Competitive Exams: Science and Technology Nuclear Science

Nuclear Science

1. Critical mass: A critical mass is the smallest amount of fissile material needed for a sustained nuclear chain reaction. The critical mass of a fissionable material depends upon its nuclear properties (e. g. The nuclear fission cross-section) , its density, its shapes, its enrichment, its purity, its temperature and its surroundings.

2. Nuclear Fission and Chain reactions: In a thermal Nuclear Power Plant, when a U – 235 atom splits, along with the released energy it also ejects three neutrons. These neutrons in turn trigger more fission reactions. But this is not the case, as these stray neutrons don't always hit a U – 235 atom, them usually miss and just go shooting off. The more dense the lump of U – 235 is, the closer together the atoms are, and the more likely it is for an ejected neutron to bump into one of the atoms.

3. If the odds of a neutron available for hitting a U – 235 atom are on an average less than 1, then the mass is subcritical. Some energy will be released, but the reaction will rapidly peter out with run out of neutrons. If the odds of a neutron hitting a U – 235 atom are exactly 1, i.e.. . On an average, each time an atom splits and ejects three neutrons an average of one of them connects, then we say the mass is critical. Fairly constant release of energy until all of the fuel is used up. This is how a nuclear reactor works.

4. If the odds of a neutron hitting a U – 235 atom are more than 1, i.e.. . On an average each split atom causes more than one other atom to split, then the mass is called supercritical. Fission will continue in a chain reaction, releasing energy faster and faster, until a mind-numbingly large explosion is met.

5. Inherent safety: Just being supercritical isn't enough. Because as soon as the very slight supercritical is there, either enough uranium is burnt up and there isn't super critically anymore, or with the excessive heat the density would go down enough to take out the supercritically.

6. Fuel used in commercial nuclear reactors is enriched to contain only about 3 – 5 % U – 235, the purity requirement for a bomb is around 90 % . The fuel of a nuclear power plant is not even close to the critical mass required for exploding. Even if

somehow which it wouldn't, the fuel got compressed so that it became supercritical, it would rapidly self-correct down to the critical level, by heating, melting or blowing apart. Therefore, there is just no way it could possibly happen by accident, even one couldn't do it on purpose with the fuel used in nuclear power reactors.

7. Nuclear meltdown: A nuclear meltdown is an informal term for a severe nuclear reactor accident that results in core damage from overheating. The terms is not officially defined by the International Atomic Energy Agency or by the US Nuclear Regulatory Commission. However, it has been define to mean the accidental melting of the core of a nuclear and is in common usage as a reference to the core's either complete or partial collapse. Core melt accident and partial core melt are the analogous technical terms.
8. A core melt accident occurs when the heat generated by a nuclear reactor exceeds the heat removed by the cooling systems to the point where at least one nuclear fuel element exceeds its melting point. This differs from a fuel element failure, which is not caused by high temperatures. A meltdown may be caused by a loss of coolant, loss of coolant temperatures, or low coolant flow rate or be the result of a critically excursion in which the reactor is operated at a power level that exceeds its design limits. A meltdown is considered a serious event because of the potential for release of radioactive material into the environment.

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