Journal of Power Sources, 37 (1992) 165–168

M-C Power commercialization program for MCFC power plants

E. H. Cámara and F. C. Schora
M-C Power Corporation, 8040 South Madison Street, Burr Ridge, IL 60521 (USA)

Abstract

M-C Power Corporation was established by the Institute of Gas Technology (IGT) to develop, manufacture, market, sell and service commercial MCFC power plants using IGT's IMHEX® fuel cell stack concept. M-C Power has created an integrated commercialization program to develop a market-responsive, natural gas-fueled MCFC power plant. M-C Power's market entry offering will range from 500 kW to 3 MW and will be designed for on-site and distributed power applications. Future products will include a wider range of sizes for distributed power and power plants for dispersed (30–50 MW) and base load (>100 MW) power generation, the latter fueled by coal-derived gases. M-C Power Corporation has established the world's most advanced MCFC components and stack manufacturing facilities at its plant in Burr Ridge, IL, capable of producing 3 MW/year of stacks based on one shift per day, five days per week operation. This capacity can be increased to 12 MW/year by adding one tape casting machine and operating three shifts per day for 330 days/year. An industry group has been formed to guide, support, and stimulate the IMHEX® Commercialization Program. This group is called the Alliance to Commercialize Carbonate Technology (ACCT). ACCT members include electric, gas and combination utilities as well as pipeline companies and potential industrial users. In addition, the program enjoys wide support from government, industry and research institutions.

Introduction

Electric power plants using MCFC technology will provide significant advantages over conventional co-generation and distributed generation systems. In the 300 kW to 20 MW size range, MCFC systems will generate electrical energy at efficiencies significantly higher than conventional power plants. Because by-product heat is available at over 700 °F, the MCFC systems will also achieve very high co-generation efficiencies.

Gaseous pollutant emissions from an MCFC power plant will be extremely low. The plant's high efficiency will result in low CO_2 emissions per unit of energy generated, which minimizes contributions to the greenhouse effect. Because fuel cells are sensitive to sulfur, essentially all sulfur will be removed from natural gas fuel before it is used. Therefore SO_x emissions will be extremely low. No significant NO_x emissions will be produced because MCFC energy conversion takes place at low temperatures compared to conventional heat engine technologies which rely on fuel combustion.

The MCFC's high efficiency results in reduced plant cooling requirements compared with conventional power generation technologies. In regions where water is scarce, air cooling will be a viable option. In addition, fuel processing water requirements may be eliminated by recovering water from the plant's exhaust stream.

0378-7753/92/$5.00

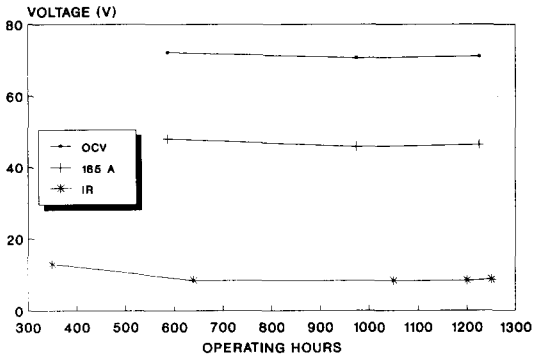

Fig. 1. *Stack operating history MCP-2/70 75% fuel utilization.*

Status of development

Recognizing the MCFC's significant advantages over conventional energy conversion technologies, IGT established M-C Power in 1987 to commercialize MCFC power plants based on IGT's internal manifold IMHEX® concept. The IMHEX® stack design offers the following advantages over the external manifold stack arrangements used by other developers:

- superior sealing of gases
- no carbonate electrolyte migration
- reduced cost through use of less metallic hardware
- lower potential for corrosion
- intrinsic accommodation of stack height changes

Since its founding, M-C Power has made significant advancements in MCFC stack technology, component manufacturing and stack assembly. M-C Power manufactured, assembled and tested the world's tallest MCFC stack in 1991. This stack, designated MCP-2, demonstrated stable performance throughout its testing period as shown in Fig. 1. Test analyses have confirmed previous predictions that electrolyte migration has been eliminated with the IMHEX® stack design.

M-C Power has designed and constructed a continuous stack manufacturing facility capable of producing 3 MW of commercial area stacks per year, assuming single-shift operation. Increased capacity is readily available with minor equipment additions and increased working hours. The M-C Power facility is the largest capacity MCFC stack production facility in the world.

The M-C Power production facility is being used to fabricate and assemble a series of commercial area (10 $ft.^2$) stacks which will lead to a 250 kW proof-of-concept stack and power plant in 1993. The first 10 $ft.^2$/cell stack is now being built. This stack, designated MCP-3, will be tested at M-C Power's full-area stack test facility later this year.

Commercialization program

Based on successful stack development efforts to date, and confidence in the ultimate viability of the IMHEX® technology, M-C Power has established a compre-

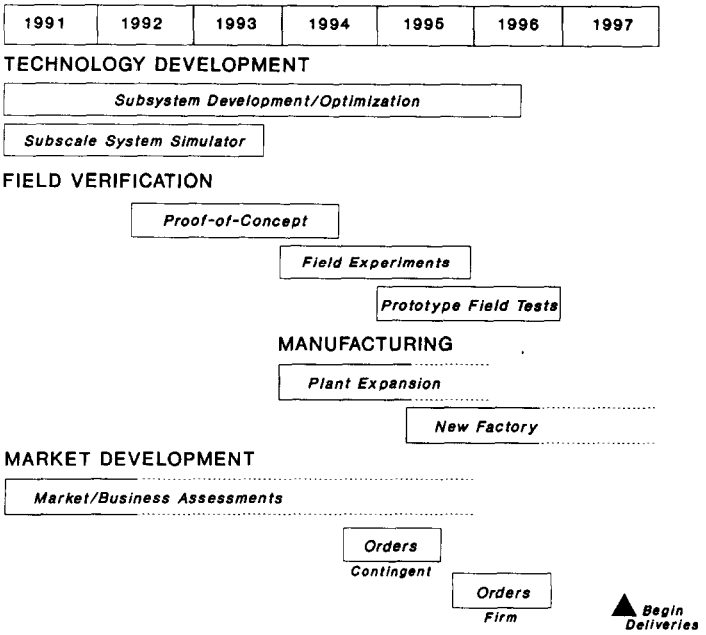

Fig. 2. IMHEX® Commercialization Program Schedule.

hensive MCFC commercialization program. The IMHEX® Commercialization Program's goal is to develop a market-responsive, natural gas-fueled MCFC power plant. Contingent orders for this unit are expected in 1995, with deliveries starting in 1997. Initial market entry units will be configured for the on-site and distributed generation markets, ranging in size from 500 kW to 3 MW. Subsequent IMHEX® products will serve dispersed generation, repowering, and new central station applications.

The IMHEX® Commercialization Program is an integrated effort which focuses on four major areas of interrelated activity.

(1) Technology development: component and sub-systems development, integrated system design and testing.

(2) Field verification: proof-of-concept, field experiment and commercial prototype unit testing.

(3) Manufacturing: development of manufacturing techniques and quality programs, design and construction of fabrication facilities.

(4) Market development: obtaining customer involvement, product definition, and commercial business assessment.

Figure 2, the program schedule, shows the overall work efforts to be carried out under each major program activity.

The IMHEX® Commercialization Program includes a number of major technical milestones to allow tracking of overall progress versus plans. The milestones and projected completion dates are shown in Table 1.

TABLE 1

Major technical milestones

1. Tall stack – 70 cells Confirm stackability and no carbonate pumping	mid-1991
2. Full-area stack – 20 cells Verify fabrication and operation	late 1991
3. 20 kW subscale system Operate reformer, stack, and controls	late 1992
4. Dual-fueled 250 kW proof-of-concept Demonstrate stack in partially integrated system at UNOCAL	mid-1993
5. Natural gas-fueled 250 kW proof-of-concept Verify feasibility of integrated system at SDG&E	mid-1994
6. Natural gas-fueled field experiments Verify design and performance characteristics	late 1995
7. Natural gas-fueled field tests Simulate commercial service, begin market entry	late 1996

Program support

The IMHEX® Commercialization Program enjoys wide technical and financial support from government, industry and research institutions. The following organizations are providing funding to the program:

Government: US Department of Energy, State of Illinois, and South Coast Air Quality Management District.

Industry: San Diego Gas & Electric, Southern California Gas Company, Union Oil of California, M-C Power, and IGT.

Institutions: Electric Power Research Institute and Gas Research Institute.

An industry group has been established to guide, support and stimulate commercial introduction of IMHEX® fuel cell power plants. Members of the Alliance to Commercialize Carbonate Technology (ACCT) include gas and electric utilities, pipeline companies, and other potential users of MCFC power plants. ACCT's major functions include monitoring technology developments and providing market insight and intelligence. This input from ACCT will ensure that the IMHEX® products developed are responsive to market and customer needs.

Acknowledgements

The authors wish to thank the US Department of Energy, Gas Research Institute, Electric Power Research Institute, State of Illinois, San Diego Gas & Electric, Southern California Gas Company, Union Oil of California, and South Coast Air Quality Management District, for their technical and financial support of critical elements of the IMHEX® Commercialization Program.