

SCIENCE AND TECHNOLOGY IN ARMENIA : TOWARD A KNOWLEDGE-BASED ECONOMY ^[1]

Committee on Science and Technology,
National Research Council of the National Academies, Washington, D.C., November 2004.

(The topics related to CANDLE)



During the Committee visit to CANDLE. From left to right: Norman Neureiter (National Acad.), Barry Barish (CalTech), Vasili Tsakanov (CANDLE), Samuel Harutiunyan (Yer. State Univ.), John Baldeschwieler (CalTech), Yuri Martirosyan, Mher Aghasyan (CANDLE).

Executive Summary

CANDLE (Center for the Advancement of Natural Discoveries using Light Emission) is an ambitious attempt to create a state-of-the-art, next-generation facility with applications in a wide range of fields, from basic physics, chemistry, and biology to applied research in drug design, medical diagnostics, and environmental remediation. It should be supported through the next pre-construction phase of detailed engineering design and of testing the concept of manufacturing equipment in Armenia. This phase will require funding of up to \$4 million over a two-year period.

Recommendations.

CANDLE (Center for the Advancement of Natural Discoveries using Light Emission) is an ambitious attempt to create a state-of-the-art, next-generation facility with applications in a wide range of fields, from basic physics, chemistry, and biology to applied research in drug design, medical diagnostics, and environmental remediation. It deserves to be supported through the next pre-construction phase of detailed engineering design and testing the concept of building prototype equipment in Armenia, which will require funding of up to \$4 million over a two-year period.

CANDLE Review.

CANDLE (Center for the Advancement of Natural Discoveries using Light Emission) is an ambitious proposal to build a 3 GeV synchrotron light source facility in Armenia. The goal of CANDLE is to develop a third-generation light source as an international facility. Several such light sources are being developed around the world, but none in the Caucasus. The motivation is to provide a springboard to help revive Armenian science to its previous standing and reverse the “brain drain” from the region. Such a facility would have a broad research and education program that would include work in the areas of physics, chemistry, biology, geology, electronics, crystallography, and medicine.

This proposed synchrotron radiation source would yield a type of radiation that has extremely high flux and other features for studies at the molecular and submolecular levels. The continuous spectrum of synchrotron radiation provided by such a facility would be more than five orders of magnitude increased in flux and more than ten orders of magnitude increased in brightness over more conventional sources. The wavelengths of emitted photons could be varied from atomic to cell structure dimensions, enabling a very broad research program.

A group in Armenia has completed a design study for CANDLE, and in August 2002 a committee of accelerator experts issued a favorable technical review of the project for the U.S. Department of State ^[2].

The CANDLE facility is housed in a remodeled laboratory and office complex outside Yerevan. About 25 technical staff members are located on-site. This group includes a team of experienced accelerator experts, some of whom have returned to Armenia from Western Europe and the United States. The quality and dedication of the team and its articulation of the goals of CANDLE are impressive. In addition to the design report, team members have successfully produced a first prototype magnet. They envision a complex of science centers in different fields on this site, with the centerpiece being the synchrotron radiation facility.

Financing is a major issue. Not only are there the initial construction costs, but there must be enough interested users and research activities to sustain the facility's operations. These issues, of course, deserve priority during further consideration of the technical feasibility of the project.

The Armenian government has provided the site and physical support facilities, while funding to develop the proposal was provided by the U.S. government as well as an Armenian-American advocate. The present estimate of construction costs is about \$50 million, and expenses for operating the facility are projected at approximately \$7 million per year. For this to be a robust project, it will require up-front funding that would cover construction with adequate contingency, plus the first few years of operations. This requirement probably means that at least \$75 million is needed to undertake the project with a reasonable chance for success.

The CANDLE initiative would be unique among the research and technical development efforts under way in Armenia. It has already drawn young, technically skilled Armenians home from abroad. If Armenia is to build a successful, technically oriented economic sector, it will be essential that there be centers of excellence for science in the country. Potentially, CANDLE could be such a center.

Research in many disciplines can be carried out with a synchrotron source, which would help to break down the stove piping that characterizes Armenian research activity. Significantly, the project has received the endorsement of the rector of Yerevan State University, even though his own institution has serious financial needs. There is potential value in having a major regional facility in

Armenia. For these reasons, it may have the kind of inspirational value needed to reinvigorate all of Armenian science and technology. It is also possible that international funding organizations, which view S&T as an essential element in the development process, might be interested.

CANDLE has created a singular bright spot of enthusiastic young people who have done a fine job thus far on the synchrotron design. Yerevan State University and the NAS-RA strongly support the project. The next step, probably costing about \$4 million and requiring about two years, would be for the CANDLE team to carry out a design and prototyping phase for the major components, including having Armenian companies acquire the capability to make dipole magnets and, if successful, quadrupole magnets and other items. The cost and time estimates for the next step are the result of the committee's preliminary analysis of the project requirements and are consistent with Armenian projections. Of course, more precise costs will depend on detailed negotiations among the organizations that would participate in project implementation during the next step.

Once the team knows whether such components can be built to specifications in Armenia, it can perform a realistic cost estimate and try to attract the large amount of money that would be needed to build such a machine and provide for initial operations.

In sum, CANDLE is a place where investment to enable the next step might lead to major improvement in the S&T infrastructure in Armenia.

year period.

^[1] SCIENCE AND TECHNOLOGY IN ARMENIA, The Report of the US National Research Council Committee, November 2004, <http://books.nap.edu/catalog/11107.html>

^[2] Report to the U.S. Department of State Relative to the CANDLE Project, August 20, 2002, posted at <http://www.candle.am/revrep/revrep.PDF>.

Appendix E: *From Presentation of Armenia Ambassador Arman Kirakossian to the National Research Council Committee on Science and Technology in Armenia.*

“There is another project that deserves the support of the government and the international community, namely the construction of Center for the Advancement of Natural Discoveries using Light Emission (CANDLE).

This project will benefit Armenia and the larger region, because fundamental science knows no boundaries. I know that’s one of the areas your team will look at in Armenia, and I certainly want that project to succeed.”