

Foreword

This special issue of *Nuclear Technology* is devoted to the technology of sodium as a reactor coolant. Sodium has been in use as a reactor coolant since the 1950s. Five sodium-cooled reactors are in operation today including both power and test reactors. Although an accurate number is not available, it has been estimated that there are approximately 300 reactor-years of sodium-cooled reactor operating experience worldwide. Experience has proven that sodium is an excellent reactor coolant and that sodium-cooled reactors can be maintained and operated reliably with high plant availability factors. Although the track record has been good overall, some reactors have encountered operational difficulties, and as a result, the extensive positive experience with sodium-cooled reactors tends to be overlooked. Because sodium-cooled reactors will continue to operate for the foreseeable future and the sodium fast reactor concept was chosen as one of the U.S. Department of Energy Generation IV reactor concepts to be developed further, documenting experience with sodium technology in one archival location will benefit engineers and scientists as this technology is reevaluated for future development, hence this special issue.

Certain properties of sodium make it attractive as a coolant for fast reactors. The first is that sodium does not act as a moderator, thus allowing its use as a fast reactor coolant, followed by its thermal properties: its very high thermal conductivity (more than 100 times greater than water), its high boiling point (882°C at atmospheric pressure), and its noncorrosiveness with reactor structural materials. Some drawbacks to the use of sodium are that it oxidizes rapidly when exposed to air and that it reacts with water, thus requiring well-engineered and well-constructed system boundaries. However, with the ability to operate sodium systems at near atmospheric pressure (due to the high boiling point), and given sodium's noncorrosiveness, these issues become manageable. As can be determined by reading the papers in this issue, the drawbacks related to the use of sodium have been successfully dealt with. Other properties of sodium can be and have been exploited to enhance reactor passive safety characteristics.

This issue includes nine technical papers ranging from a discussion about experience and technical issues associated with long-term operation of a sodium-cooled reactor, to a detailed description about removal of cesium from sodium. Since the technology associated with the use of sodium is different from the use of water or gas as coolants, the approach to system design, operation, and maintenance is also different. The technology base and the lessons learned in each of these areas are important when it comes to developing new reactor designs, avoiding the difficulties that some have encountered with this technology, and exploiting the benefits of sodium as a reactor coolant.

Although this collection of papers covers only a small part of the sodium technology experience base, it hopefully will provide a good source of reference material as a starting point for those interested in this technology. Additional papers are in preparation and will follow later either in regular monthly issues or in a second special issue. As further work is performed on development of the Generation IV concepts, we anticipate that the beneficial characteristics of sodium-cooled reactor technology will become more broadly recognized and exploited.

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