MITSUBISHI ELECTRIC POWER PRODUCTS, INC.

RIVERGATE INDUSTRIAL PARK
2865 Riverport Road, Memphis, TN 38109
Phone 901-566-3800
Website: wwww.meppi.com

August 24, 2015

Patricia A. Hoffman
Assistant Secretary, U.S. Department of Energy
Office of Electricity Delivery and Energy Reliability
1000 Independence Ave., SW
Washington, DC 20585

RE: National Power Transformer Reserve, Request for Information

Dear Assistant Secretary Hoffman,

Mitsubishi Electric Power Products, Inc. appreciates the opportunity to provide the following comments with regard to the possible establishment of a national reserve of power transformers that support the bulk power system and is managed by the Department of Energy, Office of Electricity Delivery and Energy Reliability.

About Mitsubishi Electric

Mitsubishi Electric Power Products, Inc. is the Pittsburgh-based affiliate of Mitsubishi Electric Corporation of Japan, a leader in the global production of energy infrastructure technologies with over 120,000 employees throughout the world. Via production bases in Japan and the US, Mitsubishi Electric has provided large power transformers (LPT), circuit breakers, and gas-insulated substations to North American customers for over 50 years.

In Memphis, Mitsubishi Electric operates the largest transformer factory in the US occupying over 350,000 square feet on property immediately adjacent to the Mississippi River and with direct access to 5 major rail carriers. Opened in 2013, the Memphis factory is the only US-based facility capable of producing the highest voltage transformers for the domestic transmission system.

Program Need

While the overall US manufacturing base for large power transformers has grown over the last decade so have the severity of natural and man-made threats to the grid.

US government and private sector collaborations have made important progress in addressing vulnerabilities that currently affect the bulk transmission system. However, the full-range of security implications involving a catastrophic event impacting the electricity network justifies additional initiatives that enable rapid availability of critical replacement equipment.

It is well-documented that the manufacture of large power transformers and other critical grid infrastructure is labor intensive, requires substantial production lead-times and meticulous logistics planning for transportation of equipment that can weigh in excess of 400 tons.

Mitsubishi Electric and other equipment manufacturers are working closely with stakeholders to build added security, mobility and resilience into the engineering design of new transformers. These design modifications will improve the overall performance and security of transformers when compared to the current fleet of LPTs that are rapidly approaching, and in many cases have exceeded, their lifespans of 30 years.

However, resilient transformer design is not a substitute for a readily available reserve of large power transformers with multiple locations across the U.S. The establishment of a National Power Transformer Reserve program to stockpile LPTs is a prudent and cost-effective investment to lessen the financial, energy and national security risks associated with a large-scale incident involving the failure of multiple transformers.

Power Transformer Criteria

The types and sizes of transformers that should be considered for inclusion in a transformer reserve program are critical Extra-High Voltage (EHV) transformer applications with a high voltage rating of 230 kV and above, up to and including 765 kV class applications. These transformers are typically located at major power generating facilities as well as various interconnecting substations within the bulk power transmission grid.

Ideally, the spare transformers should be designed to offer operational flexibility to be used in multiple locations throughout the bulk power grid in order to minimize and optimize the total quantity of spares needed to provide adequate coverage for the wide variety of different voltage ratings, power ratings, impedances, physical dimensions and other technical features that vary among the existing installed fleet of EHV transformers.

The level of design flexibility in each spare must be counterbalanced by not making each spare design overly and unnecessarily complex, which could increase unit costs substantially and possibly jeopardize their operational reliability. Significant study should be performed early in the program to identify the appropriate balance of unit cost and unit operational flexibility when establishing the ratings and features of the spare transformers.

Ownership & Economics

What would be an appropriate structure for procuring and inventorying power transformers? How, and by whom, should a program of this type be administered? How would a transformer reserve be funded?

These are important considerations in the development of a National Power Transformer Reserve. However, as a manufacturer of transformers, we defer these questions to other types of industry groups such as electric power utilities, Independent System Operators (ISO's) and other similar entities that are in a better position to provide information in this area.

Technical Considerations

While there will certainly be challenges, it is technically feasible to develop a reserve of large power transformers to be utilized in a National Power Transformer Reserve.

Detailed R&D will be needed by transformer manufacturers, the end operators of such equipment, and the technical groups involved in the preparation of the ordering and operational specifications for this infrastructure. Efforts should be focused on developing features and methods that would allow for rapid deployment of the spare transformers from their inventory site to the final location where they are installed and placed in operation.

Minimizing the time period from storage to operation will greatly improve the effectiveness of a spare transformer reserve program, and mitigate risks in the event of emergency situations on the power system caused by either man-made and/or natural related failures.

Areas to focus include the minimization of components to be removed for storage and transport, which ultimately need to be re-assembled prior to operation of the transformers. Features to allow the transformers to fit in a variety of site situations are critical, such as transformer foundation requirements and overall physical attributes that benefit transport and site installation flexibility options. This is particularly important considering that the equipment will likely be designed, manufactured and stored without knowing the exact location that the transformer will be placed in service.

Procurement & Management

Careful consideration should be given to the procurement, maintenance and management of the reserve power transformers The reliable manufacture, delivery and installation of high-quality, dependable EHV class power transformers is regularly practiced by a select group of transformer companies with decades of experience. The consequences of obtaining inferior quality EHV transformers from unproven and inexperienced manufacturers are severe and would completely undermine the mission of a National Power Transformer Reserve program. We strongly recommend a stringent pre-qualification process to identify capable manufacturers of EHV class transformers.

Qualification factors should include long-term track records of supplying similar EHV class transformers of the voltages, power ratings and applications envisioned for the spare transformers under the reserve program. In addition, the supply experience should focus on the US and/or North American electric utility base that operates the EHV power transmission facilities to be protected by the reserve program.

Evaluations would be needed to confirm the necessary production facilities and equipment associated with the manufacture and testing of EHV transformers are possessed by the potential manufacturer, as well as a skilled and experienced workforce to operate the associated equipment and facilities. An inspection at the manufacturing facility is one of the most effective mechanisms of obtaining the information for this evaluation.

Other factors in evaluating and qualifying potential manufacturing facilities are the level of security and dependability offered by the location of the facility from a geographic perspective. Strategic location of the manufacturing facility should be a key consideration when considering anticipated transport needs,

proximity to possible storage locations and operating locations, and on-going support for maintenance and installation associated with the spare transformer reserve. Access to a secure, dependable supply chain for critical components and materials required for the manufacture of the transformers should also be a part of the evaluation of an EHV transformer company.

Supply Chain

There are a number of critical supply chain components needed for the manufacture and delivery of large power transformers. Such critical components include high voltage bushings, high performance electrical steel for construction of the transformer magnetic circuit (cores), copper conductor for constructing the transformer windings (coils), specialized paper and pressboard insulation materials for the conductors, specialized heat transfer and cooling equipment, and specialized mineral oil for insulation and cooling of the transformers. Suppliers for all of these critical components and materials presently exist within the US, although in a limited capacity in many cases.

At the present time, these critical materials and associated skilled workforce needed are adequately available to support present industry demand, to the best of our knowledge and when considering that alternate suppliers of these critical components and materials are also available outside of the United States. However, a spare transformer reserve program could possibly incrementally increase the overall demand for power transformers to a certain extent, depending on the size and scope of the program. As a result, the program could correspondingly increase the supply for such critical components and materials.

Study would be needed to confirm if any such resulting additional capacity needs could be reliably and securely served by the present supply chain for such components and materials, including the required skilled workforce. Often, the lead-time of these critical components can directly impact the overall available lead time for the actual power transformer. Thus, this study is of significant importance in evaluating the overall needs and resulting benefits of a spare transformer reserve program.

Manufacturing Considerations

Depending on the ultimate scale of the spare transformer program, we feel that there already exists an adequate manufacturing capacity within the US to support such an initiative.

The typical lead time for engineering, manufacture, and delivery of large power transformers in the 230 kV to 765 kV voltage class is presently 12 - 16 months after order, depending on specifics with the transformer design and application, as well as the available open production capacity available for manufacture at the time of order.

It is possible that such lead times could be reduced to support a National Power Transformer Reserve. Standardizing the designs for the spare transformers also reduces the overall lead time by minimizing the amount of engineering needed for each unique transformer design to be produced.

Each spare transformer specified and produced could have certain inherent universal aspects, such as multiple voltage taps to minimize the total amount of unique designs necessary to provide spare transformers.

Stockpiling and inventorying critical long-lead time materials and components at or near the production facilities in advance of manufacturing of the transformer could also reduce the overall lead time from order of a particular pre-designed spare transformer to delivery to the storage location.

Transport and Deployment

When considering specialized transport infrastructure necessary to ship large power transformer transformers from manufacturing sites to storage locations, and from storage locations to installation site in the event of an emergency, a certain amount of critical equipment will need to be on-hand or readily available.

Such equipment includes an assortment of specialized heavy duty rail cars, each containing from 8 axles to 12, 16, or 20 axles, or more. EVH transformers can range from 100 tons to more than 500 tons in the shipping configuration alone, depending on various voltage and power ratings and other design specifics.

Often, rail cars cannot be used to transport the transformers entirely from the spare location to the ultimate installation site, and an additional assortment of over-the-road heavy transport trailers and prime mover vehicles would be needed. Additionally, in some situations it could be desirable to have a number of barges available depending on the size of the spare transformer and the limitations associated with other transport routes from the storage site to installation site.

To support the lifting, handling, unloading and final placement of the transformers in their operating locations, an additional supply of specialized heavy rigging equipment, such as hydraulic jacks, hydraulic gantry systems, mobile cranes, slide beams, cribbing, lifting beams, slings and other similar equipment would be needed as well.

To offer the most reliable and shortest overall response in the event of an emergency situation, it would be desirable to obtain and store such transportation and rigging equipment as described above. Such dedicated transportation and rigging equipment could be stored in the same location as the spare transformers, or possibly even stored in a separate secure location.

Depending on the geographical area covered by the spare transformers, and the strategic positioning of a number of discrete storage locations within the geographical area, it is preferable that most of the operational locations could be reached within a one to two week transportation time from the storage locations. The transport time can be minimized if all needed transport equipment is stored at the ready near the spare transformer location, and the spare transformer itself is stored in a manner that allows for near immediate transport from its as-stored condition.

There are a variety of possibilities for the optimal number and location of storage sites that should be taken into consideration. These factors include the location of the initial manufacture of the transformers, proximity to superior transportation infrastructure (railroads, adequate roadways, bridges, navigable waterways, airports, etc.) and security.

Periodic inspection and maintenance will be required while the transformers are stored.

Field Engineering and Installation

There are existing domestic engineering and installation resources presently available throughout the United States to install multiple bulk power transformers simultaneously. However, to ensure that these resources are immediately accessible when called upon in an emergency, a reserve of dedicated equipment and personnel must also be readily available when notified of an event that justifies deployment of this infrastructure. It may also be desirable to strategically locate such field installation resources as well.

Equipment and personnel requirements include the skilled and trained labor and supervisory personnel needed to assemble transformers at the site installation location to make the spare transformers operational, as well as the specialized equipment necessary to complete the installation process. Such specialized equipment includes mobile cranes for lifting and attaching of external components, transformer mineral oil processing and handling equipment, and specialized verification testing equipment.

Mitsubishi Electric Power Products, Inc. appreciates the opportunity to provide our perspective on the possibility of establishing a National Power Transformer Reserve. Please contact us if we can be of additional assistance.

Sincerely,

Joe Durante
General Manager – Power Transformer Division