

Appendix A: The Technology of Arms Control Verification

This report has addressed the “who” and the “how” of the management of U.S. verification technology research. This appendix discusses the “what” the kinds of research to be managed. The following sections identify some of the kinds of topics that could be productively investigated in a systematic, long-term research program. The ideas are illustrative, not exhaustive.

In considering research options, it is important to keep in mind that research and development of verification technologies is not simply a quest for ever more sophisticated, “high-tech” devices. Rather, the challenge is to find the most appropriate ones. The bottom line is in how effectively, and at what cost, technology is applied to do the job.

Future Verification Regimes

Long-term research on verification regimes would identify potential arms control measures that should be examined. For each of those, it might build a possible list of treaty-limited items. It could then explore features of the production, testing, deployment, maintenance, or destruction of those items that might most easily be monitored. Examples of potential arms control measures that are not now on the executive branch’s active agenda, but might conceivably become so someday include:

- ban on multiple-warhead ICBMs,
- nuclear warhead accounting and elimination,
- control or ban on nuclear sea-launched cruise missiles,
- control or ban on other naval tactical nuclear weapons,
- other forms of naval arms limitations,
- cutoff of nuclear weapons materials production and controls on fissile materials, and
- limits on space weapons.

Like the Conventional Forces in Europe agreement or the Chemical Weapons Convention, some future arms control arrangements may be multilateral, rather than just U.S.-Soviet. Therefore, it may be important to devise verification regimes suitable for multilateral participation and less dependent on NTM.

Monitoring Measures

Long-term research on monitoring measures would specify the kinds of measures that might apply to the potential arms control provisions under consideration. At this stage of research, some monitoring measures ‘would have broad enough application for more than one kind of arms control provision. Others might be specific to the particular features of one kind of Treaty-Limited Item (TLI) or another. Some of the research might involve analyzing the extendability of measures for current arms control monitoring to future types of arms control.

Examples of monitoring measures that might be improved with further research include:

- aerial surveillance (beyond Conventional Forces Europe agreement);
- unattended observation of TLI destruction;
- remote tag reading for later START I implementation, START II, and other arms control applications;
- portal-perimeter continuous monitoring¹⁷ (beyond INF and START treaties); and
- design and operation of new weapons in ways that make them easier to monitor.

Monitoring Systems

The above sorts of monitoring measures will require detailed analysis of the specific ways they can be put into effect. This analysis would involve not only identifying the types of devices that might be deployed, but the integration of those devices into systems as well as strategies and tactics for operating the systems to maximum effect.

Examples of monitoring systems that might have future applications include:

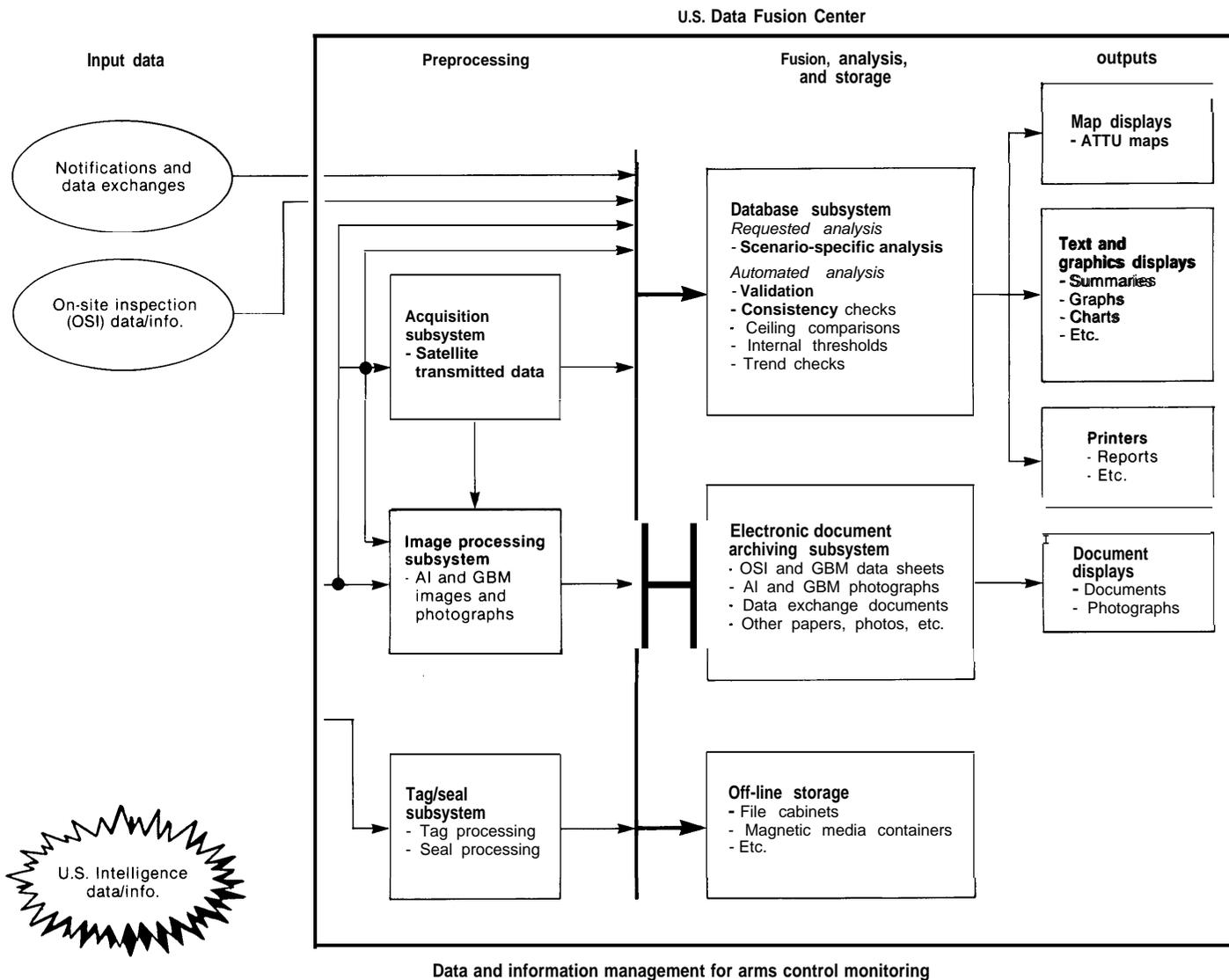
- aerial surveillance aircraft and sensor combinations and strategies for their use,
- portal-perimeter continuous monitoring systems specific to arms control measures beyond START, and
- data fusion systems to help pull together and interpret all the relevant information for arms control compliance assessments.

Technology Requirements

Analysis of potential verification regimes will take account of the existing base of ready devices

¹⁷Including study of possible penetration of perimeters, such as tunnels.

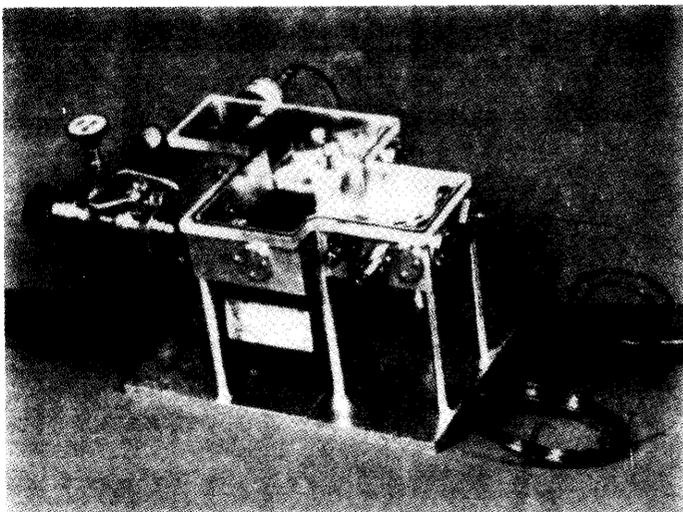
Figure 2-Schematic Diagram of a Proposed U.S. Data Fusion Center



Researchers at Sandia National Laboratories have proposed a verification data fusion center. The system would assemble information from disparate sources, including news agencies, treaty declarations, on-site inspections, aerial inspections, or open literature sources. The system would store this data both in on-line computers for immediate access and in archives for cumulative interpretation and analysis. The goal would be to provide decisionmakers with concise, comprehensible, and timely reports on the information available about foreign compliance with arms control agreements.

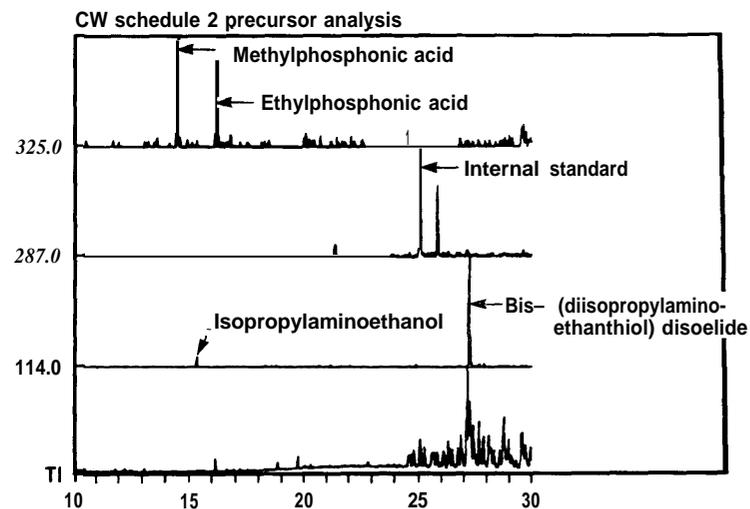
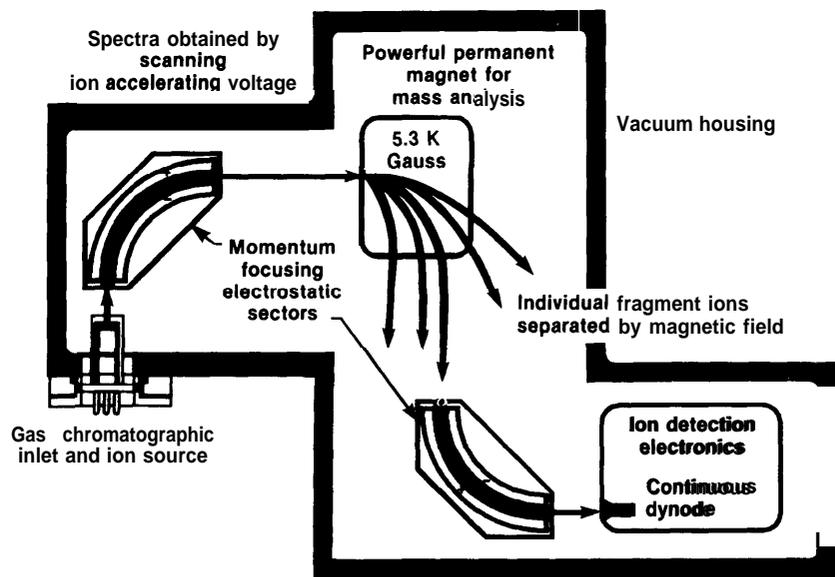
SOURCE: Sandia National Laboratories.

Figure 3--Portable High-Resolution Mini Gas Chromatograph-Mass Spectrometer



Lawrence Livermore National Laboratory is developing a portable, high-resolution gas chromatograph-mass spectrometer that may be used by inspectors monitoring compliance with the proposed international Chemical Weapons Convention. At a site suspected of manufacturing chemical weapons, this instrument might detect even minute traces of "precursor" chemicals that are combined to produce the prohibited poisons. First the gas chromatograph (the coiled tube leading into the device pictured at left) would separate a sample of air or water into different chemical components. These chemicals would be ionized and introduced into the mass spectrometer (device pictured at left, with schematic diagram below), which separates the ions according to differences in their mass. A resulting graph, shown below for a water sample containing a precursor chemical, would indicate the presence of ions of the compound of interest.

SOURCE: Lawrence Livermore National Laboratory.



and technologies available for development into ready devices. But the analysis will also suggest potential monitoring shortfalls and promising technologies that might help close the gaps. In this way,

the analytic work would serve two purposes at once: first, serve as a planning base for future arms control negotiators; second, guide investments in technology research for future monitoring systems.