CORROSION MONITORING SYSTEM ENABLES UTILITY TO AVOID RELINING STACK AND DUCTS

"With data provided by EPRI's corrosion monitoring system, we now have a better understanding of corrosion activity at Petersburg Unit 3. As a result, we've decided it is not necessary to immediately reline our carbon steel ducts and stack."

Steve Wolsiffer
Indianapolis Power & Light Co.

PROBLEM Corrosion of outlet ducts and stacks has been a primary cause of flue gas desulfurization (FGD) system unavailability. Indianapolis Power & Light Co. (IPL) reheat the flue gas discharged from its limestone FGD system on Petersburg Unit 3, both to improve plume dispersion and to avoid corrosion in downstream components. The 510-net MW, coal-fired plant has been operating for the past nine years using bypassed flue gas and steam-heated indirect air to elevate the discharged flue gas temperature above the acid dew point, thereby avoiding a highly corrosive environment. To further protect the carbon steel outlet ducts and stack, IPL tested several different organic linings, but most failed due to thermal degradation. In 1989, although IPL detected no overt signs of pervasive corrosion, utility engineers considered relining or cladding the ducts and stack, since carbon steel FGD outlet ducts are normally very susceptible to corrosion. Relining would also enable the utility to operate the plant more efficiently using less extraction steam and reheat air.

SOLUTION IPL learned of EPRI's work in developing an on-line corrosion monitoring system that continuously measures and evaluates corrosion behavior in condensing environments. The system is particularly useful in thin condensate films, where conventional monitors cannot function. The system, which includes a microprocessor that statistically analyzes four types of electrochemical signals, can accurately determine general corrosion rates and crevice corrosion propagation rates. The signals can also be correlated to identify when pitting attack is initiated. With system monitoring instrumentation loaned by EPRI, and probes, as well as technical assistance, provided by the system developer, IPL used the corrosion monitor to study the separate effects of changes in boiler load and coal sulfur content, in combination with varying amounts of both bypass gas and reheat air. The monitor provides continuous indication of corrosion activity, which engineers can relate directly to plant operating conditions. The data established IPL confidence in the integrity of the stack and ducts. The utility engineers decided against a relining outage and implemented continuous surveillance as a cost-effective alternative to immediately relining or cladding the stack. The data also provides the basis for operating guidelines that can optimize plant efficiency yet minimize the corrosive impact of harmful operating modes on bare carbon steel.

BENEFITS
- With the understanding of corrosion activity provided by the corrosion monitor, IPL was able to avoid relining the outlet ducts and stack at Petersburg 3, resulting in an estimated saving of $3.2 million.
- Using continuous, on-line corrosion monitoring, utilities can operate fossil units more efficiently with reduced outlet gas temperatures.
- Developed primarily for measuring corrosion rates in thin-film environments, particularly in FGD systems, EPRI's monitoring system can also be used elsewhere in power plant applications.
Calculated Value of Indianapolis Power & Light Co.'s Application

<table>
<thead>
<tr>
<th>Year</th>
<th>Investment Saving ($000)(1)</th>
<th>Fixed Charges(2)</th>
<th>O&amp;M(3)</th>
<th>Total</th>
<th>Present Value(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>-</td>
<td>100</td>
<td>3300</td>
<td>3400</td>
<td>3300</td>
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<tr>
<td>1991–1995</td>
<td>-</td>
<td>500</td>
<td>500</td>
<td>1000</td>
<td>372</td>
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<td><strong>Total estimated saving ($000)</strong></td>
<td><strong>3672</strong></td>
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<tr>
<td><strong>Levelized annual saving ($000)</strong></td>
<td><strong>880</strong></td>
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</tr>
</tbody>
</table>

Assumptions Used in Calculations

1. This application involves the delay of a major investment and the annual saving for that avoided cost: • IPL used EPRI's corrosion monitor to study the effects of boiler load and coal sulfur content on corrosion of the carbon steel ducts and stack at Petersburg Unit 3. Results of the monitoring program indicate that the rate of corrosion was almost always (i.e., throughout more than 95% of the test period) less than 5 mills per year during normal operation. Excursions were short-lived, and never exceeded a rate of 20 mills per year. Based on monitoring results, IPL now has confidence that the integrity of the carbon steel ducts and stack can be maintained until the next major outage opportunity. Consequently, IPL decided against immediately relining the stack and ducts. The utility estimates the present value of this benefit to be $3.2 million.

2. This application involves no fixed charges.

3. O&M saving is based on the following:
   • The corrosion trend data gives IPL a better understanding of corrosion behavior in the outlet ducts and stack. For example, the data revealed that corrosion increases with transient reductions in load as well as with prolonged operation above 500 MW. Reduced reheating leads to increased corrosion but IPL can now define acceptable limits. Using trend data, IPL can operate Petersburg 3 more efficiently with less extraction steam and reheating air and still minimize corrosion. Although the amount of associated saving is difficult to estimate, it could be appreciable over the remaining 20–30 years of plant operation. An estimated saving of 10% annual reheating cost is reflected in the above calculation.

4. The 1990 present value calculations assume an 11.5% discount rate.

References


EPRI reports are available from the Research Reports Center, (415) 965-4081.

Commercial Availability

The on-line corrosion monitor is being commercially developed by Capcis-March, Ltd. in the United Kingdom.

For further information, contact:
Electric Power Research Institute,
P.O. Box 10412, Palo Alto, CA 94303
Paul Radcliffe, Project Manager,
G&S Division, (415) 855-2720
Barry Syrett, Technical Support,
G&S Division, (415) 855-2956

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