PREFACE

In general, inspections under an arms control regime are intended:

- to deter violations,
- to detect violations, and
- to minimize the damage due to undetected violations.

Inspections are usually subject to quotas, however, and inspecting agencies' budgets are limited, so there is always pressure to accomplish these objectives with minimal inspection effort. One way to make fewer inspections go further is by making inspection choices unpredictable, relying on the risk, rather than the certitude, of detection to deter. The only reliable way to achieve unpredictability is randomness; this is the justification for introducing random elements into the scheduling of inspections.

There are many different ways to incorporate randomness in the choice of which objects of verification to inspect. Uniformity (making each possible inspection pattern equally probable) is always feasible but, where there are significant disparities in value, uniformity is far from optimal in ability to deter and to limit damage.

After an agency has decided where to inspect, it must then decide how much. The level of effort applied to a verification task often affects the results. Intensive inspections are more likely to result in unambiguous reports, and less likely to miss evidence about current or recent anomalies. On the other hand, an extensive inspection program is more likely to give timely warning of problems, especially large scale problems, although there is a greater tendency for evidence to be incomplete and misleading. In summary, inspection locations, types and intensities, must be selected very carefully in order to cost-effectiveness.

The specific objective of this research project was to study how the probability and intensity of Non-Proliferation Treaty (NPT) inspections can best be spread over the objects of verification to achieve the general goals listed above. In particular, how should the IAEA's inspection patterns reflect the variable characteristics of objects of verification within or among states, and how much of the IAEA's resources should be expended on the detection of undeclared sites and activities? Finally, what is the relation between the cost and the maximum effectiveness of NPT inspections?

i