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ENGINEERING AND MANAGEMENT ASPECTS OF THE ORMAK PROGRAM

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I. Introduction

A. Purpose

This paper has two major objectives. The first of these is to lay the groundwork for succeeding ORMAK related papers in these proceedings. The second is to make clear the general work environment in terms both of the resources and the management requirements of the ORMAK program.

B. Historical Background

The ORMAK program was conceived in early 1969 as a two-phased project in which a conservative match to the Russian TM-3 device geometry would first be made and then second, an attempt at a lower aspect ratio, larger bore version, in which hot ions could be produced, would be made. In 1970, the direction of the program was changed to one aimed directly at the production of a low aspect ratio, moderate field, large bore, hot-ion device which is the present ORMAK facility. Later that year, recognition of the potential usefulness of neutral beam injection heating led to a further evolution of the program into one stressing both confinement and heating. The completion of the ORMAK device occurred in early 1971 and after a number of months of testing and debugging, plasma operations began. Machine operation,[1] plasma production, and diagnostics all were improved throughout 1972 and basic tokamak physics experiments[2] were conducted during 1973 along with injection heating experiments which began in mid-1973.

II. Engineering

A. ORMAK (and ORMAK related) Program Elements – Purpose and Present Work

1. ORMAK Operations (Operations Group within ORMAK Section). The basic engineering thrust of this element is to improve continuously machine operation and diagnostic capabilities carrying on a large number of widely differing and usually independent tasks. Crucial problems detected early in the experimental operation have, by and large, been corrected during those first two years of operation. We are presently at a point of improving those systems which still can hamper reliable operation or impede rapid data acquisition.[3] These jobs include various disciplines of engineering from electronics to electrical engineering to mechanical engineering, cryogenics and vacuum considerations.[4,5] In terms of function, these jobs range from improving the range of the OH power supply and making it modular, to installing a subcooler on the liquid-nitrogen coolant system for increased TF coil thermal capacity, to the general aim of extending the coverage of many diagnostics[6,7] from single point measurement to multipoint profiles to two-dimensional

have been noted, analyzed, and
The present and near term work
removal of the remaining flaws
and investigating improved ways
system. These present mechanis
topology of the outer vacuum sy
be outside the machine's therma
believed that, for the long ter
would result from changing the
the mechanisms are removed from
thermal enclosures.

3. High Field ORMAK (Plan
Group within ORMAK Section). T
High Field ORMAK modification i
of the plasma current, which wi
an increasingly hot and increas
plasma. The plasma current dou
doubling both the toroidal fiel
capability of the central core.
to the work in the main. One p
curement, fabrication, and asse
system that will generate the d
from a solid-state rectifier sy
is the set of modifications to
system and other parts of the i
associated with doubling the fi
OH coil supports.

The power system provides
1-sec, 100-MVA pulse from the l
to the one-thousand-volt level
rectifier systems, control of t
wave, multi-phase bridge rectif
mission to the present ORMAK de
chine itself the toroidal field
lar to present ones, are being
mechanical strength and electri
they can withstand repeatedly t
Similarly the ohmic heating cor
provide the volt-second change
magnetic fields and the ohmic h
field coil systems must also be
the quadrupled forces.

4. ORMAK-F/BX (Planning a
within ORMAK Section). This el
gram is concerned with preparat
experiment dealing with fusion
burning. One of the basic conc
use the same facility for both
experiments with a minimum of c
At present, a conceptual design
ducted to identify the problems
consistent picture of the entire
physics knows and unknowns releva
personnel requirements, technolog
quirements, and design engineerin