Radiation Hardened Electronics Destined for Severe Nuclear Reactor Environments

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ABSTRACT:

The post nuclear accident conditions represent a harsh environment for electronics. The full station blackout experience at Fukushima shows the necessity for emergency sensing capabilities in a radiation-enhanced environment. This project will serve to develop radiation hard by design (RHBD) electronics using commercially available technology employing commercial off-the-shelf (COTS) devices and present generation circuit fabrication techniques. Such technology not only has applicability to severe accident conditions but also to facilities throughout the nuclear fuel cycle in which radiation tolerance is required. Furthermore, the methods being developed in this work will facilitate the long-term viability of such radiation-hard electronic systems, thereby avoiding obsolescence issues being experienced in the nuclear power industry.

During nuclear reactor accidents, the containment building may present extreme conditions in terms of temperature, humidity and radiation, but an environment in which electronic sensor and robotic systems must be operable. A goal of this project is to increase the radiation resilience of the more sensitive electronics such that a robot could be employed for post-accident monitoring and sensing purposes as well as for long-term inspection and decontamination missions. This two-year project will develop both board and application-specific integrated circuit (IC) level RHBD techniques for circuits destined for severe nuclear environments, specifically those that are vital to robotic circuits. In particular, the proposed project will focus on using redundancy to achieve total ionizing dose (TID) hardness by interleaving active and recovery times for individual IC or constituent circuits.