

## Project Title

Development and Deployment Assessment of a Melt-Down Proof Modular Micro Reactor (MDP-MMR)

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### ABSTRACT:

An important difference at the point of operation between non-nuclear and nuclear power generators is the release of substantial amounts of decay heat after power production has ceased and the reactor has shut down. With the production of decay heat comes the possibility that a reactor core may melt down during an accident that prevents the continued cooling of the core after shut down. The possibility of core melt down is increased in the event of a Station Black Out (SBO), when external and internal power to the reactor are not available to dissipate the decay heat. This problem is worsened by the high thermal power of typical reactors and compounded by the continuing push to design ever-higher power density cores in order to achieve better “*economy of scale*”. Newer, redundant safety systems – external to the reactor core – are routinely added to the new designs, leading to additional plant cost and complexity, and increasingly unappealing economic returns. It is estimated that nearly 30% of the overnight cost of a nuclear power plant is directly related to safety systems. Moreover, as demonstrated by the Fukushima events, the probability of a catastrophic accident may be extremely low, but the consequences are also extremely expensive.

In order to take advantage of the “*economy of mass production*” as introduced for most other power systems, such as gas-fired turbines, the problem of decay heat removal needs to be clearly resolved, with the assurance of no possibility of melt down, core damage and radioactivity release – ever – without relying on expensive external safety systems that may or may not be available when needed. In other words: the safety of the reactor should be inherent, absolute, and contained in the reactor itself.

This proposal introduces a very compact reactor concept that integrates power production, power conversion and electricity generation within a single unit – the Micro Modular Reactor (MMR). The reactor will be “melt-down proof” (MDP) under extreme circumstances, including complete loss of coolant, and will be easily transportable and retrievable, and suitable for use with minimal site preparation and Balance of Plant requirements. The MDP-MMR is designed so that it has no chance of dispersing radioactive material. It is sealed with a lifetime of fuel loaded at the factory and inaccessible to the user/operator. It would be fully assembled at the factory, including a full complement of fuel, transported to the site of operation and started, with a small amount of pre-arranged, standardized preparation and construction work. Initially, the MDP-MMR will be attractive for use in remote areas that are currently served by very expensive diesel generator produced power. However it is possible to envision that the MMR, once the appropriate licensing framework is accomplished, will be suitable for large-scale deployment similar to gas-fired systems. Given the benefit of the much lower and more stable cost per unit energy produced by nuclear fuel compared to fossil fuels, it is also possible to envision that such reactors, when produced in large numbers, will be generating power at economically competitive prices.