



REPORT
of the Special Committee of the Senate on
NATIONAL DEFENCE

Canada's Territorial
Air Defence

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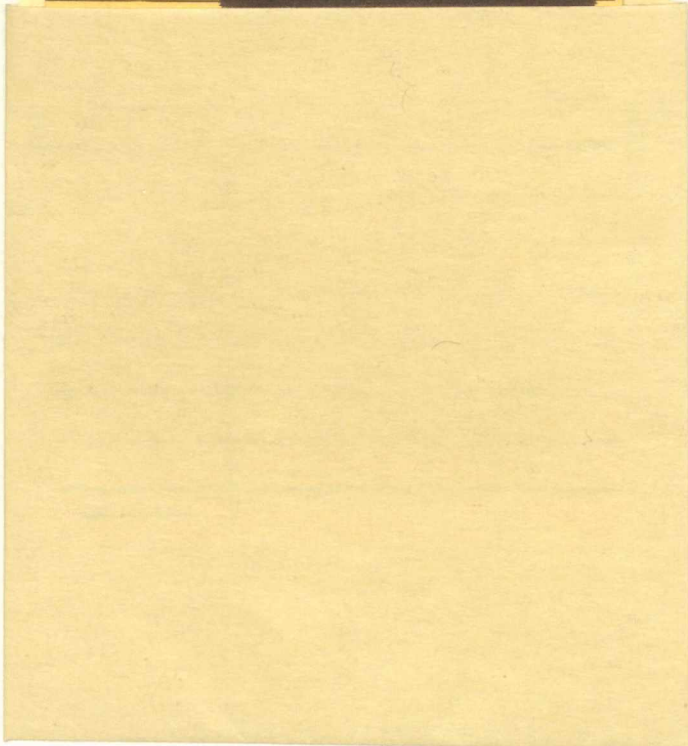
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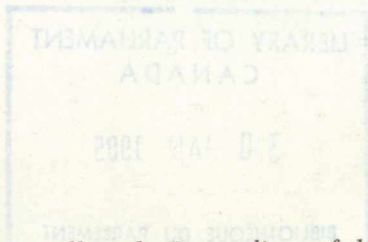


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NATIONAL DEFENCE

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**Canada's Territorial
Air Defence**

JANUARY 1985



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Membership

The Honourable Paul C. Lafond, *Chairman*

The Honourable Jack Marshall, *Deputy Chairman*

and

The Honourable:

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Henry D. Hicks

William M. Kelly

Léopold Langlois

Renaude Lapointe, P.C.

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Charles R. McElman

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*Duff Roblin, P.C.

Paul Yuzyk

*Ex officio members

Note: The Honourable Guy Charbonneau, Jacques Flynn, P.C., Royce Frith, Philippe D. Gigantès, John M. Godfrey, Jerahmiel Grafstein and H.A. Olson, P.C., also served on the Committee at various stages. Senator Lapointe served as Deputy Chairman during the Second Session of the Thirty-second Parliament.

Order of Reference

Extract from the Minutes of Proceedings of the Senate, Tuesday, November 27, 1984:

With leave of the Senate,

The Honourable Senator Lafond moved, seconded by the Honourable Senator Thompson:

That a Special Committee of the Senate be appointed to hear evidence on and to consider matters relating to national defence;

That 12 Senators, to be designated at a later date, four of whom shall constitute a quorum, act as members of the Special Committee;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, and to print such papers and evidence from day to day as may be ordered by the Committee;

That the Committee have power to adjourn from place to place within Canada, and to such places abroad where members of the Canadian Armed Forces may be stationed;

That the Committee have power to sit during adjournments of the Senate;

That the Committee be empowered to retain the services of professional and clerical staff as deemed advisable by the Committee; and

That the papers and evidence received and taken on the subject before the Committee during the Thirty-second Parliament be referred to the Committee.

After debate, and —

The question being put on the motion, it was —

Resolved in the affirmative.

Charles Lussier
Clerk of the Senate

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Summary of Recommendations and Observations

1. The committee urges the government of Canada to undertake without delay the planned defence review. A Canadian defence policy must be defined for this and the last decade of the century and the Canadian people and our allies should be informed of its aim and substance. (Pages xii, 3, 48 and 56.)
2. The committee recommends that when the review of the NORAD agreement, due to occur in 1986, takes place, Canada should explore the possibility of renewing the agreement for a period of 15 years, to the turn of the century, with provision for review every five years. (Pages 41 and 56.)
3. The committee recommends that Canada should pursue and press current negotiations on transitional arrangements for North American air defence with the aim of bringing them to an early conclusion. (Pages 55 and 56.)
4. The committee recommends that the transitional arrangements currently being negotiated comprise, for air defence purposes, a full range of peripheral early warning, tracking, assessment, and interception systems in Canada. (Chapter IV, especially pages 26 and 29; and pages 55 and 56.)
5. The committee recommends that the transitional arrangements should include some AWACS or other airborne early warning systems. (Pages 20, 22, 26, 33 and 56.)
6. The committee recommends that the option to buy 20 additional CF-18s under the terms still available under the present contract be fully exercised in order to cover attrition and round out existing capabilities if all current air commitments of the Canadian Armed Forces in Europe and North America are maintained. (Pages 43 and 56.)
7. The committee recommends that an early inquiry be conducted into Canada's present and future military requirements in space with a view to establishing a national military space programme. (Chapter V, section 1, especially pages 39 and 40; and pages 56 and 57.)
8. The committee recommends that the Canadian government define its objectives in North American aerospace defence as clearly as possible and concentrate on those aspects that are essentially defensive in nature. (Chapter VI, especially pages 53 and 54; and pages 55 and 57.)

9. The committee recommends that the government should develop an effective, immediate, and long-range industrial strategy for aerospace, aimed at maximizing long-term industrial benefits, developing new technologies, and expanding skilled and other employment. (Pages 46 and 47; and pages 55 and 57.)

10. The committee is as convinced as ever that our armed forces must be provided with the manpower, equipment, and other resources required to accomplish the tasks they are assigned. It believes that this may require that defence expenditures increase to between 2.5 and 3 percent of GNP. (Chapter V, section 3, especially page 48, and 57.)

Foreword

Peace is the foremost issue of modern times. The world must find some way to achieve it in lasting measure if mankind is to avoid disaster and establish an acceptable degree of harmony and international security.

This is the belief of the Special Committee of the Senate on National Defence, which unhesitatingly endorses Canada's policy of arms control and disarmament as well as the effort to maintain a stable military balance. The committee fully supported the objectives of former Prime Minister Trudeau's peace initiative, since endorsed by the current government, and remains firmly convinced that it is Canada's vocation to encourage the relentless pursuit of peace in our world.

The committee is especially concerned about the current state of East-West relations and the danger that it may give rise to a major new spiral in the arms race. Like many others, it is worried that if something is not done soon to curb the development and deployment of new strategic weaponry, then the opportunity to control the situation may be gone forever.

Canada is directly involved because of its geographic location between the superpowers and because partnership with the United States in continental defence is essential. Canadians cannot escape their strategic environment, but they can contribute to managing it by performing effectively in the North American Aerospace Defence Command (NORAD) and by pursuing other military and diplomatic policies designed to promote stability and confidence.

The committee firmly believes that Canada has a duty to itself and to the world in general to take a full and active part in preserving the security of this continent, particularly over Canada's own territory and waters. Lasting peace is not just waiting around the corner. It has to be pursued with vigour and imagination. We believe that the experience of the last forty years shows that peace cannot be achieved by putting our faith in illusions or letting down our guard. Canada must keep up, by itself and in association with friendly nations having the same heritage and values, the military manpower, equipment, and other resources needed to deter attack by adversaries and preserve general international stability.

Having inquired into Canada's armed forces manpower and into its maritime defence, and having reported on both, the committee turned to an examination of the air defence of North America and the protection of Canada's own airspace. It became conscious of the growing obsolescence of present North American radar networks and other warning systems and learned that there are great gaps in surveillance coverage of North American airspace at the present time. It also became aware that Canada and the United States are engaged in intensive

negotiations on new ground-based systems, and so focussed its own inquiry on one specific question: what policy should Canada pursue towards current proposals to modernize North American air defences? The results of this inquiry are contained in the present report.

The committee believes very strongly that Canada should support the upgrading of North American air defences because this is likely to enhance the survivability of the U.S. land-based deterrent and improve the protection of Canada's territory and population. National sovereignty protection in peacetime will be maintained if proper arrangements are made. Consequently, Canada should vigorously pursue the present negotiations with the United States in order to bring them to a successful conclusion as soon as possible. The Canadian negotiators should seek an equitable deal on costs that satisfies both this country and the United States, recognizing that these are not likely to be "staggering" or "astronomical" for either party. They should be well within this country's capabilities — probably under 5 percent of the annual defence budget.

The need for a new white paper became apparent during the committee's first enquiry when, from 1980 to 1982, it conducted a study of our armed forces' manpower requirements. Because there had been no general, official study of Canada's military establishments or defence effort for over a decade, the committee had to begin by surveying the whole of the defence field and by examining the linkages among the commands. The committee's study on maritime defence also came to the conclusion that a white paper was needed without delay. The present report is different from the other two, as it deals with one specific question rather than a whole aspect of defence activity or an entire command; it nonetheless concludes that additional defence expenditures and a new defence white paper are both essential. The committee is pleased to note the announced intention of the government to proceed promptly with the production of such a paper.

The committee itself intends to examine other defence activities and military commands in the future. It hopes to go on to study other aspects of Air Command's work, beginning with transport functions in support of our land forces and, following that, Canada's air defence contribution to NATO abroad.

Concerning the present inquiry, the committee wishes to express its gratitude to the many senior officers of the armed forces and senior officials of the Department of National Defence for their valuable assistance, as well as to witnesses from outside government, many of them former members of the armed forces, who readily responded to the invitation to share their views. A list of witnesses is appended.

A special note of appreciation is expressed to the Clerk of the committee, Mr. Patrick Savoie. The committee is also indebted to its technical advisor, Brigadier General (retired) Ronald Button, and to Mr. Roger Hill and Mr. Daniel Bon, of

the Parliamentary Centre for Foreign Affairs and Foreign Trade, who organized our programme and research and under the committee's direction gave form to this report. The committee acknowledges the contribution of other members of the Centre's staff and of its Director, Mr. Peter C. Dobell.



Paul C. Lafond

Chairman

January 1985

Glossary

| | |
|----------------------|---|
| ABM | Anti-Ballistic Missile |
| ADMP | Air Defence Modernization Plan |
| AFSATCOM | (U.S.) Air Force Satellite Communications |
| AIAC | Aerospace Industries Association of Canada |
| ALCM | Air-Launched Cruise Missile |
| ALMV | Air-Launched Miniature Vehicle |
| ASAT | Anti-Satellite (System) |
| AWACS | Airborne Warning and Control System |
| BMD | Ballistic Missile Defense |
| BMEWS | Ballistic Missile Early Warning System |
| BUIC | Back-Up Intercept Control |
| C³ | Command, Control and Communications |
| CADIN | Continental Air Defense Integrated North |
| 1 CAG | First Canadian Air Group |
| CAST | Canadian Air-Sea Transportable (Brigade Group) |
| DARPA | (U.S.) Defense Advanced Research Project Agency |
| DER | Directorate of Establishment Requirements (DND) |
| DEW | Distant Early Warning |
| DND | Department of National Defence |
| DoD | (U.S.) Department of Defense |
| EMP | Electro-Magnetic Pulse |
| FLEETSATCOM | (U.S.) Navy Satellite Communications |
| FOBS | Fractional Orbital Bombardment System |
| GEODSS | Ground-Based Electro-Optical Deep Space Surveillance System |
| GNP | Gross National Product |
| HOE | Homing Overlay Experiment |
| ICBM | Inter-continental Ballistic Missile |
| IISS | International Institute for Strategic Studies (London) |

| | |
|------------------|---|
| IONDS | Integrated Operational Nuclear Detonation Detection System |
| JSS | (U.S.) Joint Surveillance System |
| JUSCADS | Joint US-Canada Air Defense Study |
| MAD | Mutual Assured Destruction |
| MILSTAR | Military Strategic and Tactical Relay System |
| MX | Missile, Experimental |
| NATO | North Atlantic Treaty Organization |
| NAVSPASUR | (U.S.) Naval Space Surveillance System |
| NAVSTAR | Navigation Satellite Timing and Ranging |
| NDHQ | National Defence Headquarters |
| NORAD | Until 1981, North American Air Defense (Command). After 1981, North American Aerospace Defense (Command) |
| NWS | North Warning System |
| OTH-B | Over-the-Horizon Backscatter (Radar) |
| PARCS | Perimeter Acquisition Radar Characterization System |
| PO&M | Personnel, Operations and Maintenance |
| R&D | Research and Development |
| RAMP | Radar Modernization Project |
| ROCC | Region Operations Command and Control Centre |
| SAC | (U.S.) Strategic Air Command |
| SAGE | Semi-Automatic Ground Environment |
| SALT | Strategic Arms Limitation Talks |
| SAM | Surface-to-Air Missile |
| SDI | Strategic Defence Initiative |
| SEWS | Satellite Early Warning System |
| SLBM | Submarine-Launched Ballistic Missile |
| SLCM | Submarine-Launched Cruise Missile |
| SPADATS | Space Detection and Tracking System |
| STEALTH | a technology being developed to reduce the susceptibility of airborne objects to radar detection |
| TAC | (U.S.) Tactical Air Command |

TAV Transatmospheric Vehicle
USAF United States Air Force

Note: The terms “air defence” and “aerospace defence” are both commonly used in the field examined in the present report. For example, in 1981 the North American *Air Defence* Command was renamed the North American *Aerospace Defence* Command, but subsequently Canada and the United States agreed to negotiate about new systems on the basis of an *Air Defence* Modernization Plan. Since the main thrust of the present enquiry is into responses to the Soviet bomber and cruise missile threat, the term “air defence” is more commonly used (even in some cases where certain space-related activities may be involved, for example in Chapter IV). However, the term “aerospace defence” is also used where it seems more appropriate, for example when considering the impact of changes on the aerospace industry, or the situation which will obtain when space-based sensors have been deployed (for example in Chapter VI).

INTRODUCTION

1. The Setting

Strung out across the immensity of the Far North is one of the most distinctive defence installations of all time, the Distant Early Warning (or DEW) Line network of radar stations designed to provide early warning of an aerial attack on the territories of Canada and the United States. Standing isolated and stark as they carry out the vital task of watching the distant skies, these stations, together with other surveillance systems and interceptor aircraft, have helped to maintain the security of North America for more than a quarter of a century.

Now, after years of quietly and effectively serving their purpose, North American air defence systems have become a matter of public attention once again as Canada and the United States try to face up to new situations that are developing. Early decisions have to be made about the present structure because it has become technologically outdated and is inadequate to cope with the new bombers and air-launched cruise missiles being developed by the Soviet Union. Negotiations are therefore under way about the possible upgrading of ground radars and related aircraft and support installations and about how the costs are to be shared. Meanwhile, the space age is coming upon us with extraordinary rapidity, creating expectations that the main radars and other surveillance devices for North American air defence will be stationed in space shortly after the turn of the century.

For Canada, upgrading North American air defences raises some major issues. There are the two fundamental questions of deciding whether anti-bomber defences are necessary in the missile age and determining why it is useful to maintain and protect U.S. and other land-based deterrent forces if there are more than enough nuclear warheads in submarines to destroy the whole of the Soviet Union. Then there is the ever-present problem of costs, which could conceivably be large enough to require either a substantial increase in the defence budget or some cut-backs in Canada's defence commitments. Canada's efforts to preserve sovereignty over its own airspace may also be affected by a restructuring of North American air defences that would entail moving Canadian interceptor capability northward and dismantling the CADIN-Pinetree Line, thus leaving most of southern Canada without Canadian military radar coverage or interceptor capability.

The current negotiations between Canada and the United States focus on transitional arrangements, that is to say on the ground-based radars and other installations and aircraft needed until space-based surveillance systems are operational. These space-based systems are not included on the agenda of the

present talks. Nevertheless, Canada will soon have to decide whether it wishes to develop a national capability in this area or whether it will seek a share in U.S. space programmes.

2. Some Fundamental Considerations

Behind the consideration of transitional arrangements and eventual space-based systems is the fundamental issue of the protection of Canada's own territory and people. This is the most basic responsibility of the state. As Professor David Cox remarked during the hearings, "in our own defence policy, we have to develop a very clear sense of priorities and, in my opinion, they start with ensuring that we are not prejudicing our own territorial integrity".¹

Similar sentiments motivated this committee when, in its previous form as the Senate Sub-committee on National Defence, it studied Canada's maritime defence and recommended a mixed fleet that would enable Canada to protect its own waters while fulfilling its Alliance commitments. Its approach then was "to explore the full range of threats that modern naval forces could pose to Canada today and over the next thirty years and then to consider what steps Canada could, within reason, take to counter them".² The sub-committee stated in that report that it was a strong proponent of Canada's membership in NATO, "but felt it also had to examine the country's needs in circumstances when the Alliance might not be involved".³

In the air environment, the outstanding characteristic of Canada's situation is that this country lies directly between the superpowers. The most dangerous threats it faces are not those aimed directly against itself but rather against its neighbour, the United States. Many of the Soviet Union's long-range bombers, air-launched cruise missiles (ALCMs), inter-continental ballistic missiles (ICBMs) and submarine-launched ballistic missiles (SLBMs) would pass over Canadian territory if they were ever launched against the United States and would cause massive devastation in this country if they fell short of their American targets. In addition, Canada would suffer as much as the United States from fallout and other side-effects of a nuclear attack.

In 1957, Canada and the United States agreed to maintain jointly the air defence of the continent. Under the North American Aerospace Defence Command, radars, interceptors and other systems provide an early-warning capability that limits the danger of U.S. land-based deterrent forces being destroyed on the ground and thus ensures that one of the main pillars of world stability is preserved. These NORAD forces also have some collateral capacity to limit damage to strategic targets, people, and territory in Canada and the United States.

¹ *Proceedings of the Special Committee of the Senate on National Defence*, 8 March 1984, p. 3:33.

² *Canada's Maritime Defence*, Report of the Sub-committee on National Defence of the Standing Senate Committee on Foreign Affairs, Ottawa, May 1983, p. 3 (ISBN 0-662-52500-0).

³ *Ibid*, p. 4.

The air defence forces of Canada and the United States are also assigned the operational task of protecting national sovereignty in peacetime. At the political level, some commentators have argued that close association with the United States in continental air defence diminishes Canada's independence by aligning this country with American policies and providing arrangements for U.S. military aircraft and other forces to enter Canadian territory. In general, though, Canadians apparently feel that they can live quite comfortably with an occasional and limited U.S. military presence in peacetime, as well as with the understanding that larger U.S. forces would enter Canadian airspace when needed to participate in the joint defence in crisis periods or wartime.

Canada is also concerned about the broader international situation and participates in NATO and the United Nations in order to promote its own security, contribute to the collective security of the Alliance, and preserve world peace. Canada's contribution to NATO in particular aims at ensuring that vital countries or regions such as Norway or continental Western Europe will maintain their stability and independence; and this contribution has been substantial over the years partly because the cost of protecting Canadian airspace and carrying out other defence duties at home has so far been relatively modest. In fact, as the Soviet threat changed with the construction of a major missile force in the 1960s and 1970s, the burden of North American air defence actually diminished and Canada phased out the Mid-Canada Line, reduced the number of radars and interceptors, and concentrated on surveillance and identification rather than on active anti-bomber defence.

Today, the Soviet bomber threat is increasing again, and Canada and the United States are discussing plans for air defence upgrading that could require substantial expenditures. Consequently, there is a strong argument for this country carrying out a major reappraisal of its defence policies, designed among other things to see whether any increases in expenditure on North American air defence are likely to involve a major shift in the focus of national defence spending. This reappraisal should also consider whether the defence budget needs to be increased and whether present defence commitments ought to be maintained, altered, or diminished.

In its reports on armed forces manpower and maritime defence, the committee on two separate occasions called for a defence white paper. Holding the firm conviction that this can be achieved without delaying or hampering current defence improvement programmes, the committee remains strongly committed to a white paper and notes with satisfaction the government's declared intention to proceed in this direction.

3. Outline

In this report, the committee focuses on one specific question: the approach that Canada should adopt towards the modernization of North American air defence. It concentrates on the transitional period between 1985 and the turn of the century.

In Chapter II, the committee reviews the development of North American air defence. It considers the early focus on the bomber threat, the later concentration

on the missile threat, and the complexities of recent years when a range of new political, technological, and strategic factors have had an impact on thinking about air defence in the United States and also in Canada. The current state of negotiations between Canada and the United States over transitional air defence arrangements is described, and an attempt is made to outline the main choices available to Canada in this field. A principal theme of this chapter is that Canada faces more difficult choices today over air defence than it has confronted for many years. Yet decisions must be made soon, given the growing obsolescence of present systems, the perceived increase in the Soviet bomber threat, and the need for Canada to maintain defence arrangements with the United States that will permit this country to promote its own interests and policies as well as participate effectively in the common defence.

Chapter III describes the main features and components now being negotiated, as well as certain other aerospace defence systems.

Chapter IV examines the utility of anti-bomber defences, the need for land-based deterrent forces, the effects of the transitional arrangements on continental air defence, and Canada's capacity to maintain national sovereignty over its own airspace.

Chapter V assesses the strategic, technical, and other linkages between the transitional arrangements and eventual space-based systems, and the costs and benefits of the various results that could emerge from the negotiations. Estimated expenditures on the transitional arrangements are examined in relation to other defence requirements, and the committee then comments on the general question of defence budgets and commitments.

Chapter VI looks beyond the transitional period to the types of military activity that might characterize continental aerospace defence in the space age. The eventual relationship between Canadian military space policies and U.S. strategic postures and doctrines is considered.

Chapter VII lists the committee's main conclusions about the policies that Canada should preferably pursue on North American air defence. It also contains certain observations and the committee's recommendations.

Chapter II

THE DEVELOPMENT OF NORTH AMERICAN AIR DEFENCE

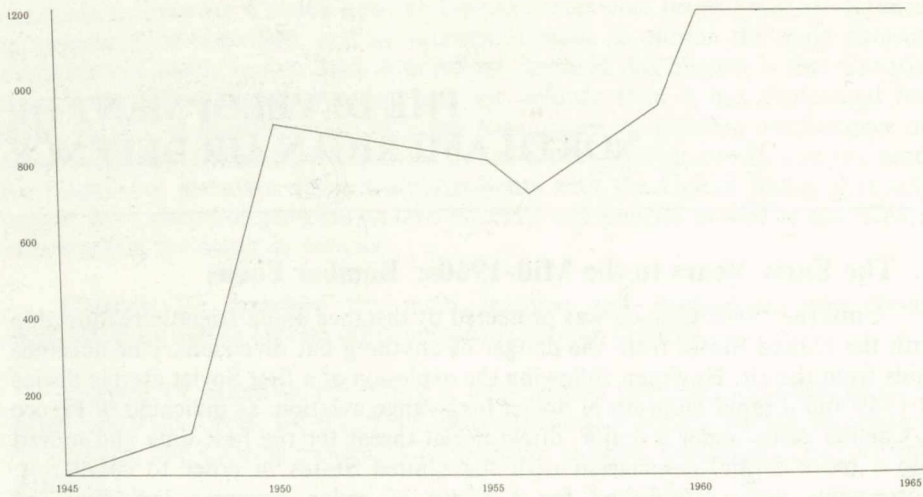
1. The Early Years to the Mid-1960s: Bomber Focus

Until the 1950s Canada was protected by distance and a friendly relationship with the United States from the danger of anything but diversionary or nuisance raids from the air. However, following the explosion of a first Soviet atomic device in 1949 and a rapid build-up of Soviet long-range aviation, as indicated in Figure 1, Canada came under a major, direct aerial threat for the first time and moved into a more formal association with the United States in order to counter it. Agreements were established for a series of radar networks including the CADIN-Pinetree Line in 1951, the Mid-Canada Line in 1954, and the DEW Line in 1955. Canada joined with the United States to set up the North American Air Defence Command on an interim basis on August 7, 1957. Formal confirmation of the NORAD agreement was provided on May 12, 1958.

From the outset, NORAD relied on a variety of active and passive defence systems. At their height, the latter consisted of the three radar lines just mentioned: the DEW Line, made up of 78 stations strung along the 70th parallel and functioning essentially as a tripwire; the CADIN-Pinetree Line, with 39 radars along the 50th parallel, discharging a control as well as a surveillance function; and the Mid-Canada Line, with 98 stations, providing detection along the 55th parallel. These radars were backed up by a variety of American sensors designed to prevent "end runs" from either the Atlantic or Pacific, including long-range early warning aircraft, U.S. Navy picket ships, and United States Air Force (USAF) "Texas tower" surveillance radars. Active defence involved close to 3,000 interceptors, including 200 Canadian aircraft dedicated to this role, and approximately 90 Bomarc and Nike surface-to-air missile (SAM) formations. Canadian Bomarc squadrons were located at North Bay, Ontario, and LaMacaza, Quebec. Both the aircraft's weapons and the SAMs were nuclear-tipped to ensure the destruction of their targets. All these systems were linked together through the computerized regional control centres of the Semi-Automatic Ground Environment (SAGE) complex, later augmented by the Back-Up Interceptor Control (BUIC) communication network. Crude but elaborate civil defence procedures and mechanisms were put in place to protect urban populations. At that time, the Canadian land forces were also "assigned a role in national survival".¹

¹ *White Paper on Defence*, Minister of National Defence, Ottawa, March 1964, Queen's Printer, p. 9.

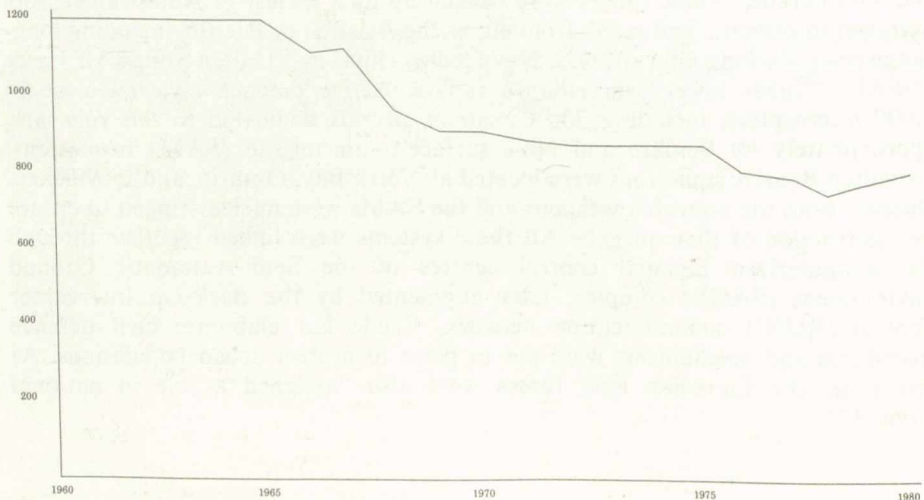
FIGURE 1: The Growth of the Soviet Strategic Bomber Force, 1945-1965



Source: *Soviet Air Power in Transition* by Robert P. Berman, Brookings Institution, Washington, D.C., 1978. (ISBN No. 0815709234)

The Military Balance, International Institute for Strategic Studies, (IISS), London, 1961-1965 issues.

FIGURE 2: The Soviet Strategic Bomber Force/Long Range Air Force, 1960-1980



Source: *The Military Balance*, IISS, London, 1961-1981 issues.

Note: After 1967 tanker aircraft of the Soviet Long Range Air Force cease to be included in combat aircraft. This accounts for a drop of some 50 in 1968.

The early period was not without its complexities and controversies, but these were about the essentially moral issue of relying on nuclear weapons and the political implications of close association with the United States, rather than the military situation as such. There was general agreement that the main direct threat to North America was the one that Soviet bombers posed to Canadian and American strategic targets and population centres. The response was to maintain interceptors, warning systems, and other installations that could detect, track, intercept, and destroy all or most of those bombers before they reached their targets.

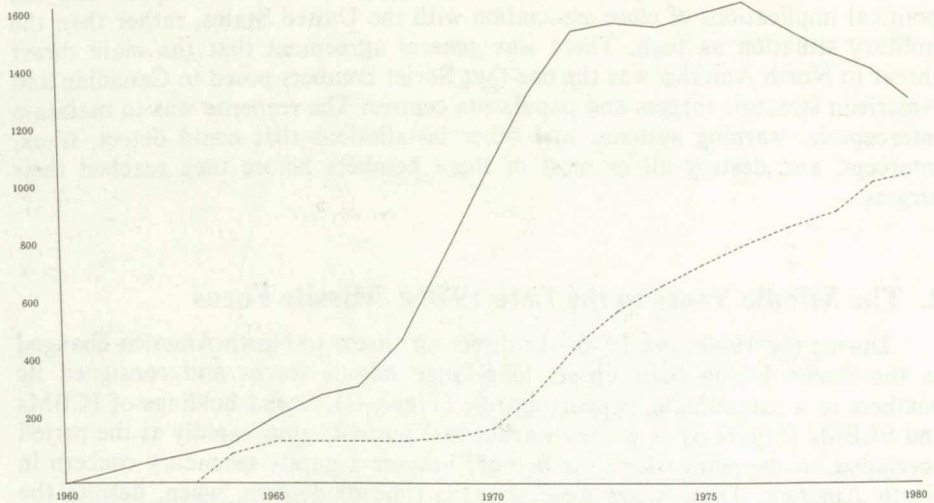
2. The Middle Years to the Late 1970s: Missile Focus

During the 1960s and 1970s the direct air threat to North America changed as the Soviet Union built up its long-range missile forces and consigned its bombers to a subordinate, supporting role (Figure 2). Soviet holdings of ICBMs and SLBMs (Figure 3) as well as warheads (Figure 4) grew rapidly as the period developed, to the point where the bomber became a purely secondary concern in North America. These years were also the time of detente, when, despite the Vietnam War and the Soviet invasion of Czechoslovakia, important agreements were reached on arms control, some of which had a direct bearing on North American air defence. The SALT I Treaty of 1972 in particular was accompanied by an accord on anti-ballistic missiles that limited each side to one complex around its capital city and another in its missile fields, and this in practice ruled out the prospect of a general strategy of active defence against aerial threats. Instead, the security of the world was to be based on the policy of mutual assured destruction (MAD), where each side would be deterred from launching an attack on the other by the latter's capacity to retaliate, devastatingly, with powerful, secure offensive forces.

As the threat changed, so did NORAD defences. The NORAD Agreement was renewed in 1968, 1973, and 1975, but during this period the DEW Line was cut back to 31 sites and the CADIN-Pinetree Line to 24 stations. The Mid-Canada Line was abandoned, and such U.S. auxiliary sensors as Texas towers and picket ships were withdrawn. The Bomarc missiles were scrapped, Nike batteries declined to seven, and the number of interceptors dropped to about 300, or approximately 10 percent of earlier strength. Early warning became the top priority, and damage limitation was relegated to a secondary level of importance.

NORAD's missions shifted to warning and assessment of ballistic missile attack, space surveillance, and the maintenance of a peacetime surveillance system in North America capable of detecting and identifying unknown aircraft and providing a limited defence against bombers. New systems were put in place to meet these altered requirements: the Ballistic Missile Early Warning System (BMEWS), a network of three radars with a range of 4,800 km built in Alaska, Greenland and the United Kingdom; the Satellite Early Warning System (SEWS), which operates three geosynchronous satellites in conjunction with the BMEWS; the Space Detection and Tracking System (SPADATS), which consists of two complementary sub-systems — the U.S. Naval Space Surveillance System (NAVSPASUR), with three transmitters and six receiver sites in the southern United States, and SPACETRACK, a network of eight radar and camera sites; six SLBM detection sites located on the coasts of the United States; and a phased

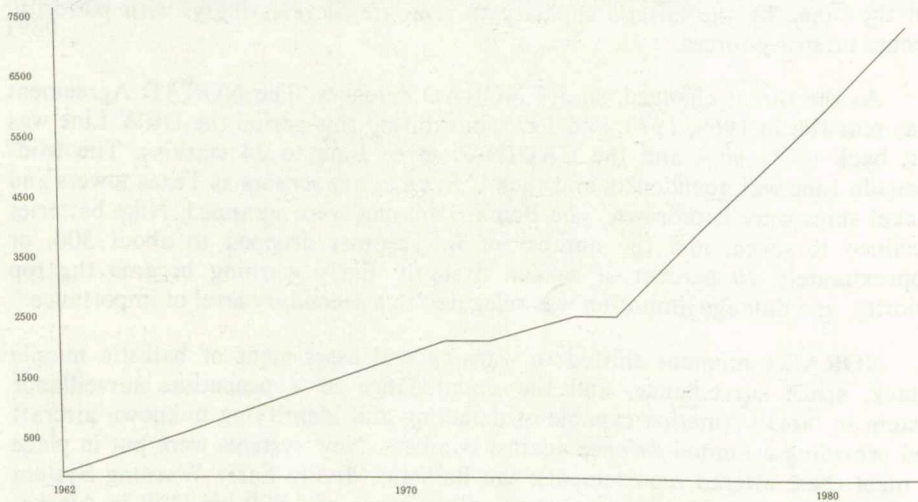
FIGURE 3: The Soviet ICBM and SLBM Arsenal, 1960-1980



Source: *The Military Balance*, IISS, London, 1961-1981 issues.

— ICBM
 ---- SLBM

FIGURE 4: The Growth in the Number of Soviet Strategic Nuclear Warheads, 1962-1982



Sources: *World Military and Social Expenditures*, Washington, D.C., 1980-1983 issues. (ISSN 0363-4795)

Canada, The Arms Race & Disarmament, United Nations Association in Canada, Ottawa, circa 1981 (no date).

Stockholm International Peace Research Institute Yearbook, 1981, London, (ISSN 0347 3395)

TABLE 1: The decline in Canadian Territorial Air Defence Resources, 1960 to the present

A. Manpower

| Year | Military | Civilian | Total |
|------|----------|----------|--------|
| 1960 | 13,845 | 3,383 | 17,228 |
| 1965 | 12,176 | 3,262 | 15,438 |
| 1968 | 10,869 | 3,015 | 13,884 |
| 1971 | 9,360 | 2,960 | 12,320 |
| 1974 | 8,206 | 2,831 | 11,037 |
| 1983 | 7,800 | 2,600 | 10,400 |

B. Interceptors

| Year | Squadrons | Aircraft* |
|------|-----------|-------------|
| 1960 | 9 | 200 CF-100 |
| 1963 | 3 | 66 CF-101 |
| 1968 | 3 | 58 CF-101 |
| 1972 | 3 | 66 CF-101** |
| 1974 | 3 | 44 CF-101 |
| 1975 | 3 | 36 CF-101 |
| 1983 | 2 | 36 CF-101 |

C. Surface to Air Missiles

| Year | Squadrons | Type |
|------|-----------|-------------|
| 1962 | 2 | 56 Bomarc B |
| 1972 | 0 | 0 |

D. Early Warning — DEW Line

| Year | Sites |
|------|-------|
| 1960 | 78 |
| 1982 | 31 |

E. Early Warning — Mid-Canada Line

| Year | Sites |
|------|-------|
| 1954 | 98 |
| 1965 | 0 |

F. Long Range Radars — CADIN-Pinetree Line

| Year | Sites |
|------|-------|
| 1962 | 39 |
| 1969 | 28 |
| 1975 | 25 |
| 1976 | 24 |
| 1983 | 24 |

* Includes aircraft in the Operational Training Unit which augment NORAD interceptor forces.

** In 1972 the USAF replaced 58 CF-101s with 66 improved versions, restoring numbers of aircraft to original levels.

Sources: A. 1960-1974: DND/NDHQ/DER.

1983: *The Military Balance, 1983-1984*, IISS, London. (ISSN 0459-7230).

B. NDHQ.

C. NDHQ.

D. JUSCADS.

E. NDHQ.

F. *The Military Balance*, IISS, London, 1963-1984 issues.

array radar in North Dakota that was originally installed as part of a planned active, anti-ballistic missile (ABM) system.

These developments were generally supported in Canada, and the Canadian government had no difficulty in agreeing to a more passive approach to the air defence task. Such a policy fitted the altered strategic circumstances and also cost less than maintaining a full, active defence effort. In fact, Canada was scarcely involved in the new missile warning and space surveillance function, contributing only a limited number of facilities such as the SPACETRACK cameras in Cold Lake, Alberta, and St. Margaret's, New Brunswick. "There is, unfortunately, not much Canada herself can do by way of effective direct defence that is of relevance against massive nuclear attack,"² the defence white paper noted in 1971. The main thrust of Canadian policy towards NORAD in these years was to try to preserve Canadian sovereignty within the NORAD system by working towards a reconfiguration of air defence boundaries so that they corresponded to the national borders and by establishing region operations command and control centres (ROCCs) in Canada. In the mid-1970s, the government also decided to re-equip Canada's air forces with a new interceptor, but this was prompted by pressure from the NATO allies to do more in defence in general and not by a strong belief on the part of the government or the country at large that Canada should do more in NORAD. The new interceptor decision put an end to one nagging irritant, however. It enabled the government to give a firm undertaking that it would phase out the last remaining nuclear weapons on Canadian soil — the Genie rockets serving as armament for the CF-101 (Voodoo) interceptor. This was in fact accomplished on July 5, 1984. (The CF-18 purchase involves an initial order for 138 aircraft; deliveries began in October 1982 and are expected to be completed in September 1988.)

3. The Recent Years to the Present: The Changing Environment

In the last seven or eight years Canada has faced a more complex and demanding situation in the field of North American air defence, partly because of the growing obsolescence of present radar networks and related military systems, but also because of global strategic and political developments and U.S. responses to them. Whatever Canada's own perceptions of the world, this country has to aim at maintaining mutually satisfactory arrangements with the United States. In the air defence area, this means dealing with American perceptions of the threat as much as with the threat itself.

From about 1978 to 1981, the main cause of concern about North American air defence was the prospect of replacing outdated equipment. Canada was going ahead with the plans to purchase a new fighter aircraft, as already mentioned, but this country and the United States encountered problems of obsolescence in many other areas. A joint United States-Canada air defence study (JUSCADS) was undertaken in 1979, prompted, as unclassified extracts from an executive

² *Defence in the 70s: White Paper on Defence*, Minister of National Defence, Ottawa, August 1971, p. 6, Information Canada (catalogue no. D3-6/1971).

summary indicate³, by the fact that most components of the North American air defence system were by then, or would soon be, obsolete.

According to the summary, JUSCADS had concluded that

the current locations of surveillance radars, aircraft identification zones, and interceptor operating areas do not cover some potential bomber penetration routes and do not reflect the evolution of civil air traffic routes. Introduction of new equipment and demands for fuel economies are changing the civil domestic and international air traffic patterns. Many trans-Atlantic great circle routes (shortest distance for bombers or civil traffic) make landfall on the Labrador coast. The external configuration of the air defence system, however, has remained much the same as it was in the late 1950s, leaving significant gaps in coverage for bomber warning and apparently ignoring airspace integrity enforcement problems.⁴

The summary included an unclassified map (Figure 5) which showed very clearly that the natural air routes from Northern Europe to central Canada and the U.S. Mid-West are now through a great gap in radar coverage in the Davis Strait-Labrador area. The same is true for the air routes from northwest Africa to the western parts of Canada and the United States.

The obvious conclusion to be drawn from the JUSCADS summary is that large parts of the existing North American air defence system are obsolete, and when they are replaced, it would make sense to "reconfigure" them to fit current rather than past requirements. In other words, Canada and the United States should think about building a new early warning system in the North to replace the aging DEW Line and should consider phasing out or scaling down the CADIN-Pinetree Line while establishing new capabilities along the Labrador coast and elsewhere as required.

The JUSCADS summary also stated that new air defence components can be expected to have useful lives of about twenty years and argued that "it is essential that the new components be effective and properly deployed against the Soviet capabilities likely to be encountered during this 20-year period".⁵ There seemed to be little expectation of major changes in the Soviet threat or U.S. strategies in the near future. Ballistic missiles were seen as the principal threat, supplemented by Soviet bombers and cruise missiles, but the means envisaged for coping with these threats were primarily early warning, detection, and attack assessment capabilities. Possibly the classified portions of the JUSCADS study offered a broader view of the situation, but the impression conveyed by those parts released to the public was that North American air defence would operate in the near future on basically the same assumptions as it had in the recent past.

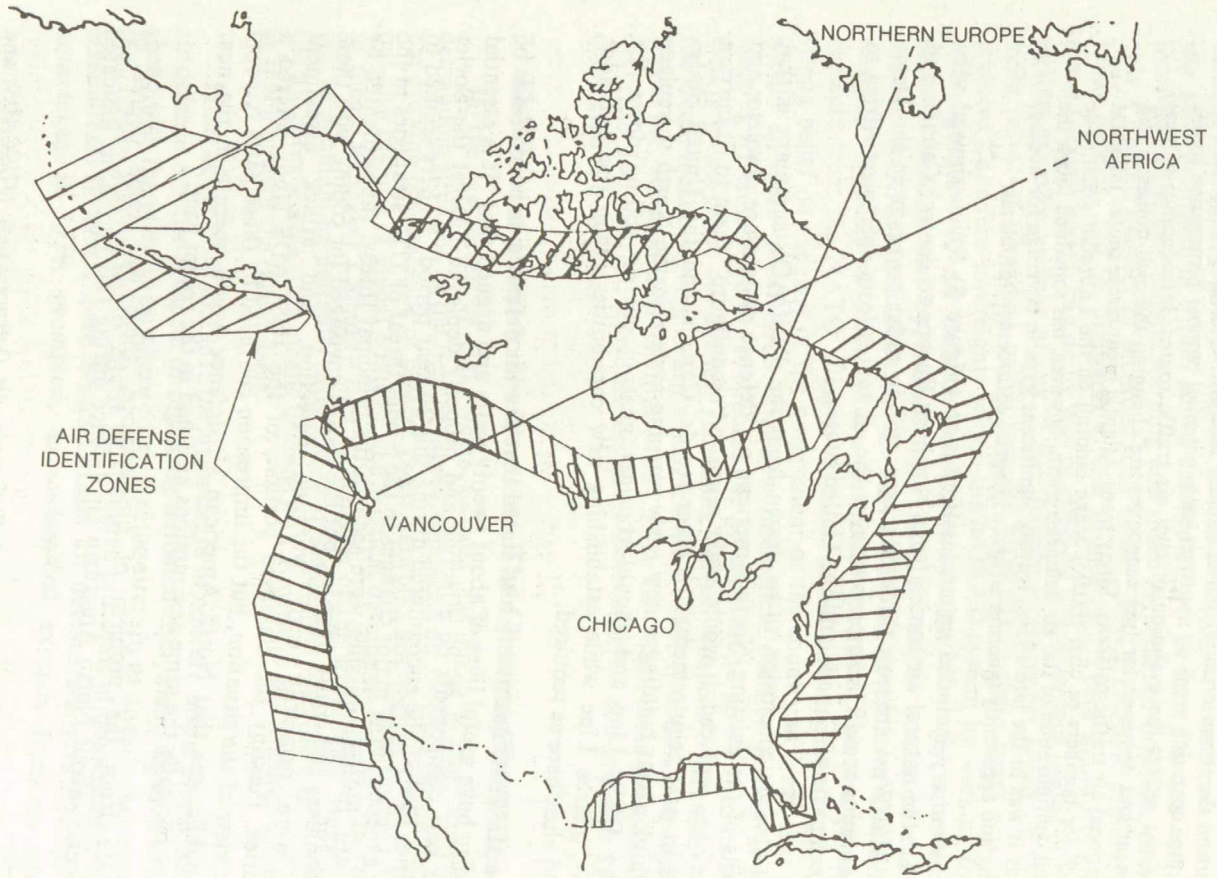
Aside from the problem of obsolescence, there was some degree of complacency about North American air defence during this period, as indicated

³ Unclassified *Summary of the Joint U.S./Canada Air Defence Study (JUSCADS)* and Unclassified *Extracts from JUSCADS Executive Summary*, provided by DND to the House of Commons Standing Committee on External Affairs and National Defence at its 20 October 1980 hearing.

⁴ *Unclassified Extracts from JUSCADS Executive Summary*, p. 5.

⁵ *Ibid*, p. 1.

FIGURE 5: Air Traffic Routes and Air Defence Identification Zones



Source: *Unclassified Extracts from JUSCADS Executive Summary*

by changes in U.S. command structures and renewals of the NORAD agreement. In 1979, the United States reorganized the USAF and split up its Air Defence Command, transferring its warning systems to Strategic Air Command (SAC) and its fighters to Tactical Air Command (TAC). This demonstrated above all that the relative importance of air defence had declined in terms of U.S. military priorities. Canada and the United States extended the NORAD agreement in 1980, and renewed it in 1981 for an additional five years (see Appendix A); but at the time there appeared to be no great sense of immediacy about the pursuit of negotiations. A review of the situation carried out by the House of Commons Standing Committee on External Affairs and National Defence noted the deployment of the Soviet Backfire bomber and the possible development of new inter-continental bombers, longer-range air-to-surface missiles and air-launched cruise missiles, but did not portray these as heralds of fundamental change in the strategic doctrines of one side or the other. That committee simply envisaged that "future strategic developments could lead to a requirement for upgraded radar systems and forward deployment of fighter aircraft".⁶

After 1981, changes in strategic thinking soon began to have a major impact on the North American air defence situation. President Reagan came to office that year and — believing that U.S. security and other interests were being seriously threatened by a Soviet arms build-up, the Soviet occupation of Afghanistan, communist involvement in Africa and Central America, and other similar developments — launched a major programme of U.S. military modernization and expansion. The Reagan Administration committed itself to the B-1 bomber — earlier cancelled by President Carter — and the MX missile, and the United States moved ahead rapidly with massive programmes for a build-up of the U.S. Navy, the installation of long-range cruise missiles on B-52s, the development of a new "stealth" bomber, the testing of an anti-satellite system, and other advances in weaponry. A separate, new U.S. Space Command was also established in 1982. A primary aim of all these programmes, at the outset, was to close off the so-called "window of vulnerability" said to afford the USSR an opportunity to destroy U.S. land-based ICBMs in a pre-emptive first strike. A policy of strengthening missile warning capabilities and anti-bomber protection was also included in the overall military expansion programme, and the United States began negotiations with Canada on this question. These talks are continuing.

The basis for this negotiation is an Air Defence Master Plan (ADMP) worked out by the U.S. Air Force and formally adopted as U.S. policy by the Reagan Administration in 1982. This provides a blueprint for the complete overhaul of North America's air defences, including the following components: replacement of the DEW Line with a more effective warning system; installation of two Over-the-Horizon Backscatter (OTH-B) radars to cover the Atlantic and Pacific approaches to the continent (under this plan another of these radars might be added to cover the southern flank); complementary coastal, gap-filling sensors; new interceptor deployment patterns; increased reliance on Airborne Warning and Control Systems (AWACS); improvements to command, control and

⁶ NORAD, Third Report to the House, *Minutes of Proceedings and Evidence of the Standing Committee on External Affairs and National Defence of the House of Commons*, Issue no. 29, 9-18, December 1980, Department of Supply and Services, Ottawa, 29:26.

communications systems (C³); and an updating for space and ground-based missile warning systems.

So far in these negotiations, tangible results have been modest: a distinction has been established between national and NORAD systems; the Pinetree Line will, for the remainder of its life, be a purely Canadian concern and the OTH-Bs a wholly American responsibility; and Canada will be expected to participate in the funding of the North Warning System (NWS) even though the United States was financially responsible for the DEW Line. There is, as yet, no agreement on the following aspects: the implementation of the plan as a whole; the exact location of parts of the NWS; a cost-sharing formula for the procurement and maintenance of gap-filling radars and interceptor forward deployment bases; the nature and extent of the AWACS programme and Canada's role in it; and certain issues of vital concern to Canada such as the scope of this country's involvement in space, missile warning, and related operations.

Although the Canadian government must have felt some concern at the outset of these negotiations about the danger of being swept into far-reaching and costly schemes, at least some of the delays in arriving at an agreement seem to have come from the American side. In the spring of 1984, John Anderson, Assistant Deputy Minister (Policy) in the Department of National Defence (DND), in Ottawa, attributed current delays to "trouble getting Congress to appropriate the funds for some of the components of this master plan".⁷ Many Americans are concerned about the size of the deficit and issues other than national defence. In the defence field itself, the need to upgrade those systems providing early warning against bomber and missile attack stands relatively low on the list of priorities. Even the United States Department of Defence (DoD) has sometimes failed to press the claims of ADMP components on the U.S. defence budget when a choice has had to be made between them and other programmes such as the B-1, the MX and, now, ballistic missile defence (BMD) systems.

For its part, however, the U.S. Administration remains committed to a successful outcome to the current negotiations, arguing that the Soviet bomber threat is increasing rapidly with the development and deployment of the new Blackjack bomber and long-range cruise missiles, and contending that the Air Defence Master Plan is needed to make sure that these forces are not allowed undetected access to the heart of the continent. American defence officials believe that upgraded, transitional ground-based systems will be essential for early warning of bomber and missile attack until space-based systems are in operation. Evidence for this is provided by the fact that the USAF has now awarded contracts for the design of long-range and short-range radars for the North Warning System. Now that national elections have taken place in Canada and the U.S., the prospects for forward movement on the air defence question may be greatly enhanced.

In the long run, anti-bomber and anti-cruise missile defences may well become increasingly important. If the American government were to base its future defence policies on the military objectives outlined by President Reagan in

⁷ *Proceedings of the Special Committee of the Senate on National Defence*, 22 February 1984, p. 2:20.

his celebrated "Star Wars" speech of March 23, 1983, and move effectively towards the development of ballistic missile defences using lasers and other advanced technology, then the United States would gradually shift from a strategy based on the threat of retaliation to one designed to counter directly all forms of Soviet and other aerial threats against its territory. In this circumstance, there would be little point in defending against ballistic missiles if the United States was not also protected against bombers, cruise missiles, and other offensive systems; a whole range of defensive weaponry and warning systems — including space-based ballistic missile defences, ground-based missile defence systems, radars, and interceptors — would be necessary.

In this complex situation, faced with questions about the outcome of the current negotiations and also about their implications, Canada confronts a number of possible courses of action. For illustrative purposes, these may be summarized as follows:

1. Canada could encourage the United States to go ahead with the upgrading of present air defence systems and could also seek a full partnership in continental aerospace defence with the United States, including an active part in U.S. defensive and offensive space systems and ballistic missile defences. This would require a fundamental change in the arms control and disarmament policies that Canadian governments have pursued throughout the nuclear era.
2. Canada could press the United States to proceed with the transitional arrangements and seek to obtain an effective but clearly delimited and defined role in them. Canada could also seek to play an effective role in essential space surveillance in cooperation with the United States through NORAD, either by developing its own military surveillance satellites or by trying to negotiate a limited part in U.S. space programmes.
3. Canada could commit itself to upgrade the ground-based systems on its territory whether or not the United States wishes to participate in their modernization. This is a course it may have to consider if the present negotiations are terminated for any reason. If Canada assumed this responsibility, it might wish to avoid the additional expenditures that space surveillance would entail. Alternatively, it could develop a national space programme or seek a part in U.S. space programmes.
4. Hypothetically at least, Canada could try to avoid decisions and opt for a passive approach to the question of upgrading North American air defences. Present systems would be maintained for the time being, and Canada would not engage or participate in any upgrading. With regard to military space activity, there would still be three options: no programme; a national programme; or participation in U.S. space programmes.
5. Although it seems unlikely under the new Canadian government, Canada could let current air defence systems decline or pull out of NORAD completely, in pursuit of policies favouring a minimal contribution to the alliance or some form of neutralism. It might avoid space activities altogether or else endeavour to develop its own independent, space-based surveillance systems.

This overview is intended to spell out some of the range of choices that Canada faces in its current negotiations with the United States on North American air defence. A number of refinements and variations of these different approaches are of course possible.

THE TRANSITIONAL ARRANGEMENTS 1985 – 2000: DESCRIPTION

1. The Urgency of the Transitional Systems

Eventually, space-based systems are likely to provide the main elements of North American air defence, because they are becoming technically feasible and cost-effective.¹ All of the witnesses appearing before the committee agreed, however, that North America will not be in a position to rely primarily on space-based systems for another fifteen to twenty years. In the interim, there is a requirement for transitional systems and arrangements, that is to say ground-based radars, interceptors, space tracking and warning devices, AWACS, and related communications networks and other facilities. Furthermore, some ground-based installations are likely to be needed indefinitely, or at least well into the next century, in order to supplement space-based systems.²

2. The ADMP Solution: Brief Description

The Air Defence Master Plan, approved by Canada and the U.S. as a basis for negotiations in 1982 and expected to provide the framework for modernization of NORAD, is a classified document. However, enough accurate information has emerged in print, speeches, and public hearings for the committee to feel confident that it is not betraying any secrets in sketching the plan's major components. Some care has been taken to screen out sensitive or contentious material; as a result, some of the details given in this report may in the future prove to have contained dated or slightly inaccurate elements. These modest imperfections do not distort significantly the perspective that the present chapter can open on the future.

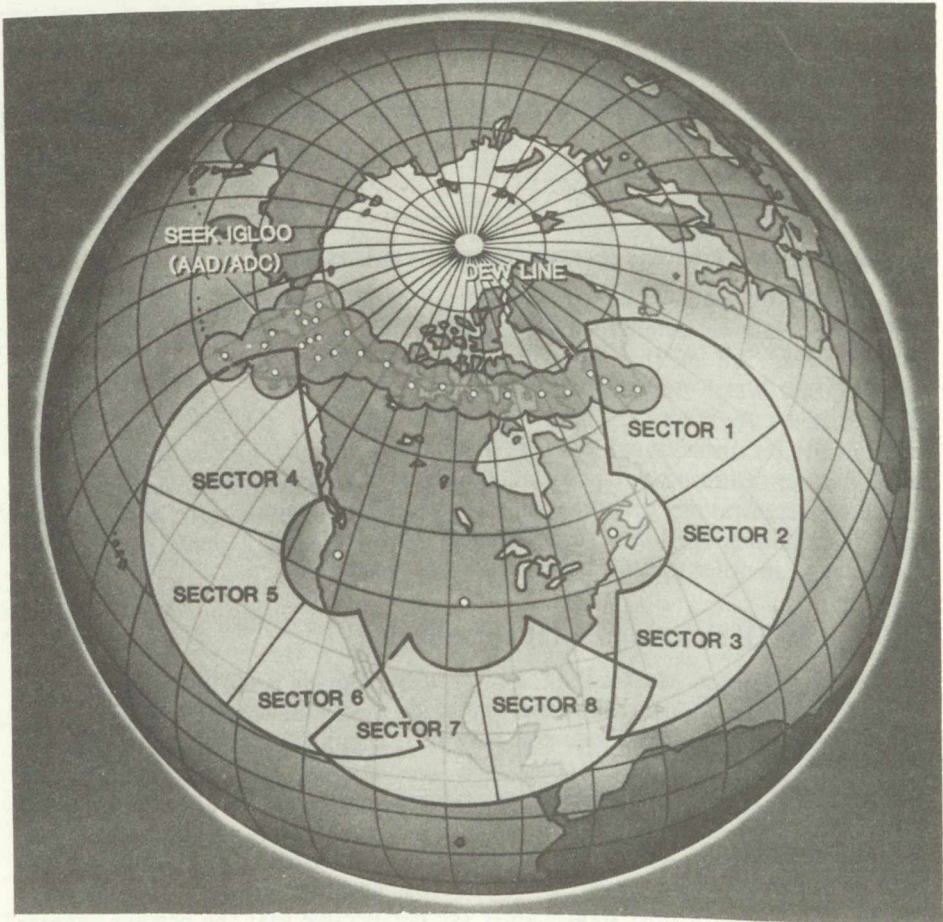
As shown in Figure 6, the ADMP aims to provide peripheral radar coverage and warning against air-breathing threats through a number of complementary systems: the Seek Igloo network in Alaska; the North Warning System due to replace the DEW Line from Alaska to southeastern Greenland; and three OTH-B radars which cover the Atlantic, Pacific, and southern approaches to North America. Not shown on the map, but also under consideration, are an extension of the NWS along the coast of Labrador and new or modernized gap-filling radars on the Atlantic and Pacific coasts of Canada. Also excluded from the map are the CADIN-Pinetree Line, which is expected to be "phased out"³, and the Joint

¹ *Proceedings of the Special Committee of the Senate on National Defence*, 14 March 1984, p. 4:24-5.

² *Ibid*, 1 February 1984, p. 1:16.

³ *Report of Secretary of Defense Caspar W. Weinberger to the Congress on the FY 1985 budget, FY 1986 authorization request, and FY 1985-89 defense programs*, Washington, D.C., February 1, 1984, p. 194.

FIGURE 6: The Proposed Warning System



Courtesy of *Aviation Week and Space Technology*, (March 19, 1984 issue, p. 85).

Surveillance System (JSS), with twins civilian and military facilities around the United States.

To these passive systems would be added the active ones mentioned earlier: several squadrons of interceptors and a number of AWACS. In keeping with the peripheral thrust of radar coverage evident in Figure 6, the grid of permanent and deployment bases from which these aircraft would operate is also expected to shift outward and, following the dismantling of the CADIN-Pinetree Line, northward. Improved and hardened communications links would tie the various elements of the system together as well as to the command centres.

Neither the composition nor the functioning of ballistic missile warning systems is expected to change. However, they will continue to undergo qualitative improvements.

3. Transition Components and Other Aerospace Defence Systems

(A) Airspace Surveillance and Control Systems

Seek Igloo would be a line of minimally attended radars providing coverage across Alaska. It would have a range of 370-460 km and an all-altitude capability. It may be powered by alternate wind and solar energy sources.⁴

The North Warning System may reach from Alaska to southern Greenland along the coast of the Arctic Ocean. Conceivably, present plans may be altered to reflect Canada's concern over the weakness of radar coverage over Labrador. The NWS would combine 13 long-range radars of the same type as *Seek Igloo* and 39 or 40 unattended gap-fillers with a more modest range of 110 to 150 km. The network would provide coverage out to 370-460 km at all altitudes.

The OTH-B radars would be located as follows: one on the east coast of the United States to cover the Atlantic approaches to the continent, one on the west coast to cover the Pacific, and possibly one in the interior to cover the southern flank of the United States. This technology involves the use of beams bounced off the ionosphere, an atmospheric layer beginning at an altitude of about 80 km. The system's receiving antennas detect reflected radar signals — "backscatter" — from the targets. Computers then determine the targets' locations and speeds, using sophisticated software that enables the computer to distinguish the actual targets from clutter and interference. Such technology would allow for all-altitude coverage over all of the area between 900 and 3,350 km from the sites in 60° fans. Three contiguous sectors on each coast would provide 180° coverage, and a two-sector unit may close the 120° angle in the south. Additional gap-filling sensors may also be needed to cover the OTH-Bs' blind spots — within 900 km of the sites — otherwise Soviet cruise missiles launched from submarines (SLCMs) within those areas could conceivably go undetected. Unfortunately, OTH-Bs do not perform well in areas subject to *aurora borealis* disturbances. This rules out their use in northern Canada and might require some backup capability in the northernmost sections of the fans off the Atlantic and Pacific coasts. Coverage that is lacking for this reason would likely be provided by a string of coastal radars in eastern and western Canada.

The OTH-Bs would vastly extend the zone under coverage. As a result, a new task would be given to NORAD: "raid recognition". Since it would not be possible to conduct a detailed investigation of all unknown aircraft tracks in the zone under surveillance (the eastern fan would reach practically to Iceland), special computer programmes would help determine whether the pattern of tracks warranted more careful examination. If so, additional steps including visual identification by NORAD interceptors would be taken as the potential threat neared the continent.⁵

⁴ The factual details in section (A) are derived mainly from the evidence provided in the committee's hearings and from *Aviation Week and Space Technology*, "USAF Hones Air Defence Capabilities", 19 March 1984, p. 87.

⁵ *Proceedings of the Special Committee of the Senate on National Defence*, 28 March 1984, p. 6:19.

Internal surveillance may be provided mainly by AWACS once most of the CADIN-Pinetree Line stations have been phased out. The northern section of the Joint Surveillance System along the Canada-United States border includes only a very limited number of sites, and their coverage does not in any case extend far into Canada.

AWACS are extremely flexible surveillance and control systems with a radar range of at least 370 km and a "look-down" capability enabling them to detect low-flying aircraft. Their major drawback is that they cost some \$200 million each to procure and \$10,000-25,000 an hour to operate. As a result, it would be extremely expensive to use them for continuous peacetime coverage. In addition, they have been repeatedly singled out as an expendable item in U.S. budget-reducing efforts, and so far none has been dedicated to NORAD, which claims a requirement of 19 for its exclusive use.

Interceptor aircraft in Canadian regions would be redeployed to reflect NORAD's new peripheral thrust. This posture would be achieved through the basing of permanent two-aircraft alert detachments in British Columbia and Newfoundland/Labrador and, on a random basis, at a number of deployment bases in the North. In a crisis, all bases could be activated on short notice, the CF-18s used for training could be made available to NORAD, and a significant number of U.S. air defence aircraft could be deployed to Canadian locations.

(B) Ballistic Missile Warning Systems

The ballistic missile warning systems may not undergo major changes in this and the next decade. But with added emphasis on space, the BMEWS and BMD will have a high priority during the remainder of this century and into the next one.⁶

Specific U.S. programmes are expected to improve the survivability, performance and coverage of the satellites and radars involved. New SEWS satellites will be connected to six mobile ground terminals, replacing older, more vulnerable ground-based data processing stations. The BMEWS will be made more accurate in assessing an attack's size and likely targets. Two new PAVE PAWS phased array radars⁷ will be deployed, one in Georgia and one in Texas, to provide surveillance of possible SLBM attack corridors to the southeast and southwest of U.S. borders. This deployment will complete a five-site SLBM warning system — including the Perimeter Acquisition Radar Attack Characterization System (PARCS) in North Dakota — due to replace the older system in use today.

In light of continuing doubts about the survivability of satellites and their ground-based processing stations in the aftermath of a nuclear attack, a new

⁶ The factual details in sections (B), (C) and (D) are derived mainly from the evidence provided in the committee's hearings and from the *Report of Secretary of Defense Caspar W. Weinberger to the Congress on the FY 1984 budget, FY 1985 authorization request, and FY 1984-88 defense programs*, Washington, D.C., February 1, 1983.

⁷ The PAVE PAWS system and other phased array radars feature an electronic steerable radar beam for detecting airborne targets. The elevation of the radar beam can be changed electronically at the same time as the radar is scanning horizontally.

system is being designed in the United States which would ensure continued operation throughout a nuclear conflict. Initially known as the Advanced Warning System, this Boost Phase and Tracking System is expected to become operational in the 1990s.

Also being developed is the Integrated Operational Nuclear Detonation Detection System (IONDS), which would detect and assess nuclear detonations. Using 18 NAVSTAR satellites, it will contribute to nuclear test ban monitoring and intelligence collection in peacetime, and might, if the eventuality ever arose, provide damage and strike assessment information during a nuclear war.

(C) Space Monitoring, ASATs, and Ballistic Missile Defence Systems

Several American programmes are seeking to improve U.S. ability to monitor space activities. Completion of the worldwide network of five ground-based electro-optical deep space surveillance sensors (GEODSS) will help to better detect and identify objects in deep space. The planned modification of several existing radars may provide additional high and low-altitude surveillance coverage. Other advanced technologies that could lead to more capable and survivable surveillance systems in the future are also being investigated.

In addition, the U.S. Air Force plans to deploy as part of its national forces a low-altitude anti-satellite (ASAT) weapon — the Air-Launched Miniature Vehicle (ALMV) — aboard some F-15s. One report indicates that two F-15 squadrons will be employed in the ASAT role, with one on each coast of the United States, and that this U.S. ASAT system

is more flexible than its Soviet counterpart, given the mobility of the aircraft (and its ability) to hit a wider variety of targets with greater speed. It will, however, only be capable of hitting targets in low earth orbit. Research is underway to determine the best means of extending the range of U.S. ASATs, including more advanced ground and air-launched interceptors based on conventional explosives as well as laser weapons.⁸

Extensive work with ballistic missile defence components has demonstrated that an active defence could conceivably protect some high-value strategic assets from ballistic missile attack.

(D) Command, Control, and Communications

Command, control, and communications form the nervous system of military structures. The ongoing process of harmonizing and integrating NORAD's C³ with its sensors and weapons will continue as NORAD adapts its response to the changing nature of the threat. Ground relays, computers, communications links, and command facilities themselves will be hardened, given greater backup capacity, and provided with endurance-enhancing features to allow them to function for as long as possible under the most rigorous and demanding conditions.

⁸ *Arms Control Chronicle: A Chronology of International Developments*, No. 2, Canadian Centre for Arms Control and Disarmament, Ottawa, May 1984, p. 14 (ISSN 0825-1908K).

In keeping with this approach, NORAD will seek to diminish the vulnerability of the operations complex at Cheyenne Mountain, Colorado Springs. It is well protected but, like all fixed installations, endangered by the sophistication of modern weapons. NORAD has also developed plans for airborne command centres. These will be hardened against the effects of nuclear detonations (including electro-magnetic pulse, or EMP), provided with highly reliable and survivable communications, and in a position to transmit information promptly. In the early phase of the transition period, before these new airborne command posts are operational, NORAD headquarters' contingency planning will rely mainly on ground-based alternate command facilities.

Command and control backup will be required by the region operations command centres. It is anticipated that this would be provided by the AWACS assigned to NORAD.

Effective, continuous control of military forces requires two-way, jam-resistant communications between commanders and their resources. The U.S. Military Strategic and Tactical Relay System (MILSTAR), a new satellite communications system with extremely high frequency communications channels, will incorporate a significant number of survivability features and provide for prompt, one-way message transmissions.

The Air Force Satellite Communications (AFSATCOM) system's transponders — carried on various host satellites, including those of the U.S. Navy's FLEETSATCOM system and of the Defence Satellite Communication System — will also provide survivable relay links for transmitting processed missile attack warning data from the satellites' early warning system to senior military authorities and to NORAD headquarters.

THE TRANSITIONAL ARRANGEMENTS: ISSUES

1. Two Basic Questions

The committee examined the transitional arrangements in terms of their ability to perform the tasks of North American air defence, that is to say early warning against hostile bombers and their missiles, warning of ballistic missile launchings, tracking of space objects, threat assessment, and some damage limitation.

The Utility of Anti-Bomber Defences

One fundamental question which arose was the following: is it wise to invest heavily in anti-bomber defences when there is no defence against ICBMs and SLBMs? There was considerable discussion during the hearings about the prospects of the opponent ever using bombers and cruise missiles when it has other, much surer strategic forces and must fear retaliation if it ever does attack.

On this question, Lieutenant General (retired) K.E. Lewis, former Deputy Commander of NORAD, drew attention to the fact that detection capabilities against ICBMs and SLBMs are at present much better than against the bomber.

Today we have the situation whereby the major threat, . . . that from the ICBMs and SLBMs, can be watched over much better than the atmospheric threat, the bomber threat. The systems that NORAD now has in place permit very reliable and early indications of missile launch and the direction of launch but in the last couple of decades we have allowed our atmospheric defences to deteriorate to the point where we believe that we might provide an option to potential enemy planners to, in fact, use that out-dated weapon.¹

John Anderson pointed out that:

If we had no warning against bombers, then they could choose, at their will, to attack us with bombers as well as with missiles or instead of missiles. The bomber is still a means of delivering quite a large weapon quite accurately. It has certain virtues that a missile does not have. When you fire a missile, it is gone; with a bomber you can call it back because it is . . . manned."²

General Lewis also argued that if the Soviet Union ever availed itself of the opportunity to launch such an attack with virtually no warning, it would aim at

¹ *Proceedings of the Special Committee of the Senate on National Defence*, 1 February 1984, p. 1:21.

² *Ibid*, 15 March 1984, p. 5:16.

knocking out key communications systems because these are crucial to the U.S. deterrent.³ Others mentioned the "precursor raid", where adversary bombers would aim at knocking out North American command and control centres as well as communications systems and other vital installations so that U.S. and Canadian forces would be decapitated, confused, unable to obtain orders, and incapable of retaliating.

Professor Douglas A. Ross remarked that

the best operational rationale for the prudent minimum of deployment within NORAD is looking after the contingency of a precursor strike. Essentially, I think that can be handled with fixed site radars, which are much less expensive, obviously... I think the northern warning system, NWS, which I believe the Canadian forces are proposing at the moment for the far north, the B.C. coast, the Yukon coast and the Labrador extension would be adequate to cope with a precursor strike, because it is in that scenario that we are taking some insurance against a limited Soviet bomber force striking at American command and control systems. That, I think, is about the only contingency against which we should buy insurance for continental defence.⁴

Later, Professor Ross stressed that

if one is trying to reduce the risk of accidental war... the precursor threat must be addressed... For that reason... we need an upgrading of our warning system especially, but the accent must be on warning and less on active defence.⁵

In a further comment, he contended that

if, indeed, a decapitation strike were going to occur with 50 to 100 warheads, it would come from Soviet submarines offshore, much closer to their designated targets. They would not be coming (in) bombers over the Pole. But one has to foreclose that possibility. If there were no radar perimeter, then that obviously would be an option they would have. One wants to foreclose that.⁶

The Need For Land-Based Deterrent Forces

Anti-bomber defence is linked to another basic question: why should we have anti-bomber defences, strategic bombers, land-based ICBMs, or other parts of the present massive deterrent forces when a few nuclear submarines can carry enough missiles and warheads to devastate the Soviet Union or North America? For example, it has been suggested that Soviet submarine-based missiles alone would be enough to destroy every city in the United States with a population of 10,000 or over, and it was stated in a recent article dealing with the same point that the destructive power contained in one nuclear submarine of the British Royal Navy equipped with Trident II missiles "could eliminate the USSR as a major power."⁷ However, relying on a limited number of nuclear submarines alone assumes that

³ *Ibid*, 1 February 1984, p. 1:21.

⁴ *Ibid*, 8 March 1984, p. 3:27.

⁵ *Idem*.

⁶ *Ibid*, p. 3:28.

⁷ G.M. Seignious II, and J.P. Yates, "Europe's Nuclear Superpowers", *Foreign Policy*, No. 55, Summer 1984, p. 44 (ISSN 0015-7228).

alone assumes that they will remain invulnerable for the foreseeable future and that the authorities in Washington and Moscow will be ready to invest the entire security of their nations in this expectation. Admiral Rickover, the founder of the U.S. nuclear submarine fleet, recently expressed concern about the continuing invulnerability of nuclear submarines, particularly in light of the danger of breakthroughs in anti-submarine warfare through the use of surveillance satellites.⁸ John Anderson, for his part, argued as follows before the committee:

Each of the systems — that is, intercontinental ballistic missiles, submarines with submarine-launched ballistic missiles and bombers — has both its strong points and its weak points. For the submarine-launched ones, the weak point may be getting in touch with the submarines, especially if the command and control systems one hopes to use have been destroyed by ballistic missiles in the meantime. This is why both of the powers have tended to keep part of their strategic forces in three different systems.⁹

Mr. C.R. Nixon, former Deputy Minister of National Defence, also addressed this issue:

I think Mr. Anderson mentioned the difficulty of communicating with a submarine . . . General Thorneycroft's scenario, which he put before you the other day, is a possibility, that is decapitation with aircraft. You must also take into consideration the fact that the American ICBMs are more than slightly vulnerable. From our own experience, we know that you can come across fleet-wide problems, whether it is an aircraft fleet or a shipping fleet. Right now we have B-52s which are quite old. I have no idea — and I am sure we will never find out — how many times they have had fleet failures or fleet groundings.

The Americans went through this exercise of a minimum deterrent. They then had to consider what would happen if they used part of their deterrent, and they were left with no riposte. Here is where we run up against a situation where prudence has to be our guide.¹⁰

Reducing existing strategic forces in pursuit of a minimum deterrence might be more easily justified if the United States, the USSR, and other countries succeeded in negotiating a far-reaching programme of arms control and disarmament including effective, massive reductions of strategic weapons and limitations on new military technology. There is little sign of this at present. East-West relations and the prospects for arms control and disarmament have deteriorated in recent years instead of improving. Consequently, there seems to be no real alternative to maintaining some degree of diversity in the deterrent forces — even though it is vital to recognize the urgency of arms control and disarmament and the need to promote these through far-reaching, balanced, and verifiable agreements.

⁸ *Newsweek*, "The War Beneath the Seas", 8 February 1982, pp. 36-7.

⁹ *Proceedings of the Special Committee of the Senate on National Defence*, 22 February 1984, p. 2:26.

¹⁰ *Ibid*, 3 April 1984, p. 7:16.

2. The Transition and Continental Air Defence

Early Warning

The ultimate purpose of early warning is to ensure the survivability of the deterrent forces on this continent by convincing the Soviet leaders that there is nothing to be gained from launching strategic bombers and missiles because most of their targets could not be destroyed on the ground. An adequate detection capability is essential to deter the bomber threat posed by hostile, long-range aircraft armed with nuclear bombs or nuclear-tipped air-to-ground or cruise missiles, and to ensure that the U.S. authorities will always have enough time, in an emergency, to order their own strategic bombers into the safety of the airspace and to decide whether to launch their inter-continental missiles. If the transitional systems are deployed, these tasks will constitute their foremost responsibilities.

The transitional systems will not only replace old equipment with modern devices, but will also eliminate many of the present deficiencies and make early warning against bombers as effective as it now is against ICBMs and SLBMs. The North Warning System will provide all-altitude coverage of the northern bomber approaches to North America. The OTH-Bs will do the same on the east and west coasts and maybe, eventually, in the south as well. Coastal radars will extend a continuous line of detection around the perimeter of the continent, and supplementary systems may fill in the OTH-Bs' blind spots. New interceptors equipped with better airborne radars will enhance detection and tracking capability behind the perimeter, and AWACS could provide some coverage, on a random basis or in crisis or wartime periods, for the interior of the continent. The Canadian contribution to identification and tracking in the interior will be diminished when the CADIN-Pinetree Line is phased out, but this system will be less essential to continental air defence purposes once a continuous peripheral system is established around North America. Some interior coverage will be provided by the JSS along the northern border of the United States as well as by the AWACS. Above all, the transitional arrangements should close off an option now available to the Soviet Union — to fly bombers largely undetected into the heart of North America and launch an attack, virtually without warning, against command and control or communication centres.

The transitional arrangements should remain effective throughout the next decade, as well as the present one, despite the deployment of more Backfire bombers, the Bear-H, the Blackjack, and long-range cruise missiles. With a continuous peripheral radar coverage around North America, attacking Soviet bombers would have to launch their cruise missiles from the Arctic or beyond OTH-B coverage out from the coasts if they wished to avoid detection. The passage of these missiles through the radar screens would also provide early warning of an attack. Accurate as cruise missiles might be, they are subsonic and would need several hours to reach North Dakota, for example, from the Canadian Arctic. As a result, the U.S. land-based deterrent would in fact be less vulnerable to an incapacitating first-strike attack.

Late in the transitional period, "stealth" technology may pose new threats. By that time, however, the space-based sensors now being developed by the United States may be coming into operation, to supplement the ground-based aerospace defence system. These sensors may provide some detection capability against Soviet "stealth" bombers.

The coverage provided by the new transitional structure would not be absolute. Some low flying bombers or cruise missiles might still penetrate the radar screens undetected, or assessment capabilities might fail to determine that an incoming aircraft was in fact a hostile one. AWACS operations within the continent are also likely to be random or occasional, owing to the sheer numbers that would be needed for extensive coverage. However, the function of an early warning system is not to provide an absolute guarantee of detecting every aircraft and missile that might enter the continental airspace, but rather to provide a sufficiently high probability of detection and warning to deter or dissuade an adversary from risking such a venture.

Early Warning and Comparative Costs

The transitional arrangements also have to be examined in terms of comparative costs. For example, one objective of early warning is to deny adversary forces the luxury of a free ride in one relatively low-cost strategic deployment option — the bomber. As Professor Cox noted, this was a prime goal of the allies in the 1963-64 period when they reasoned that to “deny access (to targets in North America) was to force the Soviet Union to use ICBMs and to increase the cost of the exercise to the Soviet Union”.¹¹ Such a policy still has some appeal, although its relevance is now questionable, because the USSR is engaged in an extensive programme of weapons development and deployment, apparently motivated by a desire to match or surpass the overall capabilities of the United States. The Soviet Union is deploying new bombers and cruise missiles even though it knows that serious consideration is being given to the upgrading of North American air defences. In fact, given the likelihood that it would develop cruise missiles whatever the cost in order to keep up with the United States in this important area of military technology, its leaders may see some extra advantage in doing so, knowing that such a move is likely to force the United States and Canada to go ahead with the expenditures involved in air defence.

Damage Limitation

The transitional arrangements will improve the damage limitation capabilities of North American air defence forces to some degree. The establishment of continuous, peripheral radar coverage around the continent, the more northerly deployment of interceptor units, and the fact that the CF-18 is equipped with a much better radar and weapons capability than its predecessors would make it possible to intercept some Soviet bombers over northern Canada before they approached strategic targets or population centres within Canada or the United States.

Still, the damage limitation capabilities of the transitional systems should not be exaggerated. The interception of incoming Soviet bombers cannot be guaranteed unless the CF-18s can make contact before those Soviet aircraft have left the southern margin of early warning radar coverage. In fact, their capacity to make contact once a bomber has flown past the peripheral radar coverage into the interior will be diminished with the phasing out of the CADIN-Pinetree Line. Bomber attacks against the United States and southern Canada can still come in over the east and west coasts of the continent as well as from the south, and there

¹¹ *Ibid*, 8 March 1984, p. 3:20.

is little prospect of extending U.S. interceptor coverage significantly to meet such attacks. The F-15 and other new U.S. interceptors are high performance aircraft but their ranges are not significantly greater than those of the interceptors they are replacing; there are no means of deploying them out at sea other than on aircraft carriers, and this would be prohibitively risky and expensive. In addition, cruise missiles constitute an increasing threat and can only be dealt with effectively with present technology by attacking their platforms. This means shooting down bombers over polar waters, or detecting and sinking nuclear submarines before they can launch their missiles.

In the transitional period, the ability to provide damage-limitation against bombers and cruise missiles will above all be constrained by sheer numbers. If one considers a major attack taking place at some point in the next few years, where the Soviet Union threw all its strategic bombers into action, the strike waves could conceivably include about 100 older Bear and Bison aircraft, perhaps 50 additional Bear-Hs, up to 100 Blackjacks, and most of the 250 Backfires not assigned an anti-shipping role — a total, at least theoretically, of about 500 aircraft. Many of these will soon be equipped with cruise missiles, meaning there could be a total in excess of 5000 nuclear warheads and missiles in a major attack. The fighter resources likely to be available to NORAD during the 1985-2000 period would be unable to cope with such an assault. Canada will have only two air defence squadrons and the U.S. about twenty, for a total of about 300 aircraft dedicated to NORAD. Even in an emergency, it is unlikely that all other U.S. and Canadian fighter squadrons with secondary, tertiary, or even lower-priority commitments to NORAD would be available. The same applies to the AWACS, none of which is currently dedicated to NORAD even though some are needed to round out the transitional arrangements.

Peacetime Surveillance and Identification

The great advantage of the transitional arrangements from the point of view of peacetime surveillance and identification is that the new radars and related systems will enable Canada and the United States to detect the vast majority of incoming military aircraft and civil airliner flights as they enter North American airspace. The gaps in coverage signalled elsewhere in this report will be closed, though the capacity to track non-compliant aircraft once they have passed through the peripheral screens will be limited.

One of the main tasks of NORAD forces in peacetime is to respond to flights in proximity to North American airspace by Soviet long-range bombers, which probe and test the continent's early warning defences as they fly across the Arctic or down the Pacific coast, or along the Atlantic coast en route to Cuba, for example. Canada and the United States should be able to demonstrate a high level of ability to detect and intercept these Soviet flights because otherwise the Soviet leaders might conclude that NORAD's early-warning capabilities are weak and that an attack on U.S. land-based strategic deterrent forces could succeed. The peripheral systems will strengthen such NORAD capabilities and thus serve to enhance international stability. Canada's own contribution will be increased because of the improved radar coverage of the approaches to this country and of the fact that the intercepts over Canadian territory will be made by Air Command's modern CF-18s.

Missile Warning and Space Tracking

NORAD's missile warning and space tracking facilities will be strengthened by some updating during the transitional period, although Canada's contribution to this task will decline with the phasing out of the last Baker-Nunn camera at St. Margaret's, New Brunswick. Throughout the transition period, North America will continue to receive the earliest possible warning of an ICBM attack (about 30 minutes) or an SLBM attack (about 12-15 minutes). Soviet missiles will no doubt become even more accurate than they are now, but it is unlikely that available warning time will be significantly reduced. SLCMs will pose a new threat but, in terms of warning time, an adequate response may be in hand, given the plans for deployment of new radars including the OTH-Bs. AWACS will probably also provide some capability in this respect. The Soviets must be convinced that the U.S. leadership will have adequate warning time to decide on appropriate responses to all forms of missile attack.

3. The Canadian Dimension

Protection and Defence of Canadian Territory and Population Centres

The transitional arrangements will obviously have an impact on the protection and defence of Canada's own territory and population centres. From this perspective, the greatest benefit is to be found in one simple equation. Once the installation of peripheral defences has been completed, it will be pointless for the Soviet Union to attack U.S. strategic sites because — as discussed earlier — the warning time provided will be sufficient for the United States to fly off its bombers or launch its inter-continental missiles before they are destroyed. But if there is no point in the Soviet Union's attacking U.S. deterrent forces, there will be little point in it attacking North America at all. The possibility of a Soviet bomber or air-launched cruise missile attack on Canada's territory and people will thus be minimized.

This situation is illustrated in Figure 7, which shows the gain in warning time under the transitional arrangements. At present, hostile bombers could fly undetected into the heart of North America and attack U.S. deterrent forces with virtually no warning. Once the new systems are established, detection will take place at the periphery, providing several hours of warning time.

Of course, there are important air defence bases and other military installations in Canada that the Soviet Union might try to destroy if an actual war broke out. It would not likely attempt this in peacetime or during a crisis period preceding war, however, because doing so would warn of a major attack and enable the U.S. to launch most of its strategic retaliatory forces.

One scenario that has sometimes been mentioned is the possibility that the Soviet Union might, in a crisis period or during an early stage of hostilities, launch a limited nuclear attack against a Canadian city in order to make an example of it, thereby giving a final warning to the United States. Professors Cox and Ross have referred to this concept on various occasions. Dr. Lindsey, Director of the Operational Research and Analysis Establishment, Department of National Defence, noted in a different context the distinction that the Soviet Union draws between its own homeland and the territories of the other Warsaw Pact states: "I

FIGURE 7: The Proposed Arrangements: Increase in Protection of Canadian Territory and Population Against the Air-Breathing Threat



- △ ICBM fields
- Major SAC bases
- ⊕ Major Trident bases
- Selected Places
- Possible undetected bomber runs under transitional arrangements
- --- Possible undetected bomber runs under existing conditions
- Net gain in warning time under transitional arrangements

Note: This map is based on the information presented to the Committee during its inquiry. It is included for illustrative purposes only and does not purport to depict accurately the possible trajectory of Soviet bombers and/or cruise missiles or the location of major targets.

Sources: *Directed Energy Missile Defense in Space*, Congress of the United States, Office of Technology Assessment, April 1984 (ICBM fields).
Air Force Magazine, May 1984 (SAC bases).

think they would be far less concerned about attacks against their own allies than they would about an attack against Russia," he argued. "They perhaps feel that the United States shares this view."¹² Even if this is so, the whole point of a Soviet final notice assault upon a Canadian city would be to give a clear and open warning to the United States and not to carry out a surprise attack. The Soviet Union could use all the strategic forces it needed to make sure that the attack succeeded — whether the transitional systems were in place or not. The crucial point, therefore, regarding this scenario is its plausibility, something which is not likely to be enhanced or diminished by any changes that may be made under the transitional arrangements.

National Sovereignty Protection in Peacetime

In its planning for the transitional arrangements, the Canadian government has to take into account not only the requirements of continental and Canadian air defence, but also the commitment to provide adequate protection of national sovereignty in peacetime. It must recognize the continuing need to maintain surveillance and control of Canadian airspace over the national territory and its surrounding waters.

Sovereignty protection was a prime commitment specified in the 1971 white paper, and must be a goal for any self-respecting country. It certainly played an important part in Canadian thinking about North American air defence in the 1970s and early 1980s and led to a reconfiguration of NORAD operational boundaries in 1983 so as to bring them in line with the Canada-United States border. Canadian region operations control centres were established in North Bay in the same period to provide a means of directing the Canadian effort to maintain surveillance and control within the national airspace.

Sovereignty is not an absolute. It arouses strong emotions but it is hard to define, and the resources committed to its maintenance have never been intended to provide total coverage of all air operations over Canada. The 1971 white paper specified that Canadian air forces assigned to North American air defence would be used for sovereignty protection, but these were limited in number, consisting of only four squadrons and 66 aircraft spread across the country. The coverage provided by related radar and communications systems is far from complete: the CADIN-Pinetree Line does not always detect aircraft flying at low or very high altitudes; the DEW Line can be penetrated by low-flying aircraft; and there are gaps along the west coast and the Davis Strait-Labrador coast that would allow intruders to fly undetected into the heartland of Canada. The only interceptors in a position to respond to flights by non-compliant aircraft over large parts of central Canada are those of the United States Air Force. The same situation will apply in western Canada until Cold Lake assumes an alert posture.

Sovereignty Protection and Northward Interceptor Deployment

The problem of sovereignty protection has been thrown into high relief by one possible component of the transitional air defence structure: the proposal to deploy Canadian interceptors north, with their main bases in Bagotville and Cold

¹² *Ibid*, 22 February 1984, p. 2:33.

Lake and their forward operational fields in British Columbia, Labrador and across northern Canada. This would enable them to provide a better response to possible Soviet incursions, but it would still leave a gap in southern Canada where there would be no Canadian interceptors on alert to conduct national interception and identification operations. The problem will be accentuated if and when the CADIN-Pinetree Line is phased out and if interceptors no longer operate out of the Chatham base.

Some level of control over airspace in the south could be provided by including a southern Canada identification function in the roles of the CF-18s based in Bagotville and Cold Lake.

Another option would be to let the United States Air Force carry out the task of surveillance over southern Canada on the premise that most incursions into our airspace will be detected at the periphery or else be sufficiently unimportant as to give little cause for concern. This assumes that virtually the only challenge to Canadian sovereignty in peacetime is the one posed by Soviet probes on long-range flights across the Pacific or the Arctic, or to Cuba, and that Canada has no need to use its own interceptors to control civil aircraft that have failed to file flight plans, light planes flying drugs or contraband into the country, or other aircraft engaged in unauthorized or illegal activity.

Failure to recognize and respond to this situation would inevitably rekindle fears that by participating in NORAD, Canada is subordinating itself to the United States. Professor Cox suggested during the hearings that there are some particular Canadian national interests to take into account when attempting to manage the Canadian-American relationship as it applies to continental defence¹³ — presumably presumably referring to the need to preserve this country's own identity and promote its economic and other development; — and it seems clear that there could be serious political dangers in brushing these aside in an effort to provide the most streamlined, effective defence against the Soviet bomber threat. On this point, Lieutenant General Manson, Commander of Air Command, after noting the difficulty of articulating the possible threats to Canada's airspace sovereignty in peacetime, stated:

I instinctively, as I think most Canadians do, have a feeling that unless we have the capability of controlling our airspace — that is, of knowing of the presence of an intruder and being able to intercept and identify that intruder to enforce our sovereignty in airspace — there is something lacking in the composition of the Canadian nation. It is a difficult question (and one that calls, not for) a military expression of the need but essentially a political one.¹⁴

Suggestions that the surveillance and control of Canadian airspace in peacetime should be conducted as far as possible by Canadian interceptors do not imply, however, that U.S. aircraft should be denied access except in crisis situations or wartime. Training missions and exercises would continue as at present in conjunction with Canadian forces, and there might conceivably be some joint operations in peacetime to counter Soviet probing if this were to grow in

¹³ *Ibid*, 8 March 1984, p. 3:18.

¹⁴ *Ibid*, 17 April 1984, p. 9:8.

intensity. NORAD provides Canada with a means of legitimizing the American presence, as Professor Cox remarked on another occasion,¹⁵ and this presence must be continued in some form if the two countries are to maintain an effective joint arrangement for the air defence of the continent.

One obvious question about peacetime sovereignty protection is: what does the United States do about its own airspace? On this point General Manson noted that the U.S. Joint Surveillance System

is a very comprehensive military/civil radar chain around the interior periphery of the United States. I believe their motivation in putting that in place relates precisely to the point that we have just been talking about; that is, that no nation can really declare that it has full control and full jurisdiction over its own airspace unless it has the capability of controlling and identifying air traffic within that zone. The Americans, I know, feel very strongly about this, and they dedicate a lot of money and resources to the JSS system. I think it must be looked upon . . . as an airspace control system, a sovereignty system, as opposed to a system that would be useful in increasing the deterrence of NORAD against air threats from within the atmosphere.¹⁶

In peacetime, the United States would not normally involve Canadian aircraft in sovereignty activity over its own territory.

Sovereignty Protection and the CADIN-Pinetree Line

Other problems may arise in the field of national sovereignty protection when the CADIN-Pinetree Line is phased out because there will no longer be a Canadian warning network across the southern part of the country to provide data for the region operations control centres. The Ministry of Transport is building a new radar system as part of the Radar Modernization Project (RAMP), but this is intended for control of compliant air traffic, not the identification and tracking of unauthorized, unnotified flights. Canada will need to rely on the U.S. JSS system along the northern border of the United States for information about unauthorized flights from the United States into Canada, and on OTH-B radars and gap-filler systems in the United States for information on unauthorized flights into some parts of Canada's coastal areas. Arrangements with the United States will have to be made to ensure that such data is transferred continually to the ROCCs in North Bay, and to develop any additional communications systems that may be necessary for this purpose. Even so, when the CADIN-Pinetree Line is phased out there will be very few ground-based military radars — Canadian or American — to track the flight paths of air traffic over Canada once aircraft have passed the peripheral systems and entered Canadian interior airspace. If an airliner or other aircraft deviates from its notified or expected route once it has passed the peripheral radar screen, only its own notification of changes, or possible detection by AWACS, would keep the Canadian authorities informed of developments.

General Manson commented on this problem in his testimony before the committee:

¹⁵ *NORAD*, op. cit., p. 29:18.

¹⁶ *Proceedings of the Special Committee of the Senate on National Defence*, 17 April 1984, p. 9:19.

The Department of Transport radar system is a system that has been established for the control of compliant air traffic, and by "compliant" I mean, of course, those aircraft which file flight plans and which have certain electronic equipment which allows them to be identified by radar on the ground. The air traffic control system is not designed as an air defence system. By and large, therefore, it would not be of great value to the air defence system. If it were deemed necessary in the future, for want of an internal radar system once the... Pinetree Line radar chain became obsolete and was withdrawn, it would be possible to charge the Department of Transport with the responsibility of filing unknown track information into the air defence system. There are some fairly substantial technical problems involved in that. The fact of the matter is, the Transport radar system does not provide full coverage of a large part of Canada. So we would not be much further ahead than we are today.¹⁷

Adjusting to U.S. programmes and activities

Canada's capacity to control its own airspace in peacetime would be affected even more fundamentally should the United States decide to go ahead with the transitional arrangements and space-based surveillance and this country not cooperate in some form. For example, if Canada were to allow the United States to build the North Warning System without itself contributing, then this country might lose the flow of data on civil flights across the North now provided by the DEW Line. If radars are not built along the Labrador coast, they are likely to be built across Greenland, and the United States will thus be aware of flights coming in from the northeast while Canada will not. Furthermore, if Canada does not seek a role at an early stage in defensive space surveillance of the continent — either by developing a national military space surveillance programme within the framework of the NORAD association or by participating in U.S. space programmes — then the United States may decide to do entirely without Canadian cooperation in North American aerospace defence, thus developing a high degree of knowledge about air activity over Canadian territory that will not necessarily be made available to the Canadian authorities.

For Canada, a serious consequence of not participating actively in the upgrading of North American aerospace defences might be the development of a Soviet-American process of probing and responding in which Canada played no part. At present, the Soviet Long-Range Air Force continually probes North American early warning defences during long-range flights such as those to Cuba. It could increase this activity as the strength of its inter-continental bomber force grows. The United States must respond to these probes in order to demonstrate the effectiveness of its early warning systems and is likely to do so over Canadian territory — at least in the Arctic and along the coasts — if Canada does not carry out this task itself. Thus, there could be a great deal of air activity in parts of Canada's national airspace in peacetime that Canada would know little about, would not participate in, and would not have sanctioned. In such a case, Canada's sovereignty over its Arctic and frontier coastal zones would be placed in jeopardy.

National Development

A major advantage of upgrading Canadian defences in the North is that national development programmes in the area will benefit. The transitional

¹⁷ *Ibid*, p. 9:8-9.

arrangements will help to further open up that region, increasing Canada's national presence there and strengthening the infrastructure and support services for a range of government activities. Additionally, if a year-round Arctic base was established in conjunction with the transitional arrangements, this could enhance Canada's capacity to assert its sovereignty in the North, as suggested in the committee's report on Canada's maritime defence. Recommendation 30 of that document called on the government to "examine the need for a year-round Arctic base to provide support for air, land and sea operations of all departments with responsibilities in the North."

Political Implications

In addition, there is a wider political dimension to efforts to protect Canada's sovereignty in peacetime. Professor Cox suggested that

what is important to Canadians is not what we think the Russians will do; it is what we think the Americans think the Russians will do, . . . and while, in the ultimate sense, there is an air of unreality to (attack scenarios), there is an intermediate stage which is very real indeed and which poses some quite intractable problems to Canadians. Let me illustrate: How comfortable are you with an enlarged military presence in Canada, with American bases for AWACS aircraft, with American dispersal bases for F-15 fighters? How comfortable would you be to see that military presence growing, ever so slightly, year by year in areas of the country where we have very little presence, namely in the North? How comfortable would you be if the Americans said to us, "you are doing little or nothing and we really cannot afford to negotiate with you any longer regarding overflight for AWACS. We are simply going to do it?"¹⁸

Canada has to walk a fine line in its policies on North American air defence, balancing its own national requirements with the need to respond to the Soviet threat and the imperatives of its relationship with its neighbour. As Professor Cox remarked, one requirement of an effective pursuit of national sovereignty is that Canada should not act "in such a manner as to invite . . . an unsympathetic policy on the part of the United States".¹⁹

¹⁸ *Ibid*, 8 March 1984, p. 3:33.

¹⁹ *Ibid*, p. 3:34.

THE TRANSITIONAL ARRANGEMENTS: LINKAGES AND IMPLICATIONS

1. Linkages and Early Decisions About Space

A major advantage of the transitional arrangements from Canada's point of view is that participating in them would enable this country to maintain its defence partnership with the United States in the period leading up to the space age. In this way, Canada could use the early part of the transition to make essential decisions about its own military space policies. This would also strengthen Canada's hand when negotiating with the United States over any cooperative, joint, or other arrangements concerning space that this country might wish to establish with its neighbour.

Current Concerns

Space-based systems already account for a major proportion of NATO and NORAD communications, navigation, weather forecasting, intelligence, and early warning networks. They are expected to acquire even greater importance in the transition years and beyond, as surveillance, anti-satellite, ballistic missile defence, and other systems are perfected or deployed.

Many experts agree that space-based bomber and cruise missile detection sensors will become operational, on an experimental basis at least, in the 1990s. The majority, however, caution against trying to rely on present bomber warning systems until then in the hope that NORAD could save itself the trouble and the cost of a transition. Their view is that such space-based bomber sensors as may become operational in the 1990s or even possibly the early 2000s, will be first generation systems, requiring the backup of a complete network of ground-based and airborne radars and related systems. They will depend on them for final testing and improvement of their own capabilities.

By the same token, decisions about the location and procurement of transitional systems must take account of the imminence of the space age. All aircraft acquired in the transition period and all installations established during that time should be compatible with the new space-based systems in terms of communications, computers, and other elements. As Major General (retired) LaFrance, former Head of Policy, Plans and Programmes, NORAD, remarked during the hearings,

the replacement of the current systems, for example the CADIN-Pinetree, and the selection of the number of fighters, has to be made not only in terms of immediate needs but also in respect of what the eventual capability will be.¹

The space-based sensors themselves have obvious attractions for Canada, one example being the ability to provide warning of a bomber raid from the moment aircraft take off from their bases rather than when these aircraft enter zones of ground-based radar coverage. However, some other aspects of space activity raise difficult questions for Canada rather than presenting easy options.

One major problem is that it is becoming increasingly difficult to draw the line between offensive and defensive capabilities and active and passive systems in the space area. A noticeable change is taking place — away from a focus on passive surveillance and communications activities — and this is creating new ambiguities. For example, in the annual reports of the U.S. Secretary of Defense to Congress, various satellite systems — such as AFSATCOM, FLEETSATCOM, the Defense Satellite Communication System, and MILSTAR — are described not only in terms of their ability to contribute to deterrence and retaliation, but also in terms of their capacity to provide survivable relay links and other facilities for relatively prolonged operations.

Whatever the place of satellites in U.S. strategy, there is no doubt that space systems can be used for offensive as well as defensive purposes depending on the circumstances. The result is an ambiguous situation that creates problems for policy makers. As Daniel Deudney noted in a recent article in *Foreign Policy*:

Paradoxically, satellite information systems that helped to stabilize the superpower arms race in the 1960s are now accelerating the drift toward nuclear war fighting by bolstering defense planners' faith in the prospect of accuracy in targeting and in the unjustified belief that nuclear wars can be limited and controlled.

Information satellites used to communicate, navigate, collect geodetic data, and find targets are force multipliers: They make existing weapons more deadly. These technologies have cumulatively undercut, if not altogether negated, the security accomplishments of the SALT process.²

As well, distinctions between military and civilian systems tend to become almost meaningless in the space field. Daniel Deudney has remarked that:

the line between civilian and military space technology is exceedingly fine, if not altogether artificial. The civilian space programs of the 1960s evolved from the military advances of the 1950s. A military missile differs from a civilian rocket in payload and target, not basic technology. When asked to explain the difference between the Atlas rocket that sent astronaut John Glenn into orbit and those poised to obliterate the Soviet Union, President John Kennedy reportedly replied, "attitude". Communications, remote sensing, and navigation and weather satellites pioneered by the military also possess this dual character.³

¹ *Proceedings of the Special Committee of the Senate on National Defence*, 28 March 1984, p. 6:24.

² Daniel Deudney, "Unlocking Space", *Foreign Policy*, No. 53, Winter 1983/84, pp. 95-6 (ISSN 0015-7228).

³ *Ibid.*, p. 92.

U.S. Space Development and Canada

These are problems that are already rooted in current space technology, and Canada is already confronted by them. Canadian "officers . . . are in key positions in the . . . NAVSTAR project office"⁴, and Canada is developing "user terminals for application to patrol aircraft and ships"⁵. NAVSTAR is a system that allows Western forces to determine their own positions with a 10-metre accuracy.⁶ Recently, some commentators have also suggested that this system enhances the accuracy of submarine-launched ballistic missiles to the point where they cease to be strictly second-strike weapons. Canada could become even more directly involved in U.S. strategic space activities in the future if NORAD's plans opened up the possibility that, in crisis periods for example, some of the air defence F-15s that the U.S. is equipping for anti-satellite operations might be dispersed to this country. Canada's participation in the U.S. space shuttle programme is already well known.

In the coming period, the pace and costs of U.S. space programmes are likely to be little short of staggering, especially when President Reagan's space-based ballistic missile defences are considered. Development work could rise to \$100 billion and then beyond before the turn of the century and, given the potential for indirect as well as direct discoveries and applications, enormous industrial benefits could be derived. The damage to Canadian industry could be irreparable if Canada did not have access to American data, technologies, and markets in that field, or if Canada was only marginally involved. As it is, DND and other government agencies are "concerned that we may be left behind in the applications of space technology to defence",⁷ even though the Defence Production Sharing Arrangement should give us a clear advantage.

Current involvement and the prospect of industrial benefits do not necessarily imply, however, that Canada should aim at becoming a junior partner in the U.S. space programme. This would probably not be supported by the Canadian government and public, who have traditionally preferred arrangements that did not involve Canada in U.S. central strategic systems. Policies entailing the deployment of space weapons would also be in conflict with the overall tenor of Canadian arms control and disarmament policies to date, which have actively sought to promote agreements banning the development or deployment of space-based weapons and, if possible, ground-based weapons intended for use in outer space.

A National Military Space Programme for Canada

An alternative would be for Canada to develop its own military space programme, dedicated to those warning, surveillance, and communications

⁴ J.-J. Blais, Minister of National Defence in a speech at McGill University, 16 March 1984, p. 14.

⁵ *Proceedings of the Special Committee of the Senate on National Defence*, 14 March 1984, p. 4:27.

⁶ Blais, *op. cit.*, p. 14.

⁷ *Proceedings of the Special Committee of the Senate on National Defence*, 14 March 1984, p. 4:24.

functions necessary to national security and at the same time beneficial to the maintenance of a stable deterrence. This can be done within the terms of the NORAD agreement and by cooperating with the United States through exchange of data, organizational arrangements, and some joint ventures. As General LaFrance remarked,

We, in Canada, should be thinking about national involvement in space which could be co-ordinated with (the US) Space Command, but could also be different and under national jurisdiction while providing information to NORAD and using NORAD information from space systems.⁸

In this way, Canada could control the use of its own satellites and make sure that they remained dedicated to passive detection and surveillance needs. Canadian military satellites over the North could also provide Canadian civil authorities with much useful information about activities in the Arctic and frontier regions. They could, for example, help monitor many forms of air, land, and sea movements across the North, keep track of oil spills and other dangers to the environment, or document the impact of development. They could improve communications with remote settlements and facilitate search and rescue operations, while at the same time enabling Canadian industry to aim at the forefront of world technological development in the space field. The number of satellites required for a viable system might consist of four to six air surveillance satellites, one or two maritime surveillance satellites, and three to four communications satellites, stationed most of the time over Canadian territory or areas relevant to Canadian military and diplomatic communications. The committee has received information indicating that development and deployment of such a large scale national programme might cost up to about \$150 million per annum in the next five years and \$350 million per annum in the following decade. This is certainly not beyond Canada's means.

It is evident that the scope and content of a Canadian military space programme are in need of further analysis. However, it is vital that decisions on this question be taken in the near future, so that effective plans can be made for the space age and the necessary funds can be invested in research and development (R&D). Canada needs to decide soon how it wishes to relate to the United States in the space area. Mr. C.R. Nixon remarked during the hearings: "The way we have tended to relate to the Americans is on specific things. I think we should be looking for some type of umbrella approach."⁹ This seems essential if Canada is to capitalize on the considerable level of expertise already developed in the space field by this country's industry and to take advantage of the technological, defence, and other possibilities offered by the space age. If such an overall approach is not clearly defined, Canada may soon be faced with no options other than to play a junior role in U.S. programmes or to drop out of the space field entirely. The former would provide no system or leverage for dealing with the United States and would likely lead to piecemeal involvement and unsatisfactory industrial results, as described by representatives of the Aerospace Industries Association of Canada (or AIAC. See the next section). The latter would simply freeze Canada out of one of the most vital areas of modern industrial development.

⁸ *Ibid*, 28 March 1984, p. 6:25.

⁹ *Ibid*, 3 April 1984, p. 7:14.

Canadian-American Relations in the Space Field

Decisions about Canadian-American relations in the space field will not be made by Canada alone. The United States will no doubt have a great deal to say and much leverage to apply. That country has established a distinct, national Space Command for its military space programmes and may wish to ensure that in the future all decision-making powers about its own projects and deployments remain firmly in its own hands. The U.S. government might be only too pleased to see Canada develop its own national, military space programme under a cooperative arrangement with NORAD and Space Command, or, failing this, to see Canada concentrate on ground-based systems, leaving space almost entirely to the United States. The latter would certainly not be at all satisfactory from the Canadian point of view. Whatever the American preference, Canada should make some urgent decisions about military space questions in the very near future so as to arrive at mutually satisfactory arrangements with the United States before NORAD loses entirely its rapidly declining jurisdiction over space matters to the new U.S. Space Command. Eventually, the United States may have little need of Canadian territory to obtain early warning and so could largely ignore Canadian preferences if it wished. All this also militates in favour of renewing NORAD in 1986 until the end of the century, that is to say for fifteen rather than the usual five years.

2. Costs and Benefits of the Transitional Arrangements

Total Cost of the Transitional Arrangements for Canada and the United States

The Wall Street Journal stated on March 28, 1984 that the United States Air Force has launched a U.S. \$7.5 billion plan to buy powerful new radar stations and to replace aging interceptor aircraft.¹⁰ As other parts of this report indicate, it is not yet certain that the United States and Canada will go ahead with the whole of this programme, but if they do, then the costs are likely to approximate the above figure, or \$10 billion (Canadian). The AWACS programme in particular seems to be in difficulty, but, as no final decisions have been taken on it either in Washington or in the negotiations, it must be included in the total cost estimates at the present time.

The Basic Approach to Dividing the Costs

Canada's share of the total is still a subject for negotiation and is impossible to predict at the present time. It is not likely to be calculated on the basis of a certain proportion of the total cost but rather in relation to specific elements such as the North Warning System and the AWACS. Some parts of the upgrading would be carried out by the United States alone, others would be a Canadian responsibility, and only the remaining components would be constructed jointly. Also, there are some programmes relating to North American air defence that are not covered in the U.S. \$7.5 billion or \$10 billion (Canadian) figure at all. These include Canada's present CF-18 programme and the U.S. Space Command's operations and programmes, which each country has funded separately even though they are related in part to continental air defence.

¹⁰ *The Wall Street Journal*, "Unfriendly Skies", 28 March 1984, pp. 1 and 29.

Apportioning Costs

Generally speaking, the United States seems inclined at present to proceed unaided with the components of North American air defence that do not involve Canada directly, while expecting Canada to play a part in those located on its own territory. Thus, the situation would appear to be as follows:

- (a) The United States has given indications that it will go ahead alone with plans to re-equip its own interceptor forces, build the OTH-B radars, and install backup systems to be located on U.S. territory. The United States also seems inclined to assume most of the responsibility for upgrading NORAD's space tracking and missile launch detection systems, since these systems are almost wholly American operated and controlled.
- (b) Canada would pay for the additional CF-18s needed to round out its air defence forces.
- (c) Canada would expect to pay a share in AWACS if this programme goes ahead.
- (d) The remaining components of the transitional structure would also come under cost-sharing arrangements, and would include the NWS, new or modernized coastal radars, new or upgraded airfields in Northern Canada, and additional communications, command and control, and support facilities.
- (e) Canada will have to decide whether it wishes to set up its own military space programme or seek a role in the U.S. space effort.

A Benchmark for Negotiations

Canada has traditionally paid about 10 percent of joint North American air defence costs under NORAD, and this figure — roughly in proportion to the two countries' populations and economies — will doubtless continue to provide a benchmark for the current negotiations (even though such costs, as already indicated, do not cover all expenditures related to North American aerospace defence).

Estimated Costs of Joint Items

Current estimates suggest that the NWS may cost about \$1.2 billion,¹¹ (Canadian), including upgrading in Greenland or along the Labrador Coast. There are no public estimates of the cost of coastal radar coverage, but it seems likely that \$150 million would be sufficient to provide the necessary new or modernized radars along Canada's east and west coasts. Upgrading of northern airfields could cost up to \$300 million; new and upgraded communications, command and control, and support facilities might cost a further \$300 million.

AWACS

If Canada and the United States proceed with an AWACS programme for NORAD, then the total cost, which the committee learned was estimated at U.S. \$2.2 billion in May 1983, could easily rise to something like U.S. \$2.4 billion, or approximately \$3 billion Canadian. At least one AWACS would normally have to be available for operations in Canada at all times. This could be achieved through

¹¹ Unless otherwise indicated, all cost figures in this report are given in Canadian dollars.

Canada's purchase of a one-third share in three AWACS — rather than one whole AWACS — to allow for maintenance and stand-down. These three AWACS would be designated as NORAD aircraft and painted with the NORAD insignia and colours, since they would be jointly owned and would operate exclusively in the NORAD area. The cost of these three one-third shares would be the equivalent of one AWACS aircraft, or approximately \$200 million, which would constitute about 6.7 percent of the total cost of NORAD's AWACS programme.

Additional CF-18s

Whatever the outcome of the negotiations on the joint items, Canada would pay the total cost of buying additional CF-18s. Unless present commitments to the First Canadian Air Group (1CAG) in Germany or to the Canadian Air Sea Transportable (CAST) force are reduced or eliminated, thus allowing Canada's interceptors to concentrate on North American air defence, additional CF-18s will be needed to compensate for expected attrition and to round out the present force. The current contract contains an option, which expires on April 1, 1985, to acquire up to 20 aircraft of the same model, in batches of five, at the then current price. This would allow Canada to avoid the problems associated with operating different models of the same aircraft. The committee believes that this option should be exercised fully. The cost for 20 aircraft would probably amount to about \$660 million.

The Canadian Share of the Capital Costs

The Canadian share of the capital costs of the transitional arrangements might lie somewhere within the following range:

TABLE 2: Capital costs to Canada
(in millions 1984 Canadian dollars)

| | Options* | | | | |
|--|-----------|--------------|--------------|--------------|--------------|
| | A | B | C | D | E |
| a) Canadian share of joint items | 0% | 10% | 25% | 50% | 100% |
| North Warning Systems | — | 120 | 300 | 600 | 1,200 |
| Coastal radars | — | 15 | 37 | 75 | 150 |
| Upgrading northern airfields | — | 30 | 75 | 150 | 300 |
| Upgrading communications, command and control, and support systems | — | 30 | 75 | 150 | 300 |
| Sub-total for joint items | — | 195 | 487 | 975 | 1,950 |
| b) Other costs to Canada | | | | | |
| Canadian share of AWACS | — | 200 | 200 | 200 | 200 |
| Additional CF-18s | — | 660 | 660 | 660 | 660 |
| Sub-total | — | 860 | 860 | 860 | 860 |
| c) Full capital costs to Canada | — | 1,055 | 1,347 | 1,835 | 2,810 |

* The designation "Option" is used subsequently to describe the case where Canada would provide 0% (Option A), 10% (Option B), and so on, of joint costs.

The objective here is to show the dimensions of the issue, not to try to predict outcomes. The eventual result could well be some mixed package not represented on the chart, where Canada would pay a greater share for one component and less for another. Option A would result only if the negotiations collapsed, either due to the United States losing interest or to Canada leaving the upgrading of North American air defence entirely to the Americans. Option E represents the other end of the scale — a decision by Canada to go ahead on its own with upgrading all the parts of the transitional arrangements located on Canadian territory, either because negotiations had collapsed or because the United States wished to concentrate on other areas such as space. Truly joint arrangements for upgrading are represented by Options B, C, and D.

Timing and Annual Capital Costs

Whatever the results of the current negotiations, the transitional arrangements will have to be in place in time to bridge the gap between the growing obsolescence of present systems and the advent of the space age. Otherwise, Canada would be left without effective warning and surveillance capabilities for a lengthy period. Capital expenditures will in fact have to be condensed into something like a five-year period, say between 1985 and 1989. Annual capital costs would thus amount to zero for Option A, \$211 million in the case of Option B, \$269 million in the case of Option C, \$367 million for Option D, and \$562 million for Option E.

Space Costs

Canada will also have to make some investment in military space activities in the coming period if this country wishes to participate in U.S. space programmes or develop a space capability of its own. The costs of so doing are not known with any precision, but some estimates mentioned earlier indicate that a major national programme for Canada might cost an average of \$150 million per year for the next five years and up to \$350 million per year throughout the 1990s.

Some Changes in PO&M Costs

Phasing out the Pinetree Line is likely to save most of the approximately \$200 million per year that Canada will otherwise have to spend on maintaining and operating this system in the coming years. However, some of the Pinetree coastal radars are likely to be kept and upgraded — incurring some costs and maintaining a limited amount of civilian employment. Canada will also face the costs associated with operating the new systems that will be built during the general upgrade. The net result might be that the Personnel, Operations and Maintenance (PO&M) costs would be reduced in the order of \$100 million per annum.

Cost Increases: A Summary

The possible increased costs for the next fifteen years in light of the various options discussed above are estimated to be as follows:

TABLE 3: Increased costs for Canada in the transitional period*
(in millions 1984 Canadian dollars)

1. *Net Annual Costs, 1985-89*

| Option | Upgrading of ground-based systems | Net savings, PO&M, after Pinetree | Net yearly cost of transitional arrangements | Space R&D | Total Net Yearly Costs |
|--------|-----------------------------------|-----------------------------------|--|-----------|------------------------|
| B | 211 | (100) | 111 | 150 | 261 |
| C | 269 | (100) | 169 | 150 | 319 |
| D | 367 | (100) | 267 | 150 | 417 |
| E | 562 | (100) | 462 | 150 | 612 |

2. *Schedule of Net Costs*

| | Options | B | C | D | E |
|--------|---------|--------------------------|-----|-----|-----|
| 1985 | | 261 | 319 | 417 | 612 |
| 1986 | | 261 | 319 | 417 | 612 |
| 1987 | | 261 | 319 | 417 | 612 |
| 1988 | | 261 | 319 | 417 | 612 |
| 1989** | | 261 | 319 | 417 | 612 |
| | | All options B – E | | | |
| 1990** | | | 250 | | |
| 1991 | | | 250 | | |
| 1992 | | | 250 | | |
| 1993 | | | 250 | | |
| 1994 | | | 250 | | |
| 1995 | | | 250 | | |
| 1996 | | | 250 | | |
| 1997 | | | 250 | | |
| 1998 | | | 250 | | |
| 1999 | | | 250 | | |

* Option A is not included in the body of this table because it is more complex than the others. Costs would depend on a variety of decisions, for example whether Canada would maintain and rebuild the Pinetree Line if it decided against joint arrangements with the United States, whether Canada would develop its own space programme if it reduced co-operation with the United States on ground systems, and so on.

** 1989 would be the last year of expenditures on new ground-based systems. As of 1990, Canada might spend \$350 million yearly on military space research, development, and deployment. The net saving of \$100 million per annum on PO&M costs would continue, reducing net yearly expenditures to \$250 million.

Impact on Canada's Defence Budget and GNP in 1985

The net capital and PO&M costs of Options B-E in 1985 in relation to Canada's defence budget and gross national product (GNP) would be as follows:

TABLE 4: 1985 Net Increases, Defence Budget, and GNP
(in millions of 1984 Canadian)

| Option | Net Cost of option | Currently estimated 1985 defence budget | Percentage increase in defence budget for option | Estimated GNP for 1985 | 1985 defence budget as % of GNP | 1985 defence budget+ Option as % of GNP | Option as % of GNP |
|--------|--------------------|---|--|------------------------|---------------------------------|---|--------------------|
| B | 261 | 9,500 | 2.75 | 440,000 | 2.16 | 2.22 | .06 |
| C | 319 | 9,500 | 3.36 | 440,000 | 2.16 | 2.23 | .07 |
| D | 417 | 9,500 | 4.39 | 440,000 | 2.16 | 2.25 | .09 |
| E | 612 | 9,500 | 6.44 | 440,000 | 2.16 | 2.30 | .14 |

In sum, the costs of the transitional arrangements would probably amount to less than 6.44 percent of the annual defence budget, or less than .14 percent of GNP. Depending on the results of the current negotiations, they might range somewhere between 2.75 percent and 4.39 percent of the defence budget, or .06 and .09 percent of GNP.

Industrial Benefits

Expenditures on the transitional arrangements and space programmes could yield benefits for Canadian industry. Representatives of the Aerospace Industries Association of Canada and some of its member companies drew attention to this possibility when they appeared before the committee. They made the point that proper arrangements could produce important contracts and would help to keep open the vital American market for Canadian aerospace products. Eighty percent of Canada's present aerospace production is exported, primarily to the United States, and Canada must maintain a place in that market if the Canadian aerospace industry is to continue to grow. Mr. Bishop, Vice-President of the AIAC, also suggested that there is a need to consider world market potential.

The aerospace industry spokesmen argued that there is a need for a national strategy based on defence and industry teamwork. They recommended using the Defence Development Sharing Agreement with the United States "to get Canadian capability more effectively involved in continental defence based programmes".¹² In Mr. Bishop's view, effective national planning has not been evident in recent years. "In fact, there is a hodgepodge of policy; everything is being done in a different way. (My) only comment... is that there is... a tremendous economic benefit in Canada to doing things in Canada and that reasonable premiums should be paid."¹³ Offset agreements, Mr. Bishop remarked, lead to "a situation where there is an absolute minimum involvement by Canadian industry in the procured product and consequently very little technology transferred."¹⁴

¹² *Proceeding of the Special Committee of the Senate on National Defence*, 13 March 1984, p. 4:16.

¹³ *Ibid*, p. 4:17.

¹⁴ *Ibid*, p. 4:13.

There were two particularly revealing exchanges on the question of government-industry cooperation in the aerospace area, one with Mr. Bishop and the other with Dr. Schofield, Chief, Research and Development, Department of National Defence. The first was as follows:

Question: There have been many estimated figures to represent the cost of the modernization of the NORAD systemWhat share do you think Canada should get . . . ?

Bishop: . . . I do not know precisely, at the moment, what they may be . . .

Question: Have you been involved in any discussions regarding what may happen in this area and how the Canadian aerospace industry could fit in? . . .

Bishop: No.¹⁵

The second exchange consisted of the following:

Question: Do Mr. Bishop's remarks suggest that you are . . . not having much communication with the industry? . . .

Schofield: I think communications with industry have improved over the last little whileThe communications had deteriorated over the years. I think we are now on an upswing.¹⁶

Mr. Bishop was also strongly in favour of early Canadian action to obtain a share of the developing U.S. and world markets for space products, both military and civilian.

I think we have to take the bull by the horns in the area of space. There have to be some rather aggressive far-reaching decisions that say there is a market out there for space and we are going to have to invest money in space per se in order to have the baseline technology, and to participate in the programmes of the future. When we have that base technology and we start to negotiate partnerships, such as was done with the Canadarm, then we have the technology to share on those programmes.¹⁷

Dr. Schofield made a similar point in his comments:

The situation, as I perceive it, is that we have to take some risks in order to prepare ourselves to participate in these large American or joint U.S.-Canada activities. If we are not prepared to make these kinds of investments, in my opinion we will never receive our fair share of manufacturing and production. In fact, it has been said to me quite unequivocally by senior people in DoD: "You make more investments in R&D and you will then be able to compete in these areas in production and manufacturing," and they are very firm about this. Therefore I think that we have to take some gambles; we have to take some risks and decide what we think are going to be the critical technologies in the system.¹⁸

¹⁵ *Ibid*, pp. 4:20-1.

¹⁶ *Ibid*, pp. 4:31-2.

¹⁷ *Ibid*, p. 4:22.

¹⁸ *Ibid*, p. 4:29.

3. Defence Budgets and Commitments

If the costs of the transitional arrangements are likely to amount to somewhere between 2.75 and 4.39 per cent of the present defence budget, as suggested above, then the case for upgrading North America's air defences seems a particularly strong one. The expenditures will not be enormous, as some people have contended, but well within this country's capabilities. The risks of making a poor investment appear to be very small, while the result will be to strengthen the defence of Canada in its most immediate sense, that is to say by protecting this country's own territory and people.

Of course these figures have to be seen in conjunction with the costs of other military requirements. In earlier reports, this committee recommended increases in annual expenditures (in 1983 dollars) of \$400 million for manpower, \$80 million for maritime personnel, operations and maintenance, and a 12-year capital programme of \$550 million annually for Maritime Command. The committee has also become aware of reports of unfunded backlogs of defence equipment requirements in the order of \$27 billion.¹⁹

In these circumstances, the committee can easily imagine that the defence budget may have to rise by about \$2 billion-\$2.5 billion per annum (in 1984 dollars) if Canada wishes to aim at fulfilling all of its current defence commitments effectively. This confirms the conclusion it reached in *Canada's Maritime Defence*, when it stated that it was "being drawn inexorably towards recommendations which would ultimately see Canada's defence expenditures rising to somewhere between 2.5 percent and 3 percent of its GNP."²⁰ This would compare with 2.16 percent at present.

The only alternative would be to cut some of Canada's present military responsibilities so as to bring commitments into line with the available funds. As the committee remarked in *Manpower in Canada's Armed Forces*: "If commitments and tasks exceed manpower and resources, then either the defence effort should be increased or the tasks should be reduced."²¹

However, cutting or rearranging Canada's defence commitments would certainly not be a simple proposition. As the committee has noted previously: "Canada's extensive territory, geographic position between the two superpowers and membership in NATO may in practice limit the scope for reductions."²²

The general question of budgets and commitments goes beyond the scope of the committee's own, recent enquiries and can only be answered by a thorough, far-reaching defence review. It must inevitably form a central issue in the development of the forthcoming white paper.

¹⁹ *Minutes of the Proceedings and Evidence of the Standing Committee on External Affairs and National Defence*, House of Commons, 22 May 1984, p. 12:14.

²⁰ *Canada's Maritime Defence*, *op. cit.*, p. xvi.

²¹ *Manpower in Canada's Armed Forces*, first report of the Sub-committee on National Defence of the Standing Senate Committee on Foreign Affairs, Ottawa, 1982, p. 6 (ISBN 0-662-51761-X).

²² *Idem.*

Chapter VI

THE SPACE AGE: BEYOND THE YEAR 2000

Sometime around the turn of the century, the focus of Canadian and U.S. efforts to maintain the air defence of North America is likely to shift to space. As Dr. Schofield remarked in his testimony before the committee:

I believe that we are witnessing a significant change in the attitude to defence space systems. For a long time there has been a general feeling that space-based systems were very expensive, that they were vulnerable, and could only be relied upon in peacetime. Dr. Robert Cooper, who was the Director of the Defence Advanced Research Projects Agency (DARPA) of the United States, described the recent changes in this perception at our November (1983) Defence Science Symposium here in Ottawa. He stated that there was a major drive to incorporate space systems into U.S. operational forces. This was based simply on the cost-effectiveness of these systems.¹

Dr. Schofield added:

In 1979, a joint U.S.-Canada Air Defence Study team concluded that a space based sensor was the preferred approach to satisfy future air defence requirements. However, at that time there were formidable technical problems and immense costs associated with such a project. Today, the costs are still large and significant technical problems remain, but it is becoming increasingly evident that a space-based surveillance system is the technology that will be implemented in perhaps the late 1990s if we are to satisfy our operational requirements.²

Dr. Schofield and Dr. Lindsey agreed that there are two main approaches to space-based surveillance: the use of orbiting infra-red sensors and the use of space-based radars. Dr. Schofield noted that the first type of system

employs infra-red emissions of a target and the natural land or ocean background. Space-based infra-red systems offer the advantages of (being technologically) more mature and of being passive. That is, you do not have to radiate anything but just look at something radiating from the target. However, they suffer somewhat from their inability to detect targets through clouds. We expect soon to sign an agreement with the United States Defence Advanced Research Projects Agency to participate in a U.S. initiated project called TEAL RUBY, which is designed to prove the concept of space-based infra-red.³

¹ *Proceedings of the Special Committee of the Senate on National Defence*, 14 March 1984, p. 4:24.

² *Ibid*, p. 4:25.

³ *Idem*.

Regarding space-based radar, Dr. Schofield noted that they would not suffer from some of the disadvantages of infra-red systems and could see through clouds:

Two principal technical problems still exist for space-based radar — the very large antenna and the high power that would be required. These are needed so that one can detect and track small targets like cruise missiles or aircraft employing stealth technology. It is considered that this technology is really only a few years away in terms of R & D.⁴

Dr. Schofield and Dr. Lindsey both stressed the importance of communication systems and ground support in the space age. Dr. Schofield remarked:

Another technology which is integral to surveillance in the air defence function is communications. The high volume of data generated from a space-based surveillance system will have to be transmitted for further analysis and for operational decisions to ground stations in southern Canada and the United States. For this purpose and to link control aircraft such as AWACS and interceptors in the overall command and control function, communication satellites will be used.⁵

On the same point, Dr. Lindsey stated that both of the space-based surveillance satellite systems

will have to have ground read-out stations and some central system of data processing. With respect to operations using these new types of detectors, the over-the-horizon radar or space-based detectors would give us early warning of approaching aircraft and would allow us to make an assessment of the threat. They could also provide the information fed to the AWACS aircraft that would then be sent forward to control interceptor aircraft. Large areas of the North could be surveyed at once, and this would allow much better use of the AWACS than can be guaranteed if the only means of detection is by the DEW Line in the North.⁶

Dr. Lindsey and others evidently feel that the manned bomber force is likely to remain a part of the Soviet inter-continental offensive inventory into the next century. However, they see the threat changing with the addition of new cruise missiles, air-to-surface missiles, the Blackjack bomber, and "stealth" aircraft. Dr. Lindsey suggested, therefore, that

with this threat of stand-off weapons facing us, there is a much increased desirability in having a defence system with lots of early warning, capable of performing early interception — especially in efforts to intercept the aircraft before it launches these missiles. This could cause great problems, in peacetime or in a time of crisis before hostilities have been declared, because bomber-type aircraft are perfectly entitled to fly over the Atlantic. If the defences observe them, they cannot do anything about it, and if the missiles were launched beyond the limits of national airspace, then we would be faced with defence against a missile, not against a bomber.⁷

"It is quite possible that the over-the-horizon radar, the AWACS, and the space-based detectors would be able to track missiles as well as aircraft," Dr. Lindsey

⁴ *Idem.*

⁵ *Ibid*, p. 4:26.

⁶ *Ibid*, 22 February 1984, p. 2:11.

⁷ *Ibid*, p. 2:12.

added, "but this may require further technical improvements of their capabilities."⁸

The development of North American aerospace defence outlined above — with space-based sensors and supporting systems — would in itself probably attract widespread support in Canada as well as in the United States. As Dr. Lindsey suggested, it does not run counter to the Outer Space Treaty or other arms control agreements, because it envisages the installation in space of passive military systems and communications devices — not weapons, which have been banned.⁹ It would be expensive, but probably not prohibitively so, and would afford a much better means of responding to the Soviet bomber threat — and perhaps ALCMs — than the system now available.

However, as the committee learned during its study, the implications of the system one chooses for North American aerospace defence may go beyond the immediate issue of attack warning. These must be taken into account when thinking about future defences. Above all, decision makers should be considering whether upgraded aerospace defences would be employed to enhance the strategy of mutual assured destruction — relying mainly on offensive strategic forces, threat of retaliation, and the balance of terror to deter an outbreak of general war — or whether they would constitute part of a whole range of new forces designed to protect North America with active defense systems.

In the former case — enhancing MAD — the primary aim would be to strengthen the survivability of U.S. deterrent forces by improving warning capabilities. Use of the bomber option would be made less attractive for the Soviet Union, even though that country is building up its bomber forces and equipping them with new air-to-ground and cruise missiles. Space-based infra-red and radar satellites and their backup systems could possibly detect bombers on launching. At present, NORAD must rely on information from ground observations and satellite intelligence about bomber force marshalling.

In the latter case — contributing to new strategic policies — space-based North American air defences might have a much more crucial role than improving present detection and tracking capabilities or making the bomber option unattractive: they might form part of a general movement by the United States towards a "strategic defence" posture. As Keith B. Payne and Colin S. Gray remarked in a recent issue of *Foreign Affairs*,

In essence, what would be involved (in developing a policy of "strategic defence") would be a new direction in U.S. nuclear policy, a transition period of possibly two decades, involving a new and serious commitment to strategic defensive forces. Of course, such a commitment could not limit itself to countering the threat from ballistic missiles, but would also call for greatly improved capabilities to defend against strategic bomber and cruise missile threats.¹⁰

⁸ *Idem.*

⁹ *Ibid.*, p. 2:13.

¹⁰ Keith B. Payne and Colin S. Gray, "Nuclear Policy and the Defensive Transition", *Foreign Affairs*, Vol. 62, No. 4, Spring 1984, p. 822 (ISSN 00157120).

The impetus for such a strategic defence initiative (SDI) was provided by President Reagan in his March 23, 1983 speech. It outlined an eventual defence posture for some time in the next century and was based on the development of ballistic missile defences in space using laser beams and other advanced technology. Payne and Gray point out that an effective defensive deterrent strategy would require layers of protection systems installed over time. They evidently had in mind not only the space-based missile defences, but also ground-based ballistic missile defence systems, anti-satellite weapons, counter-bomber systems, anti-cruise defences, and manned interceptors. Offensive strategic forces would be kept in place to maintain a residual capability for mutual assured destruction.

One problem connected with the movement into space under either strategy is that of protecting the infra-red, radar, or communications satellites against anti-satellite systems. Some ASATs are ground-based and are not, therefore, prohibited under the Outer Space Treaty or any other accord. Consequently, aerospace defence satellites are vulnerable, and development work is under way to harden them and give them a war-fighting capability. Offensive capabilities may be added to them, with the result that — unless this country develops its own defensive military space programme — it may become difficult for Canada to restrict its participation in North American aerospace defence to purely passive systems.

New developments in ballistic missile defence may have a particular bearing on future strategies. Research now under way bears on low-and high-altitude applications and ground as well as space deployments. Among the most celebrated schemes are the Homing Overlay Experiment (HOE), the "High Frontier" concept, and laser systems.

The Homing Overlay Experiment made the headlines on June 12, 1984 as a result of a significant breakthrough, when a Minuteman launcher propelled an optically guided interceptor missile towards a warhead shot from a distance of almost 11,000 km — "a bullet against a bullet". The intercepting projectile "caught" the warhead using a metal net about 4.5 m in diameter, and the collision resulted in destruction on impact — at a combined speed in excess of 6,000 meters per second. This confirmed that a ground-based non-nuclear weapon could destroy ballistic missile warheads outside the atmosphere.¹¹

The "High Frontier" approach to ballistic missile defence puts much faith for the future in ground-and space-based directed energy weapons based on high-energy laser, particle beam, and high-power microwave technologies. In its early stages, however, it would rely on "collision" technologies similar to HOE for both its outer and inner layers of defence. The outer layer would consist of some 432 satellites (or "trucks") orbiting the earth at a distance of 650 km, each armed with 40-45 self-propelled inert projectiles that would achieve a speed of 915 m per second prior to impact. The inner, point-defence layer would consist of radar-controlled launchers arrayed in the vicinity of potential high-value targets and

¹¹ *Aviation Week and Space Technology*, "BMD Homing Interceptor Destroys Re-Entry Vehicle", 18 June 1984, pp. 19-20, and *The Citizen*, "U.S. missile knocks out counterpart", 12 June 1984.

capable of scattering, with an extremely high rate of fire, swarms of kinetic energy projectiles 25 to 38 cm in length and 2.5 to 7.5 cm in diameter into the path of incoming missiles.¹²

Lasers are the BMD technology most commonly discussed in the context of area defences. Dr. Lindsey noted that there are

two military developments of lasers that we are aware of. One is the systematic improvement of lasers to make them into the sort of weapons one might use on a battlefield or perhaps as an anti-aircraft weapon... The other kind is the more strategic application where you might be able to use them against a ballistic missile at great range.¹³

Some of the questions raised by laser BMD weapons apply to all BMD systems: (1) Are they affordable? (2) Could they be trusted against massive numbers of attacking missiles? (3) Would they not let through a proportion of warheads which, even if very small, would be sufficient to annihilate our defences and population centers? and (4) Would their very effectiveness not "make the world safer for conventional war" by removing the risk of nuclear retaliation? BMD weapons also raise a number of additional questions specifically related to laser technology. One of the major issues is timing. Development work is proceeding vigorously, but the deployment of even experimental models is not expected until the late 1990s. As Dr. Lindsey remarked, "Many immense problems have to be overcome, not the least being the powering of the satellite".¹⁴ The laser weapon itself would also require massive quantities of energy. Despite these difficulties, there is a need for Canada to keep itself well informed of world developments in military laser technology.

Work is under way or about to begin on a variety of other advanced systems based on new technologies. They include weapons such as the Soviet fractional orbital bombardment systems (FOBS), which would allow nuclear-armed satellites to attack any point on earth with only three minutes' warning; the U.S. transatmospheric vehicle (TAV), which "will be able to take off from a military airfield, insert itself into the upper reaches of the atmosphere and the lower regions of space, and go around the planet in ninety minutes,"¹⁵ and will provide reconnaissance on demand and high-altitude weapons deployment; and a range of increasingly sophisticated, electronic countermeasure and electronic counter-countermeasure equipment.

If the United States and the Soviet Union eventually commit themselves to major deployments of ballistic missile defences and other advanced systems such as those mentioned above, the financial costs could be extremely high, leading to

¹² *High Frontier: A National Strategy*, LGen. (retired) D.O. Graham, U.S.A. Washington, D.C., High Frontier Inc., 1982, pp. 115-125 and 135-143 (ISBN No. 0-943070-00-7).

¹³ *Proceedings of the Special Committee of the Senate on National Defence*, 22 February 1984, p. 2:28.

¹⁴ *Idem*.

¹⁵ *Air Force Magazine*, "Bold New Missions in Space", June 1984, p. 88.

the absorption of large, additional quantities of the world's scarce resources. Our country in particular could find itself faced with an agonizing decision regarding defence. It is to Canada's advantage to be involved in defence, industrial, and other cooperative arrangements with the United States. Yet, if Canada were to support these particular American military programmes, it would be going against the grain of its own solidly-established policies on arms control and disarmament. For the world at large, the deployment of extensive ballistic missile defences would negate one of the key achievements of the post-war arms control process: the 1972 ABM Treaty. It would also run counter to the spirit of current arms control accords concerning outer space and might well destroy any hope of establishing new accords banning space weaponry. The result would be a world caught up in a massive new arms race when instead it desperately needs bold new moves to establish lasting peace and security. Canada should do everything in its power to ensure that new rounds of international negotiation on arms control and disarmament result in balanced and verifiable agreements for the reduction of nuclear and other weapons and in an increase in global stability.

Chapter VII

CONCLUSIONS, OBSERVATIONS AND RECOMMENDATIONS

North American air defence is at a turning point. Present systems are obsolete but the Soviet bomber and air launched cruise missile threat is growing. The deployment of space-based warning and surveillance is still fifteen years or so in the future. Transitional arrangements are needed, and Canada and the United States are negotiating about them.

Canada must press for an early crystallization of these negotiations. Air defence systems should be upgraded, modernized, and extended in a continuous line around the periphery of the continent. This would maintain our security in the most immediate and direct sense — through the effective defence and protection of our people and territory.

Better air defences would also increase the survivability of the U.S. land-based deterrent, which is basic to current NATO strategy. This may justifiably be seen as a major Canadian contribution to the Western Alliance.

If proper arrangements are made, upgrading will also help Canada to assert national sovereignty over its airspace in peacetime.

While the transitional arrangements are being established and coming into operation, there will be increasing interest in space, and Canada will need to move rapidly to define its own requirements and decide on national space programmes and cooperative arrangements with the United States.

Of course, upgrading North American air defences is a major task that will involve substantial costs. However, these costs will not be “staggering” or “astronomical”, as some people seem to believe; they can be met by a relatively small increase in the defense budget. They seem fully justifiable when considered in relation to the nation’s wealth and capacities.

There is also a great deal to be said for directing public expenditures to demonstrated military needs — such as North American air defence or the modest but continuing naval shipbuilding programme advocated by the committee in its last report. The transitional arrangements and a national military space programme would yield direct security benefits for this country and would also, according to the evidence received by the committee, provide long-lasting industrial and employment advantages if they were coordinated with other endeavours in a coherent, national defence and aerospace strategy.

The committee's observations and recommendations follow:

1. The committee remains strongly committed to its previous recommendations urging the early production of a new defence white paper, being firmly convinced that this can be achieved without delaying or hampering current defence improvement programmes. **The committee urges the government of Canada to undertake without delay the planned defence review. A Canadian defence policy must be defined for this and the last decade of the century and the Canadian people and our allies should be informed of its aim and substance.**
2. The committee recognizes the importance of protecting Canada and helping to ensure the survivability of the U.S. land-based deterrent through active participation in North American air defence. It is also mindful of the need for long-term planning in this area, particularly as it relates to space. **Therefore the committee recommends that when the review of the NORAD agreement, due to occur in 1986, takes place, Canada should explore the possibility of renewing the agreement for a period of 15 years, to the turn of the century, with provision for review every five years.**
3. **The committee recommends that Canada should pursue and press current negotiations on transitional arrangements for North American air defence with the aim of bringing them to an early conclusion.** Canada should not expect the United States to carry the whole cost of upgrading nor should it offer to do it all itself. A reasonable compromise should be sought and one that would ensure that the undertaking is carried out on terms satisfactory to both parties.
4. **The committee recommends that the transitional arrangements currently being negotiated comprise, for air defence purposes, a full range of peripheral early warning, tracking, assessment, and interception systems in Canada.** Major components of the transitional arrangements in Canada would include a new North Warning System, coastal radars, and northern deployment air bases. Agreements should be made to provide for a continuous flow of information from U.S.-based sources to Canadian-based ROCCs in North Bay. Procedures should also be established for the maintenance of alert interceptors in Bagotville and Cold Lake, so as to enhance this country's ability to preserve national sovereignty over its airspace in peacetime.
5. The committee is of the view that some military radar coverage should be maintained in the interior of Canada once most of the CADIN-Pinetree Line has been phased out. **It recommends that the transitional arrangements should include some AWACs or other airborne early warning systems.**
6. Canada's option to buy 20 additional CF-18s under the terms still available under the present contract will run out on April 1, 1985. **The committee recommends that this option be fully exercised in order to cover attrition and round out existing capabilities if all current air commitments of the Canadian Armed Forces in Europe and North America are maintained.**
7. The committee notes the rapid expansion of space activity and the need for Canada to develop the most effective policies in this area. **It therefore**

recommends that an early inquiry be conducted into Canada's present and future military requirements in space with a view to establishing a national military space programme.

- 8. The committee recommends that the Canadian government define its objectives in North American aerospace defence as clearly as possible and concentrate on those aspects that are essentially defensive in nature.**
- 9. The committee notes the record of inadequate government-industry cooperation in the aerospace field in Canada. It therefore recommends that the government should develop an effective, immediate, and long-range industrial strategy for aerospace, aimed at maximizing long-term industrial benefits, developing new technologies, and expanding skilled and other employment.**
- 10. The committee is as convinced as ever that our armed forces must be provided with the manpower, equipment, and other resources required to accomplish the tasks they are assigned. It believes that this may require that defence expenditures increase to between 2.5 and 3 percent of GNP.**

“Appendix A”

EXCHANGE OF NOTES BETWEEN THE GOVERNMENT OF CANADA AND THE GOVERNMENT OF THE UNITED STATES OF AMERICA CONSTITUTING AN AGREEMENT CONCERNING THE ORGANIZA- TION AND OPERATION OF THE NORTH AMERICAN AEROSPACE DEFENCE COMMAND (NORAD)

Ottawa, March 11, 1981

In force March 11, 1981
with effect from May 12, 1981

Ottawa, March 11, 1981

The Honourable Alexander Haig,
Secretary of State of the
United States of America.

Sir,

I have the honour to refer to discussions that have taken place between representatives of our two Governments regarding future cooperation between Canada and the United States in the defence of North America. Our Governments remain convinced that such cooperation, conducted within the framework of the North Atlantic Treaty, remains vital to their mutual security, compatible with their national interests, and an important element of their contribution to the overall security of the NATO area.

As neighbors and allies within North America, our two Governments have accepted special responsibilities for the security of the Canada-United States region of NATO and, in fulfilling these responsibilities, have entered into a number of bilateral arrangements to facilitate joint defence activities. Among these, the arrangements for air defence, aerospace surveillance, and missile warning embodied in the North American Air Defence Command (NORAD) have provided the means of exercising effective operational control of the forces assigned by our two Governments to the aerospace defence of North America.

In the years since the NORAD Agreement was first concluded, there have been significant changes in the character of strategic weapons and in the nature of the threat they pose to North America. The most important of these changes has been the major increase in the number and sophistication of strategic missiles. There has also been an increasing use of space for strategic and tactical purposes. In addition, although missiles constitute the principal threat, long-range bombers continue to pose a threat to North America.

In view of the continuing mission of aerospace surveillance and warning and air defence, our two Governments agree that, to properly reflect aerospace surveillance and missile warning related responsibilities, it is appropriate to redesignate NORAD as the North American Aerospace Defence Command.

In light of these developments, our two Governments retain a common interest in the maintenance of effective surveillance and control of North American airspace and in preventing its use for purposes detrimental to the security of North America. Since peacetime surveillance and control are expected to continue as functions important to the sovereign control of national airspace, each Government will maintain a system to carry out these activities in conjunction with the air defence and aerospace surveillance and warning operations of NORAD.

The large volume of air traffic flowing daily to, from, and within North American airspace, much of it across the border between our two countries, dictates that our national airspace surveillance and control systems be compatible

with each other and requires a high degree of coordination between their military components. Our Governments agree that the necessary command, control and information exchange arrangements can most effectively and economically be provided by the continued operation of NORAD.

In addition to performing the airspace surveillance and control functions related to air defence, NORAD will monitor and report on space activities of strategic and tactical interest and will provide warning of aerospace events that may threaten North America. In view of the increasing importance of space to the defence of North America, our Governments will seek ways to enhance cooperation in accordance with mutually agreed arrangements in the surveillance of space and in the exchange of information on space events relevant to North American defence.

The primary objectives of NORAD will continue to be:

- a. to assist each nation to safeguard the sovereignty of its airspace;
- b. to contribute to the deterrence of attack on North America by providing capabilities for aerospace surveillance, warning and characterization of aerospace attack, and defence against air attack; and
- c. should deterrence fail, to ensure an appropriate response against attack by providing for the effective use of the forces of the two countries available for air defence.

As in the case of all joint defence activities, the future activities envisaged for NORAD will require the closest cooperation between authorities of our two Governments. It is recognized that this can be achieved in a mutually satisfactory way only if full and meaningful consultation is carried out on a continuing basis. Our two Governments, therefore, undertake to insure that such consultation takes place.

On the basis of our common appreciation of the circumstances described and of the experience gained since the inception of NORAD, my Government proposes that the following principles should govern the future organization and operations of the North American Aerospace Defence Command.

- a. The Commander in Chief, NORAD (CINCNORAD), and the Deputy in CINCNORAD's absence, will be responsible to the Chief of Defence Staff of Canada and the Joint Chiefs of Staff of the United States, who in turn, are responsible to their respective Governments. CINCNORAD will function in support of the concepts of surveillance, warning, control, and defence approved by the authorities of our two Governments for the defence of the Canada-United States region of the NATO area.
- b. NORAD will include such combat units and individuals as are specifically allocated to it by the two Governments. The jurisdiction of CINCNORAD over those units and individuals is limited to operational control as hereinafter defined.
- c. "Operational control" is the power to direct, coordinate, and control the operational activities of forces assigned, attached, or otherwise made

available. No permanent changes of station would be made without approval of the higher national authority concerned. Temporary reinforcement from one area to another, including the crossing of the international boundary, to meet operational requirements will be within the authority of commanders having operational control. The basic command organization for the defence forces of the two countries, including administration, discipline, internal organization, and unit training, shall be exercised by national commanders responsible to their national authorities.

- d. The appointment of CINCNORAD and the Deputy must be approved by the Canadian and United States Governments. They will not be from the same country, and the CINCNORAD staff shall be an integrated staff composed of officers of both countries. During the absence of CINCNORAD, command will pass to the Deputy Commander.
- e. The North Atlantic Treaty Organization will continue to be kept informed through the Canada-United States Regional Planning Group of arrangements for the aerospace defence of North America.
- f. The plans and procedures to be followed by NORAD in wartime shall be formulated and approved by appropriate national authorities and shall be capable of rapid implementation in an emergency. Any plans or procedures recommended by NORAD that bear on the responsibilities of civilian departments or agencies of the two Governments shall be referred for decision by the appropriate military authorities to those agencies and departments and may be the subject of intergovernmental coordination through an appropriate medium such as the Permanent Joint Board on Defence, Canada-United States.
- g. Terms of reference of CINCNORAD and the Deputy will be consistent with the foregoing principles. Changes in these terms of reference may be made by agreement between the Canadian Chief of Defence Staff and the US Joint Chiefs of Staff, with approval of higher authority, as appropriate, provided that these changes are in consonance with the principles set out in this Note.
- h. The financing of expenditures connected with the operation of the integrated headquarters of NORAD will be arranged by mutual agreement between appropriate agencies of the two Governments.
- j. The Agreement between parties to the North Atlantic Treaty regarding the Status of their Forces signed in London on June 19, 1951, shall apply.
- k. Public statements by CINCNORAD on matters of interest to Canada and the United States will in all cases be the subject of prior consultation and agreement between appropriate agencies of the two Governments.

If the Government of the United States of America concurs in the considerations and provisions set forth herein, I have the honour to propose that

this Note, which is equally authentic in English and French, and your reply to that effect shall constitute an agreement between our two Governments, which will enter into force on the date of your reply, with effect from May 12, 1981. This agreement will supersede the agreement on the North American Air Defence Command concluded in Washington, D.C., on May 12, 1958; and subsequently renewed on March 30, 1968; May 10, 1973; May 12, 1975; and May 12, 1980.

The present agreement will remain in effect for a period of 5 years during which its terms may be reviewed at any time at the request of either party. It may be terminated by either Government, following 12 months' written notice to the other.

Accept, Sir, the assurances of my highest consideration.

Secretary of State for
External Affairs
Mark MacGuigan

Minister of National Defence
J. Gilles Lamontagne

Appendix B

List of witnesses showing the issue number and date of the proceedings in which their evidence appeared.

First Session of the Thirty-second Parliament, 1980-81-82-83

| Name | Issue Number | Date |
|---|--------------|--------------------|
| General G.C.E. Thériault, Chief of the Defence Staff Department of National Defence | 46 | September 27, 1983 |

Second Session of the Thirty-second Parliament, 1983-84

| | | |
|---|------------------|-------------------------------------|
| Mr. J.F. Anderson Assistant Deputy Minister (Policy) Department of National Defence | 2 5 | February 22, 1984 March 15, 1984 |
| Captain Neil Anderson Aerospace Engineering Test Establishment (AETE) CFB Cold Lake, Alberta | <i>In Camera</i> | February 14, 1984 |
| Major General L.A. Ashley Chief Air Doctrine and Operations Department of National Defence | <i>In Camera</i> | April 10, 1984 |
| Colonel Carl Bertrand Base Commander CFB Bagotville, Quebec | <i>In Camera</i> | April 16, 1984 |
| Mr. Alex Bishop Vice-President Aerospace Industries Association of Canada | 4 | March 14, 1984 |
| Honourable Jean-Jacques Blais, P.C. Minister of National Defence | 8 | April 17, 1984 |
| Lieutenant-Colonel Jean Boyle Commanding Officer, 433 Squadron CFB Bagotville, Quebec | <i>In Camera</i> | April 16, 1984 |

| Name | Issue Number | Date |
|--|------------------|-------------------|
| Lieutenant-Colonel Jim Bundschuh Operations Division NORAD HQ Colorado Springs, U.S.A. | <i>In Camera</i> | March 20, 1984 |
| Brigadier-General R.W. Buskard Director General Continental Policy Department of National Defence | <i>In Camera</i> | April 10, 1984 |
| Lieutenant-Colonel R.E. Carruthers Senior Staff Officer Intelligence, Plans and Requirements CFB North Bay, Ontario | <i>In Camera</i> | February 23, 1984 |
| Colonel Peter Carver President Canadian Air Defence Officers' Association | 6 | March 28, 1984 |
| Colonel J.A. Chambers, USAF Deputy Chief of Staff CFB North Bay, Ontario | <i>In Camera</i> | February 23, 1984 |
| Major Bill Cope Plans Division NORAD HQ Colorado Springs, U.S.A. | <i>In Camera</i> | March 20, 1984 |
| Professor David Cox Department of Political Studies Queen's University | 3 | March 8, 1984 |
| Colonel Wil Craig Plans Division, Space Command NORAD HQ Colorado Springs, U.S.A. | <i>In Camera</i> | March 21, 1984 |
| Mr. L.E. Davies Assistant Deputy Minister (Finance) Department of National Defence | 5 | March 15, 1984 |
| Major Pat Dennis Operations Division NORAD HQ Colorado Springs, U.S.A. | <i>In Camera</i> | March 20, 1984 |
| Mr. D.B. Dewar Deputy Minister Department of National Defence | 8 | April 17, 1984 |
| Major Robbie Dunlop Deputy Commanding Officer 425 Squadron CFB Bagotville, Quebec | <i>In Camera</i> | April 16, 1984 |

| Name | Issue Number | Date |
|---|------------------|-------------------|
| Captain Doug Fawcett Program Support Office Executive CFB North Bay, Ontario | <i>In Camera</i> | February 23, 1984 |
| Lieutenant-Colonel E.G. Francis Director of Operations CFB North Bay, Ontario | <i>In Camera</i> | February 23, 1984 |
| Mr. Ross Francis Director Defence Relations Division Department of External Affairs | 2 | February 22, 1984 |
| Colonel I.H. Firth Deputy Commander 14 Training Group HQ CFB Winnipeg, Manitoba | <i>In Camera</i> | February 14, 1984 |
| Major-General J.A. Fox Chief, Personnel Development Department of National Defence | 5 | March 15, 1984 |
| General James V. Hartinger, USAF Commander in Chief, NORAD Colorado Springs, U.S.A. | <i>In Camera</i> | March 20, 1984 |
| Lieutenant-Colonel D.J. Hutchison Senior Staff Officer Mobilization Planning CFB Winnipeg, Manitoba | <i>In Camera</i> | February 13, 1984 |
| Major Terry Humphries Acting Commanding Officer 410 Squadron CFB Cold Lake, Alberta | <i>In Camera</i> | February 15, 1984 |
| Major Dan Ingelido Intelligence Division NORAD HQ Colorado Springs, U.S.A. | <i>In Camera</i> | March 20, 1984 |
| Mr. John Killick Assistant Deputy Minister (Materiel) Department of National Defence | 5 | March 15, 1984 |
| Major-General (Retired) Claude LaFrance Chairman Air Force Advisory Group | 1 | February 1, 1984 |
| Major-General (Retired) Claude LaFrance Chairman Air Force Advisory Group Representing the Military and Aviation Affairs Committee of the RCAF Association | 6 | March 28, 1984 |

| Name | Issue Number | Date |
|---|--|--|
| Lieutenant-General (Retired) R.J. Lane National Chairman of FMUSIC (The Federation of Military and United Services Institute of Canada) | 7 | April 3, 1984 |
| Major John Ledgard Plans Division NORAD HQ Colorado Springs, U.S.A. | <i>In Camera</i> | March 20, 1984 |
| Lieutenant-General (Retired) Kenneth E. Lewis Vice-Chairman Air Force Advisory Group | 1 | February 1, 1984 |
| Dr. George Lindsey, Chief, Operational Research and Analysis Establish- ment Department of National Defence | 2 | February 22, 1984 |
| Major Murray MacDonald Operations Division NORAD HQ Colorado Springs, U.S.A. | <i>In Camera</i> | March 20, 1984 |
| Lieutenant-General D.C. MacKenzie Deputy Commander in Chief NORAD HQ Colorado Springs, U.S.A. | <i>In Camera</i> <i>In Camera</i> | March 21, 1984 April 12, 1984 |
| Lieutenant-General P.D. Manson Commander Air Command Winnipeg, Manitoba | <i>In Camera</i> 9 | February 14, 1984 April 17, 1984 |
| Colonel Thomas S. Moorman, Jr. Commander's Group Space Command NORAD HQ Colorado Springs, U.S.A. | <i>In Camera</i> | March 20, 1984 |
| Major-General Robert L. Mortimer Deputy Chief of Staff Plans and Programs NORAD HQ Colorado Springs, U.S.A. | <i>In Camera</i> <i>In Camera</i> <i>In Camera</i> | March 20, 1984 March 21, 1984 April 12, 1984 |
| Mr. C.R. Nixon Former Deputy Minister Department of National Defence | 7 | April 3, 1984 |
| Brigadier-General J.R. Neroutsos Commander Air Reserve Group CFB Winnipeg, Manitoba | <i>In Camera</i> | February 13, 1984 |

| Name | Issue Number | Date |
|--|------------------|-------------------|
| Major-General W.G. Paisley Commander Fighter Group CFB North Bay, Ontario | <i>In Camera</i> | February 23, 1984 |
| Major Don Read Public Affairs NORAD HQ Colorado Springs, U.S.A. | <i>In Camera</i> | March 20, 1984 |
| Dr. Douglas A. Ross Research Associate Institute of International Relations University of British Columbia | 3 | March 8, 1984 |
| Dr. D. Schofield Chief, Research and Development Department of National Defence | 4 | March 14, 1984 |
| Major Charles Shanks Chief of Communications CFB North Bay, Ontario | <i>In Camera</i> | February 23, 1984 |
| Mr. John H. Simons Executive Vice-President Canadian Marconi Co. | 4 | March 14, 1984 |
| Mr. Brian Smith Secretary and Director of Projects Aerospace Industries Association of Canada | 4 | March 14, 1984 |
| Major Bob Stickley Acting Commanding Officer 419 Squadron CFB Cold Lake, Alberta | <i>In Camera</i> | February 15, 1984 |
| Colonel A. Suelzle Chairman of Advisory Council Canadian Air Defence Officers' Association | 6 | March 28, 1984 |
| Colonel Fred Sutherland Commander CFB Cold Lake, Alberta | <i>In Camera</i> | February 14, 1984 |
| Colonel P.J. Taggart Deputy Chief of Staff for Intelligence, Plans and Requirements Air Command CFB Winnipeg, Manitoba | <i>In Camera</i> | February 13, 1984 |
| Mr. William C. Tate Vice-President and General Manager Garrett Manufacturing Ltd. | 4 | March 14, 1984 |

| Name | Issue Number | Date |
|---|------------------|----------------|
| Lieutenant-General (Retired) K.J. Thorneycroft Director Air Force Advisory Group Representing the Military and Aviation Affairs Committee of the RCAF Association | 6 | March 28, 1984 |
| Major Tom Trimble Plans Division NORAD HQ Colorado Springs, U.S.A. | <i>In Camera</i> | March 20, 1984 |
| Lieutenant-Colonel A. Valenti Vice-Chairman (Air) Conference of Defence Association Canadian Air Defence Officers' Association | 6 | March 28, 1984 |
| Lieutenant-General J.E. Vance Assistant Deputy Minister (Personnel) Department of National Defence | 8 | April 17, 1984 |
| Colonel Al Young Director of Air Defence NORAD HQ Colorado Springs, U.S.A. | <i>In Camera</i> | March 21, 1984 |