GULF POWER MERCURY RESEARCH CENTER
PLANT CRIST

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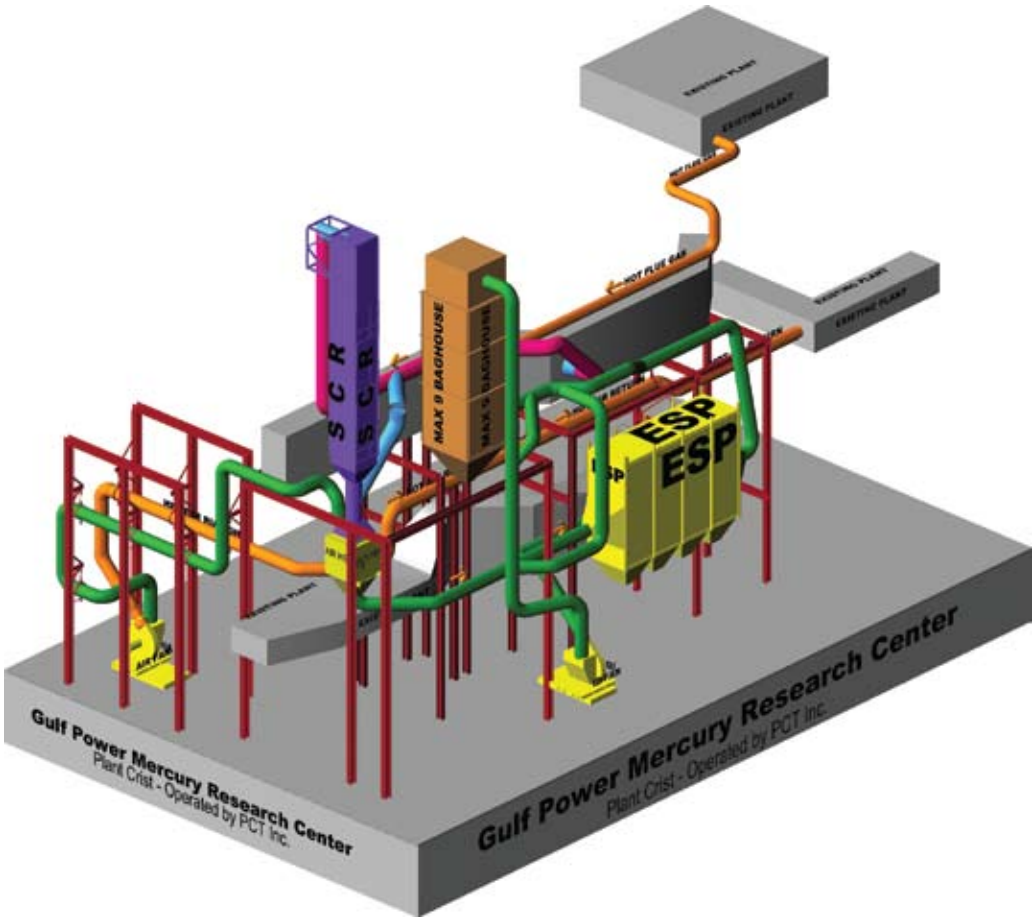

The Mercury Research Center (MRC) is located near Pensacola Florida, at Gulf Power's Plant Crist. The facility represents a one-of-a-kind platform for performing research related to environmental controls for fossil-fueled boilers. Specifically, the facility was designed to address mercury control research needs in support of the industry's efforts at finding dependable, low-cost, and highly efficient means of controlling mercury emissions. Equipped with the major back-end equipment common to utility boilers (including an SCR, rotary air preheater, electrostatic precipitator, baghouse, and wet scrubber), the facility is well positioned to perform research that is highly representative of full scale behavior. Additional equipment for the injection of sorbents, SO_2/SO_3, halogens, and other compounds, further expands the capabilities of the facility. Operating at approximately 5MW equivalent, the facility is large enough to accurately simulate full-scale boiler operation, while still being small enough to maintain operational flexibility and to provide for relatively easy equipment retrofits. Since start-up, the MRC has proven its capabilities and value as an eminent research facility.

2007 RESEARCH PROGRAMS

SO_3 Removal Technology and Effects on Mercury Capture

Industry data has shown that the presence of SO_3, especially at high levels, adversely affects the capacity of many sorbents designed for mercury capture. In addition, high levels of SO_3 adversely affect plant operations due to corrosion issues, especially with the air preheater, and are problematic due to visible plumes and acid gas emissions. Technologies have been developed that utilize injected reagents to reduce SO_3 levels in the flue gas. Tests in 2006 at the MRC demonstrated the general effectiveness of the technologies, and tests performed in 2007 examined the potential beneficial effect that these technologies have on mercury sorbents by limiting the adverse impact that SO_3 has on the sorbents.

Effects of SO_3 on Mercury Capture with Activated Carbon Injection (ACI)

Industry data has shown that SO_3 may adversely affect the performance of ACI technologies for mercury capture. A research program was conducted to examine the effects of SO_3, along with several other parameters, on the mercury capture effectives of ACI across ESPs. The test program included variations in SO_3, flue gas flow rate, temperature, and ESP operating conditions (such as number of fields in service).

SCR Interlayer Mixing

A major performance parameter related to SCR technology is the distribution of flue gas components, especially NO_X and NH_3, associated with the SCR reactor. Due to the characteristics of SCR catalysts and reactors, very little bulk mixing occurs in the flue gas between the reactor entrance and exit. The research program examined the effectiveness of interlayer mixing devices at improving SCR operation, primarily by lowering ammonia slip.

Wet Scrubber Performance Testing

A 2 MW equivalent pilot Double Contact Flow Scrubber system was installed at the MRC to investigate scrubber performance as a function of various operating parameters. In particular, the effectiveness of the scrubber for mercury capture was examined. The MRC and scrubber were operated round-the-clock during several test campaigns, and the program was supported by eight visiting researchers from Japan.

Chiyoda Scrubber Performance

A 2 MW equivalent pilot Chiyoda Jet Bubbling Reactor wet scrubber was installed at the MRC and began operation in late October. Testing included the evaluation of scrubber performance under various MRC and scrubber operating conditions. Included in the study was an assessment of mercury capture performance under a number of optimizing conditions. In addition, scrubber mercury capture performance was evaluated under a number of conditions associated with the injection of chlorine and bromine.

(Testing Period: October 19, 2007 - November 30, 2007)

Reduction of SO_3 Levels with SBS Injection

Sulfur trioxide production within an SCR can contribute to stack opacity difficulties. The use of SBS injection was studied by a client for reducing the sulfur trioxide levels at SCR installations.
(Testing Period: December 3 - December 6, 2007)

2008 RESEARCH PROGRAMS

The host boiler for the MRC was conducting a major outage for turbine and boiler controls retrofit during the first quarter of 2008. As a result, the MRC was not operated during that time. In addition, a retrofit to the MRC ammonia supply system was conducted in December, precluding testing during that timeframe.

Wet Scrubber Performance Testing

A pilot-scale Chiyoda wet scrubber was installed at the MRC to investigate scrubber performance as a function of various operating parameters. In particular, the effectiveness of the scrubber for mercury capture was examined. The MRC and scrubber were operated round-the-clock during several test campaigns, and the program was supported by representatives of Chiyoda. The testing documented the overall scrubber performance in support of full-scale design and operating functions for various U.S. installations of the scrubber. Data was acquired which established the mercury capture efficiency of the scrubber under various operational conditions.
(Testing Period: July 7 - September 1, 2008)

Flue Gas Monitoring Testing

A Fourier Transform Infra-red Spectrophotometric (FTIR) in-situ flue gas monitoring technique was tested. This method allows simultaneous detection and quantification of numerous flue gas species of interest, including halogens. The testing established the accuracy and general operability of the system. After the primary testing dates, the system remained operational in support of general facility operations.
(Testing Period: September 22 - September 26, 2008)

Proprietary Sorbent Testing

A proprietary process was tested which utilizes a sorbent for halogen and SO_3 removal. This program utilized the MRC baghouse, and established various performance and operational parameters associated with the technology.
(Testing Period: September 29 - October 12, 2008)

Proprietary Sorbent Testing (second project)

This project examined a number of sorbents for their effectiveness for mercury capture, as compared to standard activated carbon mercury sorbents. The general performance and operational parameters were established for the different sorbents.
(Testing Period: November 10 - November 16, 2008)

2009 RESEARCH PROGRAMS

Effects of Bromine on SCR Mercury Oxidation

Similar to chlorine, bromine has a strong effect on mercury oxidation across SCR catalysts, under certain conditions. The behavior may serve as the basis for the optimization of mercury oxidation across SCRs, and thus prove to be an integral part of certain mercury control schemes. A test program examining the effects of bromine on four different commercial SCR catalysts has now been completed. Work began on the first catalyst on November 13, 2007, and work was completed on the final catalyst on May 14, 2009. The data acquired has shown that a substantial beneficial effect can be obtained in terms of mercury oxidation when bromine is added to low-halogen flue gas, and that the effect was similar with all of the catalysts tested in the program. The project also demonstrated the overall improvement in mercury capture associated with increased halogens across the ESP.

(Testing Period: November 3, 2007 - May 14, 2009)

Effects of Chlorine on SCR Mercury Oxidation

Chlorine has a strong effect on mercury oxidation across SCR catalysts, under certain conditions. The behavior may serve as the basis for the optimization of mercury oxidation across SCRs, and thus prove to be an integral part of certain mercury control schemes. A test program examining the effects of chlorine on four different commercial SCR catalysts has now been completed. This work began in August, 2007 and was completed June 3, 2009. The data acquired has shown that a substantial beneficial effect can be obtained in terms of mercury oxidation when chorine is added to low-halogen flue gas, and that this general effect was consistent with all catalyst types tested. The project also demonstrated the overall improvement in mercury capture associated with increased halogens across the ESP.

(Testing Period: August 1, 2007 - June 3, 2009)

Mercury Capture by Activated Carbon in Conjunction with Trona

The effects of mercury capture using activated carbon in conjunction with Trona were investigated at various operating conditions. The testing included an analysis of the effects of variations in SO_3 on the overall system performance. Testing results helped to establish the effects of various process variables on mercury capture and SO_3 reduction.

(Testing Period: August 17 - September 4, 2009)

Multi-Pollutant Control Technology

Tests were conducted to investigate the performance (and to optimize operating variables) of a multi-pollutant control system, which simultaneously removed SO_2, SO_3, mercury, and fine particulate. The acquired data helped to establish the operating capabilities and optimal operating conditions for full-scale facilities.

(Testing Period: September 13 - September 18, 2009)

Novel NO_X Reduction Reagent

A novel NO_X reduction reagent was investigated, in conjunction with SCR catalysts, for its performance in reducing NO_X, and oxidizing mercury. The data helped to demonstrate the feasibility of the process, and to establish appropriate operating conditions.
(Testing Period: October 19 - October 23, 2009)

No testing was performed in November and December 2009 due to plant outage.

2010 RESEARCH PROGRAMS

Mercury Oxidation Performance of Advanced SCR Catalyst

The performance of an advanced SCR catalyst formulation was evaluated in terms of its ability to oxidize mercury, especially at conditions of low halogens. Testing was conducted at various operating conditions, including various levels of both chlorine and bromine. The data indicated that this advanced catalyst may be more reactive for mercury oxidation at low halogen levels than currently utilized conventional catalysts.
(Testing Period: June 29 - July 2, 2009 / January 11 - January 29, 2010)

Mercury Capture by Activated Carbon

Proprietary activated carbon testing was conducted to examine mercury capture performance. The testing included an analysis of the effects of various parameters on the overall system performance. Testing results helped to establish appropriate conditions for full-scale application.
(Testing Period: February 15 - March 31, 2010 / May 3 - May 6, 2010)

Advanced Flue Gas Monitoring Technique

Tests were conducted to investigate the performance of an advanced flue gas monitoring system. The acquired data helped to establish the operating capabilities for full-scale facilities.
(Testing Period: April 12 - May 30, 2010)

Mercury Capture by Activated Carbon

Testing was conducted to examine mercury capture performance of a proprietary activated carbon product. Testing results helped to establish appropriate process conditions and expected mercury removal rates for full-scale applications.
(Testing Period: May 3 - May 6, 2010)

Site Activation Process (SAP) for Activated Carbon Mercury Capture

The SAP process takes coal from the plant supply and produces activated carbon for mercury removal. It can also convert limestone to quick lime for acid gas clean-up. The product is directly injected into the gas stream from the SAP device. Work during the reporting period focused on the set-up and start-up of the system, including preliminary start-up system evaluation. Primary operational testing activities are expected to be conducted in the subsequent reporting period.
(Testing Period: June 1 - August 20, 2010)

2007 - 2010 REPORTS

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