Statement of:

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Before the

House Committee on Science and Technology
Subcommittee on Energy and the Environment

Mr. Chairman, Ranking Member Inglis, and members of the Committee: good morning and thank you for inviting me to address the Committee and provide GE's perspective on the Department of Energy's Office of Science's Basic Energy Sciences program.

I am Ernie Hall, a Chief Scientist in the Chemistry Technologies and Materials Characterization labs at GE Global Research, GE's centralized research and development organization. We are arguably the largest and most diversified industrial research lab in the nation, if not the world, with a proud heritage of innovation spanning more than 100 years. This is my official statement and has been entered into the record.

From breakthrough developments that include medical x-ray in the early 1900s and the first U.S. jet engine in the 1940s, to advancing new energy sources today such as solar and wind, GE researchers have a proven record of delivering meaningful technology. The mission of GE Global Research is the same as it was at the time of our founding in 1900 – to drive innovations that create new or better GE products that meet the needs of our customers and society.

In my current role, I am expected to provide a broad, technical vision to all of the global technology organizations at GE Global Research, our GE businesses and our end customers. I have 36 years of experience in advanced methods of materials characterization and I have authored more than 175 external technical publications. For

the past 17 years I managed a group of scientists at GE Global Research who use the most advanced tools for analysis of the structure and composition of GE materials, including significant usage of DOE's synchrotron and neutron facilities.

Today, I would like to share my views on the DOE's Office of Science's Basic Energy Sciences program and what it means to research conducted by GE. In short, access to national synchrotron, neutron, and electron beam facilities managed by BES is critical to the development of new technologies by GE. GE primarily uses DOE synchrotron facilities at Brookhaven and Argonne National Labs, and has used the NIST and Argonne neutron facilities, and electron microscopy at Lawrence Berkeley and Oak Ridge National Labs.

The research we perform at these national facilities is critical to GE's technology and product development, and addresses some of the most important national needs. We use the synchrotron x-ray sources to provide us with higher energy, higher resolution, and higher throughput experimentation than we can achieve in our own labs. For example, we can achieve a 30X reduction in the time required for some experiments using the synchrotron. These more intense x-ray sources also allow us to conduct experiments in environments that better approximate those encountered when the materials are used in applications such as gas turbines or aircraft engines.

Examples of our research at the synchrotron facilities include measurement of chemical processes occurring during operation of advanced batteries for hybrid vehicles; determination of the atomic mechanisms by which materials store and release hydrogen for hydrogen-powered cars; development of nanotechnology, including ceramic membranes for industrial sensors; fuel cell development; and measuring stresses and strains in a non-destructive way to predict the life of turbine parts associated with our gas turbine business in Greenville, South Carolina and our aircraft engine business in Cincinnati, Ohio and Lynn, Massachusetts. We have used the Intense

Pulsed Neutron Source at Argonne to study new phosphor and detector materials for higher-resolution medical imaging equipment, homeland security devices, and higher-efficiency lighting.

While GE is a significant user of the synchrotron light source facilities, we could never fully utilize our own synchrotron, making access to DOE facilities essential. In addition, the regional strategy put in place by DOE is a favorable model, with GE using the Brookhaven site most frequently given its proximity to our R&D center in upstate New York.

While we have found ways to effectively utilize these facilities, there are some potential improvements that I wish to highlight on behalf of the industrial user community. We would urge these facilities to make availability to industrial users a top priority. We understand that this will need to be properly balanced with outstanding fundamental research, which is currently the main priority. Industrial research has a unique set of needs and requirements, including the need for prompt access, reliable operation, and the ability to conduct repeated experiments on large numbers of samples. This process development and validation is vital to developing robust and reliable commercial technology, yet is often in competition with the drive for unique, cutting-edge academic research taking place at the national resources.

GE enjoys a strong, collaborative relationship with the DOE. However, because industrial research utilizing the synchrotrons is not a top priority, it is my team's experience that gaining access to sufficient beam time on a timely basis can be challenging. We would advocate the creation of a system that would make facility time available to industry with minimum bureaucracy and cost.

Based on my own experience as a researcher, I would like to make an additional point. If DOE wishes to impact the broadest spectrum of industrial users, then it is important

to provide more than just access to the facility. We are fortunate at GE to have outstanding scientists on our research staff, some of whom have worked at the national facilities as graduate students or post-doctoral associates. This will not be true for all companies, especially smaller businesses. In addition to beam time, it is important to provide access to facility researchers who can help with experiment set-up, data collection, and data processing and interpretation. I have been involved with the Shared Research Equipment (SHaRE) program at Oak Ridge National Laboratory, providing access mainly to electron microscopes and administered by DOE BES, and in my mind this is a good model for access to advanced instrumentation for both academic and industrial researchers.

Another area that I would like to call attention to is the need for available end-stations for specific experiments. As you may know, while the synchrotron or neutron facility produces the x-rays or neutrons needed for experimentation, it is also necessary to have experimental stations to receive the beams and conduct the experiments. Many of these are specialized for specific experiments. In the past, most of these end stations were built by Participating Research Teams, mainly from universities, which received government funding for their construction. Over time, these stations may or may not have been well-maintained, or available to industrial use. In recent years, the DOE has switched to giving the funding for end-station construction to the facility directly. We applaud this change since it makes these stations available for other users, standardizes hardware and software use across the facility, and allows the facility to continue to maintain and modernize these end-stations.

The final point that I wish to make concerns proprietary research. The competitiveness of US industry relies upon proper patent protection of the technology that we have invested to develop. There needs to be proper protection in place for the situation where an industrial researcher conducts an experiment on a proprietary material at a national facility. At present, the national facilities have a “total cost recovery” option

for proprietary research, but the high cost of this option again seems to put priority on basic, publishable research. We of course recognize that research conducted jointly by national facilities and industry should be considered as a separate category, but urge a re-examination of the case where an industrial scientist wants to run an experiment on a material under development in an industrial lab. GE has not used the "total cost recovery" option extensively, since most of our research is on the structure of engineering materials, and we can often publish these more general results. However, it is our understanding that proprietary issues can be particularly problematic for the chemical and pharmaceutical industries.

Mr. Chairman, I want to thank you and members of the Committee for the opportunity to provide testimony. We have strong collaborations in place with many agencies, especially the Department of Energy. It is our hope that we can continue to make these industrial-government partnerships even stronger so that we can deliver real technologies to the marketplace that solve some of the world's most pressing challenges. This concludes my testimony and I would be pleased to answer any questions.

Thank you.