Committee Recommendations

The Committee unanimously recommends the establishment of a deep premier national underground scientific laboratory to enable US leadership and synergism in a broad array of scientific fields in the coming decades.

The committee endorses a single primary site as the most effective method of realizing the anticipated scientific program.

The Committee believes that there are two excellent sites for a premier deep underground science laboratory: Homestake and San Jacinto. The committee admires the commitment of the proponents of the proposals to outreach and communication of basic science to the American public. Based on the information we have received, and on the independent assessment by the committee, we judged that Homestake and San Jacinto are very similar in their technical suitability for underground experiments. Although the committee is not charged with making a formal site selection, time is of the essence, and the agencies need to be aware of the time-sensitive nature of the site selection. We strongly encourage interagency cooperation to help realize this exciting opportunity for science.

At the time of this meeting the committee favors the Homestake site for the following reasons:

• faster time scale to produce important scientific results,
• less initial capital outlay to produce world-class science,
• greater positive impact on the local population,
• lower inherent uncertainties.

The San Jacinto site is also judged to have great potential for several reasons:

• horizontal access allows simple and cost effective access and operation,
• lower operating costs,
• the close proximity of strong scientific research universities.

The Homestake pre-proposal at present is not complete. First the indemnification problem must be solved. Second, a representative, national group of underground scientists must be involved in the preparation of a formal proposal that describes a detailed science program and a complete cost estimate for the laboratory. Given the imminent closure of the Homestake mine, these two issues must be solved in a timely fashion, or the advantages which lead us to favor the Homestake site will be significantly reduced.

Like Homestake, San Jacinto could become the premier site in the world, but further work is needed. Concerns include cost, construction permitting, and site optimization. A more broadly representative group of proposers would be desirable, as well as a comparison of the San Jacinto site to nearby alternatives. We encourage the San Jacinto site advocates to continue working on the preparation of a proposal. If the issues with the Homestake mine are not resolved adequately in a timely fashion, the San Jacinto site is an excellent opportunity.

The Committee has received and considered a pre-proposal from advocates for the Carlsbad Underground National Laboratory. The Technical Assessment Sub-Committee visited the Carlsbad site and the existing Soudan
Underground Laboratory. The Committee believes that both these sites have played important roles in the development of underground physics.

The considerable resources of the Carlsbad site and the relative ease of excavation in salt have and will likely continue to facilitate a number of prototype experiments. The support in New Mexico for fundamental physics at Carlsbad is impressive and provides an excellent example of how a future national laboratory should inform and educate the American people.

The Soudan Laboratory has well hosted the Soudan 2 detector for more than a decade and has recently expanded to house the far detector for the important MINOS Fermilab-to-Soudan neutrino oscillation experiment and the CDMS-II dark matter detector. The physics program at Soudan is an excellent model for how to work collaboratively to inform and educate both the general public and K-12 school children about science.

Despite these considerable assets, the Committee strongly believes that limited depth, and thus excessive cosmogenic background, preclude these facilities from being general purpose underground science facilities for the United States. The Committee further believes that while these sites have a future role in a comprehensive program, the advantages of collaboration and synergy favor focusing the majority of future detectors at a single deep site.

The Need for a National Underground Science Laboratory

Underground science includes studies at the frontiers of particle physics, nuclear physics, astronomy, geology, and biology, as well as applied areas such as materials science and nuclear proliferation. In the past decade, fundamental progress has been made in underground experiments in such diverse and exciting fields as nucleon decay, atmospheric neutrino oscillations, the solar neutrino measurements, searches for dark matter, the measurement of nuclear fusion cross sections at stellar temperatures, and the discovery of novel microorganisms that live deep in the earth. In order to participate in these discoveries, U.S. scientists have had to either take their equipment to other countries or, in a few cases, to make use of non-optimal facilities in the U.S.

The questions addressed by underground experiments are among the most fundamental and exciting problems in modern science. Underground experiments will continue to be at the forefront of fundamental science in the coming decade. Many of the science projects are described in some detail in the accompanying document “Underground Science.”

The next generation of underground experiments is more challenging technically than previous studies and will therefore require both significant resources and good planning and management to succeed. Creating a National Underground Science Laboratory (NUSL) will establish the conditions that will enable the science, which must be done with large, sophisticated equipment, to succeed in a cost effective way. A well run NUSL will have a coherent research program whose priorities are constantly reviewed in order to produce the best science results.

There are advantages in centralizing most of the experiments in one underground laboratory:

- Sharing of common infrastructure including access, machine shops, administrative support, computing, and telecommunications;
- Provision for a common safety support that must oversee equipment and procedures for dangerous components such as flammable and cryogenic materials;
- Synergistic interactions among scientists doing different experiments in an environment where they can easily exchange ideas;
- Establishment of common facilities that can be used by different groups interested in, for example, low radioactivity materials or low level counting measurements;
- Creation of a support organization that can make possible the testing and implementation of new ideas within an established coherent scientific program;
- Providing a critical mass for outreach to the local population, especially K-14, and to the public at large.
- Provide a research center that would be a base for international collaborations to maintain scientific and technical staff for developing and carrying out large scale projects.
- Provide a nurturing and exciting scientific environment in which students and young scientists would develop.
- Provides a center for international scientific meetings.

The committee believes that the arguments in favor of a National Underground Science Laboratory are compelling and urgent.

In order to be world-class, the NUSL must be deep. A depth of approximately 6000-7000 meters of water equivalent (m.w.e) is desirable for many classes of experiments and is required for certain experiments such as the next generation of solar neutrino and double beta-decay experiments. Above this level, interference from the cosmic ray related backgrounds constitute the limiting factor for high sensitivity experiments. The next generation solar neutrino detectors, dark matter searches, and double beta-decay studies require as low a cosmic ray produced muon...
flux as possible. The simplest and most reliable way to achieve lower cosmic-ray induced backgrounds is to do experiments at greater depths.

The Committee has received many Letters of Interest by scientists throughout the world who would like to perform pioneering experiments in different subjects using such a deep underground laboratory. Currently, the deepest available general underground scientific laboratory is located at a depth of 3800 m.w.e. in the Gran Sasso National Laboratory in Italy.

We believe that the United States will be in a position to lead the world in pioneering scientific investigations by establishing a National Underground Science Laboratory with a depth extending to 7000 m.w.e.