COMMITTEE ON DISARMAMENT

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Working Paper

International Surveillance of Airborne Radioactivity (ISAR)

Since the early 1960s the technique to analyse the radiation from dispersed remnants of a nuclear explosion has considerably improved. Results which twenty years back required time-consuming radiochemical treatments of samples can now be obtained in one single measurement with a so-called germanium detector. After such a measurement it is possible to establish with a high degree of certainty whether nuclear explosion debris has been collected in a sample and, if so, how long a time has passed since the explosion occurred. This has become possible because modern detectors in one step give a very detailed picture of the composition of different radioactive elements in the sample.

Possible ISAR system and cost aspects

A system for the international surveillance of airborne radioactivity (ISAR) should consist of some 50-100 fully equipped sampling stations and about half a dozen regional measurement stations (one in each continent), which could form part of the data centres already envisaged for the collection, analysis and handling of seismic data in connection with the monitoring of a comprehensive nuclear test ban treaty.

At each sampling station air would be continuously blown by a pump through a glass fibre filter, the size of which should be 0.3 - 1 m^2, with a speed of one or several tons of air per hour. The filters would be changed once or twice a week and sent for analysis at the regional measurement laboratories. The filters can be split in identical parts and these sent to different laboratories in order to ensure the quality of measurement and to minimize the possibility of cheating.

A fully equipped sampling station would cost some 20,000 dollars to establish and about half of that sum to operate per year.

Sweden and many other countries operate national surveillance networks for atmospheric radioactivity. 1/ The Swedish measurement laboratory, which is of a size comparable to what would be needed for a regional laboratory, operates on an annual budget of 300,000 dollars. The cost of establishing such a laboratory - including radiation shields, around 5-10 high-efficient detectors and a small computer to supervise the measurements and carry out the analysis and data handling - would be around 700,000 dollars (costs of premises not included).

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1/ See e.g. IEEE Transactions on Nuclear Science, Vol. NS-29, No. 1, February 1982, page 827 for a description of the Swedish air monitoring network.

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An international system for the global surveillance of airborne radioactivity would thus cost considerably less than 10 million dollars to establish and less than 3 million dollars annually to operate. If already existing sampling stations or somewhat upgraded existing stations would be made available to the network and/or if existing laboratories could be used for this purpose the costs would be significantly reduced. 2/

Study on network design

As noted in the Swedish Working Paper CD/NTB/WP.2 of 30 August 1982 a network for the international surveillance of airborne radioactivity should be designed in such a way that the detection probability would be essentially the same all over the globe. To design a network with these characteristics is from a technical point of view to a large extent a meteorological problem.

In order to somewhat clarify this matter, a study entitled "Design of a global detection system for airborne radioactivity - meteorological aspects" was carried out last winter at the Department of Meteorology at the University of Stockholm.

In the study a hypothetical network consisting of 60 stations, distributed over the globe was laid out. This was done solely on the basis of an understanding of the general circulation of the atmosphere. No consideration was thus given to the distribution between land and sea or to political boundaries. This hypothetical network had 20 stations evenly spaced around the equator and 8, 5, 4 and 3 stations evenly spaced around the 30°, 45°, 60° and 75° parallels respectively. A realistic detection limit for a station of the kind shortly described above was set to one atom per 10 m^3 of air of a characteristic, rather short-lived, fission product Barium-140 with a half-life of 12.8 days. Then nearly 10,000 small (1 kiloton) nuclear explosions were simulated in the computer, and the radioactive clouds were followed in each case for 10, 15 or 20 days. The explosion clouds were started from 410 evenly distributed emission points at an altitude of about 1.5 km (850 mbar) every fifteenth day during one year. Wind data for the period 1 December 1978-30 November 1979 were used because this is probably the best set of such data available at the present time.

The results were presented in the form of a "hit-list" for each of the release points and for each of the stations. For all the 410 release points the number of clouds detected by at least one station in the network was given, and for all the 60 stations the number of detected clouds was recorded.

These data suggested how the assumed network of stations could be rearranged to obtain a network with a more evenly distributed sensitivity. The study confirmed that, depending on what detection probability one chooses, the number of stations needed is 50-100. The main result of the study was, however, that it demonstrated a method of designing a global network of atmospheric sampling stations. This technique can then be applied to more realistic networks, where political, geographical and practical constraints are taken into account.

Copies of the report of the study may be obtained from the Swedish delegation.

2/ The figures given are in 1983 prices and are only of an indicative nature. The purpose here is merely to give an idea of the order of magnitude of the costs involved.