

REVIEW OF HELIUM COOLING FOR FUSION REACTOR APPLICATIONS*

C.B. Baxi and C.P.C. Wong

General Atomics, P.O. Box 85608, San Diego, California 92186-5608

Helium cooling has been successfully used for fission reactors by General Atomics in the past. Helium is an attractive coolant for fusion reactors because it is chemically and neutronically inert and can be used directly for power conversion in gas turbine cycle. In addition, as was shown during ITER evaluation, it is very attractive from safety considerations. On the other hand, it is thought that use of helium cooling requires high pressure, large pumping power and larger manifold sizes due its low density at atmospheric pressure. In this paper it is shown that use of heat transfer enhancement techniques reduces the flow, pumping power and pressure requirements. A number of proven heat transfer enhancement techniques such as extended surfaces, swirl tape, roughening, porous media heat exchanger and particulate addition are reviewed. Recent experiments with some of these methods have shown that expected heat fluxes of 5 to 10 MW/m² in fusion reactors can be removed by helium cooling at a modest pressure of 4 Mpa. It is concluded that a number of these techniques are practical for fusion reactor application. A system design of a helium cooled a fusion reactor is presented.

*Work supported by U.S. Department of Energy under Contract No. DE-AC03-98ER54411.