PREFACE

NUCLEAR STEAM GENERATORS

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Careful studies by demographers have led to the conclusion that a world population of 10 billion people is very likely and that 20 billion is not impossible by the year 2070 from the present level of 4 billion. These statistics take into consideration successful attempts by parents to limit their families to an average of two children. The importance of energy in such a world becomes immediately apparent, and for the long run, nuclear power with breeding is the only viable (i.e., technologically and economically demonstrated) option among the several inexhaustible sources for maintenance of the agro-industrial complex that will be required to sustain humanity at the population levels that have been estimated.

Since about 1960, the demand for electricity in the U.S. has increased at an annual rate of ~7.8% or a doubling time of ~10 yr. During this period, electricity produced by nuclear power has become less expensive than electricity produced by fossil fuels. It is believed that the demand for nuclear power will continue to increase for several reasons. First and foremost, electricity must be substituted for direct combustion of oil and natural gas, which must be conserved for our petrochemical, pharmaceutical, fertilizer, and plastic industries. As these fossil fuels become harder to find, develop, and extract, a shift to lower-priced electrical energy produced by more abundant resources of coal and uranium must occur. Although conservation will provide an early restraint, it is not expected to provide the solution in the long term. Moreover, our future source needs cannot be fulfilled solely by utilization of coal; to accomplish this, production would have to increase by a factor of 10 by the turn of the century, and, in any event, an enormous effort will be needed to meet even a portion of our requirements. Although it is expected that coal-fired plants will produce ~35% of our electricity by the year 2000 (a five-fold increase), we must seriously consider conservation of coal for the future needs for hydrocarbon derivatives to replace those currently produced from oil.

Alternate, so-called exotic, sources have been considered, but careful studies conclude that we cannot expect to obtain significant amounts of electrical energy from fusion (controlled thermonuclear), solar, tidal, wind, and geothermal over the next several decades at best. Even with major efforts, only ~10% of our requirements can be met by such alternates by the year 2000.

To provide the remaining 90% of the projected energy needs by the year 2000, there must be an increasing dependence on a balanced mixture of coal and uranium. If we accept the demographers' projection and assume that all parts of the world eventually will reach a state of development comparable to that of the present U.S., it becomes apparent that this dependence on nuclear power will be worldwide. The current generation of light water reactors use our finite uranium resources inefficiently. The nuclear power option requires the development and commercialization of breeder reactors by the turn of the century.

Nuclear reactor systems must operate reliably to help fulfill the world's energy needs. Sound design and engineering and manufacturing practices are necessary to ensure the high reliability of a nuclear plant operation. Within the nuclear reactor system, nuclear energy must be converted to accommodate conventional turbine systems, and the most convenient method is through steam

generation. The steam generator is one of the most important and sometimes most annoying components.

In addition to the important matter of selecting an efficient and dependable steam generator design, consideration must be given to the materials of construction. Primary criteria must include proven availability, weldability, and fabricability, along with acceptable mechanical properties at temperature, metallurgical stability, and, finally, compatibility with the normal and off-normal environment.

The International Conference on Materials for Nuclear Steam Generators was organized to emphasize and to bring into focus this important technological area. Papers that were presented provided a timely, practical, and penetrating review of all aspects of steam generator materials. All the current nuclear steam supply concepts were addressed in 26 papers representing the status of this technology throughout the world. Separate sessions were devoted to design, operating experience, fabrication development, environmental effects, and properties and characteristics of alloys. Speakers and session chairmen were invited on the basis of their established reputation and current involvement in the steam generator materials field. Distinguished members of the nuclear industry, M. Levenson, Director of Nuclear Power Division of Electric Power Research Institute, and G. W. Cunningham, Deputy Director, Division of Reactor Research and Development, U.S. Energy Research and Development Administration, delivered keynote addresses.