Executive Summary

This report is a preliminary exploration of potential diversion paths relevant to a fissile materials "cut-off" agreement and the implications of these paths for verification. It is intended to provide background research material to be used in preparation for discussions on such an agreement.

An analysis framework is provided which gives information on the variables contributing to the risk of potential diversion paths for nuclear weapons fissile material. An extensive, systematic list of potential diversion paths, covering both declared and undeclared sources of fissile material, is provided. From this framework, relative risks for potential diversion paths have been assessed and defined for three generic groups of states: nuclear weapons states (NWS), developed non-nuclear weapons states (NNWSD), and undeveloped non-nuclear weapon states (NNWSU). A simple yet effective method is used to provide the common relative risk ranking scale. This method is specifically designed to accommodate judgements involving many subjective variables, and can accommodate technical, economic and political factors that are particularly relevant in this type of application. The judgements used in the relative risk assessment are those of the authors only. Wider input into the assessment process was not feasible within the resources of the project, but the method used provides the assessment information in a transparent form, readily available for review and scrutiny. The method used would be easily adaptable for a state-specific diversion-risk analysis.

The framework also provides a logical structure from which a more detailed analysis of the risk- relevant variables (e.g., diversion signatures, diversion likelihood, verification techniques and verification effectiveness) could be made. Cost aspects of verification are not discussed, but the systematic framework provides a logical way of incorporating this feature if required.

Technical developments can make current risk assessments invalid. Advances may be made with obsolescent fissile material production techniques, which make them viable and attractive, and novel techniques may be developed. Uranium enrichment technologies, in particular provide a good historical example where significant advances have been continually made. Without access to classified information it should also be recognized that open literature sources on this subject should be used with caution. There are examples in the available literature of contradictory information, in particular with regard to nuclear material specifications and what is, and is not, possible for weapons design. At the level of detail provided in this report uncertainties in material specifics and in verification technique specifics should not, however, influence the risk ranking conclusions presented.

The dominant diversion risk for NWS is judged to be from existing weapon-grade material stockpiles of both U-235 and Pu-239. Verification methods for stockpiled material should be straightforward, using existing methods. These methods can be expected to provide effective verification, providing that storage methods are well defined and the number of locations are limited. The potential diversion risk of stockpiled material not being declared prior to a cut-off agreement would, however, be significant. The next highest risk is judged to be from newer U-235 enrichment techniques under development and laser isotope enrichment in particular. These pose a short term risk in that knowledge of the current status of these techniques is unlikely to be divulged for proprietary reasons. They also pose a longer term risk in that the techniques are eventually likely to be obtained by less developed states. Diversion signatures and associated verification methods for these newer techniques including laser isotope, whether declared and undeclared, are also not currently defined nor used.

For the NNWSD, diversion from existing stockpiles of both U-235 and Pu-239 (declared or undeclared) also ranks as high risk, but with the laser isotope, gas centrifuge and aerodynamic U-235 enrichment methods judged as somewhat higher risk. Safeguard techniques for declared facilities of these latter two (demonstrated) methods are used but these methods, in