Standard Analysis Study Scope and Reporting Requirements

DOE/NETL-XXXXX

September 2008

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General Subtask Requirements

The following requirements are applicable to **all activities in this subtask**. Any deviations to these items must be agreed to in advance by the subtask COR.

1. **None of the work performed under this subtask – 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 clause "I.63 Rights in Data - Special Works". The clause contains release and use restrictions.**

2. The NETL Quality Guidelines for Energy System Studies shall be consulted for guidance on defining, implementing and documenting each case study. Strict adherence to all the guidelines is not mandatory; rather, only those aspects that are deemed practical and appropriate for the purpose and scope of the subject work should be followed.

3. Economic analyses shall use the NETL Power Systems Financial Analysis Model unless there is a significant benefit of using an alternative approach, and this alternative shall be approved in advance by the subtask COR.

4. 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. Process models shall be delivered with their respective final reports.

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

6. 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.

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

8. A simulation shall be developed for each case or scenario outlined in the statement of work unless noted otherwise.

9. Each model/simulation shall encompass the complete system (from coal to busbar or coproducts). Simplified steam and gas turbine cycles are acceptable in the AspenPlus simulation if the supporting models used to develop the simulation are included as well (such as spreadsheet models, GateCycle simulations, GTPro models, etc.)

10. The Steam Cycle shall be modeled using internal Aspen Fortran calculator blocks. External code, or proprietary code, is not to be utilized unless approved for use by the COR in the analysis or simulations/models.

Standard System Study Scope

Systems studies shall encompass the following scope unless directed otherwise by a specific Activity statement of work.

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, including calculation of "system CO_2 capture"
- 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 O&M costs
- estimation of carbon dioxide transport, storage and monitoring costs
- estimation of the first-year COE and twenty-year levelized COE via a detailed discounted cash flow analysis [using the NETL Power Systems Financial Model (PSFM)] or via a simpler, capital charge factor computation. The contractor shall determine the appropriate type of economic analysis in consultation with the DOE Subtask Manager.
- sensitivity analysis of key parameters impacting COE, including a tornado diagram.

Standard System Study Deliverables

System study deliverables must meet the following requirements unless directed otherwise by a specific Activity statement of work.

Work Plan

Prior to beginning work, a Work Plan shall be submitted to, and approved by, the DOE Subtask Manager. The Work Plan shall be prepared in cooperation with the DOE Subtask Manager, and shall include the following information for each objective, as applicable.

- The approach that the Contractor intends to use to complete the objective, including, as appropriate, a more detailed schedule with intermediate milestones.
- A list of any issues or questions that need to be addressed by the DOE Subtask Manager.
- Any deviation from the list of key personnel that the Contractor originally proposed for the activity.

Interim Technical Status Reports

An interim technical status report shall be delivered for each system study case. This report shall express in tabular form 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 Subtask 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
- stream table
- energy balance table(s)
- carbon balance table
- sulfur balance table
- water balance table
- technical performance summary table

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

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 Spreadsheets

For all cases, complete and deliver the "Economic Spreadsheet Tool" supplied by OSAP.

-For the "Total Plant Cost Worksheet" the input values will be highlighted which include the input values for: Equipment Cost, Material Cost, Labor (Direct and Indirect) and % Contingencies (Project and Process), %Eng'g CM H.O. & Fees, Plant Size. The spreadsheet will calculate the following based on the input values: Bare Erected Cost, Engineering Fees, Contingencies and Total Plant Cost ($ and $/kW).
-For the "Summary Economic" worksheet, complete all highlighted input values on the "Initial & Annual O&M Expenses". Verify that all results in this spreadsheet match those of the cost estimator.
-For the "Capital Investment & Revenue Requirement Summary", verify all results to match those of the cost estimator.

Final Report Requirements

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 1.2. 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. [Programmatic cost targets should not be used as a cost estimation basis unless specified by the COR] Fuel costs and fixed and variable O&M costs shall also be built up by major plant section.

8. Carbon Mitigation Cost Analysis: For any case/study/analysis with CO_2 capture, the following values are to be calculated (when compared to an identified "Base Case/No Capture Plant") and tabulated into all results and summary tables: a.) Incremental capital cost, b.) Incremental COE (in mills/kWh or cents/kWh), c) % increase in COE, d.) \$/ton CO_2 captured, e) \$/ton CO_2 avoided.

9. Carbon Dioxide Transport, Storage and Monitoring: Using the NETL OSAP Transport, Storage and Monitoring Cost Spreadsheet, calculate and tabulate T,S&M costs for all cases involving CO_2 capture.

10. Environmental Performance: Table(s) shall be included that compares the case's environmental performance with the applicable regulatory requirements.

11. Complete Water Balance

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

Fact Sheet Frameworks

Fact Sheet Frameworks are to be delivered along with each Final Report. The objective of the Fact Sheet Framework is to provide narrative, diagrams and data sufficient for DOE to format into an NETL Fact Sheet that provides an overview of the corresponding Final Report. The contractor will provide DOE with the information necessary to produce each Fact Sheet, but will not generate the Fact Sheets.