CCAS
Coalition for the Commercial Application of Superconductors

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High Energy Physics, Medicine and Fusion Reactors

The DOE negotiated away the future for much of the currently recognized U.S. world leadership and technology advantages in materials and high field magnets essential for further scientific advances, medical instrumentation, and the development of fusion reactors. This U.S. leadership was hard won through Government and industry investment totaling more than $2 billion over the past three decades. As a result the U.S. will likely need to purchase future superconducting magnets and fusion systems from Asia and Europe rather than be the world supplier. Action is required to avoid further erosion of the U.S. competitive position.

Benefits of Government/Industry Collaboration: Historically, the synergy produced by close collaboration in High Energy Physics (HEP) between universities, National Laboratories and industry has led to major benefits to society and many high tech jobs in research, development and manufacturing. The practical benefits derived from HEP research are clear. Today, only a handful of the accelerators in operation around the world are used in particle physics research. Most are used for industrial applications ranging from micro-machining to food sterilization and for national security applications, including x-ray inspection of cargo containers and nuclear stockpile stewardship. One-third of all accelerators are involved in medical applications, such as cancer therapy, imaging, and the production of short-lived isotopes. Medicine's most powerful diagnostic tools incorporate technology developed for particle accelerators. This is testimony to the benefits derived from fundamental research in high energy physics.

High Field Magnet Development History: The Fermilab effort to develop superconducting wire and cable for the Tevatron collider brought together experts in superconductivity, physics, engineering, materials science and manufacturing, and created the industrial capacity for large-scale superconductor fabrication. This joint effort not only led to the successful completion of the Tevatron project but made superconducting magnet technology ready to play a major role in the diagnostic capabilities created by NMR and MRI. In turn, the needs of the large commercial NMR/MRI market have helped maintain the expertise and production capabilities that were necessary to support subsequent large worldwide HEP projects with the U.S. maintaining a world leading materials, technology and manufacturing position. This ongoing synergy has led to a high return on investment in fundamental science projects.

Fusion Reactors: Fusion energy is another important scientific endeavor based on superconducting technology to create an economical, environmentally attractive power generating reactor. During the 1970's-1980's the US led the world in the development of superconducting magnets for magnetic confinement fusion. Several very large projects, conceived and designed in universities and national laboratories, and constructed by US industry, were paving the way toward a growing technology base. In the 1990's the US contributed, in collaboration with Japan, the world's largest and most powerful pulsed superconducting magnet. It was built using a superconductor technology which was invented at MIT, pioneered in the US through several earlier projects and used U.S. developed materials. These materials were accepted world-wide as the standard conductor to be used in large scale fusion magnets, including the present International Thermonuclear Experimental Reactor (ITER) design.

Recent History: Since 2000, U.S. fusion technology budgets have been repeatedly cut, leading to atrophy of the engineering and technology base of superconducting magnets for fusion. This was occurring while Europe, China, Korea, and India began their own major fusion projects using the US developed superconductor technology. ITER is one of the largest international scientific collaborations ever. The DOE was not vigilant in maintaining U.S. leadership, hence the dominant position once held by the U.S. has been largely negotiated away. Supply contracts for the critical hi tech wire have been awarded primarily to Japan, China, Korea and Russia, even though U.S. manufacturers were alone in meeting wire specifications and the U.S. was originally universally expected to receive the wire contracts. The U.S. is funding approximately 10% of the ITER cost and will end up transferring technology to, and subsidizing the development of, competitive wire development and manufacturing facilities in China, Korea, Russia and Japan. This bodes ill for future U.S. jobs and technology leadership.

Required Action: In order to regain a leading competitive position and ensure future jobs it is essential that U.S. support for R&D is increased to provide a new generation of production ready superconducting materials for the design of superior low temperature, high field magnets.

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