• development of chemical exchange U-235 enrichment, (undeclared)	Table 2.1
• obtaining gas centrifuge U-235 enrichment technology, (undeclared)	Table 2.1
• obtaining small amount of HEU from research reactor fuel, (declared source)	Table 1.1
• obtained 2 gm Pu-239 from reprocessing facility, (declared and undeclared)	Table 2.2 and 1.2

North Korea:

• research reactor fuel, special inspection denial of spent fuel accountancy system, potential Pu-239 route, (declared)	Table 1.2
• suspected undeclared Pu-239 reprocessing line in existing facility (declared)	Table 1.2

Footnotes [3] and [4] have also referred to other, isolated, cases of attempted diversions. A more extensive international list of facilities that were operating or under construction before being either announced or discovered has recently been provided. [10]

From the various facilities and material acquisition sources listed above, particularly with Iraq, what is indicated is the diversity of options pursued. Thus verification strategy should not be limited to selected declared and potential undeclared facility types assessed as high risk. Rather, verification should be broad in scope and developed in particular for potential undeclared facility paths. The revelation of the use of calutron enrichment by Iraq, in particular showed an intelligence failure because the likelihood of such a facility was not analyzed by looking at those special features of Iraq that made this technology a prime contender. Instead, judgements on safeguards implementation were made according to the needs of advanced states. Figure 1 has illustrated in principle how the relevant features can be systematically identified and assessed. In a similar way to calutrons, thermal diffusion enrichment for example, a known and practical technology, became obselete following its use during the Manhattan project and has received no attention by advanced states since then.

In addition to the example of the Iraq diversions, the large range of possible diversion paths and the required time scales set by various technologies also suggest that a broad scope verification strategy is desirable. This would ensure that verification that focuses on judged high-risk diversion paths did not result in encouraging the use of other paths, not selected for verification. For instance it is quite possible that the 1981 bombing of Iraq's Osirak research reactor prompted a change from a potential reactor/Pu-239 diversion program to the U-235 diversion program. This analysis identifies as low risk, facilities such as undeclared uranium mining for example but it should be recognized that a number of low-risk facility diversions can provide definitive evidence of intent, at an early stage. Therefore some minimal verification should be used for paths other than those judged as high risk.

5.2 Declared Facilities

5.2.1 U-235 Route

For the U-235 route the importance of an undeclared facility or material acquisition route anomaly to the final acquisition of material is qualitatively assessed in the second row of analysis Table 1.1. The most important diversion paths are enrichment processes and acquisition from existing enriched uranium sources. The first row of the table assesses the likelihood an anomaly according to each of the three defined state types. For three of the enrichment facilities, assessed with high importance, a detailed decision analysis was used to

[10] Bulletin of Atomic Scientists, June 1993, p.17.