

# FINANCIAL ASSISTANCE FUNDING OPPORTUNITY ANNOUNCEMENT



## U. S. Department of Energy National Energy Technology Laboratory

**Advanced Gasification: Novel CO<sub>2</sub> Utilization Systems, Low Rank Coal  
IGCC Optimization, and Improvements in Gasification Systems Availability  
and Costs**

**Funding Opportunity Number: DE-FOA0000496**

**Announcement Type: Initial**

**CFDA Number: 81.089 Fossil Energy Research and Development**

<b>Issue Date:</b>	<b>3/15/2011</b>
<b>Letter of Intent Due Date:</b>	<b>Not Applicable</b>
<b>Pre-Application Due Date:</b>	<b>Not Applicable</b>
<b>Application Due Date:</b>	<b>5/20/2011 at 8:00:00 PM Eastern Time</b>

*This Announcement will remain open until the Application Due Date identified above; however, applications may be submitted anytime before this Announcement closes.*

*It is also recommended that application submission begin well in advance (at least 48 hours) of the Announcement closing.*

**NOTE: Applications in response to this Funding Opportunity Announcement (FOA) must be submitted through [Grants.gov](http://Grants.gov).**

## **NOTE: REGISTRATION/SUBMISSION REQUIREMENTS**

### **Registration Requirements**

There are several one-time actions you must complete in order to submit an application in response to this Announcement (e.g., obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number, register with the Central Contractor Registration (CCR), and register with Grants.gov). Applicants who are not registered with CCR and Grants.gov, should allow at least 21 days to complete these requirements. It is suggested that the process be started as soon as possible.

**Applicants must obtain a DUNS number. DUNS website: <http://fedgov.dnb.com/webform>.**

**Applicants must register with the CCR. CCR website: <http://www.ccr.gov>**

**Applicants must register with Grants.gov. Grants.gov website: <http://grants.gov/>**

**Applicants must register with FedConnect to submit questions. FedConnect website: [www.fedconnect.net](http://www.fedconnect.net)**

### **Questions**

Questions relating to the **system requirements or how an application form works** must be directed to Grants.gov at 1-800-518-4726 or [support@grants.gov](mailto:support@grants.gov).

Questions regarding the **content** of the announcement must be submitted through the FedConnect portal. You must register with FedConnect to respond as an interested party to submit questions, and to view responses to questions. It is recommended that you register as soon after release of the FOA as possible to have the benefit of all responses. DOE/NNSA will try to respond to a question within 3 business days, unless a similar question and answer have already been posted on the website.

### **Application Preparation and Submission**

**Applicants must download the application package, application forms and instructions, from Grants.gov. Grants.gov website: <http://www.grants.gov/>**

(Additional instructions are provided in Section IV A of this FOA.)

### **Where to Submit**

Applications must be submitted through Grants.gov to be considered for award. **You cannot submit an application through Grants.gov unless you are registered. Please read the registration requirements carefully and start the process immediately.** Remember you have to update your CCR registration annually. If you have any questions about your registration, you should contact the Grants.gov Helpdesk at 1-800-518-4726 to verify that you are still registered in Grants.gov.

**IMPORTANT NOTICE TO POTENTIAL APPLICANTS:** When you have completed the process, you should call the Grants.gov Helpdesk at 1-800-518-4726 to verify that you have completed the final step (i.e. Grants.gov registration).

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## SECTION I – FUNDING OPPORTUNITY DESCRIPTION

Statutory authority for this Funding Opportunity Announcement (FOA) is PL95-91DOE Organization Act, as amended by PL109-58 Energy Policy Act of 2005.

### BACKGROUND

This proposed action supports the DOE goals of lower cost Integrated Gasification Combined Cycle (IGCC) with carbon capture, while maintaining the highest environmental standards. Lower cost IGCC will help provide a clean, stable, secure, affordable energy supply to meet the nation's growing energy demands. All three topic areas in the proposed action support the Gasification Program's goal to use gasification to provide power from coal with 90% carbon capture and storage (CCS) at minimal increase in the Cost of Electricity (COE).

### PURPOSE AND OBJECTIVES

Applications to this funding opportunity announcement are sought for Research and Development (R&D) projects that will address key challenges to IGCC commercialization with CCS related to: 1) the utilization of the carbon dioxide (CO<sub>2</sub>) stream to reduce IGCC with CCS plant costs, 2) reduction of the cost of IGCC using low rank coals, and 3) the improvement of availability and costs for gasification plants. All three topic areas aim to produce results that reduce the COE, while maintaining or improving plant efficiency. Applicants shall clearly identify the topic area under which the application is being submitted. The required format for the title will be: "TA [-1, -2 or -3, specify one] (project title)."

Applications are sought for R&D in the following three topic areas:

#### **1) Novel Gasification Technology Exploiting the Availability of (Pressurized) CO<sub>2</sub> Within the Gasification Plant**

In a future where CCS will be required to make power from coal, there will be relatively pure, high pressure CO<sub>2</sub> stream(s) available within the gasification plant, often at several pressures up to a sequestration pipeline pressure of approximately 150 bar. The Gasification Program objective is to develop advanced technology whereby 90% of the of gasifier's carbon output can be captured as CO<sub>2</sub>, compressed, and stored. DOE is interested in supporting development of novel concepts for the reuse/recycle of the CO<sub>2</sub> stream(s) to enable gasification plant cost of electricity (COE) reduction, with technologies that may also increase plant-wide thermal efficiency being the most favored.

The objective of this topic area is to encourage the R&D of innovative technologies to help reduce the cost of IGCC with CCS by taking advantage of the CO<sub>2</sub> stream(s) inside a gasification plant. These novel technologies must have the potential to cause a significant reduction in the COE with carbon capture.

The topic area objective is 90% CCS; therefore, technologies that support plant wide capture of at least 90% of CO<sub>2</sub> emissions are favored. However, if biomass co-feed is a plausible part of the proposed process, technologies that support 80% CCS will also be considered, since the remaining CO<sub>2</sub> could essentially be offset though biomass co-feed. The proposed work needs to demonstrate sufficient

technical value and quality to accomplish the objectives of this topic area.

Since this topic area involves the relatively new paradigm of the existence of a sequestration-ready CO<sub>2</sub> stream, many of the proposed technologies may be at the early stages of development. However, the evaluation process will favor applications utilizing technologies closer to commercial readiness, given similar potential economic and efficiency benefits. The level of progression of the proposed projects will be proven by the applicant providing supporting data and analysis as well as demonstrating industrial participation. Proposed technologies must be shown to have the potential to significantly reduce the cost of avoiding CO<sub>2</sub> emissions, and the most favored technologies will also have the potential to increase efficiency. Concepts must also address technical hurdles and limits, such as CO<sub>2</sub> pressure process limitations based on availability fabrication and weldability characteristics of "exotic" materials, or the potentially corrosive nature of a CO<sub>2</sub> slurry. Furthermore, concepts with the widest applicability to the IGCC industry will be favored over those with a relatively narrow scope. The following are examples of areas where R&D could improve efficiency or reduce the COE: 1) supercritical CO<sub>2</sub> slurry for feeding low rank coal, 2) pre-treating coal to improve performance, and 3) use of CO<sub>2</sub> in chemical manufacture as part of a co-production concept.

For co-production concepts (power and hydrogen, fuels and/or chemicals), the power output must be greater than 50% of the total energy output of the plant.

The DOE is not interested in directly supporting new gasifier development. This topic area excludes technologies that require development of new power block or air separation technology.

Project deliverables will include:

- A. Preliminary conceptual designs and techno-economic analyses that predict plant efficiency, cost of products, and environmental performance. These studies will help to establish costs, risks, potential economic performance, and environmental impacts of such facilities and identify commercial/market potential for the products. At a minimum, the Application must include plans to perform two power production only cases using the design criteria in Attachment 1. The two power production only cases are: 1) design without the advanced technologies and 2) design with the advanced technologies. DOE/NETL may utilize the results of these studies to develop comprehensive system studies and/or models as well as to identify future R&D activities.
- B. At a minimum, lab-scale results showing the potential value of the advanced technologies must be provided. This information may be pre-existing, or may be developed as part of the project.

## **2) Scoping Studies for Novel Low Rank Coal IGCC Technologies**

Since half of the coal in the United States is low rank coal (having higher alkali and moisture contents), and its use is expected to grow significantly, a worthwhile technology path is to develop advanced technology for the use of low rank coal in power production.

The objective for projects in this topic area is the development of low rank coal gasification technologies resulting in economically viable production of power. These novel technologies must have the potential

to cause a significant reduction in the COE with CCS. Concepts must include novel, advanced technologies, resulting in significant improvements in the COE as compared to the state-of-the-art and commercially available gasification technologies. The proposed work needs to demonstrate sufficient technical value and quality to accomplish the objectives of this topic area.

The gasifier selected for use in the proposed design concept must be a commercially available gasifier, or must at least have been demonstrated at the pilot-scale, with evidence of industry support to complete gasifier development. Many of the proposed technologies may be at early stages of development. However, the evaluation process will favor applications utilizing technologies closer to commercial readiness, given similar potential economic and efficiency benefits. The level of progression of the proposed projects will be proven by the applicant providing supporting data and analysis as well as having industrial participation.

Since the Gasification Program objective is 90% CCS, technologies that support plant wide capture of at least 90% of CO<sub>2</sub> emissions are favored. However, if biomass co-feed is a plausible part of the proposed process, technologies that support 80% CCS will also be considered since the remaining CO<sub>2</sub> could essentially be offset through biomass co-feed.

Concepts with the widest applicability to the IGCC industry will be favored over those with a narrow scope. The proposed scoping study also may include co-production of hydrogen, fuels and/or chemicals, but the power output must be greater than 50% of the total energy output of the plant.

The DOE is not interested in directly supporting new gasifier development. This topic area excludes technologies that require development of new power block or air separation technology.

Project deliverables will include:

- A. Preliminary conceptual designs and techno-economic analyses that predict plant efficiency, cost of products, and environmental performance. These studies will help to establish costs, risks, potential economic performance, and environmental impacts of such facilities and identify commercial/market potential for their products. At a minimum the Application must include plans to perform two power production only cases, using the design criteria in Attachment 1. The two power production only cases are:
  - 1) design without the advanced technologies and 2) design with the advanced technologies. DOE/NETL may utilize the results of these studies to develop comprehensive system studies and/or models as well as identify future R&D activities.
- B. At a minimum, lab-scale results showing the potential value of the advanced technologies must be provided. This information may be pre-existing, or may be developed as part of the project.

### **3) Gasification Plant Availability and Cost Improvements**

Industry interviews consistently show that low availability of the gasifier and gasifier-related technologies is one of the most significant barriers to commercial deployment of gasification for IGCC. See Attachment 2 for the definition of Availability (Gasification Technology Council). Furthermore, attempts

to improve plant availability often have a direct impact on increasing the capital and/or operating costs of the plant, which results in increased product cost (e.g. cost of electricity, fuel, and/or hydrogen). For availability improvements proposed under this topic area, it is critical that technologies/techniques that improve availability not increase capital and/or operating costs. Attachment 3 shows a bibliography of open literature discussing availability issues with gasification plants.

This topic area is aimed towards encouraging gasification plant owners to collaborate with other industrial partners and the DOE to develop technologies that will improve gasification plant availabilities and costs. In exchange for DOE support, the proposed action anticipates earlier industrial deployment of these technologies and making them widely available to the gasification industry. Applications must include a credible technology transfer plan and documented support by a commercially relevant gasification plant operator. The most favored applications will be those with proposed technology development that is fundamentally and actively integrated with an IGCC or industrial gasification facility. See Section IV for complete submission instructions.

The objectives of this topic area are to: 1) develop technologies to contribute significantly to the Gasification Program's 90% IGCC availability and cost reduction goals, and 2) achieve industry-wide accessibility of the developed technology as a result of the project. Relative to a state-of-the-art plant that maximizes availability, a proposed process must either increase availability of a reference plant while maintaining current costs, or maintain the availability at decreased costs. A detailed, fully developed technical approach that supports the objectives for this topic area needs to be clearly communicated in the proposed work.

Concepts with the widest applicability to the gasification industry will be favored over those with a narrow scope. Also, technologies that both increase IGCC availability and decrease costs will be favored over those that only do one or the other. Improvements in industrial gasifiers may be submitted provided they have wide scale applicability to IGCC plants.

The following are examples of areas where R&D could improve availability and costs: 1) monitoring to reduce forced outages, enable on-line maintenance, or allow for more cost effective materials of construction, etc., 2) solids handling from feed to carbon conversion to slag removal, 3) process water handling, 4) process water separation (including sour water, brine and solid/liquid separation), 5) gas cooling, 6) other improvements aimed at elimination of plugging and fouling throughout the syngas cooling and process water systems, and 7) systems for online cleaning of heat exchangers and other components requiring frequent cleaning.

Since the Department of Energy already supports substantial research in the following areas, these parts of the plant will not be eligible for the development of availability improvements: gasifier (including refractory), air separation units, syngas acid gas and trace contaminant cleanup systems, carbon-dioxide/hydrogen separation technologies, and turbines.



## SECTION II – AWARD INFORMATION

### TYPE OF AWARD INSTRUMENT

DOE anticipates awarding cooperative agreements under this funding opportunity announcement (See Section VI.B.2 Statement of Substantial Involvement).

### ESTIMATED FUNDING

Approximately \$13,000,000 of Federal funds are expected to be available for new awards under this announcement.

### MAXIMUM AND MINIMUM AWARD SIZE

Ceiling (i.e., the maximum amount for an individual award made under this announcement): NONE

Floor (i.e., the minimum amount for an individual award made under this announcement): NONE

### EXPECTED NUMBER OF AWARDS

DOE anticipates making approximately 3-10 awards under this Announcement.

The Government reserves the right to fund, in whole or in part, any, all, or none of the applications submitted in response to this announcement and will award the number of financial assistance instruments which serves the public purpose and is in the best interest of the Government.

### ANTICIPATED AWARD SIZE

The anticipated award size for projects under each Topic Area in this announcement is:

Topic Area	Anticipated Federal Share
1	\$1,000,000
2	\$1,000,000
3	\$3,000,000 - \$8,000,000

The Recipient will be required to cost share a minimum of 20 % of the total project costs. Total Project Costs = DOE share + Recipient Cost Share. (If Federally Funded Research and Development Center (FFRDC) participates: Total Project Costs = DOE share + FFRDC Costs + Recipient Cost Share.)

## **PERIOD OF PERFORMANCE**

The anticipated period of performance for projects under each Topic Area in this announcement is:

Topic Area	Anticipated Period of Performance
1	1year
2	1year
3	3years

## **TYPE OF APPLICATION**

DOE will accept only new applications under this announcement.

## SECTION III - ELIGIBILITY INFORMATION

### ELIGIBLE APPLICANTS

All types of domestic entities are eligible to apply, except other Federal agencies, Federally Funded Research and Development Center (FFRDC) Contractors, and nonprofit organizations described in section 501(c)(4) of the Internal Revenue Code of 1986 that engaged in lobbying activities after December 31, 1995.

### COST SHARING

Cost Share 20%

The cost share must be at least 20% of the **total project costs** for research and development projects (i.e., the sum of the Government share, including FFRDC contractor costs if applicable, and the recipient share of allowable costs equals the total allowable cost of the project) and must come from non-Federal sources unless otherwise allowed by law. (See 10 CFR 600 for the applicable cost sharing requirements.) (For example: If Total Project Costs are \$500,000 the maximum DOE share would be \$400,000 and the Recipient would be required to cost share a minimum of \$100,000.)

### OTHER ELIGIBILITY REQUIREMENTS

**FFRDC Contractors:** FFRDC contractors are not eligible for an award under this announcement, but they may be proposed as a team member on another entity's application subject to the following guidelines:

Authorization for non-DOE FFRDCs. The Federal agency sponsoring the FFRDC contractor must authorize in writing the use of the FFRDC contractor on the proposed project and this authorization must be submitted with the application. The use of a FFRDC contractor must be consistent with the contractor's authority under its award and must not place the FFRDC contractor in direct competition with the private sector.

Authorization for DOE FFRDCs. The cognizant contracting officer for the FFRDC must authorize in writing the use of a DOE/NNSA FFRDC contractor on the proposed project and this authorization must be submitted with the application. The following wording is acceptable for this authorization:

"Authorization is granted for the [Name] Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complimentary to the missions of the laboratory, will not adversely impact execution of the DOE/NNSA assigned programs at the laboratory, and will not place the laboratory in direct competition with the domestic private sector."

Value/Funding. The value of, and funding for, the FFRDC contractor portion of the work will not normally be included in the award to a successful applicant. Usually, DOE/NNSA will fund a DOE

FFRDC contractor through the DOE field work proposal system and other FFRDC contractors through an interagency agreement with the sponsoring agency.

Cost Share. The applicant's cost share requirement will be based on the total cost of the project, including the applicant's and the FFRDC contractor's portions of the effort.

**FFRDC Contractor Effort:**

The scope of work to be performed by the FFRDC contractor may not be more significant than the scope of work to be performed by the applicant.

The FFRDC contractor effort, in aggregate, shall not exceed 25% of the total estimated cost of the project, including the applicant's and the FFRDC contractor's portions of the effort.

Responsibility. The applicant, if successful, will be the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues, including but not limited to, disputes and claims arising out of any agreement between the applicant and the FFRDC contractor.

**Performance of Work in the United States**

As a condition of award under this funding opportunity announcement, applicants must agree that at least 75% of the direct labor cost for the project (including subrecipient labor) will be incurred in the United States unless the applicant can demonstrate to the satisfaction of the DOE that the United States economic interest will be better served through a greater percentage of work performed outside the United States.

## SECTION IV - APPLICATION AND SUBMISSION INFORMATION

### ADDRESS TO REQUEST APPLICATION PACKAGE

Application forms and instructions are available at Grants.gov. To access these materials, go to <http://www.grants.gov>, select "Apply for Grants," and then select "Download Application Package." Enter the CFDA and/or the funding opportunity number located on the cover of this announcement and then follow the prompts to download the application package.

### LETTER OF INTENT AND PRE-APPLICATION

Letters of Intent are not required.

Pre-applications are not required.

### CONTENT AND FORM OF APPLICATION – 424 (R&R)

You must complete the mandatory forms and any applicable optional forms (e.g., SF-LLL- Disclosure of Lobbying Activities) in accordance with the instructions on the forms and the additional instructions below. Files that are attached to the forms must be in Adobe Portable Document Format (PDF) unless otherwise specified in this announcement.

#### 1. SF 424 (R&R)

Complete this form first to populate data in other forms. Complete all required fields in accordance with the pop-up instructions on the form. The list of certifications and assurances referenced in Field 17 can be found on the DOE Financial Assistance Forms Page at [http://management.energy.gov/business\\_doe/business\\_forms.htm](http://management.energy.gov/business_doe/business_forms.htm) under Certifications and Assurances.

Note that the Congressional District is entered in the format of the 2 digit state code followed by a dash and a 3 digit Congressional district code, for example VA-001. Hold over this field with your computer mouse for additional instructions.

#### 2. RESEARCH AND RELATED Other Project Information

Complete questions 1 through 6 and attach files. The files must comply with the following instructions:

##### **Project Summary/Abstract (Field 7 on the Form)**

The project summary/abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document that identifies the name of the applicant, the project director/principal investigator(s), the project title, the objectives of the project, a description of the project, including methods to be employed, the potential impact of

the project (i.e., benefits, outcomes), and major participants (for collaborative projects). This document must not include any proprietary or sensitive business information as the Department may make it available to the public after awards are made. The project summary must not exceed 2 pages when printed using standard 8.5" by 11" paper with 1" margins (top, bottom, left and right) double spaced with font not smaller than 11 point. Save this information in a file named "Summary.pdf." To attach a Project Summary/Abstract, click "Add Attachment."

### **Project Narrative (Field 8 on the Form)**

The project narrative must not exceed **25 PAGES DOUBLE SPACED**, including cover page, table of contents, charts, graphs, maps, photographs, tables, and other pictorial presentations, when printed using standard 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right) and with font not smaller than 11 point.

EVALUATORS WILL ONLY REVIEW THE NUMBER OF PAGES SPECIFIED IN THE PRECEDING SENTENCE. Do not include any Internet addresses (URLs) that provide information necessary to review the application, because the information contained in these sites will not be reviewed. See Section VIII.D for instructions on how to mark proprietary application information. To attach a Project Narrative, click "Add Attachment."

The project narrative must include the following information that **WILL** count in the project narrative page limitation:

Project Objectives: This section should provide a clear, concise statement of the specific objectives/aims of the proposed project.

Merit Review Criterion Discussion: The section should be formatted to address each of the merit review criterion and sub-criterion listed in Section V.A. Provide sufficient information so that reviewers will be able to evaluate the application in accordance with these merit review criteria. **DOE WILL EVALUATE AND CONSIDER ONLY THOSE APPLICATIONS THAT ADDRESS SEPARATELY EACH OF THE MERIT REVIEW CRITERION AND SUB-CRITERION.**

Relevance and Outcomes/Impacts: This section should explain the relevance of the effort to the objectives in the program announcement and the expected outcomes and/or impacts.

Roles of Participants: For multi-organizational or multi-investigator projects, describe the roles and the work to be performed by each participant/investigator, business agreements between the applicant and participants, and how the various efforts will be integrated and managed.

Multiple Principal Investigators: The applicant, whether a single organization or team/partnership/consortium, must indicate if the project will include multiple PIs. This decision is solely the responsibility of the applicant. If multiple PIs will be designated, the application must identify the Contact PI/Project Coordinator and provide a "Coordination and Management Plan" that describes the organization structure of the project as it pertains to the designation of multiple PIs. This plan should, at a minimum, include:

- process for making decisions on scientific/technical direction;
- publications;

- intellectual property issues;
- communication plans;
- procedures for resolving conflicts; and
- PIs' roles and administrative, technical, and scientific responsibilities for the project.

Statement of Project Objectives (SOPO): The project narrative 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 after award. It is therefore required that it shall not contain proprietary or confidential business information.

The Statement of Project Objectives is generally **5-10 DOUBLE SPACED PAGES** in total for the proposed work and these **WILL** count towards the Project Narrative total page limitation. 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. Also, include objective(s) for each phase of the work.

#### B. SCOPE OF WORK

This section should not exceed one-half page and should summarize the effort and approach to achieve the objective(s) of the work for each Phase.

#### C. TASKS TO BE PERFORMED

Tasks, concisely written, should be provided in a logical sequence and should be divided into the phases of the project, as appropriate. This section provides a brief summary of the planned approach to this project. An outline of the Project Management Plan (referenced in Task 1.0 below and required to be submitted with your application) is provided later in this Section.

### Task 1.0 – Project Management and Planning (**THIS TASK IS MANDATORY; INSERT THE FOLLOWING**)

This task shall include all work elements required to maintain and revise the Project Management Plan, and to manage and report on activities in accordance with the plan.

It shall also include the necessary activities to ensure coordination and planning of the project with DOE/NETL and other project participants.

### Task 2.0 – (Title) (Description)

Subtask 2.1 – (Title) (Description)

Subtask 2.2 – (Title) (Description)

Task 3.0 – (Title) (Description)

Subtask 3.1 – (Title) (Description)

Subtask 3.2 – (Title) (Description)

(Continue with Tasks as necessary)

#### D. DELIVERABLES

The periodic, topical, and final reports shall be submitted in accordance with the attached "Federal Assistance Reporting Checklist" and the instructions accompanying the checklist.

[Note: The Recipient shall provide a list of deliverables other than those identified on the "Federal Assistance Reporting Checklist" that will be delivered. These reports shall also be identified within the text of the Statement of Project Objectives. See the following examples:

1. Task 1.1 - (Report Description)
2. Task 2.2 - (Report Description)]

#### *End of Statement of Project Objectives*

The following Appendices are to be included in the Project Narrative document/file, but **WILL NOT** count towards the Project Narrative total page limitation:

Identification of Potential Conflicts of Interest or Bias in Selection of Reviewers Appendix: Provide the following information in this section. This appendix **WILL NOT** count in the project narrative page limitation:

*Collaborators and Co-editors:* List in alphabetical order all persons, including their current organizational affiliation, who are, or who have been, collaborators or co-authors with you on a research project, book or book article, report, abstract, or paper during the 48 months preceding the submission of this application. Also, list any individuals who are currently, or have been, co-editors with you on a special issue of a journal, compendium, or conference proceedings during the 24 months preceding the submission of this application. If there are no collaborators or co-editors to report, state "None."

*Graduate and Postdoctoral Advisors and Advisees:* List the names and current organizational affiliations of your graduate advisor(s) and principal postdoctoral sponsor(s) during the last 5 years. Also, list the names and current organizational affiliations of your graduate students and postdoctoral associates

Bibliography & References Cited Appendix: This appendix **WILL NOT** count in the project narrative page limitation. Provide a bibliography of any references cited in the Project Narrative. Each reference must include the names of all authors (in the same sequence in which they appear



in the publication), the article and journal title, book title, volume number, page numbers, and year of publication. Include only bibliographic citations. Applicants should be especially careful to follow scholarly practices in providing citations for source materials relied upon when preparing any section of the application. In order to reduce the number of files attached to your application, please provide the Bibliography and References Cited information as an appendix to your project narrative. Do not attach a file in Field 9.

Facilities & Other Resources Appendix: This appendix **WILL NOT** count in the project narrative page limitation. This information is used to assess the capability of the organizational resources, including subrecipient resources, available to perform the effort proposed. Identify the facilities to be used (Laboratory, Animal, Computer, Office, Clinical, and Other). If appropriate, indicate their capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Describe only those resources that are directly applicable to the proposed work. Describe other resources available to the project (e.g., machine shop, electronic shop) and the extent to which they would be available to the project. In order to reduce the number of files attached to your application, please provide the Facility and Other Resource information as an appendix to your project narrative. Do not attach a file in Field 10.

Equipment Appendix: This appendix **WILL NOT** count in the project narrative page limitation. List major items of equipment already available for this project and, if appropriate identify location and pertinent capabilities. In order to reduce the number of files attached to your application, please provide the Equipment information as an appendix to your project narrative. Do not attach a file in Field 11.

### **(End of Project Narrative)**

#### **Other Attachments (Field 12 on the form)**

If you need to elaborate on your responses to questions 1-6 on the "Other Project Information" document, attach a file in field 12.

Supporting Attachments Required for Topic Area Three:

Technology Transfer Plan that is sufficiently detailed, fully developed, and credible. Save this document as a single file named "Technology Transfer Plan.pdf" and attach it to the RESEARCH AND RELATED Other Project Information form. Click on "Add Attachments" in Field 12 to attach

Commercial Support documentation from a commercially relevant gasification plant operator must be included. Save this document as a single file named "Commercial Support documentation.pdf" and attach it to the RESEARCH AND RELATED Other Project Information form. Click on "Add Attachments" in Field 12 to attach

Also, attach the following files for all topic areas:

**Data Sets, Lab-Scale Results, Drawings, and Supporting Analyses:** If additional technical support exist (whether it be in the form of figures, drawings, etc.) to support the claim of the potential value of the proposed technology, or if additional analyses or lab-scale data showing the potential value of the proposed technology is available, it should be included in Field 12 on the form. Save this document as a single file named “Supporting Analyses.pdf” and attach it to the RESEARCH AND RELATED Other Project Information form. Click on “Add Attachments” in Field 12 to attach.

## **Project Management Plan**

This plan should be formatted to include the following sections with each section to include the information as described below:

Title Page:

### **PROJECT MANAGEMENT PLAN** {Date Prepared}

#### **SUBMITTED UNDER FUNDING OPPORTUNITY ANNOUNCEMENT**

DE-FOA-0000496

#### **SUBMITTED BY**

{Organization Name}  
{Organization Address}  
{City, State, Zip Code}

#### **PRINCIPAL INVESTIGATOR**

{Name}  
{Phone Number}  
{Fax Number}  
{E-mail}

#### **SUBMITTED TO**

U.S. Department of Energy  
National Energy Technology Laboratory

(End title page)

A. *Executive Summary*: Provide a description of the project that includes the objective, project goals, and expected results. For purposes of the application, this information is included in the Project Narrative (Field 8) and should be simply copied to this document for completeness, so that the Project Management Plan is a stand-alone document.

B. *Project Organization and Structure*: Provide the following information in this section:

- Organizational chart and sub-organizational charts
- A discussion of how the organizational structure will facilitate the performance of the Tasks described in the SOPO
- A description of which elements of the organization are responsible for the individual Tasks with their credentials and contact information.
- A discussion of how communication and decision-making will occur within the context of the organizational structure

C. *Risk Management*: Provide a summary description of the proposed approach to identify, analyze, and respond to perceived risks associated with the proposed project. Project risk events are uncertain future events that, if realized, impact the success of the project. As a minimum, include the initial identification of significant technical, resource, and management issues that have the potential to impede project progress and strategies to minimize impacts from those issues.

D. *Milestone Log*: Provide milestones for each budget period (or phase) of the project. A minimum of two milestones is required for each budget period. Each milestone should include a title and planned completion date, and a description of the method/process/measure used to verify completion. Milestones should be quantitative and show progress toward budget period and/or project goals. The table below illustrates an example of how the Milestone Log may be provided.

Budget Period	Milestone Description	Planned Completion	Verification Method
1	Updated Project Management Plan	11/30/2011	Project Management Plan file
1	Kickoff Meeting	12/31/2011	Presentation file

[Note: During project performance, the Recipient will report the Milestone Status as part of the required quarterly Progress Report as prescribed under Attachment 4, Reporting Requirements Checklist. The Milestone Status will present actual performance in comparison with Milestone Log, and include:

- (1) The actual status and progress of the project,
- (2) Specific progress made toward achieving the project's milestones, and,
- (3) Any proposed changes in the project's schedule required to complete milestones. ]

E. *Funding and Costing Profile*: Provide a table (the Project Funding Profile) that shows, by budget period, the amount of government funding going to each project team member. Also provide a table (the Project Costing Profile) those projects, by month, the expenditure of government funds for the first budget period, at a minimum.

- F. *Project Timeline*: Provide a timeline of the project (similar to a Gantt chart) broken down by each task and subtask, as described in the Statement of Project Objectives. The timeline should include for each task, a start date, and end date. The timeline should show interdependencies between tasks and include the milestones that are identified in the Milestone Log (Section C).
- G. *Success Criteria at Decision Points*: Provide success criteria for each decision point in the project, including go/no-go decision points and the conclusions of budget periods and the entire project. The success criteria should be objective and stated in terms of specific, measurable, and repeatable data. Usually, the success criteria pertain to desirable outcomes, results, and observations from the project.

Save this Project Management Plan in a single file named “pmp.pdf” and attach it to the RESEARCH AND RELATED Other Project Information form. Click on “Add Attachments” in Field 12 to attach.

### *End of Project Management Plan*

### **Commitment Letters from Third Parties Contributing to Cost Sharing**

If a third party, (i.e., a party other than the organization submitting the application) proposes to provide all or part of the required cost sharing, the Applicant must include a letter from the third party stating that it is committed to providing a specific minimum dollar amount of cost sharing. The letter must also identify the proposed cost sharing (e.g., cash, services, and/or property) to be contributed. Letters must be signed by the person authorized to commit the expenditure of funds by the entity and be provided in a PDF format.

Save this information in a single file named “CLTP.pdf” and then attach it to the RESEARCH AND RELATED Other Project Information form. Click on “Add Attachments” in Field 12 to attach.

### **Environmental Questionnaires (EQs) from Applicants Submitting to Topic Area 3**

If an application is submitted under topic area three, An Environmental Questionnaire (EQ) must be filled out for each geographic location where activities will be conducted for the project. This will facilitate a NEPA determination by DOE for the project activity site(s). The EQ is available for download at the following website: <http://www.netl.doe.gov/business/forms/451-1-1-3.pdf>.

Save this information in a single file (even if multiple field activity sites require multiple EQs) named “EQ.pdf” and then attach it to the RESEARCH AND RELATED Other Project Information form. Click on “Add Attachments” in Field 12 to attach.

### **Budget for DOE Federally Funded Research and Development Center (FFRDC) Contractor, (if applicable).**

If a DOE FFRDC contractor is to perform a portion of the work, you must provide a DOE Field Work Proposal in accordance with the requirements in DOE Order 412.1 Work Authorization System. This order and the DOE Field Work Proposal form are available at

[http://management.energy.gov/business\\_doe/business\\_forms.htm](http://management.energy.gov/business_doe/business_forms.htm).

Use the FFRDC name as the file name (up to 10 letters) and then attach it to the RESEARCH AND RELATED Other Project Information form. Click on "Add Attachments" in Field 12 to attach.

### **3. RESEARCH AND RELATED Senior/Key Person Profile (Expanded)**

Complete this form before the Budget form to populate data on the Budget form. Beginning with the PD/PI, provide a profile for each senior/key person proposed. A senior/key person is any individual who contributes in a substantive, measurable way to the scientific/technical development or execution of the project, whether or not a salary is proposed for this individual. Sub recipients and consultants must be included if they meet this definition.

For each senior/key person provide:

**Biographical Sketch.** Complete a biographical sketch for each senior/key person and attach to the "Attach Biographical Sketch" field in each profile. Save all resumes in a single file named "bio.pdf." The biographical information for each person must not exceed 2 pages when printed on 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right) with font not smaller than 11 point and must include:

*Education and Training.* Undergraduate, graduate and postdoctoral training, provide institution, major/area, degree and year.

*Research and Professional Experience.* Beginning with the current position list, in chronological order, professional/academic positions with a brief description.

*Publications.* Provide a list of up to 10 publications most closely related to the proposed project. For each publication, identify the names of all authors (in the same sequence in which they appear in the publication), the article title, book or journal title, volume number, page numbers, year of publication, and website address if available electronically.

Patents, copyrights, and software systems developed may be provided in addition to or substituted for publications.

*Synergistic Activities.* List no more than 5 professional and scholarly activities related to the effort proposed.

**Current and Pending Support.** Provide a list of all current and pending support (both Federal and non-Federal) for the Project Director/Principal Investigator(s) (PD/PI) and senior/key persons, including sub recipients, for ongoing projects and pending applications. For each organization providing support, show the total award amount for the entire award period (including indirect costs) and the number of person-months per year to be devoted to the project by the senior/key person. Concurrent submission of an application to other organizations for simultaneous consideration will not prejudice its review. Save the information in a separate file

and attach to the "Attach Current and Pending Support" field in each profile.

#### **4. RESEARCH AND RELATED BUDGET (Total Fed + Non-Fed)**

Complete the Research and Related Budget (Total Fed & Non-Fed) form in accordance with the instructions on the form and the following instructions. You must complete a separate budget for each year of support requested. The form will generate a cumulative budget for the total project period. You must complete all the mandatory information on the form before the NEXT PERIOD button is activated. You may request funds under any of the categories listed as long as the item and amount are necessary to perform the proposed work, meet all the criteria for allowability under the applicable Federal cost principles, and are not prohibited by the funding restrictions in this announcement (See SECTION IV.G.).

**Budget Justification** (Field K on the form). Provide the required supporting information for the following costs (See R&R instructions): equipment; domestic and foreign travel; participant/trainees; material and supplies; publication; consultant services; ADP/computer services; sub award/consortium/contractual; equipment or facility rental/user fees; alterations and renovations; and indirect cost type. Provide any other information you wish to submit to justify your budget request. If cost sharing is required, provide an explanation of the source, nature, amount, and availability of any proposed cost sharing. Attach a single budget justification file for the entire project period in Field K. The file automatically carries over to each budget year.

#### **5. R&R Subaward (Total Fed + Non-Fed) Form**

**Budgets for Subawardees, other than DOE FFRDC Contractors.** You must provide a separate cumulative R&R budget for each subawardee that is expected to perform work estimated to be more than \$500,000 or 50 percent of the total work effort (whichever is less). Download the R&R Budget Attachment from the R&R SUBAWARD BUDGET (Total Fed + Non-Fed) FORM and e-mail it to each subawardee that is required to submit a separate budget. After the Subawardee has e-mailed its completed budget back to you, attach it to one of the blocks provided on the form. Use up to 10 letters of the subawardee's name as the file name.

#### **6. Project/Performance Site Location(s)**

Indicate the primary site where the work will be performed. If a portion of the project will be performed at any other site(s), identify the site location(s) in the blocks provided.

Note that the Project/Performance Site Congressional District is entered in the format of the 2 digit state code followed by a dash and a 3 digit Congressional district code, for example VA-001. Hover over this field for additional instructions.

Use the Next Site button to expand the form to add additional Project/Performance Site Locations.

## 7. Disclosure of Lobbying Activities (SF-LLL)

If applicable, complete SF- LLL. Applicability: If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the grant/cooperative agreement, you must complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying."

## 8. Summary of Required Forms and Files

**Your application must include the following documents:**

<b>Name of Document</b>	<b>Format</b>	<b>Attach to</b>
<b>SF 424 (R&amp;R)</b>	Form	N/A
<b>RESEARCH AND RELATED Other Project Information</b>	Form	N/A
Project Summary/Abstract	PDF	Field 7
Project Narrative, Statement of Project Objectives, including required appendices	PDF	Field 8
Budget for DOE FFRDC, if applicable	PDF	Field 12
Project Management Plan	PDF	Field 12
Commitment Letters from Third Parties	PDF	Field 12
Supporting Analyses	PDF	Field 12
Environmental Questionnaire-TOPIC AREA 3	PDF	Field 12
Technology Transfer Plan - TOPIC AREA 3	PDF	Field 12
Commercial Support documentation - TOPIC AREA 3	PDF	Field 12
<b>RESEARCH &amp; RELATED SENIOR/KEY PERSON Profile (Expanded) (Optional)</b>	Form	N/A
Biographical Sketch	PDF	Attach to appropriate block
Current and Pending Support	PDF	Attach to appropriate block
<b>RESEARCH AND RELATED BUDGET (Total Fed + Non-Fed)</b>	Form	N/A
Budget Justification	PDF	Field K
<b>R&amp;R SUBAWARD BUDGET (Total Fed + Non-Fed) ATTACHMENT(S) FORM</b> , if applicable	Form	N/A
<b>PROJECT/PERFORMANCE SITE LOCATION(S)</b>	Form	N/A
<b>SF-LLL Disclosure of Lobbying Activities</b> , if applicable	Form	N/A

## SUBMISSIONS FROM SUCCESSFUL APPLICANTS

If selected for award, DOE reserves the right to request additional or clarifying information for any reason deemed necessary, including, but not limited to:

- Indirect cost information
- Other budget information which will need to be broken down by task as well as by budget period and federal/non-federal share
- Name and phone number of the Designated Responsible Employee for complying with national policies prohibiting discrimination (See 10 CFR 1040.5)
- Representation of Limited Rights Data and Restricted Software, if applicable
- Commitment letter from Third Parties Contributing to Cost Sharing, if applicable
- Environmental Questionnaire

## SUBMISSION DATES AND TIMES

Pre-applications are not required.

Application Due Date

Applications should be received by **MAY 20, 2010 NOT LATER THAN 8:00 PM EASTERN TIME**. You are encouraged to transmit your application well before the deadline. **APPLICATIONS RECEIVED AFTER THE DEADLINE WILL NOT BE REVIEWED OR CONSIDERED FOR AWARD.**

This announcement will remain open until May 20, 2010. Applications may be submitted at any time before the announcement closes. You are encouraged to submit your application as soon as practicable (at least 48 hours in advance of the due date).

## INTERGOVERNMENTAL REVIEW

This program is not subject to Executive Order 12372 - Intergovernmental Review of Federal Programs.

## FUNDING RESTRICTIONS

**Cost Principles.** Costs must be allowable in accordance with the applicable Federal cost principles referenced in 10 CFR part 600. The cost principles for commercial organization are in FAR Part 31.

**Pre-award Costs.** Recipients may charge to an award resulting from this announcement pre-award costs that were incurred within the ninety (90) calendar day period immediately preceding the effective date of the award, if the costs are allowable in accordance with the applicable Federal cost principles referenced in 10 CFR part 600. Recipients must obtain the prior approval of the contracting officer for any pre-award costs that are for periods greater than this 90 day calendar period.



Pre-award costs are incurred at the applicant's risk. DOE is under no obligation to reimburse such costs if for any reason the applicant does not receive an award or if the award is made for a lesser amount than the applicant expected.

## OTHER SUBMISSION AND REGISTRATION REQUIREMENTS

1. Where to Submit - **APPLICATIONS MUST BE SUBMITTED THROUGH GRANTS.GOV TO BE CONSIDERED FOR AWARD.**

Submit electronic applications through the "Apply for Grants" function at [www.Grants.gov](http://www.Grants.gov) . It is recommended that application submission begin well in advance (at least 48 hours) of the Announcement closing. If you have problems completing the registration process or submitting your application, call Grants.gov at 1-800-518-4726 or send an email to [support@grants.gov](mailto:support@grants.gov) .

2. One Time Registration Process - You must COMPLETE the one-time registration process (all steps) before you can submit your first application through Grants.gov (See [www.grants.gov/GetStarted](http://www.grants.gov/GetStarted) ).

**DOE recommends that you start this process at least three weeks before the application due date.** It may take 21 days or more to complete the entire process. Use the Grants.gov Organizational Registration Checklists at <http://www.grants.gov/assets/OrganizationRegCheck.pdf> to guide you through the process.

**IMPORTANT:** During the CCR registration process, you will be asked to designate an E-Business Point of Contact (EBIZ POC). The EBIZ POC must obtain a special password called "Marketing Partner Identification Number" (MPIN). When you have completed the process, you can call the Grants.gov Helpdesk at 1-800-518-4726 to verify that you have completed the final step (i.e., Grants.gov registration).

## SECTION V - APPLICATION REVIEW INFORMATION

### CRITERIA

#### 1. Initial Review Criteria

Prior to a comprehensive merit evaluation, DOE will perform an initial review to determine that (1) the Applicant is eligible for an award; (2) the information required by the announcement has been submitted; (3) all mandatory requirements are satisfied; and (4) the proposed project is responsive to the objectives of the funding opportunity announcement.

#### 2. Merit Review Criteria

All applications that pass the initial review process will receive a detailed and consistent technical evaluation utilizing the evaluation criteria described below.

##### Criterion 1 (30 %) - Scientific and Technical Merit

The application will be evaluated to determine the overall technical merit and quality of the proposed concept, including the following:

- (1) The degree to which development of the proposed technology can be expected to contribute to a scientific or technical breakthrough for the challenges described in the topic area.
- (2) The thoroughness and relevance of the scientific, engineering, and technical information and data provided to support readiness of the proposed technology.
- (3) The degree to which the proposed work is based on sound scientific and engineering principles

##### Criterion 2 (35%) - Technical Approach

The application will be evaluated to determine the overall quality, soundness, and reasonableness of the applicant's technical approach to fulfill the requirements of the proposed work, including the following:

- (1) The likelihood that the overall approach will result in successful achievement of the objectives and deliverables described in the applicable topic area, including the extent to which the proposed Statement of Project Objectives is organized, logical and complete, with appropriate technical decision points.
- (2) The extent to which the proposed approach satisfies the requirements of the applicable topic area.
- (3) The extent to which the Application includes the most favored goals and objectives described in the applicable topic area.

##### Criterion 3 (20%) - Technical Capabilities, Project Management, Facilities and Equipment

The application will be evaluated in terms of the qualifications and relative experience of key personnel assigned to the project (including subcontractors and consultants, if considered key personnel), the qualifications of the participating organizations, the proposed management of the effort, and the facilities and equipment, as outlined according to the following factors:

- (1) Ability and commitment of key personnel and subcontractors to support successful completion of the project including: scientific mastery of the described technology, pertinent systems operations and analysis experience, project management experience, and demonstrated R&D experience and capabilities relevant to the proposed work.
- (2) The extent of prior corporate experience in managing projects of similar type, size and complexity, and in successfully completing similar R&D projects.
- (3) The project organization, showing responsibilities and lines of authority, both technical and administrative, including participating organizations and key subcontractors, is clearly described and optimized to assure successful project execution.
- (4) The appropriateness and availability of facilities, equipment, and modeling analysis tools and their relevance to technology development and/or commercial applications as applicable.

#### Criterion 4 – (15 %) Project Management Plan

This criterion relates entirely to the stand-alone Project Management Plan (PMP) requirements described in the guidance provided in Section IV of this FOA. If the application does not include this stand-alone PMP, evaluators will be instructed to assign a score of zero to this criterion. The application will be evaluated on the degree to which the PMP defines or identifies the following:

- 1) Adequacy and completeness of the PMP in establishing the technical scope, budget, and schedule baselines, in identifying key milestones and decision points, in controlling project performance relative to these baselines and decision points, and in defining the actions that will be taken when these baselines must be revised.
- 2) Adequacy and completeness of the identification of, and mitigation strategies for, project risks, including technical, organizational, cost share support and other risks affecting the potential for success.

### **3. Other Selection Factors**

The selection official will consider the following program policy factors in the selection process:

- It may be desirable to select for award a group of projects which represents a diversity of technical approaches and methods;
- It may be desirable to support complementary and/or duplicative efforts or projects, which, when taken together, will best achieve the Program's research goals and objectives;
- It may be desirable that different kinds and sizes of organizations be selected for award in order to provide a balanced programmatic effort and a variety of different technical perspectives;
- It may be desirable, because of the nature of the energy source, the type of projects envisioned, or limitations of past efforts, to select for award a group of projects with a broad or specific geographic distribution.
- It may be desirable, that different types and sizes of projects be selected for award in order to best support the program budget.

## REVIEW AND SELECTION PROCESS

### 1. Merit Review

#### **Applications Subject to Merit Review**

Applications that pass the initial review will be subjected to a merit review in accordance with the guidance provided in the "Department of Energy Merit Review Guide for Financial Assistance." This guide is available under Financial Assistance, Regulations and Guidance at <http://www.management.energy.gov/documents/meritrev.pdf>.

### 2. Selection

#### **Selection Official Consideration**

The Selection Official will consider the merit review recommendation, program policy factors, and the amount of funds available.

### 3. Discussions and Award

#### **Government Discussions with Applicant**

The Government may enter into discussions with a selected applicant for any reason deemed necessary, including but not limited to: (1) the budget is not appropriate or reasonable for the requirement; (2) only a portion of the application is selected for award; (3) the Government needs additional information to determine that the recipient is capable of complying with the requirements in 10 CFR 600; and/or (4) special terms and conditions are required. Failure to resolve satisfactorily the issues identified by the Government will preclude award to the applicant.

## ANTICIPATED NOTICE OF SELECTION AND AWARD DATES

DOE anticipates notifying applicants selected for award by the end of July 2011, and making awards by September 30, 2011.

## SECTION VI - AWARD ADMINISTRATION INFORMATION

### AWARD NOTICES

#### 1. Notice of Selection

##### Selected Applicants Notification

DOE will notify Applicants selected for award. This notice of selection is not an authorization to begin performance. (See Section IV.G. with respect to the allowability of pre-award costs.)

##### Non-selected Notification

Organizations whose applications have not been selected will be advised as promptly as possible.

#### 2. Notice of Award

An Assistance Agreement issued by the contracting officer is the authorizing award document. It normally includes either as an attachment or by reference: (1) Special Terms and Conditions; (2) Applicable program regulations, if any; (3) Application as approved by DOE; (4) DOE assistance regulations at 10 CFR part 600, or, for Federal Demonstration Partnership (FDP) institutions, the FDP terms and conditions; (5) National Policy Assurances To Be Incorporated As Award Terms; (6) Budget Summary; and (7) Federal Assistance Reporting Checklist, which identifies the reporting requirements.

For grants and cooperative agreements made to universities, non-profits and other entities subject to Title 2 CFR the Award also includes the Research Terms and Conditions located at <http://www.nsf.gov/bfa/dias/policy rtc/index.jsp>

### ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS

#### 1. Administrative Requirements

The administrative requirements for DOE grants and cooperative agreements are contained in 10 CFR 600 (See: <http://ecfr.gpoaccess.gov>). Grants and cooperative agreements made to universities, non-profits and other entities subject to Title 2 CFR are subject to the Research Terms and Conditions located on the National Science Foundation web site at <http://www.nsf.gov/bfa/dias/policy rtc/index.jsp>.

#### DUNS AND CCR REQUIREMENTS

Additional administrative requirements for DOE grants and cooperative agreements are contained in 2 CFR, Part 25 (See: <http://ecfr.gpoaccess.gov>). Prime awardees must keep their data at CCR current. Subawardees at all tiers must obtain DUNS numbers and provide the DUNS to the prime awardee before the sub award can be issued.

#### SUBAWARD AND EXECUTIVE REPORTING

Additional administrative requirements necessary for DOE grants and cooperative agreements to comply with the Federal Funding and Transparency Act of 2006 (FFATA) are contained in 2 CFR, Part 170. (See: <http://ecfr.gpoaccess.gov>). Prime awardees must register with the new FSRS database and report the required data on their first tier subawardees. Prime awardees must report the executive compensation for their own executives as part of their registration profile in the CCR.

## 2. Special Terms and Conditions and National Policy Requirements

**Special Terms and Conditions and National Policy Requirements.** The DOE Special Terms and Conditions for Use in Most Grants and Cooperative Agreements are located at [http://management.energy.gov/business\\_doe/business\\_forms.htm](http://management.energy.gov/business_doe/business_forms.htm).

The National Policy Assurances to Be Incorporated as Award Terms are located at <http://www.nsf.gov/bfa/dias/policy/rtc/appc.pdf>.

**3. Intellectual Property Provisions.** The standard DOE financial assistance intellectual property provisions applicable to the various types of recipients are located at [http://www.gc.doe.gov/financial\\_assistance\\_awards.htm](http://www.gc.doe.gov/financial_assistance_awards.htm).

## 4. Statement of Substantial Involvement

The awards will be cost-shared financial assistance cooperative agreements with substantial DOE involvement. The anticipated involvement is as follows:

DOE will have substantial involvement to include the following:

- Reviewing in a timely manner project plans, including project management, testing and technology transfer plans, and recommending alternate approaches, if the plans do not address critical programmatic issues.
- Participating in project management planning activities, including risk analysis, to ensure DOE program requirements or limitations are considered in performance of the work elements.
- Conducting periodic program review meetings to ensure adequate progress and that the work accomplishes the program and project objectives. Recommending alternate approaches or shifting work emphasis, if needed.
- Integrating and redirecting the work effort to ensure that project results address critical system and programmatic goals established by DOE FE, in coordination with the DOE Gasification Program. Specific integration includes that required to ensure project plans, test plans, project milestones, and budget allocations.
- Reviewing scientific/technical reports to ensure programmatic needs and the requirements of the Financial Assistance award instrument, including intellectual property rights, are satisfied and providing comments to the Recipient in a timely manner.
- Promoting and facilitating technology transfer activities, including disseminating program results through presentations and publications.
- Serving as scientific/technical liaison between Recipients and other program or industry staff

Recipient's Responsibilities:

- Performing the activities supported by this award in accordance with the Project Management

- Plan, including providing the required personnel, facilities, equipment, supplies and services.
- Managing and controlling project activities in accordance with established processes and procedures to ensure tasks and subtasks are completed within schedule and budget constraints defined by the current Project Management Plan.
  - Implementing an approach to identify, analyze, and respond to project risks that is commensurate with the complexity of the project.
  - Defining and revising approaches and plans, submitting the plans to DOE for review, and incorporating DOE comments.
  - Coordinating related project activities with external suppliers, including DOE M&O contractors, to ensure effective integration of all work elements.
  - Attending semiannual program review meetings and reporting project status.
  - Submitting technical reports and incorporating DOE comments.
  - Presenting the project results at appropriate technical conferences or meetings as directed by the DOE Project Officer (number of conferences/meetings including DOE review meeting may not exceed two per year.)

## REPORTING

Reporting requirements are identified on the Federal Assistance Reporting Checklist, DOE F 4600.2, attached to the award agreement. For a sample Checklist, see <http://www.management.energy.gov/documents/DOEF4600pt292009.pdf>.

## SECTION VII - QUESTIONS/AGENCY CONTACTS

### QUESTIONS

Questions regarding the content of the announcement must be submitted through the FedConnect portal. You must register with FedConnect to respond as an interested party to submit questions, and to view responses to questions. It is recommended that you register as soon after release of the FOA as possible to have the benefit of all responses. DOE will try to respond to a question within 3 business days, unless a similar question and answer have already been posted on the website.

Questions and comments concerning this FOA shall be submitted not later than 3 calendar days prior to the application due date. Questions submitted after that date may not allow the Government sufficient time to respond.

Questions relating to the registration process, system requirements, how an application form works, or the submittal process must be directed to Grants.gov at 1-800-518-4726 or [support@grants.gov](mailto:support@grants.gov) . DOE cannot answer these questions.

### AGENCY CONTACT

Name: Janet Spaulding  
E-mail: [janet.spaulding@netl.doe.gov](mailto:janet.spaulding@netl.doe.gov)



## SECTION VIII - OTHER INFORMATION

### **MODIFICATIONS**

Notices of any modifications to this announcement will be posted on Grants.gov and the FedConnect portal. You can receive an email when a modification or an announcement message is posted by registering with FedConnect as an interested party for this FOA. It is recommended that you register as soon after release of the FOA as possible to ensure you receive timely notice of any modifications or other announcements.

### **GOVERNMENT RIGHT TO REJECT OR NEGOTIATE**

DOE reserves the right, without qualification, to reject any or all applications received in response to this announcement and to select any application, in whole or in part, as a basis for negotiation and/or award.

### **COMMITMENT OF PUBLIC FUNDS**

The Contracting Officer is the only individual who can make awards or commit the Government to the expenditure of public funds. A commitment by other than the Contracting Officer, either explicit or implied, is invalid.

### **PROPRIETARY APPLICATION INFORMATION**

Patentable ideas, trade secrets, proprietary or confidential commercial or financial information, disclosure of which may harm the applicant, should be included in an application only when such information is necessary to convey an understanding of the proposed project. The use and disclosure of such data may be restricted, provided the applicant includes the following legend on the first page of the project narrative and specifies the pages of the application which are to be restricted:

"The data contained in pages [Insert 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 herein 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."

To protect such data, each line or paragraph on the pages containing such data must be specifically identified and marked with a legend similar to the following:

"The following contains proprietary information that (name of applicant) requests not be released to persons outside the Government, except for purposes of review and evaluation."

## EVALUATION AND ADMINISTRATION BY NON-FEDERAL PERSONNEL

In conducting the merit review evaluation, the Government may seek the advice of qualified non-Federal personnel as reviewers. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The applicant, by submitting its application, consents to the use of non-Federal reviewers/administrators. Non-Federal reviewers must sign conflict of interest and non-disclosure agreements prior to reviewing an application. Non-Federal personnel conducting administrative activities must sign a non-disclosure agreement.

## INTELLECTUAL PROPERTY DEVELOPED UNDER THIS PROGRAM

**Patent Rights.** The government will have certain statutory rights in an invention that is conceived or first actually reduced to practice under a DOE award. 42 U.S.C. 5908 provides that title to such inventions vests in the United States, except where 35 U.S.C. 202 provides otherwise for nonprofit organizations or small business firms. However, the Secretary of Energy may waive all or any part of the rights of the United States subject to certain conditions. (See "Notice of Right to Request Patent Waiver" in paragraph G below.)

**Rights in Technical Data.** Normally, the government has unlimited rights in technical data created under a DOE agreement. Delivery or third party licensing of proprietary software or data developed solely at private expense will not normally be required except as specifically negotiated in a particular agreement to satisfy DOE's own needs or to insure the commercialization of technology developed under a DOE agreement.

**Special Protected Data Statutes.** EPACT protection will be offered to applicants that submit under Topic Areas 1 and 2 as a part of the Funding Opportunity Announcement per the most recent model agreement with EPACT protection limited to 5 years maximum. EPACT protection may not be offered to applicants that submit under Topic Area 3.

This program is covered by a special protected data statute. The provisions of the statute provide for the protection from public disclosure, for a period of up to 5 years from the development of the information, of data that would be trade secret, or commercial or financial information that is privileged or confidential, if the information had been obtained from a non-Federal party. Generally, the provision entitled, Rights in Data Programs Covered under Special Protected Data Statutes (10 CFR 600 Appendix A to Subpart D), would apply to an award made under this announcement. This provision will identify data or categories of data first produced in the performance of the award that will be made available to the public, notwithstanding the statutory authority to withhold data from public dissemination, and will also identify data that will be recognized by the parties as protected data.

## NOTICE OF RIGHT TO REQUEST PATENT WAIVER

Applicants may request a waiver of all or any part of the rights of the United States in inventions conceived or first actually reduced to practice in performance of an agreement as a result of this announcement, in advance of or within 30 days after the effective date of the award. Even if such advance waiver is not requested or the request is denied, the recipient will have a continuing right under the award to request a waiver of the rights of the United States in identified inventions, i.e., individual

inventions conceived or first actually reduced to practice in performance of the award. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784 <http://www.gc.doe.gov/documents/patwaivclau.pdf>.

Domestic small businesses and domestic nonprofit organizations will receive the patent rights clause at 37 CFR 401.14, i.e., the implementation of the Bayh-Dole Act. This clause permits domestic small business and domestic nonprofit organizations to retain title to subject inventions. Therefore, small businesses and nonprofit organizations do not need to request a waiver.

## NOTICE REGARDING ELIGIBLE/INELIGIBLE ACTIVITIES

Eligible activities under this program include those which describe and promote the understanding of scientific and technical aspects of specific energy technologies, but not those which encourage or support political activities such as the collection and dissemination of information related to potential, planned or pending legislation.

## REQUIREMENTS FOR SELECTED APPLICANTS

**Accounting System:** When an application is selected for negotiation toward award, the Recipient must have an accounting system that meets government standards for recording and collecting costs. If the recipient has not had prior government awards, a DCAA audit may be requested to verify that the accounting system is acceptable. The award may contain an article that prohibits reimbursement until the system is deemed acceptable.

**Indirect Rate:** The recipient will need to demonstrate how indirect rates are developed using an acceptable government methodology. The prime recipient and major subs may be subject to a DCAA indirect rate audit if there has not been a DCAA rate audit within the previous twelve months.

**Cost Principles:** All project costs must be allowable, allocable and reasonable in accordance with applicable government cost principles. For example, for profit entities are subject to FAR 31.2, universities to 2 CFR Part 220 (OMB Circular A-21), non profits to 2 CFR 230 (OMB Circular A-122) and State and Local Governments to 2 CFR Part 225 (OMB A-87).

## ATTACHMENT 1: Design Basis for Techno-Economic Analyses Deliverables

### ATTACHMENT 1: Design Basis for Techno-Economic Analyses Deliverables

This attachment sets forth the minimum criteria to be used in the techno-economic analyses required as project deliverables for Topic Areas 1 and 2. For each relevant factor, Table 1 below provides the minimum requirements and additional recommendations. Multiple references are made to the following NETL publications to provide additional detail on the design basis requirements and recommendations.

- NETL Cost and Performance Baseline for Fossil Energy Plants, referred to as “Baseline Studies”<sup>1</sup>
- Series of Quality Guidelines for Energy Systems Studies (QGESS)<sup>2</sup>

**Table 1. Minimum Requirements and Recommendations for Techno-Economic Analyses**

Parameter	MINIMUM REQUIREMENTS	RECOMMENDATIONS
Case Configurations	Project deliverables shall include one conventional reference coal-to-power case with carbon capture and storage (CCS) and one advanced technology coal-to-power case with CCS.	If applicable, one of the cases in the Baseline Studies could be replicated and utilized for the conventional reference case.
Coal Type	Topic Area 1: One of the representative coal specifications in Table 2 below shall be used;  Topic Area 2: Table 2 below for Montana Rosebud PRB coal shall be used.	If analyses on multiple coal types will be performed, it is recommended that the proposer first consider using the following coal types:  Topic Area 1: those defined in Table 2 below;  Topic Area 2: North Dakota lignite in Table 2.
Site location and ambient conditions	Site location and ambient conditions shall be consistent for the two required cases.	Consider using the site location and ambient conditions set forth in the Baseline Studies.
CO <sub>2</sub> Removal	>80% based on the carbon input from the coal and excluding carbon that exits the gasifier with the slag.  For cases achieving <90% CO <sub>2</sub> removal, applicability of up to 15 wt% biomass co-feeding in the advanced system shall be discussed, but the two required cases shall be 100% coal-fed.	
Environmental targets	Environmental <u>limits</u> in Table 3 below.	Environmental <u>targets</u> in Table 3 below. Additional information on the basis for these limits and

<sup>1</sup> [http://www.netl.doe.gov/energy-analyses/baseline\\_studies.html](http://www.netl.doe.gov/energy-analyses/baseline_studies.html)

<sup>2</sup> <http://www.netl.doe.gov/energy-analyses/refshelf/PubDetails.aspx?Action=View&Source=Main&PubId=355>  
<http://www.netl.doe.gov/energy-analyses/refshelf/PubDetails.aspx?Action=View&PubId=338>

<b>Parameter</b>	<b>MINIMUM REQUIREMENTS</b>	<b>RECOMMENDATIONS</b>
		targets is provided in the Baseline Studies.
Power Block	Advanced F Turbine and steam turbine cycle consistent with the Baseline Studies.	
Cooling water system	Cooling water system shall be consistent for the two required cases.	Utilize cooling water system consistent with the site location, i.e. utilize dry or hybrid cooling in locations of low water availability.
Co-Production	Co-production cases are not required. However, if co-production analyses (power plus hydrogen, chemicals or fuels) are included, power generation shall account for >50% of the total energy output.	
Availability	Basis for availability assumptions for each case shall be clearly stated; capacity factor shall be assumed to equal availability.	
CO <sub>2</sub> Storage	CO <sub>2</sub> shall be compressed to 2,215 psia. Cost of electricity (COE) shall include an estimation of the cost for CO <sub>2</sub> to be transported a minimum of 50 miles and sequestered in a saline formation at a minimum depth of 4,055 ft.	It is recommended that CO <sub>2</sub> product to storage meet the specifications set forth in Table 4.  Consider scaling CO <sub>2</sub> transport, storage and monitoring costs from the Baseline Studies, where applicable. Also see QGESS on CO <sub>2</sub> Transport, Storage & Monitoring for additional information.
Capital cost estimating	Provide basis and contingencies used for advanced technologies	Consider scaling from Baseline Studies reported capital costs, where applicable. Consult QGESS on Cost Estimating Methodology for additional information.
Operating and Maintenance (O&M) Costs		Consider scaling from Baseline Studies reported costs, where applicable.
Finance structure, discounted cash flow analysis and COE	Utilize methodology set forth in the Baseline Studies and the QGESS on Cost Reporting Methodology.	Alternate discounted cash flow analysis approaches and reporting of COE may be utilized in addition to the required approach.
Reporting Requirements	Plant and component description (references to Baseline Study descriptions are allowed);  Block flow diagrams and stream tables including component flows;  Performance summary including breakdown of gross power generation, auxiliary power requirements and net plant efficiency;  Capital costs of major components or subsystems;	Process models with brief documentation;  Economic spreadsheet tools/models;  Water usage consistent with the Baseline Studies methodology.

<b>Parameter</b>	<b>MINIMUM REQUIREMENTS</b>	<b>RECOMMENDATIONS</b>
	Break down of O&M costs; Environmental performance; COE and cost of avoiding CO <sub>2</sub> emissions.	

Table 2. Design Coal Characteristics						
	Bituminous		Subbituminous		Lignite	
	Illinois No. 6 (Herrin)		Montana Rosebud PRB		North Dakota Beulah-Zap Lignite	
	Old Ben Mine		Area D, Western Energy Co. Mine		Freedom, ND Mine	
Proximate Analysis <sup>1</sup>	Dry Basis, %	As Received, %	Dry Basis, %	As Received, %	Dry Basis, %	As Received, %
Moisture	11.12	0.00	0.0	25.77	0.0	36.08
Ash	9.70	10.91	11.04	8.19	15.43	9.86
Volatile Matter	34.99	39.37	40.87	30.34	41.49	26.52
Fixed Carbon	44.19	49.72	48.09	35.70	43.09	27.54
Total	100.00	100.00	100.0	100.0	100.0	100.0
Sulfur	2.51	2.82				
Ultimate Analysis	Dry Basis, %	As Received, %	Dry Basis, %	As Received, %	Dry Basis, %	As Received, %
Carbon	63.75	71.72	67.45	50.07	61.88	39.55
Hydrogen	4.5	5.06	4.56	3.38	4.29	2.74
Nitrogen	1.25	1.41	0.96	0.71	0.98	0.63
Sulfur	2.51	2.82	0.98	0.73	0.98	0.63
Chlorine	0.29	0.33	0.01	0.01	0.00	0.00
Ash	9.70	10.91	11.03	8.19	15.43	9.86
Moisture	11.12	0.00	0.00	25.77	0.00	36.08
Oxygen <sup>2</sup>	6.88	7.75	15.01	11.14	16.44	10.51
Total	100.00	100.00	100.0	100.0	100.0	100.0
Heating Value	Dry Basis	As Received	Dry Basis	As Received	Dry Basis	As Received
HHV, kJ/kg	27,113	30,506	26,787	19,920	24,254	15,391
HHV, Btu/lb	11,666	13,126	11,516	8,564	10,427	6,617
LHV, kJ/kg	26,151	29,544	25,810	19,195	23,335	14,804
LHV, Btu/lb	11,252	12,712	11,096	8,252	10,032	6,364
Hardgrove Grindability Index			57		Not applicable	
Ash Mineral Analysis			%		%	
Silica			38.09		35.06	
Aluminum Oxide			16.73		12.29	
Iron Oxide			6.46		5.12	
Titanium Dioxide			0.72		0.58	
Calcium Oxide			16.56		14.39	
Magnesium Oxide			4.25		6.61	
Sodium Oxide			0.54		5.18	
Potassium Oxide			0.38		0.64	
Sulfur Trioxide			15.08		16.27	
Phosphorous Pentoxide			0.35		0.56	
Barium Oxide			0.00		0.27	
Strontium Oxide			0.00		0.02	
Unknown			0.84		3.00	
Total			100.0		100.0	
Trace Components			ppmd		ppmd	
Mercury <sup>3</sup>			0.081		0.116	

<sup>1</sup> The proximate analysis assumes sulfur as volatile matter

<sup>2</sup> By difference

<sup>3</sup> Mercury value is the mean plus one standard deviation using EPA's ICR data

**Table 3. Environmental Limits and Targets**

<b>Pollutant</b>	<b>Environmental Limits</b>	<b>Environmental Targets</b>
SO <sub>2</sub>	1.4 lb/MWh	0.0128 lb/MMBtu
NO <sub>x</sub>	1.0 lb/MWh	15 ppmv (dry) @ 15% O <sub>2</sub>
PM (Filterable)	0.015 lb/MMBtu	0.0071 lb/MMBtu
Hg	20 x 10 <sup>-6</sup> lb/MWh	>90% capture

**Table 4. CO<sub>2</sub> Pipeline Specifications**

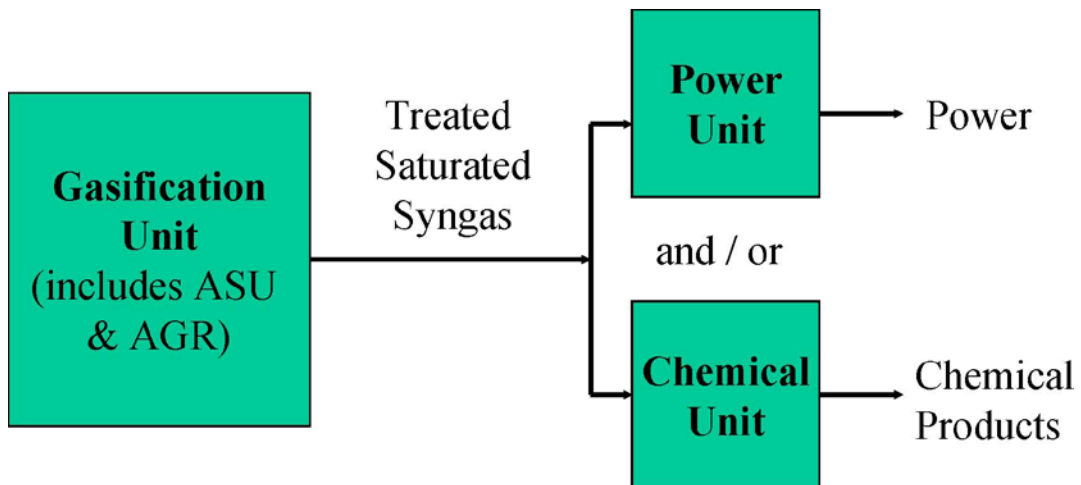
<b>Parameter</b>	<b>Units</b>	<b>Parameter Value</b>
Inlet Pressure	MPa (psia)	15.3 (2,215)
Outlet Pressure	MPa (psia)	10.4 (1,515)
Inlet Temperature	°C (°F)	35 (95)
N <sub>2</sub> Concentration	ppmv	< 300
O <sub>2</sub> Concentration	ppmv	< 40
Ar Concentration	ppmv	< 10



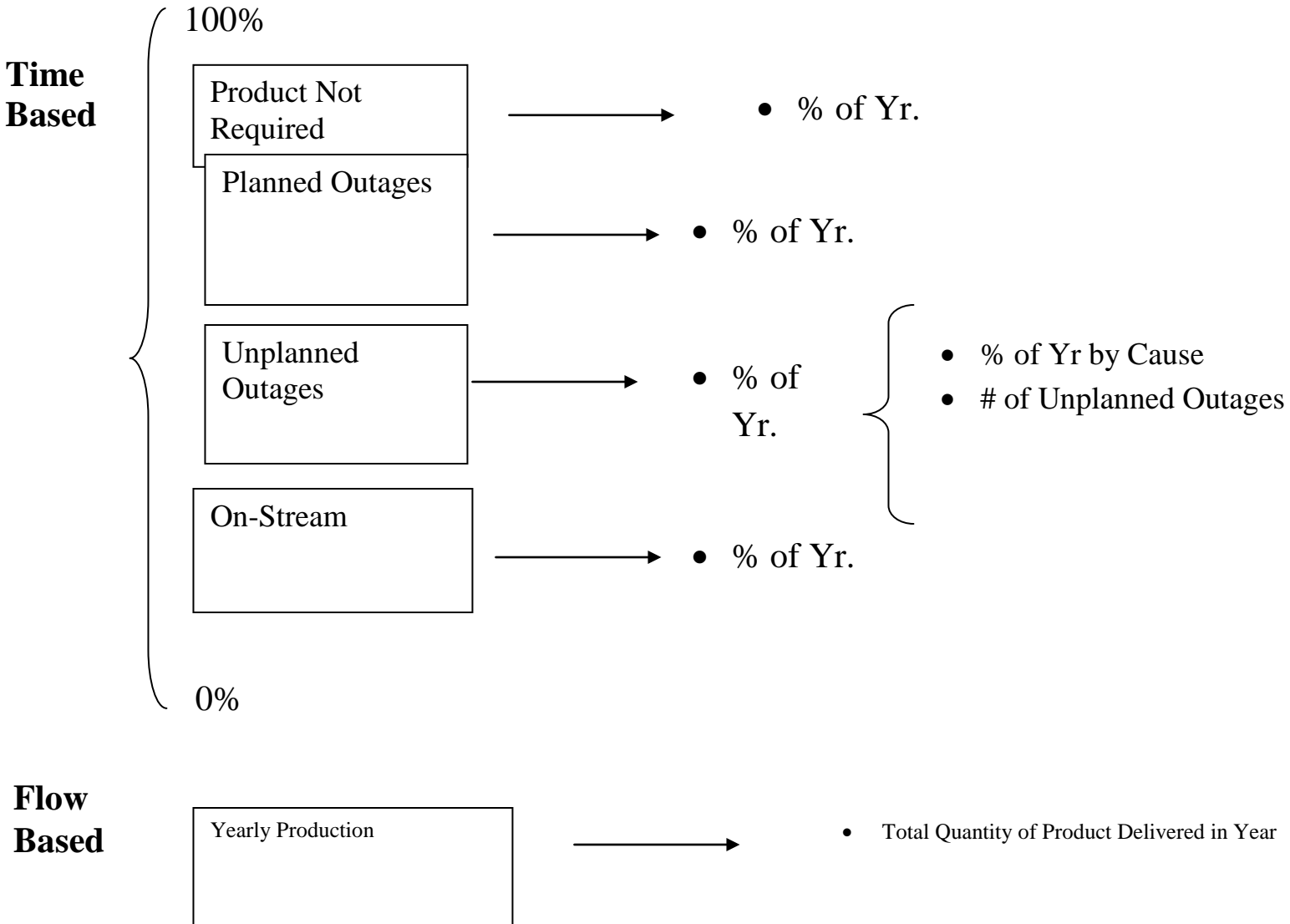
# GTC Guidelines for Reporting Operating Statistics

- The objective of these guidelines is to present a standardized way for reporting the operating statistics of gasification facilities. The statistics are primarily time-based, however, a single flow-based indicator is also included. An example is included.
- The gasification facility is divided into two units so that the operating statistics can be reported for each of these critical areas of the facility. The units are defined as follows:
  - Gasification (including ASU and Acid Gas Removal Unit )
  - Product Units
  - Power production block, and / or
  - Chemical production block
- Authors are also asked to indicate the specific configurations of the units with regard to back-up and multiple trains.

# Gasification Facility Operating Units



## Unit Operating Statistics – Measured



## Definitions – Measured Statistics

- Product Not Required
  - % of year that the product from the unit was not required, and therefore, the unit was not operated. The unit was generally available to run and not in a planned outage or forced outage.
- Planned Outages
  - % of the year that the unit is not operated due to outages which were scheduled at least one month in advance. Includes yearly planned outages as well as maintenance outages with more than one month notice.
- Unplanned Outages
  - % of the year the unit was not operated due to forced outages which had less than one month notice. Includes immediate outages as well as maintenance outages with less than one month notice.
- On-Stream
  - % of the year the unit was operating and supplying product in a quantity useful to the downstream unit or customer.
- Yearly Production
  - Defined as the total quantity of product actually delivered from the unit in a calendar year. For the gasification unit the production is reported on the basis of total clean synthesis gas.

# Unit Operating Statistics - Calculated

**Time  
Based**

$$\text{Forced Outage Rate} = \frac{\text{Unplanned}}{[\text{On-Stream} + \text{Unplanned}]}$$

$$\text{Availability} = \frac{\text{On-stream} + \text{Product Not Required} * [1 - (\text{Forced Outage Rate}/100\%)]}{\text{On-stream} + \text{Product Not Required}}$$

**Flow Based**

$$\text{Annual Loading Factor} = \frac{\text{Yearly Production}}{\text{Rated Capacity}}$$

# Definitions – Calculated Statistics

- **Forced Outage Rate**

- Defined as the time during which the down-stream unit or customer did not receive product due to unplanned problems divided by the time during which they expected product, expressed as a percentage.

- **Availability**

- Defined as the sum of the time during which the unit was on-stream plus an estimate of the time the unit could have run when product was not required, expressed as a percentage of the year. Assumption is that unit could have operated at the same Forced Outage Rate when product was not required.

- **Annual Loading Factor**

- Defined as the yearly production of the unit divided by the rated capacity, expressed as a percentage.

- **Rated Capacity**

- Defined as the design quantity that the unit would produce at the design rate over the calendar year when operated in an integrated manner. Calculated by multiplying 365 times the average annual daily design rate. Note that the Design Production can change over time as the plant is debottlenecked or re-rated.

# Example

- **Operating Unit is a gasification train which is designed to make 200 mmscfd of syngas**

- **Measured Unit Operating Statistics for this Example:**

- Product Not Required = 10% of year
- Planned Outages = 8 % of year
- Unplanned Outages = 4% of year
- Breakdown of the 4% by Cause
  - Report # of interruptions
- Onstream = 78% of year
- Yearly production = 55,000 mmscf of syngas

- **Resulting Calculated Unit Operating Statistics:**

- Forced Outage Rate =  $4\% / [ 78\% + 4\% ] = 4.9\%$
- Availability =  $78\% + 10\% * [ 1 - (4.9\% / 100\% ) ] = 78\% + 9.5\% = 87.5\%$
- Rated Capacity =  $365 \text{ d} * 200 \text{ mmscfd} = 73,000 \text{ mmscf}$
- Annual Loading Factor =  $55,000 \text{ mmscf} / 73,000 \text{ mmscf} = 75.3\%$

## ATTACHMENT 3: Bibliography

<b>Attachment 3 - Bibliography</b>	
<b>Example Literature Discussing Availability Issues With Gasification Plants</b>	
1	Holt, N., "Operating experience and improvement opportunities for coal-based IGCC plants," <i>Materials at High Temperatures</i> , 20(1), 1-6, 2003
2	Holt, N., Coal-based IGCC Plants – Recent Experience and Lessons Learned, EPRI, Palo Alto, CA, Gasification Technologies Conference, Washington, DC October 4-6, 2004
3	Phillips, J., "RAM Modeling of UDSB Configurations," EPRI, Palo Alto, CA, USA, CoalFleet General (Technical) Meeting, Greenville, SC, July 24, 2007
4	Higman, C., "Integrated Gasification Combined Cycle (IGCC) Design Considerations for High Availability–Volume 1: Lessons from Existing Operations," EPRI, Palo Alto, CA: 2007, 1012226.
5	T. Rui, "Integrated Gasification Combined Cycle (IGCC) Design Considerations for High Availability–Volume 2: RAM Modeling of Standard Designs," EPRI, Palo Alto, CA, 2007, 1014871.
6	Domenichini, R., "Precombustion Capture Plants IGCC with CCS, Design and Experience," Foster Wheeler Italiana, Workshop on Operating Flexibility of Power Plants with CCS, London, UK, November 12, 2009.
7	Bressan L. and S. Curcio, "A key aspect of integrated gasification combined cycle plants availability," Foster Wheeler Italiana, IChemE Gasification Technology in Practice, Milan – Italy, 1997
8	Higman, C., Della Villa, S. and Steele, R. "The Reliability of IGCC Power Plants." Presented to Gasification Technologies Conference, San Francisco, October 2005.
9	Higman, C., Della Villa, S. and Steele, R. "The Reliability of IGCC Power Generation Units." Paper presented at IChemE European Gasification Conference, Barcelona, April 2006.
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11	Higman, C., Della Villa, S. and Steele, R. "The Reliability of IGCC Power Generation Units," Paper presented at 22nd Annual International Pittsburgh Coal Conference, Pittsburgh, PA, Sept. 11-15, 2005