Demonstration and commercial design of the Clean Oil Shale Surface Process

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Combustion Resources, Inc. has completed four years of work to develop and demonstrate a clean surface oil shale process (C-SOS). This work was sponsored by the Department of Energy (Mr. Robert Vagnetti, Program Officer). An indirect-fired rotary kiln (0.83 ft. diameter by 7 ft. in length) was constructed and operated to demonstrate the process and to obtain data for commercial scale-up. Useful pilot plant data included kiln capacity, optimum kiln operating conditions, properties and quantities of product shale oil cuts and hydrogen requirements for upgrading. The pilot process was also evaluated with the CR rotary kiln model and the PRO II process model. Based on these results, interaction with commercial kiln companies and design data from government reports for surface shale mining and size reduction, work has been completed for the preliminary design of a 6000 ton/day commercial demonstration plant using four kilns. A high-grade oil shale (36 gal/ton) was used in the design. An indirect-fired kiln, 12 feet in diameter and 127 feet in length has been specified. Kiln size and capacity were established through kiln manufacturing company interactions, pilot scale data and our computerized kiln design model. Preliminary capital and operating cost projections have been determined using standard design procedures for two alternatives for the product oil: (1) delivery of the raw crude oil from the 6000 ton per day plant to a refinery for upgrading, (2) use of recovered hydrogen to upgrade the oil before delivery. Projected capital and operating costs for the commercial plant provide a basis for comparison with market petroleum costs per barrel. Also considered was the use of a single kiln to handle over 1000 tons/day of oil shale fines at a shale processing plant that cannot process fines.