June 18, 2001

Professor Geraldine L. Richmond
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Dear Professor Richmond:

I very much appreciate your willingness to serve an additional term as Chair of the Basic Energy Sciences Advisory Committee (BESAC). I believe that the continuity in leadership you provide is critical as BES hosts its first Committee of Visitors and as BESAC embarks on new challenges, which are detailed below. Under your leadership during the past few years, BESAC activities have produced extraordinary results that already have – and will continue to have – broad impacts in the Basic Energy Sciences program. I want to thank you for your leadership of BESAC, and I also want to express my sincere appreciation for the superb job that you did during your testimony on May 17th at the Hearing on *Department of Energy Office of Science – Issues and Opportunities* before the U.S. House of Representatives Committee on Science. I have heard from many that your testimony was articulate, focused, and had an enormous impact.

During the coming year, I would like BESAC to take on two new challenges relating to the research programs of the BES program. I expect that each will require one or more workshops. I have provided an overview of each activity below. The first activity is an extension of work that was done in the areas of nanoscale science and complex systems. I know that BESAC has been engaged in activities relating to nanoscale science, including the formation of Nanoscale Science Research Centers, and has clearly articulated that scientific understanding at the nanoscale is required for the development of larger functional systems that use nanoscale building blocks. *The report of the workshop on Complex Systems outlined an exciting science agenda that integrates the disciplines of physics, chemistry, materials science, and biology to build on the foundations that now have been put in place by the National Nanotechnology Initiative. I would like you to help refine that research agenda.* In the world "beyond nano," it will be necessary to use atoms, molecules, and nanoscale materials as the building blocks for larger supramolecules and hierarchical assemblies. As was described in *Complex Systems – Science for the 21st Century*, the promise is nanometer-scale (and larger) chemical factories, molecular pumps, and sensors. This has the potential to provide new routes to high-performance materials such as adhesives and composites, highly specific membrane and filtration systems, low-friction bearings, wear-resistant materials, high-strength lightweight materials, photosynthetic materials with built-in energy storage devices, and much more. The magnitude of the challenge is perhaps more daunting than any faced before by these disciplines. I would greatly appreciate BESAC's help in defining these challenges.

The second activity might build on some of the ideas discussed above to answer the question: *What are the 21st century fundamental scientific challenges that BES must consider in addressing the DOE missions in energy efficiency, renewable energy resources, improved use of fossil fuels, safe and publicly acceptable nuclear energy, future energy sources, science-based stockpile stewardship, and reduced environmental impacts of energy production and use?* Over the years, the BES research portfolio has evolved to address these issues and more. There have been many successes. The

National Energy Policy noted that the U.S. economy grew by 126 percent since 1973, but energy use increased by only 30 percent. Approximately one-half to two-thirds of the savings resulted from technological improvements in products and services that allow consumers to enjoy more energy services without commensurate increases in energy demand. At the heart of these improvements is fundamental research. During this 30-year period, the basic research supported by the BES program has touched virtually every aspect of energy resources, production, conversion, efficiency, and waste mitigation. The basic knowledge derived from fundamental research has resulted in a vast array of advances, including • high-energy and high-power lithium and lithium ion batteries and thin-film rechargeable microbatteries; • thermoacoustic refrigeration devices that cool without moving parts and without the use of freons; • compound semiconductors, leading to the world's highest efficiency photovoltaic solar cells; • strong, ductile alloys for use in high-temperature applications; • new steels, improved aluminum alloys, and high-performance magnet materials; • polymer materials for rechargeable batteries, car bumpers, food wrappings, flat-panel displays, wear-resistant plastic parts, and polymer-coated particles in lubricating oils; • new commercial processes for ethanol production, pulp and paper manufacturing, and *in planta* production of oils; and • new catalysts for the production of polymers and for a host of other products and energy-efficient processes; and • a host of new instruments, such as superconducting quantum interference devices (SQUIDs) that can sense minute magnetic fields for use in applications ranging from resource exploration to monitoring the human brain and heart. *These advances came by exploiting the results of basic research that sought answers to fundamental questions. The challenge is to continue the tradition of discovery. To that end, I would like BESAC to oversee a small number of workshops (perhaps 2 or 3) that articulate 21st century discovery potential in DOE mission areas. Defining the role and challenges of basic research is particularly timely given the recent release of the President's National Energy Policy.*

I would hope that by the time of the February 2002 BESAC meeting, the "Beyond Nano" workshop will have taken place and at least one workshop in the second category is scheduled. Again, thank you for your continued expert leadership of our largest Office of Science program.

With best regards,

signed June 18, 2001

James F. Decker
Acting Director
Office of Science

cc:
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