2020 Workshop

Separating Nuclear Reactors from the Power Block with Heat Storage: A New Power Plant Design Paradigm

July 29-30, 2020
Charlotte, North Carolina (EPRI Offices)

Nuclear plant design has followed coal plant design with the reactor tightly integrated to the power block that includes the turbine generator. There is an alternative design, the nuclear reactor is in the security zone with the power block outside the security zone coupled to gigawatt-hour heat storage systems. This has been proposed by several organizations developing reactor concepts. Changes in nuclear plant requirements may make this the preferred option for future reactors. Electricity markets are changing because of (1) the addition of wind and solar that causes price volatility and (2) the goal of a low-carbon grid. This creates incentives for adding heat storage but low-cost gigawatt-hour heat storage systems are very large and couple to the power block. The storage system size may exceed the physical size of the nuclear power plant and the power block. If the power station includes heat storage, the reactor is a heat production system that converts a cold heat storage medium, such as salt, to a hot medium (hot salt) and is effectively decoupled from the production of electricity or sending heat to industry—avoiding the complications from directly coupling the reactor and the grid. Second, nuclear requirements (security, construction, licensing, operations, etc.) raise the costs of anything tightly coupled to the nuclear reactor. With separation of reactor from power block, the nuclear reactor has the nuclear licensing, construction, and security costs. The power block and heat storage are designed, licensed, built and operated to normal industrial standards with an over-the-fence separation from the nuclear systems. Such an alternative design strategy has major implications for design, licensing, construction, security, operations and the business model—with large implications for capital and operating costs. The workshop is a first look at this alternative reactor design option that is applicable to multiple reactor types.

This is a joint Massachusetts Institute of Technology (MIT), Idaho National Laboratory (INL), Electric Power Research Institute (EPRI) workshop. It will be held at the EPRI offices in Charlotte, North Carolina at 1300 West WT Harris Boulevard. The contacts are: Charles W Forsberg (cforsber@mit.edu), Piyush Sabharwall (piyush.sabharwall@inl.gov) and Andrew Sowder (asowder@epri.com).

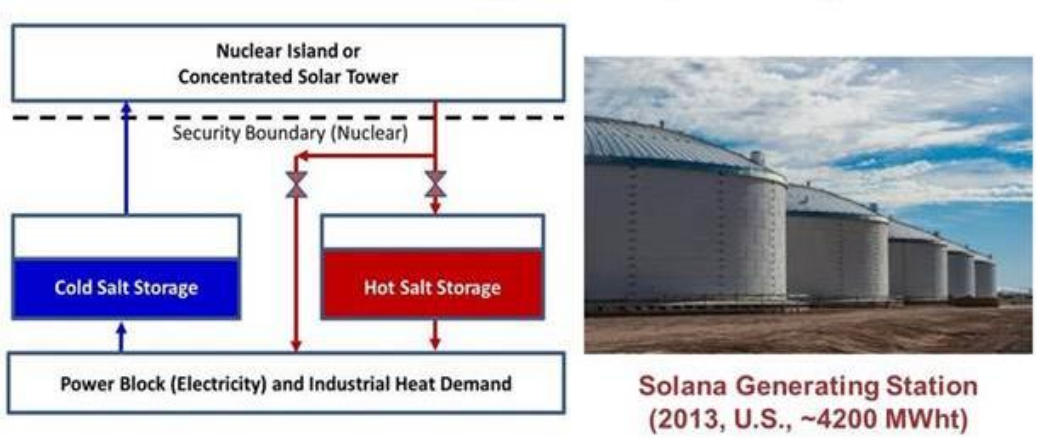

Fig. 1. Schematic of alternative systems design. This systems design is currently used by concentrated solar power systems that use salt as a heat storage medium.