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PHASE II CALDERON PROCESS TO PRODUCE
DIRECT REDUCED IRON
RESEARCH AND DEVELOPMENT PROJECT

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QUARTERLY TECHNICAL PROGRESS REPORT
PHASE II CALDERON PROCESS TO PRODUCE DIRECT REDUCED IRON
RESEARCH AND DEVELOPMENT PROJECT

CALDERON ENERGY COMPANY
COOPERATIVE AGREEMENT NO. DE-FC22-95PC92638

Reporting Period: 7-01-06 to 9-30-06

Date of Report: 10-20-06;

Phase II Award Date: 6-23-00; Anticipated Completion Date: 12-03-07

Total Project: \$ 14,732,316.00 Total DOE Share This Action: \$6,457,000.00

Contracting Officer's Representative (COR): John Stipanovich;

Project Director: Albert Calderon

Assistant Project Director: Reina Calderon

Abstract

This project was initially targeted to the making of coke for blast furnaces by using proprietary technology of Calderon in a phased approach, and Phase I was successfully completed. The project was then re-directed to the making of iron units. In 2000, U.S. Steel teamed up with Calderon for a joint effort to produce directly reduced iron with the potential of converting it into molten iron or steel consistent with the Roadmap recommendations of 1998 prepared by the Steel Industry in cooperation with the Department of Energy by using iron ore concentrate and coal as raw materials, both materials being appreciably lower in cost than using iron pellets, briquettes, sinter and coke.

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Executive Summary

The commercialization path of the Calderon technology for making a feedstock for steelmaking with assistance from DOE initially focused on making coke and work was done which proved that the Calderon technology is capable of making good coke for hard driving blast furnaces. U.S. Steel which participated in such demonstration felt that the Calderon technology would be more meaningful in lowering the costs of making steel by adapting it to the making of iron - thus obviating the need for coke.

U.S. Steel and Calderon teamed up to jointly work together to demonstrate that the Calderon technology will produce in a closed system iron units from iron concentrate (ore) and coal competitively by eliminating pelletizing, sintering, coking and blast furnace operation. If such process steps could be eliminated, a huge reduction in polluting emissions and greenhouse gases (including CO₂) relating to steelmaking would ensue. Such reduction will restructure the steel industry away from the very energy-intensive steelmaking steps currently practiced and drastically reduce costs of making steel.

The development of a technology to lower U.S. steelmaking costs and become globally competitive is a priority of major importance. Therefore, the development work which Calderon is conducting presently under this Agreement with the U.S. Department of Energy becomes more crucial than ever.

The work performed during the Third Quarter of 2006, which the present Progress Report covers, was advanced on two parallel paths. The first path was conceiving, designing, and fabricating a device--"a breaker"--to eliminate or drastically reduce the "avalanches" occurring at the discharging end of the reactor. There is a consensus among Calderon's personnel that these "avalanches" have prevented the attainment of uniformly reduced

iron/carbon product from the reactor. The design of such breaker was completed, and fabrication was about 90% complete at the end of the Quarter. The plan is to install it and test it in the Fourth Quarter. It is hoped that the breaker will improve the quality of the intermediate product which will meet U.S. Steel's qualification criteria of 80% metallization prior to homogenization.

The second path was entering into an agreement with AHMSA on July 13 with respect to running a test with AHMSA's ore concentrate and coal wherein a statement was included in the agreement which stated the following: "Calderon wishes to emphasize again that the iron/carbon product produced by the Calderon process is a non-uniform, intermediate feedstock that needs to be homogenized by melting it to make hot metal as the Calderon product is NOT a DRI." This statement is to be found on page 2, paragraph 1, of the Letter of Agreement that was submitted in the previous Quarterly Report as Exhibit 8. After five years of persistent R&D work by Calderon, a steel company finally is accepting that the Calderon process will be evaluated after the homogenization of the iron/carbon product (feedstock) by melting it to make a hot metal.

Experimental Work

During the Quarter, six test runs were conducted that consisted of I-207, on July 10 and 11, for Iron Dynamics prior to the signing of the Letter of Agreement with AHMSA on July 13, and I-208, I-209, I-210, I-211, and I-212 for AHMSA. The test for Iron Dynamics related to the removal of ZnO from electric-furnace dust by mixing it with ore concentrate and pyrolyzing the mixture in the reactor. Table 1 tabulates the dates, the length of each test, and the number of pushes relating to the tests.

Table 1

Test Run #	Date 2006	Length in Hours	No. of Pushes
I-207	7/10 & 7/11	35 hrs : 45 min	405
I-208	7/17, 7/18 & 7/19	52 hrs : 25 min	564
I-209	7/24, 7/25 & 7/26	59 hrs : 45 min	682
I-210	8/1, 8/2 & 8/3	60 hrs : 00 min	638
I-211	8/14 & 8/15	35 hrs : 45 min	405
I-212	8/21, 8/22 & 8/23	59 hrs : 00 min	655

Results and Discussion

Once there was an agreement with AHMSA on the 13th of July with respect to its TEST, most of the effort was concentrated to prepare for such TEST. Originally, the TEST was set for the 14th of August. A week before the TEST, AHMSA requested that the TEST be postponed to the 21st; Calderon agreed. Test Runs I-208 through I-211, inclusive, were conducted in preparation for the main TEST. The ore and the coal that were shipped were inadequate to run a 60-hour test. It was decided that during the first 14 hours Calderon would use its own ore concentrate and coal, as such an accommodation would be immaterial because the initial 18 hours are required to bring the equipment to temperature from a cold start.

Calderon was informed that AHMSA would send six personnel, divided into two groups, to observe the test; three would be present during the day shift and three during the night shift, each shift being a 12-hour duration. The qualifications of the three men were as follows: a leader, an engineer, and a technician who manned AHMSA's analytical equipment. It was

decided that Monday the 21st be spent in organizing the test, with start-up at 11:00 p.m.; Tuesday, Wednesday, and Thursday, the conducting of the TEST; and Friday collecting and packaging the materials produced for shipment to Mexico. It was also decided that the last five hours of the test be spent on homogenizing hot iron/carbon product by melting it into hot metal and poured into 20-lb. pigs (ingots).

The first grind test took place on Tuesday at 4:45 a.m., and it was 18 out of 18; the second grind at 5:45 a.m. was 23 out of 24; the third at 6:45 a.m. was 23 out of 24; the fourth at 7:45 a.m. was 24 out of 24; the fifth at 8:45 a.m. was 24 out of 24; the material in general was quite satisfactory with respect to the hourly grind tests. The charging of the AHMSA material was started at 1:03 p.m. At 5:00 p.m., drum "A" was switched to drum "B," 18 hours after start-up. At 8:45 p.m., it was noticed that the material in drum "B" (by then the product of iron/carbon made exclusively from AHMSA's ore and coal) was not agglomerating; the grinds were deteriorating, and pushing pressure became excessive. Adjustments to the lance practice and the injection of oxygen were made in an attempt to improve the grinds and overcome the excessive pushing pressure. Some success was obtained, but evidence of the material sticking was identified by the increase in pushing pressures. On Wednesday at 5:30 a.m., some 46 hours after start-up, the pusher stalled at push 478; the operators were unable to loosen it. It was decided to dig some material out of the reactor. They succeeded in putting the unit back into operation at 8:35 a.m. The pusher continued to stall several times after that: at push 506, at push 539, at push 542, and at push 573. The operators were able to limp along until the end of the TEST by prying the material with a bar from the port where the optical temperatures are taken at the discharge end of the reactor. Despite the problems

experienced, melting did take place to homogenize the material by melting it. The unit was shut down at 10:00 a.m. on Thursday morning, 59 hours after start-up.

Conclusion

Despite the problems encountered, it was concluded that AHMSA's coal must have been a non-caking coal which would not blend with the ore upon heating; therefore, no agglomeration took place between the iron and the coke. Around the middle of September, the chairman of AHMSA, Mr. Ancira, indicated to Calderon via a telephone conversation that AHMSA wished for the tests to continue with other coals despite the problems experienced in Test I-212. Calderon received a telephone call from Monclova that 10 tons of ore would be shipped in December for Calderon to try to make the iron/carbon intermediate material with different coals.

During the next quarter, the plan is to install the breaker and operate with the hope of continuing tests for all three; namely U.S. Steel, AHMSA and IDI.

Submitted by:

Albert Calderon
Project Director

References - Not Applicable

The work performed in this quarter which the report covers, was original work. No reference material was relied upon for the work.