NATIONAL ENERGY TECHNOLOGY LABORATORY

Standard Systems Analysis Study Requirements

January 2009

Disclaimer

A. General Requirements

The following requirements are applicable to all ESPA related systems analyses work. Any deviations to these items must be agreed to in advance by the Task COR.

1. None of the work performed under this Task – including analysis results and the associated models/simulations -- shall be presented or delivered to sources outside of NETL without the prior authorization of NETL. For more information, see Section I Clause "970.5227-1 Rights in Data – Facilities (DEC 2000)".

2. Economic analyses shall use the NETL Power Systems Financial Model (PSFM) unless there is a significant benefit of using an alternative approach, and this alternative shall be approved in advance by the Task COR. Additional information on the PSFM model is in the PSFM User Guide and can be downloaded from the Site Support Contractor Solicitation—Electronic Reading Room http://www.netl.doe.gov/business/solicitations/ssc2008/DE-SO26-08000664.html

3. As part of the project documentation, all process models developed as part of the project (e.g., AspenPlus input files) must be delivered to DOE with brief documentation that describes the modeling approach. For AspenPlus simulations, interfaces shall be provided (using OSE workbook) for easy reporting/tabulating of key results. Process models shall be delivered with their respective final reports.

4. Model cases using only non-proprietary information. If approved in advance by the Task COR, proprietary data may be used to develop an enhanced simulation based on the initial, non-proprietary simulation.

5. The contractor shall notify the COR whether any existing or planned secrecy agreements will impact NETL's ability to manipulate/publish the results of the proposed work. The COR must approve of the use of proprietary data in advance of its inclusion in the analysis or simulations/models.

6. All simulations/models shall run in the current NETL software/hardware environment.

7. Each model/simulation shall encompass the complete system within the plant boundary.

8. Simplified steam and gas turbine cycles are acceptable in an AspenPlus simulation if the supporting models used to develop the simulation are included as well (such as spreadsheet models, GateCycle simulations, GTPro models, etc.)

9. Unless agreed to by the COR in advance, the Office of Systems Analysis and Planning requires that all products be developed using software that is compatible with NETL's software infrastructure and/or use software license agreements available at NETL for the following software packages:
   ASPENPlus 2004 and 2006
   Thermoflow (Thermoflex, SteamPro and PEACE)

GTPro
VISIO Professional 2007

B. Standard System Study Scope

Systems studies shall encompass the following scope unless directed otherwise.

The technical and environmental performance of each case shall be derived from an AspenPlus process simulation and shall include:

- design basis description
- plant description
- block flow diagram
- component descriptions
- sparing philosophy
- process flow diagrams
- stream table
- energy balance
- mass balance
- carbon balance
- sulfur balance
- water balance
- technical performance assessment (e.g., efficiency, effective thermal efficiency, feedstock requirements, product outputs, parasitic loads, etc.)
- environmental performance assessment (e.g., air emissions, characterization of any liquid or solid waste streams)

At a minimum, the economic performance of each case shall include:

- estimation of capital cost, including contingencies as appropriate
- estimation of operating and maintenance costs
- estimation of carbon dioxide transport, storage and monitoring costs
- estimation of the required selling price of the primary product via a detailed discounted cash flow analysis using the NETL Power Systems Financial Model (PSFM)
- if electric power is a product, estimation of the first-year cost of electricity (COE) and thirty-year levelized COE using the NETL PSFM or via a simpler, capital charge factor computation
- sensitivity analysis of key parameters impacting COE, including a tornado diagram

C. Standard System Study Deliverables

System study deliverables must meet the following requirements unless directed otherwise.

Design Basis

This document shall describe the approach the contractor intends to take to perform the system study, including, but not limited to, assumptions regarding:

- plant location and ambient conditions
- fuel types and characteristics
- technology selections for key components
- key assumptions and design decisions, and a brief discussion of why other reasonable options were not selected
- block flow diagram
- environmental requirements, such as key permitting limits
- year basis of cost estimation
- finance structure
- data quality requirements and quality assurance procedures

Interim Technical Status Reports

An interim technical status report shall be delivered for each system study case. This report shall express in tabular form, with minimal explanatory text, the initial results of process modeling and/or simulation. The purpose of the interim status is twofold: i) to transmit draft results as soon as possible to DOE, and ii) to give the Task Manager an opportunity to redirect the case if necessary before the contractor proceeds with its detailed documentation. The interim status shall contain the following elements:

- block flow diagram
- data required by Table 1
- stream table
- energy balance table(s)
- carbon balance table
- sulfur balance table
- water balance table
- technical performance summary table

Detailed narrative descriptions, cost estimates, and economic and environmental performance assessments are not required as part of the interim status report.

Process Models

As part of the project documentation, all process models developed as part of the project (e.g., AspenPlus input files) must be delivered to DOE with brief documentation that describes the modeling approach. For AspenPlus simulations, interfaces shall be provided (using OSE

workbook) for easy reporting/tabulating of key results. Process models shall be delivered with their respective final reports.

Economic Spreadsheet Tools/Models

As part of the project documentation, all economic spreadsheets/models/tools (developed in EXCEL or other program such as the NETL Power Systems Financial Model) developed as part of the project must be delivered to DOE with brief documentation that describes the financial approach and calculations. All economic models shall be delivered with their respective final reports.

Process Flow Diagrams

As part of the project documentation, all process flow diagrams (developed in Visio, EXCEL or another computerized aided drawing software package) developed as part of the project must be delivered to DOE with their respective final reports.

Final Reports

A Final Report shall be completed for each case that documents the work completed according to the prescribed scope. The guidance below shall be followed for applicable sections of the report:

1. Plant Description - Provide a written description of the entire plant from a process engineering perspective. The narrative should feature thoughtful analysis that explains why key assumptions and design decisions were made in light of the options available – it should document the thought process that was the basis of the system configuration and modeling. As appropriate, other report elements can be integrated with the plant description, e.g., block and process flow diagrams.

2. Component Descriptions - For each major component or subsystem, provide the information required to fill out Table 1. The table is provided merely as an example; the exact format in which the information is presented is left to the discretion of the analyst.

3. Sparing Philosophy - Identify major equipment components that have been specified as part of a sparing strategy (e.g., a spare gasifier) and describe how spares affect the assumptions made regarding plant availability and capacity factor.

4. Block Flow Diagrams and Stream Tables - Block flow diagrams should be included that identify all key components and number all key process streams. Stream tables that are keyed to the block flow diagram should also be provided.

5. Process Flow Diagrams - Include process flow diagrams (which show more detail than block flow diagrams) as appropriate to document the analysis and/or enhance the clarity of other sections.

6. Heat and Mass Balances - Provide tables that quantitatively demonstrate that heat and mass streams are balanced for the overall system and selected subsystems (e.g., gasification, gas cleanup, gas turbine, steam cycle). Energy balances must break down the energy content of inlet and outlet streams into the following categories: chemical energy (HHV), sensible and latent energy, and electrical energy (power). Energy balance tables should include "process losses" and be accompanied by narrative that provides insights into where energy is being "lost".

7. Capital & O&M Costs - The capital cost shall be built up by each major component or subsystem, including the process contingency applied to each. Furthermore, the estimation basis for each cost component shall be provided, e.g., a programmatic cost target, a factored analysis based on a similar system, vendor estimates for commercial equipment or vendor projections for conceptual equipment. Fuel costs and fixed and variable O&M costs shall also be built up by major plant section.

8. Environmental Performance - Tables shall be included that compares each case's environmental performance with the applicable regulatory requirements.

9. Conclusions and Recommendations - A thoughtful analysis of key findings and recommendations for follow-on work should be included.

Table 1: Description of Key Components / Subsystems

Component / Subsystem	Technology Type	Basis for Design & Performance (check one)			Operating Conditions*				Assumed or Specified Performance Characteristics**	Calculated Performance Characteristics	Contaminant Removed, (% Removed)	Assumptions Regarding Anticipated Application Issues***
					Inlet		Outlet					
		self-defined or generic	vendor data - commercial design	vendor data - future design	Temperature (F)	Pressure (psia)	Temperature (F)	Pressure (psia)				

* Provide inlet and/or outlet operating conditions for the component, as appropriate.

** List any performance parameters that were assumed for the component, e.g., efficiency, conversion, etc.

*** List any assumptions that were made about the ability of the component to overcome anticipated application issues, e.g., tolerance to contaminants, ability to withstand pressure/temperature.