PREFACE

FUELS FOR PULSED REACTORS

JAMES A. HORAK

Oak Ridge National Laboratory, Metals and Ceramics Division
Oak Ridge, Tennessee 37830

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In February 1974 the program committee of the Materials Science and Technology Division of the American Nuclear Society (ANS) initiated plans for a special session on the subject of Fuels for Pulsed Reactors, to be conducted during an upcoming ANS Annual or Winter meeting. Because of the experimental work on the improvement and development of pulsed reactor fuels that I had been involved in during the previous five years, bestowed on me was the responsibility for planning and conducting the proposed session.

The time was appropriate for assessing the current technology for fuels and/or fuel systems that can withstand high rates of energy deposition for several hundreds and even thousands of operations. We wanted to bring to the attention of the nuclear power reactor industry, and especially that segment of the industry with safety as its chief concern, that fuel materials and fuel-clad systems can withstand large energy depositions, even at extremely rapid rates (>30 μsec and longer) and neither fail nor create unsafe conditions within the reactor system. The very presence of the several pulsed reactors that are in operation daily attest to this. If fuel materials could not withstand large amounts of energy deposition at very rapid rates in a safe manner, there would be no pulsed reactors.

We also wanted to inform those responsible for reactor safety that pulsed reactors are excellent test facilities for reactor safety research. Pulse widths currently achievable range from ~30 μsec in some of the compact fully enriched metal-fueled systems such as the Sandia Pulsed Reactor II, SPR-II, to times as long as a millisecond in the more dilute lower enrichment systems such as VIPER at Aldermaston, England and the IBR-2 at Dubna, USSR. A time rate of pulsing that differs by more than 2×10^4 can be obtained in the existing pulsed reactors. Therefore, the energy deposition and rate of deposition associated with a reactor excursion of slight overpower—through a high level rapid transient—to fuel melting can be attained with the existing pulsed reactors. Furthermore, the very rapidly pulsed reactors, also called Fast Burst Reactors, are the only facilities currently in existence that have the correct neutron energy spectrum and time rate of energy deposition relevant to liquid-metal fast breeder reactor (LMFBR) fuels and fuel element testing. Test facilities that produce fission in the test fuel primarily by thermal neutrons do not produce fission densities in the fuel representative of the fission densities produced in LMFBRs. Also, the time rate of energy deposition in the thermal-neutron facilities is too slow to be used to study the major effects of rapid power transients in an LMFBR.

In addition to the use of pulsed reactors for the LMFBR programs, these reactors appear to be valuable facilities for some of the materials development programs of the Division of Controlled Thermonuclear Research. In the current plans for harnessing fusion energy for thermal and electrical energy production, most of the controlled thermonuclear reactors (CTRs) have to be operated in a pulsed mode. Hence, the behavior of CTR structural materials under conditions of cyclic loading combined with radiation must be determined. Pulsed reactors can be utilized to simulate the burn cycles associated with some of the CTR conceptual designs. With the use of pulsed reactors, the combined fatigue-irradiation behavior of structural alloys can be studied in a pulsed radiation field to provide the information required to build the first CTR experimental reactors prior to the availability of a testing facility that contains the actual CTR environment.

For these aforementioned two reasons, it was decided that the special session should be conducted at the Winter meeting held in Washington, D.C. in October 1974. This would provide the best

opportunity for maximum attendance by personnel from the appropriate U.S. Energy Research and Development Administration agencies that are involved with reactor safety and/or reactor overpower conditions.

It was further decided to have a session of invited presentations by researchers currently active in the area of pulsed reactor fuels and/or fuel systems. Because of the importance of the information to be presented at the Washington, D.C. meeting, we realized that it would be very desirable to have an up-to-date full-length version of the materials science and technology of pulsed reactor fuels session compiled in one place for ease and convenience of working and reference. Consequently, the authors who were invited to prepare oral presentations were also invited to prepare full-length versions of their work for publication together in one issue of *Nuclear Technology*. Hence the six papers dealing with pulsed reactor fuels in this issue. Although there were nine oral presentations at the session in October, only six of the papers received clearance from the respective laboratories involved for publication of the full-length papers.

To achieve the original purpose of providing all of the current information available on Fuels for Pulsed Reactors, permission was received from the authors of the three presentations for which full-length papers are not available to include the information that they presented orally in the Summary in this issue.