Programme Area: Carbon Capture and Storage

Project: Network Modelling

Title: Executive Summary

Abstract:

Given the required speed of roll-out, cost and complexity of the future CCS infrastructure in the UK, modelling will play a crucial role in ensuring a practical, cost effective and robust network of assets. Modelling can potentially support decisions at a range of business levels, from strategic planning through to plant & system operation and maintenance. Through detailed strategic analysis and stakeholder engagement, the ETI has identified that a need exists to develop a Modelling Tool-Kit for partial (but full-chain) CCS systems to develop understanding of and support business decisions around the design, operation and maintenance of assets (eg power stations, compressor stations) within a future CCS system. In order to define the requirements for such a Modelling Tool-Kit, the ETI commissioned a short FRP Project, led by E4tech and supported by Process System Enterprises (PSE) and Amec. The project made recommendations on the functionality of the component & whole system models and the modelling environment within which such models would be developed. Based on the project's recommendations, the ETI launched a Request for Proposals for a full project to develop a Modelling Tool-Kit in October 2010.

Context:

A scoping study to identify the requirements for the project subsequently procured by the ETI to develop a CCS system modelling toolkit.

ETI Executive Summary

Programme: Carbon Capture & Storage

Project Name: System Modelling FRP

Deliverable: CC2003/D5

Introduction

Given the required speed of roll-out, cost and complexity of the future CCS infrastructure in the UK, modelling will play a crucial role in ensuring a practical, cost effective and robust network of assets. Modelling can potentially support decisions at a range of business levels, from strategic planning through to plant & system operation and maintenance.

Through detailed strategic analysis and stakeholder engagement, the ETI has identified that a need exists to develop a Modelling Tool-Kit for partial (but full-chain) CCS systems to develop understanding of and support business decisions around the design, operation and maintenance of assets (eg power stations, compressor stations) within a future CCS system.

In order to define the requirements for such a Modelling Tool-Kit, the ETI commissioned a short FRP Project, led by E4tech and supported by Process System Enterprises (PSE) and Amec. The project made recommendations on the functionality of the component & whole system models and the modelling environment within which such models would be developed.

Based on the project's recommendations, the ETI launched a Request for Proposals for a full project to develop a Modelling Tool-Kit in October 2010.

Project Approach

A multi-disciplinary team from E4tech, PSE and Amec engaged with ETI member organisations and other potential stakeholders in the CCS Modelling Tool-Kit to develop a set of end-user requirements. Responses from the stakeholder interviews were collated and used to develop a series of findings that were in turn used to develop requirements for the Tool-Kit. Results from this process were presented back to key ETI members in a focus group meeting to ensure that the team's findings accurately reflected the collective view of the required Tool-Kit capabilities.

In addition a review of potential modelling tools was completed, and suggestions made for a project plan to develop an initial version of the CCS Modelling Tool-Kit.

Results summary

The report (Reference 1) includes:

- A list of requirements for the modelling Tool-Kit including:

  - Use cases

  - General Tool-Kit capabilities

  - Provisional lists of subsystems, components, events, scenarios and species that the Tool-Kit must be capable of modelling

  - Requirements for the physical property models

- A review of available modelling tools and recommendations regarding the suitability of various types of modelling tools for the CCS Tool-Kit modelling needs

- Recommendations on an approach to Tool-Kit validation as well as information on potential sources of validation data

- Recommendations on the structure of a phased Tool-Kit development project

- Recommendations on potential Tool-Kit development project participants

The outline of the recommended phased Tool-Kit development project is as follows:

- Development of a detailed technical specification

- Development of Tool-Kit core functionality

- Component, subsystem and system model testing and verification

- Delivery, deployment and training

- On-going support and development

The team estimated that the Tool-Kit development project would represent a 24 to 36 calendar month effort that would require a budget on the order of £1.5 to £2.5 million. The team also recommended that effective completion of the Tool-Kit development project would require a consortium including a modelling company or software developer and an engineering company with support provided by specialists in key technology areas.

Key findings

- The Tool-Kit must be able to interface to a wide range of existing and future modelling tools, including proprietary models

- The Tool-Kit must include a full suite of non-proprietary subsystem and component models that would enable any given user to put together a model of a complete representative CCS chain

- The Tool-Kit non-proprietary models must have the capability to match each other on operating characteristics and size, that is, they must include some sizing capability

- The modelling of time-dependent events down to a timescale of seconds was seen as a priority although the modelling of sub-second timescale events such as pressure waves was seen as beyond the immediate scope of the current exercise

- The Tool-Kit must include a set of physical property model as this is seen as a key enabler for model integration. These physical property models must be able to demonstrate robust behaviour close to the critical point of pure CO_2 and mixtures of CO_2 and other gases

- The Tool-Kit is not intended to capture details of multi-phase flow but should issue warnings if phase boundaries are being approached in a process

- The Tool-Kit must include rich capability for modelling and defining time-based events as the key operational events of interest to stake holders are time dependent

- Producers of the Tool-Kit will be required to retain responsibility for future Tool-Kit development and support.

Further work

A Request for Proposals for a CCS Operational Modelling Tool-Kit development project was published in October 2010 with the aim of establishing 2 – 3 year ETI project with funding of the order of £2M.

References

1. Modelling of Carbon Capture and Storage: Project Definition Study. Final Report, September 2010