

**INDIA****EVALUATION OF CHANCES OF SEQUENTIAL OPCW INSPECTIONS****Background**

1. The Chemical Weapons Convention is an international treaty that bans the development, production, possession, or use of chemical weapons, and requires the destruction of existing weapons. After years of negotiation among various countries in the world, the Convention was opened for signature on 13 January 1993. It entered into force on 29 April 1997. India is one of 127 countries (called States Parties) that signed the treaty at the outset. As of today's date there are 188 member countries to the Convention. The current agreement is administered by the Organisation for the Prohibition of Chemical Weapons (OPCW), which is an independent organisation. The OPCW has a Technical Secretariat for technical support.
2. In order to minimise the chances of violation, the State Parties agreed to accept inspections at declared industrial sites. The chemicals whose production come under the ambit of inspection are:
 - (a) Schedule 1 chemicals, which have little or no use outside of chemical weapons (e.g., mustard and nerve agents);
 - (b) Schedule 2 chemicals, which have legitimate small-scale applications other than chemical weapons (e.g., thiodiglycol, which can be used in the manufacture of mustard agents, but is also used as a solvent in inks); and
 - (c) Schedule 3 chemicals, which have large-scale use apart from chemical weapons (e.g., phosgene, which has been used as a chemical weapon but also commonly used in pharmaceuticals).
3. Article VI of the treaty provides guidelines for production of such chemicals, while subjecting the production facilities to international inspection. Parts VI, VII and VIII of the Verification Annex of the treaty provides for on-site inspection of randomly selected facilities that manufacture these chemicals. As a further precaution, Part IX of the Verification Annex provides for on-site inspection of randomly selected facilities, which manufacture other chemicals, but can be used for production of chemical weapon ingredients. These sites are called other chemical production facilities (OCPFs). The verification efforts are centred on OCPF plants that produce



phosphorus, sulfur or fluorine (referred to as PSF plants), while sites producing discrete organic chemicals (DOCs) are also of interest.

4. The methodology for random selection of inspection sites has been a subject of much debate among the States Parties over the past fifteen years or so. The currently used method does not take into account all the criteria originally envisaged in the Convention as per paragraph 11, Part IX of the Verification Annex. Several alternative methods have been proposed by the States Parties, the Secretariat, and the Director-General of the OPCW from time to time. As a State Party, India has to take an informed position about implementation of the method currently used, and suitability of new proposals.
5. As per the present arrangement, there is an upper limit on the maximum number of sites that may be inspected in a single year in a single signatory country. No two sites are inspected in the same week. Apart from the selection of these sites for inspection, the selection of inspection time for the selected sites is an issue. The principle of random selection should apply here also.
6. The OPCW has recently informed India that in the year 2012, there would be an instance of two sites in the same city of India being selected for inspection in consecutive weeks, and there could possibly be another such occurrence later in the year too. It appears on the surface that occurrences of such *sequential inspections* should have a relatively small probability. Since sequential inspections involve savings on the travel cost of the inspection team, there may be pressure on the OPCW to compromise on the randomness of the selection process in such a way that sequential inspections are favoured.
7. Compromising on randomness of the selection can have important implications. For instance, if one wishes to maximise the occurrence of sequential inspections to save costs, then selection of all the sites for inspection in a year has to be made at the beginning of the year. Thus, there would necessarily be a gap of up to one year between the decision to inspect a particular site and the actual inspection. This gap would increase the chances of leakage of information of the impending inspection to the site concerned. This possibility of advance warning could reduce the chance of detection of violation of norms and could defeat the very purpose of inspection. Thus, as a matter of principle, randomness of the selection of time of inspection is as important as the randomness of the site selection.
8. The Indian National Authority instituted a quick and brief statistical study to establish the occurrence of sequential inspections when sites are selected on a random basis.
9. This report attempts to provide a quick estimate of the probability of occurrence of one or more sequential inspections in a year in a country, if selections are random.

Methodology

10. In a proper simulation study to determine this probability, one should mimic the selection methodology used by the OPCW Technical Secretariat. This would be time consuming. On the other hand a quick estimate can be obtained by simplifying the procedure. The following simplifications were used:

- (a) As per the present arrangement, each State Party can receive up to 20 inspections. The simulations were restricted to exactly 20 sites in India.
 - (b) It was assumed for the purpose of simulations that none of the sites to be selected for inspection had been inspected previously.
 - (c) Since OCPF and Schedule 3 sites constitute most of the Indian sites that remain to be inspected, it was assumed that selections would be restricted to these sites only. As per the 2010 declarations and the inspection history till 2011, this assumption led to a total of 509 sites (including 494 OCPF and 15 Schedule 3 sites) to choose from.
 - (d) Instead of using the geographical and technical components currently used for determining selection probabilities, all sites were assumed to have the same probability of selection.
 - (e) The inspections were assumed to occur at the rate of at most one per week. Thus, every week of the year would have either one inspection, or none.
 - (f) Sites were grouped by the name of district given in the address contained in the declaration. Thus, for the purpose of the present study, inspection of two sites in the same district in consecutive weeks would constitute sequential inspections.
11. On the basis of these simplifications, the following methodology for selection was used. Twenty sites are selected from the list of 509 sites with equal probability. Likewise twenty weeks for inspection are selected from the list of 52 weeks in a year. The sampling protocol is SRSWOR (simple random sampling without replacement). There is no need to order the selected site numbers or the selected week numbers, after selection.
12. Since the selection of sites and inspection dates should be independent of one another, and the selected sites are not ordered, the first selected week is allocated to the first selected site, the second selected week is allocated to the second selected site, and so on.
13. For a given set of 20 pairs of sites and weeks, a 'coincidence' is defined as an occasion of two sites from a common district being inspected in consecutive weeks. The total number of 'coincidences' (X) can thus be counted for this set.
14. The above computation, starting from the selection of sites and weeks up to the computation of X , constitute a single sample in a Monte Carlo simulation study. The probability distribution of X was computed from 10,000 simulation runs.

Results

15. The results of the simulation study, obtained from 10,000 simulation runs, are summarised in the following table.

Number of coincidences (X)	Probability
0	52.9%
1	34.2%
2	10.7%
More than 2	2.3%

16. It transpires from the above table that the event of *more than one coincidence* out of 20 selected sites ($X > 1$) in a year is a somewhat rare event, having only a 13% chance of occurring from a random selection. Such an event should occur, on the average, once in 10 years.
17. It also transpires from the above table that the event of *at least one coincidence* out of 20 selected sites ($X > 1$) in a year has about a 47% chance of occurring from a random selection. Such an event should occur, on the average, once in two years.

Concluding remarks

18. This study shows that in a random selection regime, one should expect any sequential inspections in India only once in two years. Multiple occurrences of sequential inspections should be very rare. More frequent occurrence of sequential inspections, either in a particular year or over a span of a few years, would put a question mark against the randomness of the selection procedure, and the credibility of the inspection process.
19. These percentage probabilities computed here could change somewhat if the simplifying assumptions are removed and a full scale simulation study is conducted. However, the broad conclusions are unlikely to change.