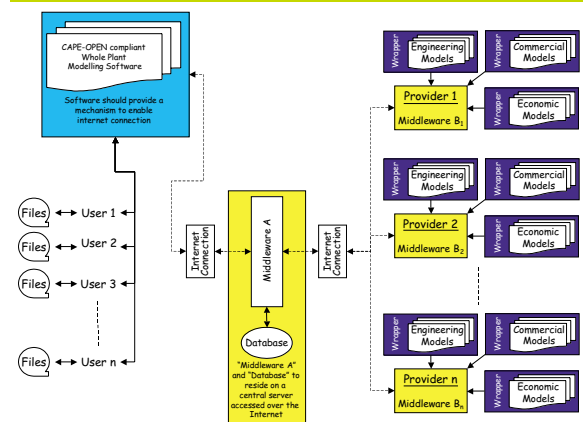## OBJECTIVES

- To develop a detailed, written specification defining the required Virtual Plant Demonstration Model (VPDM).

- To develop the design of the interface structure and middleware required for the VPDM.

- To obtain data for model testing and validation.

- To construct the VPDM, test and validate it.

- To demonstrate that the VPDM meets the specification and, in particular, that it is possible to link a variety of components and whole plant models across the internet.

- To apply the VPDM to a new fossil fuel technology that is of interest to UK plc, which incorporates $CO_2$ capture.

## SUMMARY

UK power generation and associated industries are facing growing pressures from ever-tightening environmental constraints, the drive for sustainability and increasing global competition. This provides new challenges and applications for power plant modelling in: new plant development; design and manufacture; plant demonstration and authorisation; engineering support. The recently completed project on Power Plant Modelling (see Project Summary 336), which was supported by the DTI, proposes a new UK power plant modelling initiative: the development of a VPDM.

A future VPDM will provide an integrated software framework which will allow the full potential for whole-plant software modelling to be realised. As a result, UK industry could provide competitive power plant solutions and ultimately zero emission technologies with significantly reduced development costs, risk and very competitive prices. The development of the full VPDM will be split into two phases, each lasting three years.

**Phase 1** will develop the whole plant concept of the VPDM with integrated components utilising the internet. The VPDM developed will be limited for application to steady state operating conditions. Phase 1 will also include two whole plant applications: a test application based on an existing plant and a demonstration application



Virtual plant demonstration model basic framework

that will include a new fossil technology of interest, eg carbon capture.

Completion of Phase 1 will produce a VPDM that will be able to utilise the most accurate component models available, many of which are proprietary and residing on various hardware platforms at different locations. It will also introduce common standards for interfacing. Both of these attributes will give significant benefits over other existing power plant models.

**Phase 2** will extend the Phase 1 VPDM to include dynamics and control analysis. Developments will also be made that will allow integration with design and construction management software.

This project undertakes Phase 1 of the VPDM development. The project will also propose a mechanism for supporting the developed VPDM in the future to benefit UK plc.

The basic framework that will form the core of the VPDM is illustrated in the figure. The whole plant model will be the user's selected model, which could be a commercial or an in-house software package. The component models will be application - specific but they are likely to be a selection of: furnaces; boilers; gasifiers; gas turbines; steam turbines; fuel cells; $CO_2$ capture plant.

The interface structure will need to be standardised for all the software modules and the CAPE-Open standard will be the first approach to be tried. The middleware A and B will manage the communications, security, register of component module addresses, etc.

Some of the key activities in this project are being developed into a collaborative project with the US Department of Energy (USDOE) under the auspices of the Memorandum of Understanding on energy research between the UK and the USA. Although this UK VPDM project does not need these UK-US collaboration activities to achieve its objectives and benefits, successful collaborations will provide the additional benefits of: developing compatible US and UK platforms for integrating plant simulation programs; adopting common security systems to protect confidential and proprietary information; advancing the incorporation of computational fluid dynamics into system models.

## COST

The total cost of this project is £2,349,100, with the Department of Trade and Industry (DTI) contributing £1,170,119, and the partners the balance.

## DURATION

36 months – July 2004 to June 2007

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