Abstract submission form

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Presentation type **[1]**	Oral
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Subject of the presentation	Development of a field test for molten core concrete interaction in reactor accidents
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Development of a Field Test for Molten Core Concrete Interaction in Reactor Accidents

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Abstract

Radiocesium-bearing aerosols that also contained high levels of silicates were observed in the environment after the Fukushima Daiichi reactor accidents [1,2]. Silicates are fairly ubiquitous in the environment, but the main source of silicates in a nuclear reactor building is the concrete in the building structures that surround the reactor pressure vessels. It is hypothesized, therefore, that the observed radiocesium-bearing silicate aerosols probably originated from interaction of the molten core with concrete (in a process called molten core-concrete interaction, MCCI). This is only possible in accidents with major core damage, where the reactor pressure vessel has failed, as is known to have had occurred during the Fukushima Daiichi reactor accidents. Consequently, the presence of cesium silicate aerosols in the environment after a reactor accident would indicate that the accident had proceeded to a severe core damage accident with MCCI. This connection could, in principle, be exploited in a field test for MCCI, which could be operated at a distance without the use of nuclear plant instrumentation.

The Cesium Aerosol Generation (CAGE) tests were performed in the CNL Molten Material Laboratory to collect aerosols from the interaction of molten uranium-based thermite with concrete that had been doped with non-radioactive cesium hydroxide. The aerosols were collected on thimble filters and flat filters by purging the test tank with argon while the sample cooled. Samples from the flat filters were examined by SEM/EDX to determine whether the aerosols formed were similar to those from the Fukushima reactor accidents, and whether a field test can be devised to indicate the presence of cesium silicate aerosols. The field test would involve:

- leaching aerosol materials from a section of filter,
- separating soluble material from residual solid material (containing cesium silicate aerosols), then
- observing the fractions of cesium in the soluble material and the residual solid material.

Tracking the progression of an accident during a nuclear emergency is important for informing what mitigation actions can be taken to slow the progression of an accident at the plant, and to protect the public in the surrounding area. MCCI only starts to occur once a severe accident is at an advanced stage, and plant operators may not have available instrumentation to assess the situation. The test technique being proposed would provide an independent, field-deployable method for identifying markers of MCCI, and would, therefore, provide this essential information on the state of the reactors without having to rely on data from the plant itself.

[1] S. Higaki, Y. Kurihara, H. Yoshida, Y. Takahashi, and N. Shinohara, Discovery of non-spherical heterogeneous radiocesium-bearing particles not derived from Unit 1 of the Fukushima Dai-ichi Nuclear Power Plant, in residences five years after the accident, Journal of Environmental Radioactivity, Vol. 177, pp. 65-70, 2017.

[2] N. Yamaguchi, M. Mitome, A-H. Kotone, M. Asano, K. Adachi, and T. Kogure, Internal structure of cesium-bearing radioactive microparticles released from Fukushima nuclear power plant. Scientific reports, Vol. 6, No. 20548, pp. 1-6, 2016.