rank the three state types. Results are shown in Figures 1.1.1a, 1.1.1b and 1.1.1c. Intuitive rankings were used to rank the rest of the diversion paths by state type. As noted in Appendix D, Section D4, the precision indicated by the decision analysis program output is not, in this application, justified, as the subjective judgements cannot in principle be accurate to three figures. The results, however, include data on all the main variables of Figure 1, and provide a logically derived ranking, which intuitive judgement does not.

The figures referenced from the bottom row of Table 1.1 provide the overall diversion-risk relative rankings as a function of state type derived from the hierarchy of Figure 2. For NWS and NNWSD the dominant diversion-risk potential for declared facilities (Figures 2.1.1a and 2.1.1b) are generally similar and are from existing stockpiles of weapons-grade material, the laser isotope separation technique, enrichment techniques under R & D and enriched uranium conversion/enriched-fuel fabrication facilities. The various techniques implied under R & D enrichment techniques are simply treated as a group but, as noted in Section 5, enrichment technology is dynamic and actual development progress may not be known. For example, the French development of the chemical exchange enrichment method was underway for nine years before it was revealed in 1977. Declared sources of HEU for use in research reactors or for naval uses are medium risk, because the fresh fuel material for them could be weapons-grade, and the physical volumes involved are not large. Gas centrifuge enrichment in particular has features that makes this method vulnerable for clandestine HEU production in declared facilities licensed to produce low enrichments and is assessed as somewhat higher relative risk for the NNWSD than the NWS. Safeguard techniques are used for verification of this type of facility and can be made quite effective but the basic process vulnerability remains. The safeguards involve more process equipment monitoring and calibration activities, compared to the more common materially-oriented safeguards used in other facility types. New design advances being made with gas centrifuges will greatly enhance the potential for clandestine HEU production if safeguard techniques are not upgraded.

For the NNWSU, Figure 2.1.1c shows quite different diversion risks than for the developed states. The electromagnetic (calutron) enrichment method, gas centrifuge enrichment method, aerodynamic separation and enriched uranium conversion/fuel fabrication facilities have the highest risk rankings. This analysis assumes that undeveloped states have a declared uranium enrichment program which in itself is quite unlikely and the only (declared) facility likely to be supported is a research/test reactor, although the aim could be self-sufficiency for fuel for future power-reactor projects. Currently there are no declared electromagnetic U-235 enrichment facilities and no safeguard program exists for them. The aerodynamic separation process currently has effective safeguards, but the discussion above regarding gas centrifuge misuse applies similarly to this technique. The medium risk from a declared research reactor would also depend upon its size, the nature of fuel and any isotope production program. The NNWSU are very unlikely to have declared advanced laser isotope or other R & D enrichment methods, so those paths are the lowest risks. Because of the unlikeliness of a declared enriched uranium program in a NNWSU, the overall risk of all the diversion paths from declared facilities would be expected to be much less than for declared facilities in the developed states.

For the verification methods listed in Table 1.1, a variety of existing safeguards routine inspection techniques are available for facility design, operations and inventory change verification for the known enrichment technologies, gas centrifuge and aerodynamic separation, and also for research reactors and conversion facilities. For the developed enrichment technologies and other existing facilities, identified as high importance, current routine inspections can provide adequate verification of diversion. As noted, safeguard techniques for gas centrifuge and aerodynamic enrichment methods need to be kept upgraded with advances in facility designs. Safeguard techniques remain to be developed for laser isotope and other enrichment methods under research and development.