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External Affairs  
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Affaires extérieures  
Canada



# Verification Research:

Canada's Verification Research Program



*We believe that it is necessary to enhance strategic stability by pursuing arms control and that the best path forward is one that includes mutual agreements, balanced and deep reductions, and adequate means of verification.*

**Recommendation 15 in the Report of the Special Joint Committee of the Senate and the House of Commons, (The "Hockin-Simard Report"), June 1986**

*The government welcomes the committee's endorsement of the government's vigorous pursuit of this policy in the various arms control negotiations. Through the work of the Verification Research Unit the government will be advancing practical suggestions for verification procedures.*

**Canada's International Relations: Response of the Government of Canada to the Special Joint Committee of the Senate and the House of Commons, December 1986**

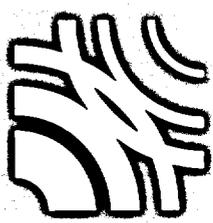
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# Verification Research:

## Canada's Verification Research Program

Dept. of External Affairs  
Min. des Affaires extérieures

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The chart illustrated on the cover displays contracts, studies and proposals pertaining to verification research by Canada from 1981 to 1987. The numbered circles identify projects that have been completed, are in progress or are in the conceptual stage. These projects are linked, in the diagram, to the relevant arms control and disarmament issues as well as to the negotiating or deliberative forums. The chart gives a general idea of where the work of the Verification Research Program is concentrated.

The graphic on the upper part of the cover page represents the ongoing dialogue on arms control and disarmament issues in Canada and between Canadians and the world community.

On peut se procurer une version française de cette étude en écrivant à l'adresse suivante :

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# Introduction

The first part of the report deals with the general situation in the country. It is a very interesting and informative study of the economic and social conditions of the country. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is a valuable contribution to the study of the country.

The second part of the report deals with the specific details of the country. It is a very detailed and thorough study of the country. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is a valuable contribution to the study of the country.

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The eighth part of the report deals with the specific details of the country. It is a very detailed and thorough study of the country. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is a valuable contribution to the study of the country.

## Introduction

It is hard to imagine buying a house or a car without first being able to check that what the salesman says about it is true. Similarly, it is difficult to envisage a hockey or football game without rules and referees. Common sense tells us all that we need to be able to check the accuracy of statements about the quality of the goods upon which we are spending our hard-earned money. We also need some independent way of ascertaining violations of the rules during the heat of playing games. In many ways these situations are similar to what arms control verification is all about: the need to independently check the information provided

by other governments and to ascertain that they are, in fact, complying with the rules by which they have agreed to live.

As for any analogy, however, in some ways there are important differences. In international affairs there are no police or courts to rely upon if we are cheated by unscrupulous salesmen. Moreover, a successful violation by one party threatens not only the loss of an individual's money or of a hockey game; instead the security and welfare of an entire nation or group of nations may be put at risk. The stakes are very high in arms control and disarmament, and

**Figure 1 Prime Minister Brian Mulroney addressing Consultative Group on Disarmament and Arms Control Affairs on October 31, 1985**



consequently, the issue of verification is of vital importance to negotiations in this field.

Canada has long been committed to arms control and disarmament. As the Prime Minister of Canada, the Right Honourable Brian Mulroney expressed it to the Consultative Group on Disarmament and Arms Control in Ottawa, October 31, 1985:

*The pursuit of arms control and disarmament has its place beside the defence effort, peacekeeping and conflict resolution. All are essential components of Canada's approach to international peace and security.*

We should have no illusions that Canada alone can somehow force other countries to agree to arms control and disarmament agreements. Nevertheless, we can hope to contribute to progress towards such agreements and the greater peace and security they represent, by practical, realistic actions on Canada's part.

It was this ongoing commitment to pragmatic steps in arms control and disarmament, combined with the recognition of the critical importance of verification in the achievement and implementation of arms control agreements, that led to the establishment of the Verification Research Program within the Department of External Affairs.

This brochure will outline briefly the history of the Verification Research Program, its objectives and mandate, and some of its research activities.

**Figure 2 Conferences Supported by the Verification Research Program**



A number of universities and research institutes have undertaken studies and conferences in co-operation with the Arms Control and Disarmament Division of External Affairs related to specific aspects of the verification process. The proceedings of a number of these have been published and are illustrated here.

# Background

1964

1965

The following is a summary of the background information provided in the report. It covers the period from 1964 to 1965, focusing on the activities and findings of the research team. The report details the methods used, the data collected, and the conclusions drawn from the study. It also discusses the implications of the findings and the potential for further research in this area.

The research was conducted in a laboratory setting, where various conditions were controlled to ensure the accuracy of the results. The data was analyzed using statistical methods, and the results were compared to previous studies in the field. The findings indicate that there is a significant correlation between the variables studied, and this relationship can be used to predict future outcomes. The report concludes with a list of references and a summary of the key points.

The data collected during the study shows a clear trend over time, with a steady increase in the measured values. This trend is consistent with the theoretical model proposed in the introduction. The results are supported by the experimental data, which shows a high degree of reproducibility. The study also identified several factors that influence the outcome, and these factors were carefully controlled throughout the experiment. The findings have important implications for the field, and they provide a solid foundation for further research. The report is intended to provide a comprehensive overview of the study and its findings.

The study was supported by the following grants and funding sources. The research team is grateful to the funding agencies for their support and to the participants who made the study possible. The report is a result of the collective effort of the research team, and it is hoped that it will contribute to the advancement of knowledge in this field. The authors would like to thank the reviewers for their helpful comments and suggestions. The report is published in the journal of Applied Research, and it is available to all interested parties.

## Chapter 1

### Background

Since the Second World War, Canada has been a prominent participant in most of the multi-lateral arms control discussions of this period. Indeed, apart from the major powers, few countries can claim as long or as important an involvement in this process, as can Canada. This almost unrivalled background has provided Canada with a unique opportunity to contribute to the multilateral arms control process and has permitted Canada to acquire considerable experience in, and understanding of, this process.

Verification of compliance has constituted a central theme in disarmament and arms limitation discussions throughout the postwar period. In the Baruch Plan of 1946, for example, verification was reflected in many of the activities and responsibilities of the proposed International Atomic Development Authority, most notably with respect to its powers of inspection. Another early example of the pivotal nature of verification was the innovative "Open Skies" proposal of President Eisenhower in 1955, which was designed to prevent surprise attack and to begin a comprehensive and effective process of inspection and disarmament. The proposals made by both the USSR and the USA during the early 1960s on general and complete disarmament (GCD), including the McCloy-Zorin agreed-upon statement and

exchange of letters, recognized the need for the very extensive use of an international control organization to monitor compliance.

Later in the 1960s, as the focus of negotiations moved away from comprehensive proposals for GCD, the issue of verification remained a central concern. The debate about verifying a nuclear test ban foreshadowed this trend, receiving much attention in the late 1950s, most notably at the first meeting of seismic experts in Geneva in 1958.

The 1960s and 1970s saw tremendous strides in the development of remote sensing technologies for military intelligence and other purposes. These advances involved the use of remote sensors or, as they have come to be known, "national technical means" (NTM), to monitor events from great distances. The ability to adapt certain of these remote sensing techniques to arms control verification greatly facilitated the negotiation of significant bilateral strategic arms limitation agreements during the 1970s.

#### **Canada and the Issue of Verification**

In 1979, following a reassessment of Canada's participation in the arms control and disarmament process and a restructuring of

**Table 1**  
**Canadian participation in multilateral arms control forums, 1945-1987**

- **January 1946:** The Atomic Energy Commission (AEC) was established under the United Nations Security Council, composed of the members of the Security Council plus Canada when not a member of the Security Council itself.
- **February 1947:** The Commission for Conventional Armament (CCA) was established under the Security Council composed of the members of the Security Council plus Canada.
- **January 1952:** The AEC and CCA were dissolved and replaced by a single Disarmament Commission (DC) under the Security Council composed of the members of the Security Council plus Canada. In 1957, the DC's size was increased by 14 members and, in 1959, it was further increased to include all members of the United Nations (UN). The DC did not meet after 1965. At its 1978 Special Session the United Nations General Assembly re-established the DC as a deliberative body and it now meets for about three weeks each year.
- **April 1954:** The DC established a five-power sub-committee composed of Canada, France, the UK, the USA and the USSR. This sub-committee met in private and periodically reported to the DC and United Nations General Assembly.
- **July 1958:** Conference was held of experts from four Western and four Eastern bloc countries on methods of detecting nuclear tests.
- **November 1958:** Conference of Experts on Prevention of Surprise Attack, composed of representatives from five Western and five Eastern bloc countries, was held.
- **September 1959:** Ten-Nation Disarmament Committee (five Western and five Eastern bloc countries) was established. The TNDC was not a UN body although a personal representative of the UN Secretary-General attended. The Conference of the TNDC met from March to June 1960.

- **December 1961:** The Eighteen-Nation Committee on Disarmament (ENDC), endorsed by the United Nations General Assembly, was established. The Conference of the ENDC opened on March 15, 1962. Like the TNDC, the ENDC was not a UN body.
- **August 1969:** The ENDC was enlarged to 26 members and changed its name to the Conference of the Committee on Disarmament.
- **July 1973:** The Conference on Security and Co-operation in Europe (CSCE) opened in Helsinki. Its participants included all the states of Europe (except Albania) plus Canada and the United States. It concluded on August 1, 1975, with agreement on a Final Act.
- **October 1973:** Mutual Balanced Force Reduction (MBFR) talks opened in Vienna between seven NATO and four Warsaw Pact countries. The discussions concerned conventional arms limitations within an area of Central Europe.
- **May 1975:** The First Review Conference of the Non-Proliferation Treaty met in Geneva. Canada also participated in the negotiations of the late 1960s which led to the conclusion of this Treaty in July 1968.
- **June 1977:** The Review Conference of the Seabed Treaty met in Geneva. Canada also participated in the negotiations of the early 1970s which led to the conclusion of this Treaty in February 1971.
- **October 1977:** The first Follow-Up Meeting to review the implementation of the CSCE Final Act opened in Belgrade.
- **May 1978:** The United Nations General Assembly began a Special Session on Disarmament (UNSSOD I). On July 1, it adopted a Final Document.
- **January 1979:** Pursuant to the recommendation of UNSSOD I, the CCD was expanded to 40 members and changed its name to the Committee on Disarmament (CD).

- **March 1980:** The First Review Conference of the Biological Weapons and Toxins Convention met in Geneva. Canada also participated in the negotiations of the early 1970s which led to the conclusion of this Treaty in April 1972.
- **August 1980:** The Second Review Conference of the Non-Proliferation Treaty met in Geneva.
- **November 1980:** The second Follow-Up Meeting to review the implementation of the CSCE Final Act opened in Madrid.
- **June 1982:** The United Nations General Assembly began a second Special Session on Disarmament.
- **January 1984:** The Conference on Confidence- and Security-Building Measures and Disarmament in Europe (CCSBMDE) opened in Stockholm pursuant to the agreement worked out at the Madrid CSCE Follow-Up Meeting. The first phase of the CCSBMDE concluded with the adoption of the Document of the Stockholm Conference on September 19, 1986.
- **February 1984:** The Committee on Disarmament was redesignated as the Conference on Disarmament (CD) with no change of membership.
- **September 1984:** The Review Conference of the Environmental Modification Treaty met in Geneva. Canada also participated in the negotiations of the mid-1970s which led to the conclusion of this Treaty in May 1977.
- **August 1985:** The Third Review Conference of the Non-Proliferation Treaty met in Geneva.
- **September 1986:** The Second Review Conference of the Biological Weapons and Toxin Convention met in Geneva.
- **November 1986:** The third Follow-Up Meeting to review the implementation of the CSCE Final Act opened in Vienna.
- **February 1987:** Members of the Warsaw Pact met with members of NATO for exploratory talks regarding conventional arms limitations in Europe from the Atlantic Ocean to the Ural Mountains.

this function within the Department of External Affairs, verification was recognized as "the most significant factor in international disarmament and arms control negotiations in the decade of the 1980s." The need for a deeper understanding of verification was evident: this area was one in which much misunderstanding existed and to which relatively little research was being directed. Moreover, while the necessity of some sort of verification in arms control and disarmament agreements had long been recognized, this issue was discussed, almost without exception, on an *ad hoc* basis and provisions relating to verification were developed specifically to meet certain sensitivities and security criteria within individual negotiating packages. It was decided, therefore, to redirect some of the scant resources of the department toward a program that would serve to broaden specialist and public understanding of the verification issue as well as advance negotiations on these matters.

As a result, an initial modest co-operative program was developed between the Operational Research and Analysis Establishment of the Department of National Defence and the Arms Control and Disarmament Division of the Department of External Affairs. The aim was to study arms control verification in a general

conceptual manner as well as to support specific negotiations. It was an attempt, through the establishment of a generally accepted approach and the development of a common lexicon, to introduce a degree of gentle leadership and co-ordination, while at the same time leaving the field open to contributions from other nations in areas of their own expertise.

This modest *ad hoc* program resulted in the production of a trilogy of studies on verification which, it is fair to say, continue to serve today as basic reference documents on the subject in international negotiations. These three documents include:

- the *Compendium of Arms Control Verification Proposals* (1980),
- the *Quantitative Analysis of the Compendium of Arms Control Verification Proposals* (1980), and
- the *Conceptual Working Paper on Arms Control Verification* (1981).

The *Compendium* was updated in 1982 and a new edition is to be released in 1987.

On June 18, 1982, during a speech to the second United Nations Special Session on Disarmament (UNSSOD II), then Prime Minister, the Right Honourable Pierre Elliott Trudeau identified the arms control and disarmament issues that Canada considered to

be priority matters and highlighted the subject of verification. Recognizing that verification was not only a matter of access, but that it entailed a technology of its own, and realizing that research on this issue should prepare the way for arms control agreements, Mr. Trudeau pledged the Canadian government to substantially increase research on verification. He promised to devote more attention to utilizing expertise available inside and outside government to this end. Further details of the Canadian commitment were provided to the Conference on Disarmament in February 1983.

On February 20, 1984, formal approval was given for the establishment of the Verification Research Unit within the Arms Control and Disarmament Division of the Department of External Affairs. This permitted the Verification Research Program (first funded in October 1983) to begin operations as personnel became available for the Verification Research Unit. Much of the initial groundwork necessary to establish a research capability as an integral contribution to the verification issue had already been accomplished within the narrower mandate and limited resources of the Arms Control and Disarmament Division.

**Figure 3 Working Documents Produced by the Verification Research Unit**



*It is important for diplomats and researchers to have ready access to the past work and statements of others. To facilitate this task, the Verification Research Unit regularly produces compilations of materials relating to verification. These useful reference tools are produced in limited quantities and are made available within a number of arms control and disarmament fora to other governments as well as to selected research institutes in Canada and abroad.*

*The Verification Research Unit also produces Discussion Papers and Research Reports for internal use within the Canadian government. Often these documents eventually appear as Working Papers in various arms control and disarmament discussions and/or as other publications available generally.*

# Objectives and Mandate

2010-2011

2010-2011

The primary objective of the program is to provide a comprehensive and integrated approach to the management of the organization's resources. This includes the development of a clear vision and mission statement, the establishment of a strong organizational culture, and the implementation of effective management practices. The program is designed to ensure that the organization is able to meet its long-term goals and objectives in a sustainable and responsible manner.

The program is structured to provide a clear and concise overview of the organization's objectives and mandate. It is designed to be a practical and actionable guide for all employees, providing them with the information and tools they need to contribute effectively to the organization's success. The program is also designed to be flexible and adaptable, allowing it to be tailored to the specific needs and circumstances of the organization.

## Chapter 2

### Objectives and Mandate

On September 25, 1985, at the 40th session of the United Nations General Assembly, Canada's Secretary of State for External Affairs, the Right Honourable Joe Clark, spoke of Canada's approach to the issue of verification. He outlined what he termed a "program of action" for the latter half of the disarmament decade of the 1980s. He pledged Canada "to step up its work in improving the verification process." In his address to the 41st session of the General Assembly on September 24, 1986, Mr. Clark reinforced his earlier pledge by

urging all nations "to co-operate and indeed participate in the development of the verification techniques needed to provide the confidence necessary to ratify ACD agreements."

At the heart of Canada's program of action is the Verification Research Program of the Department of External Affairs. Innovative in concept and focussed on the multilateral process in application, the program is currently funded at \$1 million per annum. It provides a natural framework within

**Figure 4** The Secretary of State for External Affairs, Mr. Clark, addressing the United Nations General Assembly on September 24, 1986



**Table 2**  
**Canadian government departments and agencies associated with the Verification Research Program**

- Department of External Affairs
- Department of National Defence
- Energy, Mines and Resources Canada
  - Geological Survey of Canada
  - Canada Centre for Remote Sensing
- Agriculture Canada
- Department of Communications
- Atomic Energy Control Board
- Health and Welfare Canada
- National Research Council
- Ministry of State for Science and Technology
- Department of Regional Industrial Expansion
- Supply and Services Canada

which Canadian expertise from government, the business sector and the academic community can be combined to address the issue of arms control verification.

The program has succeeded in initiating projects involving researchers from a dozen Canadian universities and research institutes as well as from a number of commercial firms. In addition, it has drawn upon the full scope of expertise within the federal government through a system of *ad hoc* interdepartmental technical advisory groups established to assist with major projects.

The program's work has improved co-operation, communication and understanding within government and between government and other sectors of Canadian society, particularly at the technical or working levels. It has also accentuated internationally the projection of Canadian efforts in this field, as a co-ordinated pragmatic program.

The central aim of the Verification Research Program is to contribute to the process of achieving verifiable arms control and disarmament agreements that will serve to improve the security of Canada and its allies. To achieve this central aim it focusses on certain Canadian arms control priorities in the

multilateral arms control and disarmament field. These include:

- achievement of a comprehensive convention to ban chemical weapons;
- the negotiation of a comprehensive nuclear test ban;
- the development of a treaty to prevent an arms race in outer space;
- the pursuit of arms control and military confidence-building in Europe; and
- the conduct of other research as may be required from time to time.

To achieve its objectives, the program provides for a modest in-house research capability, in addition to projects contracted out to universities and commercial firms. The Verification Research Unit develops initiatives in support of ongoing negotiations and activities that involve primarily five Canadian delegations abroad:

- The Conference on Disarmament in Geneva. This 40-nation body is the only ongoing multilateral negotiating forum for arms control and disarmament that addresses issues on a global basis.

**Table 3**  
**Some Canadian universities and research institutes**  
**involved in Verification Research Program projects**

- Carleton University
  - Norman Paterson School of International Affairs
  - School of Journalism
- McGill University
  - Institute and Centre for Research of Air and Space Law
- University of Saskatchewan
  - Toxicology Research Centre
  - College of Arts and Science
- Université de Québec à Montréal
  - Institut Armand-Frappier
- York University
  - Centre for International and Strategic Studies
- University of Toronto
  - Department of Physics
- University of Calgary
  - Strategic Studies Program
- University of Alberta
- University of Waterloo
- Queen's University at Kingston
  - Centre for International Relations
- University of Manitoba
- Canadian Centre for Arms Control and Disarmament
- Canadian Institute of Strategic Studies

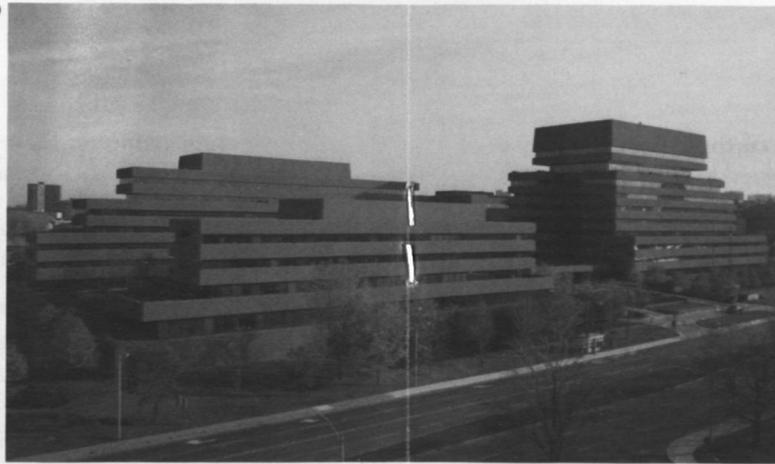


2



4 Canada is a member of the North Atlantic Treaty Organization (NATO) whose headquarters is located in Brussels, Belgium. Although not often recognized, NATO is heavily involved in developing and co-ordinating the arms control and disarmament policies of its members. As a defensive alliance, NATO is strongly committed to the arms control and disarmament process as one important avenue for the pursuit of its collective security objectives.

1



### Figure 5 The Verification Research Program and Canadian Missions Abroad

This set of photographs shows some of the Canadian missions abroad to which the work of the Verification Research Program is relevant. The Verification Research Unit, located in the Lester B. Pearson Building in Ottawa 1, provides the focal point for research done by several Canadian universities, research institutes and private sector companies. The results of this research, as well as of that done within the unit itself, are used to assist the activities of a number of Canadian missions working at multilateral arms control and disarmament fora. In many cases these results are also made available to other countries either through the multilateral fora illustrated here or bilaterally through Canadian embassies abroad.

2 The United Nations in New York is the location of the General Assembly (UNGA). The First Committee of the General Assembly is the main UNGA forum dealing with arms control, disarmament and international security matters. The UNGA plenary generally limits itself to consideration of, and voting upon, the reports of the First Committee. These bodies meet in the autumn of each year.

The United Nations Disarmament Commission (UNDC), which meets in New York each spring, is a deliberative body open to all members of the United Nations. It gives a more in-depth consideration to a narrower range of arms control and disarmament items than the First Committee.

3 The Palais des Nations, the old headquarters of the League of Nations, is the location of the Conference on Disarmament. This body is the world's only on-going multilateral negotiating forum that concentrates on global issues. It meets for two sessions each year — one in spring and one in summer.

The Palais des Nations is also the home of the United Nations Institute for Disarmament Research (UNIDIR). Canada is the second-largest

contributor to UNIDIR and the Verification Research Program has regularly made Canadian researchers from the academic sector available to UNIDIR for specialized projects.

5 The Mutual and Balanced Force Reduction talks between members of NATO and the Warsaw Pact are held in the Redoutensaal wing of the Hofburg Palace in Vienna. These discussions, which began in 1973, focus on reducing conventional forces within an area of Central Europe.

6 The Conference on Security and Co-operation in Europe (CSCE) opened its first meeting in August 1975. Since that time two Follow-Up Meetings — Belgrade and Madrid — have been held to review progress in achieving the aims set out in the Final Act. A third Follow-Up Meeting, being held in the Hofburg Palace in Vienna, began in November 1986. The participants in the CSCE include all European countries (except Albania) plus Canada and the United States.



5



7 The Conference on Confidence- and Security-Building Measures and Disarmament in Europe (CCSBMDE) opened in January 1984. Its meetings were held in the Kulturhuset in Stockholm, Sweden. The first phase of the CCSBMDE concluded with the adoption of the "Document of the Stockholm Conference" on September 19, 1986. This document outlines a set of confidence- and security-building measures to be applied in Europe. The results of the Stockholm Conference and the nature of its possible successor constitute one part of the discussions taking place at the CSCE Follow-Up Meeting in Vienna.

- The Conference on Security and Co-operation in Europe (CSCE) Follow-Up Meeting in Vienna. This is the third Follow-Up Meeting to the CSCE to review the implementation of the 1973 Final Act of the CSCE. It will decide on a successor to the Conference on Confidence- and Security-Building Measures and Disarmament in Europe which recently concluded its first phase in Stockholm.
- The Mutual and Balanced Force Reduction talks in Vienna. These discussions between NATO and Warsaw Pact countries focus on reducing forces within an area of Central Europe.
- The North Atlantic Treaty Organization (NATO) in Brussels. NATO is intimately involved in arms control policy formulation and negotiations.
- The United Nations Organization in New York. The First Committee and the Disarmament Commission meet annually to deliberate on arms control and disarmament matters. On the basis of the recommendations of the First Committee, the General Assembly passes numerous resolutions in this field.

Results of the research work carried out under the program are tailored primarily to the

requirements of these Canadian missions involved in multilateral arms control and disarmament discussions. Through these missions and through other contacts with foreign governments, Canadian verification research contributes pragmatically to progress in specific negotiations. In addition, many of the results of the program's activities are made available to universities and research institutes in Canada and abroad. Through the dissemination of its work and findings, as well as its other activities, the program promotes a greater understanding of the issue of verification within the international community and encourages further research into and consideration of this vital subject.

### **Is Verification Really an Important Issue?**

Not all nations agree with this focus on verification. The most frequently heard criticisms of this emphasis on verification can be summarized as follows:

- Verification cannot be usefully considered in a general way, that is, outside the context of a specific agreement.
- Verification is used as a pretext deliberately to impede or avoid progress in the negotiation of agreements.
- Perfect verifiability is elusive and should not stand in the way of concluding agreements.

With respect to the first point, it is unrealistic to insist that discussion of verification can only be agreement-specific. In fact, there are many constructive initiatives that a country might undertake outside the context of negotiations that could contribute to the potential for the verification of specific agreements. A good example of this is the work of the Conference on Disarmament's Group of Scientific Experts, whose co-operative research into seismological techniques, despite the absence of a specific comprehensive test ban treaty (CTBT), has advanced considerably the global capability for monitoring a future CTBT. Research into verification, of course, is not an end in itself; but a clear understanding of the principles and process of verification will facilitate arms control and disarmament negotiations.

It is also contended that generic research into and discussion of verification is not productive. Such a view ignores the possibility of applying general procedures and techniques to specific arms limitation questions. For example, procedures and techniques developed by the International Atomic Energy Agency (IAEA) have potential application in the verification of a variety of multilateral agreements, including a convention on chemical weapons. Moreover, the basic principles of verification, such as those devel-

oped at the first United Nation's Special Session on Disarmament (UNSSOD I), have applicability to all specific arms limitation issues. Attempts to study the implications of these principles and relate them to the procedures and techniques involved in verification can be highly productive, both in generating new ideas and solutions to specific problems and in overcoming obstacles in specific negotiations. For example, verification research into remote sensing can assist in developing general information-gathering techniques that improve the capability for collecting agreement-relevant data while reducing the need for physical intrusion.

The verification requirements of certain agreements may be so complex that, without substantial preconsideration of verification questions, negotiations may founder and agreements may become impossible to conclude. Therefore, it is crucial that there be attempts to address verification concerns beginning in the earliest stages of agreement consideration. Moreover, technologies and procedures for verification purposes must be continually discussed, researched and updated if verification capabilities are to keep pace with the demand placed on them through relentless technological development and increasingly complex arms limitation agreements.

There is considerable scope for joint research among countries and for the sharing of information on verification research. Such endeavours not only serve to promote progress in arms limitation negotiations, but also help build confidence between nations as they co-operate in overcoming mutual problems.

As to the second criticism of verification, there is no question that there is potential that excessive demands for verification can be used as a smokescreen or guise for a party which does not wish to negotiate in good faith. Similarly, there is always the possibility that countries can impede progress in arms limitation by not agreeing to legitimate demands for reasonable verification measures. The verification issue is not unique in this respect; all treaty issues (e.g., scope, nature, purpose) can be similarly used as pretexts for avoiding sincere negotiations.

The third criticism sometimes appears to carry with it the implication that the act of concluding an arms control agreement, however inadequately verified, is preferable to achieving no agreement at all. Such an attitude ignores the profoundly detrimental ramifications of an agreement that, as a result of insufficient verification, either overlooks violations or gives rise to unfounded allegations of non-

compliance. Clearly, a treaty that is not being complied with can be a greater danger than no treaty whatsoever, because of the distrust and tension that are inevitable when compliance is in doubt and national security is at risk.

It must be acknowledged that perfect verifiability is not possible. The objective must be to reach agreement on verification measures that would provide all parties to an agreement with the assurance that non-compliance of a nature which would threaten their national security would be reliably detected in a timely way.

# Projects and Activities

1950-1951

1950-1951

The first project was a study of the local community. The students were divided into groups and assigned to investigate different aspects of the community. They collected data on population, industry, and social services. The results of their study were presented in a report to the school board.

The second project was a study of the local economy. The students were assigned to investigate the different industries in the area and their contribution to the local economy. They collected data on the number of workers, the value of production, and the amount of taxes paid. The results of their study were presented in a report to the school board.

The third project was a study of the local government. The students were assigned to investigate the different branches of government and their functions. They collected data on the number of officials, the amount of money spent, and the types of services provided. The results of their study were presented in a report to the school board.

The fourth project was a study of the local culture. The students were assigned to investigate the different customs and traditions of the area. They collected data on the types of festivals, the kinds of music, and the styles of clothing. The results of their study were presented in a report to the school board.

The fifth project was a study of the local environment. The students were assigned to investigate the different natural resources of the area and the ways in which they were being used. They collected data on the types of forests, the amount of water, and the quality of the air. The results of their study were presented in a report to the school board.

The sixth project was a study of the local history. The students were assigned to investigate the different events and people of the area. They collected data on the types of buildings, the names of the streets, and the dates of the events. The results of their study were presented in a report to the school board.

## Chapter 3

### Projects and Activities

To date, more than a hundred projects have been identified as part of the Verification Research Program relating to a wide variety of subjects. These projects have generally taken several forms:

- Research studies for application to problems in international negotiations.
- Research studies to amass and analyze what has been said and written on the subject of verification.
- Specialized technical training programs.
- Hosting of and participation in international meetings of experts on specific topics.
- Liaison with national and international bodies engaged in verification issues outside Canada.
- Public presentation of verification issues.

It would take too much space to provide details of all the projects of the Verification Research Program since its formation; however, the following sections will highlight some of the more recent activities.

#### Chemical Weapons

Canadian research on this subject seeks both to reinforce the 1925 Geneva Protocol prohibiting the use in war of chemical (and biological) weapons, as well as to

support efforts to conclude a comprehensive, global and verifiable prohibition of the very existence of chemical weapons. This research has resulted in a larger number of projects than on any other single issue, and the reasons for this should be clearly understood.

Not to be ignored is the fact that Canadians were victims of the first massive chemical attack, in April 1915. This experience has had a lasting psychological effect on Canadians since the First World War. It has prompted an active Canadian involvement in efforts to do away with chemical weapons altogether, while not ignoring the very real necessity to maintain, in the meantime, a degree of preparedness by focusing on research into passive defences to assure protection of Canadian military personnel.

A second and pressing reason for such Canadian involvement is that confirmed reports (through investigations initiated by the United Nations Secretary-General) and allegations of use have made this an actual — not just an historical or potential — matter of concern. This concern is heightened by reports that additional countries are developing, or appear interested in developing, a chemical offensive capability.

**Figure 6 Demonstrator Trichothecene Sensor Kit**



*Demonstrator Trichothecene Sensor Kit for the detection of T-2 mycotoxin in human blood samples. Final report of this study by the Institut Armand-Frappier has been presented to the United Nations Secretary-General.*

Under the Verification Research Program and the activity which preceded its formation, Canadian research projects have tended to focus on verification of allegations of the use of chemical weapons. As mentioned earlier, these efforts were seen as reinforcing the existing agreement (the 1925 Geneva Protocol) and as leading the way in addressing one very important requirement — a verifiable ban on use — that a future chemical weapons convention must be able to fulfil. Projects have been sponsored which have involved Canadian scientists in work in the field, in the laboratory, and as active par-

ticipants in the international negotiations at the Conference on Disarmament in Geneva.

For example, in relation to allegations of the use of mycotoxins in Southeast Asia (the so-called “yellow rain” issue), Canada initiated its own investigations in the region and has subsequently reported its findings to the United Nations and to the public at large. In the laboratory, Canadian scientists have improved upon techniques to detect, identify and quantify mycotoxins in the blood of alleged victims of such agents. Similarly, the first steps have been taken in the development of

## Chapter 3

## Topics and Activities

a portable kit for the use of personnel who may be tasked with investigating any future allegations of the use of mycotoxins, and the intention is to make this research available to the United Nations Secretary-General. In the same vein, Canadian scientists and officials recognized a requirement and produced the *Handbook for the Investigations of Allegations of the Use of Chemical or Biological Weapons* to assist investigators in more rigorously executing their tasks.

#### Seismic Verification of a Nuclear Test Ban

The priority which the Canadian government accords to the achievement of a comprehensive

test ban (CTB) on nuclear explosions is well known. Equally important, however, is the requirement to develop adequate global verification techniques to ensure compliance by all parties. A global seismic verification system does not exist at this time, but it is likely that such a system could be developed, given full-fledged support by all nations. Recent indications are that this support may be forthcoming. Canada works toward this objective through the Conference on Disarmament (CD) and its Group of Scientific Experts (GSE).

In 1976, the Conference of the Committee on Disarmament in

Figure 7 Participants of the Seismic Workshop



Group photo of participants from seventeen countries who attended Workshop on the Exchange of Seismic Waveform Data in October 1986.

**Figure 8 The Right Honourable Joe Clark at the Seismic Workshop**



*The Secretary of State for External Affairs, Mr. Joe Clark, speaking to some of the participants at the Workshop on the Exchange of Seismic Waveform Data.*

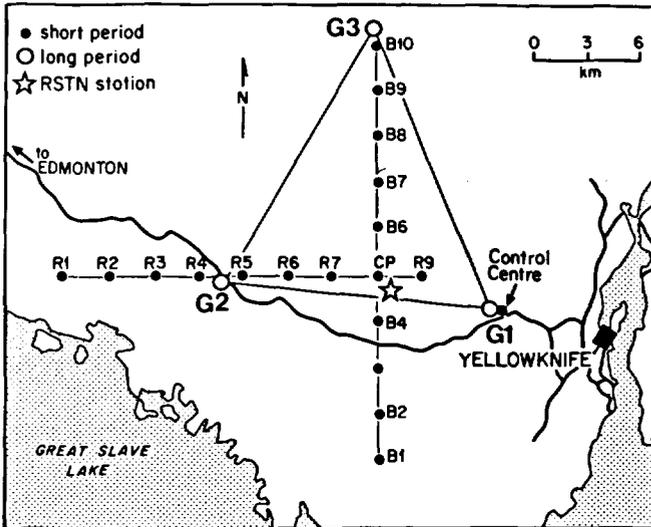
Geneva (the predecessor of the CD) gave the GSE its first mandate. The group was asked to specify the technical features of a possible international seismic data exchange system and to provide factual results and analysis of data exchange methods. The system, as now envisaged, would make data available to any participating country desiring them. Analyzing these data would remain a national responsibility.

Members of the GSE meet in Geneva for two weeks twice each year. As a result of their initiatives, international experiments were conducted in 1980, 1981 and 1984 to test and improve a key element in worldwide monitoring, that of speedy international data

exchange. By far the most important of these experiments was the International Seismic Data Exchange experiment, conducted on a worldwide basis from October 15 to December 15, 1984. Canada was a major contributor to this test.

Planning is now in progress for an even more ambitious experiment relating to the transfer of more detailed seismic data. As a major contribution to this planning process, the Verification Research Program funded a Workshop on the Exchange of Seismic Waveform Data, held in Ottawa in October 1986. While a significant event in terms of its subject matter alone, this workshop was also important because

Figure 9 Yellowknife seismograph array, N.W.T.



*Yellowknife seismograph array in the Northwest Territories. The short-period seismometers, separated by 2.5 km, form a cross; the long-period seismometers form a triangle about 16 km on a side. The Yellowknife facility is currently being modernized.*

of the participation of representatives from 17 countries, including, for the first time at such a meeting, the Soviet Union, Czechoslovakia and Poland.

To sharpen the Canadian capability to monitor underground tests, an interdepartmental program has been undertaken wherein the Verification Research Program has provided funding to the Earth Physics Branch of Energy, Mines and Resources Canada for additional personnel and hardware. This permitted, among other things, the recent upgrading of the Earth Physics

Branch's analytical capability in Ottawa as well as the development of a dedicated work station for seismic verification.

As an adjunct to this interdepartmental program, the Canadian government approved in February 1986 a \$3.2 million upgrading and modernization of the Yellowknife Seismic Array, an internationally recognized facility. When the modernization is completed in 1989, the array will constitute a world class facility which could serve as a prototype for international stations developed to participate in

an International Seismic Data Network.

In addition to these activities, the Verification Research Program has recently funded a \$200,000 multi-year project at the University of Toronto in which significant original research is being conducted into "high frequency detection" of seismic events.

### Outer Space

The Verification Research Program has addressed the question of arms control and outer space from two directions. Beginning

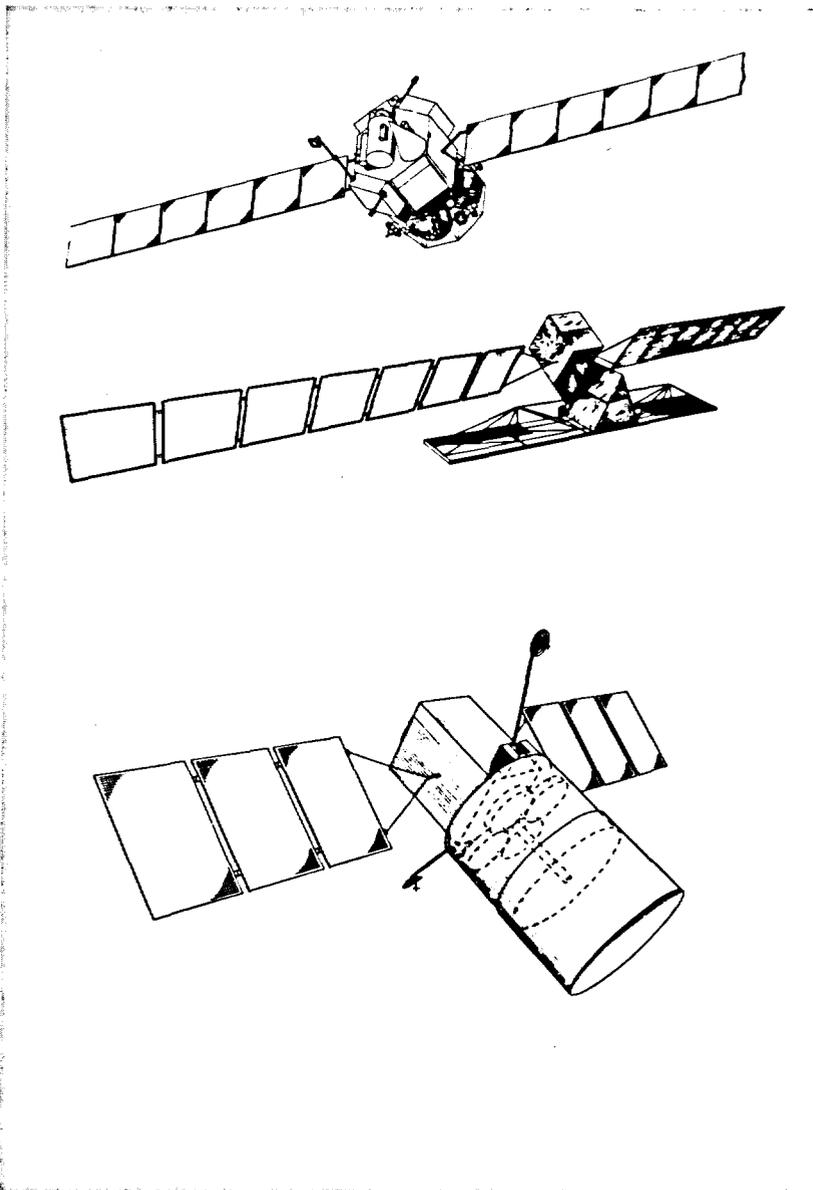
in 1983 the program sponsored general research into the legal aspects of this subject through contracts with the Institute and Centre for Research of Air and Space Law (ICRASL) at McGill University. This support of a centre of Canadian expertise provided the necessary background research to produce several working papers for the Conference on Disarmament that dealt with the current outer space legal regime and terminology relevant to the subject. The ICRASL has also held several symposiums and a series of lec-

**Figure 10** Participants of the Outer Space Workshop



*The Outer Space Workshop was held in Montreal on May 14 to 16, 1987, for representatives from the 40-nation Geneva-based Conference on Disarmament. The workshop was attended by 39 representatives from 35 countries including 11 ambassadors. The participants attended sessions at McGill University hosted by the Centre for Research of Air and Space Law and at Spar Aerospace Ltd. in Ste-Anne-de-Bellevue. The workshop afforded an opportunity to these diplomats and scientists to consider certain legal and technical questions as they pertain to the issue of the prevention of an arms race in outer space. Projects of the Verification Research Program through both McGill University and Spar Aerospace formed major contributions to this workshop.*

**Figure 11** Line drawings of three remote sensing spacecraft from Canada's PAXSAT studies



tures involving authoritative legal experts from around the world on questions relating to arms control and outer space in which the issue of verification played a prevalent part.

The second set of projects aimed at the subject of outer space drew upon expertise from the private sector through contracts with Spar Aerospace of Montreal, which, in turn, called upon the expertise of a number of sub-contractors from both the industrial and academic sectors of Canada. The aim of the first such project, which is called PAXSAT 'A', was to determine whether a space-based observation system could help verify an outer space arms control regime. Among the initial observations of the PAXSAT 'A' project, the most notable is that space observation of an object in space could determine the role or function of that object particularly regarding whether it is a weapons system. Moreover, a viable PAXSAT spacecraft could be designed to do this, using components available within the technology of civilian space organizations in non-superpower countries.

### **Conventional Weapons**

The focus of Canadian efforts in this regard has been on agreements to control conventional forces in Europe. The Verification Research Program has sponsored work on the topic of confidence-

and security-building measures, the most prominent example of which is the excellent book by James Macintosh of York University. Entitled *Confidence- (and Security-) Building Measures in the Arms Control Process: A Canadian Perspective*, this work has been welcomed as one of the most comprehensive and thorough discussions of this approach to regulating military- and security-related tensions. Further studies have concerned the nature of the verification regime that would be appropriate for monitoring agreements involving confidence- and security-building measures as well as agreements dealing with more substantial arms control and disarmament measures.

The Program has also sponsored research into the application of space-based remote sensors for verifying agreements on ground-based conventional forces. This project, known as PAXSAT 'B', was undertaken with Spar Aerospace as prime contractor and with several other industrial and research organizations as sub-contractors. Among its preliminary observations is that space-based remote sensors would be useful for this type of verification but current and planned civilian satellites because of their insufficient resolution and coverage could only provide limited "detection" level data in a

**Figure 12 Verification discussed at United Nations Disarmament Commission**



Canadian Ambassador for Disarmament Mr. Douglas Roche chairs a working group on "verification in all its aspects" at the 1987 session of the United Nations Disarmament Commission (UNDC). This working group achieved significant progress in elaborating consensus principles for multilateral verification. The Canadian delegation drew extensively on the expertise of the Verification Research Unit, most notably in the preparation of a chairman's paper that provided a detailed and comprehensive overview of the subject and which was praised by many other delegations.

Canada also made available to other delegations a three-volume compendium compiling almost 700 summaries of research reports, government statements and academic papers on the subject of arms control verification. This document, which was produced by the Verification Research Unit, should assist members of the UN and other serious researchers in their consideration of this subject.

These efforts at the UNDC provide a recent example of how the Verification Research Program is used to support Canadian missions in their attempts to promote progress in arms control.

confidence-building context. A dedicated PAXSAT 'B' system would require further research and development.

### **Generic Verification Research**

One of the central themes of the Canadian Verification Research Program is the recognition that verification can be usefully studied in a general way, outside the context of a specific agreement. This type of generic verification research may involve the relatively simple, though laborious, task of compiling and reviewing what has been and is being said on the issue of verification. Development of such a database provides an essential foundation for further research both of a generic nature and of an agreement-specific orientation. The Verification Research Program has been very generous in disseminating the results of these labours to other governments and to researchers throughout the world. The objective in sharing this work is to promote investigations which may develop procedures and techniques that could overcome negotiating obstacles related to questions of verification.

Another avenue of generic research being pursued by the program relates to the development of general models of arms control verification systems. This can involve the application of very theoretical approaches, such as

game theory, to verification questions. It can also include investigations of how aspects of some verification methods used in one context, such as International Atomic Energy Agency safeguards, might be applied in other contexts.

The program's generic research has been instrumental in providing a foundation for significant political initiatives. The prime example of this has been the comprehensive study of April 1986 which was produced in response to the Canadian-initiated United Nations General Assembly Resolution 40/152(o) "Verification in all its aspects". This "thoughtful analysis", to use the words of the representatives of another country, was by far the most detailed response to be submitted to the Secretary-General on this subject. It exemplifies the uses to which a thoroughly prepared database, generated by background research, can be put. Such a database expands the options available to policy-makers and facilitates their decisions with respect to specific negotiations. Maintenance of this database is an ongoing activity which provides a backdrop to the many other projects having a narrower focus on specific issues such as chemical weapons or a nuclear test ban.

# Conclusion

The first part of the report deals with the general situation of the country. It is a very interesting and informative study of the country's development. The author has done a great deal of research and has presented a very clear and concise picture of the country's progress. The second part of the report deals with the specific details of the country's economy. It is a very detailed and thorough study of the country's economic situation. The author has done a great deal of research and has presented a very clear and concise picture of the country's economic progress. The third part of the report deals with the specific details of the country's social situation. It is a very detailed and thorough study of the country's social situation. The author has done a great deal of research and has presented a very clear and concise picture of the country's social progress.

The fourth part of the report deals with the specific details of the country's political situation. It is a very detailed and thorough study of the country's political situation. The author has done a great deal of research and has presented a very clear and concise picture of the country's political progress. The fifth part of the report deals with the specific details of the country's cultural situation. It is a very detailed and thorough study of the country's cultural situation. The author has done a great deal of research and has presented a very clear and concise picture of the country's cultural progress. The sixth part of the report deals with the specific details of the country's environmental situation. It is a very detailed and thorough study of the country's environmental situation. The author has done a great deal of research and has presented a very clear and concise picture of the country's environmental progress.

The seventh part of the report deals with the specific details of the country's international relations. It is a very detailed and thorough study of the country's international relations. The author has done a great deal of research and has presented a very clear and concise picture of the country's international progress. The eighth part of the report deals with the specific details of the country's future prospects. It is a very detailed and thorough study of the country's future prospects. The author has done a great deal of research and has presented a very clear and concise picture of the country's future progress. The ninth part of the report deals with the specific details of the country's current situation. It is a very detailed and thorough study of the country's current situation. The author has done a great deal of research and has presented a very clear and concise picture of the country's current progress. The tenth part of the report deals with the specific details of the country's overall situation. It is a very detailed and thorough study of the country's overall situation. The author has done a great deal of research and has presented a very clear and concise picture of the country's overall progress.

## Conclusion

We live today in an imperfect world, too frequently characterized by suspicion, uncertainty and lack of trust. Regrettably, in the history of international affairs, this lack of trust has all too often been justified by the actions of some countries. We must, therefore, be cautious where important questions of national security are involved. We must seek to ensure that compliance with arms control undertakings is adequately verified.

Verification should also help to meet the need to institutionalize, in the context of relations between states, the same kind of accepted rules, procedures and expectations as those that govern the conduct of relations among individuals in all civilized societies. Such rules and procedures do not presume bad faith or malevolent intent on the part of others, but they allow for such a possibility as well as provide a framework in which unjustified accusations can be authoritatively rebutted, misunderstandings clarified and resolved, and actual non-compliance objectively established.

Canada's Verification Research Program seeks to directly address these important tasks. As Canada's Secretary of State for External Affairs, the Right Honourable Joe Clark stated before the House of Commons on October 21, 1986:

*Many of the persisting obstacles to negotiating progress arise directly from a lack of trust. The priority attention Canada has given to verification issues in particular attacks this question directly. Arms control agreements alone do not produce security; confidence in compliance produces security. Verification justifies that confidence.*

**Table 4**  
**Verification Research Program publications available  
to the general public**

*Arms Control Verification Studies Series*

- No. 1 *A Conceptual Working Paper on Arms Control Verification.*  
By F.R. Cleminson and E. Gilman. January 1986.
- No. 2 *The Role of Astronomical Instruments in Arms Control Verification.*  
By Chris A. Rutkowski. September 1986.
- No. 3 *The Sinai Experience: Lessons in Multimethod Arms Control  
Verification and Risk Management.* By Brian S. Mandell.  
1987.

*Arms Control and Disarmament Studies Series*

- No. 1 *Confidence- (and Security-) Building Measures in the Arms Control  
Process: A Canadian Perspective.* By James Macintosh.  
August 1985.

*Verification Brochures*

- No. 1 *Seismic Verification.* 1986.
- No. 2 *The PAXSAT Concept: The Application of Space-based Remote  
Sensing for Arms Control Verification.* 1987.
- No. 3 *Verification Research: Canada's Verification Research Program.*  
1987.

*Others*

*Verification in All Its Aspects: A Comprehensive Study on Arms Control and  
Disarmament Verification Pursuant to UNGA Resolution 40/152(o).*  
April 1986.

**Table 5**  
**Verification Research Program publications available**  
**through selected libraries\***

***Chemical Weapons***

- (1) *Chemical Weapons: Compendium of Working Papers and Procès Verbal from the Committee on Disarmament and Its Predecessors, 1969-1982.* 4 volumes.
- (2) *Handbook for the Investigation of Allegations of the Use of Chemical or Biological Weapons.* November 1985.
- (3) *Chemical Weapons: Compendium of Working Papers and Procès Verbal from the Committee on Disarmament and the Conference on Disarmament, 1983-1985.* 5 volumes.
- (4) *Chemical Weapons: Compendium of Working Papers and Procès Verbal from the Conference on Disarmament, 1986.*
- (5) *Verification: Development of a Portable Trichothecene Sensor Kit for the Detection of T-2 Mycotoxin in Human Blood Samples.* March 1987.

***Outer Space***

- (1) *Outer Space: Compendium of Working Papers and Procès Verbal from the Conference on Disarmament and Its Predecessors, 1962-1984.* 2 volumes.
- (2) *Outer Space: Compendium of Working Papers and Procès Verbal from the Conference on Disarmament, 1985.* 2 volumes.
- (3) *Outer Space: Compendium of Working Papers and Procès Verbal from the Conference on Disarmament, 1986.*

***Radiological Weapons***

- (1) *Radiological Weapons: Compendium of Working Papers and Procès Verbal of the Conference on Disarmament and Its Predecessors, 1970-1984.* 2 volumes.

### **Verification**

- (1) *Compendium of Arms Control Verification Proposals*. Second Edition, 1982.
- (2) *Quantitative Overview of the Second Edition of the Compendium of Arms Control Verification Proposals*. 1983.
- (3) *Compendium of Verbatim Statements on Verification from the Conference on Disarmament and Its Predecessors, 1962-1984*. 3 volumes.
- (4) *Compendium of Arms Control Verification Proposals*. Third Edition, 1987.

### **Proceedings**

- (1) *Proxy for Trust: Views on the Verification Issue in Arms Control and Disarmament Negotiations*. Edited by John O'Manique. (Ottawa: Carleton University, Norman Paterson School of International Affairs, 1985).
- (2) *Arms Control and Disarmament in Outer Space: Lecture-Seminars Given at the Centre for Research of Air and Space Law*. Edited by Nicolas Mateesco Matte. (Montreal: McGill University, Centre For Research of Air and Space Law, 1985).
- (3) *An Arms Race in Outer Space: Could Treaties Prevent It?* Edited by Nicolas Mateesco Matte. (Montreal: McGill University, Centre for Research of Air and Space Law, 1985).

- (4) *Highly Toxic Chemicals: Detection and Protection Methods: Proceedings of an International Symposium*. Edited by H. Bruno Schiefer. (Saskatoon: University of Saskatchewan, Toxicology Research Centre, 1985).
- (5) *Compliance and Confirmation: Political and Technical Problems in the Verification of Arms Control of Chemical Weapons and Outer Space*. Edited by Harald von Riekhoff. (Ottawa: Carleton University, Norman Paterson School of International Affairs, 1986).
- (6) *Multilateral Approaches to Verification: With a Review of Canadian Research on Arms Control Verification*. Edited by John O'Manique. (Ottawa: Carleton University, Norman Paterson School of International Affairs, 1987).
- (7) *Arms Control and Disarmament in Outer Space: Lecture-Seminars Given at the Centre for Research of Air and Space Law: Volume II*. Edited by Nicolas Mateesco Matte. (Montreal: McGill University, Centre for Research of Air and Space Law, 1987).

\* Because of the nature of these publications, only very limited quantities are produced and distributed to selected university and research libraries across Canada and throughout the world. Proceedings are distributed through the university involved.

Figure 13 Some Verification Research Program Publications



This picture shows several publications produced by the Verification Research Program. Verification Brochures present discussions of various topics relating to arms control verification in clear, readily understandable language. They are produced for distribution to the general public. The Arms Control and Disarmament Studies Series and Arms Control Verification Studies Series are intended to address more technical subjects and are distributed to a more specialist audience in governments and academic institutions throughout the world.

**Figure 14 For example...**

The initial results of the multi-year project funded by the Verification Research Programme at the University of Toronto, concentrating on the use of high frequency seismic signatures for verifying a nuclear test ban, were reported in the June 1987 issue of the University of Toronto Research Highlights:

***Researchers Discover Method for Monitoring Small Nuclear Blasts***

*Researchers in the Department of Physics have made significant progress in two areas considered vital to a verifiable nuclear test ban treaty: improved accuracy for estimating explosive yield size and a method to differentiate small nuclear explosions (a few tons of TNT) from small earthquakes.... Drs. Kin-Yip Chun, Gordon West and Richard Kokoski used mineblast and earthquake data to devise a mathematical method that eliminates the amplitude fluctuations from seismic wave readings.... Using their mathematical method, the researchers have devised a way to recapture wave frequencies that are lost as the seismic waves from an explosion or earthquake move out from the source.... If their methodology is confirmed, it will eliminate one of the most irksome problems in the path of a Low Threshold Test Ban Treaty, considered by some to be a necessary transitional step toward a Comprehensive Test Ban Treaty....*

This type of innovative research, in concert with the on-going activities of Canadian experts in the Group of Scientific Experts in Geneva, the upgrading of the analytical capabilities at the Geological Survey of Canada in Ottawa, the sponsorship of specialist workshops on seismic verification, and the modernization of the Yellowknife seismic array, combine to form a comprehensive research package aimed at developing an effective verification system for a global nuclear test ban.



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*If politics is the art of the possible, research  
is surely the art of the soluble. Both are  
immensely practical-minded affairs.*

Arthur Koestler  
*The Art of Creation* 1964

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Verification Research Program. --  
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**Verification Brochures**

No. 1 *Seismic Verification*, 1986

No. 2 *The PAXSAT Concept*, 1987

