INTRODUCTION

Nuclear power currently provides about 17% of the world's electricity, primarily from thermal reactors cooled by water. However, in parallel with the development and construction of these thermal reactors, several countries have undertaken research and development programmes on fast reactors cooled by a liquid metal, usually sodium.

These liquid metal fast reactor (LMFR) programmes have resulted in commercial operation of four plants and construction of three plants as of December 1994. The purpose of this publication is to provide a compilation of the design and operational parameters of a total of 30 LMFRs. The data have been arranged in three groups:

a) experimental reactors, typically with power of up to 100 MW(th), built to demonstrate the technology but often with steam plant and turbine-generators to allow operation as a small power station;
b) demonstration or prototype reactors, in which much of the scaling up required for a commercial station, in terms of both overall size and individual components, has been incorporated; and
c) commercial-sized reactors developed as lead stations to demonstrate the system's capability to operate in a utility environment.

In many cases the overall experience with these reactors has been extremely good, the reactors themselves and, more frequently, particular components showing remarkable performances well in excess of design expectations. The fast reactor system has also been shown to have very attractive safety characteristics, resulting to a large extent from a fast reactor being a low pressure system with large thermal inertia and negative power and temperature coefficients.

The latest designs of the LMFR are now close to achieving economic competition with other reactor types. They also have the added benefit of being able to burn radwaste and plutonium arising from thermal reactors or from military sources. In the current world economic climate in which the demand for power in some industrialized countries has either been static or has diminished, the introduction of a new system such as the LMFR may not be considered by many utilities and some governments as a near future option when compared to other potential sources. However, by being able to produce up to sixty times more energy from a given amount of uranium than could be reproduced from a thermal reactor, the LMFR offers a significant possibility for solving energy problems for the next generation.

The present compilation of data was produced by members of the IAEA's International Working Group on Fast Reactors (IWGFR), a group of leading specialists representing those countries with LMFR programmes. The IWGFR, through annual meetings and other technical committee and specialists meetings, provides a forum for the exchange of information and experience relating to the LMFR. Many of these countries have a significant history of fast reactor development, often extending over a period of thirty years.

This TECDOC is a reference compilation of background data on the LMFR for the use by member countries. What will be apparent in examining the tables is the way in which the various national programmes have converged. The parameters of the early experimental reactors show a wide variability, but those of the commercial sized plants are very similar. Even with the initiation of a wholly new line of development, such as in the USA, of a modular reactor, it is interesting to observe that in many of the tables the parameters are close to those of the large monolithic reactors being advocated elsewhere. To some extent this is due to the tradition in the IAEA/IWGFR of exchanging information on experience, both good and not so good. It is, however, also a further proof that the laws of physics and the principles of good engineering inevitably lead to the same optimal solution, whatever the beginning. It also shows a commonality of achievement which begs for wider international co-operation or joint partnership.