5.2.2 Pu-239 Route

Table 1.2 provides an analysis for declared Pu-239 potential diversion paths similar to that described in Section 5.1.1 for the declared U-235 route. The diversion paths with the highest importance for final material acquisition, assessed in row 2, are dual-purpose and dedicated Pu-239 production reactor facilities for fuel irradiation, plutonium reprocessing (extraction) facilities and acquisition from existing declared weapon-grade plutonium sources. Intuitive rankings to assess the likelihood of facility anomaly by state type, row 1 data, were considered sufficiently simple that the decision analysis method was not applied in this case.

The figures referenced from the bottom row of Table 1.2 provide the overall diversion-risk relative rankings, as a function of state type. Figure 3 decision analysis hierarchy was used to derive these rankings; results are shown in Figures 3.1.2a, 3.1.2b and 3.1.2c.

For the NWS and NNWSD, Figures 3.1.2a and 3.1.2b, the diversion path risk rankings are basically the same. The diversion paths judged with the most overall diversion-risk potential are from existing weapon-grade stockpiles, plutonium reprocessing/plutonium fuel fabrication facilities, dual- use reactors, and research/test reactors. The risk from dedicated Pu-239 production reactors is small because the detection of facility clandestine operation (they would be shut-down as part of a cut-off agreement) would be conclusive from verification by relatively simple technical means.

For the NNWSU, Figure 3.1.2c, the dominant risks are research reactors and Pu-239 reprocessing/plutonium fuel fabrication facilities. An example of potential diversion using this route would be the recent concern over North Korea. Power reactors were excluded, by the definition of NNWSU, but were actually left in the risk rankings for illustration. The power reactor route risk would be expected to be low, as shown, again because of the ease of diversion verification, using spent fuel material accountancy.

Verification effectiveness, for declared stockpiles and dual-use and research/test reactors should be conclusive, as noted in Table 1.2, using existing safeguard techniques, primarily material accountancy and seal methods. Limiting the number of declared-stockpile locations, in particular, would maximize the effectiveness of these verification methods. Technical means alone would be very effective for identifying operation of declared production reactors. As noted above the reason for this is that the reactors would be shut-down under a cut-off agreement and the signatures of an operational reactor are very easy to detect. Diversion from plutonium reprocessing/conversion facilities is quite difficult to verify effectively using routine inspections, and special inspections do not provide any great advantage over routine inspections. A reprocessing plant is physically large and handles a large amount of fissile material in both solid and liquid form in continous processes. A complex accounting system requiring a significant, and continuous, inspection effort to audit is thus needed. Similarly the material accounting system of plutonium conversion/fuel fabrication facilities, which are smaller scale facilities than reprocessing plants, require significant effort to ensure that material balance uncertainties are acceptably small.

5.2.3 U-233 Route

Table 1.3 analyzes declared U-233 diversion paths in a manner similar to that described in the previous two sections. As discussed in Section 5, the U-233 route, in principle, is considered much more unlikely than both Pu-239 or U-235, for all state types. Material acquisition routes are the same as shown for Pu-239 in Table 1.2, reactor irradiation and fuel reprocessing/U-233 extraction being the key ones. The risk rankings of diversion paths would be expected to be the same as that of the equivalent Pu-239 facilities, Figures 3.1.2a, 3.1.2b and 3.1.2c, and