(20.5) ^{232}U is formed in a thermal ^{232}Th based breeder. (a) By which chain of reactions is it formed? (b) Will the choice between a continuous or discontinuous (once a year) reprocessing of the Th blanket affect the isotopic composition of the isolated uranium (assume that all other actinides remain in the blanket)?

Study Fig. 20.3. From this figure we get the following answers.

(a) $^{232}Th(n,2n)^{231}Th(\beta^-)^{231}Pa(n,\gamma)^{232}Pa(\beta^-)^{232}U$

(b) Yes. Continuous reprocessing with isolation of ^{233}Pa and decay of this isotope to ^{233}U outside the reactor will give purer ^{233}U than from yearly reprocessing with isolation of U, Pa or both. ^{233}U is formed by the reactions: $^{232}Th(n,\gamma)^{233}Th(\beta^-)^{233}Pa(\beta^-)^{233}U$. Main side reactions leading to other uranium isotopes are:

(a) above,

$^{233}Th(n,\gamma)^{234}Th(\beta^-)^{234m}Pa(\beta^-)^{234}U$,

$^{233}Pa(n,\gamma)^{234g,m}Pa(\beta^-)^{234}U$, and finally

$^{233}U(n,\gamma)^{234}U$.