

2005 Annual DOE Superconductivity Peer Review

August 2, 2005

HTS Industry Status & Outlook

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In the interest of having your full and undivided attention, I won't be using any fancy view graphs today. My message is one of cautious optimism, starting with a brief retrospective on our Industry:

- **It has been close to 20 years since HTS was first discovered.**

The major breakthrough discovery in composition of matter leading to the so called ReBCO ceramic based materials occurred in 1986. Many in this room have been engaged in HTS R&D since that time. SuperPower has been involved in HTS research since 1988, initially through Intermagnetics General Corporation, our parent company, and then on and after SuperPower was formed in March 2000. It is interesting to observe that it has taken most of the intervening years for the related patent litigation to finally run its course.

- **Participants in our industry have come and gone.**

When you look at the landscape of participants in this industry, there have been many really impressive major multinational companies that entered the game early, spent millions of dollars, and now are either on the sidelines, perhaps awaiting the availability of 2G wire, or are out of the game altogether. Hopefully, we can get some of them to reenter.

- **The lessons learned over the years will especially benefit new entrants, many of whom are off shore.**

Places like China, South Korea, India and Eastern Europe did not commit the millions of dollars in the past, but appear to be ready to do so now, learning from some of the pitfalls others of us have encountered.

- **DOE has invested more than \$500 million in HTS R&D.**

For the last decade these investments have underwritten:

- The National Laboratories;
- Strategic R&D;
- HTS wire development; and
- The Superconductivity Partnership Initiative (SPI).

In fact, HTS technology development closely correlates with the R&D priorities of the White House. Hence it's comforting to acknowledge that even the Commander-in-Chief is on our team.

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- **Recent history underscores the difficulty in obtaining adequate HTS funding.**

DOE HTS Budget

Government Fiscal Year	Actual Funding (millions)	OMB Request
2003	\$38	\$48
2004	\$32	\$48
2005	\$39	\$45
2006 (est.)	\$35-37	\$45

Those of us who spend time on the Hill know that Member directed programs are like motherhood and apple pie, they are a Member privilege, not to be undone. I often characterize 2004 as a “Train Wreck”. In 2005 we did better, thanks to an angel named Zach Wamp, who helped add \$10 million to the HTS budget. While the E&W appropriations bill is still in play, this year it appears our angel may be Senator Domenici, who has been instrumental in adding funding to cover Member programs.

- **Military funding for HTS helps to supplement DOE funding and has paramount importance for the national security.**

HTS can be enabling for the Military’s Directed Energy Weapons Program, which includes high power microwave, pulsed lasers, rail guns and magnetic launch equipment. Then there is the Navy’s All Electric Ship Program. Even though DOE funding is bedrock for HTS, it is prudent to diversify the portfolio with DOD funding. We are indeed grateful for the Title III Program, programs funded by AFRL and AFOSR at Wright Patterson and for DARPA HTS funding.

- **The Private Sector not only needs prowess in science and technology, but especially in Governmental Relations to survive.**

A mighty effort on the Hill is essential -- it’s “the squeaky wheel that gets the oil” these days. There is enormous competition for a shrinking pool of federal dollars. We need to educate and communicate, both as individual companies and through the industry trade association.

- **The Pacific Rim has sustained its HTS funding levels, and more recently that funding is increasing.**

Japan has been one of the earliest entrants in HTS R&D. The Japanese government continues to commit the equivalent of \$50-60 million annually to HTS. South Korea has \$100 million committed through its HTS Frontier Program. Electricity demand growth in China is 10 – 15% annually fueled by the rapid pace of industrialization. China will invest in HTS R&D because it is essential for sustainable expansion of their critical electrical delivery infrastructure.

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- **Commercial Superconductivity applications have been elusive.**

I believe it is fair to say that since superconductivity was discovered in the early 20th Century, MRI technology has been the only major LTS commercial application, and for HTS we are still trying, without any significant achievements yet.

- **There is no Corporate Welfare here.**

When the pundits say no more federal funding because it's corporate welfare, I say the term is misplaced if used in the context of HTS R&D. Let there be no doubt that but for the federal funding, as well as state and local funding, the private sector would not be in the HTS game. Moreover, DOE's SPI program requires industrial partners to cost share. Now that is "skin in the game". Consequently, the private sector has a very large incentive to engage in R&D that leads to commercial viability at the earliest possible time. But lest we forget, major technological breakthroughs typically don't occur over night. Indeed, as many of us have experienced, it can take decades. For every thrill of victory, there are many more agonies of defeat.

- **This industry is dealing with a really tough business model.**

Not only are we confronting high technical risk, but at the same time contending with high financial risk. That is a formula that equates to a private sector that is prudently risk averse.

- **The customer is King. We will not dictate the products that our customers will purchase.**

The electric power industry is focused first and foremost on reliability, and then on cost effectiveness, and finally adherence to equipment performance standards. These will initially be huge hurdles for immature HTS products and devices.

- **Fortunately, there has been a wealth of demonstration efforts thanks to the DOE's SPI Program.**

Applications which include SMES, motors, generators, magnetic separation, fly wheels, HTS cable systems and fault current limiters. Many of these applications will be the subject of presentations and discussion at this year's Peer Review.

- **The availability of 1G wire has been an important enabler for demonstration programs.**

There have been literally only a few organizations globally willing to invest the aggregate hundreds of millions of dollars which has permitted these demonstration programs to proceed with 1G wire as an enabler.

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- **The focus is now just beginning to turn to the availability of 2G wire.**
- **So will HTS drive a technological revolution for the electric power industry, just like fiber did for the telecommunications industry? Is it a matter of if or a matter of when?**

Frankly, I must confess I just think it is too early to tell.

- **Secretary Garman announced today that DOE has issued an Expression of Interest in a new round of SPI's emphasizing the use of 2G wire.**

It is good that this will be done now so that emerging demonstration efforts will be funded in the government's 2007 fiscal year.

- **The Utility industry continues to be extremely conservative, as it always has since Edison generated the 1st kilowatt-hour at the Pearl Street generating station more than 100 years ago.**

The cliché in use is that the industry is "first to be second". I should be able to testify to that having spent more than 30 years of my career in electric power. And why not, they are conservative because they have a mighty responsibility to uphold. You just don't ever lose the lights. It's the Holy Grail for the power industry.

But then it was only two years ago that the northeast went dark. Clearly, that event was symptomatic of many years of neglect of the critical, but aging delivery infrastructure. The underlying resiliency we built into the system has been fully absorbed by the relentless appetite of consumers for more and more electricity. In the decade of the 1990's alone peak demand growth exceeded 25%. It has been estimated that it will take an investment of \$100 billion or more over the next ten years to restore the reliability of the power grid. Compare that to the average investment in new transmission facilities, which in recent years has been less than \$500 million annually.

Meanwhile we have built lots of new generating plants, but we built them in all the wrong places. Rather than located in the major population centers, the new plants are remote, and not fully integrated into the grid. Hence on the days of highest electrical demand, the least efficient units must be run to keep the lights on. The price consumers pay is borne in the enormous cost of congestion on existing transmission facilities that are often loaded to their limit.

- **The electric power industry has undergone sea-level change in the last 15 years, and enormous uncertainty associated with deregulation.**

There has been a lot of resulting fragmentation in the industry, especially among transmission providers, which runs counter to encouraging new investment in the grid.

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- **How big will emerging markets be, when, and in what application areas?**

In point of fact, no one knows for sure. The forecasts are all over the map.

- **National Energy Policy has been out of step with the need to upgrade the critical infrastructure, and now perhaps finally we will see some progress with the adoption of the 2005 Energy Policy Act.**

After 5-years of debate and delay the President is expected to sign the Bill into law on August 8. Don't get me wrong, the Act is by no means nirvana, but it's good for HTS.

- **Our industry will be especially favored by the imposition of mandatory reliability rules, the repeal of the antiquated depression era Public Utility Company Holding Act (PUCHA), and by the Power Delivery Research Initiative (PDRI).**

We should now finally begin to witness significant industry consolidation. It started even before PUCHA was repealed with the AEP acquisition of Central & Southwest Power. Pending are large mergers involving Exelon and Public Service Enterprise Group, and Duke and Cinergy. Even Warren Buffett of Berkshire Hathaway fame, has decided to be a player in the Electric Power Industry. Earlier he acquired MidAmerican Energy Company, and now has proposed to acquire PacifiCorp from ScottishPower. Now here is a man who has complained that he has \$40 billion in cash – yes that's BILLION with a B, and can't find worthy acquisition targets! So what does he do? He invests in electric power. Why? Because of those billions that will be invested in rate base, mostly in so called wires and pipes companies that will continue to be regulated monopolies, and as such, will generate earnings for the next 35 – 40 years.

- **So is the Energy Bill a cure all for all that ails us?**

The answer is no, but it is a good start. The solution lies in being sure that we have three legs on the stool. The first leg is capital formation through consolidation, and on that point the Energy Bill is a good shot in the arm. The second leg is regulatory reform, because as John Rowe said some time ago the "Rat needs to smell the cheese". The point being that investors in the grid need higher allowed rates of return as an incentive to invest, and the Energy Bill will help move that in the right direction. Finally, we have not in my backyard, NIMBY, that makes it difficult if not impossible to get new power lines licensed. You know unless we want another civil war, the feds will not preempt the states on eminent domain. So how do we deal with NIMBY? The answer is better technology, and that is where HTS can make a big difference, because it is technology that is better aesthetically. Technology that is safer, cleaner, lighter and smaller than the conventional counterpart.

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- **We also need to consider Homeland Security. Take it from me I ought to know, the power grid is extremely vulnerable.**

HTS again is the technology of choice, because it is mostly below grade, or inside buildings, because it is not flammable or explosive.

- **There needs to concerted emphasis in our future R&D efforts in the development of fault current limiters, DC HTS cable technology, electrical insulation material science compatible with the ultra cold operating environment characteristic of HTS, and with the reduction of cost and reliability enhancement of cryogenic systems.**
- **The National Laboratories must be kept vital.**

I would not be here, nor would SuperPower if it were not for the extraordinary R&D work at the national labs. We have worked most closely with Los Alamos, Oak Ridge and Argonne, and I tell you all that there is much work to be done before 2G can be a form fit replacement for copper. We must keep the brilliant minds that we have cultivated at the labs in the game. These people are a national treasure, they are irreplaceable.

Concluding remarks:

Here are my thoughts on the status of the HTS industry:

Following nearly 20 years of R&D since the seminal HTS breakthrough in 1986, much has been accomplished. 1G wire has been made available in sufficient length and with adequate performance to permit enumerable demonstration efforts covering most conceivable technology applications.

In that regard, 1G has been the so called “work horse” that has permitted the industry to demonstrate to the world that a technological revolution fueled by HTS is indeed a possibility. For that, we owe a tremendous debt of gratitude to those who engaged, and then more importantly persevered.

And now, as I trust will be underscored by the results in our joint research endeavors to be reported at this Peer Review, we are fast approaching an exciting cross-roads to the introduction of 2G wire in sufficient length, and with the requisite mechanical, thermal, electrical and in-field performance characteristics to enable the state of development of HTS technology to be taken to the next level cost effectively, ultimately to be head on head competitive with copper.

Indeed these are exciting times, but not nearly a point at which we can afford to let our guard down, or rest on our laurels.

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And, as to the outlook for the HTS industry:

The public/private partnership between government and industry has never been more vital to sustainability. Our industry will not round the bases and score the home runs we all aspire to ever, unless the public/private partnership is kept alive, well and even much more robust than it has been in recent memory.

The addressable markets for HTS products and devices globally are awesome. Take as an example power cables, transformers, and switch gear. Today that is an annual market on the order of \$20 billion. But, the penetration of these markets for HTS will be painfully slow. In reality, it will probably take at least another decade for that penetration to start to be noticeable. Meanwhile, the private sector has to be able to survive at least several more years of red ink before any profitability is in hand. For a publicly traded company, that is no mean feat.

We live in an era of shareholder value. Be it right, or be it wrong, we must focus on earnings, and not earnings 5, or 10 years out, but what did we earn in the last quarter, and what are we guiding to in the next quarter, or at most in the current fiscal year. When we publish milestones we need to meet them, and preferably beat them.

A word to the wise is to stay fine tuned and focused in our research endeavors. We must choose the best prospects for success and ultimate profitability. We need to stage gate our programs to measure success, or as the case may be disappointment. In that respect kudos are owed to DOE for establishing the Readiness Review Program.

It's up to all of us to be the standard bearers for HTS. We need to take our message to our elected officials on Capital Hill and in the state houses. The education process is our continuing, unending obligation until we can declare victory when the technological revolution wrought by HTS is a reality.

Thank you all, it has been a pleasure.