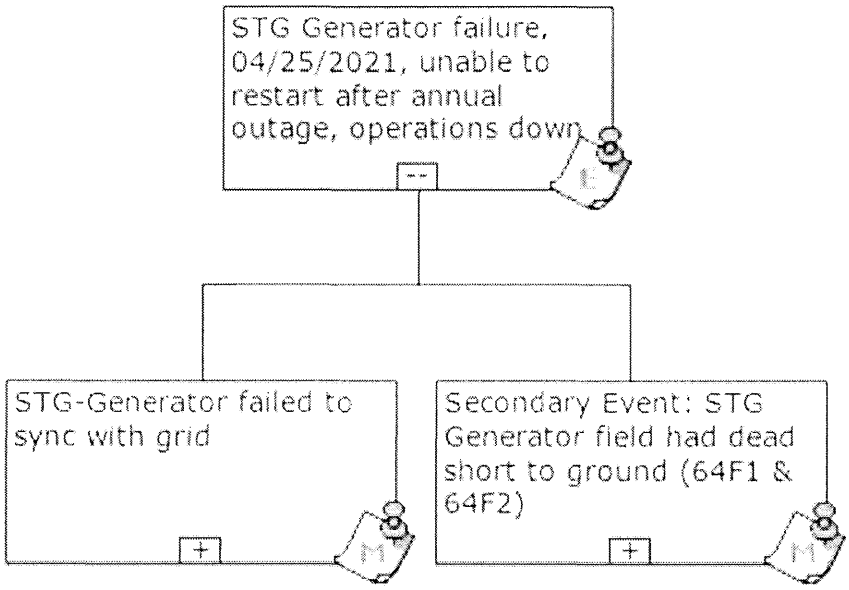


Figure 20, Trend data showing insulation failure, 64F1, 64F2 and 86ET trips.

PROACT® Logic Tree

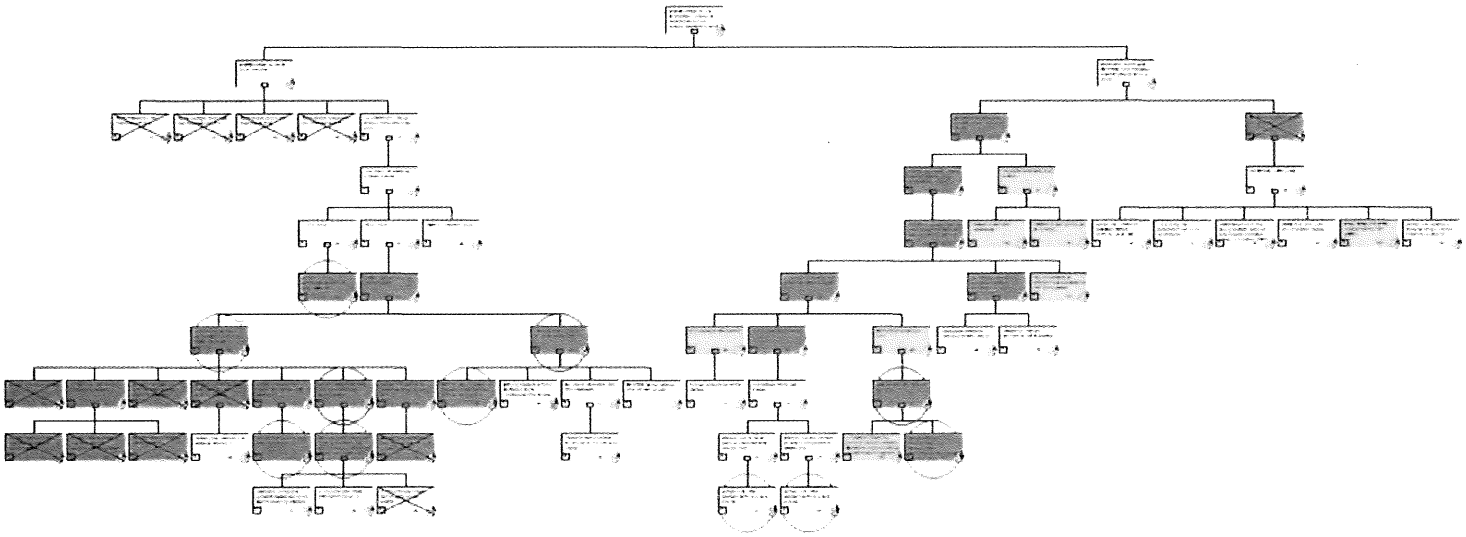
Any undesirable outcome is a result of a series of "cause-and-effect" relationships. The data provided by AES, in-person interviews and on-site visits, serve as proof (evidence) as to what did or what did not occur. A Logic Tree was utilized in the PROACT® application to graphically express the "cause-and-effect" relationships. In this approach, the top two levels of blocks represent the EVENT Level 1 and the MODE Level 2. From-level-to-level the path represents a "cause-and-effect" relationship. These levels specifically represent the "undesirable outcomes" that did occur (facts only). From the MODE Level, the analysts do not know why they have occurred, just that they did occur. From this point the analysis becomes hypothetical and the analysts repeatedly ask the question "How Can?". As hypotheses are developed in this fashion, the evidence collected is used to verify what is true and what is not true. In this fashion, facts lead the analysis not assumptions. This process is reiterated until true root causes are uncovered; the reasons why people make decision errors that lead to undesirable outcome. Root causes originate from vulnerabilities in the organizational systems upon which employees depend to make informed decisions. These are called Latent Root Causes or Organizational Root Causes. Vulnerabilities in organizational systems lead to poor decisions being made by well-intentioned individuals. These decisions are referred to as Human Root Causes. Decision errors lead to the Physical Root Causes, or events or conditions that are visible. When the Latent Roots or Organizational System Roots are identified and addressed, the investigation becomes a true and effective Root Cause Analysis.

Top Box (problem definition)

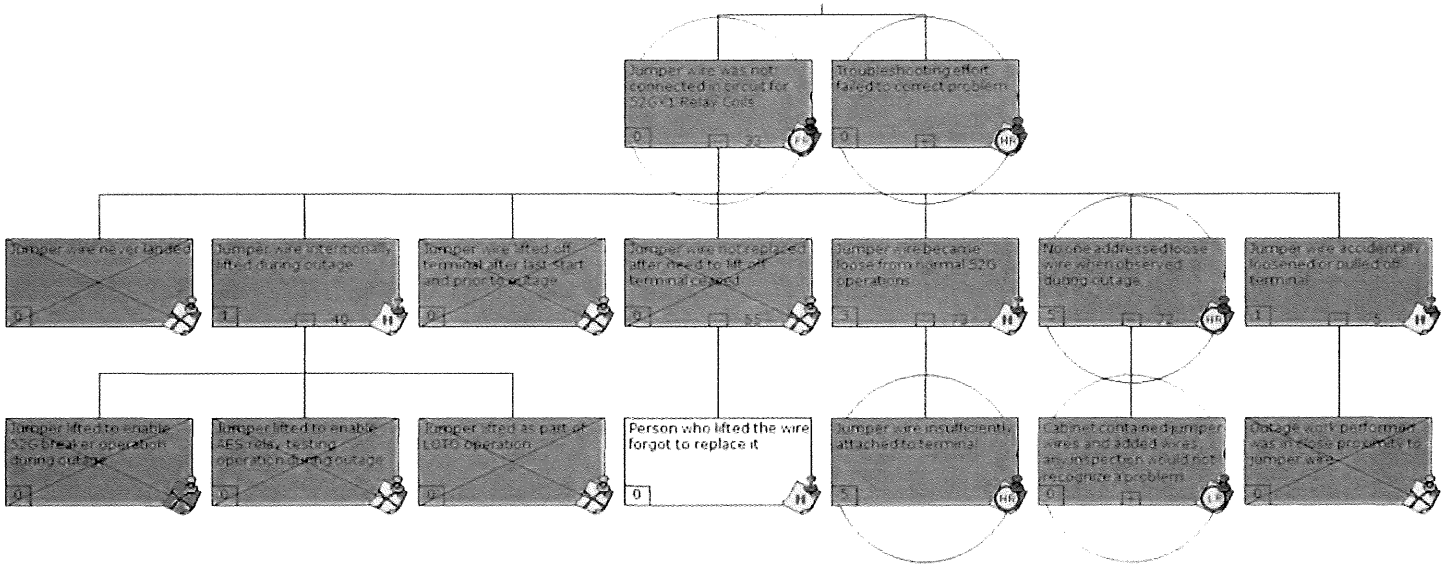


PROACT® Logic Tree Top Box

Entire Logic Tree



Hypotheses for jumper wire becoming disconnected.



Analysis Team Information

RCA Team Charter

To identify the root causes of the STG-1 generator failure to synchronize with grid and the damage to the generator field at the Eagle Valley power plant facility. This includes identifying deficiencies in, or lack of, management systems and oversight. Appropriate recommendations for root causes will be communicated to management for rapid resolution.

Analysis Critical Success Factors

- A cross-functional section of personnel/experts will participate in the analysis.
- All analysis hypotheses will be verified or disproven.
- Management agrees to fairly evaluate the analysis team's findings and recommendations.
- A disciplined RCA approach will be utilized.
- Use of an unbiased team facilitator who is an expert in the PROACT® RCA methodology.

Analysis Team Members

Name	Role	Company	Title
Kevin Cook	Sponsor	AES	Facility Manager
Brandon Berlin	Analyst	AES	Maintenance Leader
Jason Hoage	Analyst	AES	Operations Leader
Holcombe Baird	Facilitator	Reliability Center, Inc.	Senior Reliability Consultant

Analysis Dates

Event Date: 04/25/2021
Analysis Start Date: May 2, 2021
Analysis Team Completion: July 9, 2021

Appendix A: Reference Reports

Excitation Breaker (41E) Control

PowerPoint by Toshiba, June 1, 2021, A report on Toshiba investigative findings and explanation of 41E Breaker operational logic

Appendix B: Contributors to Analysis Effort

John Griffin – IPL DCS Technician
Ron Stiles – IPL DCS Technician
Kirk Daily – IPL CP
Matt Lockwood – IPL CP
Billy Hunt – IPL Operator
Dave Haymond - IPL Operator
Jamin Quin – Electrician
Jonathon Marques – AES Electrical Engineer
David Eads – AES Relay SCADA Technician
Doug Warren – AES Relay/SCADA Technician
Bryan Hang – Toshiba Technician
Mark Magnuson - Toshiba Project Manager
Arron Kreel – Toshiba Project Manager
George Lala – Toshiba Instrumentation and Control System Manager
Jesse Johnson – Toshiba Instrument and Control Systems Engineer
Jacques Potgieter – ABB technician
Ricardo Covarrubias – Generator Engineer

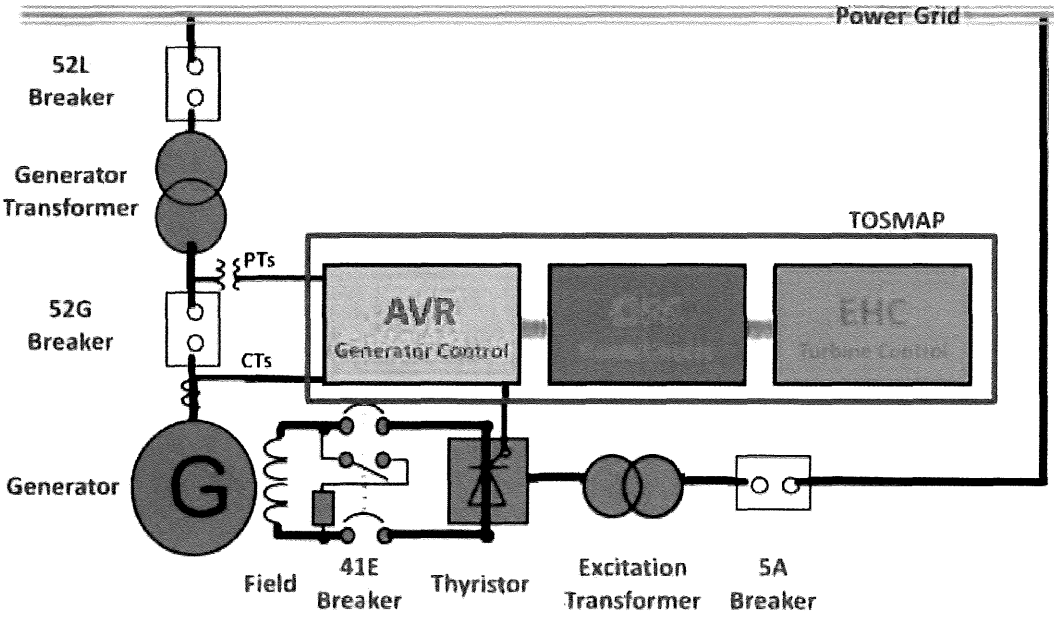


Figure 1, Simplistic diagram of generator protection and control components