Mission Assurance through Energy Assurance – Measuring Mission Availability and Mission Resilience throughout Disruption

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Idaho National Laboratory

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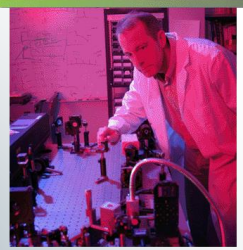
Idaho National Laboratory Vision

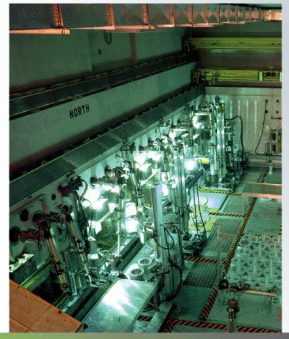
Foster education, research, industry, government and international collaborations to produce the needed investment, programs and expertise

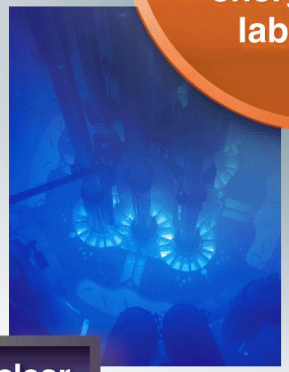
CAES
Center for Advanced Energy Studies

Become a leading clean energy RD&D laboratory and a regional resource



Become the preeminent internationally-recognized nuclear energy RD&D laboratory





Develop world-class nuclear energy capability

Become a major center for national and homeland security technology RD&D

The U.S. National Nuclear Laboratory with Multi-program Capabilities

Disciplined System Analyses

- Clear Understanding of Customer Needs
- Concise Problem Definition
- Concise System / Project Boundaries
- Strategic Planning
- "Concept" of Operations
- Stakeholder Buy-in
- Acquisition Strategy
- Proposals & White Papers

- Technical, Functional, and Operational Analysis
- Requirements Elicitation, Clarification, Derivation, and Tracking
- System Verification and Validation
- Change Control and Impact Analysis

- Analysis & Integration of Viable Solutions
- Trade Studies
- Decision Metrics and Weights
- Organization and Analysis of Complex Data
- Risk-informed Decision Making

- Risk Identification and Tracking
- Justification for Funding Contingency
- Risk Handling Strategy
- Risk-informed Path Forward
- Risk Reduction Plan

- Technology Maturity Analysis & Integration
- Technology Development Roadmap/Path Forward
- System Assessments (e.g., energy systems)
- Program & Project Integration
- Laboratory-wide R&D Integration
- Laboratories / Industries / Universities Integration

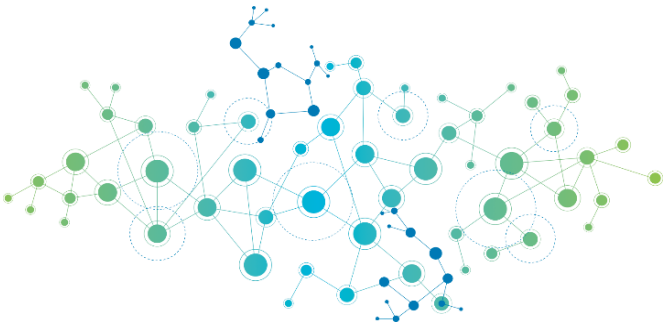
Outline

- Motivation
- The concept of Mission Availability
- The concept of Mission Resilience
- Framework
- Mission Thread – Stressed and Unstressed
- Model Based Systems Engineering Conclusion

Motivation

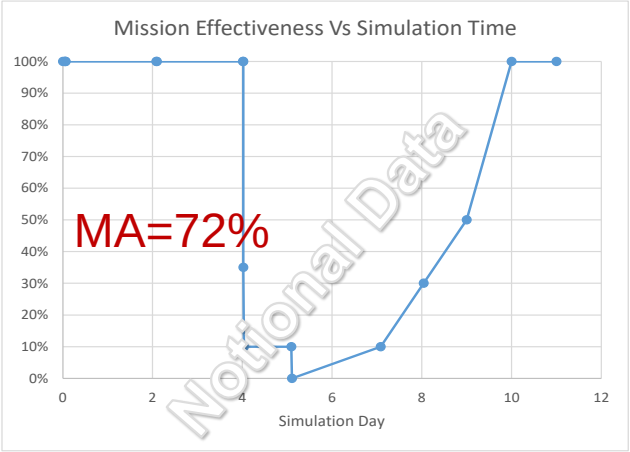
- Increased complexity with widespread use of digital devices to monitor and control installations and weapons systems
- Increasingly brittle, aging, and expansive power systems (substations, power lines, generators, fuel storage)
- Increased reliance on modern technology and powered critical assets
- Increased external disruptions from severe natural disasters and/or determined adversaries

- December 2017 Hartsfield-Jackson Airport [ATL]
  - Far-reaching and unexpected consequences



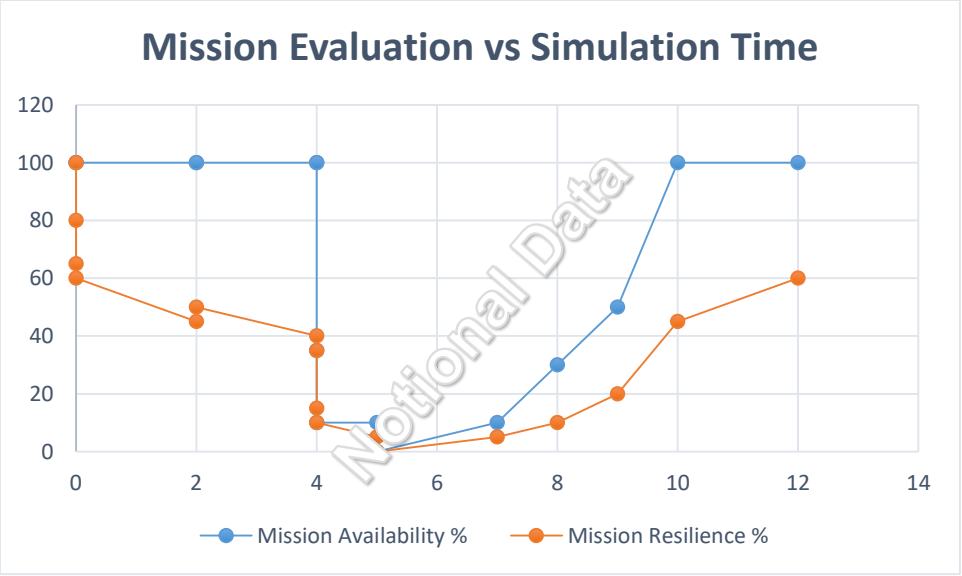
The Concept of Mission Availability

- WHAT IF
  - Accurately predict mission degradation in the face of prolonged and widespread power disruption (against a variety of the most likely scenarios)
- THEN
  - Introduce needed improvements (materiel acquisitions, non-materiel policy or procedural changes) and measure area under curve → Mission Availability (MA)
- OUTCOME
  - Robust, Mission-Informed Decision Making Methodology

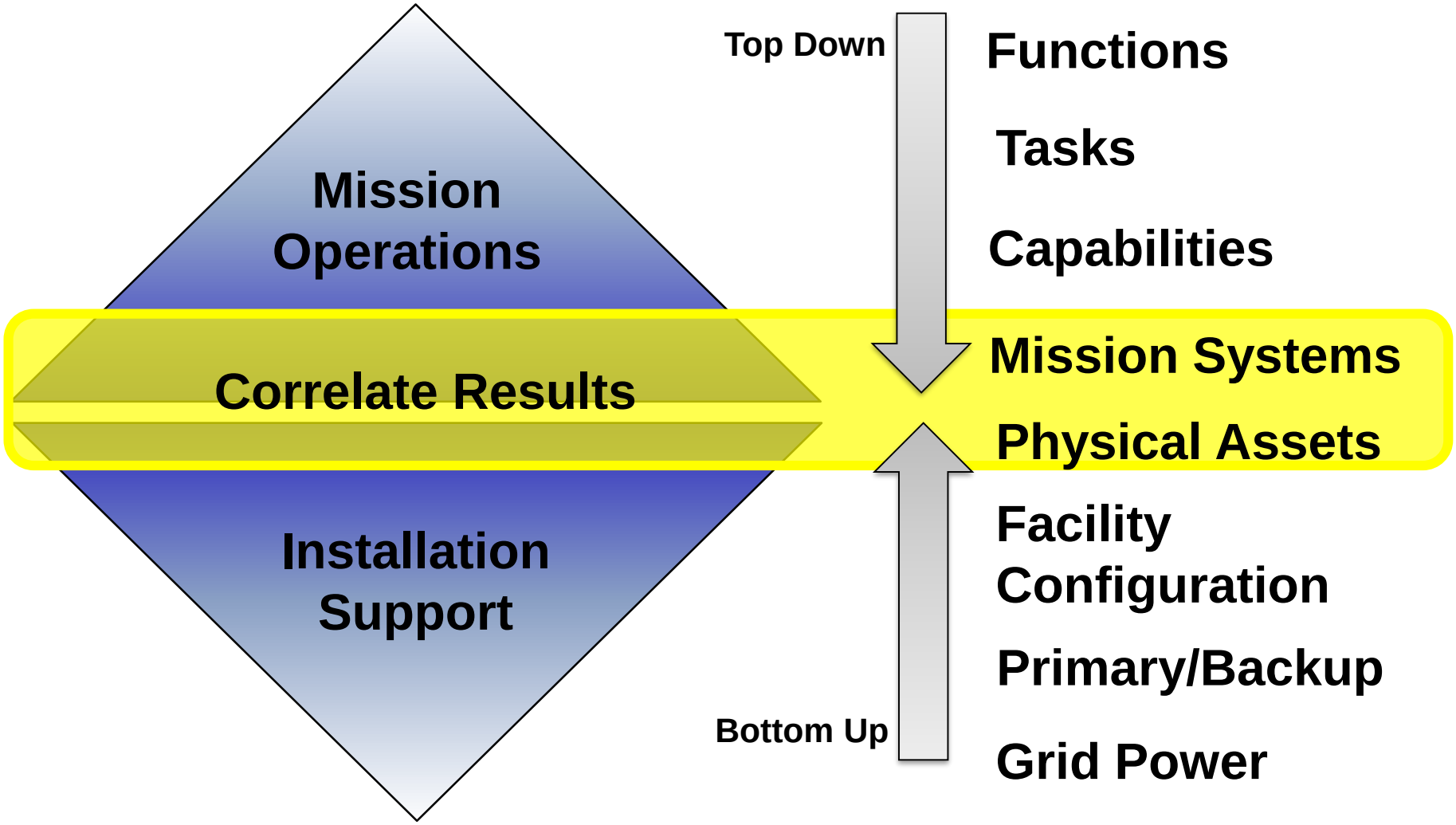


The Concept of Mission Resilience

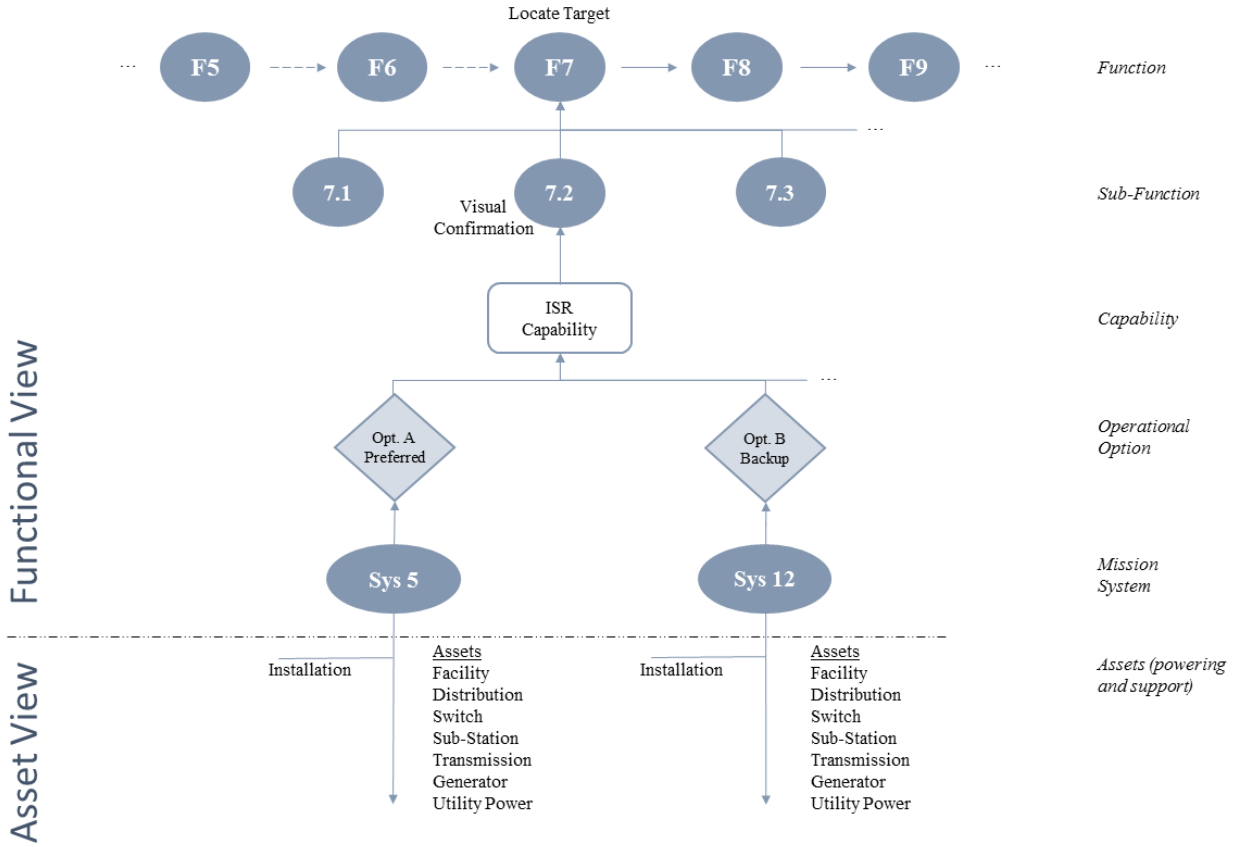
- WHAT IF
  - Leading indicator could provide early warning of potential mission degradation
  - Leading indicator could provide a measure of mission robustness
- THEN
  - Integrate mission operations robustness with installation power resilience
- OUTCOME
  - Overall Mission Resilience



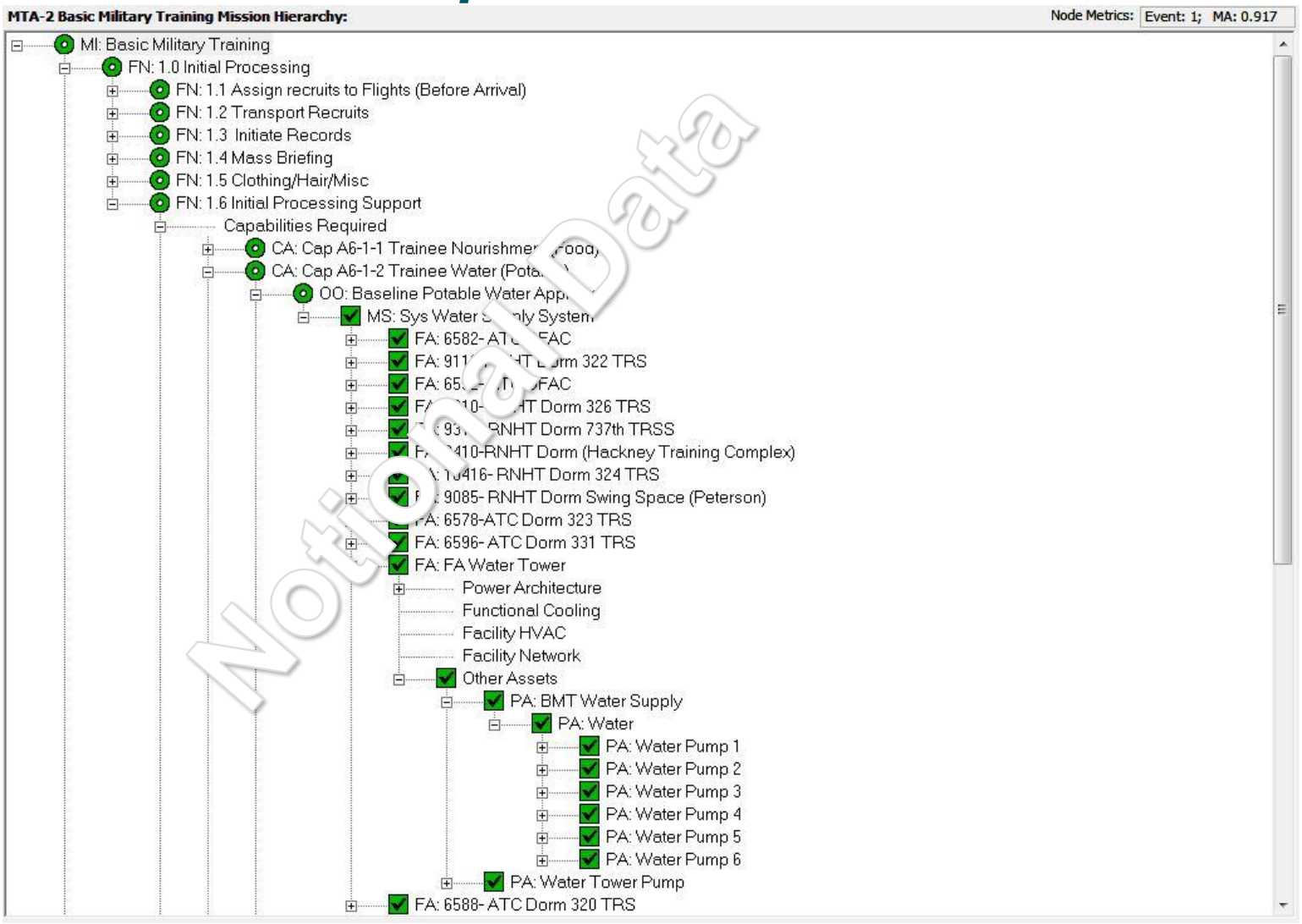
Framework


Mission Operations
Correlate Results
Installation Support
Top Down
Functions
Tasks
Capabilities
Mission Systems
Physical Assets
Facility Configuration
Primary/Backup
Grid Power
Bottom Up

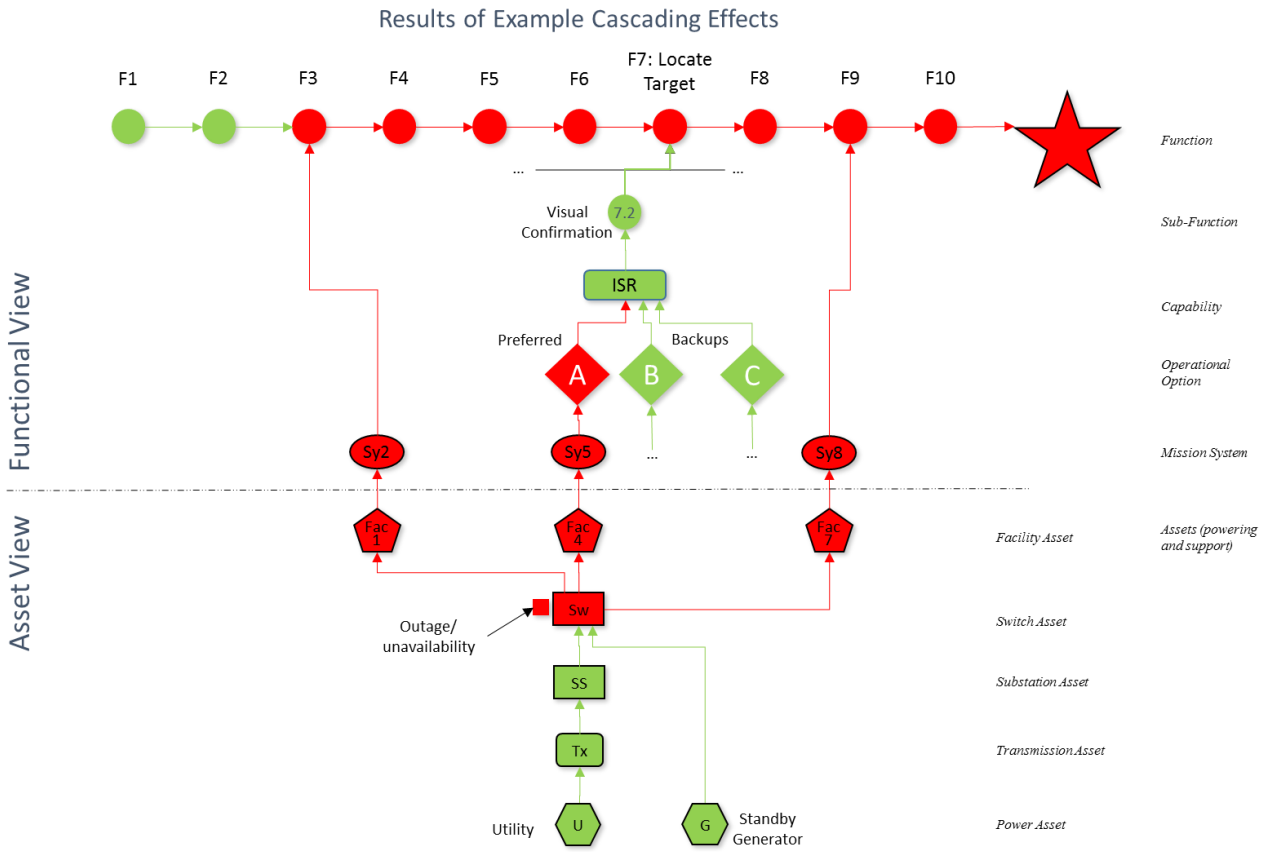
Example – Mission Thread Analysis



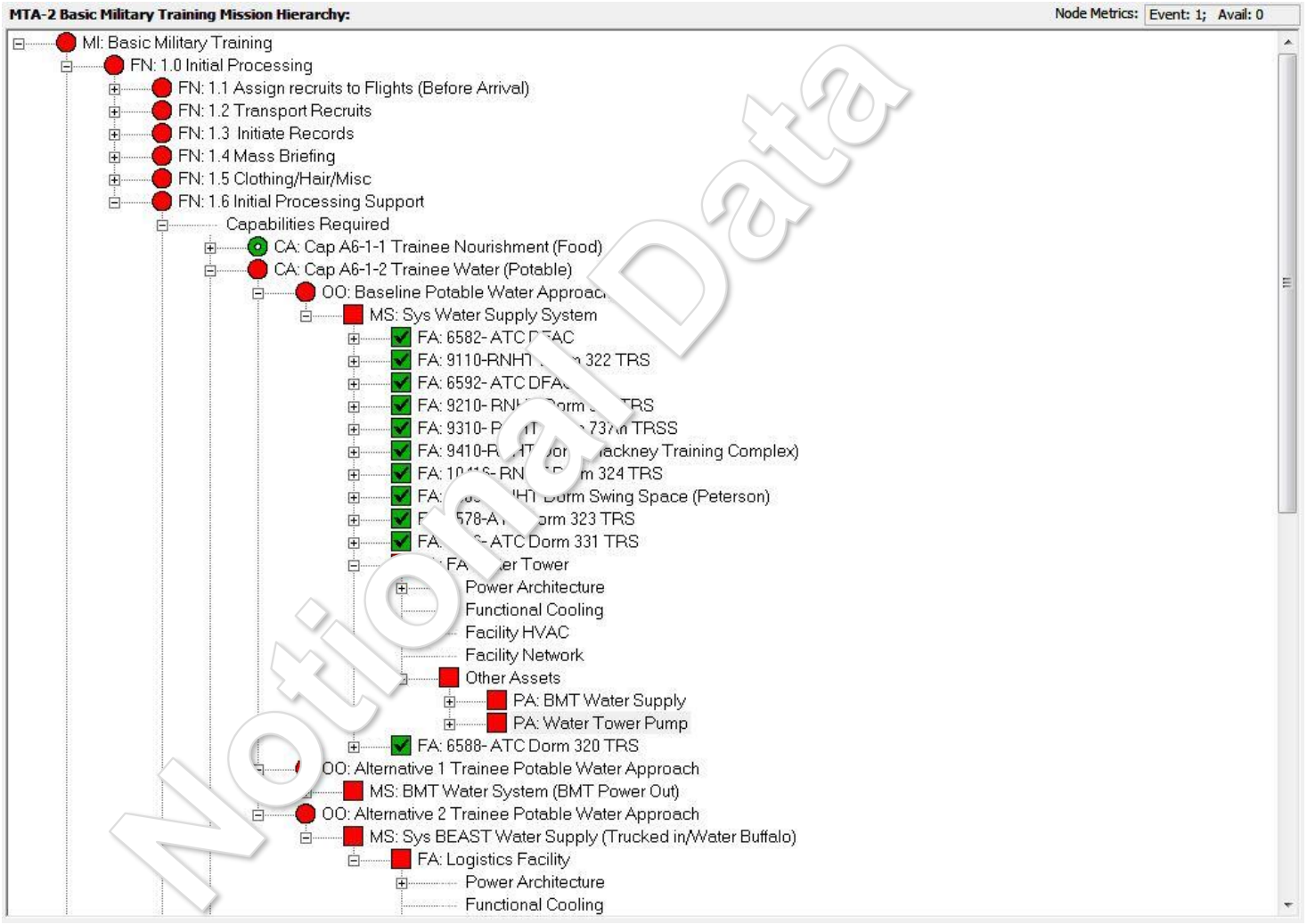
Mission Thread Relationships are Modeled to Understand Interdependencies



Example – Mission Thread is Stressed



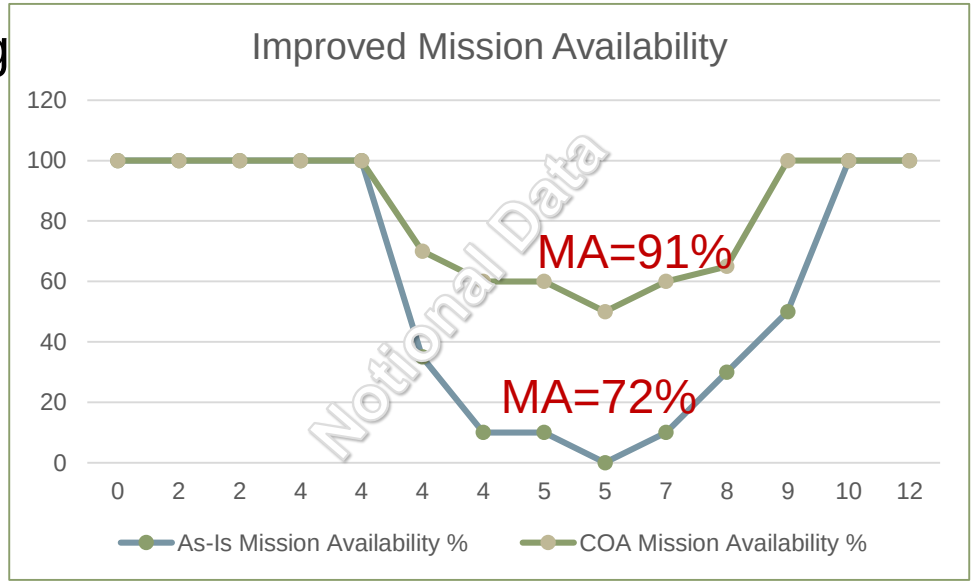
Model measures Mission Degradation under Stress



This method is the DEEPR Process (Decomposition for Energy Assurance and Electrical Power Resilience)

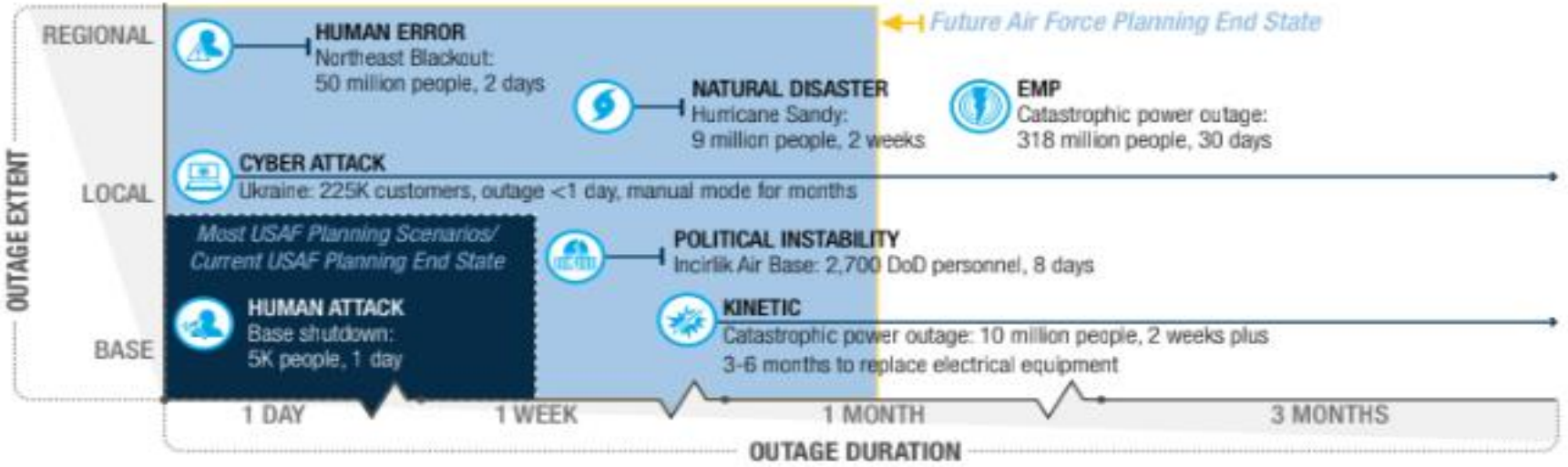
The Concept of Cost Benefit Analysis

- WHAT IF
  - Establish Mission Availability against As-Is Configuration
- THEN
  - Simulate Mission Availability against Enhanced Configuration
- OUTCOME
  - Benefit Metric against Project Cost
  - Metric to aid Decision Making



How is DEEPR different?

- Mission focus, not installation focus
- Structured approach to mapping interdependencies
- Includes consideration for high impact, prolonged, widespread outages
- Combines strategic options, operational workarounds, with powering redundancy to:
  - Understand mission resilience to power vulnerabilities
  - Focus acquisitions or policy modifications on maximizing mission availability and resilience



Model Based Systems Engineering

- DODAF, Sapphire, Relationship Management System, All Hazards Analysis
- Mission thread modeling using the DEEPR process demonstrates:
- The ability to use a relational database to
  - Measure key mission readiness performance parameters
  - Predict mission impact
  - Integrate mission operational workarounds with backup powering assets for overall key mission performance parameters
- The ability to use a graphical database to
  - Depict dynamic mission thread from functions to systems to the assets that power them
  - Determine the critical assets most often involved in mission degradation