LONG-TERM MERCURY MONITORING AT NORTH DAKOTA POWER PLANTS

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Project Description

Long-term testing (approximately 20 days in duration) of two North Dakota facilities that combust Fort Union North Dakota lignite obtained mercury variability and speciation data as a function of unit configuration and operation. Long-term data acquired using mercury continuous emission monitors (Hg CEMs) and the Ontario Hydro (OH) method were compiled and evaluated as a first step in developing mercury control strategies.

Goal

The goal of this project was to demonstrate long-term use of Hg CEMs and to collect the information necessary to develop mercury control strategies for North Dakota facilities firing Fort Union lignite. Both elemental (Hg^0) and oxidized mercury data were collected over an extended period (~20 days). By comparing these data to coal and ash chemistry, as well as the plants' operational data, correlations could then be drawn between configuration and plant operation and the resulting mercury emissions.

Rationale

The variability of mercury speciation has a bearing on the type of mercury control technologies that would be effective. Facilities that combust North Dakota lignites are faced with greater challenges than many other facilities when attempting to control mercury emissions. Considerable effort has been made to understand mercury issues related to combusting Fort Union lignites. Although it is known that these facilities emit mostly Hg^0, little data existed concerning species variability as a function of plant configuration and operation.

Mercury removal information from the U.S. Environmental Protection Agency's (EPA's) information collection request indicated that the standard air pollution control devices (APCDs) capture little, if any, mercury when Fort Union lignites are fired. That short-term data indicated the removal rates ranged from 44% at R.M. Heskett Station to only 2% for M.R Young Station and indicated a direct correlation between the oxidation at the stack and the removal rates.

Because significantly less data exist concerning speciation and mercury control options for North Dakota lignites as compared to higher-rank fuels, these issues must be examined and addressed before developing any mercury control strategy.

Approach

Long-term testing was conducted at two North Dakota utilities to obtain the mercury emission and variability data. The first, R.M. Heskett Unit 2, has an 85-MW fluidized-bed combustor followed by an electrostatic precipitator (ESP). The second unit tested was M.R. Young Power Station Unit 2, which is a 440-MW unit with a cyclone boiler and an ESP followed by wet flue gas desulfurization (FGD) for SO_2 control.

At R.M. Heskett Station, Hg CEMs were placed at the inlet to the ESP and at the stack to determine mercury species variability; at M.R. Young Station, Hg CEMs were placed at the ESP outlet and the stack. The OH method was used at the same locations to obtain particulate-bound mercury results and to provide EPA-accepted data. Plant operational data included load, NO_x, SO_x, CO_2, and boiler O_2 and were correlated to Hg CEM variability. Concurrent sampling was done of coal, ash, and FGD sludge. These were analyzed for mercury content, among other constituents, in order to conduct mercury mass balances across the APCDs.

Progress

Testing for the two units has been completed, and all analysis has been concluded. Statistical analysis was done on the Hg CEM data to determine the amount of variability present as compared to the initial variability of the coal. Each unit had somewhat different results.

At R.M. Heskett Station, the mercury removal across the ESP averaged 53%, probably due to a reactive carbon in the fly ash as indicated by a high loss-on-ignition factor. The removal rates across the ESP were very consistent over time. The average mercury concentration at the stack was 3.7 $\mu g/Nm^3$ with statistical analysis showing that 90% of the data fell within 35% of the average (3.4 ± 1.1 $\mu g/m^3$) when the unit was at full load, showing less variability than that shown in the initial coal chemistry. Figure 1 shows the effect of load on mercury emissions. The emissions measured at the stack were 92% Hg^0, as illustrated in Figure 2.

At M.R. Young, both load and mercury emissions were fairly consistent over the sampling period. Based on ash and scrubber sludge analysis, mercury removal of the ESP averaged 20%, and the FGD removal rates averaged about 8%. The mercury concentration at the stack was 12.5 $\mu g/Nm^3$ with 90% of the data falling within 23% of the average (9.3 ± 2.2 $\mu g/m^3$) for the entire sampling period, as shown in Figure 3. As is typical for a North Dakota lignite, the mercury emissions were > 90% Hg^0, as shown in Figure 4.

Status

Testing and analysis for both plants have been completed. This project indicates that the variability in mercury emissions is consistent with the variability of mercury content in the coal. However, plant configuration and operations may reduce the overall variability of mercury emissions [1].

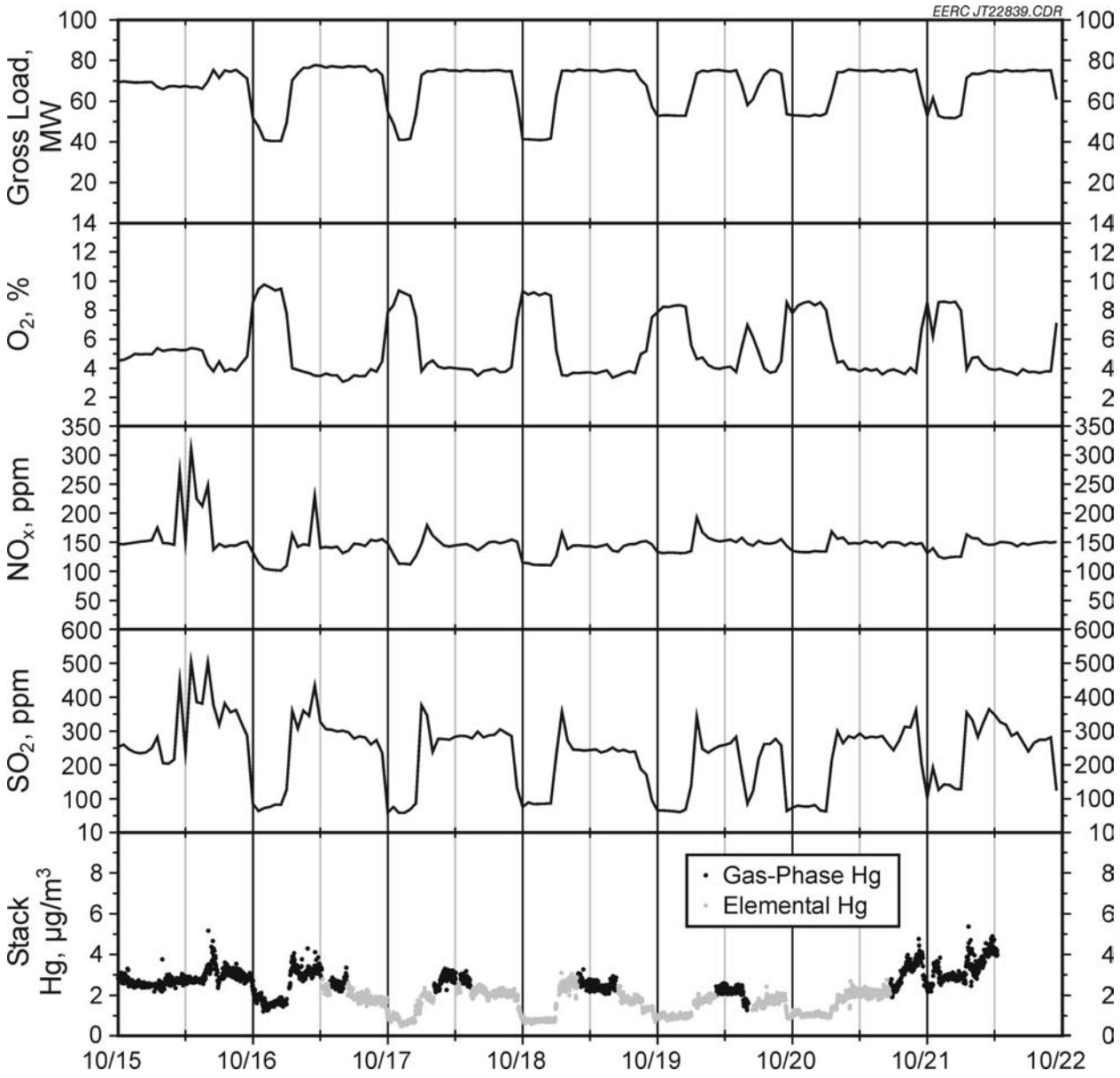

Figure 1. Correlation Between Plant Operations, Including Load, and Resulting Mercury Emissions at R.M. Heskett Station

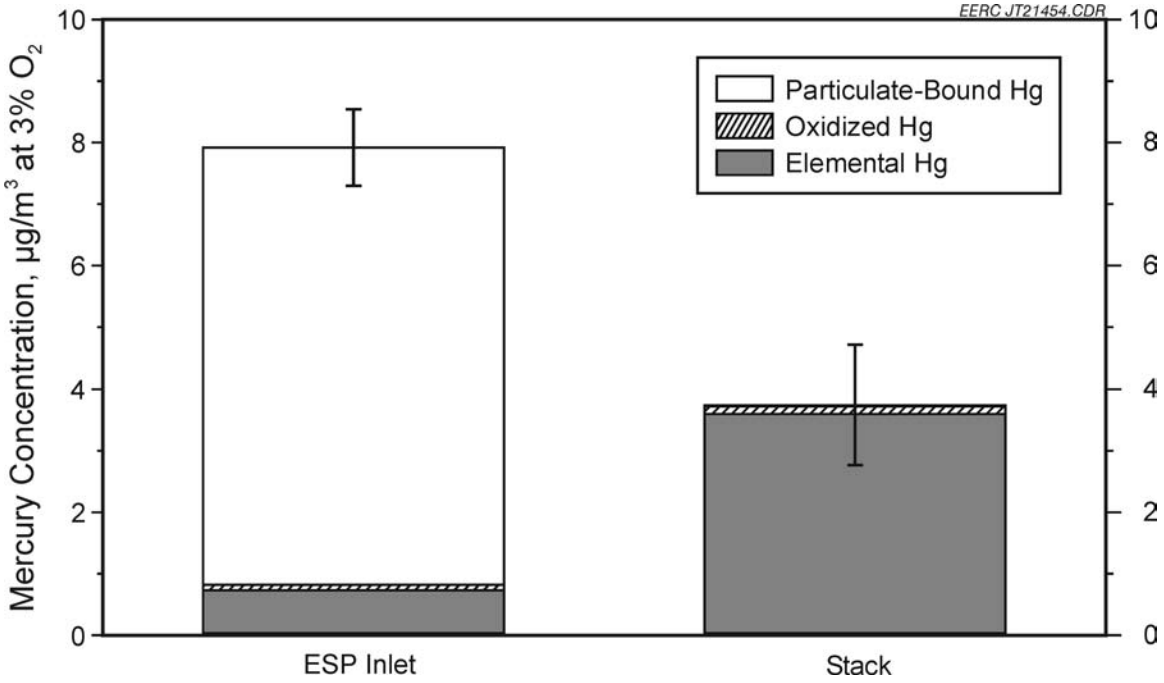

Figure 2. Mercury Speciation Data at R.M. Heskett Station

Quality Assurance/Quality Control

Hg CEM data were validated with periodic OH results to show an average concentration over a 2-hour period. The testing at these facilities complied with the standards in place for the OH method, American Society for Testing and Materials Method 6784-02. It is standard procedure with this method to perform spikes and blanks in the field in order to detect contamination or other problems. Routine chain-of-custody was observed with regard to the samples.

Potential Users/Technology Transfer

The data obtained by this project will be used to evaluate mercury variability in North Dakota coals and identify available mercury control options for Fort Union lignites. Although ESPs and wet scrubbers can reduce the overall variability of mercury emissions, Hg^0 makes up the majority of flue gas emissions and is not affected by control strategies currently in place. Additional investigation is ongoing to find appropriate mercury controls for units with the configurations represented in North Dakota.

References

1. Thompson, J.T.; Holmes, M.J.; Laudal, D.L. *Long-Term Mercury Monitoring at North Dakota Power Plants*; Final Report under DOE Contract No. DE-FC26-98FT40321; May 2003.

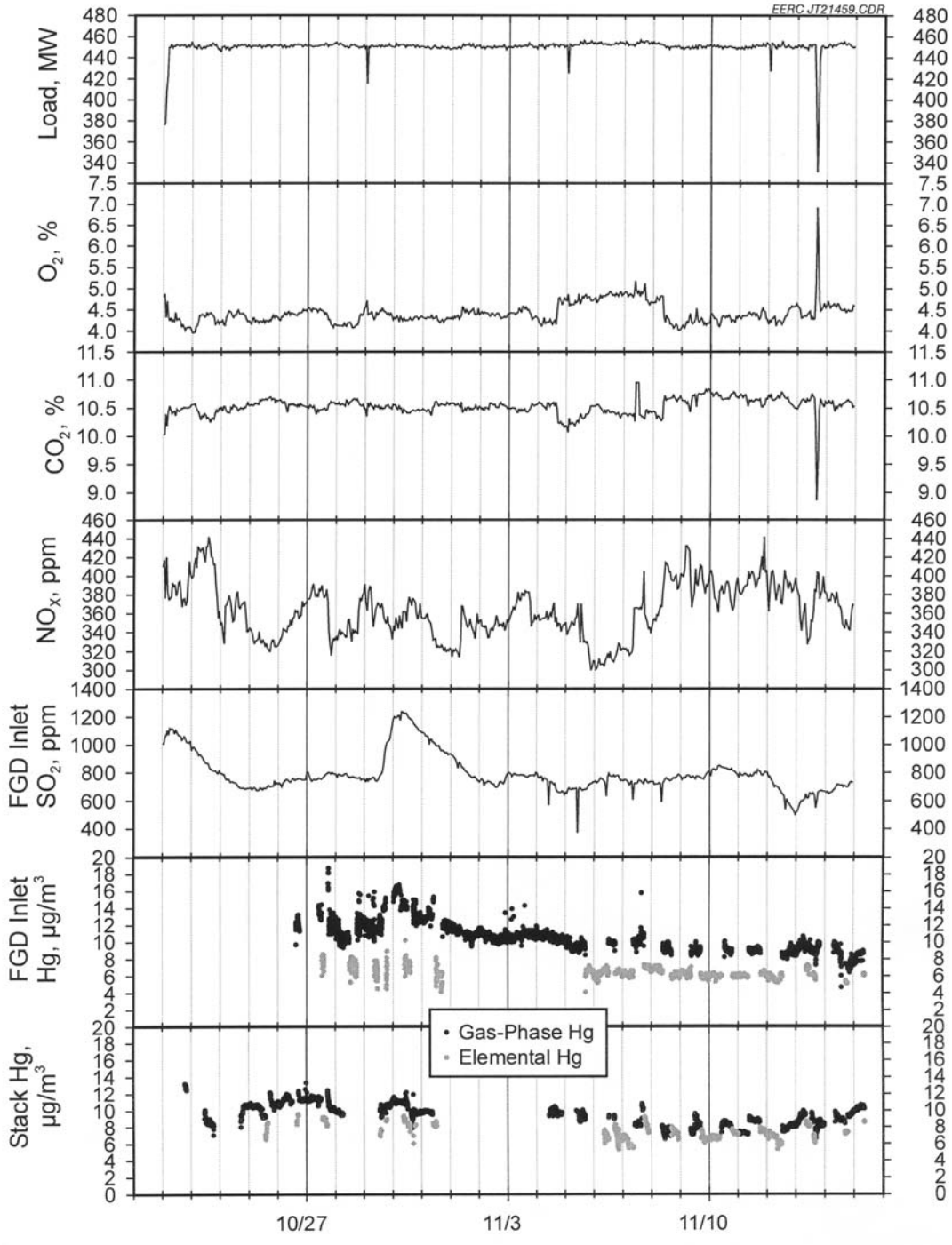

Figure 3. Correlation Between Plant Operations, Including Load, and Resulting Mercury Emissions at M.R. Young Station

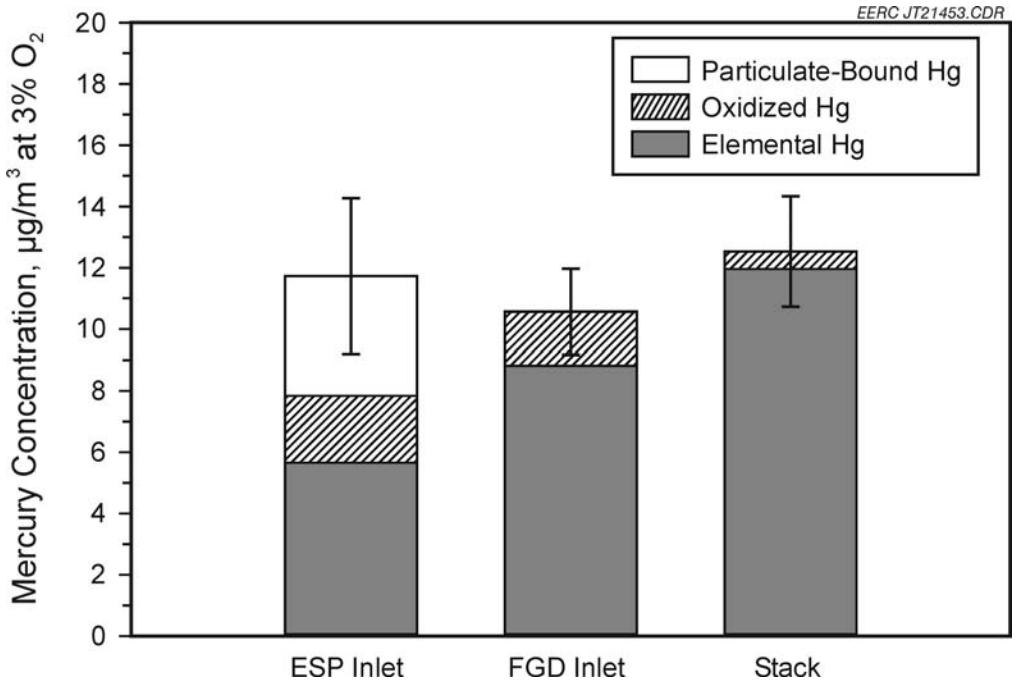

Figure 4. Mercury Speciation Results at M.R. Young Station