PFC/RR-85-14 DOE/PC-70512-1

DEVELOP AND TEST AN ICCS FOR LARGE SCALE MHD MAGNETS

QUARTERLY PROGRESS REPORT
Period from August 21, 1984 to September 30, 1984

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NOTICE

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1.0 Introduction

This is the first Quarterly Progress Report covering work done on Tasks I and II of the full-scale conductor development program being conducted by MIT for the Pittsburgh Energy Technology Center (PETC) under Contract DE-AC22-84PC70512. This report covers the period August 21, 1984 to September 30, 1984.

The conductor development program consists of the following four tasks:

I. Design Requirements Definition
II. Analysis
III. Experiment
IV. Full Scale Test

The objective of Task I is to establish the design requirements definition for full-scale conductors for use in early commercial MHD magnets. Since the focus of MHD power train development is now on relatively small systems such as may be used in retrofit applications, the Task I work concerns conductors suitable for systems of that size and type.

Emphasis during the three-year program (Tasks I through IV) will be on the development of the internally cooled cabled superconductor (ICCS) concept for the MHD application. This concept, which has been under investigation at MIT for a number of years[1,2], offers great promise in resolving the issues of constructibility and long-term durability for commercial MHD magnets.

2.0 Approach (Task I)

In order to establish a conductor design requirements definition, it is necessary to know the requirements which the MHD system imposes on the magnet and also to know the design characteristics of the magnet that will be needed to meet those requirements.

Requirements which retrofit-type MHD systems impose on magnets are being determined based on information obtained from PETC, from contractors working on Advanced Power Train studies and from others in the MHD community. This information is supplemented with information on magnet requirements obtained from earlier studies.

Since the scope of the Advanced Power Train studies does not include magnet design, preconceptual design work necessary to establish magnet characteristics is being done by MIT. The first phase of this effort thus provides double service; magnet design data to the APT contractors and conductor design requirements definition for conductor development, including functional requirements, system interfaces, design criteria, and design parameters (typical).

3.0 Work Accomplished

To briefly summarize the work accomplished, a review of past magnet designs was initiated to provide design data as a starting point. Discussions regarding preliminary design requirements were initiated with APT contractors, and preconceptual design work was started on retrofit size

MHD magnets. Supporting analyses were initiated in the areas of conductor heating, stability margin, electromagnetics, and structures engineering. The work, which is described in more detail below, was accomplished during the period from August 21, 1984 through September 30, 1984.

3.1 Review of Past Magnet Designs

A brief review of past MHD systems and superconducting magnet designs in the small commercial and retrofit size range was initiated. Data from existing designs were collected for summary and analysis. Of particular interest were characteristics such as MHD channel power, peak on-axis field, stored magnetic energy, and, most particularly, winding and conductor design data, including current levels and conductor current densities, as well as conductor design concepts.

3.2 Magnet Requirements Obtained from APT Contractors

Preliminary discussions regarding magnet requirements for retrofit-size MHD systems were initiated with Advanced Power Train (APT) personnel at Avco Research Laboratory TEXTRON (Avco) and Westinghouse Electric Corporation (Westinghouse). These discussions were aimed at determining the required magnet bore size and magnetic field distribution for the retrofit preconceptual magnet design.

3.3 Retrofit Magnet Preconceptual Design

Work was started on the preconceptual design of a retrofit MHD magnet to serve as a basis for developing conductor design requirements.

3.4 Supporting Analysis

Analysis in support of the preconceptual design magnet and conductor were started during the report period. Supporting analyses were initiated in the areas of conductor heating, stability margin, electromagnetics, and structures engineering.

3.5 Management Plan

A management plan was prepared by MIT and submitted to DOE/PETC for review and approval. The document defines the management plan to be used to guide and monitor the ICCS development program. The plan includes: a statement of the objectives of the program; a description of the relevant management structures, both at MIT and DOE; a work plan, program schedule, and cost plan; a definition of the reporting and review procedures; a definition of the procedures for implementing changes to the plan; and a signature page for approval of the plan. DOE/PETC comments on the plan were received and incorporated.

4.0 References

1. MHD Magnet Technology Development Program Summary, Plasma Fusion Center, MIT, September 1982 (PFC/RR-83-6).

2. MHD Magnet Technology Development Program Summary, Plasma Fusion Center, MIT, September 1984 (PFC/RR-84-18).

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