Ms. Alice Lippert
United States Department of Energy
Office of Electricity Delivery and Energy Reliability
Forrestal Building, Room 1E-078
1000 Independence Avenue SW
Washington DC, 20585

Via Electronic Delivery
(lpt.rfi.2015@hq.doe.gov)

SYNEXXUS, Inc., on behalf of EmPower, LLC
Response to the:
Department Of Energy Request for Information:
National Power Transformer Reserve

Dear Ms. Lippert,

In 2014, Delta Star, Inc., a leading power transformer and mobile substation manufacturer, and SYNEXXUS, Inc., a leading supplier of battlefield data distribution systems, organized EmPower, LLC ("EmPower"). Delta Star's power industry experience and SYNEXXUS's combat systems experience combine to provide a secure, scalable, adaptable transformer intelligence system.

EmPower is in the process of developing a transformer intelligence system, which will open the door to remote situational awareness in real time; giving the user, whether an asset owner, operator, or other end-user, aggregate information anywhere its needed. In addition to its remote situational awareness capabilities, EmPower's system will also include other sophisticated features, including:

- A built-in recorder, which captures and synchronizes events across the control system;
- The ability to integrate thermal data, advanced metering, analog sensors, device annunciation with dissolved gas analysis, and moisture data onto a single platform to provide a complete view of an otherwise piecemeal and asynchronous information;
- The capability to capture through fault data and specific event waveforms, each available for viewing at any time;
- Transformer temperatures and other analog data, which are available for graphing and trending;
- Current systems status, power quality, and load conditions, which exist in real time;

- On-line moisture and gas generation oversight, integrated through leading third-party devices, which provides continuous supervision and serves as an indicator for developing conditions;
- Thermal insulation aging factors and accumulated through fault current exposure data, which may be utilized to activate alerts at specific loss of life milestones; and
- Drawings, manuals, and test data may be stored and accessed

EmPower can utilize embedded fiber optic sensors to measure direct winding hot spot temperatures, which will unlock the potential to deliver precise transformer dynamic ratings based on existing ambient temperatures. This means a transformer or mobile substation can provide real time loading capacity, which may be above the transformer nameplate power rating. The user may configure the system to report load capacity at different aging factors. Under an emergency overload condition, the system can tell the user how long the load can be sustained before reaching specific top oil or hot spot thresholds. The user may also program the system to automatically select tap positions to reduce heating or configure the system to proactively turn on cooling systems ahead of learned or projected loading cycles. If the cooling system has not been activated in some time due to light loading, the system will self-activate to maintain health and prevent locked rotors.

EmPower's intelligent transformer system is organically designed for information assurance, with multiple layers of data security. A combination of purpose build hardware, locked-down operating systems, and secure application development deliver a complete and vertically integrated cyber solution. Whether the user desires direct SCADA integration through protocols such as IEC 61850, DNP 3.0, Modbus serial/TCP or an end-to-end solution, the control system can be designed to suit. The system will also simplify communications and unify by integrating other devices with serial, fiber, or Ethernet ports.

National Power Transformer Reserve RFI Questions Answered

2. Power Transformer Criterion

What types and sizes of power transformers should be considered for inclusion in a transformer reserve program versus operational spare capacity? What are the design considerations for replacement transformers to support the bulk power system?

Large power transformers ("LPTs") and mobile substations contain sophisticated control system to provide asset protection, power quality, grid reliability, safety, and management. The operating utility specifies which control system to use in order to facilitate integration into the control and protection architecture. In reference to reserve transformers, it is critical the operating utility select a control architecture that provides the maximum flexibility for integration into competing communications standards and protection schemes, while providing a standalone backup system for secure communication of critical operational data for outlying cases. Whichever criteria chosen for an LPT or mobile

substation, the Department should consider systems that provide for maximum flexibility in communicating on multiple data and SCADA platforms.

4. Technical Consideration

Is it technically feasible to develop a reserve of large power transformers when most are custom engineered? Is additional research and development (R&D) necessary to develop suitable replacement transformers that can be rapidly deployed from inventory in the event of an emergency?

Reserve LPTs and mobile substations are likely to be placed in operational situations that are already stressed by system damage. To account for this system damage, a control system should be able to manage the operation of the LPT and mobile substation in extreme cases of operation. The complete operational picture needs to be considered when loading a transformer near its extremes or in fault heavy conditions. Some advanced control situations should be considered are:

1. Cooling forecasting using predicted load and ambient temperature to ensure that maximum capacity is retained before load shedding is needed;
2. Sensors embedded in the transformer element determine the current real conditions that the insulation is exposed to;
3. Dynamic loading capability to allow for the unit to be loaded beyond the nameplate rating, while understanding loss of insulation life and without affecting power quality;
4. Online health monitoring systems to allow for the monitoring of the health of a unit that is stressed; or
5. Operational data logging so that the life expectancy and preventative maintenance of reserve units can be tracked and predicted to ensure reliability.

Some of these issues can be addressed using a multiple-platform SCADA system that can communicate such data from discreet and distinct operational platforms to a centralized operation center, giving maximum perspective of the grid operations.

Implemented control architectures should be compliant with modern cyber security standards. CIP 006-5 medium impact and NIST RMF controls are reasonable starting points. The fact that the reserve units will be deployed when the grid is vulnerable heightens the need to protect the assets from cyber exploitation. Secure backup communications channels will allow for the management and monitoring of the status of the deployed unit and health of the surrounding power nets.

5. Procurement and Management

How should procurement and management the reserve power transformers be conducted? For example, should manufacturers be pre-qualified, and if so, according to what criteria?

6. Supply Chain

What are the critical supply chain components for the manufacture and delivery of large power transformers (e.g., electrical steel, cooper, silicone, high voltage bushings, etc.)? Are there shortages or other considerations that could necessitate using the Defense Production Act Priority Ratings to ensure sufficient parts are available in a time of need? Are there related skilled workforce issues?

FERC has directed NERC to develop a supply chain standard to help eliminate vulnerabilities contained in embedded malware and firmware. During the procurement stage, attention should be paid to the suppliers providing reserve LPTs and mobile substations, with a special emphasis on security and reliability. The need for such emphasis relates to the persistent threats to the power controls industry, which has become one of the most targeted industries for cyber-attach. Moreover, many international supply vendors may have distinct specifications/operations consistent with their home regions that may not include procurement and sourcing practices that prevent software and hardware within the designs. One recommendation to eliminate faulty procurement and sourcing practices is to establish a set of qualifying factors for suppliers who provide critical control components for these LPTs and mobile substations, including security accreditation, software development, and supply chain process control.[1]

Thank you for the opportunity to be included in this Request for Information and we look forward to continuing to provide appropriate levels of assistance as requested.

Respectfully,

Mik Wimbrow
Synexxus, Inc.
Managing Director of Commercial Enterprise
Director of Platform Integration

jwimbrow@synexxus.com
(703) 501-3293

[1] Federal Energy Regulatory Commission. (2015). Revised Critical Infrastructure Protection Reliability Standards. Retrieved from http://ferc.gov/whats-new/comm-meet/2015/071615/E-1.pdf