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NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

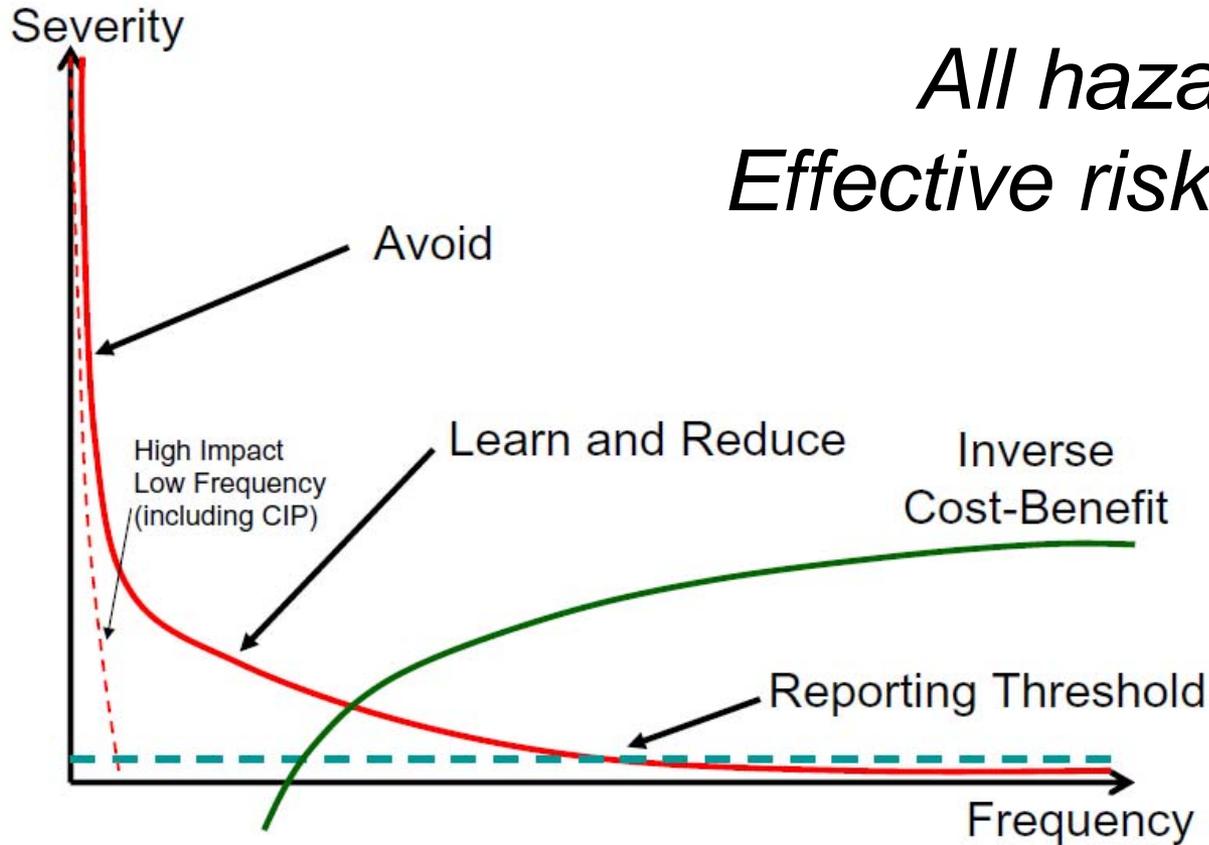
Special Reliability Assessment: Interim Report

Effects from Geomagnetic Disturbances on the Bulk Power System

RELIABILITY | ACCOUNTABILITY

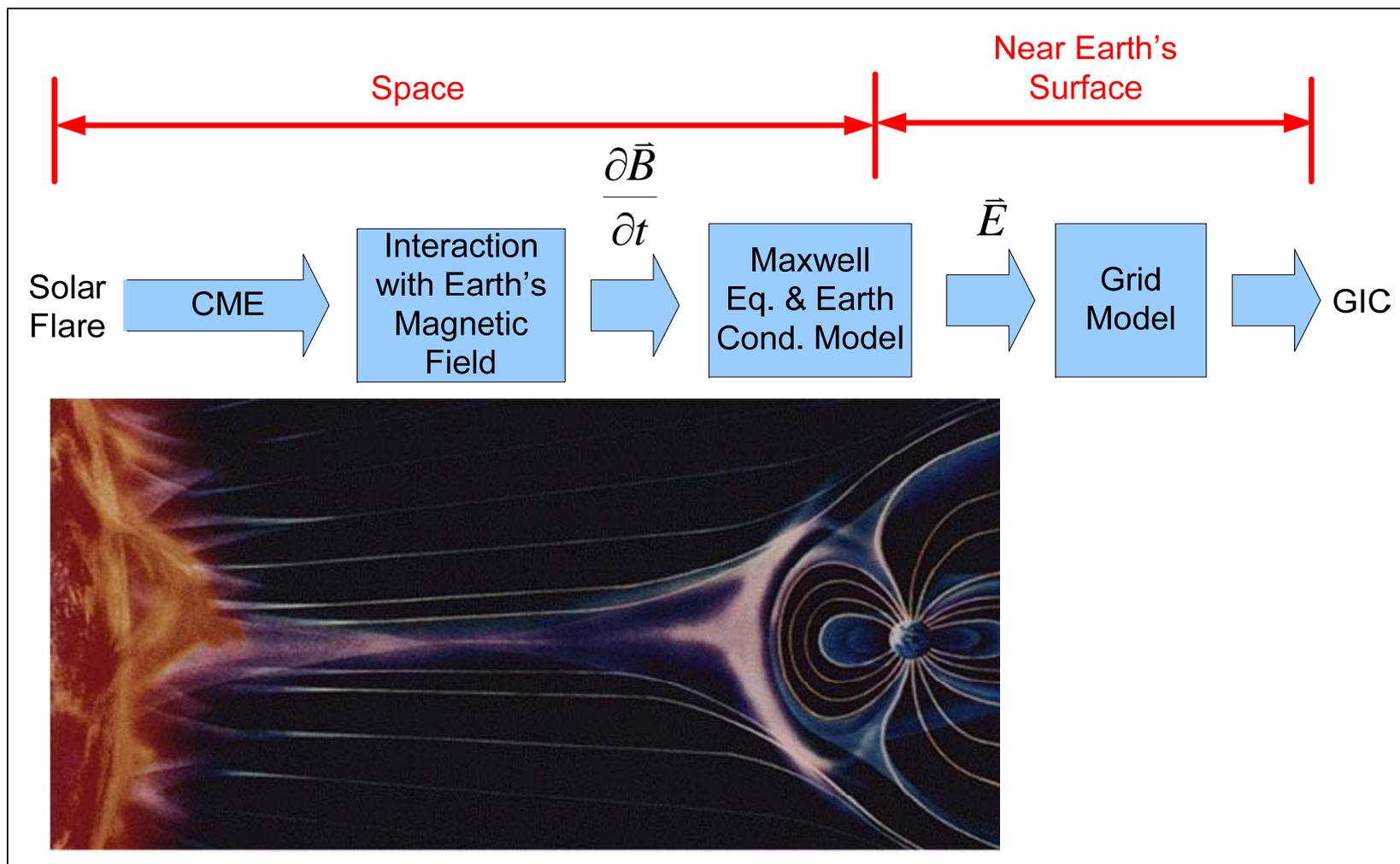


Cornerstone of risk-management concepts

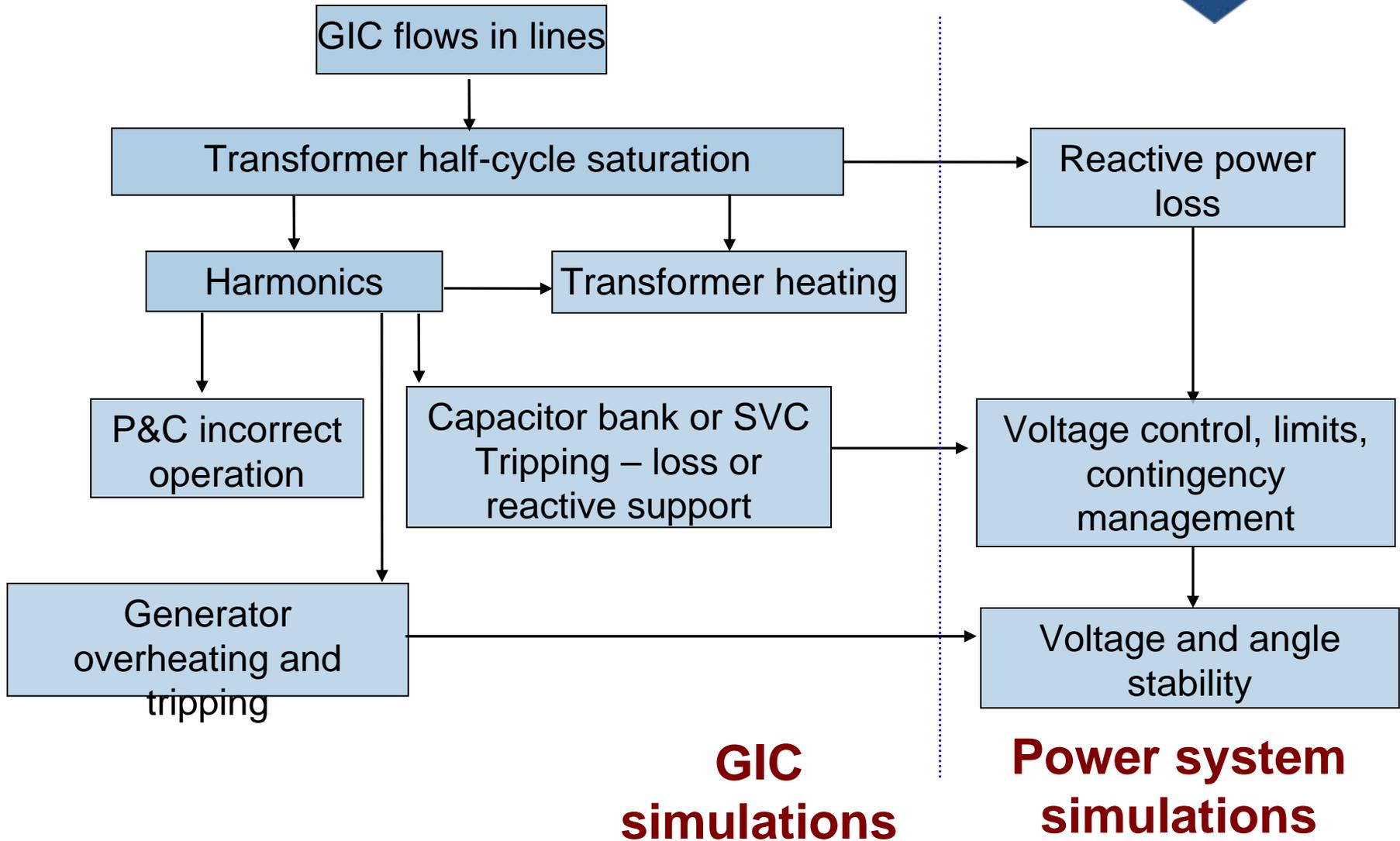


All hazards
Effective risk controls

Geomagnetic Disturbances



Effects of GIC in HV Network



Major Conclusion No. 1

- Most likely result from a severe GMD event in North America will be elevated risk of voltage instability or collapse

Major Conclusion No. 2

- System operators and planners need analytic tools and information sharing to understand impacts and develop mitigation strategies

Major Conclusion No. 3

- Some transformers may be damaged or experience reduced life, depending on design and current health



- Identify facilities most at-risk from severe GMD
 - Assess and mitigate impacts to priority equipment and operations
- Conduct wide-area GMD vulnerability assessments
 - Assess risks to transformer health and reactive power loss
- Identify spare equipment availability
 - Build from existing spare equipment and database
 - Assess types and locations of spare equipment available
- Enhance equipment specifications to be GMD capable
 - Including enhanced instrumentation for monitoring
- Enhance training for system operators and planners

- Refine probabilistic GMD storm scenarios
 - 1 in 100 year event and worst-case event scenarios
 - Work with NASA and Canadian Space Agency
- Perform comprehensive tests of transformers to geomagnetically induced currents (GIC)
 - Enhanced performance monitoring of equipment
 - Equipment failure forensics

- Increase the number of GIC monitoring locations across North America including data concentrators
 - Common database for research and analysis
- Develop new analytic tools for system planners and operators to reliably manage any GMD impacts
 - NERC-EPRI collaborative toolset
 - Work with vendors on transformer models
 - U.S. Geological Survey and Natural Resources Canada on ground impedance maps



- Improve space weather forecasting
 - Increase warning time-frames and granularity of forecasts
 - Improved operational alerts
- Develop GMD as a normal planning and operational scenario for utilities to study (planning standards)
- Develop spare equipment strategy – all hazards
 - Expand recovery transformer development
 - Hold retiring equipment as spares
- Develop equipment standards (IEEE and IEC)
- Expand reactive resources, modify/replace equipment

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Questions?

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