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What's New in the World of Superconductivity (November & December, 2006)

Power

American Superconductor Corporation (November 2, 2006)

American Superconductor Corporation (AMSC) has reported its second quarter financial results for the period ending September 20, 2006. Revenues in the second quarter amounted to US $9.6 million, compared to $10.9 million for the same period in the previous fiscal year. Net losses for the period totaled $7 million, compared with $6.8 million for the same period in the previous fiscal year. The company ended the quarter with no debt and $46.1 million in cash, cash equivalents, and short-term investments. AMSC expects to significantly reduce its cash burn during the second half of fiscal 2007 and remains on track to end the fiscal year with at least $38 million in cash, cash equivalents, and short-term investments, as previously forecasted. AMSC also expects to receive a large amount of cash from customers during the remainder of the fiscal year, including $12 million from the U.S. Navy. The company booked $15.8 million in new orders and contracts during its second quarter, compared with $5.2 million for the same period in the previous fiscal year; this brings the total backlog of orders and contracts to $42.6 million, more than double the amount after the same period in the previous fiscal year. The $42.6 million does not include several new contracts and orders received in October and totaling $6.2 million. These contracts included the first in a series of new U.S. Navy contracts for the design and manufacture of a 36.5-MW HTS ship propulsion motor, a new D-VAR® order for wind farm grid interconnection, and a wire order from Shanghai Electric Cable Research Institute. Further orders for HTS and power electronics products are expected during the remainder of fiscal 2007, most of which will be included in the backlog for fiscal 2008. AMSC forecasts its revenue for fiscal 2007 to be in the range of $50 – 52 million, with a net loss in the range of $23 to 27 million.

Source:
"American Superconductor Reports Second Quarter Fiscal 2007 Financial Results"
American Superconductor Corporation press release (November 2, 2006)
http://phx.corporate-ir.net/phoenix.zhtml?c=86422&p=irol-newsArticle_Print&ID=925403&highlight

American Superconductor Corporation (November 16, 2006)

American Superconductor Corporation (AMSC) has announced that most of the company's 344 superconductors slated for shipment during the present fiscal year (ending March 31, 2007) will be used in the development of fault current limiters. "The race for market leadership in HTS fault current limiters is on. There has been strong demand for fault current limiters among domestic and overseas utilities, and, with our 344 superconductors now available, we are beginning to capitalize on this significant business opportunity," stated Greg Yurek, chief executive officer and founder, American Superconductor. "In addition to our own fault current limiter product development effort with Siemens, at least seven other electrical equipment developers in four countries are now utilizing 344 superconductors to develop fault

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current limiters. This is a vast new market opportunity for HTS that the U.S. Department of Energy forecasts to be in the billions of dollars."
Source:
"American Superconductor Reports Increasing Demand for 344 Superconductors Used in Fault Current Limiter Applications"
American Superconductor Corporation press release (November 16, 2006)
http://phx.corporate-ir.net/phoenix.zhtml?c=86422&p=irol-newsArticle_Print&ID=931951&highlight

American Superconductor Corporation (November 29, 2006)

American Superconductor Corporation (AMSC) has signed a definitive agreement to acquire Windtec, a private Austrian company that develops and licenses proprietary wind turbine system designs and sells wind turbine electrical systems. The transaction will be completed in January 2007. AMSC expects the acquisition to strongly enhance AMSC's revenue growth in the wind energy market and to speed the time required to achieve overall corporate profitability. The Windtec purchase price was set at 1.3 million shares of AMSC common stock, or approximately US $12.4 million. The all-stock transaction also includes an earn-out opportunity with the potential for another 1.4 million shares of AMSC common stock to be issued based on the achievement of certain revenue growth targets for the fiscal years ending March 31, 2008, through to March 31, 2011. The transaction includes the acquisition of 27 worldwide patents and patents pending on wind turbine technology. AMSC expects Windtec's revenues for the 12-month period ending December 31, 2006, to total approximately $13 million and its net income to be at least 8% of its revenues, or $1 million. These figures are significantly higher that the $2.7 million in revenues and break-even bottom-line for full-year 2005. Windtec currently has more than $20 million in backlog, which AMSC expects to recognize as revenue in fiscal 2008. Once the transaction is completed, Windtec will become a wholly owned subsidiary of AMSC. AMSC is not assuming any debt in the transaction, and it expects the acquisition to be accretive to earnings beginning in its first full quarter of operations as an AMSC subsidiary.
Source:
"American Superconductor to Acquire Windtec™"
American Superconductor Corporation press release (November 29, 2006)
http://phx.corporate-ir.net/phoenix.zhtml?c=86422&p=irol-newsArticle_Print&ID=936714&highlight

American Superconductor Corporation (December 18, 2006)

American Superconductor Corporation (AMSC) has revised its forecasted operating results for the third quarter and full fiscal year for several reasons. First, the company has not received planned incremental funding and has received only partial payment from the U.S. Department of Energy for costs incurred during the installation of the HTS power transmission cable in the Long Island Power Authority's grid. Payment has been delayed and reduced on a monthly basis because the U.S. Congress did not complete the passage of the Energy and Water appropriations bill before its recess in December. This funding will be handled under a "Continuing Resolution" until at least February 15, 2007. The delay in funding will lower AMSC's revenue recognition and cash collections in its third, and possibly fourth, quarter. Despite these funding delays, AMSC will move forward with this important project, which should be

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commissioned in the summer of 2007. Second, AMSC had expected the U.S. Navy to accept the 36.5-MW superconductor motor that AMSC is developing by the end of calendar 2006; because of the need to repair a crack in a non-superconductor component of the motor, however, AMSC now expects to deliver the motor in March 2007. The costs for solving this problem are expected to be approximately US $3 million. Cash collection from the Navy for the delivery of the motor will likely be deferred to the fourth quarter of fiscal 2007 and the first quarter of fiscal 2008. Third, the shipment of the first commercial SuperVAR™ Synchronous Condenser to the Tennessee Valley Authority will occur about one month later than previously expected because of an issue with a portion of the product's electrical insulation, which has now been resolved. The second SuperVAR is on schedule for shipment by the end of March 2007, as originally planned. Revenue for both systems, which totals about $1.9 million, should now be recognized in the first quarter of fiscal 2008. As a result of these delays, AMSC's anticipated revenues will be reduced and its losses increased in the company's third fiscal quarter. Revenues for the third quarter are now expected to be approximately $9 million, while the net loss is expected to be $9 – $11 million. The company's financial results should improve significantly in the fourth fiscal quarter of 2007. AMSC is also adjusting its forecasted net loss for fiscal year 2007 to $29 - $32 million (from its previous forecast of $23 to $27 million). In addition, the company's cash balance as of March 31, 2007, may be less than the $38 million it previously forecast. Regarding the full year revenue forecast, the company reaffirmed its forecasted total revenues of $50 to $52 million. Although its SuperMachines and AMSC Wires business wires are expected to be below budget because of the above-mentioned reasons, sales in the Power Electronic Systems business continue to grow rapidly, and the forecasted revenue for this business unit has been upgraded from $22.5 million to approximately $25 million.

Source:
"American Superconductor Provides Updated Financial Forecasts for Fiscal 2007"
American Superconductor Corporation press release (December 18, 2006)
http://phx.corporate-ir.net/phoenix.zhtml?c=86422&p=irol-newsArticle_Print&ID=942869&highlight

General Electric Company (December 20, 2006)

GE Global Research, the centralized research organization of the General Electric Company, has announced that a collaborative research effort has been made with Sumitomo Electric Industries (SEI) to develop industrial equipment using higher temperature superconducting materials. SEI will concentrate their research activities on superconducting wire development, while GE Global Research will focus on the design and prototyping of new industrial applications for superconducting wires. GE is presently involved in the development of a broad range of products, including medical diagnostic imagers, power-generating turbines, and industrial drives that would benefit from more advanced superconducting materials. Michael Idelchik, Vice President of Advanced Technology at GE Global Research, commented, "This collaboration with SEI will combine SEI's strength in superconducting wire technology with our experience in the design and development of industrial products using superconducting materials to enable new commercial applications in energy and health care. Together, we have a great opportunity to deliver new technology that greatly expands opportunities in the superconducting market."

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Source:
"GE, Sumitomo Electric Industries Enter Research Collaboration to Develop Industrial Equipment Using Higher Temperature Superconducting Materials"
General Electric Company (December 20, 2006)
http://home.businesswire.com/portal/site/ge/index.jsp?ndmViewId=news_view&newsId=20061220005803&newsLang=en&ndmConfigId=1001109&vnsId=681

SuperPower, Inc. (December 21, 2006)

SuperPower has shipped 9.7 km of second-generation HTS wire to Sumitomo Electric Industries for use in the world's first second-generation HTS power cable, which will be installed in 2007 as part of the second phase of the Albany HTS Cable Project. The first phase of this project was energized in July 2006, and the cable has been performing flawlessly since then.
Source:
"SuperPower, Inc. Delivers 2G HTS Wire to Sumitomo Electric Industries"
SuperPower, Inc. press release (December 21, 2006)
http://www.igc.com/SuperPower/News%20_%20Events.aspx

Material

Superconductive Components, Inc. (November 1, 2006)

Superconductive Components, Inc. (SCCI) has announced its third quarter financial results for the period ending September 30, 2006. Total revenue more than doubled to US $2 million from $1 million for the same period in the previous fiscal year. Gross profit also rose to $469,007, compared with $276,409 for the same period in the previous fiscal year, while a net income of $116,532 was obtained, versus a net loss of $38,023 for the same period in the previous fiscal year. SCCI exited the quarter with a backlog of $3.4 million. Dan Rooney, President and Chief Executive Officer, stated, "The Company's record third quarter revenue reflects solid increases in each of our markets, led by a significant gain in sales to photonic customers."
Source:
"SUPERCONDUCTIVE COMPONENTS, INC. REPORTS RECORD THIRD QUARTER REVENUE"
Superconductive Components, Inc. press release (November 1, 2006)
http://www.sciengineeredmaterials.com/investors/ne/earnings/scci36.htm

Magnet

Oxford Instruments (December 13, 2006)

Oxford Instruments has been selected to lead a project that has been awarded a £778,368 grant by the UK's Department of Trade & Industry (DTI) to support a £1.55 million, 3-year research and development project entitled "Integrated Modeling Package for Designing Advanced HTS Materials Applications." Oxford Instruments NanoScience will collaborate with

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Vector Fields Ltd. and Southampton University on the project. Together, the consortium will work to develop an integrated modeling package for the design of advanced HTS products and systems, including the modeling and characterization of HTS physical material properties, the integration of HTS in high-field magnets, and the behavior of HTS materials during production. The goal of the project is the development of advanced modeling techniques and design software tools that will enable the commercial exploitation of HTS and lead to the new or improved design and manufacture of magnets for MRI, NMR, and FTMS analytical systems. Additional opportunities include inserts for ultra-high-field magnets (greater than 25 T) and medium fields at higher temperatures (greater than 4.2 K). Jim Hutchins, Managing Director of Oxford Instruments NanoScience, commented, "…this award recognizes Oxford Instruments' world-class capability to develop engineering analysis packages. Our strong track record in the development and manufacture of truly unique superconducting magnet products is under-pinned by extensive in-house modeling capability. This work also compliments the program of HTS wire development being carried out by Oxford Instruments. The award will enable our engineering team, in conjunction with the collaborating organizations, to develop and apply advanced analysis techniques to the rapidly expanding field of high temperature superconductivity. This will be the basis for faster and more effective product development for our business as we begin to exploit this technology in a broad range of applications."
Source:
"Oxford Instruments NanoScience, Vector Fields and University of Southampton awarded DTI grant for advanced HTS materials"
Oxford Instruments press release (December 13, 2006)
http://www.oxford-instruments.com/wps/wcm/connect/Oxford+Instruments/Internet/Press/Current+News/Oxford+Instruments+NanoScience%2C+Vector+Fields+and+University+of+Southampton+awarded+DTI+grant+for+advanced+HTS+materials

Electronics

HYPRES Inc. (November 7, 2006)

HYPRES Inc. has successfully tested a fabricated integrated circuit featuring a critical current density of 20 kA/cm^2. The achievement represents the third generation of HYPRES' integrated circuit fabrication process and paves the way for the construction of an all-digital transceiver capable of operation in excess of 80 GHz clock speeds. HYPRES has already fabricated and successfully tested several RSFQ digital circuits, including a 325 GHz digital frequency divider, a 4-bit binary counter, and various input/output elements. Richard Hitt, president and CEO of HYPRES, added, "These test results show that even with our swift pace of progress we're just scratching the surface of the outstanding performance levels this technology has to offer the world of wireless communications. The next few years are going to be very exciting as digital superconducting transceivers, switches and processors make an impact on everyday communications." The fabrication technology was developed with support from the U.S. Office of Naval Research.
Source:
"New Fabrication Process Paves Way for Next Generation All-Digital Transceiver Capable of

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Operation In Excess Of 80 GHz Clock Speed"
HYPRES Inc. press release (November 7, 2006)
http://www.hypres.com/pages/new/bnew_files/criticalcurrent.pdf

HYPRES Inc. (December 11, 2006)

HYPRES Inc. has received two new contracts from the U.S. Army's Communications-Electronics Research, Development and Engineering Center (CERDEC) for work related to the development of digital superconductivity electronics for military satellite communications (MILSATCOM). The total value of the two contracts is approximately $1.5 million. The first Small Business Innovative Research (SBIR) Phase II contract, valued at $730,000, is for the development of an analog-to-digital converter (ADC) capable of directly digitizing Ka/EHF band RF signals. The ADC will be designed to digitize a 20 GHz microwave signal with a maximum bandwidth of 1 GHz. The second SBIR Phase II contract, also valued at $730,000, is for a hybrid digital receiver comprised of digital superconductor electronics and commercial FPGAs (field programmable gate arrays). As part of this effort, a high-speed digital interface will be designed to connect HYPRES' multi-gigahertz receiver with conventional room-temperature signal processing electronics. The development of such an interface is critical to making X-band and K-band MILSATCOM receivers capable of taking full advantage of the superior sensitivity, linearity, low jitter, and ultra fast clock rates conferred by the digital superconductor components, enabling significant performance gains.
Source:
"U.S. Army Awards HYPRES $1.5M To Develop Digital RF Electronics For MILSATCOM"
HYPRES Inc. press release (December 11, 2006)
http://www.hypres.com/pages/new/bnew_files/cerdec.pdf

HYPRES Inc. (December 13, 2006)

Elie K. Track, Ph.D. and senior partner at HYPRES Inc., has created a 'Top-10' list of breakthroughs in the field of superconductivity that are likely to occur in 2007. The list is the result of comprehensive industry research, conversations with numerous scientific experts around the world, and ongoing work at HYPRES and was put together in an effort to gather information on the wide variety of superconductivity projects worldwide and to begin a dialog on innovative advancements and breakthrough applications that are positioned to occur during 2007. Dr. Track's 'Top-10' list is as follows:

1) A low-cost MRI machine that leverages superconducting technology, making it easier and cheaper to screen for many serious medical conditions in an open environment.
2) Ultra-high-speed Internet switches that enable Internet traffic to be carried at a much higher level of density and complexity. These switches would utilize superconducting technology to process optical signals in interconnecting circuits, leading to 100 Tbps routers.
3) High-capacity power lines that use superconducting cables to carry electricity to areas presently without power infrastructure.
4) A field demonstration of a wireless digital receiver based on superconducting electronics that will ultimately lead to significantly improved wireless communication systems for military and commercial applications.

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5) FDA approval for the use of superconducting sensors in advanced magnetocardiography machines.
6) A proven design for a 10 TFLOPS workstation computer to replace room-sized systems.
7) Demonstration of a superconductor-based ship propulsion motor for the U.S. Navy.
8) Progress in the development of an analog quantum computer, expected to improve the speed of processing complex mathematical computations from years to minutes.
9) The successful demonstration of the SCUBA-2 infrared camera on the James Clerk Maxwell Telescope in Hawaii, the most complex demonstration of superconducting electronics ever to be performed.
10) The addition of an AC Josephson voltage standard device, leading to sharp improvements in the fundamental accuracy of the measurement of electrical signals.

Source:
"Cheaper MRI Machines and Ultra-Fast Internet Switches Top the List of Predicted Superconductivity-Based Breakthroughs For 2007"
HYPRES Inc. press release (December 13, 2006)
http://www.hypres.com/pages/new/bnew_files/breakthroughs.pdf

Accelerator

CERN (November 20, 2006)

CERN has reported that the ATLAS Barrel Toroid magnet, the largest superconducting magnet ever built, has been successfully powered up to its nominal operating conditions on the first attempt. The magnet will be used to provide a powerful magnetic field for one of the major particle detectors that have been incorporated into CERN 's Large Hadron Collider (LHC), the new particle accelerator scheduled for operation in November 2007. The ATLAS Barrel Toroid contains eight superconducting coils, each of which is 5 m wide, 25 m long, and 100,000 kg. The entire magnet is 46 m long, 25 m wide, and 25 m high and is the largest volume detector ever to be constructed for a particle physics application. The magnet was initially cooled to 4.15 K over a 6-week period in July – August 2006. It was then powered up in a step-by-step manner, reaching 21 kA for the first time in November. The current was then turned off, and a total of 1.1 GJ of stored magnetic energy was safely dissipated, raising the cold mass of the magnet to 55.16 K.

Source:
"World's largest superconducting magnet switches on"
CERN press release (November 20, 2006)
http://press.web.cern.ch/press/PressReleases/Releases2006/PR17.06E.html

CERN (November 28, 2006)

CERN has received delivery of the last superconducting main magnet for the Large Hadron Collider (LHC), completing the full set of 1624 main magnets that will be required to build the world's largest and most powerful particle accelerator. The construction of the LHC has been a technical and logistical challenge for CERN and its numerous industrial partners, involving more than 200 manufacturers around the world. The superconducting components

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include 1232 ‘dipole' magnets used to guide the beams and 392 ‘quadrupole' magnets used to focus the beams. The dipole magnets were assembled by Babcock Noell GmbH (Germany), Alstom MSA-Jeumont (a French consortium), and Ansaldo Superconduttori (Italy) to CERN’s exacting specifications, while the quadrupole main magnets were designed by CEA-DAPNIA laboratory (France) and assembled by ACCEL Instruments (Germany). The final assembly processes should be completed by mid-2007, and the LHC is scheduled to begin operation in November 2007.
Source:
“Last LHC superconducting main magnet completes the suite at CERN”
CERN press release (November 28, 2006)
http://press.web.cern.ch/press/PressReleases/Releases2006/PR18.06E.html

Basic

University of Illinois at Urbana-Champaign (November 27, 2006)

A team of researchers at the University of Illinois at Urbana-Champaign has announced that they have obtained “unambiguous evidence for ‘p-wave’ symmetry with a complex order parameter that breaks time-reversal symmetry” in a ruthenate superconductor. While predicted by theoreticians, this complex odd symmetry state has never been fully confirmed until now. The evidence for p-wave symmetry was obtained using the Josephson interferometer technique, a method developed by researchers at UIUC 10 years ago. The technique directly measures phase differences in the superconducting order parameter, allowing an unambiguous determination of the pairing symmetry. The team’s findings were reported in the November 24 issue of Science.
Source:
“Complex order parameter in ruthenate superconductors confirmed”
University of Illinois at Urbana-Champaign press release (November 27, 2006)
http://www.news.uiuc.edu/news/06/1127superconductors.html

Cornell University (December 5, 2006)

Researchers at Brookhaven National Laboratory and Cornell University have reported some surprising findings regarding the behavior of high-temperature superconductors. In cuprate superconductors, plots of the energy required to pull the electron pairs apart versus the direction in which the electrons are being pulled form a typical cloverleaf pattern. So far, the explanation for this “pseudogap” phenomenon has eluded physicists. Surprisingly, researchers at Brookhaven and Cornell have found that the same cloverleaf pattern appears even in cuprates that are not superconducting at any temperature. The group used samples of non-superconducting LBCO cooled to near absolute zero, enabling the first measurement of a cuprate’s electronic structure without interference from the material’s superconductivity. The finding that the same materials in two very different states have identical energy-gap structures has important implications to our understanding of the superconductivity phenomenon. The research was described online in the November 16 issue of Science Express and will appear in print in a future edition of Science.

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Source:
"'Stripes' and superconductivity – Two faces of the same coin?"
Cornell University press release (December 5, 2006)
http://www.news.cornell.edu/stories/Dec06/pseudogap.ws.html

National Institute of Standards and Technology (December 22, 2006)

Physicists at JILA (a joint institute of NIST and the University of Colorado at Boulder) have developed a method for visualizing defects, or disruptions, in rotating patterns. The technique combines the use of optical lattices and atoms in a Bose-Einstein condensate spinning in a trap, similar to planets orbiting a sun. Using this method, researchers can simulate why and how defects arise in superconductors. The JILA experiments utilized 3 million rubidium atoms held in a magnetic trap that was spun to create a superfluid of about 100 vortices. Lasers were then used to create optical lattices focused on the BEC cloud. When the overlapping lattice and vortices were spun at about the same rate, they locked together. The energy peaks of the lattice "pinned" the BEC at those spots by reducing the density of the superfluid flowing around the local vortex. Using photographs and an image processing technique, the JILA group was able to visualize the structure and repeating patterns of the pinned vortex lattice. Since the BECs and optical lattices can be precisely controlled, the technique can be used to study the patterns in superfluids and superconductors. The research was published online in Physical Review Letters (December 12, 2006).
Source:
"'Vortex lattices' may help explain material defects"
National Institute of Standards and Technology press release (December 22, 2006)
http://www.nist.gov/public_affairs/techbeat/tb2006_1221.htm#vortex

(Akihiko Tsutai, Director, International Affairs Department, ISTEC)

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