Superconducting Magnetic Energy Storage
SDIO Program Plan

This summary document presents information on 1) Applications of superconducting magnetic energy storage 2) The acquisition strategy which can be brought to bear for prompt initiation of a program in this technology 3) Definition of a methodology to transfer information between the SDIO program, industry, and the general public.

BACKGROUND

Superconducting Magnetic Energy Storage (SMES) is a technique for storing electrical energy in large, football field-size coils. It has been under investigation for a number of years for electric utility applications. These studies and designs, funded by the Department of Energy (DOE), the Electric Power Research Institute (EPRI), and various utilities, have explored the use of SMES for load leveling--that is, the "high tech" equivalent of pumping water into a reservoir at night when electricity demand is low and using the stored capacity to provide additional generating capability to meet increased daytime demands. The technical feasibility of SMES has been verified and the economics of construction and operation established. The next logical step is to build a utility-scale demonstration unit; decreased funding for energy-related activities has precluded initiation of such an effort.

In the SDI context, SMES has been studied as a means by which the unprecedented electrical power requirements of various ground based SDI systems can be satisfied. It has been evaluated and compared with other electrical power sources such as batteries, diesel electric generators, and fuel cells for potential ground based laser applications; SMES fares extremely well in this competition.

REQUIREMENTS AND CAPABILITIES

The regime in which SMES becomes of interest for utility applications is for energy levels of 10s to 100s of MW hours, with discharge rates of 10-100 MW. Eventual GBFEL power requirements are in the range of 1000 MW. The present requirement for the near term GBFEL Technology Integration Experiment is for 300 MW of prime power for the laser itself, with 20 MW available for ancillary systems. Three five minute full power tests per day are planned. The two most critical parameters are the maximum achievable ramp rate from zero to full power, and voltage regulation of $\pm$0.5%. The SMES engineering test model (ETM) proposed is easily capable of satisfying these requirements. In addition, it would simultaneously be capable of meeting utility needs for load leveling. In an actual application, two independent power conditioning systems would be provided for interface with the grid and with the laser. The SMES unit would normally operate in the utility load-leveling mode; it would be disconnected from the grid when laser power is required. The benefits to both the civilian and military sectors are real and noteworthy. Rarely do technology advancement and evolving need meet in such serendipitous synergism.

Among the advantages which SMES has to offer are instantaneous response, extremely high efficiency, relatively low cost, fuel independance, siting ease, relative insensitivity to earthquake, blast, or electromagnetic pulse, etc. SMES makes sense with present day superconductors and liquid helium storage and refrigeration techniques. The advent of the new high temperature superconductor materials, assuming that the path from laboratory curiosity to usable power technology can be successfully traversed, offers promise of significant risk reduction in design and construction, as well as important decreases in system operating complexity and cost.

The SDIO is sufficiently impressed with the potential of this technology that we are immediately launching a major effort to build and test a demonstration unit which, while smaller than that required for the final GBL operation, is large enough to exceed the requirements given above and to function in a utility environment. To contribute to the success of this effort, we are actively soliciting the involvement--in terms of input guidance, management oversight, and funding--of the DOE, EPRI, and various associations of electric utilities. It is our intent to quickly exploit this ultimate of SDI spinoffs; one in which the civilian use of SDI developed technology is not merely a by-product, but is intrinsically an integral part of the concept from inception. The goal of the program is 99% use of the SMES unit by the utility.

ACQUISITION STRATEGY

The acquisition strategy will support construction of an engineering test model within five years. This system will be capable of supplying 20-50 MW-hours for utility applications, and 0.2-1.0 GW for 100 seconds for SDIO applications. To meet the very tight time constraints, a limited source procurement will be initiated. The solicitation will be issued in June 1987. The work will be conducted in two phases: I) Conceptual design and proof-of-principle experiments II) (Optional) Construction of the engineering test model. There will be multiple awards made for Phase I work, with downselection to the best designs made prior to initiating Phase II. Phase I start will be via letter contracts to be let in September 1987; Phase I will be complete in September 1989, and the ETM will be operational in September, 1992. Funding will be provided by SDIO, DOE, EPRI, and electrical utilities. Technical direction will be the responsibility of SDIO/DNA, and all contracting will be done through DNA.

INFORMATION TRANSFER

To insure timely and effective transfer of information between the SMES program, the DoD, the electrical utilities industry, and the general public, an Energy Storage Coordinating Council (ESCC) will be established as a subcommittee to the SDIO Advisory Committee. The ESCC will assist in the identification and resolution of civil and military interface issues associated with the establishment of a Superconducting Magnetic Energy Storage (SMES) facility and serve as spokespersons and representatives of the SMES development program to the electrical power community. The committee shall be comprised of up to ten volunteer representatives of the electrical power industry and utility companies from all regions of the Nation. The membership shall include, as a minimum, one representative each from the Electrical Power Research Institute and the North American Electric Reliability Council. The chairman of the committee will report to the SDIO Advisory Committee and also be a member of the SDIO Power Generation, Transmission, and Storage Technology Applications panel. The Council shall meet on a quarterly basis and advisors will serve without compensation as non-paid government consultants for a minimum period of two years.

SUMMARY

Development of SMES will mark a significant SDI payoff in technology which is of direct benefit to the public at large. Without SDI participation and leadership, this technology will not be developed--SDIO is serving as the catalyst for initiation of the joint DOE/EPRI/Utility/SDIO effort. We look forward to an aggressive program which will result in significant technical progress, address a critical SDI need, and at the same time serve as a tie between SDIO and the civilian sector via the utilities industry.