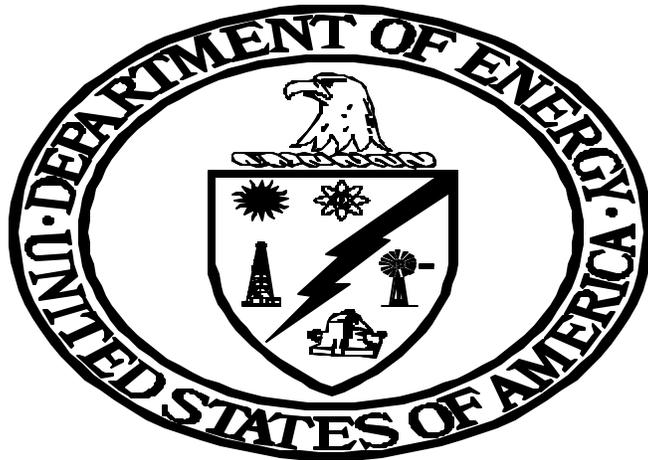


**SOLICITATION FOR FINANCIAL
ASSISTANCE APPLICATIONS
MASTER SOLICITATION NO. DE-PS26-03NT41634-00**



**SUPPORT OF ADVANCED COAL RESEARCH AT U.S.
UNIVERSITIES AND COLLEGES**

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ATTACHMENTS

- Attachment 1 Certification of Intent to Comply with DOE Budget Limitations and/or
Cost Sharing Requirement (BUDGETCERT.doc or BUDGETCERT.pdf)
- Attachment 2 Teaching Professor/Student Employment Certification (TEACHCERT.doc
or TEACHCERT.pdf)
- Attachment 3 Table - Solicitation Extension Numbers for Submission of Applications

SECTION I - TECHNICAL REQUIREMENTS

1.0 INTRODUCTION

Since its inception in Fiscal Year 1980 (by congressional direction), the University Coal Research (UCR) Program has endeavored to maintain and upgrade the educational, training, and research capabilities of U.S. colleges and universities in the field of coal science and technology. The academic environment is well suited to fundamental research of high payoff potential. The involvement of professors and students will be conducive to the generation of fresh ideas and, as the secondary purpose of this program, will ensure a future supply of U.S. coal scientists and technologists. Through Program Solicitation DE-PS26-03NT41634, the Department of Energy's (DOE) Office of Fossil Energy (FE) and the National Energy Technology Laboratory (NETL) are seeking applications with the potential to overcome barriers in technology development and accelerate the identification of solutions for energy and environmental problems. Proposed research should contemplate nearly total carbon closure by the year 2015 along with substantial increases in energy conversion efficiency.

Statutory authority for the UCR Program is provided by Public Law 95-224, as amended by 97-258.

1.1 BACKGROUND

The current landscape of the U.S. energy industry, not unlike that in other parts of the world, is undergoing a transformation driven by changes such as deregulation of power generation, more stringent environmental standards and regulations, climate change concerns, and other market forces. The traditional settings of how energy (both electricity and fuel) is generated, transported, and utilized are likely to be very different in the coming decades. As market, policy, and regulatory forces evolve and shape the energy industry both domestically and globally, the opportunity exists for university, government, and industry partnerships to invest in advanced fossil energy technologies that can return public and economic benefits many times over. These benefits are achievable through the development of advanced coal technologies for the marketplace.

Energy from coal-fired powerplants will continue to play a dominant role as an energy source, and therefore, it is prudent to use this resource wisely and ensure that it remains part of the sustainable energy solution. DOE's focus is on a relatively new concept called Vision 21. Vision 21 is a pathway to clean, affordable energy achieved through a combination of technology evolution and innovation aimed at creating the most advanced fleet of flexible, clean and efficient power and energy plants for the 21st century. Clean, efficient, competitively priced coal-derived products, and low-cost environmental compliance and energy systems remain key to our continuing prosperity and our commitment to tackle environmental challenges, including climate change. It is envisioned that Vision 21 plants can competitively produce low-cost electricity at efficiencies higher than 60% with coal. This class of facilities will involve "near-zero discharge" energy plants--virtually no emissions will escape into the environment. Sulfur dioxide and nitrogen oxide pollutants would be removed and converted into environmentally benign substances, perhaps fertilizers or other commercial products.

Clean coal-fired powerplants remain the major source of electricity for the world while distributed generation, including renewables, will assume a growing share of the energy market. Technological advances finding their way into future markets could result in advanced co-production and co-processing facilities, based upon Vision 21 technologies developed through universities, government, and industry partnerships.

This Vision 21 concept, in many ways is the culmination of decades of power and fuels research and development. Within the Vision 21 plants, the full energy potential of fossil fuel feedstocks and “opportunity” feedstocks such as, petroleum coke and other materials that might otherwise be considered as wastes, can be tapped by integrating advanced technology "modules." These technology "modules" include fuel-flexible coal gasifiers and combustors, gas for fuels and chemical synthesis. Each Vision 21 plant can be built in the configuration best suited for its market application by combining technology modules. Designers of Vision 21 plant would tailor the plant to use the desired feedstocks and produce the desired products by selecting and integrating the appropriate technology "modules."

The goal of Vision 21 is to eliminate effectively, at competitive costs, environmental concerns associated with the use of fossil fuel for producing electricity and transportation fuels. Vision 21 is based on three premises. The first is that we will need to rely on fossil fuels for a major share of our electricity and transportation fuel needs well into the 21st century. Secondly, it makes sense to rely on a diverse mix of energy resources, including coal, gas, oil, biomass and other renewables, nuclear, and so-called “opportunity” feedstocks, rather than on a reduced subset of these resources. Finally, the third premise is that R&D directed at resolving our energy and environmental issues can find affordable ways to make energy conversion systems meet even stricter environmental standards.

1.2 APPLICATION CATEGORIES

Applications submitted in response to this solicitation will be accepted in three program areas: **(1) the Core Program, (2) the Innovative Concepts (IC) Phase I Program, and (3) the IC Phase II Program.**

Core Program Applications

Financial assistance research grants awarded under the Core Program are intended to maintain and upgrade educational, training, and research capabilities of U.S. colleges and universities in the fields of science and technology related to coal. U.S. colleges and universities may submit applications to either individual or joint application categories. Joint applications are encouraged to (1) promote cooperative research between academia, industry, and the government, and (2) enrich the research experience for faculty and students by expanding their experience to include cooperative work with researchers at other universities and in industry.

Applications under the Core Program are invited for the focus areas identified in Section I, Clause 1.4 and will be categorized as one of the following:

- a. Individual application - Application submitted by an individual college/university or from a team of two colleges/universities submitting a single application. The college/university submitting the application on behalf of both colleges/universities will act as the bargaining agent and will be the recipient of the DOE award. (**Note:** Individual applications require only one university to participate, however, two universities partnering together may submit.)
- b. Joint University application - Application submitted by one college/university on behalf of a team comprising the applicant and two (or more) colleges/universities. The college/university submitting the application on behalf of the team will act as the bargaining agent for the team and will be the recipient of the DOE award. (**Note:** Joint University applications REQUIRE a team of at least three universities partnering together.)
- c. Joint University/Industry application - Application submitted by one college/university on behalf of a team comprising the applicant, one (or more) other colleges/universities, and one (or more) industrial collaborator(s). The college/university submitting the application for the team will act as the bargaining agent for the team and will be the recipient of the DOE award. (**Note:** Joint University/Industry applications REQUIRE a team of at least two universities and one industrial collaborator partnering together.)

Private industry collaboration is permissible on Individual and Joint University applications. However, it is a mandatory requirement for the Joint University/Industry applications. Industrial collaboration is limited to a maximum of 25% of the DOE support for the project.

Definition of Industrial Collaborator for the Joint University/Industry application: Small businesses, large businesses, and 501c organizations qualify as an "Industrial Collaborator." The following are specifically **EXCLUDED** from recognition as industrial collaborators: Federal, State or Local government agencies, DOE National Laboratories, and other colleges or universities.

Types of Industrial Collaboration: Industry collaboration may include but is not limited to the following:

- Designation of one or more industry scientists as co-investigators for a project including performing experiments related to the project or acting as a resource person to others working on the project.
- Offering Industrial Internships to faculty and/or students involved in the project.
- Providing industrial facilities and/or equipment to the university to conduct work related to the project.
- Cash cost sharing (5% or more of DOE support for project) received by the university awardee from Industrial Collaborators. Waived fee or profit will not be recognized as allowable cost sharing under this Program Solicitation.

IC Phase I Program Applications

The goal of the IC Phase I Program is to develop unique approaches for addressing fossil energy related issues. **Applications under the IC Phase I Program are invited to respond to the focus areas identified in Section I, Clauses 1.4 (Core Program) and 1.5 (IC Phase I Program).** IC Phase I Program applications submitted under the core focus areas must adhere to the IC Phase I Program page limitations and will be evaluated based upon the criteria identified for IC in Section IV, Clause 4.4. Industrial collaboration is not required but strongly encouraged.

IC Phase II Program Applications

The goal of the IC Phase II Program, the principal R&D effort of the IC Program, is to solicit research that augments research previously funded through the Phase I Program. Only institutions receiving a Phase I grant awarded in Fiscal Year 2001 will be eligible to submit an application for continuation of their Phase I projects. Institutions submitting an application with approaches that appear sufficiently promising from the Phase I efforts could receive a Phase II award in 2003. **Applications under the IC Phase II Program are invited to respond to the focus areas identified in Section I, Clause 1.6.** Industrial collaboration is not required but strongly encouraged.

1.3 FOCUS AREAS OF INTEREST AND SOLICITATION EXTENSION NUMBERS

This solicitation contains multiple programs with specific focus areas of interest identified in the solicitation. Applicants are cautioned that this solicitation is a master solicitation and that each program has its own specific focus areas of interest and solicitation number extensions for submission of applications. For example, Core Program: Sub Focus Area of Interest 1.1, “Membranes for Hydrogen Separation” has a solicitation number of DE-PS26-03NT41634-01. Applications will not be considered for evaluation if they are submitted under the master solicitation. **Please refer to Attachment 3, Solicitation Extension Numbers for Submission of Applications, to this solicitation for a concise listing of the specific focus areas/sub focus areas and corresponding solicitation number extensions.**

Applicants should submit their application under the program focus/sub focus area which best fits the majority of the effort to be performed. If DOE believes an application fits more appropriately in another program focus/sub focus area of interest, the applicant may be directed to resubmit their application under the appropriate focus/sub focus area of interest. Do not submit an identical application under more than one program focus/sub focus area of interest.

There is no limitation on the number of different applications an applicant may submit. However, a separate application must be submitted for each Program Focus/Sub Focus Area of Interest for which the applicant is interested in receiving an award. Each application must be complete and shall not rely upon another application for submission of the required documents.

1.4 CORE PROGRAM

To develop and sustain a national program of university research in fundamental coal studies, the DOE is interested in innovative and fundamental research pertinent to coal conversion and utilization. The DOE anticipates funding at least one application in each focus area under the Core Program; however, high-quality applications in a higher priority focus area may be given more consideration during the selection process. Research under the Core Program is limited to the following six (6) focus areas identified in descending order of programmatic priority. This programmatic priority will be used in guiding the selection of the awards. The sub focus areas within a focus area are equally weighted.

Focus Area 1.0 Materials and Components for Vision 21 Systems

The advanced power systems concepts being pursued under Vision 21 are directed toward very high efficiency and low emissions, particularly of carbon dioxide. Many of these systems depend on the ability to separate hydrogen, oxygen, or carbon dioxide from mixtures containing these gases. Because of the very high overall efficiency and cost goals, R&D emphasizing gas separations and high temperature materials that are significant improvements over conventional methods/systems are of interest. Three (3) sub focus areas are:

Sub Focus Area 1.1 Membranes for Hydrogen Separation

Hydrogen separation in gasification-based systems can be a main source of low cost H₂ for use in refineries, as fuel for fuel cells, and for H₂ product gas. Various ceramic membranes, including both high- and low-temperature membranes and novel non-membrane methods are being developed and tested for hydrogen separation. Two types of ceramic membranes are being investigated for the recovery of hydrogen from coal gasification streams: porous membranes and dense membranes. These membrane types differ significantly in their microstructures, and, therefore, gas separation takes place by entirely different hydrogen diffusion mechanisms as described below.

In porous membranes, hydrogen is transported through the pores as molecules and the separation membrane is usually made from silica and/or alumina supported by a highly porous ceramic layer. Porous membranes are being designed to operate at temperatures in the region 300-400° C to be compatible with IGCC integration. Currently, the maximum operating temperature for these membranes is 300° C, although even at this temperature, there are concerns over the stability in H₂O-containing atmospheres.

In dense membranes, hydrogen is transported in the solid phase as hydrogen ions (protons). The materials of interest for dense membranes are those which show high protonic conductivity, such as SrCeO₃ and BaCeO₃. Transport in the solid phase requires more thermal energy than gas phase transport. Additionally, hydrogen fluxes comparable to those obtained from porous membranes are only achievable at much higher temperatures, typically around 900° C. However, the dense ceramics operating at 900° C are not compatible with gasification because it is not possible to clean up the gas at those temperatures, unless it is demonstrated that the membranes are not affected by the contaminants. Nevertheless, dense

membranes offer a significant advantage - in principle, they can produce very high purity hydrogen because only hydrogen is transported through the membrane.

Grant applications are sought to further the development of either or both types of these ceramic membranes for commercial hydrogen production. Proposed approaches must demonstrate that the hydrogen can be produced in large quantities and at high purity; therefore, both the permeation properties and the selectivity of the membranes must be well characterized and understood.

Sub Focus Area 1.2 Ultra-High Performance Materials

Intermetallic compounds offer the potential for the use of metallic structures at temperatures well above 1000 °C, perhaps up to 1500 °C. Ongoing progress in the development of these alloy systems suggests that properties can be achieved that will allow them to be used in engineering applications. The temperature range of interest overlaps that in which ceramic materials are thought to be needed, i.e., these alloys are alternatives to ceramics. Examples of such alloys are Laves phase alloys such as Cr₂Ta and boron modified molybdenum silicide based on Mo₅Si₃. The challenges with these alloys are to modify them to provide acceptable mechanical properties, including ductility and toughness, and corrosion resistance to allow them to be used in structural applications such as gas turbines. Innovative approaches to the processing of these materials are sought which will provide useful product forms while maintaining a structure that has adequate fracture toughness.

Sub Focus Area 1.3 Coatings Development

Component reliability and long-term trouble-free performance of structural materials are essential in power-generating processes that utilize coal as a feedstock. The two major elements of this materials technology category address these concerns through the development of surface protection by coatings, claddings, etc., and examination of the corrosion behavior of the structural components, (both alloys and ceramics) and protective (thermal and environmental) barriers applied to the component surfaces. There is a need to demonstrate/confirm the efficacy of conventional gas turbines in a coal-derived synthesis gas system. Different hot gas environments are obtained and there is a dearth of long-term performance data for these environments. Applications based on selection and verification testing of turbine hot path component materials and protective coatings are invited. Additionally, hot corrosion and erosion-corrosion models to predict the lives of candidate gas turbine hot gas path materials in realistic environments for a gas turbine operating on coal-derived gases are needed. These models are necessary to assess potential lives of such components, and establish changes to these environments that would significantly extend these lives.

Focus Area 2.0 Sensors and Control

Sensors for high temperature (1000 °C), harsh environment applications represent a significant research and development challenge. New uses of high temperature materials or advancements

in materials science are needed to develop the basis for novel in-situ or at line micro-sensing systems to monitor gases commonly present in coal and coal-derived syngas applications. Sensor materials and platforms capable of detecting one or more of the following are of interest: NO_x, SO_x, CO, H₂, O₂, CH₄, NH₃, mercury, and arsenic.

These sensors and detection systems, when placed in protective housings can serve as low cost devices that are critical to operating power systems at peak efficiency and minimal emissions. The sensing materials must be able to function appropriately at temperatures at or near 1000 °C, and the minimum test temperature for the sensors is 500 °C. Micro-sensors designed with, or fabricated using, high temperature substrates and materials including but not limited to silicon carbide, alumina, or sapphire are of interest. Revolutionary ideas that have the sound scientific basis to support significant advancements in this technology area are sought. Extractive systems or incremental improvements over existing technology are discouraged.

In addition to gas sensor development, new approaches to embedded sensor designs or novel non-destructive evaluation (NDE) techniques that facilitate on-line monitoring of critical parts or components (e.g., stress, corrosion, pressure, thermal barrier coating wear, refractory wear, etc.) are needed. Sensors need to be able to function in an ultra high temperature harsh environment. “Smart” sensing capabilities such as self-diagnostics and wireless data communication are desirable features.

Successful application of these sensors or NDE techniques will improve system control, protect capital equipment investment, and promote safety through prevention of catastrophic equipment failure. Equipment that could potentially benefit from component monitoring includes gasifiers, turbines, engines, pumps, advanced combustors, fuel cells; other equipment commonly employed in energy and power generation systems.

Focus Area 3.0 Advanced Coal Systems By-Product Utilization

Currently more than a million tons of byproducts are generated annually in the U.S. However, utilization rates of the material are only approximately 30 percent. DOE has a goal to see utilization increased to 50% by 2010. Grant applications are needed to identify novel concepts for increased utilization of byproducts to assist in meeting DOE’s utilization goal both in the gasification and coal combustion programmatic areas.

Sub Focus Area 3.1 Gasification

The economics of gasification can be improved by fully utilizing all outlet streams of the process. Sale of value-added byproducts from waste streams and minimization of waste disposal can substantially improve the economics of gasification processes. By-products include ash/slag and sulfur. Applications are sought that will expand market options, such as improving the quality of slags and improving the use of sulfur. Applications are encouraged which do one of the following:

- a. Seek to find, and provide proof of concept for, a viable commercial market for coal gasification slag in its natural high moisture, high carbon state.

- b. Develop the methods for reducing the carbon content, moisture content and particle size of the ash/slag so that it will be more marketable.
- c. Lead to the development of new markets and ways to utilize sulfur.

Sub Focus Area 3.2 Coal Combustion

In December of 2001, the Environmental Protection Agency (EPA) announced its intention to regulate mercury emissions from coal-fired power plants. DOE is funding tests where activated carbon is being used to control mercury emissions. Preliminary research suggests that the addition of activated carbon to the fly ash could make the fly ash unmarketable or increase the cost of disposal. Research is necessary:

- a. To identify technologies to mitigate the affects of high carbon concentrations on resale of the ash.
- b. To develop novel utilization technologies for fly ash that contains very high concentrations of either unburned or activated carbon.

Other environmental regulations are leading many utilities to install selective catalytic reduction systems (SCR). It has been estimated that 80-90 new installations of SCR will occur in the next several years. Questions exist as to the effect of SCR on ash from coal-fired units. Grant applications are sought to establish a better understanding of the effect of SCR systems on fly ash and evaluate that fly ash for mercury removal potential including evaluation of the specific characteristics of the fly ash that have higher mercury capture potential (i.e., amount of carbon, form of carbon present, coal origin).

Future regulations for emissions control of PM_{2.5}, regional haze or sulfur dioxide will require lower emissions of sulfur dioxide from power plants. Since many utilities will add flue gas desulfurization systems (FGD) that will generate additional quantities of by-products, grant applications are also sought to identify novel uses of this FGD material.

Focus Area 4.0 Computational Chemistry for Reforming Technology

The use of fuel cells is anticipated to undergo a large expansion in the future. The market for these power sources is expected to expand dramatically in the coming years because they offer high-energy efficiency and low emissions. Many fuel cells rely on high purity hydrogen as the fuel. When used in this way, hydrogen serves as an energy carrier. Hydrogen may be generated from conventional fossil fuels, coal being a foremost candidate. Although hydrogen has highly desirable properties for use in a fuel cell, its distribution from the central point of manufacture to the point of use remains a stubborn problem. At present, the infrastructure for the transport, storage, and dispensing of hydrogen is largely lacking and expensive to install.

Transporting and storing other fuels with higher volumetric energy density than hydrogen would alleviate some of the major roadblocks. Methanol is one potential energy transport molecule. Commercial production of methanol from coal is now well established. Reforming methanol to generate hydrogen at the point of use still needs to be improved. Catalytic reformers that can operate on a small scale intermittently, reliably, and efficiently over a long period of time are design challenges to chemical engineers. Computational chemistry is becoming an ever more powerful tool that speeds the development of improved catalysts. Application of computational chemistry to the development of leading principles for improved methanol reforming catalysts and catalytic systems can be an effective way to speed their entry into the marketplace.

To assist advancement in the field of methanol reforming technology, applications in computational chemistry that address fundamental chemical processes in producing fuel cell grade hydrogen from methanol are requested. Computational chemistry can provide guidance in the search for more effective, durable, and poison resistant catalytic materials. The overall intent is to speed the development of improved catalyst and reactor systems by providing insight on the major issues such as the function and use of promoters, coking resistance, stability during thermal cycling, and tolerance to operation over a range of flow and thermal conditions. The applications must deal with a specific methanol reforming issue in terms of the fundamental chemistry and physics of the molecular processes involved. Applications based on generic catalyst issues such as those called for in previous solicitations will not be considered unless they deal specifically with a methanol reforming.

Focus Area 5.0 Electrical Interconnects for Coal-Based Solid Oxide Fuel Cell Systems

The push toward oxygen-based coal gasification technologies creates an opportunity to supply pure oxygen to solid oxide fuel cell (SOFC) power generators supplied with coal synthesis gas. When operating on pure oxygen vice air, the power density of SOFCs is nearly double. The research challenge is to develop a suitable electrical interconnect that can survive in both the oxidizing environment of pure oxygen and the reducing environment of coal synthesis gas.

Much research has been performed in the past with regard to ceramic oxide interconnect materials, primarily on lanthanum chromate (LaCrO_3), for high temperature ($>800\text{ }^\circ\text{C}$) operation. Recent developments in SOFC research have advanced the potential for lower temperature operation in the range of 500 to 800 $^\circ\text{C}$.

Cold gas clean-up processes make the application of low temperature SOFCs more attractive by minimizing the energy requirements to heat both the oxidant and the fuel gas up to the SOFC operating temperature. Resolving oxidation problems with metallic interconnects to maintain high electrical conductivity in the relatively low partial pressure of oxygen in air is a major focus of current SOFC research. For coal-based SOFCs supplied with pure oxygen, even advanced metallic interconnects emerging from this research are expected to suffer serve oxidation. Thus a more robust ceramic-oxide interconnect capable of high electrical conductivity at temperatures ranges from 500 to 800 $^\circ\text{C}$ is required.

Grant applications are sought to investigate and characterize ceramic-oxide electrical interconnects, other than LaCrO_3 for SOFC applications in coal-based power plants. Of specific

interest is fundamental research on ceramic interconnect material chemical, electrical conductivity and mechanical properties in oxidizing and reducing environments for coal-based power plants. It is particularly important to investigate the compatibility and adhesion of the interconnect, and the interfacial resistance with other SOFC components to make quality electrical connections with SOFC materials.

Focus Area 6.0 Partitioning and Mechanism Studies for Mercury and Associated Trace Metals within Coal-Fired Processes

Understanding mercury chemistry and process-related speciation mechanisms and transformations in laboratory experiments provide necessary steps to first understanding partitioning and subsequently developing mercury removal processes for industrial and coal-fired applications for PC-boilers, cyclone boilers, tangentially-fired boilers, fluidized-bed boilers and gasification processes. Past research has shown a reasonable link between mercury speciation and several parameters including the various constituents of fly ash (i.e., unburned carbon/ LOI); fly ash properties (such as fly ash alkalinity); and process specific information (coal rank, boiler type, flue-gas temperature, Cl concentration, NO_x concentration, sulfur compounds, and CO/CO₂ concentrations). Grant applications are sought to further understand partitioning and chemistry of mercury and other trace metal and organic substances in coal-fired (bituminous, subbituminous, and lignite) systems. Specifically, modeling or experiments using statistical analysis of these identified parameters on chemical intermediaries and mechanisms is sought.

1.5 IC PHASE I PROGRAM FOCUS AREAS

The goal of solicited research under the IC Phase I Program is to develop *unique* approaches for addressing fossil energy-related issues. These approaches should represent significant departures from existing approaches, not simply incremental improvements. The IC Phase I Program seeks “out-of-the-box” thinking; therefore, mature ideas, past the conceptual stage, are not eligible for the Phase I Program. Applications are invited from individual college/university researchers. Joint applications (as described under the Core Program) will also be accepted, although no additional funds are made available for joint versus individual applications. Unlike the Core Program, student participation in the proposed research project is strongly encouraged, however, not required.

In the twenty-first century, the challenges facing coal and the electric utility industry continue to grow. Environmental issues such as pollutant control, both criteria and trace pollutants, waste minimization, and the co-firing of coal with biomass, waste, or alternative fuels will remain important. The need for increased efficiency, improved reliability, and lower costs will be felt as an aging utility industry faces deregulation. Advanced power systems, such as a Vision 21 plant, and environmental systems will come into play as older plants are retired and utilities explore new ways to meet the growing demand for electricity.

Innovative research in the coal conversion and utilization areas will be required if coal is to continue to play a dominant role in the generation of electric power. IC applications will be accepted in either of the six (6) focus areas listed in the Core Program (Section I, Clause 1.4) or the seven (7) IC Phase I Program areas listed below. IC Phase I Program applications submitted

under the core focus areas must adhere to the IC Phase I Program page limitations and will be evaluated based upon the criteria identified for IC in Section IV, Clause 4.4. The focus areas under the IC program are not listed in any programmatic priority.

Focus Area 1.0 Smart Sensors

The development of innovative concepts and techniques for smart sensing are needed to foster the development and implementation of advanced power generation technologies using coal or coal derived syngas. Approaches to sensing combustion related parameters at ultra-high temperatures using laser-based techniques and other non-destructive rapid assessment techniques are encouraged.

Many innovative approaches to sensing are being developed using laser-based techniques or micro-sensors fabricated with silicon as the substrate material. While these developments are viewed favorably. They are not applicable to many industrial systems due to the high temperature harsh conditions. This solicitation seeks to overcome the temperature barriers associated with novel sensing techniques.

The ultimate goal is the utilization of sensor networks, which are low cost, reliable, and accurate for the real-time monitoring. Integrating these sensor networks with advanced control algorithms are envisioned for the on-line optimization of complex power and chemical production facilities conceived under the Vision 21 Program.

Focus Area 2.0 N₂/CO₂ Separation

Since the primary source of greenhouse gas emissions, primarily carbon dioxide, is combustion of fossil fuels such as coal or natural gas, options to reduce carbon dioxide emissions are being examined. In particular, inorganic membranes based on metals, ceramics or zeolites are suitable for the separation of such gases because they can sustain severe conditions such as high pressure, chemical corrosion, and high temperature. Approaches are needed whereby the membrane can be tailored to separate carbon dioxide from the nitrogen, the latter being the predominant component in the flue gas of a fossil fuel fired power plant. For example, the separation could be caused by dopants in the inorganic membrane that prefer to bond with carbon dioxide and facilitate its surface diffusion along the pore wall. Applications are invited wherein factors such as concentration of dopant and pore diameter will be investigated, along with molecular simulations, in order to maximize the separation factor.

Focus Area 3.0 Direct Utilization of Carbon in Fuel Cells

High and intermediate temperature fuel cells offer significant advantages in the direct conversion of carbon to electrical power without an intermediate coal gasification process. Both slurry based and solid-state (e.g., consumable electrodes) based fuel cells have the potential to more directly utilize coal than conventional fuel cell technologies that operate on clean coal synthesis gas.

Grant applications are sought for identification and characterization of one or more (considering the time and financial constraints) fuel cell concepts that utilize carbon from coal. The characterization should demonstrate as much as possible both the power density achievable and the degree of power degradation versus operating time. The characterization should include chemical stability between the components and the impact of coal contaminants on fuel cell performance and operating life. Lifetime effects (phase stability, thermal expansion compatibility, conductivity aging, and electrode sintering) should be considered and characterized as much as possible. The characterization of the material set should in general be as complete as possible and not duplicate publicly known information.

Focus Area 4.0 Mercury and Associated Trace Metal Chemistry Studies within NOx Control Systems

By the year 2010, it is estimated that over 50% of coal-fired utilities will install either selective catalytic reduction or selective non-catalytic reduction units to meet NOx emission limits. Understanding mercury chemistry and process-related speciation mechanisms and transformations related to NOx control systems would provide necessary information to develop more effective, less costly mercury removal processes for industrial and coal-fired boilers. Past research has shown a probable relationship between degree of mercury oxidation and age of NOx catalyst, coal rank, size (or residence time) of NOx control vessel, degree of NOx conversion, amount of SO2 converted to SO3, and ammonia slip. Grant applications are sought to further understand partitioning and chemistry of mercury and other trace metal and organic substances in coal-fired (bituminous, subbituminous, and lignite) systems utilizing SCR/SNCR or ammonia injection. Specifically, statistical analysis clarifying the importance of each of these identified parameters and/or their interactions on chemical intermediaries and mechanisms is sought.

Focus Area 5.0 Water Impacts from Coal-Burning Power Plants

Producing electric power from coal has impacts to water quality from the beginning of the process, mining the coal, to the disposal of ash remaining after the coal has been combusted. Coal mining has left large amounts of overburden wastes that contain sulfide minerals that weather to form sulfuric acid. Many of these areas are causing problems with water quality and re-vegetation. It is estimated that 10,000 miles of streams in the United States are affected by acid mine drainage. The EPA has initiated a Total Maximum Daily Load (TMDL) program to restore impaired water bodies, some of which are degraded from past mining. Coal washing is used to remove pyritic sulfur and other impurities that could be emitted into the air; however, wastewater from this process may release these substances to water bodies. A large quantity of water is used in power plants to condense the steam leaving the turbine. Once-through cooling systems can damage aquatic life and add heat to streams. The EPA has developed new regulations under the Clean Water Act, section 316(b), to reduce once through cooling usage of water and improve cooling water intake structures. Re-circulating cooling towers require the addition of biocides and corrosion inhibitors, which may be released to water bodies during blowdowns. Wet scrubbing of air pollutants from flue gas generates a large quantity of wastewater. Ash ponds have the potential for creating run-off problems and groundwater infiltration. Research opportunities for improving water quality associated with coal combustion for power generation include: (1) novel active and passive treatment technologies to address acid

mine drainage; (2) innovative solutions to restoring abandoned mine lands to enhance watersheds; (3) improved intake and outflow structures for cooling water; (4) novel uses for waste heat from power plant cooling; (5) advanced water-related sensors and controls at power plants to minimize adverse impacts to water quality; (6) novel treatment techniques for scrubber wastewater; and (7) novel techniques for reducing coal-washing waste and ash pond runoff.

Focus Area 6.0 Simulation of CO₂-Brine-Mineral Interactions

One strategy under evaluation to mitigate increasing atmospheric concentrations of CO₂ is to inject it into geological formations such as deep saline aquifers. When CO₂ is injected into brine formations it can be trapped by several mechanisms. The CO₂ can react with the host rock and/or brine to form mineral carbonates (mineral trapping) or it can become dissolved in and react with the slow moving basal brine (hydrodynamic trapping) to form carbonic acid and its dissociation products. Mineral trapping is the preferred storage mechanism. In order to begin to evaluate the feasibility of geological sequestration in deep saline aquifers the thermodynamic and kinetic properties of the H₂O-CO₂-NaCl system must be known in order to simulate chemical reactions in these complex systems. These properties are not only critical for the interpretation of laboratory experiments, but also to field scale tests, and reservoir scale simulation. Most simulations of these systems use an equation of state (EOS) to describe the properties of the H₂O-CO₂-NaCl system. The thermodynamic properties for gas-liquid-salt systems can be described by EOS, which describes the quantitative relationships between intensive parameters of a system (e.g., T, P) and extensive parameters (e.g., volume, mass). Consequently, research directed toward evaluation of the ability of existing EOS to accurately estimate the properties of this system is of interest to the U.S. DOE.

Grant applications directed toward critical evaluation of the ability of existing equations of state (EOS) to predict the properties of the H₂O-CO₂-NaCl system at temperatures up to 200 C and pressures up to 500 atmospheres are sought. A comparison of the ability of existing EOS to describe the properties of the system under these conditions is needed. An estimation of the deviation between properties predicted using various EOS found in the literature with measured values under a wide range of temperature and pressure must be included. Based upon the results of this evaluation of existing EOS, the researchers may decide to develop a new EOS as part of the application.

Focus Area 7.0 CO₂ Separation from Coal Gasification Process

Separation of CO₂ from coal derived synthesis gas for capture and sequestration is a key technology in the reduction of greenhouse gas emissions to the environment. Existing technologies can be applied to capture CO₂; however, such applications require expensive solvent and operate at less than 40 C, imparting a severe energy penalty on the system. The following CO₂ separation technologies are being investigated in existing projects: production of carbon dioxide hydrates, dry scrubbing processes with regenerable sorbents, and membrane separation (dense ceramic and polymer). Applications are invited that incorporate "outside-the-box" approaches to the separation of CO₂ from the coal gasification process. As this would be the first step toward a completely novel approach, applications comprising literature

studies, theoretical approaches and/or modeling analysis, etc. would be expected. The goal of this work would be to find an approach that:

1. Does not require expensive/proprietary solvents or cool temperatures.
2. Is not already being considered by existing projects.
3. Minimizes the cost of CO₂ separation.

Technologies that produce both high-pressure hydrogen and CO₂ (in separate streams) are preferred.

1.6 IC PHASE II PROGRAM FOCUS AREAS

The goal of the IC Phase II Program is to solicit research that augments research previously funded through the IC Phase I Program. Twelve (12) Fiscal Year 2001 award recipients under the Phase I Program are eligible and invited to submit an application for continuation of their Phase I projects. The only eligible applicants under the IC Phase II Program for this solicitation are:

University of Alabama
Arizona State University
University of Southern California
University of Cincinnati
University of Arizona
Pennsylvania State University
University of Washington
University of New Hampshire
The John Hopkins University
West Virginia University
University of Utah
Clemson University

Applications for the IC Phase II Program must be based upon research efforts previously defined under Fiscal Year 2001 focus areas. All applications for IC Program Phase II must respond to one of the following four (4) focus areas upon which their Phase I award was selected:

- | | |
|-----------------------|---|
| Focus Area 1.0 | <u>Advanced Sensors for Vision 21 Systems</u> |
| Focus Area 2.0 | <u>Carbon Sequestration</u> |
| Focus Area 3.0 | <u>Mercury and Other Emissions in Advanced Power Systems</u> |
| Focus Area 4.0 | <u>Thermodynamics Measurement for Mixture of Asymmetric Hydrocarbons</u> |

SECTION II - CONDITIONS AND NOTICES

2.0 ELIGIBILITY REQUIREMENTS

Pursuant to 10 CFR 600.6(b) eligibility for award is restricted to U.S. universities and colleges. Only universities, colleges, or university-affiliated research institutes located in the United States of America and its territories, including the Commonwealth of Puerto Rico and the Virgin Islands, may submit applications for consideration under this Program Solicitation. Submissions from university-affiliated research institutes must be made through the university. The university, not the university-affiliated research institute, will be the award recipient.

Eligibility for award under the IC Phase II Program will be restricted to recipients of awards under the Fiscal Year 2001 IC Phase I Program.

2.1 PARTICIPATION BY FEDERAL ORGANIZATIONS OR FEDERALLY AFFILIATED ORGANIZATIONS (MAR 2002)

Applications submitted by, or on behalf of: (1) a Federal agency; (2) a Federally Funded Research and Development Center (FFRDC), or (3) a Department of Energy (DOE) Management and Operating (M&O) contractor will not be eligible for an award under this solicitation. However, these organizations may be proposed as team members subject to the following guidelines.

- (a) For DOE M&O contractors, the proposed use of such entity must be authorized in writing by the DOE Contracting Officer or authorized designee responsible for managing the M&O Contractor. The applicant must also provide any additional submission requirements identified in Section 3-Application Preparation Instructions for Volume I - Offer and Other Documents Preparation Instructions, of this solicitation. The DOE Contracting Officer responsible for managing the M&O Contractor must determine that performance by the M&O contractor: (1) is consistent with or complementary to DOE missions and the missions of the facility to which the work is to be assigned; (2) will not adversely impact execution of assigned programs of the facility; (3) will not place the facility in direct competition with the domestic private sector; and (4) will not create a detrimental future burden on DOE resources. DOE will make award to the applicant for the applicant's portion of the effort. For the M&O effort, DOE shall fund the work, in whole or in part, through a DOE field work proposal to the M&O contractor. If DOE funds a portion of the M&O effort, then the Recipient is responsible for funding the remaining portion of the effort through a Cooperative Research & Development Agreement (CRADA) or a service agreement utilizing their own funds.
- (b) For FFRDC contractors (other than a DOE M&O contractor), the proposed use of such entity must be consistent with the FFRDC's authority under its contract with the cognizant Federal agency and such work must not place the FFRDC in direct competition

with the private sector. DOE shall fund the FFRDC work through an interagency agreement with the cognizant Federal agency.

- (c) For Federal agencies, the proposed effort must not place the agency in direct competition with the private sector. DOE shall fund the other agency work through an interagency agreement.
- (d) An applicant's cost sharing requirement shall be based on the total cost of the project, including the applicant's and the Federal agency, FFRDC and M&O's portions of the effort.
- (e) The estimated total cost of the Federal agency, FFRDC or M&O contractor(s) work, in the aggregate, shall not exceed twenty-five (25) percent of the total estimated project cost.

2.2 NUMBER AND TYPE OF AWARDS (JAN 2000)

It is anticipated that there will be 28-32 awards resulting from this solicitation. However, the Government reserves the right to fund, in whole or in part, any, all, or none of the applications submitted in response to this solicitation and will award that number of financial assistance instruments which serves the public purpose and is in the best interest of the Government. The Government intends to use Financial Assistance Grants as the type of award instrument(s).

2.3 AVAILABILITY OF FUNDS (AUG 1999)

It is estimated that \$4 million will be available for award under this solicitation, subject to the availability of funds.

Estimated funding for each of the program areas is presented below. These estimates are provided for general information only and do not imply that a specific amount or any amount will be obligated to awards from any area of interest. This funding may be distributed among the various areas of interest identified in this solicitation as program and policy requirements may dictate.

	<u>Estimated Available Funding</u>
Core Program	\$2,200,000
IC Phase I Program	\$ 700,000
IC Phase II Program	\$1,100,000

2.4 LIMITATIONS ON FUNDING, PROJECT PERIODS, AND COST SHARE REQUIREMENTS

Applications must include a budget form for each year and supporting cost detail for each year that funds are requested consistent with the application preparation instructions provided in

Section III. Fee or profit will not be paid to the recipients of financial assistance awards resulting from this solicitation.

CORE PROGRAM

Individual Applications

The maximum DOE funding for individual applications varies according to the length of performance period:

12 month project period	\$ 80,000 (max. DOE funds)
13-24 month project period	\$140,000 (max. DOE funds)
25-60 month project period	\$200,000 (max. DOE funds)

Cost sharing is not required but is strongly encouraged.

Joint University Applications

The maximum DOE funding for joint university applications is \$400,000 requiring a performance period of thirty-six (36) months. Cost sharing is not required but is strongly encouraged.

Joint University/Industry Applications

The maximum DOE funding for joint university/industry applications is \$400,000 and requires a performance period of thirty-six (36) months. Cost sharing from a non-federal source is required at a **minimum level of twenty-five (25) percent of the total proposed project value** (cost-sharing may be provided by the colleges/universities, industrial collaborator or combination thereof). Cost-sharing must be included on the Budget Form and clearly identified (type and source) in the supporting cost detail. For example, for a project having a total project cost of \$533,333, the maximum DOE funding would be \$400,000, and the difference (\$133,333) would be the Recipient's minimum cost share. As another example, if the total proposed project cost is \$500,000, then the maximum DOE funding would be \$375,000 (75%) and, the minimum recipient funding would be \$125,000 (25%).

“Cost Sharing” (10 CFR 600.30) is a generic term denoting any situation where the Government does not fully reimburse the applicant for all allowable costs necessary to accomplish the project or effort. Cost sharing may be in various forms or combinations, which include but are not limited to cash outlays, real property (or interest therein) needed for the project, personal property (equipment) or services, cost matching, or other in-kind sharing. Cost sharing may be accomplished by a contribution of either direct or indirect costs provided such costs are otherwise allowable in accordance with the applicable cost principles. Allowable costs which are absorbed by the applicant as part of its cost share may not be charged directly or indirectly to the Federal Government under other contracts, agreements or grants. The applicant's cost sharing may be provided by the applicant or other companies/associations with which it has

contracts. Cost sharing may include the value of contributions of other non-Federal sources, provided the contributions were not previously obtained free of charge from Federal sources.

“Third Party In-Kind Contributions” represents noncash contributions which are directly beneficial, specifically identifiable and necessary to the performance of the project. Third party in-kind contributions must be verifiable from the third party's books and records. The value of any noncash contribution shall be established by the DOE after consultation with the applicant and/or third party donor; however, adequate supporting documentation must be provided in the application for the estimated value of any noncash contribution.

75% of the DOE support for the project must be expended at the proposing university(ies) (this 75% limit excludes equipment included in the university budget). Fee or profit cannot be paid to the proposed collaborators under this Program Solicitation.

IC PHASE I PROGRAM

The maximum DOE funding for IC Phase I Program applications is \$50,000 and requires a performance period of twelve (12) months. Cost sharing is not required for applications to the IC Program but is strongly encouraged.

IC PHASE II PROGRAM

A maximum DOE funding for IC Phase II Program applications is \$200,000 and requires a performance period of thirty-six (36) months. Cost sharing is not required for applications to the IC Program but is strongly encouraged.

2.5 TIME, DATE AND PLACE APPLICATIONS ARE DUE IIPS (FEB 2002)

All applications shall be submitted in an electronic format through DOE's Industry Interactive Procurement System (IIPS) in accordance with the application preparation instructions contained in Section III of this solicitation

ALL APPLICATIONS MUST HAVE AN IIPS TRANSMISSION TIME STAMP OF NOT LATER THAN 10:00 P.M. EASTERN TIME ON DECEMBER 5, 2002.

The only acceptable mode of application transmission is through IIPS. Applications submitted through the U.S. Postal Service, facsimile, telegraphically, courier companies, or hand-delivered hard copies will be considered non-responsive.

Applicants are advised to begin transmission 24 hours in advance of the deadline in order to prevent any transmission difficulties.

2.6 QUESTIONS/AMENDMENTS TO SOLICITATION -- IIPS (NOV 2001)

All requests for explanation or interpretation of any part of the solicitation must be submitted through the “Submit Question” feature in IIPS. Once a question is submitted, it can not be

edited. Questions submitted as well as the government's response to these questions may be viewed by using the "View Questions" feature in IIPS. The Government reserves the right not to respond to questions submitted by telephone, E-mail or in person at any time.

The only method by which any term of this solicitation may be amended is by an express, formal amendment generated by the issuing office and disseminated through IIPS. No other communication, whether written or oral will amend or supersede the terms of this solicitation.

Applicants are encouraged to periodically check IIPS to ascertain the status of any amendments and review the answers to questions as hard copies will not be distributed. Applicants are encouraged to click on the "Join Solicitation Mailing List" link if they would like to receive e-mail notifications on updates and/or modifications to the specified solicitation.

2.7 LATE APPLICATIONS, AMENDMENTS AND WITHDRAWALS OF APPLICATIONS -- IIPS (JAN 2001)

An application or amendment of an application shall be timely if it is transmitted through IIPS, and the date/time of the transmission indicated by IIPS is on or before the closing date indicated in Clause 2.5 above.

Applications or amendments of applications may be withdrawn by written notice by an authorized representative to the Contract Specialist via E-mail or by contacting the IIPS HELP Desk. A second application or amendment may then be submitted. The second or subsequent application must be submitted before the closing date to be considered.

In the event that two or more applications are received for the same project with the same file name, the application with the latest transmission time stamp will be considered for review. Therefore, it is important that you not merely make page changes and resubmit portions of the application that are amended. A complete amended application must be sent. Contact the IIPS HELP Desk for assistance.

2.8 EVALUATION PERSONNEL (AUG 2000)

Applications will be evaluated in accordance with the criteria set forth in Section VI of the solicitation. In conducting this evaluation, the Government may utilize assistance and advice from qualified personnel from other Federal Agencies, DOE Contractors, universities and industry. APPLICANTS NOT WISHING TO HAVE THEIR APPLICATION EVALUATED BY NONFEDERAL PERSONNEL SHALL INDICATE THEIR "NON-CONSENT" IN VOLUME I. Applicants are further advised that DOE may be unable to consider an application withholding such consent.

When using personnel from other Federal agencies, DOE contractors, or other consultants to DOE in the evaluation of applications, DOE will obtain assurances from all evaluators that DOE's commitments are met relating to the proprietary nature of any application information.

2.9 APPLICATION PREPARATION COSTS (DEC 1999)

This solicitation does not obligate the Government to pay any costs incurred in the preparation and submission of applications, or in making necessary studies or designs for the preparation thereof or to acquire, or contract for any services.

2.10 CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER (CFDA) (DEC 2000)

CFDA NO. 81.057. The Applicant should put this CFDA number in Block 10 of the Standard Form 424, Application for Federal Assistance.

2.11 APPLICATION ACCEPTANCE PERIOD (AUG 1999)

The minimum application acceptance period shall be 180 calendar days after the deadline(s) for receipt of applications.

2.12 APPLICATION CLARIFICATION (JULY 1999)

DOE reserves the right to require applications to be clarified or supplemented to the extent considered necessary either through additional written submissions or oral presentations.

2.13 CONTENT OF RESULTING AWARD (NOV 2000)

Any agreement awarded as a result of this solicitation will contain the applicable terms and conditions found in the Model Financial Assistance Agreement located at the NETL Website located at:

<http://www.netl.doe.gov/business/faapiaf/MODEL.PDF>

Blank areas appearing in the model agreement indicated by "[]" will be completed after negotiations.

Note: Awards to Recipients under the Federal Demonstration Program will contain the applicable terms and conditions for Federal Demonstration Program participants.

2.14 DETERMINATION OF RESPONSIBILITY (JAN 2001)

DOE will evaluate the potential Recipient's responsibility before award. Responsibility determinations are focused on the Recipient's capability to manage and account for the funds, property and other assets provided and to perform satisfactorily under the terms of the award. If a potential Recipient is determined to not be in compliance or cannot or will not comply with generally applicable requirements (see 10 CFR Part 600, Appendix A), the contracting officer will find the Recipient not responsible and may either disapprove the application or use special restrictive conditions as a term of award.

2.15 AWARD WITHOUT DISCUSSIONS (AUG 2000)

Notice is given that award may be made after few or no exchanges, discussions or negotiations. Therefore, all applicants are advised to submit their most favorable application to the Government. The Government reserves the right, without qualification, to reject any or all applications received in response to this solicitation and to select any application, in whole or in part, as a basis for negotiation and or award.

2.16 REPORTING REQUIREMENTS (FEB 2001)

The Reporting Requirements identified in the model financial assistance agreement located at <http://www.netl.doe.gov/business/faapiaf/MODEL.PDF> are required to be submitted during performance of the award.

In addition to the standard reports identified in the model, the following reports will be incorporated in the resultant award:

Federal Cash Transaction Report, Form No. SF-272, to be submitted quarterly, and
Technical Progress Report, to be submitted yearly and as a final at project completion.

2.17 ANTICIPATED SELECTION AND AWARD DATES (AUG 1999)

It is anticipated that selections for award will be made during the third quarter of FY-2003. Awards are expected to be made within ninety (90) calendar days following the selection.

2.18 COMMITMENT OF PUBLIC FUNDS (AUG 1999)

The Contracting Officer is the only individual who can legally commit the Government to the expenditure of public funds in connection with the proposed award. Any other commitment, either explicit or implied, is invalid.

2.19 FALSE STATEMENTS (AUG 1999)

Applications must set forth full, accurate, and complete information as required by this solicitation. The penalty for making false statements in applications is prescribed in 18 U.S.C. 1001.

2.20 PRESUBMISSION REVIEW AND CLEARANCES (AUG 1999)

Presubmission review under Executive Order 12372, "Intergovernmental Review of Federal Programs" is not required.

2.21 LOANS NOT AVAILABLE (JULY 1999)

Loans are not available under the DOE Minority Economic Impact (MEI) loan program, 10 CFR Part 800, to finance the cost of preparing a financial assistance application.

2.22 PATENTS, DATA, AND COPYRIGHTS

Core Program

Individual and Joint University/College Applications. Policies and procedures for patents, data, and copyrights are in accordance with 10 CFR 600.27. The recipient and subcontractors who qualify as a domestic small business firm or nonprofit organization may retain the entire right, title and interest to each invention that is conceived or first actually reduced to practice under the grant, subject to the provisions of 10 CFR 600.27.

Joint University/Industry Applications. Industrial collaborators, other than domestic small business or non-profit organizations, have the right to request, before or within 30 days after the effective date of award of their subcontract, a waiver of all or any part of the rights of the U.S. in subject inventions. To receive consideration for a request for such patent waivers, a twenty (20%) percent cost share is normally required from the requestor.

IC Phase I and Phase II Programs

Policies and procedures for patents, data, and copyrights are in accordance with Public Law 96-517. The recipient may retain the entire right, title and interest to each invention, subject to provisions of 10 CFR 600.27.

2.23 TRANSFER OF GRANTS

Financial assistance awards are made to educational institutions not individuals. Should the Principal Investigator leave the employment of the university at any time before expiration of the grant, the university will be required to provide a substitute Principal Investigator of acceptable qualifications to DOE, in order to continue research with grant monies.

2.24 ANNUAL CONTRACTOR'S REVIEW MEETING/TRAVEL

Principal Investigators will be required to attend a two (2) day, Annual Contractors' Review Meeting. In Fiscal Year 2003, it is anticipated that the Annual meeting will be held in Pittsburgh on June 3-4, 2003. Annual budgets submitted with applications must include estimated expenses for attending this yearly meeting. Additionally, award funds may be used for domestic travel to one (1) technical meeting per year, each year of the respective grant. Included in each budget with regard to travel must be detailed information on travel type (i.e. surface, air), hotel/motel accommodations, and per diem.

SECTION III - APPLICATION PREPARATION INSTRUCTIONS

3.0 IIPS APPLICATION PREPARATION INSTRUCTIONS - GENERAL (MAY 2002)

The application shall be prepared as set forth herein to provide a standard basis for evaluation and to insure that each application will be uniform as to format and sequence.

Submission of applications in an electronic format is required utilizing the Industry Interactive Procurement System (IIPS) through the Internet at <http://e-center.doe.gov/>. IIPS provides the medium for disseminating solicitations, receiving applications, and evaluating applications in a paperless environment. Individuals who have the authority to enter their college/university into a legally binding contract and intend to submit applications via the IIPS system must register and receive confirmation that they registered prior to being able to submit an application on the IIPS System. An IIPS "User Guide for Contractors" can be obtained by going to the IIPS Homepage at <http://e-center.doe.gov> and then clicking on the "Help" button. Questions regarding the operation of IIPS may be E-mailed to the IIPS Help Desk at IIPS_HelpDesk@e-center.doe.gov or call the Help Desk at (800) 683-0751.

During review of the complete application, DOE may request the submission of additional information if the information is essential to evaluate the application.

3.1 OVERALL ARRANGEMENT OF APPLICATION (MAR 2002)

The overall application shall consist of three (3) physically separated volumes, individually entitled as stated below and submitted through IIPS at <http://e-center.doe.gov>.

APPLICATION VOLUME -- TITLE

- Volume I -- Offer and Other Documents
- Volume II -- Technical Application
- Volume III -- Cost Application

All forms and instructions needed for preparation of each volume are found on the NETL homepage at: <http://www.netl.doe.gov/business/faapiaf/main.html>. Instructions for completion of the forms are contained on the back of each form. Questions on completion of the forms should be addressed to the Contract Specialist.

In order for a complete application package to be received correctly through IIPS, applicants are advised to download all files needed for transmission from the NETL homepage and complete all volumes entirely prior to initiating transmission through IIPS. Submission of all required volumes must be performed at the same time and from the same computer. Submission of volumes at different times or from different computers may separate the volumes and make it difficult to determine the applicant's responsiveness to the requirements.

3.2 FILE FORMAT (NOV 2001)

To aid in evaluation, applications shall be clearly and concisely written as well as being neat, indexed (cross-indexed as appropriate), and logically assembled. All pages of each part shall be appropriately numbered, and identified with the name of the applicant, the date, and the solicitation number to the extent practicable.

Application files are to be formatted in one of the following software applications:

Microsoft Word (preferred when feasible) OR **Adobe Acrobat PDF**

Files shall be saved with filenames which clearly identify the file being submitted. Filename extensions shall clearly indicate the software application used for preparation of the documents, i.e. .pdf or .doc.

In order to create PDF documents, complete the fillable PDF forms, save them, and/or electronically transmit them to DOE, the full version of Adobe Acrobat must be acquired. Information regarding Adobe Acrobat software can be obtained from Adobe Systems, Inc. at <http://adobe.com>.

The following general format must be used in preparing all documents: (1) minimum margins (top, bottom, left and right) of one (1) inch on 8-1/2 x 11-inch paper, and (2) font size shall be a minimum of 12 point.

3.3 UNNECESSARILY ELABORATE APPLICATIONS (SEPT 2000)

Unnecessarily elaborate applications beyond those sufficient to present a complete and effective response to this solicitation are not desired. Elaborate art work and expensive visual presentations are neither necessary nor wanted.

3.4 SIGNED ORIGINALS (NOT REQUIRED)

Submission of electronic applications via IIPS will constitute submission of signed copies of the required documents. The name of the applicant's authorized official shall be entered (typed or electronic signature) in the appropriate space shown on the form(s).

3.5 VOLUME I - OFFER AND OTHER DOCUMENTS PREPARATION INSTRUCTIONS (JAN 2002)

When the applicant begins to "Create Proposal" in IIPS under the proper Focus Area, the applicant will complete the fields on the cover page and attach the following files to the link identified as: Attach Volume 1/Offer or Other Documents. For consistency, the applicant is instructed to use the file names specified below. Filename extensions shall clearly indicate the software application used for preparation of the documents, i.e., ".pdf" for Adobe Acrobat or ".doc" for Word files:

	<u>MANDATORY FILE</u>	<u>FILENAME</u>
File 1	Volume 1, Application Cover Sheet	V1_COVER.---
File 2	SF 424, Application for Federal Assistance	424.---
File 3	SF424b, Assurances, Non-Construction Programs	424b.---
File 4	D1600.5, Assurance of Compliance	1600_5.---
File 5	Certifications Regarding Lobbying; Debarment, Suspension and Other Responsibility Matters; and Drug-Free Work Place Requirements	CERT_LLD.---
File 6	Representation of Limited Rights Data and Restricted Computer Software	PATENT.---
File 7	SF-LLL Disclosure of Lobbying Activities	LLL.---
File 8	NEPA Environmental Questionnaire	NEPASOL.---
File 9	Certification of Intent to Comply with DOE Budget Limitations and/or Cost Sharing Requirement	BUDGETCERT.---
File 10	Teaching Professor/Student Employment Certification	TEACHCERT.---

All Co-Principal Investigators should be identified as Team Members on the Application Cover Page. In the event that the applicant takes exceptions or deviations are taken to the Model Agreement or other portions of this solicitation, these exceptions/deviations shall be clearly labeled and included as a second page to File 1, Application Cover Sheet. If the application contains Proprietary Information, the legend as specified in Section III, Clause 3.7 shall be included as the subsequent page following the exceptions.

NOTE:

File 1-File 8 The forms and instructions needed for preparation of these forms are found on the NETL homepage at:

<http://www.netl.doe.gov/business/faapiaf/volume1/volume1.html>

Questions on completion of the forms should be addressed to the Contract Specialist via IIPS.

File 9 **CERTIFICATION OF INTENT TO COMPLY WITH DOE BUDGET LIMITATIONS AND/OR COST SHARING REQUIREMENTS**

The Applicant must provide this certification as an assurance that they will comply with the budget limitations and cost sharing requirements identified in Section II, Clause 2.4. This certification is Attachment 2 (Filename: BUDGETCERT.doc or BUDGETCERT.pdf) to this solicitation.

File 10 **TEACHING PROFESSOR/STUDENT EMPLOYMENT CERTIFICATION**

The Principal Investigator or Co-Principal Investigator listed on the application must be a teaching professor at the submitting college/university. The Core Program applications have an additional requirement that at least one (1) registered student at the college/university must receive compensation for work performed in conducting the proposed research. The Teaching Professor/Student Employment Certification must be signed by the Principal Investigator or a Co-Principal Investigator of the submitting university/college. This certification must also be provided by any other college/university participating in the proposed effort. This certification is Attachment 3 (Filename: TEACHCERT.doc or TEACHCERT.pdf) to this solicitation.

3.6 VOLUME II-- TECHNICAL APPLICATION PREPARATION INSTRUCTIONS - IIPS (NOV 2001)

When the applicant begins to “Create Proposal” in IIPS under the proper Focus Area, the applicant will complete the fields on the cover page and attach the following files to the link identified as: Attach Volume 2/ Technical Proposal. For consistency, the applicant is instructed to use the file name specified below. Filename extensions shall clearly indicate the software application used for preparation of the documents, i.e, “.pdf” for Adobe Acrobat or “.doc” for Word files.

	<u>MANDATORY FILE</u>	<u>FILENAME</u>
File 1	Comprehensive Technical	TECHNICAL.---

The technical application will consist of the Applicant's outline addressing the technical and management aspects of the assistance action, the Applicant's capabilities and what the Applicant will do to satisfy the requirements of the solicitation. Since the technical information contained in this section will be evaluated to determine such matters as understanding of the work to be performed, technical approach, and potential for completing the desired work, it should be specific and complete in every detail. The Application should be practical and be prepared simply and economically, providing a straightforward, concise delineation of what it is the Applicant will do to satisfy the requirements of the solicitation. This file shall contain and be assembled in the following format:

A. COVER PAGE

The cover page shall indicate the solicitation number; program area; focus area of interest; name of applicant (university); title of project; PI's name, address, phone number, fax number and e-mail address; and the names of all Co-PIs/team.

B. PUBLIC ABSTRACT

A public abstract of not more than one (1) single spaced typewritten page clearly stating the objectives of the proposed research, the title of the project, methodology, and sponsoring organization(s). It is a stand alone document. The applicant shall provide a point of contact for coordination, preparation and distribution of press releases in this abstract. This abstract may be released to the public by DOE in whole or in part at any time. It is, therefore, required that it shall not contain proprietary data or company sensitive business information.

C. SCIENTIFIC DISCUSSION (page limitation set forth do not apply A, B, and D)

Format and Page Limitation

Core Program Focus Areas: The scientific discussion, shall not exceed 25 pages, double spaced, using 12 point font, 1" margins, and when printed will fit on size 8 1/2" by 11" paper.

IC Phase I Program Focus Areas: The scientific discussion, shall not exceed 5 pages, double spaced, using 12 point font, 1" margins, and when printed will fit on size 8 1/2" by 11" paper.

IC Phase II Program Focus Areas: The scientific discussion, shall not exceed 25 pages, double spaced, using 12 point font, 1" margins, and when printed will fit on size 8 1/2" by 11" paper.

These page limitations include figures, tables, etc. Figures and/or tables may be reduced and combined with text, provided that the figures/tables retain their legibility. The scientific discussion should be independently numbered starting with the page number 1. The applicant is cautioned that if the combined length of the scientific discussion exceeds the page limitations delineated above, the excess pages will not be reviewed.

Content

The scientific discussion shall:

- a. contain an introduction identified as page 1;
- b. provide a detailed description of the program objectives toward which the application is addressed and a detailed presentation of the research work and procedures that will be conducted to achieve these objectives;
- c. describe the rationale behind and the technical adequacy of the research approach;
- d. describe any prior experience(s) with the subject topic addressed and list applicable studies conducted that were related to the subject;
- e. contain any literature references; and
- f. identify participating team members for Joint Universities and Joint University/Industry Applications. Team members must be clearly identified, i.e., the application must set forth the role of each team member by task and the budget detail must identify and support the associated cost(s) and cost-share(s).

The scientific discussion of the technical application should relate directly to the technical evaluation criteria identified in Section IV, Clause 4.4.

D. RESUMES OF KEY PERSONNEL, PUBLICATIONS, FACILITIES, PAST, CURRENT, AND PENDING SUPPORT, AND LETTERS OF COMMITMENT

- a. **Vitae** (Single Spaced) Provide a brief vitae for the Principal Investigator and the Co-Principal Investigator(s), if any.
- b. **Publications** List publications pertinent to the proposed research
- c. **Facilities** Identify existing facilities, including specialized equipment, available for use in the proposed research
- d. **Past, Current, and Pending Support** Identify any past, current or pending support related to the proposed work, and include other DOE Program Offices or Government agencies to which the proposed work has been submitted, and
- e. **Letter of Commitment** Include letters of commitment/intent from industrial and university collaborators for joint applications and resumes of proposed "consultants," etc.

E. STATEMENT OF PROJECT OBJECTIVES

NETL uses a specific format for Statement of Project Objectives in its awards. In solicitations such as this one, where the Government does not provide a Statement of Project Objectives, the Applicant is to provide one, which the DOE will then use to generate the Statement of Project Objectives to be included in the award.

All applications must contain a single, detailed Statement of Project Objectives that addresses how the project objectives will be met. The Statement of Project Objectives must contain a clear, concise description of all activities to be completed during project performance and follow the structure discussed below. The Statement of Project Objectives may be released to the public by DOE in whole or in part at any time. It is therefore required that it shall not contain proprietary or confidential business information.

The Statement of Project Objectives should be no more than two (2) pages for the proposed work. Applicants shall prepare the Statement of Project Objectives in the following format:

TITLE OF WORK TO BE PERFORMED

(Insert the title of work to be performed. Be concise and descriptive.)

- A. **OBJECTIVES**
Include one paragraph on the overall objective(s) of the work.

- B. **SCOPE OF WORK**
Include one paragraph to summarize the effort and approach to achieve the objective(s) of the work.

- C. **TASKS TO BE PERFORMED**
Tasks, concisely written, should be provided in a logical sequence.

Task 1.0 - (Title)
(Description)
 - Subtask 1.1 (Optional)
(Description)
Task 2.0 - (Title), etc.

- D. **DELIVERABLES**
The periodic, topical, and final reports shall be submitted in accordance with the “Federal Assistance Reporting Checklist” and the instructions accompanying the checklist.

- E. **ANNUAL CONTRACTORS REVIEW MEETING**
The Recipient shall annually attend a two (2) day, Annual Contractors' Review Meeting held in Pittsburgh, PA.

3.7 TREATMENT OF PROPRIETARY INFORMATION (AUG 1999)

An application may include technical data and other data, including trade secrets and/or privileged or confidential commercial or financial information, which the applicant does not

want disclosed to the public or used by the Government for any purpose other than application evaluation. To protect such data, the applicant should specifically identify each page including each line or paragraph thereof containing the data to be protected and mark the cover sheet of the application with the following Notice as well as referring to the Notice on each page to which the Notice applies:

NOTICE OF RESTRICTION ON DISCLOSURE AND USE OF DATA

The data contained in pages [] of this application have been submitted in confidence and contain trade secrets or proprietary information, and such data shall be used or disclosed only for evaluation purposes, provided that if this applicant receives an award as a result of or in connection with the submission of this application, DOE shall have the right to use or disclose the data therein to the extent provided in the award. This restriction does not limit the Government’s right to use or disclose data obtained without restriction from any source, including the applicant.

DOE shall not refuse to consider an application solely on the basis that the application is restrictively marked.

3.8 VOLUME III - COST APPLICATION PREPARATION INSTRUCTIONS – IIPS (JAN 2002)

When the applicant begins to “Create Proposal” in IIPS under the proper Focus Area, the applicant will complete the fields on the cover page and attach the following files to the link identified as: Attach Volume 3/Cost Proposal. For consistency, the applicant is instructed to use the file names specified below. Filename extensions shall clearly indicate the software application used for preparation of the documents, i.e, “.pdf” for Adobe Acrobat, or “.doc” for Word files:

	<u>MANDATORY FILE</u>	<u>FILENAME</u>
File 1	Budget Form	D4600_4.---
File 2	Supporting Cost Detail	DETAIL.---
File 3	Submission Requirements for Participating DOE M&O Contractors, Non-DOE Federally Funded Research and Development Center (FFRDC’s or Federal Agencies (if applicable))	FWTP.---

File 1 The forms and instructions needed for preparation are found on the NETL homepage at:

http://www.netl.doe.gov/business/faapiaf/volume3/budget_forms.html

Questions on completion of the forms should be addressed to the Contract Specialist.

File 2 The supporting cost detail shall include: (1) the Total Project Budget, (2) Yearly Budget (for each year of project performance) and (3) a "budget explanation" showing how costs are derived for each major cost element. The "Budget Explanation" should include, as a minimum, the following information:

1. **Personnel**. Identify individual labor categories and man-hours or percentages of time/individual, including wage-rate or salary used in the computation of cost and any applicable escalation factor(s).
2. **Fringe Benefits**. Provide the estimated cost of fringe benefits if calculated separately from Labor. Provide a copy of the applicable Colleges and Universities Rate Agreement which supports the proposed fringe benefit rate, or explain how the rate was computed.
3. **Travel**. Itemize each trip as to destination, number of travelers and duration. Rates used to estimate airfare, lodging, meals and incidental expenses, and ground transportation costs should be provided. Principal investigators will be required to attend a two (2) day, Annual Contractors' Review Meeting. Annual budgets submitted with applications must include estimated expenses for attending this yearly meeting. Principal Investigators are also required to attend a "peer review" of their project in the final year of performance and should budget travel funds accordingly. Additionally, award funds may be used for domestic travel to one (1) technical meeting per year, each year of the respective grant.
4. **Contractual (Contracts and Consultants)**. Identify proposed contracts to other organizations and their relative cost, providing the same level of cost detail as that required of the applicant (i.e., labor, benefits, supplies, etc.). If a consultant is proposed, provide the hourly/daily rate and its basis, and certify whether or not the proposed rate is the consultant's "most favored customer" rate. Furnish resumes or similar information regarding qualifications or experience. **Profit or fee is NOT permitted** to be paid to contractors under this Program Solicitation.
5. **Equipment, Materials and Supplies**. Elements of cost should be itemized to the extent possible and the basis of the proposed prices substantiated as to written/verbal vendor quotes, catalog pricing, etc. Copies of written quotes and/or the vendor catalog pages should be provided to substantiate costs.
6. **Other Direct Costs (ODC's)**. The amount and basis for proposed costs not otherwise shown should be included here.
7. **Indirect Costs**. Provide "Current Rate Agreement -- Colleges and Universities," which substantiates proposed indirect rates with the Federal Government. This may be obtained from the college/university business office (photocopy acceptable). If no such Rate Agreement exists, explain how the rates were derived.

8. **Cost Participation** Is considered contributions by the applicant, private sector or other third-party co-funder. The Budget Page and the detailed budget breakdown must be consistent and supportable as to source and type of cost-participation;
9. **Total Amount Requested from DOE**. Should not exceed maximum funding limits as set forth in Section II.
10. **Total Project Costs**. Total allowable project costs include both costs to be advanced/reimbursed by DOE and costs to be shared by the applicant or third parties, thus total project costs must reflect all costs to be incurred in the performance of the proposed project.

File 3 **Application Submission Requirements for Participating DOE M&O Contractors, Non-DOE Federally Funded Research and Development Center (FFRDC's or Federal Agencies (MAR 2002).**

The following must be submitted if your application includes work to be performed by a DOE M&O contractor, Non-DOE FFRDC, or Federal agency:

1. Justification
 - a. For participation by a DOE M&O contractor, authorization is required from the DOE Contracting Officer. The applicant must submit a document from the DOE Contracting Officer or authorized designee stating that the DOE M&O contractor is authorized to participate in the proposed work effort.
 - b. For FFRDC contractors (other than DOE M&O contractors), the proposed use of such entity must be consistent with the FFRDC authority under its contract with the cognizant Federal agency and such work must not place the FFRDC in direct competition with the private sector.
 - c. For Federal agencies, the proposed effort must not place the agency in direct competition with the private sector. DOE will fund the other agency work through an interagency agreement.
2. Work-Scope

The application must provide a scope of work for the effort to be performed by the applicant and a separate scope of work for the effort to be performed by the DOE M&O contractor, FFRDC, or Federal agency. If the applicant is teaming with a DOE M&O contractor, see DOE Order 412.1-Work Authorization System (<http://www.directives.doe.gov/>) for further submission instructions regarding Field Work Proposals, which is the vehicle used to fund the DOE M&O contractor.

3. Cost Information

The application must include a budget page with cost information for that portion of the applicant's effort in the project and for the DOE M&O, FFRDC or Federal agencies' portion of the project. The cost information should be submitted in the same format and level of detail as prescribed under Volume III-Cost Application (NETL Business Internet link accessed at <http://www.netl.doe.gov/business/index.html>) for the purposes of evaluation. An applicant's cost sharing requirement shall be based on the total cost of the project, including the applicant, FFRDC, DOE M&O or Federal agencies' portions of the effort.

4. Teaming Agreement

The managerial arrangement between the applicant and the DOE M&O contractor, FFRDC or Federal agency.

DOE will review the application to determine that it meets these criteria and reserves the right to reject any application that fails to do so.

SECTION IV --EVALUATION AND SELECTION

4.0 INTRODUCTION

This section contains the evaluation approach as well as the individual criteria to be used in the evaluation of applications.

4.1 GENERAL

It is the policy of DOE that all financial assistance is awarded through a merit-based selection process, which means a thorough, consistent and independent examination of applications based on pre-established criteria by persons knowledgeable in the field of the proposed project.

4.2 PRELIMINARY SCREENING AND REVIEW

Prior to a comprehensive evaluation, applications will undergo an initial review to determine whether the information required by the solicitation has been submitted timely and is complete. Applications will be reviewed to ensure that eligibility requirements, cost-sharing requirements, funding limitations, and industrial collaboration have been met. Failure to successfully meet any of the preliminary review criteria may result in the elimination of the application and no further consideration in the Comprehensive Evaluation. In the event that an application is eliminated, a notice will be sent to the Applicant stating the reason(s) that the application will not be considered for financial assistance under this solicitation.

4.3 COMPREHENSIVE EVALUATION

Applications passing the preliminary evaluation shall be subject to a comprehensive technical evaluation. The technical evaluation is conducted to determine the merits of the technical application with regard to the established technical evaluation criteria outlined in Section IV, Clause 4.4.

The comprehensive technical evaluation is conducted by Peer Review Panels that comprise evaluators from academia, industry, and government. The evaluators will score, rank, and provide substantive technical comments for each application.

4.4 EVALUATION CRITERIA

Core Program

Volume II - Technical applications that pass the pre-screening process described previously will be evaluated according to criteria, (1) through (4), below. The relative importance of each criterion is indicated by the maximum point score (shown in parentheses) allotted.

Criterion 1: The overall merit of the proposed project. (Maximum 45 points) The research represents a significant contribution to expanding the base of knowledge in the defined focus area. The proposed approach is innovative and represents a significant

departure from state-of-the-art approaches to the described problem. An awareness of the state-of-the-art in related areas of coal research is demonstrated.

Criterion 2: The stated objectives and the probability of achieving those objectives. (Maximum 40 points) The application clearly addresses a problem, concept or question described within the focus area. A well defined, logical statement of work is provided to effectively address the technical issues. An approach is described that is scientifically sound and well planned and current methods (or methods adequate to solve the problem) are used in the investigation.

Criterion 3: The qualifications of the Principal Investigator(s) or key personnel considered critical to the success of the proposed project. (Maximum 10 points)

Criterion 4: The facilities or specialized equipment/techniques available to the applicants to meet the project objectives. (Maximum 5 points)

IC Phase I and Phase II Programs

Volume II - All technical applications that pass the pre-screening process described previously will be evaluated according to criteria, (1) through (4), below. The relative importance of each criterion is indicated by the maximum point score (shown in parentheses) allotted.

Criterion 1: The overall merit of the proposed project and the degree of innovation employed. (Maximum 60 points) The research represents a significant contribution to expanding the base of knowledge for developing solution to a technological problem that is a barrier to the broader or improved use of coal. The proposed approach is innovative and represents a significant departure from state-of-the-art approaches to the described problem.

Criterion 2: The probability of achieving the research objectives. (Maximum 25 points) The applicant clearly defines an important problem, concept or question to be investigated. A well defined, logical statement of work is provided and an approach is described that is scientifically sound.

Criterion 3: The qualifications of the Principal Investigator(s) or key personnel considered critical to the success of the proposed project. (Maximum 10 points)

Criterion 4: The facilities or specialized equipment/techniques available to the applicants to meet the project objectives. (Maximum 5 points) The applicant should possess all equipment critical to the success of the project at the time the application is submitted. The purchase of major equipment, post award, is not allowed.

4.5 PROGRAM POLICY FACTORS

These factors, while not indicators of the Application's merit, e.g., technical excellence, cost, applicant's ability, etc., may be essential to the process of selecting the application(s) that,

individually or collectively, will best achieve the program objectives. Such factors are often beyond the control of the Applicant. Applicants should recognize that some very good applications may not receive an award because they do not fit within a mix of projects which maximizes the probability of achieving the DOE's overall research and development objectives. Therefore, the following Program Policy Factors may be used by the Source Selection Authority to assist in determining which of the ranked application(s) shall receive DOE funding support.

- a. Geographic/Regional Balance
- b. Broad University Participation
- c. Collaborative Participation - when two applications are considered equal, consideration will be given to those with collaboration.

4.6 REVIEWER COMMENTS

A summary of reviewers' comments will be made available to applicants post-selection.