Official Communique
The 8th International Superconductivity Industry Summit
October 12 -14, 1999
Kyoto Kokusai Hotel, Kyoto, Japan

EXECUTIVE SUMMARY

The 8th International Superconductivity Industry Summit (ISIS-8) was held at the Kyoto International Hotel on October 12-14, 1999. Approximately 40 participants, mostly members of CCONECTUS*1 , CSAC *2, and ISTEC*3 *3attended the summit. Concerned government representatives and academics also participated in the meeting.

Seven years ago, the first ISIS meeting was held on May 11- 13, 1992, in Washington, D.C. Since then, international leaders in government, industry, and academia interested in promoting the industrialization of superconductivity have gathered once a year, with the support of various governments and academic circles. This year, the eighth such meeting was held. ISIS is an international forum for industrialists that allows them to meet under one roof to discuss their common goal of promoting and providing leadership for the industrialization and commercialization of superconductivity technology. The annual summits have not only helped to deepen the general understanding of the benefits, advantages and need to industrialize superconductivity, but have been effective in providing a place to discuss ways of achieving this goal at the earliest possible date.

The discovery of high-temperature superconductors (HTS) triggered a world-wide ″superconductivity fever,ŧ and the optimistic view that superconductivity would soon be commercialized prevailed among researchers. This period of optimism was followed by one of gradually increasing pessimism, in which researchers encountered numerous technical issues that demanded resolution before commercialization could become a reality. Today, however, efforts towards superconductivity commercialization and industrialization have progressed steadily, keeping pace with the advancement of superconductivity technology. The successful introduction of superconductivity technology into the worldwide electric power, medical, and electronics market place is now regarded by experts as one of the most vital industrial events of the coming century. The reason for this view is that

superconductivity technology has both environmental and energy-saving benefits that are unequaled by other technologies. The need to invest in these benefits will become increasingly important as our society continues to advance technically. As consensus on this issue increases, cooperation among industrial, governmental and academic circles aiming at the commercialization of superconductivity technology and the creation of new industries is intensifying on a global scale.

In reaction to these world trends, various discussions were held at the seven earlier summits on the themes described in the attachment. At ISIS-8, two important themes were addressed:

1. Participants discussed the **progress** in both material development and superconductivity applications that has been made over the past year and presented ideas

on how expanded commercialization can best be achieved. They emphasized that continued progress in the development of superconductivity applications will be tied to the further improvement of material performance and costs.

At the 7th International Superconductivity Industry Summit held last year in Washington, D.C., panel discussions were held on areas in which superconductivity has been, or soon will be, industrialized. The status of these technologies and their outlook were then discussed and confirmed. The task of ISIS-8 was to trace the flow of commercialization in specific areas as a result of the remarkable progress in superconductivity technology that has been made in several countries over the past year. Specifically, the technological progress that has been made in feasibility demonstrations of large-scale power applications and small-scale electronics in Japan, Europe and the United States was reviewed, and methods of encouraging their commercialization were discussed. Thus, a renewed appreciation of the need for the practical use of superconductivity and the development of new products using this technology was gained.

2. Participants discussed the role that **venture businesses** may play in promoting the commercialization of superconductivity technology and considered ways in which such enterprises could be encouraged.

As with other innovative forms of technology, venture businesses are expected to play a major role in furthering the commercialization of superconductivity technology. Thus, the founders of venture businesses and other industrialists were invited to ISIS-8 to discuss the various problems they have met and their methods of resolving them, thereby providing a valuable learning experience. In this, the participants sought to show the direction industrial circles should take when promoting the commercialization of superconductivity. Furthermore, the participants recognized the need to establish systems for promoting cooperation among industrial, governmental and academic circles as well as international cooperation.

OVERVIEW, OUTLOOK, AND RECOMMENDATIONS

Considering these ideas, the ISIS-8 delegates engaged in discussions for two days and came to a consensus on the following points:

(1) The worldwide demand for electricity is expected to increase in the next century as a result of the rapidly advancing information and telecommunications industries. The combination of a larger power demand and the importance of energy savings and environmental issues will intensify the requirements of future technologies. HTS is being increasingly seen as one of the most viable solutions to the complex problem of an environment-friendly energy supply. Thus, the need to advance research and speed-up the commercialization of HTS technology can not be stressed enough.

(2) Although levels of superconductivity industrialization and commercialization vary from region to region, steady progress is anticipated.

(3) Presently, the majority of HTS R&D and commercialization activities are being pursued by the private sector. To further support and promote this work, however, both

international cooperation and public sector assistance must be strengthened.

(4) Venture businesses may play a large role in the commercialization of superconductivity, and it is essential that governments improve the climate for their growth by creating beneficial tax programs and restructuring the equity market.

(5) To accelerate HTS commercialization, it is essential for businesses to promote research and development through ongoing investment. In addition, governments must continue to expand superconductivity programs. Furthermore, information on research and development should be openly disclosed and made readily available to interested parties.

(6) Efforts must be made to scale-up manufacturing processes as quickly as possible.

(7) ISTEC]s role and contribution in the promotion of international collaboration are widely recognized. The participants urged ISTEC not only to continue, but to expand upon their activities.

SALIENT POINTS OF DISCUSSION IN EACH ISIS-8 SESSION

Session 1: Superconductivity Technology

Discussions highlighted the status of industrialization and commercialization in major segments of the superconductivity market, including material development, medical service, electric power, electronics, processing industries, research applications, cryogenic technology, and transportation.

(1) Material Development

Underlying all superconductivity applications, both LTS and HTS, is the continual improvement of material properties, processing techniques, and cost performance. All three international parties have strong programs in material development. The ISIS-8 participants urged both private and public sectors worldwide to maintain these programs and expand them to include manufacturing scale-ups.

(2) Medical Service Technology

Magnetic resonance imaging (MRI) is an excellent example of the beneficial impact from a major low-temperature superconductivity (LTS) application, and the annual MRI market continues to be at a level of US $2 billion. The number of MRI systems for medical service installed throughout the world now exceeds 10,000, some 3,700 of which are in Japan. Superconductivity systems occupy 75% of the total, and their number is growing at a rate of approximately 10% a year.
Efforts to explore the possibility of HTS MRI units using superconducting magnets are continuing. Last autumn, Oxford Instruments in the UK and Siemens in Germany announced the status of a joint development demonstration project for an open MRI (0.2T) system using BSCCO 2223 tapes.
Efforts to develop biomagnetic field measurement systems (such as magnetoencephalography and magnetocardiography) using superconducting quantum interference devices (SQUIDs) are also showing exciting progress. An interesting

development was announced in both Europe and the US earlier this year in the field of magnetocardiography (MCG). LTS MCG can be used to diagnose certain cardiac pathologies that cannot be identified by any other means. These findings may spawn a major industry, analogous to MRI, that has the potential to become a vital tool for cardiac internal medicine.

(3) Electric Power

Japan is very active in research and development on HTS cables, generators, fault current limiters, HTS transformers, HTS flywheels, and SMES systems. In particular, the Tokyo Electric Power Company (TEPCO) and electric wire makers are jointly developing HTS electric power cables. In 1999, TEPCO and Sumitomo Electric Industries launched a joint project to manufacture and evaluate the reliability of three-core, 100 meter long HTS cables. They are presently conducting current and voltage loading tests using a single-core, 30 meter long cable. Also in Japan, ISTEC, the Chubu Electric Power Company, and other companies are working on the development of superconducting magnetic energy storage (SMES) systems in an attempt to establish the basic and systemization technologies required for the development of a 100 kWh pilot plant using LTS.
Two kinds of demonstrators have been connected to the commercial grids of two utility companies. The first is a 1 kWh/ 1 MW SMES connected to the grid of the Kyushu Electric Power Company, Inc. The second demonstration is a 70 MW generator connected to the 77 kV grid of the Kansai Electric Power Company, Inc.
In the US, Detroit Edison is working with Pirelli, American Superconductor Corporation, and EPRI to produce and install 130-meter-long electricity distribution cables for use in a power distribution network. Furthermore, American Superconductor is now manufacturing and selling commercial SMES devices (3 MJ storage capacity) for both industrial power quality applications and for transmission grid reliability. American Superconductor has installed 10 units at industrial sites and has a current backlog of orders for eight additional commercial units. In parallel, Intermagnetics General Corporation has produced a prototype SMES device for power quality applications.
In Europe, ongoing activities are concentrated in a number of full demonstration cable projects in France, Italy, Germany and Denmark. The installations in France and Italy represent a multinational cooperative effort with wire coming from American Superconductor in the United States, the cables being produced by Pirelli in Italy, and utilities in France (EDF) and Italy (ENEL and Edison) participating in the cable specifications and tests. The development of fault current limiters and transformers for the transportation industry and electrical power grids is also being pursued. These projects benefit from at least 5 European and one American producer of HTS BSCCO tapes and several suppliers of HTS bulk materials.

(4) Electronics

Wireless communication (or carrier) companies in Japan, Europe and the US are continuing their evaluation of HTS filters for ground and satellite-based systems. Other applications, such as HTS adaptive antenna arrays, are also attracting interest. In the United States, the telecommunications industry is beginning to show acceptance of cryo-based cellular ground stations, several hundred of which have been installed or tested over the past year. However, costs remain too high to capture a major portion of the present demand. On the other hand, given the continuing explosion in wireless communication within the United States, it is very likely that a performance limit on bandwidth, range and voice quality will be reached in the next five years that only HTS rf filter technology will be able to overcome. Thus, the outlook for this technology is very promising.

Steady progress is being observed, especially in Europe, in the commercialization of HTS SQUIDs for various specialty markets, like non-destructive testing or geophysical exploration. The development of scanning SQUID microscopy, both LTS and HTS, and its successful commercialization portends increased employment in semiconductor chip quality control and medical magnetotomography (see Medical Services section). In addition, non-destructive testing and analysis applications using superconducting sensors are being developed at a modest pace in the US.

In Japan, R&D projects aimed at applying digital LTS and HTS single flux quantum (SFQ) devices to the measurement and communications fields are continuing to progress. In the US, the long dormant field of superconducting digital electronics is also showing signs of revival with the improved performance of LTS rapid single flux quantum (RSFQ) devices and their integration into ﾒhybrid technologies, multi-threadedｴ (HTMT). National security needs of the American government may engender a major development program over the next ten years to realize massively parallel petaFLOPS-scale computers, requiring technology far beyond semiconductor capabilities. RSFQ-HTMT is seen as the only possible technical solution. However, the size of the devices must be reduced by three orders of magnitude to become feasible. The commercial fall-out of such a national program would be enormous, perhaps resulting in personal workstations of teraFLOPS performance, yet dissipating less than 500 watts.

(5) Processing Industries

Steel processing is an area in which large energy-saving benefits can be realized by the introduction of superconductivity technology. In 1995, Japan launched a six-year national project on the "Electromagnetic Processing of Materials." Within this project, researchers are developing a system for controlling the flow of molten steel using LTS electromagnetic brakes. Presently, these electromagnetic brakes are expected to enable the conventional casting speed to be doubled.

Also in Japan, a superconducting magnet containing Bi-based superconducting wires is being developed for use in high-purity Si single-crystal pulling systems. Coil tests have confirmed that the performance of this magnet exceeds its design values. Applications in this area are expected to rapidly diversify if the cost of these magnets is reduced.

(6) Research Applications

At the CERN research institute in Europe, the fabrication of LTS superconducting magnets for a large hadron collider (LHC) is being accelerated, and Japanese, American and European firms are extending their cooperation. All involved parties, especially European firms, are significantly increasing their production rates to supply the large volume of NbTi wires that is required. Japan is also engaged in the production and testing of model Q magnets. This project is progressing smoothly. The LHC project, together with a general growth in the demand for accelerator technology, has resulted in the rapid

growth of low-Tc superconductivity businesses.
Despite the discontinued attempt to build the Superconducting Supercollider (SSC), interest remains high in a future US-sited large hadron collider facility. Several model explorations have been funded at Fermilab to examine the technical, and most importantly, financial feasibility of a machine capable of 50 – 100 TeV center-of-mass collisional energies. All promising designs, targeted for construction beginning in 2008, would use massive amounts of LTS superconducting wire and appreciable quantities of HTS wire as well.

(7) Cryogenic Refrigeration Technology

All applications of superconductivity require reliable and low cost cryogenic support. It was the universal consensus of ISIS-8 that more effort must be expended on the development of cryogenic equipment, since these items will be vital components of the future superconductivity industry.

(8) Transportation

Development of the superconducting MAGLEV system in Japan is continuing favorably. Presently, researchers are engaged in the continuation of running tests.

Session 2: Learning from Venture Businesses

Creating innovative manufacturing technology and ensuring a competitive advantage in the marketplace through products created using new technologies is an issue that must be addressed in each country's industrial policy. For this reason, each country is vigorously advancing a policy of promoting technological innovation. Under these policies, small and medium-scale enterprises are working in coordination with large corporations and academia. These collaborations and new venture businesses are succeeding in the development of new products and markets.
The most noticeable national policy is the Small Business Innovation Research (SBIR) grant system in the US that aims to promote the development of leading-edge technology and its commercialization. Supported by the SBIR system, American venture businesses are leading others in the development of new products using superconductivity technology and establishing new product markets.
Meanwhile, methods for encouraging small and medium-scale enterprises and venture businesses have recently been proposed in Japan. Several of these proposals have been made by referring to America⅂s SBIR system. In the future, many venture businesses are expected to develop products using superconductivity and create new markets by making the most of such assistance.
In Europe, it is widely accepted that close collaboration between large corporations, academic institutions and their spin-offs, and small and medium-sized enterprises is essential for the advancement of commercialization of leading-edge technologies such as superconductivity. Only this specific collaboration model provides the necessary combination of long-term committed capital, flexible fast-track organizations, and research activities focused on leading-edge R&D and market needs. In particular, CONECTUS stresses the importance of cost-sharing national and EU-funded programs for enhancing these collaborations.

CLOSING COMMENTS

The delegates from each country participating in ISIS-8 agreed that this year1s summit was a valuable opportunity for exchanging ideas and opinions. ISIS-9 will be hosted by CONECTUS and is tentatively scheduled for October 1 – 3, 2000, in Copenhagen, Denmark.

APPENDIX I

Previous ISIS Meetings:

Meeting	Date	Location	Main Theme
ISIS-7	Oct. 11-13, 1998	Willard IntercontinentalWashington, D.C., USA	-Grand Challenges for 21st Century: Panel Discussions
ISIS-6	Sept. 17-19, 1997	Conference CenterFlorence, Italy	-Present Status of Technology and Market Development /Road Maps
ISIS-5	May 14-16, 1996	Hotel Mt. Fuji, Yamanakako Yamanashi, Japan	-Worldwide Market Forecast for Superconductivity (2nd)-Technical Tour: Yamanashi Maglev Test Line
ISIS-4	July 24-25, 1995	ANA HotelWashington, D.C., USA	-Education for Commercialization of Superconductivity- Superconductivity -A Global Perspective (Pamphlet)
ISIS-3	May 17-19, 1994	Hartwell House HotelAylesbury, UK	-Practice Results to Commercialization-Exhibition of Superconductivity Technologies
ISIS-2	May 14-16, 1993	Hakone Prince HotelHakone, Kanagawa, Japan	-Towards Wider Commercialization of Superconductivity-Worldwide Market Forecast for Superconductivity
ISIS-1	May 11-13, 1992	Wyndham Bristol HotelWashington, D.C., USA	-The Global Future Vision for Superconductivity

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Participating Organizations and Countries:
CONECTUS (Europe)
Cryoelectra GmbH, Germany
CONECTUS, EU
Forschungszentrum Karlsruhe, Germany

MASPEC−CNR, Italy
Merck KGaA, Germany
NKT Research Center, Denmark
Nordic Superconductor Technologies A/S, Denmark

CSAC (USA)
ABB Power T & D Company Inc.
American Superconductor Corporation
Electric Power Research Institute (EPRI)
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ISTEC (Japan)
Agency of Industrial Science and Technology, MITI
Central Research Institute of Electric Power Industry
Cryodevice Inc.
Du Pont K.K.
ISTEC/SRL
Japanese Patent Office
NEC Corporation
New Energy and Industrial Technology Development Organization
Nippon Steel Corporation
Railway Technical Research Institute
Sumitomo Electric Industries, Ltd.,
Tokyo Electric Power Company
Toshiba Corporation
Yokohama National University

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*1 CONECTUS：Consortium of European Companies Determined to Use Superconductivity
*2CASC ： Council on Superconductivity for American Competitiveness
*3 ISTEC：International Superconductivity Technology Center