PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Advanced Research

09/2004

NOVEL CORROSION SENSOR FOR ADVANCED FOSSIL ENERGY POWER SYSTEMS

Description

The overall objective of this proposed project is to develop a new technology for on-line corrosion monitoring based on an innovative concept. The specific objectives and corresponding tasks are (1) develop the sensor and electronic measurement system; (2) evaluate and improve the system in a laboratory muffle furnace; and (3) evaluate and improve the system through tests conducted in a pilot-scale coal combustor (~1 MW).

Fireside corrosion refers to the metal loss caused by chemical reactions on surfaces exposed to the combustion environment. Such corrosion is the leading mechanism for boiler tube failures and is a serious concern for current and future energy plants due to the introduction of technologies targeting emissions reduction, efficiency improvement, or fuel/oxidant flexibility. Corrosion damage can lead to catastrophic equipment failure, explosions, and forced outages. The resulting economic loss can be substantial. Proper management of corrosion requires real-time indication of corrosion rate. However, currently there is no mature technology available for on-line fireside corrosion monitoring.

Phase I includes the development of the sensor design and feasibility demonstration. Phase II is focused on the design fabrication and pilot scale evaluation of the sensor prototype. The team members include experts from the University of Alabama at Birmingham, the Electric Power Research Institute, and the Southern Research Institute.

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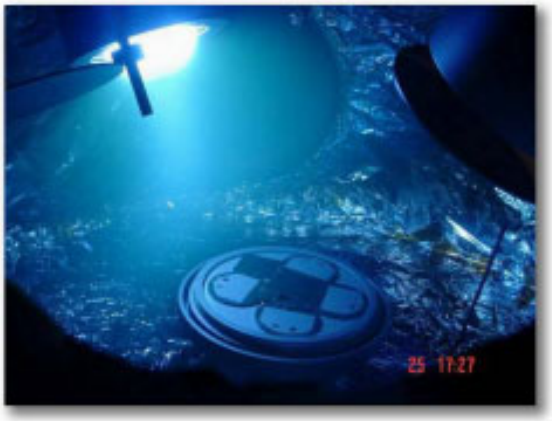

Sputtering deposition in the fabrication of the sensor.

PARTICIPANT / PRINCIPAL INVESTIGATOR

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PROJECT COST

$250,000

PROJECT DURATION

09/12/2001-07/31/2006

CUSTOMER SERVICE

1-800-553-7681

WEBSITES

www.netl.doe.gov/coal

Accomplishments

Phase I demonstrated that a micro sensor design using a ceramic substrate uniquely coated with two different metal materials could be used to measure the corrosiveness of a system by monitoring the change in capacitance of the sensor. The application method, deposition area, and materials can all be tailored for the system for which it is applied. Current efforts are focused on the manufacture of a sensor optimized for a coal combustion application and improvement to the data acquisition system. The sensor will be tested against corrosion coupons and other noncommercial on line methods. The pilot scale test will allow the sensor to be tested under conditions which cannot be simulated in the laboratory and provide data on the commercial viability of this novel approach.

Benefits

Having real time fireside corrosion data can help to accomplish the following:

- quickly diagnose corrosion problems;
- monitor the effect of operating condition changes on corrosion;
- provide advance warning of system upsets that could lead to corrosion damage;
- determine the need to invoke process controls;
- establish a realistic inspection or maintenance schedule; and
- accurately estimate the useful service life of equipment.

Because fireside corrosion has a negative economic impact on energy plant availability, corrosion management can increase the overall efficiency of the plant by accomplishing the following:

- reducing the negative economic impact such as plant downtime for repair;
- saving hundreds of millions per year;
- preventing corrosion damage leading to catastrophic explosions that endanger life and safety;
- assisting in reducing failure by providing a continuous assessment of corrosion rates; and
- aiding in predicting failure and conducting preventative maintenance.

Laboratory experimental system.