

4.1.1 Fissile Material Type

The only fissile isotopes from which fission weapons have been made to date, [Appendix A, Bibliography references (i), (ii), (iii), (iv), (v)] are U-235, U-233, and Pu-239. Other plutonium isotopes, or mixtures of plutonium isotopes involving Pu-240 to Pu-243, are also technically feasible. The technical disadvantages and production disadvantages of the latter isotopes are such that their use can be considered as extremely improbable, and they are not specifically considered in this report. The data presented here for Pu-239 would, however, also be generally valid for other plutonium isotopes.

The specific purity requirements for the three isotopes identified for practical weapons is not discussed (e.g., what is meant by weapons-grade plutonium). At the level of detail discussed in the report this should not significantly influence the conclusions. As an example, it has been widely reported in recent years that the US has demonstrated a nuclear explosion with reactor-grade plutonium. Other sources have disputed this (New Scientist, April 9th, 1994, p. 430). Without access to classified literature sources, this and similar issues associated with fissile isotope specifications and associated weapons tests cannot be confirmed. Bibliography references (iv) and (vi) provide the most detailed technical descriptions of weapon material purity requirements that are available in the unclassified literature.

Tritium is also an important non-fissile isotope for the advanced weapons states, as it is used to boost the fission power from fissile isotopes and to provide a neutron initiator. Tritium provides the basis for a reduced size of weapon, thus increasing the variety of delivery systems that could be used. It also increases the weapon shelf life compared to non-tritium neutron initiator designs. Although tritium cut-off is not included in the scope of the current study, it is discussed briefly in Section 6 for completeness. Pure fusion-isotope-initiated nuclear explosive devices remain undeveloped, so that safeguards preventing the diversion of fissile isotopes would automatically prevent the production of thermonuclear explosives.

To simplify the information presentation, each of the three potential isotope diversion routes is dealt with in a separate table. Facility types that contribute in a similar manner to more than one isotope route have been noted by cross references in the tables.

4.1.2 Generic Diversion Route Based on Facility Declaration Status

Two generic diversion routes to weaponization for each of the three defined isotopes, based on the declaration status of facilities, are defined to be:

- (i) declared facilities, and
- (ii) undeclared facilities and other undeclared fissile material acquisition methods.

In this report the term declared is intended to refer to facility status following a cut-off agreement and assumes that existing known weapons facilities are put under safeguards similar to the 'declared facility' status of current International safeguards.

These two generic routes are separated because the diversion risks and appropriate verification methods to confirm a fissile material production cut-off are, in general, quite different.

The declared facilities could logically be divided, according to the intent of the facilities, into: