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## Advanced Fuel Qualification Methodology Report

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### *Abstract*

**Project Objectives:** The specific objectives of TerraPower’s proposed project is to develop an Advanced Fuel Qualification Methodology Report for TerraPower’s Traveling Wave Reactor (TWR) fuel, and to deliver the report to the NRC for review and evaluation. The Advanced Fuel Qualification Methodology Report will be developed for metallic fuel in a sodium fast reactor (SFR) environment. Key results will include identification of regulatory requirements applicable to metallic fuel qualification, an assessment of testing and analysis activities required to support licensing, and a description of TerraPower’s plan to use historic data to validate modeling tools.

**Description of the Project:** TWR designs are Generation IV, liquid sodium-cooled fast reactors. TerraPower has achieved significant progress in the development of the TWR design and is continuing to advance TWR technology. The initial TWR design will be based on existing, or extensions of existing, SFR nuclear technologies and will require extensive in-reactor testing. There are risks inherent with this approach. The Advanced Fuel Qualification Methodology Report will result in a significant reduction of risk in regulatory requirements, design, and testing. TerraPower will identify and address specific regulatory requirements and regulatory deficiencies for SFR metallic fuel that may result from having no regulatory documents that provide explicit guidance for fuel qualification. This will reduce design risk by verifying the regulatory requirements identified and developed by TerraPower to prevent fuel design limits from being exceeded. This mitigates the potential for expensive design changes late in the project lifecycle.

To reduce testing risk, TerraPower is planning to use a combination of historic irradiation test data, separate effects tests, limited integral tests, mechanistic models, and a fuel surveillance program in the initial reactor. Early evaluation by NRC of our proposed test program can help verify the adequacy of the test program. This will preclude expensive delays that could result if deficiencies were not identified until after PSAR submission. Use of historic data will supplement the limited amount of testing planned.

The fuel qualification methodologies developed by TerraPower will be applicable across multiple advanced reactor technologies, including future reactor designs. Use of an approved methodology will increase regulatory certainty for other advanced reactor developers. After a fuel-type is qualified, it would be more attractive to prospective buyers, thus enhancing the competitiveness of the U.S. nuclear energy industry, domestically and internationally. The approved methodologies could also benefit the DOE and National Laboratories in their efforts to design, develop, and license the Versatile Test Reactor.

