Chernobyl and Fukushima nuclear accidents: Similarities and Differences

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Human history has witnessed several major disasters that required mobilization of considerable human and financial resources. Severe nuclear accidents are very rare events that affect profoundly individuals (e.g., workers and local residents), society, and environment over long time. Level-7 nuclear events, according to the INES scale, result in release of total activity to the environment radiologically equivalent to that of an atmospheric ^{131}I release of at least several tens of PBq (the corresponding ^{137}Cs activity is lower by a factor of 40).

During the 68 years-long use of ^{235}U fission for commercial production of electric energy with nearly zero gaseous emissions, only two accidents were rated at level-7 and non at level-6. The accidents occurred 25 y apart in spring time during hot power reactor shutdown and each of them had a guessed momentary cost of the order of 10^{11} Euros. They were caused by reactor power-surge and loss-of-coolant, respectively. Their root causes are considered to identical, poor safety culture and safety management, both locally and centrally. The number of the caused losses of human life is the sum of the number of the prompt fatalities, radiological on not (32 and 2, respectively) and the number of the delayed ones. The accidents also caused, as anticipated, various non-fatal health, psychologic and socio-economic adverse effects, such as exposure-related cancers, loss of income, and effects due to evacuation, dislocation, and temporary or permanent resettlement of the inhabitants of the heavily contaminated areas.

The 1986 accident occurred at Chernobyl, Ukraine, during a very low-power engineering test of a 1000 MW_e LWGR unit, just 2 y after it began its commercial operation. The test brought it into unstable state, led to power surge, explosion, and extensive fire. The 2011 accident at Fukushima-1 plant in Japan was triggered by a very severe, but anticipated, natural disaster. At the time, reactors 1, 2, 3 were in normal operation at a combined power of ~2000 MW_e (the remaining reactors in the plant were temporarily out of service) and were automatically shut-down. These three 2nd generation reactors were in commercial use since 35 to 40 years and had not been adequately upgraded by the owner and operator. Lack of adequate electric power supply led to core overheat, partial core melt, and explosions during the following days, that breached the containment vessels of No 1, 3, and 4 reactors. Due to the prevailing winds, about 80% of the released activity was deposited in the Pacific Ocean.

Since these accidents occurred under very different political, social, legal, and financial framework at the time in USSR and Japan, different disaster management methodologies were used, both on-site and off-site. However, in both cases the radioactive clouds were coupled with clouds of panic and fear often obliterating rational thinking. Some adverse effects were enhanced by politically driven misconceptions about the health effects of radiation, despite the fact that the released radiologically equivalent activities were orders of magnitude lower than those released during atmospheric nuclear weapons testing during just in two years (1961 and 1962) with a total of almost 260 Mt yield, under Cold War muting conditions.

Taking into account the potential significant harm due to the various lifecycle phases of nuclear energy and the experience gained from the nuclear accidents that occurred so far, uranium fission is considered by many experts as one of the less dangerous currently available reliable sources for electric energy production per energy unit to the electric power grid.