# Bulk Electric Systems Operations absent Energy Management System and Supervisory Control and Data Acquisition Capabilities—a Spare Tire Approach

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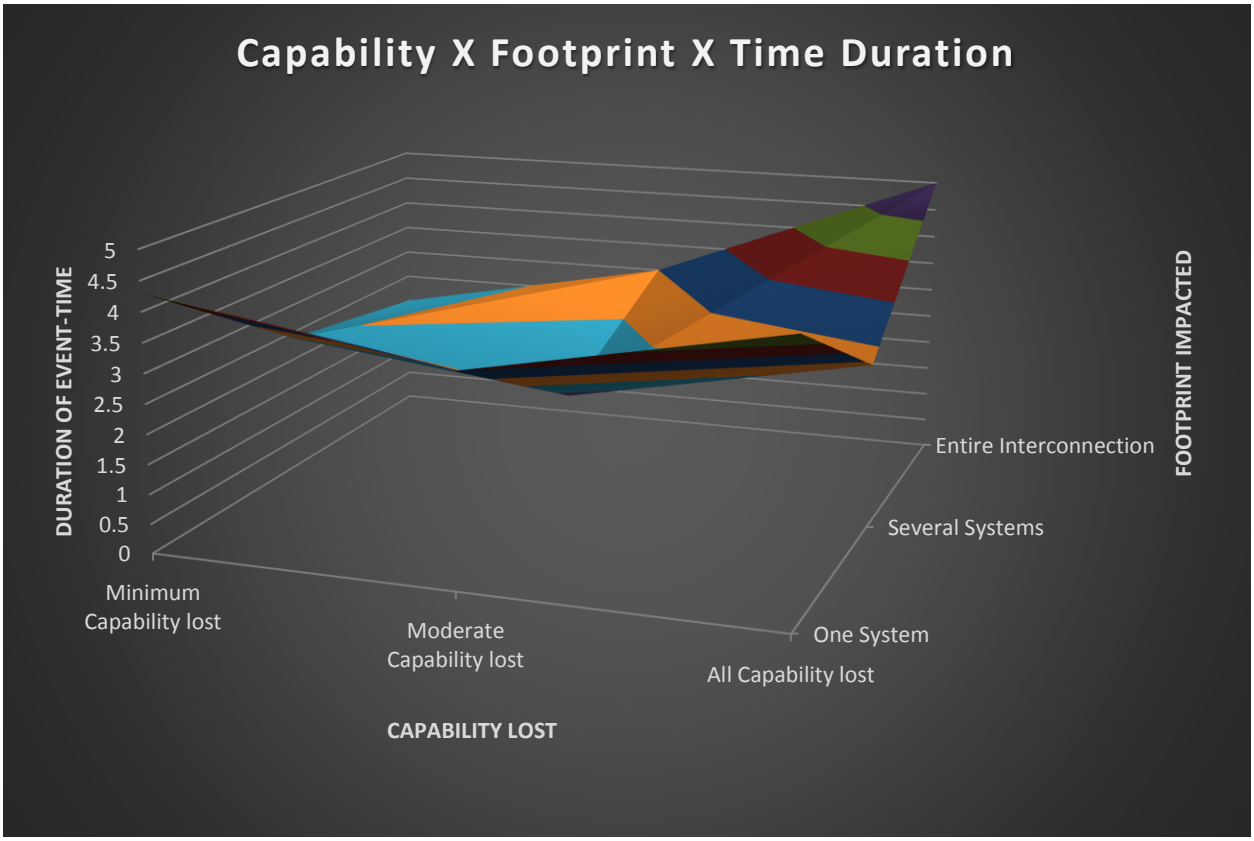
This NATF Reference document, representing research performed by industry personnel who have in excess of 200 years of cumulative experience, is in response to a question originally raised by the Electric Subsector Coordinating Council (ESCC) regarding how electric utilities would continue to operate during an event causing loss of both primary and backup control systems (i.e., total loss of the Energy Management System (EMS)/Supervisory Control and Data Acquisition (SCADA)). This concept was subsequently characterized as a "Spare Tire" approach to ensure continued system operations following the loss of critical applications. As such, this document[1]:

- Captures the results of an assessment of what operating strategies and reliability tools are present today for Bulk Electric System (BES) operations during times when traditional tools for situational awareness, system control, balancing and communications are unavailable, both internally and coupled with external loss of capabilities
- Identifies future areas of industry work and research to better enable operations during scenarios where there is a total loss of all EMS/SCADA capability

The scope of the event assessed was a complete loss of EMS/SCADA where the extent of condition expanded across multiple regions for multiple days. This approach (Capability x Footprint x Timeframe) was necessary to evaluate the impacts on operations and industry readiness. The concept of this approach is shown in the figure below.




[1] A companion NATF Reference Document- *Bulk Electric System Monitoring and Control - An Overview of Backup Capabilities*, provides an overview of the key capabilities for the reliable operation of the BES, along with a description of the various approaches used within the industry to ensure redundancy for critical capabilities so that System Operators are able to continuously monitor and control the BES in the event of the loss of the primary control center capabilities.

In performing the assessment, the team identified 11 key capabilities needed for system operations in the event of loss of EMS/SCADA. These capabilities were included in a limited industry survey in order to (1) determine their rank in priority for "Spare Tire" operations and (2) understand the levels of redundancy generally associated with each. The results indicated the following:

| **Priority Rank Order** |
|---|
| 1. External Voice Communications |
| 2. Internal Voice Communications |
| 3. Area Control Error Calculation |
| 4. Frequency Telemetry |
| 5. Transmission System Monitoring and Control |
| 6. Generation Dispatch and Automatic Generation Control |
| 7. Personnel Deployment (Human Remote Terminal Unit) |
| 8. State Estimation / Real-Time Contingency Analysis |
| 9. Interchange Scheduling |
| 10. Off-line Power Flow Analysis |
| 11. Load and Wind Forecasting |

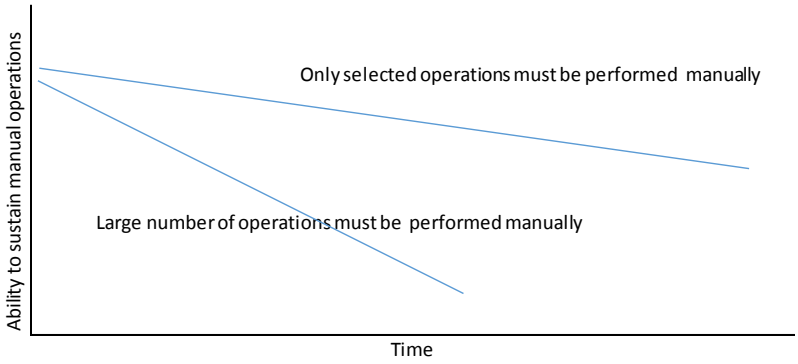
The ability to communicate was the highest ranked capability from the survey. This suggests the importance of having a robust communication network along with sufficient operating protocols available to enable effective communication with internal personnel, neighboring utilities, emergency responders, and other impacted stakeholders. The NATF survey also indicated that at least half of the respondents have implemented redundant capabilities beyond primary and secondary redundancy for the four highest ranked capabilities. At the same time, the results highlight other primary capabilities that remain critical for "Spare Tire" operations that may not generally employ redundancy beyond secondary levels.

Another key observation of the team is that any replacement of EMS/SCADA systems with alternate methods, such as involving humans, trucks, telephones, etc. would be:

- Limited in capability – the system will not function with comparable levels of efficiency and reliability
- Limited in time frame – given the personnel constraints and comparative inefficiency of this form of operation, it cannot be maintained indefinitely
- Resource-consuming – the same personnel who would be working to restore the system (along with ongoing forced outages) will be called upon for this type of operating environment
- Procedurally limited – it is possible that response and recovery procedures generally do not thoroughly define detailed responses to long-term events as described in the document.

It is of the utmost importance that utilities consider not only the availability for resource deployment but also the plans and protocol necessary across the entire enterprise to effectively execute this capability for prolonged periods. This includes the identification of critical skills needed to operate the grid in this manner in addition to the training requirements for any

personnel needed to perform tasks consistent with manual operation. This degradation of the ability to sustain manual operations is shown in the figure below.




Due to the various event scenarios possible, it was concluded that a single recovery method is not appropriate to address all events rendering an EMS/SCADA unavailable. However, as part of the review process for considering a "Spare Tire" strategy, consideration was given to principles that help prepare for and respond to multiple types of high-impact, low-frequency events. The following operating principles were found to be common across multiple entities based on shared experiences, similarities between procedures, and ranked responses for key capabilities.

- Understand impact and plan for personnel safety, training, and coordination
- Ensure availability of alternative communication capabilities
- Consider greater levels of redundancy for primary operating capabilities
- Ability to notify stakeholders and request (or lend) assistance
- Comprehensive and clear logistical plans for personnel and data distribution
- Understand and plan for resource implications (field, engineering, operations, etc.)
- Codify and practice concepts for "Spare Tire" operations
- Consider strategies that mitigate multiple high-impact, low-frequency threats

As for next steps to even better position the industry to address a "Spare Tire" scenario, the team identified the following areas for future work:

- Continue to address voice and data communications- Lead: DOE/National Labs/EPRI
- Develop additional Reliability Tools/Data Availability to aid situational awareness during a "Spare Tire" event- Lead: DOE/National Labs/EPRI
- Formalize strategies and plans for "Spare Tire" operations scenarios- Lead: Individual utility companies
- Formalize data sharing on "Spare Tire" operations strategies- Lead: NATF
- Harden EMS hardware components and develop streamlined EMS recovery process and capabilities- Lead: EMS vendors

It should be noted that individual company practices may vary from descriptions provided in this document. Also, this document does not create binding norms, establish mandatory reliability standards, or create parameters by which compliance with NERC Reliability Standards is monitored or enforced.