EPRI Electromagnetic Pulse Research

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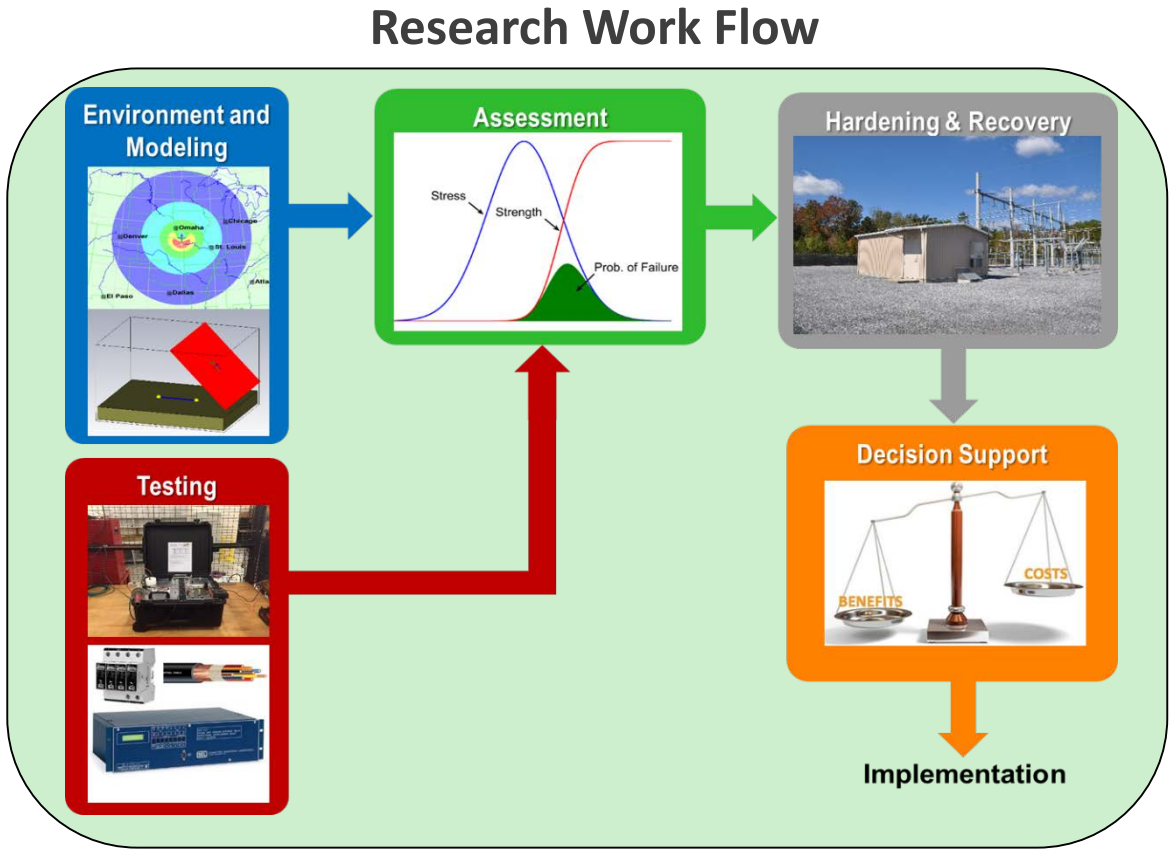
EPRI EMP Research Project

- Initial research project focused on switchyards, lines, and substations (Transmission)
- Assessed impacts of E1, E2, E3 and combined E1 + E3
- Answered two important questions:
  - What are the potential impacts of HEMP on the Transmission system?
  - If impacts are significant concern, can they be mitigated in cost-effective ways?



April 2016 – April 2019
Collaboration with 63 U.S. Utilities

Collaborative EMP Research

- Transparent, objective R&D involving numerous energy stakeholders
- Collaboration with 63 U.S. utilities
- Leveraged resources and knowledge from U.S. DOE, National Labs, DoD
- Applied industry-leading expertise to address national security threat

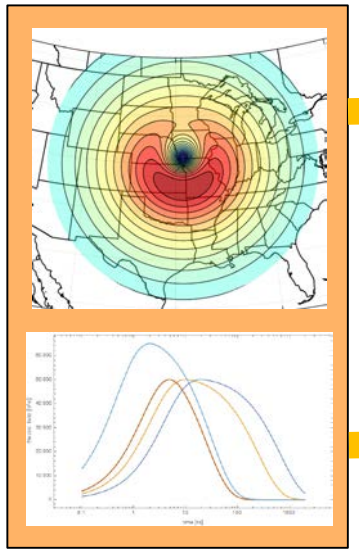
EMP Community Collaboration

Lawrence Livermore National Laboratory

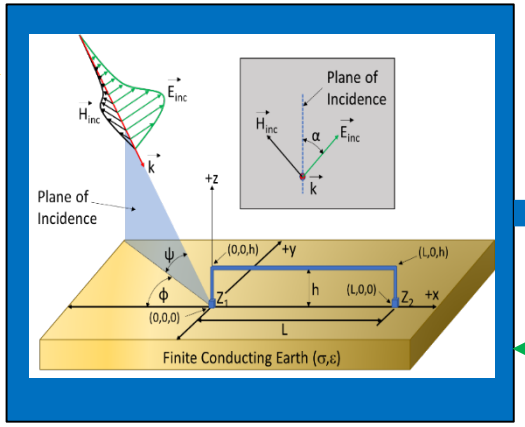
HEMP E1 Threat Assessment of U.S.

Component Testing Based on MIL-STDs (Strength)

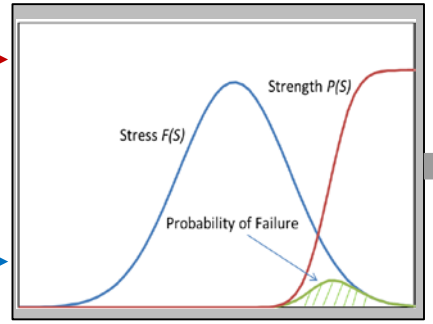
E1 Environments (LANL, LLNL, STDs)



Modeling (Stress)



Impact Assessment



Identify/Develop Cost-Effective Mitigation Options

Field Trials

E1 has the potential to damage substation electronics, but mitigation options were identified

Field Trials of HEMP E1 Mitigation Are Needed

- Potential options for mitigating impacts of E1 on substation electronics were identified
- Identification/management of unintended consequences is critical
- Design improvements, cost data and long-term asset management are also very important

Next Steps

- Continue technical support and field evaluation of HEMP E1 hardening options
- Initiate HEMP E1 investigation of non-nuclear generating facilities and telecomm
- Continue to work with other Critical Infrastructures to transfer initial results
- Continue to advance the state of the science and investigate impacts to other portions of the grid (dist., loads, etc.)

EPRI is working with member utilities to perform field trials of E1 hardening options in 19 substations across the U.S.

Together...Shaping the Future of Electricity