Temperature Transient Conformance in Westinghouse AP1000TM LOCA Testing Assurance Technical Services

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Abstract

Of all the elements of a LOCA (Loss of Coolant Accident) test of Class 1E equipment, the element most difficult to achieve in the laboratory, and most subject to varying interpretations, is typically the initial transient. During the initial transient, temperature and pressure are increased abruptly in order to simulate the effect of a rapid blowdown of a high energy system (e.g. a reactor's primary cooling circuit) into a fixed volume (e.g. the reactor's containment). Clearly, the purpose of including this transient in a LOCA test is to subject the test specimen to thermal shock conditions comparable to those expected during a hypothetical accident in order to determine whether the tested equipment is likely to perform its safety function as intended.

In recent years, the specified rate of change during the initial transient has increased substantially. For instance, the most recent specification for the AP1000 design requires a maximum LOCA transient temperature ramp rate ($\partial T/\partial t$) roughly 50 times higher than that given in the IEEE 323-1974 example. Since the initial thermal shock delivered to a test specimen is a critical element of LOCA testing, and achieving the necessary transient is becoming increasingly difficult, it is useful to have an objective, coherent, and repeatable method for judging conformance with transient requirements.

In this presentation:

- ATS' interpretation of the requirements of IEEE-323, as they pertain to the initial temperature transient, is explained.
- A numerical model for evaluating temperature transients is introduced with examples of actual LOCA test data.
- Implementation of a Westinghouse AP1000TM LOCA test, including measurement and evaluation of temperature data, is discussed. (Note: Since the presentation forum is in the public domain, ATS will guard against disclosure of Westinghouse proprietary information.)