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March 3, 2005

Jaclyn A. Brilling, Secretary
New York State Public Service Commission
3 Empire State Plaza
Albany, New York 12223-1350

Dear Secretary Brilling:

We enclose the original and fifteen (15) copies of the Response of SuperPower, Inc. (SuperPower) to your Notice Soliciting Comments in Case 05-M-0900 – in the Matter of the Systems Benefits Charge III, dated January 28, 2005.

The Systems Benefit Charge (SBC) has provided funding for a great many important initiatives in New York State. Under SBC II, SuperPower received critical assistance from NYSERDA in the form of a $6 million award related to the Albany high temperature superconducting (HTS) Cable Project. This HTS project is just one example of HTS applications that could provide a solution to the much needed renewal and upgrade of New York's electric system. We feel that additional investment in important new technologies for the energy industry, such as HTS, will go a long way toward the restoration of an appropriate level of electric reliability.

It is for this reason that we submit our strong support for a further extension of the Systems Benefit Charge. Without the funding provided to small, cutting edge R&D organizations such as SuperPower, we would not be able to complete the critical work that we do in an appropriate timeframe, and I might add with the much needed concomitant economic development benefits to the State.

Thank you for this opportunity to provide our input to this process. Should you have any questions about our submission, please let me know.

Sincerely,

Philip J. Pellegrino
President, SuperPower, Inc.

Enclosures

COMMENTS

Regarding

CASE 05-M-0090

In the Matter of the System Benefits Charge III

Issued January 28, 2005

State of New York
Public Service Commission

Submitted by

SuperPower, Inc.
450 Duane Avenue
Schenectady, NY 12304

March 3, 2005

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Introduction

On August 14, 2001 SuperPower, Inc, a wholly owned subsidiary of Intermagnetics General Corporation announced its receipt of a $6 million award from the New York Energy Research and Development Authority (NYSERDA) to design and build a quarter-mile long prototype high temperature superconducting (HTS) transmission cable for installation into the power grid of Niagara Mohawk, a National Grid Company, in Albany, New York. This initial support from NYSERDA under the Systems Benefit Charge (SBC) Extension Order was the critical component that allowed the start of the Albany HTS Cable project and is expected to result in the world's first in-grid demonstration of second generation HTS technology in 2006.

Since 2002, SuperPower has also been actively developing an HTS device that would operate as a "power valve" in current surge situations that have the potential to wreak havoc in the transmission and distribution system. SuperPower's patent-protected **Matrix Fault Current Limiter** (MFCL) uses its superconductivity characteristics to limit potentially catastrophic fault currents to levels that can be safely interrupted by the circuit breakers in use today. It is to assist the development process of this device and accelerate its availability to the utilities who are in urgent need of such a grid solution, that SuperPower submits its support and commentary for an additional Extension Order to the SBC scheduled to expire in June 2006.

SuperPower notes that in accordance with the directions included in the Commission's Notice, responses were requested to be submitted with reference to a list of fourteen (14) questions posed by Staff. SuperPower's commentary is intended to be responsive primarily to the T&D portion of Staff's question #12: *Should SBC funds be extended to programs that encompass research and development into retail and/or wholesale electric market competitiveness issues, or transmission and/or distribution of the State's energy resources?* SuperPower also believes this commentary has relevance, but to a lesser extent, to Staff questions #2, 3, 7, 8 and 14.

Industry Challenges

In the years since 1998 when the SBC was established, New York's power delivery infrastructure has continued to age and, though considerable investment has been made to increase generation capacity with new installations, by restarting previously retired generating units, and by upgrading existing units, there continues to be a gap between conception and construction of merchant transmission projects.[1] SuperPower would comment

[1] "Power Trends, New York's Success & Unfinished Business," Report by the New York Independent System Operator, May 2004.

that a new focus be added to the SBC to allow support for investment in programs that will improve the transmission and distribution system.

Need for Investment

The Cambridge Energy Research Associates (CERA) contend that investment gridlock in the US is resulting in persistent transmission constraints in the eastern three-fourths of the country. The unprecedented power outage that affected 50 million people in the northeastern United States and Canada on August 14, 2003 and cost an estimated $6 billion in lost business, emergency response requirements and power grid restoration[2], dramatically highlighted the limitations of our aging, capacity-constrained electric transmission and distribution system. Only a few weeks later, wide-scale blackouts occurred in London, Denmark and Italy, underscoring the fact that the deteriorating reliability of the power grid is a global problem. These events have provided a much needed reminder that the time to invest in the renewal and expansion of the critical electrical delivery infrastructure is now. In fact, the Electric Power Research Institute (EPRI), has estimated that $100 billion will need to be invested over the next ten years to reverse the trend of deteriorating electric reliability[3].

Increasing Congestion Costs

The demand for electricity in the U.S. continues to grow 2-3% annually. While the addition of new generating capacity in the United States has increased dramatically since 1990, the annual investment in the transmission network has declined from about $6 billion in 1960 to less than $0.5 billion today[4]. The remote location of new generating stations only exacerbates the situation, resulting in severely congested transmission pathways[5]. Congestion costs are increasing every day, and with continued failure to reinforce the delivery system, consumers pay the ultimate cost[6].

Need for Regulatory Reform

In the past, single entities owned both power plants and the transmission lines that served customers. When a utility built a new plant, it built lines to match.

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[2] "Blackout cost could be $6 billion," Associated Press, August 19, 2003.
[3] "U.S. power lines need huge investment analysts say," Reuters, August 17, 2003.
[4] "Grounded in Reality: Bottlenecks and Investment Needs of the North American Transmission System," Cambridge Energy Research Associates (CERA), 2004.
[5] "Power Trends, New York's Success & Unfinished Business," Report by the New York Independent System Operator, May 2004, p. 9.
[6] Federal Energy Regulatory Commission (FERC): Total congestion costs during summers of 200 and 2001 in the U.S. aggregate to more than $1 billion, predominating in the Northeast.

Customers paid for both. Now, however, many electrical generators are privately owned while transmission grids are in the hands of regulated entities. While the generators build new plants because they see an incentive to join the market, there is less incentive to build transmission lines.

Due to the so-called 'NIMBY' (not in my backyard) concerns of the public, siting of new generation facilities is a long process, often taking up to 15 years for approval and resulting in generation facilities being sited in areas remote from population centers. This requires the installation of high voltage overhead transmission lines to move the power from the points of generation to the points of use. Because the public does not want to see these long overhead transmission lines across the landscape either, the addition of the much-needed new transmission lines becomes not only difficult, but also extremely expensive, with little likelihood of financial gain on the investment[7].

According to New York Independent System Operator (NYISO), "Although transmission reinforcement was not a factor in the August 14 Blackout, it could become important in dealing with future events."[8]

Need for New Technologies

The reliability of the electric power system is critical to the safety and well-being of New Yorkers and to continuing the State's economic resurgence. In the last forty years, large-scale debilitating power outages were infrequent events. Beyond the blackout events of 1965, 1977 and 1996, and other isolated incidents, the power distribution "grid" has enabled people in the western world to carry out the daily routines of modern life with relative consistency and ease[9]. Despite the grid's complexity, it has been more or less invisible. However, recent events have demonstrated that we can no longer assume that electric service is a given, simply there with the flick of a switch. Rather, power interruptions have the potential of being catastrophic, affecting the health and safety of hundreds of millions of people. While New York State's power delivery system ranks very favorably when compared to other regions, the recent power outages suggest that power delivery systems need to be made even more robust and less vulnerable to interruptions that cause major economic disruption. A major requirement in this effort is the use of new, improved technologies.

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[7] Rebecca Smith, "Electricity Industry Capacity Glut Jolts Investors," The Wall Street Journal, November 11, 2003, p. A2.
[8] "Power Trends – New York's Success & Unfinished Business," Report by the New York Independent System Operator, May 2004, p. 7.
[9] "Major Power Outage hits New York, Other Large Cities," CNN.com, August 14, 2003.

Superconductivity in the Electric Grid

Applied superconductivity is envisioned to become an integral part of the technology solution to upgrading the power grid. The U.S. Department of Energy has predicted that superconductivity has the potential to revolutionize the way we generate and receive electricity – to create a superhighway for electricity much like what fiber optics did for the telecommunications industry. It has been estimated that when superconducting materials become a standard component for electrical equipment and are fully integrated into the electric grid and utility sectors, the technology is expected to save $16 billion per year in reduced energy loss[10].

SuperPower, a 5-year old high tech firm housed in a 175-year old renovated facility in an Empire Zone in the City of Schenectady, NY, believes the ultimate commercial success of most HTS electric power applications will primarily depend on the development of cost-effective 2nd generation (2G) HTS wire – the "enabling" technology for the next evolution of devices such as power cables, generators, motors and electrical transformers.

Superconductors are superior to the copper conductors used today because, when cooled to very low temperatures, they become perfect conductors and continuously conduct electrical current without resistance. Thus, they allow more power – as much as 140 times that of conventional conductors - to flow even more efficiently, offering an attractive solution to enhancing transmission and distribution.

The application of superconductors to electric power systems has been pursued for more than thirty years, originally with low temperature superconductors (LTS). The limitation in the cost efficiency of these was the expense of maintaining a temperature near absolute zero with the use of liquid helium as a coolant. Discovered in 1986, high temperature superconductors (HTS) become superconducting at higher temperatures, thereby requiring less sophisticated and less costly cryogenic refrigeration systems. The development of these HTS materials into a cost-efficient conductor has rapidly moved from 1st generation (1G) to 2nd generation (2G) material, providing the basis for widespread technological and economic feasibility.

HTS superconductors are cooled using liquid nitrogen, an environmentally benign, cost-effective and relatively easy to handle substance, and offer the following important performance advantages to electric power devices:

- greatly enhanced capacity
- improved reliability and quality of power
- increased operational flexibility for the utility grid

[10] "Traveling the Path of Least Resistance: Superconductivity, Redirecting the Future of Electric Power," U. S. Department of Energy, April 1999.

- increased efficiency in the generation, transmission, distribution and storage of energy
- reduced operating costs
- environmental benefits, including the elimination of the pollution and fire hazards of oil as a cooling agent, and the reduction in harmful emissions caused by fossil-fuel-powered generating plants
- security benefits resulting from the lighter weight and smaller footprint of HTS devices, allowing these to be sited indoors

Albany HTS Cable Project

As the world's first in-grid demonstration of 2G HTS wire, SuperPower expects to install a 350-meter HTS cable system on the Niagara Mohawk grid in Albany, NY in 2005. The initial phase of the installation will utilize the currently available 1G HTS wire. In 2006 a 30-meter section of the system will be removed and replaced with a cable fabricated with SuperPower's 2G HTS wire. This will be a global showcase for New York State, ultimately providing an important lynchpin in the commercial launch of 2G HTS products and devices.

SuperPower's Albany HTS Cable Project is a prime example of how SBC can benefit New York State by fostering technology that will lead to new jobs and an increased tax base. HTS cables are attractive to utilities because the can carry 3 – 5 times the power of a conventional copper cable with the same cross sectional area. This is particularly important for underground applications in densely populated areas like New York City where digging up the streets to install more conduits may be prohibitively expensive, enormously disruptive, or just not possible. Instead, when moving to HTS cables, the conventional cables can be pulled out of existing conduits and replaced with HTS cables without disruption. The Albany HTS Cable Project is one of three in the U.S. seeking to demonstrate to utilities the technical feasibility of HTS cables and thus provide a key step towards a commercial product.

In August 2001 NYSERDA awarded $6 million to SuperPower to design, build, install and operate a 34.5 kV, 800 A_{rms}, nearly quarter-mile long underground HTS cable on the Niagara Mohawk grid in Albany. This followed an earlier feasibility study that was also supported by NYSERDA. The Albany HTS Cable Project was funded under the auspices of Systems Benefit Charge (SBC) II. By providing $6 million – the largest award ever made by NYSERDA – SBC was the nexus that allowed this project to proceed. Without this contribution, it would not have been feasible for SuperPower or its parent, Intermagnetics General Corporation, to fund the approximately $26 million project on its own.

The initial $6 million "seed money" for this project enabled SuperPower to convince Sumitomo Electric Industries (SEI), one of the world's largest

conventional cable manufacturers and one of only a handful of companies in the world with experience in fabricating HTS cables, to join the project and contribute both needed technical expertise and in-kind services, reducing SuperPower's technical risk and cost share to a feasible level. Subsequently, the US Department of Energy (DOE) agreed to provide 50% of the project funding through its Superconductivity Partnerships with Industry (SPI) program, and the BOC Group agreed to provide in-kind services for the cryogenic refrigeration system needed to cool the cable to operational temperatures.

SuperPower's business plan projects that one of the largest applications for HTS technology will be underground HTS cables in urban areas. The funding provided by SBC II enabled SuperPower to secure the additional funding from the DOE, SEI and BOC, as well as critical technical expertise from SEI and BOC. The Albany HTS Cable Project will serve to demonstrate technical feasibility and lead to a commercial HTS cable product that will bring jobs and tax revenues to New York State. Our business plan anticipates that by 2015 we will have added approximately 150 high paying, highly-skilled engineering, manufacturing and administrative jobs in New York to produce 2G HTS wire for cables. This would not have been possible without the financial support from NYSERDA, provided by way of the SBC.

The MFCL Solution

To build on the enormous potential for superconducting devices to address some of the major concerns relating to the reliable and efficient transmission and distribution of electric power, SuperPower has developed a patent-protected Matrix Fault Current Limiter device to protect against damaging surges in electrical current.

The Business Case for MFCL

A fault condition may result in an electric power transmission system from events such as lightning striking a power line, or downed trees or utility poles shorting the power lines to ground. The fault creates a surge of current through the electric power system that can cause serious damage to grid equipment. Switchgear, such as circuit breakers, are deployed within transmission substations to protect substation equipment. When power delivery networks are upgraded or new generation is added, fault levels can increase beyond the capabilities of the existing equipment, with circuit breakers in an "over-duty" condition. This problem necessitates upgrades such as the modification of substations or replacement of multiple circuit breakers, which can be expensive and require extended outages. Increased fault currents due to load growth and industry structural changes have become a significant

factor in system planning and operation. Equipment and personnel safety, power quality, and overall system reliability are all at stake if techniques and tools are not found to mitigate the higher levels of fault current in today's grid.

SuperPower and Nexans are developing new HTS technology to solve fault current over-duty problems in utility transmission networks. The Matrix Fault Current Limiter (MFCL) is targeted to address fault current over-duty problems at the transmission voltage level of 138kV and higher. The MFCL is expected to help utility transmission planners meet the threat of higher levels of fault duty in the grid cost-effectively and with no adverse side effects. The MFCL is presently being developed through a project sponsored by the DOE Superconductivity Partnerships with Industry (SPI) and EPRI. The MFCL will reduce the available fault current to a lower, safer level so the existing switchgear can still protect the grid. SuperPower holds three patents on the unique MFCL technology, with additional applications in process.

The MFCL development effort underway at SuperPower since 2002, is a milestone driven program to develop the world's first device capable of fault current limiting at transmission system voltages. A significant milestone was reached in 2004, when a pre-prototype MFCL device was successfully tested off-grid, and demonstrated the expected current limiting performance. The device began to limit current before the first peak of the fault, which demonstrates the ability of the device to limit the peak short circuit stress on utility system components. The device also demonstrated significant current limiting by the third cycle in order to reduce the fault current that the circuit breaker needs to interrupt. The MFCL development program is now in the Alpha prototype stage, where the device will be tested off-grid at the rated 138kV level in early 2006 to achieve the next significant milestone. This will be followed by a Beta prototype, to be tested in the American Electric Power (AEP) 138kV grid in early 2007. AEP, like Niagara Mohawk in the case of the Albany HTS Cable Project, has agreed to be the utility host for the MFCL, and is providing an in-kind contribution to facilitate development.

MFCL Deployment in New York State at Consolidated Edison[11]

In 2000, Consolidated Edison Co. of New York, Inc. (Con Edison) reported[12] that thirteen developers had plans to interconnect approximately 9,500 MW of new generation into their transmission system. The interconnection of this additional generation increased the magnitude of fault currents to levels significantly above the ratings of circuit breakers at various 345kV, 138kV, and

[11] Commentary submitted in this section should be attributed exclusively to SuperPower. References to Con Edison are illustrative only, and are not intended to indicate or imply that Con Edison was consulted prior to preparation of these comments; has reviewed these comments in advance of submission (which it has not); or for that matter would necessarily concur with SuperPower's statements either in whole or in part.

[12] "Report on the Fault Current Mitigation Solution for the Con Edison Transmission System", November 27, 2000.

69kV substations. As a result of this growth, Con Edison assembled a System Fault Current Task Force to develop a plan to manage the fault currents on their bulk power transmission system so the additional generating sources proposed by third party developers could be safely connected into the system. The recommended plan employed a mix of the available conventional solutions such as series reactors, bus splits and circuit breaker replacements. Con Edison was able to solve the immediate issues, but they were concerned about the limitations of the conventional solutions, side effects, and the numerous outages needed for the circuit breaker upgrades, and the ability to accommodate future growth.

As a result, the Con Edison study noted that the accelerated development of new technology is needed to simplify the addition of new generation. In particular, HTS technologies can have an impact on the footprint limitation in dense urban environments like those encountered in the Con Edison system. HTS also is safer, since it employs benign liquid nitrogen as a coolant and electrical insulator, instead of flammable oil like that used in conventional utility equipment. A Con Edison representative currently sits on the SuperPower MFCL Technical Advisory Board, which helps to guide the development project, and provides Con Edison with the latest information on the status of the SuperPower MFCL product development. Con Edison is also a member of the superconductivity trade association, the Coalition for the Competitive Application of Superconductors (CCAS).

Con Edison appears to be interested in the development of the new HTS technologies because the system planning process has fundamentally changed and the location of new generation cannot be coordinated with the capability of the existing transmission system. The continued use of series reactors has limitations because of the losses and the aggravation of generator stability limits. Fault current levels have reached the 80kA level, but the use of expensive 80kA breakers is prohibitive. Surgically applied FCLs provide the ideal solution to accommodate the addition of distributed or aggregate generators and defers expensive substation upgrades. Superconductivity could support advanced substations and interconnection designs that allow larger amounts of power to be routed between substations, feeders and networks in much less space. Superconducting FCLs also enable other HTS technologies like HTS cables, since this can mitigate the recovery time problem of HTS cables and allow the cable cores to reduce size and further exploit the space advantage for retrofit in existing ducts.

Proposal for MFCL at Con Edison

Given Con Edison's need for a transmission level fault current limiting device to accommodate ongoing growth in their system, SuperPower proposes that a

second Beta prototype program be funded by SBC funds. This second Beta prototype will focus on the dense urban environment application, and will provide a basis for the applications in the New York City area. The second prototype will also focus on Con Edison's vision for advanced substations and interconnection designs that addresses the unique needs for a secure urban power system. This prototype could be installed on the Con Edison grid sometime in late 2007 or early 2008, depending on the availability of the funds. It is estimated that $4M - $5M of funds would be needed to support this program. A portion of this would provide 50% cost share on the development costs, and the remainder would support the cost for the second Beta unit. This estimate may be lower or higher, depending upon the actual site and application requirements for the second Beta prototype device at Con Edison.

Conclusion

An addition to the SBC to provide funding for research and development programs that will improve and upgrade the transmission and distribution infrastructure would enable both consumers and businesses to benefit significantly from the cost savings of a more efficient and reliable system. Building on the early SBC funding support for SuperPower's Albany HTS Cable Project has been critical to the advancement of this promising new technology. Following on this world-class –program lead by providing SBC funding to host a Beta prototype MFCL device in New York State would result in the early benefit to the state of enhanced grid quality, reliability and safety.

SuperPower, as a subsidiary of Intermagnetics General Corporation, is a company with deep roots in New York State. Intermagnetics was founded in New York in 1971 and currently employs about 400 workers in the Capital Region of New York State. Since its formation in March 2000, SuperPower has grown from an original staff of 23 to 50 highly skilled and highly compensated employees today. In the next five years as the technology and the product line matures and is brought to market, a more than four-fold increase in workforce is expected. For Schenectady, a city more experienced in recent years with job losses than gains, SuperPower's arrival and ultimate success is of particular relevance.

With a market for the MFCL alone expected to surpass $600 million by 2015, the economic impact for New York State is expected to be enormous. A contribution to SuperPower's MFCL development effort through an additional SBC extension would help to ensure the commercial success of this much needed new power device and would help to improve the quality and reliability of New York's transmission and distribution infrastructure.