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Recent and Advanced Nuclear Safety of the Nuclear Power Plant Generations

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Abstract

The first natural nuclear reactor of 1.9 billion year ago –OKLO (West Africa), was discovered in 1972. Its fuel was depleted uranium ore of 0.6-0.44% ²³⁵U. It was cooled and moderated by natural water.

The first man-made reactor of Fermi design coded as CP-1 ,was operated in 2 dec. 1942. It had no cooling system of any kind.

Recently, after Chernobyl 1986 and Fukushima 2011 accidents ,an evolution in the nuclear reactor safety concepts has been established and integrated. Generation III and III+ of high redundant and diversified passive and active safety systems are currently in operation and under construction.

Inherent Safety Concept, the features used in reactor design and material selection which can make the NPP immune to potential hazards like core meltdown or release of radioactivity is a reality in the time being. These features rely on choice of design concept, laws of nature, properties of materials and internal stored energy with no reliance on engineering mechanisms or operator actions to prevent accidents. These features are in-built in reactor which avoid unwarranted power excursions and help to mitigate effects of accident sequence. Some Important Inherent Safety Characteristics of advanced reactors are:

- Negative reactivity coefficients
- Negative void & temperature coefficient of reactivity
- Low power density
- No hydrogen generation by metal water reaction and oxidation;

Nowadays, Over 16,000 Cumulative Reactor-Years of Commercial Nuclear Power Operation in 33 Countries are recorded as shown in the following figure.

The defense in depth (DID) with its multiple barriers and 5 levels are objective and strategy of NPPs from design, operation to decommissioning phase.

A presidential strategic decision has been taken in last Nov. 2015 for our home Egypt to construct 4 VVER1200 units at Al-Dabaa site. Focus on passive and active safety systems of the VVER1200 will be given in this paper.

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