NUCLEAR ENERGY

The curve of binding energy per nucleon E_{bn} has a long flat middle region between **A = 30 and A = 170**. In this region the binding energy per nucleon is nearly constant (**8.0 MeV**).

For the lighter nuclei region, **A < 30**, and for the heavier nuclei region, **A > 170**, the binding energy per nucleon is less than **8.0 MeV**, as we have noted earlier.

Now, the greater the binding energy, the less is the total mass of a bound system, such as a nucleus

Consequently, if nuclei with less total binding energy transform to nuclei with greater binding energy, there will be a net energy release. This is what happens when a heavy nucleus decays into two or more intermediate mass fragments (**fission**) or when light nuclei fuse into a heavier nucleus (**fusion**.)

Fission

$$ {}^{1}_{0}\mathrm{n} + {}^{235}_{92}\mathrm{U} \rightarrow {}^{236}_{92}\mathrm{U} \rightarrow {}^{144}_{56}\mathrm{Ba} + {}^{89}_{36}\mathrm{Kr} + 3\,{}^{1}_{0}\mathrm{n} $$

The same reaction can produce other pairs of intermediate mass fragments

$$ {}^{1}_{0}\mathrm{n} + {}^{235}_{92}\mathrm{U} \rightarrow {}^{236}_{92}\mathrm{U} \rightarrow {}^{133}_{51}\mathrm{Sb} + {}^{99}_{41}\mathrm{Nb} + 4\,{}^{1}_{0}\mathrm{n} $$

Or, as another example,

$$ {}^{1}_{0}\mathrm{n} + {}^{235}_{92}\mathrm{U} \rightarrow {}^{140}_{54}\mathrm{Xe} + {}^{94}_{38}\mathrm{Sr} + 2\,{}^{1}_{0}\mathrm{n} $$

the total gain in binding energy is 216 MeV

Nuclear reactor

There is a release of extra neutron (s) in the fission process. Averagely, 2.5 neutrons are released per fission of uranium nucleus (ie 2 or 3)