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High SO_2 Removal Efficiency Testing

Quarterly Report
January 1 - March 31, 1997

By
Gary Blythe

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For
U.S. Department of Energy
Office of Fossil Energy
Federal Energy Technology Center
P.O. Box 880
Morgantown, West Virginia 26507-0880

By
Radian Corporation
P. O. Box 201088
Austin, Texas 78720-1088

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Prepared for:

Tom Feeley
U.S. Department of Energy
Pittsburgh Energy Technology Center
P.O. Box 10940
Pittsburgh, PA 15236

Prepared by:

Gary Blythe
Radian International
P.O. Box 201088
Austin, TX 78720-1088

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1.0 INTRODUCTION

This document provides a discussion of the technical progress on DOE/PETC project number DE-AC22-92PC91338, "High Efficiency SO_2 Removal Testing", for the time period 1 January through 31 March 1997. The project involves testing at six full-scale utility flue gas desulfurization (FGD) systems, to evaluate low capital cost upgrades that may allow these systems to achieve up to 98% SO_2 removal efficiency. The upgrades being evaluated mostly involve using performance additives in the FGD systems.

The "base" project involved testing at the Tampa Electric Company's Big Bend Station. All five potential options to the base program have been exercised by DOE, involving testing at Hoosier Energy'sMerom Station (Option I), Southwestern Electric Power Company's Pirkey Station (Option II), PSI Energy'sGibson Station (Option III), Duquesne Light'sElrama Station (Option IV), and New York State Electric and Gas Corporation's (NYSEG)Kintigh Station (Option V). The originally planned testing has been completed for all six sites. However, additional testing is planned at the Big Bend Station.

The remainder of this document is divided into four sections. Section 2, Project Summary, provides a brief overview of the status of technical efforts on this project. Section 3, Results, summarizes the outcome from technical efforts during the quarter, or results from prior quarters that have not been previously reported. In Section 4, Plans for the Next Reporting Period, an overview is provided of the technical efforts that are anticipated for the second quarter of calendar year 1997. Section 5 contains a brief acknowledgement.

2.0 PROJECT SUMMARY

On the base program, testing was completed at the Tampa Electric Company's (TECo) Big Bend Station in November 1992. The upgrade option tested was DBA additive. Additional testing is planned at this site, and that testing was begun during the last quarter of calendar year 1996. However, due to operating difficulties with the FGD system and test equipment problems, this testing was stopped after only four days. These problems are being resolved, and the testing is anticipated to resume in May 1997.

For Option I, at the Hoosier Energy Merom Station, results from another program co-funded by the Electric Power Research Institute (EPRI) and the National Rural Electric Cooperative Association have been combined with results from DOE-funded testing. Three upgrade options have been tested: DBA additive, sodium formate additive, and high pH set-point operation. All testing was completed by November 1992. There were no activities for this site during the current quarter.

Option II involved testing at the Southwestern Electric Power Company's Pirkey Station. Both sodium formate and DBA additives were tested as potential upgrade options. All of the testing at this site was completed by May 1993. There was one minor activity for this site during the current quarter - some follow-up chemical analyses on FGD solid byproduct samples.

On Option III, for testing at PSI Energy's Gibson Station, testing with sodium formate additive was completed in early October 1993, and a DBA additive performance and consumption test was completed in March 1994. There were no efforts for this site during the current quarter.

Option IV is for testing at Duquesne Light's Elrama Station. The FGD system employs magnesium-enhanced lime reagent and venturi absorber modules. An EPRI-funded model evaluation of potential upgrade options for this FGD system, along with a preliminary economic evaluation, determined that the most attractive upgrade options for this site were to

increase thiosulfate ion concentrations in the FGD system liquor to lower oxidation percentages and increase liquid-phase sulfite alkalinity, and to increase the venturi absorber pressure drop to improve gas/liquid contacting. Parametric testing of these upgrade options was conducted in March 1994. There were only reporting activities for this site during the current quarter.

Option V is for testing at the NYSEG's Kintigh Station. Baseline testing was conducted in July 1994. Parametric testing at this site was conducted in late August, and a sodium formate additive consumption test was conducted in September 1994. There were only reporting activities related to this site during the current quarter.

3.0 RESULTS

Results from the base program (at the TECo Big Bend Station) and the first optional site (Hoosier Energy Merom Station) were presented in detail in the April 1993 quarterly Technical Progress Report, and updates were included in the July 1993 and October 1993 reports. The additional testing planned for the Big Bend site began in late October but was stopped after four days because of various problems. This effort was briefly described in the previous (January 1997) Technical Progress Report.

For the second optional site (the Southwestern Electric Power Company's Pirkey Station), results were presented in the July 1993 quarterly Technical Progress Report and updated in the October 1993 report. During the current quarter, the Pirkey Station requested that we analyze some of their FGD solids byproduct samples to confirm their limestone utilization results. These analytical results are discussed below.

For the third optional site (the PSI Energy Gibson Station), baseline testing was conducted in May 1993, and those results were presented in the July 1993 quarterly report. Parametric testing at this site was completed in early October 1993, and these results were discussed in the January 1994 Technical Progress Report. A DBA performance and consumption test was conducted in February and March of 1994. Preliminary results from this test were discussed in the April 1994 Technical Progress Report. An update of the results from this site was presented in the April 1995 quarterly report.

Baseline testing at the fourth optional site (Duquesne Light's Elrama Station) was completed in July 1993. Those results were discussed in the October 1993 quarterly report. The results of EPRI-funded FGDPRISM modeling and preliminary economic evaluations of potential upgrades for this FGD system were discussed in the January 1994 Technical Progress Report. In March of 1994, parametric testing of the most promising upgrade options was conducted. The preliminary results of these tests were discussed in the April 1994 Technical Progress Report. A draft Technical Note for this site was submitted to DOE in January 1995. An overview of new

results presented in this draft Technical Note was included in the Technical Progress Report for the time period October through December 1994, dated 3 February 1995.

For the fifth optional site at NYSEG's Kintigh Station, baseline, parametric, and additive consumption tests were completed during the third quarter of 1994. Results from the baseline testing at this site were discussed in the Technical Progress Report for the third quarter of calendar year 1994, dated December 1994. The parametric and additive consumption tests at this site were also completed late in the third quarter. These results were discussed in the April 1995 quarterly Technical Progress Report. Late in the fourth quarter of calendar year 1994, FGDPRISM modeling of the Kintigh FGD system was completed, as were the economic evaluations of potential upgrade options for this site. A draft report discussing these results was submitted to DOE and to NYSEG in the first quarter of calendar year 1995. These results were discussed in the quarterly Technical Progress Report dated July 1995.

The only new project results to present this quarter are the analytical results from the Pirkey Station, as were mentioned above. These results are briefly summarized below.

3.1 Southwestern Electric Power Company's Pirkey Station

The testing conducted in 1993 at the Pirkey Station indicated that even if the utility did not currently need to achieve higher levels of SO_2 removal across their FGD system, dibasic acid (DBA) additive could be used cost effectively. That is, with DBA additive, the utility could maintain SO_2 removal performance at lower recirculating slurry pH set points. An unanticipated benefit of DBA addition was that sulfite oxidation percentages could be maintained below 15%. The lower pH set points would improve limestone utilization, reducing annual limestone expenses, and the reduced sulfite oxidation should allow the FGD absorbers to operate free of gypsum scale. Radian's economic analysis showed that these benefits should outweight the costs associated with DBA addition.

Subsequent to the test program conducted in 1993, the plant installed a DBA addition system, and has been adding DBA to the FGD absorbers. In early 1997, Radian was contacted by the plant about an apparent discrepancy in their limestone utilization results. The plant laboratory analyses indicated limestone utilization values in the range of 95% or greater, whereas overall material balances conducted by the plant engineering staff indicated utilization values in the range of 85%. It is interesting to note that Radian observed similar discrepancies when we compared plant laboratory chemical analyses results with plant limestone consumption, lignite consumption, and lignite sulfur content data back in 1993.

The plant submitted to Radian a number of FGD byproduct solids samples from early 1997, during DBA addition to the FGD system. Radian's analyses indicated that limestone utilization in the absorbers is very high, averaging 97% in four lower-loop samples (blowdown from the FGD system is from the lower loop). Upper-loop sample utilization values were also high, averaging 96% limestone utilization. These results suggest that the FGD system is in fact operating at very high limestone utilization values. If the plant material balance values show lower limestone utilization values, these results suggest that either there is an undocumented loss of limestone from elsewhere in the system, or that one or more of the measurements used to calculate limestone utilization by material balance is in error.

Although sulfite oxidation percentages were not in question, Radian's analytical results provided an indication of the oxidation percentages in these samples. The samples all showed between 11 and 12 percent oxidation. This suggests that with DBA addition, the Pirkey FGD system remains below 15 percent sulfite oxidation and should be avoiding gypsum scale formation within the system.

4.0 PLANS FOR THE NEXT REPORTING PERIOD

Scheduled efforts during the second quarter of calendar year 1997 will consist of project management and reporting and a second attempt to conduct the additional testing at the TECo Big Bend (base program) site. As described in previous Technical Progress Reports, there is a plan to demonstrate high-efficiency SO_2 removal operation for a longer period of time (up to six months) at that site. A three-week intensive test period will likely commence in May, and longer-term monitoring of the system performance should continue into the third quarter of calendar year 1997.

Options I, II, and III (Hoosier Energy's Merom Station, SWEPCo's Pirkey Station, and PSI Energy's Gibson Station, respectively) are completed. No efforts are expected for these options during the next quarter.

A draft Topical Report for Duquesne Light's Elrama site (Option IV) will be submitted to DOE and to Duquesne Light during the next quarter. For Option V, testing at NYSEG's Kintigh Station, a draft Topical Report for this site was submitted to DOE during the current quarter (March 1997). No action is expected for this option until review comments are received on that draft report.

5.0 ACKNOWLEDGEMENTS

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