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## Derisking Advanced Reactor Investment with Sensor Digital Twins for Enhanced Operations

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### ABSTRACT:

The nuclear industry is currently experiencing its first major surge of momentum in decades. Federally funded demonstration projects are deep into licensing activities. First mover customers, such as data centers, are investing hundreds of millions of dollars. Projects to reopen shutdown nuclear reactors are developing. The industry is justifiably optimistic about its future. At the same time, experienced nuclear engineers have seen various editions of the ‘nuclear renaissance’ come and go. The question on many minds is “how resilient is this momentum?” The challenges to successful deployment of advanced reactors are diverse: construction, materials, supply chain, licensing, public perception, financing, etc. At this point of the innovation cycle, perhaps the largest challenge currently is sustaining and growing customer interest as the current demonstration projects are completed in the coming years. Nuclear advocates point to very high capacity factors of the currently operating fleet as a major mitigating factor of the high upfront cost and long construction times. However achieving this level of availability is far from certain. The capacity factor during the early years of existing reactors was much lower and did not reach current levels for several decades. Failing to reach acceptable availability in a few years will likely motivate investors to find alternative approaches. A major outstanding risk to sustained deployment of nuclear reactors is the lack of a rapid innovation pathway for integrating new sensors and instrumentation applications in nuclear reactors. **This work will establish a foundation for combined theoretical and experimental approaches to characterize sensor performance that will fill this gap, providing crucial support for the nascent advanced reactor industry.**