

A World First! Demonstration of 500 metric tons per day CO₂ Capture and Storage Begins at Coal-Fired Thermal Power Plant

MHI, in partnership with Southern Company, a major American electric utility company, launches the world's largest system for CO₂ recovery from the flue gases produced by a coal-fired thermal power plant.



CO₂ recovery plant located at Plant Barry in Alabama, U.S. Plant Barry is owned and operated by Alabama Power (a Southern Company subsidiary) which supplies electricity to about two-thirds of the state of Alabama, including nearly 1.4 million households, offices and factories.

The goal of the project was to install a flue gas CO₂ capture plant and storage system at the power plant that was capable of capturing and storing* 500 tons of CO₂ per day. In terms of human respiration, this is the equivalent of the CO₂ exhaled by about 570,000 people in one day.

MHI partnered with Southern Company, a major American electric utility company, and worked on many aspects of the CO₂ recovery plant, ranging from the plant's basic design and engineering along with the provision of core equipment and technical support.

*MHI supervises the recovery of CO₂, its compression and transmission to the opening of the pipeline that leads to the underground storage area. The CO₂ is then pumped deep underground into aquifers where it will remain sealed. This latter process is overseen by the Southeast Regional Carbon Sequestration Partnership (SECARB) with support from the U.S. Department of Energy's Regional Carbon Sequestration Partnership Phase III program.

Overcoming technical issues, expediting global warming countermeasures

By its nature, practical CO₂ recovery at coal-fired power plants presents major obstacles. Unlike the flue gas from natural gas-fired plants, flue gas from coal-fired plants contains many impurities; removing these impurities makes it essential to refine the performance of the pre-treatment equipment (the flue gas desulfurizer). An important goal for this

demonstration, therefore, was to identify the differences in various types of coal and in coal from various mining areas, and determine how best to handle the impurities. Other important aims included demonstrating the reliability of the system — to prove that it would perform consistently in long-term continuous operation — and that it could recover CO₂ efficiently, making it cost-effective.

MHI is the only company in the world that has experience operating CO₂ recovery plants for flue gas from both large-scale natural gas-fired and coal-fired boilers. With ten large commercially operational flue gas CO₂ recovery plants for natural gas-fired boilers at chemical factories, MHI leads the industry. The knowledge gained from this extensive commercial experience, and the experience being gained from Plant Barry will raise the MHI flue gas CO₂ recovery technology to a commercially viable level for coal-fired power plants.

The Plant Barry project is not only the first integrated demonstration of CO₂ capture, transportation and storage in the world that has been proven to be operationally successful, it is also the first demonstration to be run at a scale of 500 metric tons per day. As a demonstration test with implications for the realization of a low-carbon society, it is attracting attention from around the world.

Technology for energy-saving CO₂ recovery

Chemical absorption is the leading technique used in flue gas CO₂ recovery plants. The technique uses a special solvent to absorb the CO₂ from the power plant's flue gas; the CO₂ is subsequently separated and recovered from the solvent. In this process, the solvent performs an important role.

MHI's flue gas CO₂ recovery plants have the advantage of using a recovery method known as the KM CDR Process[®], utilizing KS-1[™] solvent, an energy-saving solvent developed in cooperation with Kansai Electric Power Company. Because of its high CO₂ absorption performance, the amount of solvent used is small in comparison to conventional solvents, and its low corrosion and low degradation properties enhance its overall excellence. A CO₂ recovery rate of over 90% has been achieved with the KM CDR Process[®]. In addition, the process cuts down on the amount of power consumed by the recovery plant during operation, successfully reducing the energy used in CO₂ recovery.

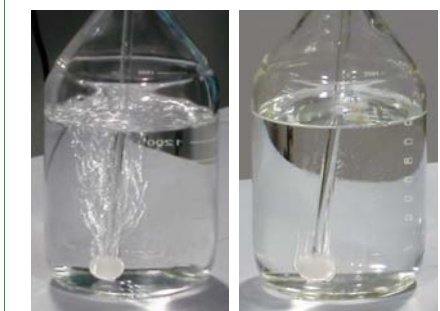
*The KM CDR Process[®] is a registered trademark of MHI in Japan, the U.S., the European Union (CTM), Norway, Australia and China. The process is superior in terms of ease of maintenance and inspection, and the amount of energy it consumes is much smaller.



A: Mr. Fanning, Chairman, President and Chief Executive Officer of Southern Company and Mr. Omiya, MHI President, who made a courtesy call following the start up of the demonstration plant. Southern Company presented MHI with samples of bedrock mined from the CO₂ underground storage area as souvenirs, while MHI provided Southern Company with OLEDs developed by Lumitec Inc.



B: Barge transporting a huge modular facility weighing over 460 tons on the Black Warrior River.



water KS-1[™]
CO₂ being injected into vessels. One vessel contains water, and the other contains KS-1[™]. Almost no air bubbles are seen in the KS-1[™], and it is evident that the CO₂ is being absorbed by the solvent.

500 metric tons per day! The world's largest demonstration plant

The abundant deposits and low cost of coal make it a natural resource which cannot be easily ignored. Consequently, it is expected to be used in coal-fired thermal power plants and in many other power industry applications of the future. That said, the amount of CO₂ emissions from these power plants is a cause for concern. Of all CO₂ emissions in the world, approximately 60% originate from large-scale

facilities that emit more than 100,000 tons per year, and some 76% of this amount is produced by coal-fired thermal power plants. This is driving the search, both at home and abroad, for a breakthrough solution that will reduce the amount of CO₂ emitted into the atmosphere.

It was against this backdrop that the world's largest demonstration project for integrated capture, transport and storage of CO₂ from flue gas generated by a coal-fired thermal power plant began operation in June 2011 at Plant Barry in Alabama (U.S.)



The demonstration facility is located at Plant Barry in southern Alabama (U.S.)

Establishing robust reliability through communicative project exchanges

MHI's association with Southern Company began in 2007 with the delivery of flue gas desulfurization equipment to the Gorgas power plant. Similar equipment was subsequently supplied to four more power plants. Our position as a technology development partner has been further strengthened by, among other things, recently proving a mercury removal system at a Southern Company power plant. Mercury removal is to be mandated by new U.S. regulations.

For the Barry project, while rising construction costs were an issue, MHI used modular construction methods whereby the facility was prefabricated at a factory and assembled on-site, making every effort to simplify and optimize construction. As a result, the delivery deadline was met and the project came in within budget.

MHI appointed a U.S. citizen as the site project manager and adopted a management style that emphasized communication. The strategy was a success, creating a positive atmosphere that encouraged the constructive exchange of ideas and opinions, an atmosphere in which client and vendor were

equally free to express their views. Unusual for a U.S. electric utility company, Southern Company has its own R&D division and is proactive about understanding and compiling technology, similar to MHI. This synergy of a shared pursuit of technology was an important backdrop to the project.

During the project, on-site plant operators who had never before operated a chemical plant worked together with MHI's young engineers through an around-the-clock test run, building relationships of mutual trust. In the future, MHI hopes to contribute to society through this environmental technology, putting the valuable experiences gained on this project to work in promoting the commercialization of CO₂ recovery plants in order to realize the anticipated low-carbon society.



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