U.S. DEPARTMENT OF ENERGY

# UK-US Collaboration on Fossil Energy R&D
## Advanced Materials

DEPARTMENT OF ENERGY & CLIMATE CHANGE

**project duration**
April 2004 - April 2009

**project partners**

**UK:**
Alstom Power Ltd
Cranfield University
* National Physical Laboratory

**US:**
Alstom Power
* Oak Ridge National Laboratory

** Task Leaders*

# Standards and Databases

## background

**With the continued drive for the development of new and improved materials and the optimal use of existing materials in a cost effective manner, the ability to share and compare data and testing methods from laboratories is of increasing importance. Collaborative programmes such as this offer clear financial and technological advantages to those involved, through the sharing of resources, results and complimentary laboratory work. With the ever-increasing global partnerships and national testing sources involved in co-operative materials testing programmes, the need for comparability between results and an efficient, comprehensible method for data collection, analysis and exchange is essential.**

Recognizing that the overall UK-US programme would generate a significant amount of test data using numerous different test methods within each of its tasks and in order to capture this information and evaluate any difference in results, a Standards and Databases task was established.
The overarching aim was to provide standardized tools for the entire programme that would:

- Allow transfer of data, between partners and between tasks by setting up a consistent and easily accessed data transfer format
- Ensure that the testing techniques applied by the various partners would be directly comparable
- Create a database structure suitable for storage and retrieval of materials and microstructural data

With the variety of data envisaged and the quantities that were projected to be generated, the UK-US collaboration provided a highly suitable arena in which to build and validate such tools. Within this developed structure, the methods used and the data generated in all tasks have been recorded and stored. This task's long-term goal is for future co-operative projects to adopt the tools produced and continue to populate and use them, within the limits of the collaborative agreement.

## objectives

- To identify critical differences between standards for measurement of high temperature materials properties
- To identify where further standardization for measurement of high temperature materials properties is required
- To develop a common format for data exchange and use this to disseminate the results of the test work within the consortium
- To investigate the use of commercial database software for collecting and maintaining materials properties data and micrographs

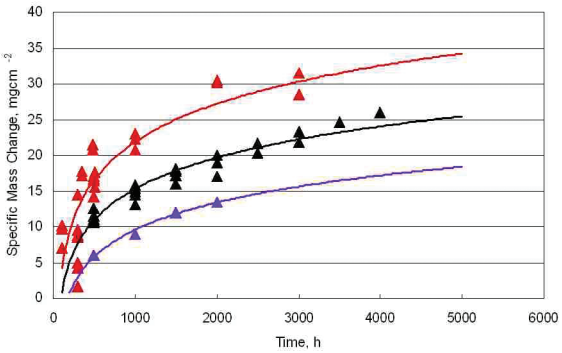


Figure 1. Comparison of steam oxidation data for T92 material at 650 °C

## work programme

The task consisted of three main parts, a review of current standards, the development of a data exchange and storage tool and an inter-comparison exercise for boiler corrosion and steam oxidation testing. The review of standards was focussed on the availability or otherwise of national or international testing standards of relevance to the partners, a decision was taken to exclude "material specification" standards from this activity. Whilst it was acknowledged that many of the standards already existed a review was deemed timely to examine whether further work within the collaboration was required.

Across all tasks it was clear that a large amount of data would be produced and that a data transfer and collation method was therefore required. The data transfer method deemed most appropriate was based around spreadsheets. These were distributed to all the partners for data collation including metadata and test results and collected at the end of the collaboration and will remain available to all partners. In addition, a database was developed which acts as a repository for the data and would also enable the collation and labelling of any micrographs generated.

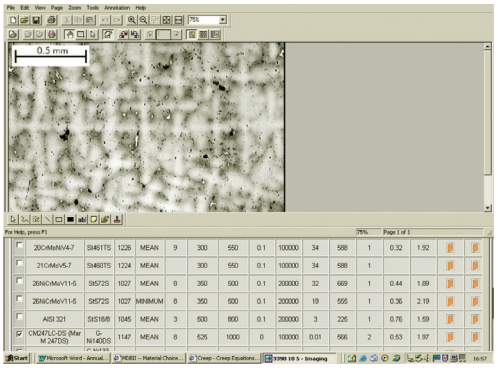


Figure 2. Typical display of a micrograph contained in the database of results.

The third part of the work program concerned running two international inter-comparison exercises. The first of these was in conjunction with the steam oxidation task and participants conducted tests following in-house practices on common materials and temperature conditions. The second inter-comparison exercise was concerned with boiler corrosion. The test procedure in this case was more prescriptive with the temperature, salt deposit and gaseous atmosphere all being well defined.

## key results

- The need for additional activities to revise current or develop additional standards for high temperature mechanical testing is not required at this time
- A method of data collection and storage has been designed to allow rapid communication of test data (including detailed microstructural information) between national and international organizations
- An inter-comparison exercise clearly demonstrated the requirement for standardization of high temperature corrosion tests, in particular for steam oxidation testing. Here clear differences relating to specimen geometry, test method and specimen preparation resulted in different oxidation rates and exfoliation properties. An example of this is shown in Figure 1
- In the case of the boiler corrosion inter-comparison, which was performed under more prescribed conditions, there was generally good agreement between the laboratories for longer duration tests (1000 h), but some differences in the metal loss rate were identified for shorter duration tests. At higher temperatures these aggressive tests produced more scatter between the participating laboratories, reinforcing the need to fully quantify test methodology and the measurement and analysis techniques
- The database of the results including microstructural data (Figure 2) generated during this collaborative programme continues to be populated and made available to the participants

## future activities

- Further work is recommended to address the scatter shown in the steam oxidation inter-comparison. Issues such as the effect of pressure, specimen geometry and testing procedure need to be addressed and a best practice agreed on. This should lead to future standardization for steam oxidation testing
- The boiler corrosion inter-comparison tests showed some scatter and a repeat exercise under less harsh conditions would help to develop improved methods for specimen manufacture and metal loss measurement, the two areas identified as possible causes of the scatter
- Continued use of the data collection and storage tools developed in the task should be maintained
- Whilst future activities have been identified and are worthwhile, doing these as part of a separate task is deemed to be unnecessary, and so future activities around data collection, analysis and testing will be integrated into individual future tasks

Further information on the UK-US Collaboration on Energy Research and Development, please visit - http://us-uk.fossil.energy.gov/