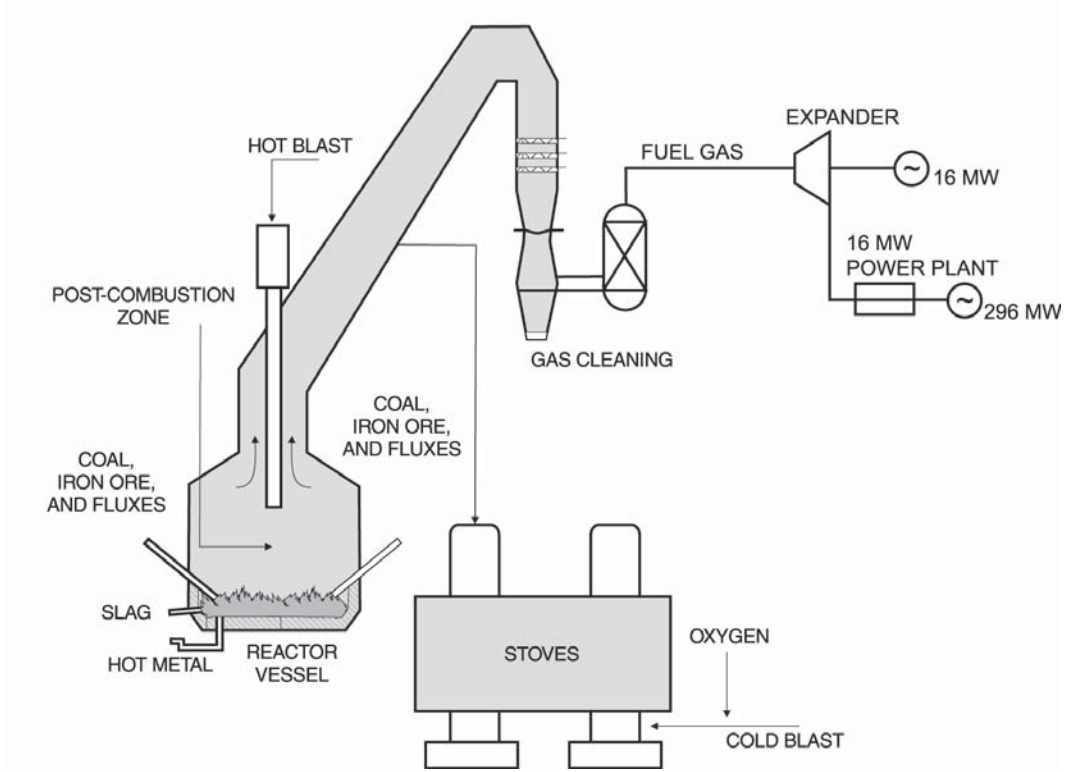
Clean Power from Integrated Coal/Ore Reduction (CPICOR™)



Participant

CPICOR™ Management Company LLC (a limited liability company composed of subsidiaries of the Geneva Steel Company)

Additional Team Members

Geneva Steel Holdings corporation—cofunder, constructor, host, and operator of unit

Location

Vineyard, Utah County, UT (Geneva Steel Co.'s mill)

Technology

HIsmelt® direct iron-making process

Plant Capacity/Production

3,300 ton/day liquid iron production and 296 MW (gross) of electricity

Coal

Bituminous, 0.5% sulfur

Project Funding

Total	$1,065,805,000	100%
DOE	149,469,242	14
Participant	916,335,758	86

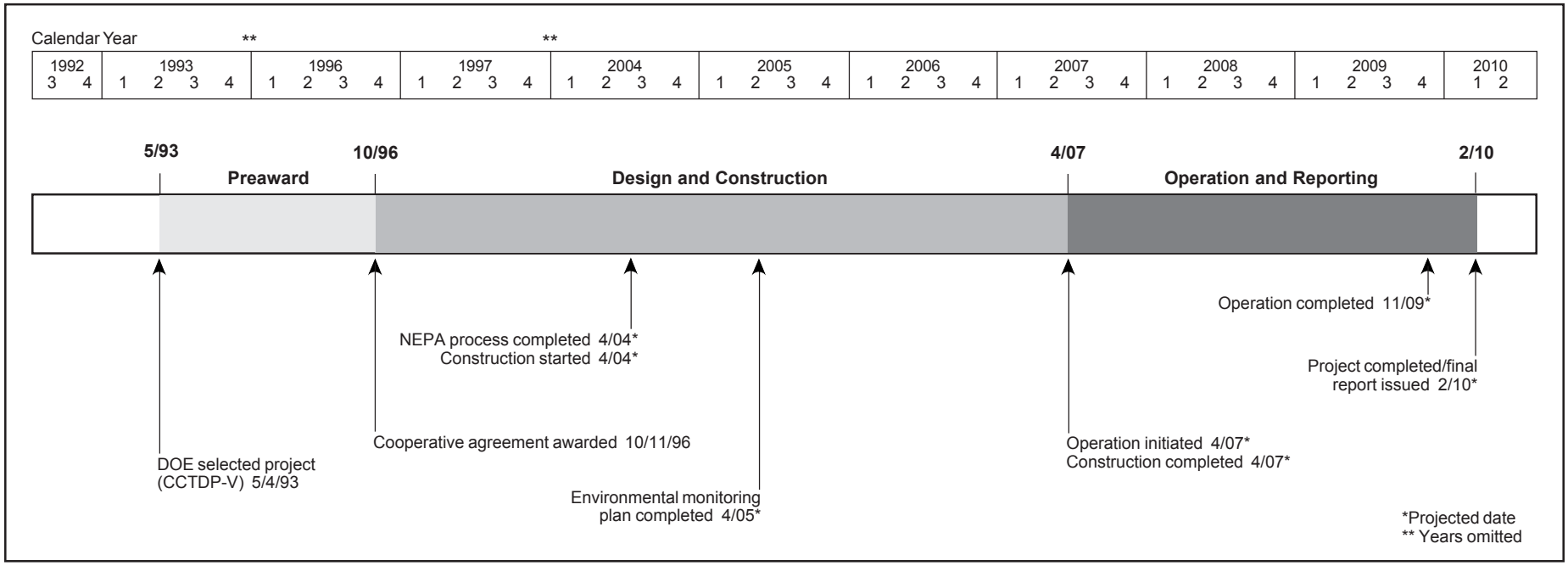
Project Objective

To demonstrate the integration of direct iron making with the coproduction of electricity using various U.S. coals in an efficient and environmentally responsible manner.

Technology/Project Description

The HIsmelt® process is based on producing hot metal and slag from iron ore fines and non-coking coals. The heart of the process is producing sufficient heat and maintaining high heat transfer efficiency in the post-combustion zone above the reaction zone to reduce and smelt iron oxides. The HIsmelt® process uses a vertical smelt reduction reactor, which is a closed molten bath vessel, into which iron ore fines, coal, and fluxes are injected. The coal is injected into the bath where carbon is dissolved rapidly. The carbon reacts with O_2 (from the iron ore) to form CO and metallic iron. Injection gases and evolved CO entrain and propel droplets of slag and molten iron upward into the post-combustion zone. The iron reduction reaction in the molten bath is endothermic; therefore, additional heat is needed to sustain the process and maintain hot metal temperature. This heat is generated by post-combusting the CO and hydrogen from the bath with an O_2-enriched hot air blast from the central top lance. The heat is absorbed by the slag and molten iron droplets, which are returned to the bath by gravity. Droplets in contact with the gas in the post-combustion zone absorb heat, but are shrouded during the descent by ascending reducing gases, which, together with bath carbon, prevent unacceptable levels of FeO in the slag. The molten iron collects in the bottom of the bath and is continuously tapped from the reactor through a fore-hearth, which maintains a constant level of iron in the reactor. Slag, which is periodically tapped through a conventional blast furnace-type tap hole, is used to coat and control the internal cooling system and reduce the heat loss. Reacted gases, mainly N_2, CO_2, CO, H_2, and H_2O, exit the vessel. After scrubbing, the cleaned gases will be passed through an expander and then combusted to produce electricity. The cleaned gases can also be used to pre-heat and partially reduce incoming iron ore.

HIsmelt is a registered trademark of HIsmelt Corporation Pty Limited.



Project Status/Accomplishments

The cooperative agreement was awarded on October 11, 1996. CPICOR™ analyzed the global assortment of new direct iron-making technologies to determine which technology would be most adaptable to western U.S. coals and raw materials. Originally, the COREX® process appeared suitable for using Geneva's local raw materials; however, lack of COREX® plant data on 100% raw coals and ores prevented its application in this demonstration. Thus, CPICOR™ chose to examine alternatives. The processes evaluated included: AISI direct iron-making, DIOS, Romelt, Tecnored, Cyclonic Smelter, and HIsmelt®. The HIsmelt® process appears to offer good economic and operational potential, as well as the prospect of rapid commercialization. CPICOR™ has completed testing of two U.S. coals at the HIsmelt® pilot plant near Perth, Australia.

Project definition, preliminary design, and environmental permitting are ongoing. On July 28, 1999, DOE issued a Notice of Intent to prepare an Environmental Impact Statement for the project. A NEPA public scoping meeting was held in Provo, Utah on July 15, 1999.

On February 1, 1999, Geneva Steel Company (CPICOR™ Management Company's parent corporation) filed a voluntary petition for bankruptcy under Chapter 11 of the United States Bankruptcy Code in the U.S. Bankruptcy Court for the District of Utah. Geneva Steel emerged from Chapter 11 bankruptcy in early 2001 with a restructured balance sheet that enables full participation in this demonstration project.

On January 25, 2002, Geneva Steel LLC filed a voluntary petition under Chapter 11 of the United States Bankruptcy Code. The filing in the United States Bankruptcy Court for Utah, Central Division, was required by the company's secured lenders as a condition to providing continued access to cash proceeds from the sale of inventory and the collection of accounts receivable. Without such access, Geneva Steel would not have sufficient liquidity to continue its activities and protect its facilities.

CPICOR™ has issued several major contracts for the engineering design of the project. HIsmelt Plc. will perform all preliminary engineering required for Phase I of the project. Lurgi Metallurgy will assist in the design of the direct iron making process, with Rio Tinto (the parent company of HIsmelt Plc.) providing funding support. Lurgi will also provide engineering services for the co-generation process, including investigation of a turbo expander for power generation.

Commercial Applications

The HIsmelt® technology is a direct replacement for existing blast furnace and coke-making facilities with additional potential to produce steam for power production. Of the existing 79 coke oven batteries, half are 30 years of age or older and are due for replacement or major rebuilds. There are about 60 U.S. blast furnaces, all of which have been operating for more than 10 years, with some originally installed up to 90 years ago. HIsmelt® represents a viable option as a substitute for conventional iron-making technology.

The HIsmelt® process is ready for demonstration. Two pilot plants have been built, one in Germany in 1984 and one in Kwinana, Australia in 1991. Through test work in Australia, the process has been proven—operational control parameters have been identified and complete computer models have been successfully developed and proven.