Conceptual Design for DUSEL at Kimballton, Virginia

Project Summary

Intellectual Merit of the Proposed Activity:

The Kimballton DUSEL site in SW Virginia offers unprecedented opportunities to conduct a broad range of research in fields that match well with preliminary technical infrastructure matrices established by the S1 process. The Kimballton site is hosted by sedimentary rocks, which cover about 3/4 of the earth's land surface. About 90% of the earth's groundwater is currently being produced from sedimentary rocks. Nearly all (99+%) of the world's hydrocarbon resources are hosted in sedimentary rocks, as well as 85% of underground mines. Sedimentary rocks and deep aquifers in sedimentary basins also constitute important reservoirs for carbon storage to address climate change issues that threaten the global economy.

Kimballton meets the depth (shielding) and cavern size requirements of the physics community whose goals are to understand the origins and evolution of the Universe. At the same time, the geological characteristics of the Kimballton site are ideally suited for geoscience and engineering research related to issues of societal relevance, including water resources, climate change, carbon management, development of underground space, and the origin and exploration for hydrocarbon and other energy resources. Sedimentary rocks (and their contained fossil aquifers) that have been isolated from the earth's surface for 100's of millions of years similarly provide opportunities to study the limits of life on earth and survivability of life in extreme environments.

The team assembled for the Kimballton S2 conceptual design planning effort includes over 60 internationally recognized experts in fields such as rock mechanics and underground construction, uncertainty and risk analysis/assessment, environmental assessment, public relations and consensus building, education and outreach, and management of major projects. The asssembled group also represents a significant investment by the Physics, Geoscience, Engineering and Biology divisions of the NSF.

Broader Impacts of the Proposed Activity:

The conceptual design being developed for Kimballton DUSEL includes education and outreach (E&O) components that build upon successful local (e.g., VT Mobile Chemistry Laboratory) and national (e.g., NSF Earth Scope) programs, as well as E&O documents developed through the NUSL, NeSS and EarthLab workshops. Kimballton DUSEL provides an excellent opportunity to build Science, Technology, Engineering, and Math (STEM) literacy for the public, K-16 students and teachers, local communities and other stakeholders as they learn how DUSEL projects are exploring the universe and our earth. Kimballton is an ideal location for such efforts because it is rural, while still offering accessibility to broad audiences through existing transportation and technology corridors: Kimballton is within a day's drive for 50% of the U.S. population. The project will increase the broad recognition of Southern Appalachia as a place engaged in big science, complementing existing research centers such as the Marshall Space Flight Center (NASA), Huntsville, AL; Oak Ridge National Laboratory (DOE), Oak Ridge, TN; the University of Tennessee-Knoxville; the National Radio Astronomy Observatory (NSF); Green Bank, WV; and Virginia Tech. These and future initiatives represent a change from an economic base built upon the mineral extractive industries historically associated with the region, to a new, sustainable, economy based on science and technology. Professionals with broad experience in national and international E&O, as well as local involvement in grass roots programs within the southern Appalachian region, will lead this effort.

CONCEPTUAL DESIGN FOR DUSEL AT KIMBALLTON, VIRGINIA

Introduction

The Kimballton DUSEL site in SW Virginia offers unprecedented opportunities to conduct a broad range of research in fields that match well with preliminary technical requirements established by the S1 process. Kimballton meets the needs of the physics community whose goals are to understand the origins and evolution of the Universe, and biologists whose research is related to the limits of life on Earth. At the same time, the unique characteristics of the Kimballton site are ideally suited for research related to issues of societal relevance, such as water resources, climate change, carbon management, development of underground space, and the origin and exploration for hydrocarbon energy resources. In this proposal we describe those features that make the Kimballton DUSEL site an ideal venue to address a broad range of fundamental and practical problems in science and engineering.

Sedimentary rocks, such as those at the Kimballton site, cover about 3/4 of the earth's land surface. About 90% of the earth's groundwater is currently being produced from sedimentary rocks. Nearly all (99+%) of the world's hydrocarbon resources are hosted in sedimentary rocks (with about half in carbonate rocks similar to Kimballton), and 85% of underground mines are in sedimentary rocks (MSHA, 2002). Sedimentary rocks and deep aquifers in sedimentary basins constitute important reservoirs for carbon storage to address global warming issues. As modern societies continue to develop underground infra-structure and workspaces to minimize ener-gy use, address urban crowding, and combat global terrorism, the ability to safely and economically develop underground space in the most prevalent near-surface rock type will become increasingly important.

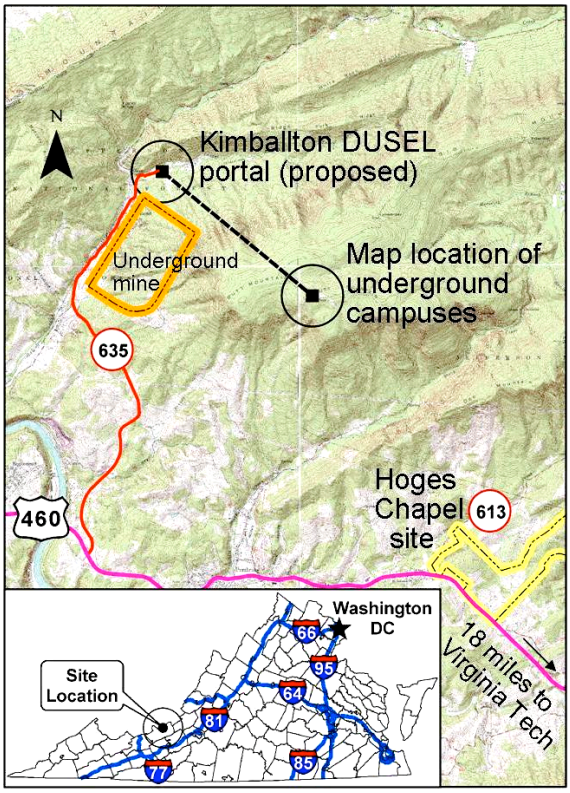


Figure 1. Location map for Kimballton DUSEL showing the location of the Kimballton DUSEL portal; map (surface) location of underground campuses; and the Hoges Chapel site of the proposed Visitor and Education Center.

Recently, the National Research Council was tasked with assessing the research needs of the engineering community with respect to rock fracture characterization and fluid flow. The committee concluded that:

In situ facilities should be developed in a variety of rock types with different styles of fracturing. A number of excellent facilities already exist in crystalline rocks, but there is a dearth of in situ research facilities in bedded [sedimentary; ed.] rocks, especially where more than one fluid phase is present. Consequently, less is known about how to effectively characterize flow and transport

*in bedded rocks. Research at facilities in bedded rocks would have a significant impact on understanding enhanced oil and gas recovery processes in fractured reservoirs. (*NRC, 1996)

The Kimballton DUSEL site can satisfy all criteria currently being developed in the S1 Phase of DUSEL, and will provide unique opportunities for research in physics, earth sciences, civil, environmental and mining engineering and microbiology, as well as education and outreach through a world-class Visitor and Education Center.

Appendices referred to in this proposal are available to the public at:
http://www.phys.vt.edu/~kimballton/S2appendices

Summary of Extant Information on the Kimballton Site

The Kimballton site is located south-western Virginia and is the only potential DUSEL site in the eastern U.S. (Fig. 1). The portal to the lab is 30 minutes from Virginia Tech, the largest (28,000 students) research university in the State of Virginia. Kimballton DUSEL is a 5-hour drive southwest from Washington, D.C. on Interstates 66 and 81 and is connected to I-81 via Route 460, a four-lane divided U.S. highway. The site offers an exceptional combination of research infrastructure, beautiful surroundings, low cost living, and pleasant climate. Outside Magazine (Grudowski, 2001) calls Blacksburg and surrounding areas one of the *"Ten Dream Towns-The Perfect Places to Live Big, Play Hard and Work (if you Must)"* in the U.S. The nearest full service airport is the Roanoke Regional Airport, 64 km from the site. The Virginia Tech Executive Airport is located 30 minutes from the mine portal. Norfolk Southern Railway Company maintains a major rail line within 8 km of the mine portal with a spur that runs to the mine. Existing infrastructure includes adequate power, telecommunications and water, as outlined in Appendix A.

The Chemical Lime Company and its predecessors have been mining chemical-grade limestone at Kimballton for over 50 years, with sufficient reserves for another 80 years of mining at the current capacity.

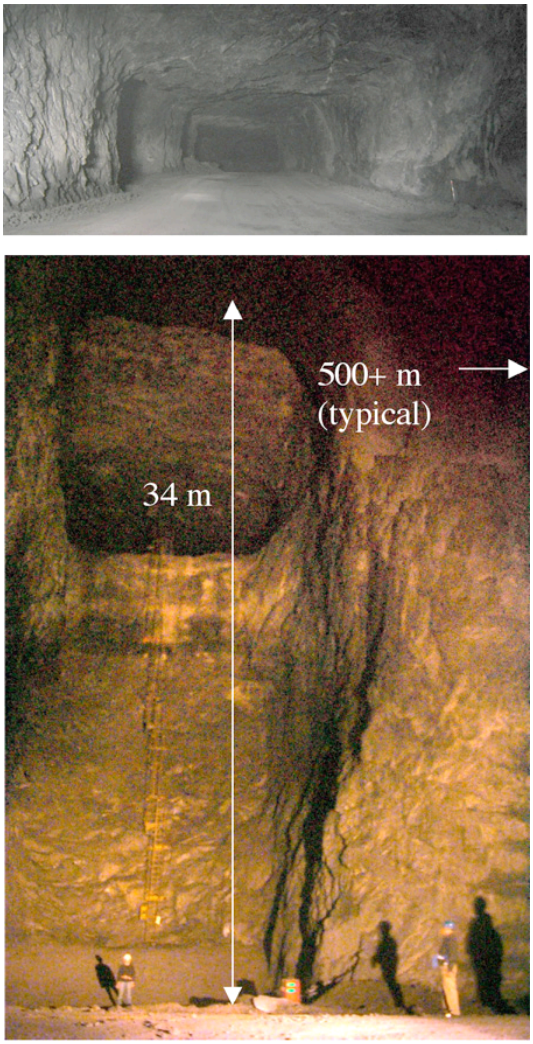


Figure 2. Typical Kimballton Ramp 12.8 x 8 m (top); typical stope in the Kimballton Mine (bottom).

Approximately 80 km of underground workings are currently open. Access tunnels are a minimum of 12.8 m wide and 8 m high, with a 10% grade. Mined out stopes are up to 34 m high (Fig. 2). The Five Oaks Limestone that is being mined is a strong, massive, unfractured rock that supports large existing underground chambers. The current mine descends 365 m from the portal while

the surface topography rises 335 m, so that the current maximum depth beneath the surface is 700 m. The mine is relatively dry and has the great advantage that the little water that does enter the workings comes in via a few well-characterized fractures associated with a known fault, thus providing an opportunity to conduct state-of-the-art research on fracture flow.

The deep portion (2290 m) of the proposed Kimballton DUSEL site lies directly under the highest part of Butt Mountain (Fig. 3), approximately 1.5 km southeast of the deepest workings in the Kimballton Mine. The deep laboratory campus location is under U.S. Forest Service land, and access tunnels to the site cross under property controlled by Chemical Lime Company and the U.S. Forest Service. Discussions have been ongoing with various stakeholders to assure that the proposed site will be available to construct DUSEL. A preliminary signed agreement has been negotiated with Chemical Lime Company for access to the property. A low-level counting facility and NSF-funded AMADEUS rock engineering study are currently in progress at Kimballton.

Geologically, Kimballton lies in the Appalachian foreland fold-thrust belt, with folded sedimentary rock of Paleozoic age arranged in overlapping thrust sheets. Rock types are dominated by massive dolomite and limestone, with minor shale and sandstone. A detailed summary of the geology of the site is included in Appendix B. The locations of the underground campuses and the access tunnels were selected such that the only rock units that will be encountered during construction of access tunnels and caverns are Middle Ordovician limestone and the Knox dolomite and limestone (Fig. 3). These rocks have unconfined compressive strengths of 80-170 MPa (Appendix C), which correspond to the "very strong" classification of Hoek (2000; Table 11-2).

A preliminary environmental analysis has been conducted to help assure that the project's oversight obligations are fulfilled and satisfy the rules and regulations of the National Environmental Policy Act (NEPA). The preliminary NEPA checklist is included as Appendix D. No obvious environmental impacts have been identified. The rock to be excavated is dominantly limestone, the same rock used as aggregate and highway sub-grade in the construction industry – this excavated rock will be stored, either underground or in a nearby abandoned quarry, and sold for aggregate as needed. The rock contains no trace elements that are known to be carcinogens (such as As or Hg) or to pose other health risks. Water that currently flows into the Kimballton Mine is of sufficient quality that it satisfies all EPA requirements and is pumped directly into Big Stony Creek without treatment.

The Kimballton site is comparable to or offers distinct advantages *vis-à-vis* other potential sites both inside and outside the United States. The site is ideally situated for measurements of parameters critical to particle physics. The list of frontier questions raised in S1 that can be covered at Kimballton includes experiments on baryon and lepton number nonconservation, studies of dark matter, and neutrino astrophysics. Long baseline experiments using neutrino beams from accelerator laboratories would form a significant part of the DUSEL program at Kimballton, with the promise of accurate determination of these critical parameters, thereby providing answers to fundamental questions in particle physics. Details are provided in Appendix E.

The S1 physics infrastructure matrix specifies depth (shielding) and cavern size required for various experiments. Preliminary assessment of the geomechanical properties of the rocks at Kimballton indicates that it is feasible to construct tunnels and large-volume caverns that satisfy these requirements. It should be emphasized here that large caverns in limestone have already been constructed at a depth of 1200 m

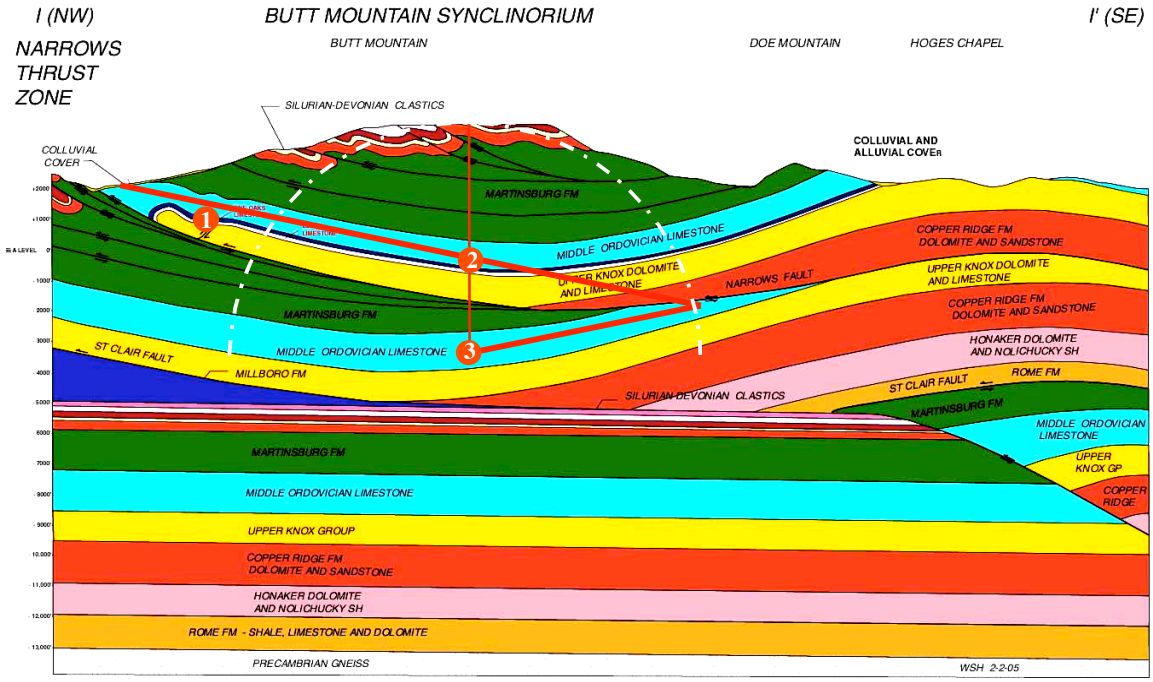


Figure 3. Cross-section of the Butt Mountain Synclinorium, showing access and vent tunnels; shallow (1), central (2), and deep (3) campus locations, and 6000 mwe boundary (dashed line).

at the Gran Sasso laboratory in Italy (Fig. 4). Caverns of sufficient size to host most of the physics experiments identified in the S1 matrices already exist in the Kimballton mine at 700 m and have remained stable for the 50 years since they were originally excavated. Excellent rock mechanical properties, combined with the low U-Th contents of the rocks, make Kimballton a suitable site to conduct neutrino and other physics experiments identified in S1 and other reports.

The ideal site for a broad range of geoscience, engineering and microbiology research is one that offers access to large volumes of fresh, homogeneous rock of several lithologies. Some candidate DUSEL sites are characterized by fresh, homogeneous rock of only a single lithology, while others are characterized by highly variable but also highly altered (mineralized) lithologies that limit the effectiveness of coupled-process experiments that require an initially fresh and well characterized rock mass in order to extract meaningful results. The diverse geology of the Kimballton site, characterized by large volumes of fresh, homogeneous rock of variable lithology, provides a wider variety of research opportunities and meets or exceeds the site characteristic requirements identified in the S1 matrices. The presence of numerous and repeating interfaces of various lithologies at increasing depth (pressure) and temperature provide opportunities for scaling and coupled-process experiments over a range of temperature and pressure – such experiments are an important component of the S1 earth science and engineering matrices. The geological and geomechanical properties of the Kimballton site thus meet the stringent needs of the physics community in terms of depth or shielding and cavern size, as well as provide an environment for world-class research in the geosciences, biosciences and engineering disciplines. A summary of the unique science and engineering opportunities can be found in Appendix E.

Figure 4. Hall C at LNGS, Italy. The hall is excavated in dolomite and is 20x20x100 m.

The relative advantages and disadvantages of greenfield versus brownfield sites have been discussed at workshops over the past year. A brownfield site (existing mine) might reduce the geologic unknowns associated with developing caverns at the required depth, and might facilitate "early science", but will also provide less flexibility in terms of designing space specifically to meet research requirements and may show various types of physical and biological contamination that might compromise research. Conversely, greenfield sites exhibit greater uncertainty with respect to subsurface conditions, but can be designed to maximize the flexibility of the laboratory and provide the best opportunities for expansion and future use, and provide access to ground that has not been disturbed and contaminated by drilling or mining activities.

The Kimballton site offers advantages of both brownfield and greenfield sites. Large underground chambers at the existing Kimballton Mine argue for the feasibility of constructing large, stable caverns in limestone and provide suitable space to conduct early science (such as the NRL-VT low background facility, the LENS prototype, and the NSF-funded AMADEUS experiments that are currently underway). Additionally, the mid- and deep-level DUSEL campuses are essentially greenfield sites that offer the flexibility for designing the facility to maximize research potential.

Qualifications of the Team Relevant to Developing the Conceptual Model for DUSEL at Kimballton

The Kimballton team includes approximately 150 scientists, administrators and public officials. The PI, co-PIs and senior collaborators number approximately 50. They are listed in Supplementary Material.

The Kimballton DUSEL PI is Dr. Mark McNamee, Provost and Vice-President for Academic Affairs at Virginia Tech. Dr. McNamee is the chief academic officer of the largest research university in the State of Virginia and has experience managing large enterprises and budgets. His Ph.D. is in physical chemistry and his research program focuses on biochemistry and biophysics. Dr. McNamee provides the overall leadership for Kimballton DUSEL, and his participation as PI reflects the strong commitment of the University to provide leadership and resources necessary for the success of this project.

The five co-PIs represent active and successful researchers whose expertise provides the qualifications necessary to develop a competitive conceptual design for Kimballton. Co-PIs Vogelaar and Raghavan provide leadership to assure that the conceptual design meets the requirements and addresses issues relevant to the physics community. Co-PIs Bodnar and Hatcher are senior earth scientists who will lead the effort to assure that the conceptual design meets the needs of the geosciences and biogeosciences communities. Co-PI Einstein is a recognized expert in rock mechanics and assessing uncertainties associated with development of underground space. He will assure that the conceptual design includes all risks that may be encountered during construction of DUSEL, and identify counter-measures to minimize the consequences.

We have assembled an outstanding group of senior collaborators and other

experts to ensure that all aspects of the conceptual design are considered. A key component of the conceptual design is related to the construction of the tunnels and caverns for the laboratory. The Mining Engineering and Civil and Environmental Engineering Departments at Virginia Tech are nationally ranked with several highly qualified faculty who are members of our team, including Professors Westman, Mauldon, Dove and Gutierrez. In addition, we have supplemented this strong group with other leading experts in the field of rock mechanics, including Dr. Evert Hoek (consultant from Vancouver, British Columbia) and Professor C. Derek Martin of the University of Alberta. These distinguished experts have agreed to work with the Kimballton team to identify uncertainties associated with building an underground laboratory at Kimballton, and to develop strategies to reduce risks associated with changing conditions during construction. We have also engaged Dr. Lee Petersen of CNA Consultants to assist with designing the underground facility.

Plan for Developing the Conceptual Design

The conceptual design will be developed to match preliminary information on the technical requirements for science and engineering established by the S1 process. This process will include plans for developing the initial suite of experiments, the longer-term capability of the site beyond the initial experiments, integration of scientific and engineering communities, and international participation.

Plan for developing the initial suite of experiments:

The initial suite of experiments will be consistent with preliminary criteria that have been developed during the S1 process. Physics experiments identified in S1 include solar neutrino, neutrino mixing, double beta decay, dark matter, nuclear astrophysics, proton decay and multi-purpose detectors. Earth science and engineering experiment modules have been characterized as shaft access and run-of-mine, pristine or perturbed large block experiments, remote very large block, drift structure, and deep earth probing experiments. The Kimballton DUSEL will be designed to accommodate as many of the proposed experiments as is feasible within construction and funding limitations.

The initial suite of experiments will satisfy the S1 requirements (or their successors). Specific experiments will be decided by the broader scientific community through a series of community-wide workshops and letters of intent to prioritize experiments. This process will be all-inclusive and will lead to a broad consensus within the different disciplines represented by DUSEL.

Longer-term capability of the site:

The Kimballton conceptual design provides for flexibility to expand as new experiments are proposed. The preliminary vision of the conceptual design for DUSEL at Kimballton involves a mid-depth campus at approximately 1200 m (4000 ft) beneath Butt Mountain, and a deeper campus at approximately 2300 m (7500 ft). The two campuses will be designed to accommodate the range of experiments identified in the S1 matrices, and will provide space and flexibility to permit expansion as additional experiments are planned.

Large underground caverns in the existing Kimballton Mine have remained stable for the approximately 50 years the mine has been in operation. Little rock bolting is used in the Kimballton Mine -- and only in areas with high traffic (such as the lunch room area) or where bad ground is occasionally encountered. This record suggests that tunnels and caverns built as part of DUSEL have a high probability of remaining stable over the 30-50 year lifetime of the laboratory.

Plans for integrating the scientific and engineering communities:

The commitment of the Kimballton team to integrating the science and engineering communities is emphasized by

the large numbers of researchers from both of these areas included in the list of senior collaborators. Furthermore, characterization studies proposed as part of the S2 process, as well as the initial suite of experiments to be developed, include strong engineering and science components.

Dr. Watts of the Dept. of Geology at Radford University will oversee the integration of science and engineering during the S2 process and beyond. Dr. Watts is highly qualified to lead this effort based on his background, which includes degrees in Geology and Engineering Geology. He currently conducts research in engineering geology, and is widely recognized as a leading expert in rock slope engineering.

International Cooperation:

The Kimballton team brings extensive experience in multi-national underground research and construction projects, from microbiology to $100 million physics experiments to billion dollar underground civil works. The level of cooperation required for such projects, as well as the enabling aspects for new and exciting research of multi-national participation, makes international cooperation key for success of DUSEL.

Geoscientists and engineers from around the world will conduct research at DUSEL if, and only if, the facility offers research opportunities that are not available at other locations, such as existing mines. For example, a DUSEL sited in an existing or former metal mine would represent one of several thousand such opportunities worldwide and would be less likely to attract international (or even national) participation. However, if the DUSEL is sited in what would be considered fresh, unaltered and unmineralized rock that researchers could access from various directions in the subsurface, this would truly represent a unique research opportunity. [Such facilities do not exist because mining companies frown on spending hundreds of millions of dollars to excavate caverns in rock that has no economic value.] Fundamental questions related to fluid flow, ore-forming processes, origin and exploration for hydrocarbon occurrences, microbiology and rock mechanics, among others, require an initially fresh rock mass that can be perturbed under known and carefully controlled conditions. The Kimballton DUSEL site provides such opportunities, and as such would attract researchers from around the world.

Developing a Comprehensive Plan to Address Site-Based Issues

The S2 process will identify and address site-based issues associated with construction of DUSEL at Kimballton. Topics include geological and geotechnical conditions, environmental issues, safety and health issues, permitting, assessing local community support and opposition, sharing infrastructure with non-laboratory entities, uncertainty, and the timeliness and costs of conducting the preceding activities.

Geological Characterization:

A major focus of the S2 effort will be to better characterize the geologic and tunneling conditions for the laboratory in order to minimize uncertainty during construction. The surficial geology of the Kimballton site has been studied in detail and the layered and folded stratigraphy results in abundant outcrops that permit extrapolation into the subsurface. Limited deep seismic investigations recently completed on Butt Mountain in preparation for the S2 submission, and deep bore holes and seismic imaging studies of this same package of rocks elsewhere in the southern Appalachians, have confirmed the basic geological model shown in Fig. 3. Additional geologic and engineering characterization will be conducted as part of the S-2 process to further reduce uncertainty and to better plan for facility design and construction.

Mr. William Henika, who is recently retired from the Virginia Division of Mineral Resources and holds an Adjunct Faculty position in the Department of Geosciences at Virginia Tech, will lead the

geological characterization task during S2. He is widely recognized as a leading expert in the geology of the southern Appalachians. Geoscientists, engineering geologists and engineers on the Kimballton Team will work closely with Mr. Henika to plan and implement the geological characterization process. Members of the Kimballton Conceptual Design Activities team will lead sub-tasks of this process.

The S2 process involves several sub-tasks to better characterize the geology and rock mechanics / tunneling conditions at depth and to provide input for uncertainty analyses associated with Kimballton DUSEL. Work to be accomplished as part of this procedure is summarized as follows:

1. A core hole will be drilled from the top of Butt Mountain to the deep campus location to confirm the geology over the entire 2100 m from the surface to the deep campus. The drilling effort will be coordinated by Drs. Burbey and Mauldon. Sonic logging and resistivity logging will be conducted to better constrain rock strength and lithologic variability at depth. Temperature and fluid conductivities will be investigated under ambient and pumping conditions to identify active fracture networks, and an optical televiewer will provide information on fracture apertures and orientations. This information is critical to assessing changing conditions that might be encountered during tunneling and cavern excavation. Borehole flow meters will measure water inflows. This information will be used to design the optimum tunneling methodology and operational criteria.

2. The proposed laboratory design includes a tunnel adjacent to the operating Kimballton Mine, with the portal on mine property and one or more connections to the existing mine. To confirm the feasibility of this model, one or more shallow drill holes will be located in the vicinity of the proposed portal site to identify potential ground entry challenges. These holes provide additional information on lithology, rock quality, fracture characteristics and the potential to intersect water-bearing zones during construction. The shallow drilling effort will be coordinated by Drs. Burbey and Dove, in collaboration with the geological staff at the Kimballton Mine.

3. Fracture data from the existing Kimballton mine will continue to be collected and analyzed to supplement data already collected from nearby quarries and road cuts. This information is needed to help predict structural features that might be encountered in the same rock units at depth during tunnel construction. Dr. Mauldon will coordinate this effort.

4. Preliminary analysis of aerial photography and digital elevation models indicate widely spaced lineaments representing steeply dipping fractures. To reduce the uncertainty associated with tunnel construction in the vicinity of these lineaments, electrical resistivity studies will be conducted to help constrain the depths to which the fractures extend, and may be extrapolated to greater depths based on information obtained from other characterization studies. This work will be conducted by Dr. William Seaton of ATS, Inc. and will be coordinated by Dr. Watts.

5. A deep seismic survey conducted during 2004 provided confirmation of the subsurface geology in the vicinity of the proposed lab. Additional seismic studies are not currently included in our S2 geological characterization plans, but may be conducted if results of the deep drilling program indicate inconsistencies with the inferred subsurface geology. If such studies are required, the task will be led by Drs. Imhof and Hole.

Virginia Tech will provide funding for the geological characterization studies described above (see letter from Dr. Brad Fenwick, Vice President for Research at Virginia Tech, in Supplementary Materials). This represents a significant investment by Virginia Tech into the DUSEL effort, and reflects the strong support of the University.

Environmental assessment:

The S2 process will involve an in-depth assessment of environmental impacts associated with construction and operation of DUSEL at Kimballton. In preparation for this activity, the Kimballton team has contracted with Schnabel Engineering to prepare an environmental impact checklist for the site. The environmental impact checklist was developed and implemented based on National Environmental Policy Act (NEPA) protocol for preliminary assessment of projects that are being considered for Federal funding – the completed checklist is included as Appendix D. The intent and approach used in completing the NEPA Checklist was to take as broad a view as reasonably possible of the various aspects of the proposed action. This provided for both an initial appraisal of the project and the development of the scope for the environmental impact assessment to follow in S2, where a more detailed evaluation of the critical elements will be performed.

Safety and Health Issues:

The mission statement for safety and health at Kimballton DUSEL is as follows: *Through proactive training and proper facility design by experienced engineers, the life safety and health of each individual working at Kimballton DUSEL will not be compromised.* This guiding vision will be used during each phase of construction and operation.

During S2, health and safety issues will be addressed and appropriate programs implemented through the following tasks. 1) Assess life safety requirements per national and local building codes. 2) Develop and incorporate design-level life safety elements including, but not limited to: multiple routes of egress to underground spaces; smoke proof areas of refuge along access routes; smoke detection, control, and exhaust systems; sprinkler systems; emergency power and lighting; and personnel tracking sensors. 3) Implement worker and visitor safety training and monitoring procedures. 4) Work to develop common health and safety procedures for the mine portions of the laboratory. 5) Develop containment designs, emergency response procedures and protocols for handling flammable materials, cryogens and oxygen-displacing gases. 6) Develop procedures for safe transport of materials from the surface to the underground laboratory and incorporate these into the facility design. The plan for addressing safety and health is included as Appendix F.

Permitting:

A preliminary study was conducted to identify points of contact, lead agencies or jurisdictions, and requirements for permits. During S2, the complete process for acquiring the required permits will be undertaken. Details are included in Appendix G and summarized below.

1. Access Permits. The portal and surface campus are located on property owned by the Chemical Lime Co. The underground campus and access tunnels will be located on land owned by the U.S. Forest Service land, and the agency is aware of the Kimballton DUSEL project (see attached letter from District Ranger Cynthia Schiffer). During the summer, 2004, permits were obtained from the USFS for geophysical imaging on top of Butt Mountain. Faculty at Virginia Tech have a long and well-established relationship with the local USFS office.

2. Construction permits from Giles County will be required.

3. While not specifically a permit, completion and review of the National Environmental Policy Act (NEPA) process is required (see discussion in the section on *Environmental Issues*).

4. Approval of a Soil Erosion and Sediment Control plan is required of land disturbing activities prior to issuance of a construction permit.

5. Air quality permits may be required for air discharges during construction and for normal ventilation during operation. Specific requirements will be discussed with US Environmental Protection Agency Region III and the Virginia Dept. of Environmental Quality (VADEQ).

6. Water quality discharge permits and certifications under Sections 401, 402 and 404 of the Clean Water Act may be necessary during construction for potential discharge into Big Stony Creek. The US Army Corps of Engineers and the VADEQ have jurisdiction over these permits.

Rock Disposal. Several options exist for excavated rock disposal, including: 1) reutilization, 2) stockpiling in nearby unused quarries, and 3) stockpiling in unused excavations underground. Limestone and dolomite meets durability requirements for highway aggregate, and thus could be sold to material suppliers. It is understood from discussions with VADEQ that stockpiling in unused quarries is exempt from landfill permitting and monitoring requirements. Permitting requirements for underground storage of excavated rock materials would be evaluated on a case-by-case basis. Rock transport and disposal is not an issue at Kimballton.

Assessing local public support:

A significant effort has already begun to engage the local community and to solicit input. Informational meetings have been held with various stakeholders in the New River Valley and Giles County. The response to date has been overwhelmingly supportive. Support letters from Mr. Chris McKlarney, County Administrator for Giles County, Mr. William Aden, President of the Blacksburg Partnership, Ms. Annette Perkins, Chairperson of the New River Planning District Commission, and from Dr. Steven Craig, President of the Giles County Rural Development Group are included in the Supplementary Materials.

During the S2 planning process, Dr. James Phillips, Director of the Conflict Resolution Institute at the L. Douglas Wilder School of Government and Public Affairs at Virginia Commonwealth University at Richmond, Virginia, will lead the effort to assess public support for or opposition to DUSEL Kimballton. Dr. Phillips specializes in providing a wide range of conflict and dispute resolution services to Federal, State, and local government agencies that are engaged in citizen participation processes to minimize public opposition to proposed public projects. The Institute also provides services to citizens seeking to provide input and comment on proposed public projects and programs. Dr. Phillips is a former Assistant Attorney General of Virginia and has over 15 years of experience in resolving protracted policy and legal issues involving the public.

In addition to local support, the Kimballton DUSEL project enjoys unprecedented support at both State and Federal government levels. The revised 2004-2006 biennial budget of Virginia Governor Warner includes a request for a $150 million bonding authority. The language of the budget document states that *"the Commonwealth shall issue bonds, through an existing economic development authority or authority established for such purpose, for construction and infrastructure of said project in an amount not to exceed $150 million."* This request has been approved and is included as a provision in the appropriations act. While the State funding will not decrease NSF's funding obligation to DUSEL, it will allow construction to begin immediately upon approval of the project, and will permit NSF to spread construction costs over several years as the bonds are retired.

Kimballton DUSEL also has the support of the Virginia Congressional delegation, including the U.S. Senators, as evidenced by

the support letters included in Supplementary Materials. We wish to emphasize that the State and Federal support for DUSEL is not intended to circumvent the normal peer review process. Rather, we simply wish to inform the scientific community that if Kimballton DUSEL is found to be satisfactory from the science and engineering perspective, construction of DUSEL will not be hindered by local community opposition, and will have State and Federal support to secure funding and permitting for the laboratory. Without these assurances, construction times could be increased by years or decades, and construction costs could increase by billions of dollars, as evidenced by the significant delays and cost escalation experienced by the Yucca Mountain Nuclear Waste Repository because of local community and State of Nevada opposition to the project.

Sharing Infrastructure:

At the present time, the Kimballton team is sharing infrastructure with the Kimballton Mine to conduct low-level counting experiments in collaboration with the Naval Research Laboratory. Preliminary plans for DUSEL at Kimballton involve constructing a tunnel on Chemical Lime property (see Fig. 1), adjacent to the active mine workings, with one or more tunnels connecting into the existing mine. The connecting tunnels will improve ventilation for the existing Kimballton Mine, and provide an additional emergency egress from the eastern area of the mine workings. The connecting tunnels may also be used to transport rock excavated during construction of the DUSEL tunnels and caverns. Empty stopes in the Kimballton mine are one possible means of disposing of waste rock from tunnel and cavern construction. Further details related to shared infrastructure will be investigated during the S2 process.

Uncertainty:

An important aspect of the S2 process is to develop a plan to accommodate uncertainty associated with changed conditions encountered during construction. These uncertainties will affect cost and time to build and operate the laboratory, and may include:

- Political and regulatory uncertainties including future changes
- Geology and other environmental conditions
- Construction processes
- Operational (management) processes
- Experimental technology
- Experimental errors

It is absolutely essential that uncertainties and their effects are clearly identified and that the laboratory management plan includes processes that minimize the uncertainties and their consequences. Developing the structure of these processes and management plans will be a central part of the proposed S2 work.

Co-PI Einstein of MIT will lead the task to develop the plan to address uncertainty and risk associated with construction and operation of the Kimballton DUSEL. Dr. Einstein is an acknowledged leader in this area (see bio-sketch). A detailed description of the process that will be followed to address uncertainties associated with the construction and operation of Kimballton DUSEL is included in Appendix H.

The methodology for risk identification/assessment, risk analysis and risk management is well established and practical applications to similarly complex projects have been demonstrated. The process to identify uncertainty will be similar to that used by the Washington State Department of Transportation for its major projects (Reilly et al., 2004), or other projects such as the Great Belt Tunnel in Denmark, a VECP for a section of the Boston CAT project, or DOE projects.

The consequences of uncertainty are usually expressed in terms of cost and time but can also be expressed as multi-attribute utilities (Keeney & Raiffa, 1976). Uncertainties and consequences will then be combined in the risk assessment/analysis phase, either formally (quantitative

probabilistic risk assessment) or semi-formally (characterization of risks relative to each other). This will be done starting at the aggregate level and then working toward more details. An example of a successful application at the intermediate and detailed level is the DAT (Decision Aids for Tunnelling; Einstein, 2004) that allows assessment of geologic and construction uncertainties and their financial and time related consequences.

With the structures, processes and tools discussed above and in Appendix H, the DUSEL management and the funding agencies will be provided with complete information on the overall uncertainties and associated financial and time related risks as well as other (environmental e.g.) risks. The process will also include the identification of countermeasures, their mitigating effects and the associated uncertainties (a counter measure may not reduce the risk with 100% certainty). Countermeasures can be either active (reducing initial uncertainties) or passive (reducing the consequences) or both.

A structure based on established methodology and, to some extent, on practical applications will be developed in Phase 2, which will allow one to assess the effect of countermeasures in reducing the risks. This will, in its practical implementation in Phase 3, allow the decision maker to examine the effect of different countermeasures. Examples are additional exploration to reduce geologic uncertainties, requesting legal rulings regarding regulations to reduce associated uncertainties, and technical modifications of experiments.

Because it will be impossible to remove all uncertainties prior to construction and operation of the laboratory, it will be necessary to have a feedback process in place. Specifically, the construction and operation components that are uncertain, for instance, the geology during construction, will be monitored and countermeasures put in place. The underlying concept and methodology is well known, and practical processes are used extensively and will be expanded to fit the DUSEL management process.

<u>Developing, Maintaining and Operating the Infrastructure:</u>

Developing the timelines and costs for the full DUSEL construction is an iterative process that the DUSEL community has been engaged in at various sites over the past several years. Many of the basic infrastructure requirements are common to all sites. We plan to make full use of the collective wisdom and specific knowledge gained by the community so far. To facilitate this effort, we have engaged Dr. Lee Petersen of CNA Consulting and Associates (see preliminary design report in Appendix I). They have been active in the ongoing S1 process and are aware of the needs of the scientific and engineering communities and have a clear understanding of the process that will be followed to design and construct DUSEL.

Each site will develop its own strategy to satisfy the broadest range of S1 technical requirements, consistent with the local geology, code environment, and existing facilities. The ongoing Kimballton DUSEL development program, including the work to be completed as part of S2, will further constrain costs and timelines and reduce the uncertainties associated with construction of DUSEL at Kimballton.

The project manager, in conjunction with the risk analysis team and professional firms such as CNA will develop, update, and distribute for critical review the timelines and costs and make revisions accordingly.

A major activity during the S2 project period will be to develop a plan to maintain and operate the DUSEL facility, including liability and insurance issues. The model for maintenance and operation of Kimballton DUSEL will build upon models that have been used successfully at similar facilities domestically and abroad. The planning effort will be led by Dr. Ray Martin, who is the former CEO and President of Schnabel Engineering Associates. Dr. Martin has considerable experience in managing large projects and will provide guidance and advice in developing a plan to maintain and operate DUSEL at Kimballton.

Education, Human Resource Development and Outreach:

Kimballton DUSEL provides an excellent opportunity to build Science, Technology, Engineering, and Math (STEM) literacy for the public as they learn how DUSEL projects are exploring the universe and our earth. This is a unique location for such efforts because it is rural, while still offering accessibility to broad audiences through existing transportation and technology corridors: Kimballton is within a day's drive for 50% of the U.S. population. (NRVPDC, 2004). This project will increase the broad recognition of Southern Appalachia as a place engaged in big science, complementing existing centers such as the Marshall Space Flight Center, Huntsville, AL (NASA), Oak Ridge National Laboratory, Oak Ridge, TN (DOE), the University of Tennessee-Knoxville, the National Radio Astronomy Observatory, Green Bank, WV, and Virginia Tech. These and future initiatives represent a change from an economic base built upon the mineral extractive industries historically associated with the region, to a new, sustainable, economy based on science and technology. An important component of DUSEL Kimballton E&O will be a world-class visitor and education center. Giles County has offered any or all of a 650 acre parcel of land on Route 460 at Hoges Chapel (Fig. 1) to locate the center and any other surface facilities associated with DUSEL.

The immediate proximity of Virginia Tech, a major research university, to this major interdisciplinary science facility is synergistic in many ways, including education and outreach (E&O) capitalizing on the land-grant mission of Virginia Tech. We will embrace E&O from the outset to have an early impact on understanding of this complex project. We will seek input from E&O advisory groups to make most effective use of resources. Staff will be dedicated to integrating E&O into the planning, design, construction, and implementation of K-DUSEL, as well as its ongoing research programs.

NSF and other agencies have identified Science, Technology, Engineering, and Math (STEM) education as a critical need in our nation (NSB, 2004). To meet science and engineering workforce needs and encourage future economic development, we want to inspire male and female students and citizens in the Southern Appalachians and rural America to pursue the learning needed in science and technology careers. **Inclusion of this diversity would be a deliberate focus of E&O from K-DUSEL.** Additional information about short- and long- range E&O plans and potential projects can be found in Appendix J.

Dr. Susan Pfiffner of the University of Tennessee and Ms. Llyn Sharp of Virginia Tech will lead the E&O effort. Both are experienced science education professionals. Pfiffner has worked with other underground outreach experiences and is well networked in the USL world, enabling her to easily call on colleagues. She is an active scientist, with a PhD in microbial ecology. Sharp works for VT as a science outreach coordinator in southwestern Virginia and is familiar with local and State K-12 networks and needs, as well as the university research environment. She has also planned indoor and outdoor interpretive facilities and designed many educational programs for diverse audiences.

During the S2 funding period (August 2005-February 2006) K-DUSEL E&O activities will include:

(1) Provide forums to facilitate communication, information exchange, and discussion for local citizens and decision-makers and establish a connection to communities. Conduct project scoping or "town meetings" to do preliminary needs assessments for different audiences, and to build partnerships for planning follow-on work at K-DUSEL.

(2) Hold a workshop with these partners and other stakeholders such as: other related projects, teachers, decision-makers, students and faculty, scientists, technical professionals, and community decision-leaders to further develop E&O programs to fit the community's needs and have

community involvement in facilities planning. Document the E&O plan, using a website for dissemination and feedback.
(3) Maintain E&O engagement in facilities planning and design to incorporate E&O guidelines and continue E&O staff participation in S3 proposal development.
(4) Develop and distribute informational materials about K-DUSEL and the sciences and technologies involved. Materials would be used as the basis for media releases and presentations to interested groups locally and regionally. Establish an E&O web presence offering general information as well as additional resources for K-12 teachers.

Economic Impact:

While not specifically requested in the S2 solicitation, we will conduct an in-depth economic impact assessment of DUSEL at Kimballton. It is expected that DUSEL will have a major economic impact on Giles county, as well as the broader New River Valley (NRV). Construction costs are estimated in the hundreds of millions of dollars over a three to five year period, with the majority of the workforce drawn from within the NRV. The annual operating budget of the facility is projected at $25 million annually for at least 40 years. This budget includes the employment of a permanent staff of about 75, mostly in skilled professional, technical, and administrative positions. Further, the annual science budget is projected at $25 million, including several hundred visiting researchers per year. An Education and Visitor Center is projected to attract several hundred thousand visitors per year.

Dr. Brad Mills will lead the economic impact assessment task. Dr. Mills has considerable experience in this area, and recently completed an assessment of the economic impact of Virginia Tech on the New River Valley.

Management Plan for the Planning Effort

A management plan for the planning effort has been developed that involves a hierarchy of management personnel, with individual tasks being led by experienced experts in that area. The plan includes a clear understanding of the roles and responsibilities of the PI and co-PIs in the planning process. Also included is an outline of the costs and the timelines to complete the various activities.

During the planning effort, Dr. John Wilson, Assistant Vice President for Administration in the Research Division at Virginia Tech, will serve as the Interim Project Manager for Kimballton DUSEL until a search for a permanent manager is completed. The Project Manager will work to implement the plans of the PIs to meet their goals, and manage the distribution of resources to assure that tasks are completed in a timely and cost-effective manner. During the S2 process, regular meetings, teleconferences, interim reports and other activities will be scheduled to assure that progress is being made towards goals defined as part of the S2 process.

Responsibilities of the PIs:

The responsibility of the PIs is to establish the goals to be achieved during the S2 process. The PIs are further responsible for interacting with the Project Manager to assure that these goals are achieved. One major goal to be achieved during this process is to establish a management plan for Kimballton DUSEL. The PIs will work closely with the Conceptual Design Activities Task Leaders to assure that goals of S2 are completed within the time and at costs set forth in this proposal. An external Advisory Board will be established to provide advice and guidance during this process.

Timeliness and Cost of Carrying out S2 Activities:

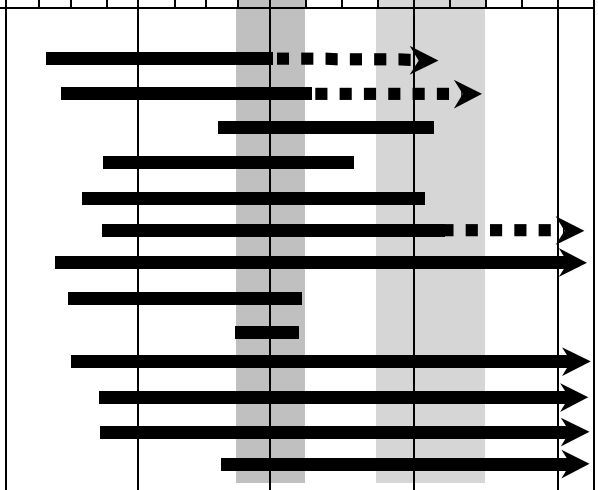
With an endeavor of the magnitude and complexity of DUSEL, it is not possible to stop and start activities to match perfectly with arbitrary (and unknown) project start dates. Development of the conceptual design for Kimballton DUSEL is a continuous process that began in March 2004. These

activities are now moving forward and will continue through the six-month S2 funding period, which we anticipate to be August 2005 through January 2006. Some activities, such as the deep core hole from the top of Butt Mountain, require considerable lead-time to arrange for a drilling contractor and necessary permits, and to evaluate the results following completion of the hole. As such, we will initiate this task immediately, with the cost to be borne by Virginia Tech. Other tasks, such as other geological and engineering characterization studies, environmental assessment under the NEPA process, surface lab planning and design, and permitting will be conducted mostly during the S2 project period. All activities described in this proposal as part of the S2 process will be completed by the end of the S-2 project period, which is estimated to be February 1, 2006.

The total cost of activities to be conducted during S2 is estimated to be $2.665 million. The differential between this amount and funding provided by NSF will be provided by Virginia Tech. Costs and timelines of major activity categories are summarized in Table 1, with additional details provided in Appendix K.

Table 1: Timelines and Costs for Kimballton DUSEL Activities

Item	Cost $1,000's	Year and Quarter: 2004 1 2 3 4 | 2005 1 2 3 4 | 2006 1 2 3 4 | 2007 1 2 3 4 | 1
Subsurface Characterization	1,845.0[(1)]	
Underground Lab Planning & Design[(2)]	100.0	
Surface Lab Planning & Design[(2)]	80.0	
Environmental Assessment	70.0	
Permitting	40.0	
Risk Analysis & Uncertainties	40.0	
Public Relations	70.0	
Administration	50.0	
Personnel	190.0	
First Science	80.0	
Science & Engineering Integration	10.0	
Outreach & Education	60.0	
Economic Impact	30.0	
Total Cost of S2 Activities	**$2,665.0**	



Notes:
1. Budget numbers are for S2 activities only.
2. See Work Breakdown Structures for a more complete list of design tasks.
3. Assumed S2 performance period from 4th quarter 2005 until 1st quarter 2006.
4. Assumed S3 performance period from 4th quarter 2006 until 2nd quarter 2007.

Summary

The 150+ member Kimballton team is convinced that a Kimballton DUSEL best captures the desired synergy between all interested NSF divisions, as evidenced in our strong letters of support for this initiative. Kimballton DUSEL represents a unique opportunity to build a world-class facility that will attract top scientists for years to come and become a leading component of the NSF research infrastructure.

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Kimballton-DUSEL Senior Collaborators

Collaborator	Institutional Affiliation	Field
Mark G. McNamee (PI)	Virginia Tech	biochemistry; Provost, Virginia Tech
Robert J. Bodnar (co-PI)	Virginia Tech	geosciences
Herbert H. Einstein(co-PI)	MIT	engineering; rock mechanics
Robert D. Hatcher (co-PI)	University of Tennessee	geosciences; structural geology
Raju S. Raghavan (co-PI)	Virginia Tech	physics; neutrinos
Robert B. Vogelaar(co-PI)	Virginia Tech	physics; weak interactions
John S. Wilson	Virginia Tech	Kimballton-DUSEL project manager
William A. Aden	Draper Aden Associates	engineering; surface infrastructure
Nicholas R. Barton	Nick Barton & Associates	engineering; rock mechanics
Dennis A. Bazylinski	Iowa State University	biology; microbiology
Jay B. Benziger	Princeton University	engineering; chemical purification
Jeff C. Blackmon	Oak Ridge National Laboratory	physics; nuclear astrophysics
Antonio Bobet	Purdue University	engineering; rock mechanics
Doug A. Bowman	Virginia Tech	computer science;geological modeling
Thomas J. Burbey	Virginia Tech	geosciences; hydrogeology
Arthur E. Champagne	University of North Carolina	physics; nuclear astrophysics
Lay Nam Chang	Virginia Tech	physics; high energy theory
Martin C. Chapman	Virginia Tech	geosciences; seismology
Gang Chen	University of Alaska	engineering; rock mechanics
John A. Chermak	Virginia Tech	geosciences; environmental studies
Kimberly L. Davis	University of Tennessee	education, outreach
Emmanuel Detournay	University of Minnesota	engineering; hydraulic fracturing
Joseph E. Dove	Virginia Tech	engineering; geoengineering
Derek Elsworth	Pennsylvania State University	engineering; rock mechanics
Alfredo Galindo-Uribarri	Oak Ridge National Laboratory	physics; solar neutrinos
David P. Genereux	North Carolina State University	geosciences; hydrogeology
Leonid N. Germanovich	Georgia Institute of Technology	engineering; rock mechanics
Leslie S. Gertsch	University of Missouri-Rolla	engineering; mining engineering
Frank Giovane	Naval Research Laboratory	physics; ultra-low background devices
Marte S. Guiterrez	Virginia Tech	engineering; rock mechanics
William S. Henika	Virginia Tech	geosciences; structural geology
Evert Hoek	Evert Hoek Cons. Engineer Inc.	engineering; rock mechanics

Note: Letters of commitment for the above senior collaborators can be found in the following pages.

Kimballton-DUSEL Senior Collaborators, continued

Collaborator	Institutional Affiliation	Field
John A. Hole	Virginia Tech	geosciences;seismic imaging,tectonics
Matthias G. Imhof	Virginia Tech	geosciences;seismic imaging,tectonics
Gary K. Jacobs	Oak Ridge National Laboratory	environmental science
Yuri A. Kamyshkov	University of Tennessee	physics; nucleon decay
Thomas L. Kieft	New Mexico Inst. of Mining and Tech.	biology; geomicrobiology
Richard A. Kroeger	Naval Research Laboratory	physics; ultra-low background devices
John G. Learned	University of Hawaii	physics; nucleon decay, neutrinos
C. Derek Martin	University of Alberta	engineering; geotechnical
Ray E. Martin	Schnabel Engineering	engineering; geotechnical
Matthew Mauldon	Virginia Tech	engineering; geotechnical
Stefano Mazzoli	University of Naples	geosciences; structural geology
Amitabh Mishra	Virginia Tech	engineering; electrical
Biswarup Mukhopadhyay	Virginia Tech	biology; evolutionary microbiology
Lawrence C. Murdoch	Clemson University	engineering; geomechanics
Lothar Oberauer	Tech. Universität München	physics;neutrinos,nuclear astrophysics
Sandip Pakvasa	University of Hawaii	physics; neutrinos
Wayne D. Pennington	Michigan Tech. University	geosciences; seismology
Susan M. Pfiffner	University of Tennessee	education, outreach
Tommy J. Phelps	Oak Ridge National Laboratory	biology; microbial ecology
James D. Phillips	Virginia Commonwealth U.	public policy and community relations
Mark L. Pitt	Virginia Tech	physics; weak interactions
Jean-Claude Roegiers	University of Oklahoma	geosciences; rock mechanics
Kate Scholberg	Duke University	physics; neutrinos
S. Llyn Sharp	Virginia Tech	education, outreach
Stefan M. Spanier	University of Tennessee	physics; neutrinos
Tatsu Takeuchi	Virginia Tech	physics; high energy theory
Werner Tornow	Duke University	physics; double-beta decay
Roger M. Turpening	Michigan Tech. University	geosciences; seismic imaging
Frans F. von Feilitzsch	Tech. Universität München	physics;neutrinos,nuclear astrophysics
Chester Watts	Radford University	geosciences; engineering geology
Erik C. Westman	Virginia Tech	engineering; tomographic engineering
Albert R. Young	North Carolina State University	physics; double-beta decay

Note: Letters of commitment for the above senior collaborators can be found in the following pages.

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

Office of the Vice President for Research

301 Burruss Hall, Blacksburg, Virginia 24061-0244
Phone: (540)231-6077 Fax: (540)231-4384

February 25, 2005

The National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

To Whom It May Concern:

As the Virginia Tech Vice President for Research, I am pleased to submit this letter of support on behalf of the institution's proposal for the Deep Underground Science and Engineering Laboratory (DUSEL). In the past year, in excess of a million dollars of institutional funds have been expended on our DUSEL proposal efforts. If selected to advance to the next phase, Virginia Tech is committed to expend the millions more needed for the geological and engineering characterization of our proposed location. The University's strong commitment stems from our desire to demonstrate to the scientific community and the National Science Foundation that we can offer a credible and uniquely qualified DUSEL location.

Sincerely,

Brad Fenwick
Vice President for Research

BF/php

United States Senate

WASHINGTON, DC 20510

February 28, 2005

Dr. Arden L. Bement, Jr.
4201 Wilson Boulevard
Arlington, Virginia 22230

Dear Dr. Bement:

We are writing to express our strong support for the National Science Foundation initiative to establish a Deep Underground Science and Engineering Laboratory (DUSEL) and specifically our support for establishment of DUSEL at a site in Giles County, Virginia. This national laboratory will significantly enhance the nation's research infrastructure and provide unique opportunities for research in physics, earth and environmental sciences, hydrology, civil and environmental engineering, rock mechanics, mining engineering and microbiology.

A national team of researchers lead by Virginia Tech has identified a site that meets the requirements for a successful underground science and engineering laboratory. The site is located in Giles County, Virginia adjacent to the Kimballton limestone mine. The owners of the mine, Chemical Lime Company, have agreed to collaborate with Virginia Tech in this effort and there is strong local and State support for this endeavor.

Several research groups are preparing proposals to the National Science Foundation, advocating various sites for the laboratory. The U.S. scientific community will be most effectively served by selecting a site that offers the best opportunities to conduct a broad range of world-class science at a competitive cost. Other important considerations include operational costs over the estimated 50 year lifetime of the laboratory, the environmental impact of lab construction and long-term environmental effects associated with operation and working in the laboratory.

The proposed Kimballton site offers many advantages over competing sites. The geology at Kiballton is highly variable, permitting a broad range of science experiments. The site is suitable for many physics experiments designed to better understand fundamental processes operating in the Universe. At the same time, large blocks of fresh, homogeneous rock permit detailed studies to examine the effects of fluid flow and thermal and chemical perturbations on the natural system. Such information is becoming increasingly valuable as modern societies work to develop safe and effective means of deposing hazardous wastes. The lab would be hosted in sedimentary rocks, providing opportunities for state-of-the-art research related to oil and gas deposits, carbon management technology, management of water resources, development of new technologies to remediate contaminated aquifer systems and to safely explore for and produce natural resources and to study the limits of life in extreme environments. The rock that would be removed during construction is dominantly limestone, an environmentally benign rock compared to those that would be removed at competing sites.

We are pleased to have this opportunity to bring the Virginia Tech effort to your attention and we look forward to supporting this NSF initiative as the process evolves. We hope that you will give the Virginia Tech proposal the most careful and thorough consideration as you evaluate the scientific merit of this and competing proposals. Please treat this letter in conformance with all applicable procedural rules and ethical guidelines.

Thank you for your consideration of this request.

Sincerely,

George Allen

John Warner

Congress of the United States

Washington, DC 20515

February 25, 2005

Dr. Arden L. Bement, Jr.
Director, National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

Dear Dr. Bement:

We are writing to express our strong support for the National Science Foundation initiative to establish a Deep Underground Science and Engineering Laboratory (DUSEL) and specifically our support for establishment of DUSEL at a site in Giles County, Virginia. This national laboratory will significantly enhance the nation's research infrastructure and provide unique opportunities for research in physics, earth and environmental sciences, hydrology, civil and environmental engineering, rock mechanics, mining engineering and microbiology.

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opportunities for state of the art research related to oil and gas deposits, carbon management technology, management of water resources, development of new technologies to remediate contaminated aquifer systems and to safely explore for and produce natural resources, and to study the limits of life in extreme environments. The rock that would be removed during construction is dominantly limestone, an environmentally benign rock compared to those that would be removed at competing sites.

We are pleased to have this opportunity to bring the Virginia Tech effort to your attention and we look forward to supporting this NSF initiative as the process evolves over the next several years. We hope that you will give the Virginia Tech proposal the most careful and thorough consideration as you evaluate the scientific merit of this and competing proposals. With kind regards, we remain

Sincerely,

Rick Boucher

Eric Cantor

Jo Ann Davis

Thelma Drake

Virgil Goode Jr.

Tom Davis

Jim Moran

Bob Goodlatte

United States Department of Agriculture
Forest Service
New River Valley Ranger District
110 Southpark Drive
Blacksburg, VA 24060

155 Sherwood Forest Road
Wytheville, VA 24382

File Code: 2720

Date: February 24, 2005

Robert J. Bodnar
Department of Geosciences
Virginia Tech
Blacksburg, VA 24061

Dear Dr. Bodnar:

You asked for a short letter acknowledging that we are aware of your proposal to develop a conceptual plan for a deep underground laboratory in Giles County, beneath Butt Mountain. You also asked for a general description of various stakeholders and the permitting agencies that you might need to interact with, if this site was selected by the National Science Foundation.

We are fully aware of the scope of this proposal (including the potential visitor's center), its implications for the Jefferson National Forest, and its importance. We've already worked with you on permitting the seismic survey work the Kimballton group accomplished last fall on the top of Butt Mountain. As we've discussed, the United States Forest Service will continue to work with you to review environmental issues pertinent to the portions of this project that would affect national forest system lands. The complexity of the environmental analysis will depend on the extent of ground disturbance and the proposed long term impacts to national forest lands. We would coordinate with the agencies (such as Virginia Department of Game and Inland Fisheries, Virginia Department of Historic Resources, and US Fish and Wildlife Service) needed to complete our environmental analysis. Our review would also include input from the public. You would need to coordinate directly with any permitting agencies who would be involved regardless of whether the location is on national forest or not.

If you have questions or concerns, please contact Bill Compton at 540-953-3564 or me at 540-552-4641.

Sincerely,

/s/ Cynthia R. Schiffer

CYNTHIA R. SCHIFFER

District Ranger

County of Giles

Board of Supervisors

315 North Main Street
Pearisburg, Virginia 24134

February 23, 2005

Dr. Robert J. Bodnar
DUSEL Project
Department of Geosciences
4044 Derring Hall
Virginia Tech
Blacksburg, VA 24061

Dear Dr. Bodnar:

I would like to take this opportunity to thank you and the University for your hard work and dedication to the proposed DUSEL project here in Giles County. This project has tremendous potential to create meaningful and long-term employment for our citizens, as well as to diversify our economy with the required service industries.

Giles County will make every effort to work with you and the University to establish relationships with the local community and surrounding areas. We will offer any and all resources available to ensure that the public is well informed and has the opportunity to interact in this project. Giles County will also work with you, the National Science Foundation, and various funding agencies to develop the required infrastructure for the laboratory.

Once again, thank you for your work with the application. Please do not hesitate to contact us if you need any assistance or information.

Sincerely,

Chris McKlarney
County Administrator

Telephone: (540) 921-2525 FAX: (540) 921-1846

NEW RIVER VALLEY PLANNING DISTRICT COMMISSION

6580 Valley Center Drive
Radford, VA 24141

Phone: (540) 639-9313 **Fax**: (540) 831-6093 **Email**: nrvpdc@nrvdc.org **Website**: www.nrvpdc.org

David W. Rundgren
Executive Director

November 16, 2004

Charles W. Steger
President
Virginia Tech
210 Burress Hall
Blacksburg, VA 24061

Dear Dr. Stegar,

On behalf of the New River Valley Planning District Commission we would like to congratulate you on Virginia Tech's aggressive approach into the rigorous scientific requirements of the National Science Foundation's proposed DUSEL project. As the regional entity charged with the responsibility of planning development, we are perhaps uniquely qualified to comment positively about the appropriateness of the Giles County site for the DUSEL project and resultant economic development possibilities that the project would bring to the New River Valley. The Commission is fully supportive of the project and Virginia Tech's efforts to locate it in Giles County.

As we understand the requirements for this project, Giles County and the New River Valley offer the National Science Foundation an unparalleled opportunity to conduct important research in an educational and physical environment that is unparalleled. In addition, this project brings the type of economic and tourism development that this region is well positioned to support.

In addition to the international draw of the proposed facility for research projects, it will also provide employment for the tremendous talent that your great university creates but is all too often exported from the region.

Thank you for your efforts to bring this amazing project to the New River Valley.

Sincerely,

Annette Perkins,
Chairperson
New River Valley Planning District Commission

February 25, 2005

Mr. Robert J. Bodnar
Department of Geosciences
University Distinguished Professor, and
C. C. Garvin Professor of Geochemistry
Virginia Tech
Blacksburg, VA 24061

RE: DUSEL

Dear Bob:

I would like to take this opportunity to express, on behalf of The Blacksburg Partnership, our support for the proposal that you are preparing for the Deep Underground Science and Engineering Lab (DUSEL), to be constructed in Giles County.

The 25 members of the Blacksburg Partnership, made up of executives from Virginia Tech, the Town of Blacksburg, and local business communities, recognize the tremendous economic benefit a facility such as this would bring to our area. As such, we are 100% behind this project and will lend any support necessary to help secure its location in our area.

Please feel free to contact me at any time if you need additional support materials for this recommendation. We look forward to working with you as we proceed on a successful path to construction of the DUSEL in our area.

Sincerely,

William Aden
President

Joe Gabbard, Treasurer
Giles Rural Development Alliance (Giles RDA)
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"Promoting Responsible and Sustainable Development in Giles County"

February 28, 2005

To Whom It May Concern:

Giles Rural Development Alliance (Giles RDA) is a non-profit community group located in Giles County (Newport) Virginia. Giles RDA's goals are to:

- Promote responsible development in Giles County,
- Engage in efforts designed to preserve and protect the rural character of Giles County,
- Sponsor educational workshops and seminars for county officials and interested citizens,
- Preserve and protect the natural resources of the area through funded research, and,
- Support co-existence of traditional farms with low density residential lands.

Giles RDA has engaged in a number of activities to support our stated goals. For example, we have collaborated with other local organizations to provide county officials with grant-funded educational workshops. Giles RDA has funded research detailing the effects of development on sensitive karst areas of Giles County, and we continue to research and provide information to citizens and county officials to support growth and development in an educated manner.

In the past few years, we have organized and hosted a number of community-based events, including some in which diverse opinions on local development issues were solicited. These open community forums allow citizens to voice concerns in a neutral environment, and in some cases, afford organizations involved in a development effort an opportunity to present their perspective, and propose solutions to community concerns.

Giles RDA President Steve Craig and I have spoken with Virginia Tech's DUSEL Executive Committee Chair, Robert J. Bodnar, UDP and DUSEL Project Director, Bruce Vogelaar regarding Virginia Tech's NSF DUSEL proposal. From our discussions, we feel that our experience facilitating Giles county community meetings provides an opportunity for the DUSEL team to not only solicit local community opinions on the project, but also provide feedback to the community in terms of economic benefits, advancements in science, development and construction plans, mitigation strategies, and so on. This opportunity will enable the VT DUSEL team to maintain an ongoing dialogue between their project efforts and Giles County citizens; a dialogue that we feel is critical to the long term viability and success of the project.

As a result, we are submitting this "letter of interest" to convey our interest in participating in the project.

If you have any questions, feel free to contact me directly at 540-544-7594.

Sincerely,

Joe Gabbard, Treasurer