# Allocation of Cheating and Inspection Resources

# Under Chemical Weapons Treaties

Allocation is an important problem under arms control agreements because most such agreements rely on the threat of close inspections with little or no warning to deter cheating. Generally, there are many more opportunities to cheat than inspections. Thus, as an inspector, a side faces the problem of how to spread its inspections over its inspection opportunities in such a way as to keep the amount of cheating to a minimum.

It is also important to an inspecting side to know how an opponent who is motivated to cheat would optimally allocate violations over opportunities to violate. One reason this information is useful is that private information about specific situations may become available. How can the inspector tell where the cheater is most vulnerable to inspection without a measure of the "normal" amount of cheating? In other words, an inspector may wish to adjust its inspection pattern to take advantage of violation data when such data is available. To do so, it must have a yardstick with which this other data can be compared.

Knowledge of the optimal allocations of both cheating and inspection effort is therefore essential if a treaty, or a potential treaty, is to be evaluated. In particular, these quantities provide estimates of the amount of violation to be expected when both sides are sophisticated. As well, an appreciation of how the details of a treaty -- inspection frequency and thoroughness, for example -- affect those optimal levels is of great value when treaties are negotiated or renegotiated.

The objective of the allocation direction of this research is to build and analyze an abstract but useful treaty model which allows certain optimal allocation problems, like those indicated above, to be solved formally. Similar work includes Maschler (1966), which is based on quite restrictive assumptions, and Brams, Davis and Kilgour (1988), which is designed to be applicable to the Intermediate-range Nuclear Forces (I.N.F.) Treaty.

The abstract treaty model used here has been chosen in part because it is a good general description of a simple chemical weapons inspection problem. These are discussed in detail in Avenhaus, Fichtner, and Vachon (1987). With some modifications, this model also applies approximately to verification problems under the Stockholm Document.

The specific features of the inspection problem studied here are chosen to represent the problem of inspection of a single chemical plant under a non-production treaty. To take a typical case, suppose that the minimum time for set-up, production, and clean-up of a prohibited chemical is two weeks. Then a treaty might be written so that every two weeks the inspector must be given the opportunity to inspect the facility. However, because inspections can be disruptive and costly in other ways, there are usually severe restrictions on the number of inspections an inspector can make. To return to the typical case, in a 1-year treaty the inspector might be allowed only 5 inspections to cover the 26 2-week time slots. The inspector's strategic problem is then to allocate his few inspections over the many time slots so as to deter cheating as much as possible, and to have the highest possible probability of detecting any cheating that does occur.