Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis for
The Office of Science of the Department of Energy (DOE-SC)

Missions:

To provide the science needed to support the basic missions of DOE in areas such as energy, national security, and the environment.

To conduct excellent science in areas that Congress has assigned to DOE as a special responsibility, such as high energy and nuclear physics.

To continue to maintain and advance capability in key areas of science and technology such as accelerator science.

Strengths:

DOE-SC is a large science agency, with an excellent record of scientific accomplishment and sole responsibility for important scientific fields such as nuclear physics and high energy physics.

It supports and oversees a number of national laboratories that represent an extraordinary national resource and provide unique research facilities to scientists from around the world.

It has the capacity to launch and manage scientific research projects on a very large scale (beyond that of other basic research agencies such as NSF and NIH) and to develop and support unique research infrastructure to the scientific community.

DOE-SC has strong relationships with research universities, both through the involvement of academic scientists at national laboratories and facilities and through its support of scientific research on the campuses.

Its activities have an unusually broad geographical distribution and political footprint.

Weaknesses:

The organizational structure of DOE makes it difficult for SC to achieve the visibility and priority both within DOE and the federal government necessary to achieve funding commensurate with the importance of its missions.

SC lacks an advisory board comparable in stature and influence to those of other major science agencies (e.g., NSF and NIH), capable of raising the priority of DOE-SC within the Department, the administration, and Congress.

There is a relatively weak organizational link between SC and the various mission offices (e.g., NNSA, NE, ENV, Fossil) that hinders the capacity of SC to provide the basic scientific research needed by these more applied R&D programs. As a result, there are research areas critical to fundamental DOE missions that are not being supported by adequate scientific research (e.g., nuclear fission energy, liquid fossil fuel technology, environmental remediation).

DOE-SC may be overly constrained by both its national laboratory culture and ongoing major initiatives in areas such as high energy physics, supercomputing, and the human

genome project to take advantage of the increasing importance of interdisciplinary research opportunities and alliances among laboratories and between DOE and other federal agencies.

The DOE laboratories are burdened and judged by compliance with DOE prescriptions in areas such as construction management, safety, security, and procurement and rarely on performance of research, encumbered by the complexity of DOE management organizations.

DOE-SC does not seem to be as effective in supporting "small science" on the campuses through new research paradigms (e.g., science and technology centers, engineering research centers, collaboratories) compared to NSF, NIH, and DARPA.

There has long been difficulty in managing the competition between intramural research (conducted by DOE laboratories) and extramural research (conducted on the campuses or by university scientists).

The low visibility of SC as a major science agency is compounded by the poor reputation of its DOE parent in Washington (e.g., excessively stove-piped, nonresponsive, politically inept) and confusion over its multiple missions (energy, national security, environment).

The political independence of the national laboratories, coupled with the more limited merit review of their research activities and funding and their management difficulties, undermines efforts to build adequate funding for SC as a component of DOE.

As with other components of DOE, there are ongoing concerns about the workforce demographics of DOE-SC programs (e.g., an aging workforce, the lack of diversity).

Opportunities:

The national laboratories are a unique resource for educational outreach and especially for teacher training. SC could provide the leadership for education as a fundamental component of DOE's science mission.

The recent concerns about the growing imbalance between federal investment in the biomedical sciences (e.g., NIH) and the physical sciences and engineering, as expressed by PCAST and the National Academies (COSEPUP), could be addressed, in part, by a substantial increase in funding of DOE-SC.

The efforts of OMB to establish performance metrics for basic research may provide DOE-SC an opportunity for enhance funding priority, since these are based in part on recommendations from the National Academies (e.g., the COSEPUP reports on GPRA and International Benchmarking) that stress the importance of "expert review to assess the quality of research, the relevance of that research to the mission, and the leadership of the research".

Although DOE-SC plays an important role in graduate education, it has an unrealized potential to contribute far more significantly to education at other levels (K-12, teacher education, public education), particularly in an interagency mode. With a more inclusive mission integrating research and education, funding such activities might be made more effective.

Threats:

The continued erosion of funding for DOE-SC threatens not only the national leadership and capacity in key areas of science such as nuclear physics, materials science, and high energy physics, but as well technologies such as particle accelerators that are critical to many fields such as medicine, materials, and biotechnology.

Without adequate fundamental research in DOE-SC linked to their activities, many of the more applied R&D programs relevant to DOE missions could find themselves not only without an adequate scientific foundation but as well an inadequate supply of trained scientists and engineers (e.g., nuclear fission technology, which is already hindered by an inadequate research base and the erosion of academic programs and reactor facilities).

The dysfunctional organizational structure of DOE will continue to handicap SC and undermine its fundamental scientific missions.

Recommendations:

Although perhaps unlikely, some consideration should be given to elevating the organizational priority of DOE-SC both within DOE and the federal government, perhaps to a level comparable to NNSA, or preferably, even NSF and NIH.

A strong advisory board should be created for DOE-SC, comparable in stature and influence to the National Science Board and the President's Advisory Council on Science and Technology, which can not only raise the visibility and appreciation of quality scientific research and DOE-SC within the Department, but moreover make a forceful case for the support of these activities to Congress and the administration.

DOE-SC should develop a clear and compelling mission statement (e.g., NSF's mission statement reads: "To promote the progress of science; to advance the nation's health, prosperity, and welfare; to secure the national defense; and for other purposes.")

DOE should establish strong linkages between the applied R&D programs of its various mission offices and basic research programs within DOE-SC. In some cases, basic research and education programs within mission offices should be considered for transfer to SC in an effort to enhance their quality and priority. (E.g., the NERI and University Programs activities of DOE-NE.)

Strategic and organizational change in DOE-SC is likely needed to erode barriers between fields in the physical sciences themselves as well as between the physical and other sciences that would benefit by closer ties and cooperation.

DOE-SC should consider adopting a mission and management strategy more focused on flexibility and change, while creating a management structure that encourages and rewards cross-disciplinary boundary research efforts.

In a similar spirit, DOE-SC should place more emphasis on multi-agency partnerships such as the Quarks to Cosmos vision that can strengthen science overall by taking advantage of the greater intellectual acumen available through such partnerships (the whole can be greater than the sum of the partners).

Since in the current fiscal climate it is unlikely that the administration (OMB) would provide DOE with the budget increase to fund substantial growth in DOE-SC, no matter how warranted by scientific importance, some consideration should be considered to the shifting of funds to SC from more applied DOE programs of lower priority (including the possibility of transferring some basic research programs from mission offices to SC).