Foreword

Special Issue on Accelerated Fuel Qualification

Guest Editors

Ron Faibish[a] and Chris Stanek[b]

[a]*General Atomics Electromagnetic Systems, San Diego, CA;* [b]*Los Alamos National Laboratory, Los Alamos, NM*

We are excited to present this special issue of *Nuclear Technology* on the important topic of accelerated fuel qualification (AFQ). Each of the papers in this special issue uses elements of the AFQ methodology that were described in a white paper published in October 2021.[a] It's worth noting that this white paper was the product of numerous workshops and discussions held by an AFQ Working Group composed of industry and national laboratory representatives. The contributions to this special issue provide real-world examples of the AFQ methodology being employed for state-of-the-art use cases. To provide context for those papers, we briefly introduce the key elements of the method below.

Generally speaking, AFQ is a methodology for the development and qualification of new nuclear fuels in an accelerated time frame as compared to the current, conventional methodology of fuel qualification. As implied in its name, the goal of AFQ is to significantly reduce the time to qualify new fuels and materials (or to support extension of existing fuels and materials for use in different operating conditions). Historically, fuel qualification has taken more than 20 years, and the goal of AFQ is to reduce that to as few as five years.

The AFQ methodology relies on the combination of advanced modeling and simulation and separate effects experiments to work in conjunction with classic integral tests. This methodology provides fuel developers a framework to more efficiently develop and perform targeted experiments with the use of modeling and simulation (M&S) analysis tools and diagnostics to demonstrate fuel performance. The methodology also incorporates bounding uncertainties and risks for a risk- and performance-based qualification of new fuel systems. In essence, the AFQ methodology brings together a combination of advanced, physics-informed nuclear fuel performance M&S with targeted experiments to ultimately reduce the number of integral tests needed to qualify a new fuel and hence save time and cost for the overall qualification process.

AFQ is a well-timed initiative given the recent significant increase in interest in rapidly deploying advanced nuclear technologies. An aim of this special issue is to increase the familiarity of AFQ as a step for it to be broadly accepted as the state of the art in qualifying new nuclear fuels, particularly if these are to be deployed in both new and existing reactors in a timely manner. Such new fuels are typically designed to offer better operational safety margins that can enhance the overall safety case of nuclear power plants while also offering overall improvement to nuclear energy economics. AFQ is broadly useful—not only for new and advanced non–light water reactor systems that achieve higher fuel utilization and multiyear lifetimes, such as those used in efficient high-temperature gas-cooled or molten salt reactors, but also for the expanded use of fuels in existing light water reactors.

This special issue includes seven papers dedicated to the implementation of various elements of the AFQ methodology described in the aforementioned AFQ white paper. It is not the intent to obligate AFQ practitioners to use the methodology as is. Rather, it is left to the subject matter experts to decide what elements of the methodology would be most useful for their specific fuel qualification needs.

We hope that you enjoy reading these important papers and more importantly find use in them for your own fuel qualification needs. We also sincerely hope that the U.S. Nuclear Regulatory Commission staff continue to engage with the AFQ Working Group and the broader nuclear community and recognize the methodology to facilitate more efficient and timely qualification of new fuel systems.

[a]*Accelerated Fuel Qualification White Paper* (Oct. 1, 2021); https://www.nrc.gov/docs/ML2128/ML21287A646.pdf.